BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B1 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.913 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04042	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.73 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	129.28 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	129.28 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B1 / D22x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.903 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00528	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.38 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	16.59 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B1 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.681 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05661	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.16 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	182.63 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	182.63 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B1 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.046 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05874	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.75 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	189.74 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	189.74 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B1 / D22x30	-
Combination / Station	UCOMBO1 / 1,230.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.417 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08429	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.93 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	276.22 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	276.22 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B1 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	16.588 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09699	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	26.58 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	320.17 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	320.17 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B1 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	16.591 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09701	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	26.58 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	320.23 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	320.23 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B1 / D22x30	-
Combination / Station	UCOMBO1 / 2,050.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.536 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08499	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	23.13 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	278.63 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	278.63 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B1 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.283 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06012	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.13 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	194.36 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	194.36 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B1 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.924 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05803	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.55 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	187.37 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	187.37 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B1 / D22x30	-
Combination / Station	UCOMBO1 / 2,870.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.294 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00756	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.97 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	23.78 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B1 / D22x30	-
Combination / Station	UCOMBO1 / 3,170.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.415 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03751	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.94 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	119.78 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	119.78 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B2 / D22x40	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-13.393 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04717	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.19 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	195.09 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	195.09 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B2 / D22x40	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	1.742 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00614	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.06 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	24.84 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	73.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B2 / D22x40	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	18.834 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06633	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	23.01 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	277.24 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	277.24 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B2 / D22x40	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	19.286 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06793	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	23.59 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	284.15 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	284.15 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B2 / D22x40	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	29.393 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10352	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	36.69 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	442.02 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	442.02 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B2 / D22x40	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	36.151 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12732	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	45.78 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	551.56 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	551.56 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B2 / D22x40	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	36.261 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12771	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	45.93 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	553.37 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	553.37 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B2 / D22x40	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	36.199 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12749	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	45.85 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	552.35 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	552.35 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B2 / D22x40	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	32.788 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11548	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	41.22 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	496.62 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	496.62 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B2 / D22x40	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	32.557 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11467	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	40.91 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	492.88 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	492.88 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B2 / D22x40	-
Combination / Station	UCOMBO1 / 3,150.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	22.462 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07911	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	27.64 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	333.03 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	333.03 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B2 / D22x40	-
Combination / Station	UCOMBO1 / 3,600.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	9.018 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03176	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.82 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	130.30 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	130.30 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B2 / D22x40	-
Combination / Station	UCOMBO1 / 3,600.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	8.476 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02985	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.15 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	122.34 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	122.34 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B2 / D22x40	-
Combination / Station	UCOMBO1 / 4,050.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-11.826 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04165	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.26 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	171.75 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	171.75 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B2 / D22x40	-
Combination / Station	UCOMBO1 / 4,390.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-29.386 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10350	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	36.68 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	441.91 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	441.91 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B3 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-8.976 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05248	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.02 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	168.94 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	168.94 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B3 / D22x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.397 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00232	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.60 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	7.27 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B3 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.170 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05946	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.95 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	192.15 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	192.15 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B3 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.564 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06177	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.59 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	199.86 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	199.86 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B3 / D22x30	-
Combination / Station	UCOMBO1 / 1,055.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.290 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08355	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.72 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	273.68 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	273.68 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B3 / D22x30	-
Combination / Station	UCOMBO1 / 1,347.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	17.751 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10379	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	28.55 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	344.01 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	344.01 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B3 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	20.153 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11783	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	32.69 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	393.86 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	393.86 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B3 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	20.588 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12038	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	33.45 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	402.99 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	402.99 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B3 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	19.609 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11466	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	31.75 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	382.50 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	382.50 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B3 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	16.871 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09864	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	27.05 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	325.94 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	325.94 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B3 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	13.190 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07712	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.89 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	251.69 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	251.69 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B3 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.193 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05960	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.99 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	192.60 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	192.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B3 / D22x30	-
Combination / Station	UCOMBO1 / 2,695.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	7.766 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04541	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.09 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	145.61 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	145.61 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B3 / D22x30	-
Combination / Station	UCOMBO1 / 2,695.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.497 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02629	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.93 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	83.47 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	83.47 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B3 / D22x30	-
Combination / Station	UCOMBO1 / 2,987.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.885 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01687	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.42 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	53.29 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B3 / D22x30	-
Combination / Station	UCOMBO1 / 3,170.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-7.564 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04423	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.77 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	141.74 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	141.74 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B4 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-23.067 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.13487	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	37.82 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	455.60 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	455.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B4 / D22x30	-
Combination / Station	UCOMBO1 / 351.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-14.477 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08465	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	23.03 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	277.44 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	277.44 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B4 / D22x30	-
Combination / Station	UCOMBO1 / 703.3 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-4.206 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02459	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.47 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	78.00 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	78.00 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B4 / D22x30	-
Combination / Station	UCOMBO1 / 1,055.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.879 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01683	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.41 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	53.18 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B4 / D22x30	-
Combination / Station	UCOMBO1 / 1,360.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.037 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03530	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.35 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	112.59 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	112.59 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B4 / D22x30	-
Combination / Station	UCOMBO1 / 1,665.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.339 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03706	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.82 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	118.33 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	118.33 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B4 / D22x30	-
Combination / Station	UCOMBO1 / 2,016.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.244 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01897	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.98 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	59.99 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	59.99 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B4 / D22x30	-
Combination / Station	UCOMBO1 / 2,368.3 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-3.038 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01776	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.66 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	56.14 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B4 / D22x30	-
Combination / Station	UCOMBO1 / 2,610.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-8.886 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05196	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.88 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	167.21 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	167.21 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B5 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-7.496 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04383	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.66 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	140.45 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	140.45 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B5 / D22x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.266 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00156	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.40 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	4.88 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B5 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	8.457 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04945	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.19 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	158.92 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	158.92 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B5 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	8.771 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05128	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.69 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	164.98 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	164.98 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B5 / D22x30	-
Combination / Station	UCOMBO1 / 1,055.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	11.900 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06958	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.77 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	226.10 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	226.10 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B5 / D22x30	-
Combination / Station	UCOMBO1 / 1,347.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.618 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08547	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	23.26 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	280.27 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	280.27 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B5 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	16.277 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09517	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	26.05 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	313.83 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	313.83 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B5 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	16.671 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09748	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	26.72 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	321.87 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	321.87 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B5 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	15.955 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09329	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	25.51 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	307.29 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	307.29 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B5 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	13.504 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07896	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.41 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	257.94 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	257.94 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B5 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.388 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06074	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.30 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	196.41 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	196.41 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B5 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	7.910 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04625	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.32 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	148.38 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	148.38 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B5 / D22x30	-
Combination / Station	UCOMBO1 / 2,695.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	5.953 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03481	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.21 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	111.00 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	111.00 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B5 / D22x30	-
Combination / Station	UCOMBO1 / 2,695.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.334 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01949	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.12 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	61.66 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	61.66 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B5 / D22x30	-
Combination / Station	UCOMBO1 / 2,987.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.578 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.01507	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.95 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	47.57 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B5 / D22x30	-
Combination / Station	UCOMBO1 / 3,170.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.340 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03707	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.82 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	118.35 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	118.35 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B6 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.689 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03911	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.38 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	125.00 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	125.00 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B6 / D22x30	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.713 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01002	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.62 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	31.54 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B6 / D22x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.044 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01195	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.13 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	37.67 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B6 / D22x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.086 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01220	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.19 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	38.44 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B6 / D22x30	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.781 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00457	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.19 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	14.34 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B6 / D22x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-3.745 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02190	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.76 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	69.35 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	69.35 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B6 / D22x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-4.035 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02359	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.21 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	74.79 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	74.79 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B6 / D22x30	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-13.758 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08045	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.83 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	263.03 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	263.03 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B6 / D22x30	-
Combination / Station	UCOMBO1 / 2,590.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-23.241 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.13589	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	38.13 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	459.34 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	459.34 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B7 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.030 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03526	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.33 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	112.46 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	112.46 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B7 / D22x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.914 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00535	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.39 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	16.79 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B7 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.158 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05940	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.93 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	191.93 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	191.93 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B7 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.781 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06304	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.94 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	204.11 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	204.11 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B7 / D22x30	-
Combination / Station	UCOMBO1 / 1,230.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	13.778 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08056	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.86 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	263.42 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	263.42 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B7 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	16.490 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09642	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	26.41 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	318.18 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	318.18 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B7 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	16.494 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09644	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	26.42 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	318.26 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	318.26 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B7 / D22x30	-
Combination / Station	UCOMBO1 / 2,050.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	13.846 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08096	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.98 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	264.78 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	264.78 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B7 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.913 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06381	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.16 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	206.69 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	206.69 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B7 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.302 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06024	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.16 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	194.74 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	194.74 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B7 / D22x30	-
Combination / Station	UCOMBO1 / 2,870.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.144 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00669	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.75 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	21.03 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B7 / D22x30	-
Combination / Station	UCOMBO1 / 3,170.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-5.737 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03354	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.87 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	106.90 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	106.90 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B8 / D22x40	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-34.886 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12287	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	44.06 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	530.80 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	530.80 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B8 / D22x40	-
Combination / Station	UCOMBO1 / 483.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-14.462 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05093	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.52 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	211.09 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	211.09 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B8 / D22x40	-
Combination / Station	UCOMBO1 / 966.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	8.565 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03017	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.26 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	123.65 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	123.65 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B8 / D22x40	-
Combination / Station	UCOMBO1 / 966.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	9.178 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03233	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.01 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	132.64 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	132.64 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B8 / D22x40	-
Combination / Station	UCOMBO1 / 1,449.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	25.080 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08833	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	31.03 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	373.82 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	373.82 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B8 / D22x40	-
Combination / Station	UCOMBO1 / 1,932.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	37.122 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.13074	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	47.11 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	567.58 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	567.58 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B8 / D22x40	-
Combination / Station	UCOMBO1 / 1,932.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	37.355 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.13156	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	47.43 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	571.44 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	571.44 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B8 / D22x40	-
Combination / Station	UCOMBO1 / 2,415.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	41.604 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.14653	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	53.33 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	642.53 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	642.53 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B8 / D22x40	-
Combination / Station	UCOMBO1 / 2,898.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	41.993 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.14790	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	53.88 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	649.11 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	649.11 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B8 / D22x40	-
Combination / Station	UCOMBO1 / 2,898.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	41.889 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.14753	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	53.73 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	647.35 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	647.35 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B8 / D22x40	-
Combination / Station	UCOMBO1 / 3,381.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	34.332 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12092	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	43.31 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	521.74 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	521.74 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B8 / D22x40	-
Combination / Station	UCOMBO1 / 3,864.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	22.916 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08071	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	28.23 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	340.06 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	340.06 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B8 / D22x40	-
Combination / Station	UCOMBO1 / 3,864.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	22.472 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07914	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	27.66 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	333.18 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	333.18 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B8 / D22x40	-
Combination / Station	UCOMBO1 / 4,347.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	2.914 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01026	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.46 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	41.63 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	73.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B8 / D22x40	-
Combination / Station	UCOMBO1 / 4,720.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-14.832 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05224	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.98 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	216.64 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	216.64 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B9 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.888 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04027	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.69 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	128.80 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	128.80 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B9 / D22x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.950 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00556	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.45 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	17.45 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B9 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.758 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05705	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.28 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	184.13 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	184.13 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B9 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.149 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05934	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.92 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	191.75 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	191.75 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B9 / D22x30	-
Combination / Station	UCOMBO1 / 1,230.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.510 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08484	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	23.08 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	278.09 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	278.09 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B9 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	16.671 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09748	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	26.72 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	321.87 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	321.87 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B9 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	16.673 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09748	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	26.72 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	321.90 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	321.90 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B9 / D22x30	-
Combination / Station	UCOMBO1 / 2,050.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.561 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08514	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	23.17 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	279.12 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	279.12 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B9 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.250 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05993	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.08 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	193.72 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	193.72 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B9 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.862 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05766	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.45 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	186.15 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	186.15 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B9 / D22x30	-
Combination / Station	UCOMBO1 / 2,870.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.115 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00652	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.70 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	20.50 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B9 / D22x30	-
Combination / Station	UCOMBO1 / 3,170.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.678 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03904	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.36 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	124.79 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	124.79 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B10 / D22x40	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-13.160 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04635	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.91 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	191.62 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	191.62 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B10 / D22x40	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	1.870 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00659	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.21 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	26.67 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	73.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B10 / D22x40	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	18.823 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06629	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	23.00 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	277.07 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	277.07 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B10 / D22x40	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	19.271 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06787	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	23.57 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	283.91 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	283.91 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B10 / D22x40	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	29.251 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10302	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	36.50 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	439.74 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	439.74 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B10 / D22x40	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	35.881 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12637	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	45.41 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	547.13 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	547.13 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B10 / D22x40	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	35.988 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12675	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	45.56 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	548.88 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	548.88 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B10 / D22x40	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	35.782 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12602	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	45.28 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	545.49 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	545.49 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B10 / D22x40	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	32.226 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11350	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	40.47 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	487.53 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	487.53 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B10 / D22x40	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	31.994 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11268	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	40.16 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	483.78 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	483.78 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B10 / D22x40	-
Combination / Station	UCOMBO1 / 3,150.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	21.728 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07653	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	26.70 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	321.68 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	321.68 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B10 / D22x40	-
Combination / Station	UCOMBO1 / 3,600.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	8.114 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02858	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.71 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	117.03 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	117.03 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B10 / D22x40	-
Combination / Station	UCOMBO1 / 3,600.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	7.522 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02649	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.00 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	108.38 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	108.38 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B10 / D22x40	-
Combination / Station	UCOMBO1 / 4,050.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-12.397 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04366	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.96 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	180.25 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	180.25 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B10 / D22x40	-
Combination / Station	UCOMBO1 / 4,390.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-29.668 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10449	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	37.05 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	446.42 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	446.42 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B11 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-18.421 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10771	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.70 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	357.82 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	357.82 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B11 / D22x30	-
Combination / Station	UCOMBO1 / 453.3 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-9.574 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05598	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.99 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	180.54 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	180.54 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B11 / D22x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.763 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00446	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.16 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	14.01 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B11 / D22x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.606 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00355	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.92 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	11.13 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B11 / D22x30	-
Combination / Station	UCOMBO1 / 1,360.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.134 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01832	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.81 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	57.94 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.94 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B11 / D22x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.606 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02108	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.54 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	66.75 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	66.75 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B11 / D22x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.555 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02079	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.46 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	65.80 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	65.80 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B11 / D22x30	-
Combination / Station	UCOMBO1 / 2,266.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.580 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00339	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.88 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	10.64 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B11 / D22x30	-
Combination / Station	UCOMBO1 / 2,610.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-5.887 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03442	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.11 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	109.74 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	109.74 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B12 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.484 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03791	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.05 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	121.10 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	121.10 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B12 / D22x30	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.637 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00957	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.50 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	30.13 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B12 / D22x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.951 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01141	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.98 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	35.93 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B12 / D22x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.014 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01178	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.08 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	37.11 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B12 / D22x30	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.804 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00470	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.22 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	14.75 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B12 / D22x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-3.628 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02121	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.57 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	67.16 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	67.16 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B12 / D22x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-3.916 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02290	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.02 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	72.56 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	72.56 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B12 / D22x30	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-13.521 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07906	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.44 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	258.29 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	258.29 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B12 / D22x30	-
Combination / Station	UCOMBO1 / 2,590.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-22.914 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.13398	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	37.55 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	452.33 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	452.33 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B13 / D22x40	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-34.635 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12198	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	43.72 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	526.69 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	526.69 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B13 / D22x40	-
Combination / Station	UCOMBO1 / 483.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-14.258 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05022	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.27 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	208.03 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	208.03 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B13 / D22x40	-
Combination / Station	UCOMBO1 / 966.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	8.708 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03067	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.44 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	125.74 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	125.74 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B13 / D22x40	-
Combination / Station	UCOMBO1 / 966.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	9.319 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03282	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.18 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	134.71 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	134.71 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B13 / D22x40	-
Combination / Station	UCOMBO1 / 1,449.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	25.174 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08866	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	31.15 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	375.29 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	375.29 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B13 / D22x40	-
Combination / Station	UCOMBO1 / 1,932.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	37.170 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.13091	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	47.18 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	568.38 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	568.38 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B13 / D22x40	-
Combination / Station	UCOMBO1 / 1,932.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	37.402 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.13173	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	47.50 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	572.23 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	572.23 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B13 / D22x40	-
Combination / Station	UCOMBO1 / 2,415.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	41.615 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.14657	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	53.35 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	642.73 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	642.73 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B13 / D22x40	-
Combination / Station	UCOMBO1 / 2,898.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	41.968 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.14781	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	53.84 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	648.70 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	648.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B13 / D22x40	-
Combination / Station	UCOMBO1 / 2,898.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	41.863 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.14744	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	53.70 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	646.92 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	646.92 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B13 / D22x40	-
Combination / Station	UCOMBO1 / 3,381.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	34.274 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12071	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	43.23 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	520.80 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	520.80 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B13 / D22x40	-
Combination / Station	UCOMBO1 / 3,864.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	22.825 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08039	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	28.11 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	338.66 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	338.66 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B13 / D22x40	-
Combination / Station	UCOMBO1 / 3,864.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	22.381 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07883	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	27.54 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	331.77 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	331.77 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B13 / D22x40	-
Combination / Station	UCOMBO1 / 4,347.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	2.787 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00982	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.30 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	39.81 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	73.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B13 / D22x40	-
Combination / Station	UCOMBO1 / 4,720.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-14.986 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05278	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.17 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	218.96 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	218.96 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B14 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-7.926 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04634	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.34 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	148.68 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	148.68 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B14 / D22x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.003 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00002	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.00 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	0.05 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B14 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	8.933 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05223	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.96 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	168.13 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	168.13 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B14 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.304 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05440	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.55 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	175.30 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	175.30 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B14 / D22x30	-
Combination / Station	UCOMBO1 / 1,230.0 mm	-
$b \times h$; h_0; a'	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	13.734 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: $\beta = 0.8$ up to B60; $\beta = 0.7$ for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.08030	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.79 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	262.54 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	262.54 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B14 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	15.965 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09334	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	25.52 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	307.48 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	307.48 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B14 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	15.969 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09337	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	25.53 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	307.58 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	307.58 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B14 / D22x30	-
Combination / Station	UCOMBO1 / 2,050.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	13.906 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08131	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.08 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	265.97 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	265.97 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B14 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.643 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05638	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.10 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	181.89 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	181.89 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B14 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.282 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05427	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.52 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	174.88 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	174.88 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B14 / D22x30	-
Combination / Station	UCOMBO1 / 2,870.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.557 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00326	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.85 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	10.22 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B14 / D22x30	-
Combination / Station	UCOMBO1 / 3,170.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-7.221 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04222	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.22 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	135.16 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	135.16 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B15 / D22x40	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-16.471 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05801	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.03 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	241.35 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	241.35 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B15 / D22x40	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-0.862 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00304	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.02 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	12.27 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	73.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B15 / D22x40	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	16.857 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05937	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.52 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	247.19 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	247.19 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B15 / D22x40	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	17.327 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06103	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.11 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	254.31 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	254.31 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B15 / D22x40	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	28.013 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09866	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	34.87 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	420.05 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	420.05 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B15 / D22x40	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	35.350 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12450	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	44.69 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	538.39 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	538.39 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B15 / D22x40	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	35.478 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12495	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	44.86 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	540.49 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	540.49 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B15 / D22x40	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	35.996 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12678	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	45.57 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	549.02 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	549.02 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B15 / D22x40	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	33.166 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11681	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	41.73 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	502.76 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	502.76 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B15 / D22x40	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	32.953 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11606	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	41.44 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	499.30 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	499.30 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B15 / D22x40	-
Combination / Station	UCOMBO1 / 3,150.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	23.410 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08245	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	28.86 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	347.75 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	347.75 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B15 / D22x40	-
Combination / Station	UCOMBO1 / 3,600.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	10.519 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03705	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.65 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	152.40 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	152.40 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B15 / D22x40	-
Combination / Station	UCOMBO1 / 3,600.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	9.992 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03519	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.00 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	144.62 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	144.62 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B15 / D22x40	-
Combination / Station	UCOMBO1 / 4,050.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-10.044 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03537	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.07 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	145.39 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	145.39 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B15 / D22x40	-
Combination / Station	UCOMBO1 / 4,390.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-27.403 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09651	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	34.06 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	410.39 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	410.39 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B16 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-11.521 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06736	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.15 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	218.64 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	218.64 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B16 / D22x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.942 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00551	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.44 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	17.30 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B16 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	11.406 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06669	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.96 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	216.37 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	216.37 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B16 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	11.872 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06942	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.72 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	225.56 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	225.56 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B16 / D22x30	-
Combination / Station	UCOMBO1 / 1,055.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	16.394 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09586	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	26.25 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	316.23 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	316.23 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B16 / D22x30	-
Combination / Station	UCOMBO1 / 1,347.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	20.343 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11894	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	33.02 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	397.84 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	397.84 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B16 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	22.671 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.13256	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	37.11 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	447.14 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	447.14 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B16 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	23.147 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.13534	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	37.96 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	457.32 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	457.32 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B16 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	21.699 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12687	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	35.40 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	426.44 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	426.44 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B16 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	18.479 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10804	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.80 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	359.01 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	359.01 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B16 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.245 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08329	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.64 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	272.77 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	272.77 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B16 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.865 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06353	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.08 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	205.75 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	205.75 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B16 / D22x30	-
Combination / Station	UCOMBO1 / 2,695.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	8.087 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04728	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.60 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	151.79 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	151.79 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B16 / D22x30	-
Combination / Station	UCOMBO1 / 2,695.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.251 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02486	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.55 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	78.85 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	78.85 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B16 / D22x30	-
Combination / Station	UCOMBO1 / 2,987.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-4.174 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02441	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.43 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	77.41 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	77.41 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B16 / D22x30	-
Combination / Station	UCOMBO1 / 3,170.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-9.788 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05723	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.33 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	184.72 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	184.72 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B17 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-18.639 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10898	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	30.08 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	362.34 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	362.34 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B17 / D22x30	-
Combination / Station	UCOMBO1 / 351.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-10.907 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06377	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.15 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	206.57 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	206.57 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B17 / D22x30	-
Combination / Station	UCOMBO1 / 703.3 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.883 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01101	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.88 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	34.68 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B17 / D22x30	-
Combination / Station	UCOMBO1 / 1,055.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.955 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02312	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.08 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	73.28 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	73.28 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B17 / D22x30	-
Combination / Station	UCOMBO1 / 1,360.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.031 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03526	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.34 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	112.47 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	112.47 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B17 / D22x30	-
Combination / Station	UCOMBO1 / 1,665.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	5.251 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03070	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.11 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	97.70 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	97.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B17 / D22x30	-
Combination / Station	UCOMBO1 / 2,016.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.909 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00531	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.39 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	16.69 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B17 / D22x30	-
Combination / Station	UCOMBO1 / 2,368.3 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.621 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03871	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.27 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	123.70 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	123.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B17 / D22x30	-
Combination / Station	UCOMBO1 / 2,610.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-13.326 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07791	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.12 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	254.39 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	254.39 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B18 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-11.169 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06531	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.57 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	211.72 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	211.72 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B18 / D22x30	-
Combination / Station	UCOMBO1 / 351.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.662 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01556	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.08 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	49.14 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B18 / D22x30	-
Combination / Station	UCOMBO1 / 703.4 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	8.116 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04746	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.65 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	152.36 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	152.36 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B18 / D22x30	-
Combination / Station	UCOMBO1 / 703.4 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	8.741 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05111	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.65 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	164.41 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	164.41 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B18 / D22x30	-
Combination / Station	UCOMBO1 / 1,055.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	15.989 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09349	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	25.56 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	307.98 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	307.98 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B18 / D22x30	-
Combination / Station	UCOMBO1 / 1,406.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	20.387 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11920	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	33.10 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	398.76 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	398.76 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B18 / D22x30	-
Combination / Station	UCOMBO1 / 1,406.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	20.647 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12072	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	33.55 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	404.22 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	404.22 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B18 / D22x30	-
Combination / Station	UCOMBO1 / 1,758.3 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	22.448 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.13125	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	36.72 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	442.37 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	442.37 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B18 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	22.415 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.13106	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	36.66 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	441.67 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	441.67 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B19 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-9.463 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05533	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.81 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	178.39 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	178.39 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B19 / D22x30	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-3.012 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01761	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.62 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	55.67 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B19 / D22x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.698 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01577	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.13 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	49.80 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B19 / D22x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.784 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01628	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.27 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	51.40 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B19 / D22x30	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.708 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01583	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.15 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	50.00 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B19 / D22x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.588 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00344	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.90 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	10.78 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B19 / D22x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.809 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00473	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.23 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	14.85 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B19 / D22x30	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-9.661 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05649	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.13 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	182.24 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	182.24 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B19 / D22x30	-
Combination / Station	UCOMBO1 / 2,590.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-18.485 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10808	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.81 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	359.13 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	359.13 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B20 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-8.789 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05139	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.72 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	165.33 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	165.33 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B20 / D22x30	-
Combination / Station	UCOMBO1 / 351.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.630 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00953	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.49 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	29.99 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B20 / D22x30	-
Combination / Station	UCOMBO1 / 703.4 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	7.929 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04636	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.35 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	148.75 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	148.75 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B20 / D22x30	-
Combination / Station	UCOMBO1 / 703.4 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.559 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06174	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.58 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	199.76 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	199.76 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B20 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.921 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06386	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.17 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	206.86 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	206.86 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B20 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	12.237 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07155	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.32 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	232.77 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	232.77 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B20 / D22x30	-
Combination / Station	UCOMBO1 / 1,113.3 mm	-
$b \times h$; h_0; a'	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	15.623 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: $\beta = 0.8$ up to B60; $\beta = 0.7$ for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.09135	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	24.95 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	300.55 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	300.55 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B20 / D22x30	-
Combination / Station	UCOMBO1 / 1,406.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	18.300 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10700	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.49 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	355.32 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	355.32 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B20 / D22x30	-
Combination / Station	UCOMBO1 / 1,406.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	19.583 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11450	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	31.70 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	381.95 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	381.95 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B20 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
$b \times h$; h_0; a'	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	20.097 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: $\beta = 0.8$ up to B60; $\beta = 0.7$ for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.11751	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	32.60 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	392.70 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	392.70 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B20 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	20.256 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11844	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	32.87 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	396.03 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	396.03 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B20 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	19.120 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11180	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	30.90 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	372.32 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	372.32 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B20 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	17.868 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10448	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	28.75 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	346.41 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	346.41 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B20 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.415 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08429	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.92 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	276.19 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	276.19 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B20 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	11.519 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06735	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.14 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	218.60 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	218.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B20 / D22x30	-
Combination / Station	UCOMBO1 / 2,695.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.050 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05292	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.14 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	170.39 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	170.39 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B20 / D22x30	-
Combination / Station	UCOMBO1 / 2,695.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	5.304 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03101	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.19 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	98.70 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	98.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B20 / D22x30	-
Combination / Station	UCOMBO1 / 2,987.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.949 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01724	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.52 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	54.49 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B20 / D22x30	-
Combination / Station	UCOMBO1 / 3,170.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-8.456 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04944	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.19 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	158.90 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	158.90 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B21 / D22x40	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-30.761 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10834	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	38.51 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	463.92 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	463.92 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B21 / D22x40	-
Combination / Station	UCOMBO1 / 483.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-11.840 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04170	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.27 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	171.96 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	171.96 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B21 / D22x40	-
Combination / Station	UCOMBO1 / 966.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	9.241 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03255	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.09 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	133.57 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	133.57 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B21 / D22x40	-
Combination / Station	UCOMBO1 / 966.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	9.778 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03444	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.74 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	141.47 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	141.47 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B21 / D22x40	-
Combination / Station	UCOMBO1 / 1,449.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	23.264 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08194	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	28.68 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	345.48 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	345.48 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B21 / D22x40	-
Combination / Station	UCOMBO1 / 1,932.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	32.890 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11584	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	41.36 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	498.28 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	498.28 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B21 / D22x40	-
Combination / Station	UCOMBO1 / 1,932.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	33.056 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11642	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	41.58 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	500.97 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	500.97 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B21 / D22x40	-
Combination / Station	UCOMBO1 / 2,415.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	34.830 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12267	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	43.98 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	529.87 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	529.87 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B21 / D22x40	-
Combination / Station	UCOMBO1 / 2,898.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	32.743 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11532	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	41.16 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	495.89 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	495.89 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B21 / D22x40	-
Combination / Station	UCOMBO1 / 2,898.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	32.572 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11472	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	40.93 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	493.13 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	493.13 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B21 / D22x40	-
Combination / Station	UCOMBO1 / 3,381.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	22.625 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07968	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	27.85 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	335.55 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	335.55 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B21 / D22x40	-
Combination / Station	UCOMBO1 / 3,864.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	8.817 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03105	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.57 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	127.34 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	127.34 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B21 / D22x40	-
Combination / Station	UCOMBO1 / 3,864.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	8.272 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02914	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.91 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	119.35 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	119.35 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B21 / D22x40	-
Combination / Station	UCOMBO1 / 4,347.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-12.907 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04546	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.59 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	187.83 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	187.83 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B21 / D22x40	-
Combination / Station	UCOMBO1 / 4,720.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-31.904 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11237	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	40.03 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	482.32 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	482.32 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B22 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.367 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03723	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.87 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	118.86 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	118.86 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B22 / D22x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.364 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00213	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.55 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	6.67 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B22 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.311 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05444	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.56 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	175.45 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	175.45 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B22 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.774 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05715	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.31 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	184.43 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	184.43 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B22 / D22x30	-
Combination / Station	UCOMBO1 / 1,230.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	12.682 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07415	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.05 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	241.59 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	241.59 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B22 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	15.300 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08946	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	24.41 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	294.02 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	294.02 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B22 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	15.229 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08905	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	24.29 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	292.59 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	292.59 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B22 / D22x30	-
Combination / Station	UCOMBO1 / 1,940.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	13.732 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08029	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.79 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	262.50 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	262.50 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B22 / D22x30	-
Combination / Station	UCOMBO1 / 2,240.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	12.080 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07063	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.06 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	229.66 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	229.66 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B23 / D22x40	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-16.242 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05721	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.75 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	237.89 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	237.89 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B23 / D22x40	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-0.716 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00252	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.85 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	10.20 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	73.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B23 / D22x40	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	16.893 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05950	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.56 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	247.72 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	247.72 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B23 / D22x40	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	17.358 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06114	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.15 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	254.79 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	254.79 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B23 / D22x40	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	27.955 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09846	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	34.79 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	419.13 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	419.13 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B23 / D22x40	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	35.202 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12398	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	44.49 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	535.96 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	535.96 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B23 / D22x40	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	35.328 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12442	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	44.66 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	538.03 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	538.03 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B23 / D22x40	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	35.752 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12592	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	45.24 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	545.00 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	545.00 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B23 / D22x40	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	32.828 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11562	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	41.28 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	497.27 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	497.27 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B23 / D22x40	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	32.616 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11487	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	40.99 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	493.83 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	493.83 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B23 / D22x40	-
Combination / Station	UCOMBO1 / 3,150.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	22.965 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08088	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	28.29 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	340.83 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	340.83 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B23 / D22x40	-
Combination / Station	UCOMBO1 / 3,600.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	9.965 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03510	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.97 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	144.23 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	144.23 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B23 / D22x40	-
Combination / Station	UCOMBO1 / 3,600.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	9.397 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03310	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.28 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	135.87 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	135.87 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B23 / D22x40	-
Combination / Station	UCOMBO1 / 4,050.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-10.225 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03601	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.29 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	148.07 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	148.07 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B23 / D22x40	-
Combination / Station	UCOMBO1 / 4,390.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-27.273 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09605	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	33.89 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	408.33 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	408.33 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B24 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-14.355 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08394	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.83 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	274.99 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	274.99 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B24 / D22x30	-
Combination / Station	UCOMBO1 / 453.3 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.655 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03891	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.32 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	124.36 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	124.36 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B24 / D22x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.640 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00374	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.97 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	11.74 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B24 / D22x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.755 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00442	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.15 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	13.87 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B24 / D22x30	-
Combination / Station	UCOMBO1 / 1,360.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.029 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01771	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.65 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	55.97 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B24 / D22x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.033 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01189	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.11 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	37.46 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B24 / D22x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.947 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01139	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.98 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	35.87 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B24 / D22x30	-
Combination / Station	UCOMBO1 / 2,266.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-3.969 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02321	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.11 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	73.56 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	73.56 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B24 / D22x30	-
Combination / Station	UCOMBO1 / 2,610.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-10.626 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06213	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.69 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	201.06 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	201.06 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B25 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-9.471 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05537	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.82 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	178.54 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	178.54 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B25 / D22x30	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-3.103 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01814	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.76 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	57.35 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.35 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B25 / D22x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.499 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01461	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.83 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	46.10 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B25 / D22x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.611 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01527	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.00 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	48.19 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B25 / D22x30	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.842 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01662	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.36 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	52.49 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B25 / D22x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.148 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00086	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.22 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	2.70 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B25 / D22x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.327 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00191	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.50 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	5.99 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B25 / D22x30	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-8.990 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05257	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.05 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	169.23 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	169.23 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B25 / D22x30	-
Combination / Station	UCOMBO1 / 2,590.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-17.672 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10333	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	28.42 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	342.38 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	342.38 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B26 / D22x40	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-31.623 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11138	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	39.66 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	477.79 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	477.79 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B26 / D22x40	-
Combination / Station	UCOMBO1 / 483.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-12.469 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04392	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.05 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	181.31 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	181.31 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B26 / D22x40	-
Combination / Station	UCOMBO1 / 966.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	8.914 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03139	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.69 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	128.76 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	128.76 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B26 / D22x40	-
Combination / Station	UCOMBO1 / 966.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	9.450 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03328	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.34 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	136.64 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	136.64 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B26 / D22x40	-
Combination / Station	UCOMBO1 / 1,449.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	23.138 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08149	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	28.51 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	343.51 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	343.51 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B26 / D22x40	-
Combination / Station	UCOMBO1 / 1,932.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	32.965 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11610	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	41.46 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	499.50 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	499.50 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B26 / D22x40	-
Combination / Station	UCOMBO1 / 1,932.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	33.141 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11672	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	41.70 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	502.34 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	502.34 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B26 / D22x40	-
Combination / Station	UCOMBO1 / 2,415.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	35.182 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12391	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	44.46 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	535.65 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	535.65 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B26 / D22x40	-
Combination / Station	UCOMBO1 / 2,898.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	33.364 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11751	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	42.00 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	505.97 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	505.97 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B26 / D22x40	-
Combination / Station	UCOMBO1 / 2,898.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	33.199 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11693	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	41.78 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	503.30 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	503.30 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B26 / D22x40	-
Combination / Station	UCOMBO1 / 3,381.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	23.618 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08318	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.13 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	350.99 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	350.99 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B26 / D22x40	-
Combination / Station	UCOMBO1 / 3,864.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	10.177 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03584	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.23 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	147.35 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	147.35 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B26 / D22x40	-
Combination / Station	UCOMBO1 / 3,864.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	9.652 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03399	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.59 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	139.61 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	139.61 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B26 / D22x40	-
Combination / Station	UCOMBO1 / 4,347.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-11.138 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03923	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.41 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	161.55 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	161.55 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B26 / D22x40	-
Combination / Station	UCOMBO1 / 4,720.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-29.834 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10508	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	37.27 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	449.06 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	449.06 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B27 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-7.783 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04550	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.11 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	145.94 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	145.94 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B27 / D22x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.146 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00085	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.22 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	2.68 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B27 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.077 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05308	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.19 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	170.92 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	170.92 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B27 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.448 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05524	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.78 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	178.11 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	178.11 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B27 / D22x30	-
Combination / Station	UCOMBO1 / 1,230.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	13.885 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08118	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.04 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	265.55 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	265.55 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B27 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	16.122 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09426	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	25.79 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	310.68 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	310.68 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B27 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	16.127 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09429	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	25.80 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	310.78 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	310.78 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B27 / D22x30	-
Combination / Station	UCOMBO1 / 2,050.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.071 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08228	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.35 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	269.29 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	269.29 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B27 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.817 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05740	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.38 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	185.28 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	185.28 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B27 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.456 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05529	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.80 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	178.26 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	178.26 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B27 / D22x30	-
Combination / Station	UCOMBO1 / 2,870.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.747 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00437	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.14 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	13.72 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B27 / D22x30	-
Combination / Station	UCOMBO1 / 3,170.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-7.018 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04104	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.90 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	131.29 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	131.29 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B28 / D22x40	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-16.987 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05983	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.68 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	249.16 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	249.16 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B28 / D22x40	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-1.187 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00418	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.40 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	16.91 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	73.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B28 / D22x40	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	16.784 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05911	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.43 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	246.09 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	246.09 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B28 / D22x40	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	17.261 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06079	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.03 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	253.31 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	253.31 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B28 / D22x40	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	28.174 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09923	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	35.08 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	422.62 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	422.62 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B28 / D22x40	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	35.739 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12587	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	45.22 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	544.78 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	544.78 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B28 / D22x40	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	35.874 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12635	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	45.40 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	547.01 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	547.01 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B28 / D22x40	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	36.612 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12895	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	46.41 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	559.16 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	559.16 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B28 / D22x40	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	34.001 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11975	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	42.86 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	516.34 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	516.34 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B28 / D22x40	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	33.796 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11903	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	42.58 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	513.00 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	513.00 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B28 / D22x40	-
Combination / Station	UCOMBO1 / 3,150.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	24.464 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08616	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	30.23 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	364.17 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	364.17 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B28 / D22x40	-
Combination / Station	UCOMBO1 / 3,600.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	11.783 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04150	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.20 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	171.11 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	171.11 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B28 / D22x40	-
Combination / Station	UCOMBO1 / 3,600.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	11.260 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03966	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.56 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	163.37 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	163.37 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B28 / D22x40	-
Combination / Station	UCOMBO1 / 4,050.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-8.557 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03014	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.25 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	123.52 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	123.52 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B28 / D22x40	-
Combination / Station	UCOMBO1 / 4,390.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-25.751 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09069	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	31.90 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	384.34 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	384.34 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B29 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-11.435 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06686	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.01 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	216.94 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	216.94 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B29 / D22x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.911 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00533	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.39 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	16.73 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B29 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	11.360 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06642	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.89 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	215.48 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	215.48 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B29 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	11.824 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06913	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.64 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	224.60 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	224.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B29 / D22x30	-
Combination / Station	UCOMBO1 / 1,055.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	16.302 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09532	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	26.09 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	314.35 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	314.35 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B29 / D22x30	-
Combination / Station	UCOMBO1 / 1,347.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	20.196 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11808	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	32.77 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	394.76 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	394.76 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B29 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	22.469 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.13138	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	36.76 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	442.83 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	442.83 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B29 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	22.934 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.13410	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	37.58 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	452.76 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	452.76 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B29 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	21.445 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12539	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	34.95 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	421.06 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	421.06 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B29 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	18.237 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10663	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.38 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	354.02 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	354.02 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B29 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.046 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08213	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.31 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	268.79 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	268.79 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B29 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.700 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06256	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.81 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	202.51 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	202.51 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B29 / D22x30	-
Combination / Station	UCOMBO1 / 2,695.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	7.947 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04646	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.38 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	149.09 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	149.09 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B29 / D22x30	-
Combination / Station	UCOMBO1 / 2,695.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.147 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02425	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.38 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	76.90 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	76.90 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B29 / D22x30	-
Combination / Station	UCOMBO1 / 2,987.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-4.184 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02446	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.44 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	77.59 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	77.59 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B29 / D22x30	-
Combination / Station	UCOMBO1 / 3,170.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-9.739 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05695	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.25 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	183.76 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	183.76 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B30 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-16.926 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09897	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	27.15 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	327.08 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	327.08 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B30 / D22x30	-
Combination / Station	UCOMBO1 / 351.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-9.486 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05547	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.85 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	178.85 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	178.85 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B30 / D22x30	-
Combination / Station	UCOMBO1 / 703.3 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.888 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00519	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.35 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	16.30 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B30 / D22x30	-
Combination / Station	UCOMBO1 / 1,055.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.524 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02645	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.97 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	83.99 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	83.99 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B30 / D22x30	-
Combination / Station	UCOMBO1 / 1,360.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.231 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03643	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.65 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	116.29 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	116.29 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B30 / D22x30	-
Combination / Station	UCOMBO1 / 1,665.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	5.083 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02972	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	7.84 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	94.51 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	94.51 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B30 / D22x30	-
Combination / Station	UCOMBO1 / 2,016.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.315 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00184	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.48 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	5.77 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B30 / D22x30	-
Combination / Station	UCOMBO1 / 2,368.3 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-7.640 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04467	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.89 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	143.20 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	143.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B30 / D22x30	-
Combination / Station	UCOMBO1 / 2,610.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-14.638 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08559	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	23.30 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	280.66 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	280.66 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B31 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-11.346 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06634	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.86 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	215.18 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	215.18 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B31 / D22x30	-
Combination / Station	UCOMBO1 / 351.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.801 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01638	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.29 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	51.73 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B31 / D22x30	-
Combination / Station	UCOMBO1 / 703.4 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	8.031 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04696	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.51 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	150.72 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	150.72 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B31 / D22x30	-
Combination / Station	UCOMBO1 / 703.4 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	8.660 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05063	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.52 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	162.83 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	162.83 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B31 / D22x30	-
Combination / Station	UCOMBO1 / 1,055.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	15.957 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09330	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	25.51 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	307.34 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	307.34 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B31 / D22x30	-
Combination / Station	UCOMBO1 / 1,406.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	20.404 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11930	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	33.13 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	399.14 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	399.14 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B31 / D22x30	-
Combination / Station	UCOMBO1 / 1,406.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	20.668 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12084	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	33.59 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	404.67 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	404.67 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B31 / D22x30	-
Combination / Station	UCOMBO1 / 1,758.3 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	22.528 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.13172	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	36.86 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	444.09 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	444.09 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B31 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
$b \times h$; h_0; a'	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	22.554 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: $\beta = 0.8$ up to B60; $\beta = 0.7$ for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.13188	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	36.91 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	444.64 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	444.64 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B32 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-10.008 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05852	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.69 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	189.01 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	189.01 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B32 / D22x30	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-3.501 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02047	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.38 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	64.78 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	64.78 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B32 / D22x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.286 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01337	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.50 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	42.15 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B32 / D22x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.373 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01388	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.63 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	43.77 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B32 / D22x30	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.354 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01377	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.60 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	43.42 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B32 / D22x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.885 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00518	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.35 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	16.26 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B32 / D22x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.104 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00646	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.68 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	20.29 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B32 / D22x30	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-9.903 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05790	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.52 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	186.95 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	186.95 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B32 / D22x30	-
Combination / Station	UCOMBO1 / 2,590.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-18.687 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10926	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	30.16 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	363.33 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	363.33 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B33 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-8.822 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05158	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.78 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	165.96 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	165.96 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B33 / D22x30	-
Combination / Station	UCOMBO1 / 351.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.673 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00978	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.56 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	30.78 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B33 / D22x30	-
Combination / Station	UCOMBO1 / 703.4 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	7.871 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04602	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.25 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	147.64 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	147.64 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B33 / D22x30	-
Combination / Station	UCOMBO1 / 703.4 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.498 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06138	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.48 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	198.57 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	198.57 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B33 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.860 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06350	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.07 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	205.65 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	205.65 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B33 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	12.173 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07117	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.22 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	231.50 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	231.50 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B33 / D22x30	-
Combination / Station	UCOMBO1 / 1,113.3 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	15.552 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09093	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	24.83 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	299.12 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	299.12 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B33 / D22x30	-
Combination / Station	UCOMBO1 / 1,406.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	18.222 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10655	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.36 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	353.71 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	353.71 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B33 / D22x30	-
Combination / Station	UCOMBO1 / 1,406.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	19.503 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11403	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	31.56 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	380.28 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	380.28 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B33 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	20.016 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11703	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	32.45 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	391.00 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	391.00 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B33 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	20.173 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11795	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	32.73 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	394.27 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	394.27 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B33 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	19.032 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11128	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	30.75 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	370.48 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	370.48 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B33 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	17.781 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10397	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	28.60 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	344.62 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	344.62 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B33 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.344 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08387	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.81 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	274.76 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	274.76 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B33 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	11.459 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06700	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.05 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	217.43 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	217.43 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B33 / D22x30	-
Combination / Station	UCOMBO1 / 2,695.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	8.999 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05262	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.06 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	169.39 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	169.39 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B33 / D22x30	-
Combination / Station	UCOMBO1 / 2,695.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	5.264 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03078	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.13 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	97.93 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	97.93 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B33 / D22x30	-
Combination / Station	UCOMBO1 / 2,987.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.962 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01732	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.54 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	54.73 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B33 / D22x30	-
Combination / Station	UCOMBO1 / 3,170.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-8.452 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04942	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.18 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	158.82 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	158.82 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B34 / D22x40	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-29.636 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10438	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	37.01 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	445.89 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	445.89 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B34 / D22x40	-
Combination / Station	UCOMBO1 / 483.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-10.749 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03786	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.93 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	155.79 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	155.79 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B34 / D22x40	-
Combination / Station	UCOMBO1 / 966.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	10.288 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03623	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.37 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	148.99 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	148.99 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B34 / D22x40	-
Combination / Station	UCOMBO1 / 966.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	10.824 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03812	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.02 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	156.91 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	156.91 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B34 / D22x40	-
Combination / Station	UCOMBO1 / 1,449.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	24.277 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08550	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.99 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	361.26 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	361.26 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B34 / D22x40	-
Combination / Station	UCOMBO1 / 1,932.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	33.870 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11929	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	42.68 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	514.20 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	514.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B34 / D22x40	-
Combination / Station	UCOMBO1 / 1,932.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	34.035 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11987	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	42.90 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	516.89 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	516.89 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B34 / D22x40	-
Combination / Station	UCOMBO1 / 2,415.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	35.775 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12600	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	45.27 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	545.38 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	545.38 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B34 / D22x40	-
Combination / Station	UCOMBO1 / 2,898.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	33.655 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11853	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	42.39 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	510.71 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	510.71 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B34 / D22x40	-
Combination / Station	UCOMBO1 / 2,898.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	33.483 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11793	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	42.16 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	507.91 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	507.91 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B34 / D22x40	-
Combination / Station	UCOMBO1 / 3,381.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	23.506 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08279	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	28.99 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	349.24 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	349.24 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B34 / D22x40	-
Combination / Station	UCOMBO1 / 3,864.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	9.668 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03405	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.61 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	139.85 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	139.85 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B34 / D22x40	-
Combination / Station	UCOMBO1 / 3,864.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	9.122 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03213	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.94 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	131.81 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	131.81 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B34 / D22x40	-
Combination / Station	UCOMBO1 / 4,347.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-12.066 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04250	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.55 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	175.33 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	175.33 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B34 / D22x40	-
Combination / Station	UCOMBO1 / 4,720.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-31.071 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10943	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	38.92 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	468.90 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	468.90 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B35 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.513 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03808	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.10 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	121.65 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	121.65 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B35 / D22x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.234 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.00137	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.36 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	4.29 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B35 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.205 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05382	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.39 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	173.39 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	173.39 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B35 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.668 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05653	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.14 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	182.37 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	182.37 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B35 / D22x30	-
Combination / Station	UCOMBO1 / 1,230.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	12.582 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07357	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.89 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	239.61 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	239.61 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B35 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	15.207 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08891	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	24.25 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	292.13 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	292.13 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B35 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	15.136 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08850	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	24.13 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	290.70 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	290.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B35 / D22x30	-
Combination / Station	UCOMBO1 / 1,940.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	13.637 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07973	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.63 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	260.60 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	260.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B35 / D22x30	-
Combination / Station	UCOMBO1 / 2,240.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	11.983 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07006	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.90 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	227.74 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	227.74 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B36 / D22x40	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-16.767 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05905	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.40 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	245.83 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	245.83 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B36 / D22x40	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-1.043 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00367	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.23 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	14.85 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	73.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B36 / D22x40	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	16.830 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05927	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.48 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	246.77 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	246.77 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B36 / D22x40	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	17.303 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06094	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.08 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	253.94 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	253.94 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B36 / D22x40	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	28.139 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09910	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	35.03 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	422.05 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	422.05 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B36 / D22x40	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	35.625 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12547	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	45.06 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	542.92 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	542.92 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B36 / D22x40	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	35.759 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12594	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	45.25 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	545.12 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	545.12 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B36 / D22x40	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	36.419 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12827	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	46.15 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	555.98 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	555.98 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B36 / D22x40	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	33.730 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11880	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	42.49 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	511.92 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	511.92 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B36 / D22x40	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	33.526 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11808	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	42.22 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	508.60 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	508.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B36 / D22x40	-
Combination / Station	UCOMBO1 / 3,150.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	24.105 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08490	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.76 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	358.57 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	358.57 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B36 / D22x40	-
Combination / Station	UCOMBO1 / 3,600.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	11.335 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03992	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.65 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	164.48 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	164.48 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B36 / D22x40	-
Combination / Station	UCOMBO1 / 3,600.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	10.775 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03795	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.96 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	156.19 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	156.19 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B36 / D22x40	-
Combination / Station	UCOMBO1 / 4,050.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-8.628 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03039	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.34 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	124.57 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	124.57 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B36 / D22x40	-
Combination / Station	UCOMBO1 / 4,390.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-25.510 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08985	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	31.59 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	380.56 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	380.56 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B37 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-12.786 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07476	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.22 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	243.66 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	243.66 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B37 / D22x30	-
Combination / Station	UCOMBO1 / 453.3 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-5.484 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03207	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.48 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	102.11 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	102.11 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B37 / D22x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.286 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00752	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.96 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	23.64 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B37 / D22x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.389 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00812	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.12 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	25.54 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B37 / D22x30	-
Combination / Station	UCOMBO1 / 1,360.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.180 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01859	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.88 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	58.79 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	58.79 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B37 / D22x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.701 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00995	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.60 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	31.32 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B37 / D22x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.604 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00938	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.45 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	29.51 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B37 / D22x30	-
Combination / Station	UCOMBO1 / 2,266.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-4.830 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02824	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	7.45 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	89.74 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	89.74 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B37 / D22x30	-
Combination / Station	UCOMBO1 / 2,610.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-11.878 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06945	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.73 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	225.67 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	225.67 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B38 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-10.136 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05927	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.90 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	191.50 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	191.50 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B38 / D22x30	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-3.690 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02158	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.67 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	68.33 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	68.33 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B38 / D22x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.015 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01178	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.08 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	37.12 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B38 / D22x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.132 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01246	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.26 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	39.29 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B38 / D22x30	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.470 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01444	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.78 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	45.57 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B38 / D22x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
$b \times h$; h_0; a'	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.413 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: $\beta = 0.8$ up to B60; $\beta = 0.7$ for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.00241	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.63 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	7.57 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B38 / D22x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.589 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00344	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.90 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	10.80 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B38 / D22x30	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-9.140 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05344	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.29 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	172.13 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	172.13 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B38 / D22x30	-
Combination / Station	UCOMBO1 / 2,590.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-17.737 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10371	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	28.53 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	343.72 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	343.72 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B39 / D22x40	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-30.426 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10716	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	38.06 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	458.54 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	458.54 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B39 / D22x40	-
Combination / Station	UCOMBO1 / 483.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-11.317 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03986	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.63 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	164.21 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	164.21 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B39 / D22x40	-
Combination / Station	UCOMBO1 / 966.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	10.006 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03524	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.02 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	144.84 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	144.84 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B39 / D22x40	-
Combination / Station	UCOMBO1 / 966.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	10.542 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03713	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.68 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	152.74 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	152.74 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B39 / D22x40	-
Combination / Station	UCOMBO1 / 1,449.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	24.186 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08518	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.87 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	359.84 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	359.84 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B39 / D22x40	-
Combination / Station	UCOMBO1 / 1,932.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	33.970 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11964	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	42.82 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	515.84 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	515.84 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B39 / D22x40	-
Combination / Station	UCOMBO1 / 1,932.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	34.144 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12026	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	43.05 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	518.68 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	518.68 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B39 / D22x40	-
Combination / Station	UCOMBO1 / 2,415.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	36.145 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12730	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	45.77 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	551.47 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	551.47 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B39 / D22x40	-
Combination / Station	UCOMBO1 / 2,898.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	34.286 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12076	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	43.24 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	520.99 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	520.99 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B39 / D22x40	-
Combination / Station	UCOMBO1 / 2,898.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	34.121 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12017	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	43.02 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	518.29 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	518.29 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B39 / D22x40	-
Combination / Station	UCOMBO1 / 3,381.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	24.503 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08630	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	30.28 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	364.79 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	364.79 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B39 / D22x40	-
Combination / Station	UCOMBO1 / 3,864.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	11.026 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03883	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.27 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	159.90 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	159.90 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B39 / D22x40	-
Combination / Station	UCOMBO1 / 3,864.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	10.499 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03698	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.63 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	152.10 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	152.10 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B39 / D22x40	-
Combination / Station	UCOMBO1 / 4,347.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-10.305 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03630	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.39 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	149.25 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	149.25 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B39 / D22x40	-
Combination / Station	UCOMBO1 / 4,720.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-29.013 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10218	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	36.19 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	435.96 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	435.96 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B40 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-7.991 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04672	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.45 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	149.94 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	149.94 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B40 / D22x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.307 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00179	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.47 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	5.63 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B40 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	8.397 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04910	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.10 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	157.77 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	157.77 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B40 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	8.758 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05121	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.67 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	164.74 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	164.74 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B40 / D22x30	-
Combination / Station	UCOMBO1 / 1,230.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	13.038 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07624	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.64 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	248.67 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	248.67 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B40 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	15.242 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08912	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	24.31 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	292.85 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	292.85 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B40 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
$b \times h$; h_0; a'	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	15.246 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: $\beta = 0.8$ up to B60; $\beta = 0.7$ for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.08915	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	24.31 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	292.93 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	292.93 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B40 / D22x30	-
Combination / Station	UCOMBO1 / 2,050.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	13.195 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07715	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.90 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	251.79 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	251.79 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B40 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.067 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05302	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.17 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	170.72 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	170.72 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B40 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	8.715 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05095	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.60 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	163.89 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	163.89 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B40 / D22x30	-
Combination / Station	UCOMBO1 / 2,870.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.196 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00115	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.30 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	3.59 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B40 / D22x30	-
Combination / Station	UCOMBO1 / 3,170.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-7.352 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04299	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.43 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	137.68 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	137.68 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B41 / D22x40	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-16.993 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05985	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.69 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	249.25 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	249.25 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B41 / D22x40	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-1.646 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00580	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.95 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	23.46 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	73.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B41 / D22x40	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	15.890 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05596	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.30 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	232.57 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	232.57 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B41 / D22x40	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	16.357 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05761	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.89 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	239.62 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	239.62 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B41 / D22x40	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	27.013 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09514	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	33.55 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	404.22 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	404.22 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B41 / D22x40	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	34.506 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12153	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	43.54 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	524.58 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	524.58 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B41 / D22x40	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	34.641 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12201	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	43.73 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	526.79 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	526.79 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B41 / D22x40	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	35.429 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12478	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	44.80 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	539.70 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	539.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B41 / D22x40	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	33.053 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11641	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	41.58 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	500.93 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	500.93 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B41 / D22x40	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	32.858 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11573	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	41.32 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	497.76 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	497.76 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B41 / D22x40	-
Combination / Station	UCOMBO1 / 3,150.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	23.867 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08406	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.45 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	354.86 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	354.86 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B41 / D22x40	-
Combination / Station	UCOMBO1 / 3,600.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	11.712 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.04125	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.12 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	170.06 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	170.06 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B41 / D22x40	-
Combination / Station	UCOMBO1 / 3,600.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	11.207 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03947	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.49 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	162.57 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	162.57 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B41 / D22x40	-
Combination / Station	UCOMBO1 / 4,050.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-7.944 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02798	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.51 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	114.55 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	114.55 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B41 / D22x40	-
Combination / Station	UCOMBO1 / 4,390.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-24.512 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08633	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	30.29 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	364.93 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	364.93 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B42 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-11.453 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06696	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.04 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	217.30 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	217.30 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B42 / D22x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.180 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00690	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.80 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	21.70 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B42 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.809 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06320	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.99 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	204.65 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	204.65 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B42 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	11.262 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06585	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.72 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	213.54 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	213.54 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B42 / D22x30	-
Combination / Station	UCOMBO1 / 1,055.0 mm	-
$b \times h$; h_0; a'	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	15.610 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: $\beta = 0.8$ up to B60; $\beta = 0.7$ for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.09127	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	24.92 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	300.28 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	300.28 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B42 / D22x30	-
Combination / Station	UCOMBO1 / 1,347.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	19.373 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11327	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	31.34 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	377.58 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	377.58 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B42 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	21.553 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12602	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	35.14 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	423.35 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	423.35 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B42 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	21.994 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12860	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	35.92 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	432.72 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	432.72 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B42 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	20.480 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11975	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	33.26 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	400.73 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	400.73 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B42 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	17.386 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10166	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	27.93 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	336.51 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	336.51 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B42 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	13.315 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07785	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.10 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	254.18 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	254.18 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B42 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.059 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05881	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.77 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	189.98 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	189.98 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B42 / D22x30	-
Combination / Station	UCOMBO1 / 2,695.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	7.378 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04314	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.47 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	138.17 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	138.17 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B42 / D22x30	-
Combination / Station	UCOMBO1 / 2,695.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.692 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02159	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.67 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	68.36 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	68.36 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B42 / D22x30	-
Combination / Station	UCOMBO1 / 2,987.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-4.410 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02578	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.79 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	81.84 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	81.84 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B42 / D22x30	-
Combination / Station	UCOMBO1 / 3,170.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-9.804 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05732	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.36 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	185.02 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	185.02 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B43 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-14.192 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08298	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.55 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	271.71 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	271.71 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B43 / D22x30	-
Combination / Station	UCOMBO1 / 351.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-7.388 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04320	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.49 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	138.38 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	138.38 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B43 / D22x30	-
Combination / Station	UCOMBO1 / 703.3 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.380 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00222	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.58 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	6.96 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B43 / D22x30	-
Combination / Station	UCOMBO1 / 1,055.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	5.074 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02967	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	7.83 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	94.35 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	94.35 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B43 / D22x30	-
Combination / Station	UCOMBO1 / 1,360.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.251 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03655	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.68 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	116.66 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	116.66 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B43 / D22x30	-
Combination / Station	UCOMBO1 / 1,665.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.657 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02723	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	7.18 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	86.48 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	86.48 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B43 / D22x30	-
Combination / Station	UCOMBO1 / 2,016.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.519 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00303	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.79 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	9.51 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B43 / D22x30	-
Combination / Station	UCOMBO1 / 2,368.3 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-8.768 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.05127	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.69 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	164.93 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	164.93 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B43 / D22x30	-
Combination / Station	UCOMBO1 / 2,610.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-15.902 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09298	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	25.42 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	306.21 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	306.21 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B44 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-11.030 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06449	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.35 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	208.99 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	208.99 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B44 / D22x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.297 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00759	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.98 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	23.85 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B44 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.954 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05820	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.60 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	187.95 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	187.95 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B44 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.367 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06062	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.27 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	196.01 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	196.01 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B44 / D22x30	-
Combination / Station	UCOMBO1 / 1,055.0 mm	-
$b \times h$; h_0; a'	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.549 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: $\beta = 0.8$ up to B60; $\beta = 0.7$ for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.08507	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	23.15 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	278.88 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	278.88 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B44 / D22x30	-
Combination / Station	UCOMBO1 / 1,347.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	18.105 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10586	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.16 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	351.30 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	351.30 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B44 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	20.078 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11739	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	32.56 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	392.29 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	392.29 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B44 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
$b \times h$; h_0; a'	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	20.554 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: $\beta = 0.8$ up to B60; $\beta = 0.7$ for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.12018	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	33.39 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	402.29 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	402.29 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B44 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	19.467 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11382	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	31.50 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	379.52 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	379.52 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B44 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	16.508 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09652	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	26.44 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	318.54 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	318.54 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B44 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	12.571 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07350	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.87 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	239.38 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	239.38 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B44 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.462 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05532	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.81 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	178.37 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	178.37 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B44 / D22x30	-
Combination / Station	UCOMBO1 / 2,695.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.934 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04054	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.76 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	129.68 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	129.68 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B44 / D22x30	-
Combination / Station	UCOMBO1 / 2,695.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.440 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02011	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.28 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	63.64 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	63.64 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B44 / D22x30	-
Combination / Station	UCOMBO1 / 2,987.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-4.301 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02515	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.62 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	79.78 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	79.78 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B44 / D22x30	-
Combination / Station	UCOMBO1 / 3,170.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-9.469 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05536	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.82 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	178.51 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	178.51 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B45 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-10.468 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06121	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.43 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	197.97 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	197.97 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B45 / D22x30	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-3.865 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02260	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.94 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	71.61 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	71.61 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B45 / D22x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.209 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01292	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.38 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	40.73 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B45 / D22x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.327 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01361	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.56 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	42.92 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B45 / D22x30	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.116 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01822	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.78 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	57.59 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.59 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B45 / D22x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.869 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00508	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.32 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	15.95 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B45 / D22x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.675 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00395	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.03 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	12.39 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B45 / D22x30	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.628 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03875	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.28 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	123.84 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	123.84 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B45 / D22x30	-
Combination / Station	UCOMBO1 / 2,590.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-14.159 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08279	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.50 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	271.05 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	271.05 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B46 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-7.498 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04384	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.66 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	140.48 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	140.48 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B46 / D22x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.463 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00271	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.70 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	8.49 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B46 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.205 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05967	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.01 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	192.85 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	192.85 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B46 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.902 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06375	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.14 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	206.48 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	206.48 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B46 / D22x30	-
Combination / Station	UCOMBO1 / 1,230.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.778 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08641	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	23.53 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	283.49 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	283.49 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B46 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
$b \times h$; h_0; a'	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	17.340 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: $\beta = 0.8$ up to B60; $\beta = 0.7$ for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.10138	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	27.85 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	335.55 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	335.55 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B46 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	17.346 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.10142	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	27.86 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	335.69 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	335.69 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B46 / D22x30	-
Combination / Station	UCOMBO1 / 2,050.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.894 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08708	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	23.72 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	285.82 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	285.82 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B46 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	11.127 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06506	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.50 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	210.89 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	210.89 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B46 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.449 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06110	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.40 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	197.61 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	197.61 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B46 / D22x30	-
Combination / Station	UCOMBO1 / 2,870.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.883 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00516	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.35 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	16.21 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B46 / D22x30	-
Combination / Station	UCOMBO1 / 3,170.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.950 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04064	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.79 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	129.98 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	129.98 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B47 / D22x40	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-18.215 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06415	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.23 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	267.81 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	267.81 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B47 / D22x40	-
Combination / Station	UCOMBO1 / 483.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-6.234 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02196	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	7.44 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	89.61 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	89.61 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B47 / D22x40	-
Combination / Station	UCOMBO1 / 966.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	7.942 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02797	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.51 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	114.52 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	114.52 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B47 / D22x40	-
Combination / Station	UCOMBO1 / 966.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	8.321 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02931	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.97 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	120.07 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	120.07 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B47 / D22x40	-
Combination / Station	UCOMBO1 / 1,449.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	16.878 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05945	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.54 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	247.51 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	247.51 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B47 / D22x40	-
Combination / Station	UCOMBO1 / 1,932.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	23.925 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08426	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.53 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	355.77 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	355.77 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B47 / D22x40	-
Combination / Station	UCOMBO1 / 1,932.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	24.039 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08467	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.68 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	357.55 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	357.55 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B47 / D22x40	-
Combination / Station	UCOMBO1 / 2,415.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	24.767 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08723	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	30.62 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	368.92 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	368.92 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B47 / D22x40	-
Combination / Station	UCOMBO1 / 2,898.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	23.986 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08448	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.61 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	356.71 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	356.71 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B47 / D22x40	-
Combination / Station	UCOMBO1 / 2,898.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	23.872 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08408	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.46 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	354.94 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	354.94 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B47 / D22x40	-
Combination / Station	UCOMBO1 / 3,381.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	16.748 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05899	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.38 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	245.54 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	245.54 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B47 / D22x40	-
Combination / Station	UCOMBO1 / 3,864.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	8.115 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02858	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.72 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	117.05 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	117.05 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B47 / D22x40	-
Combination / Station	UCOMBO1 / 3,864.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	7.741 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02726	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.26 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	111.57 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	111.57 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B47 / D22x40	-
Combination / Station	UCOMBO1 / 4,347.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-6.394 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02252	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	7.63 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	91.93 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	91.93 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B47 / D22x40	-
Combination / Station	UCOMBO1 / 4,720.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-18.343 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06460	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.39 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	269.75 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	269.75 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B48 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.453 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01434	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.76 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	45.26 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B48 / D22x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.147 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01840	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.83 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	58.18 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	58.18 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B48 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.555 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06171	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.57 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	199.67 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	199.67 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B48 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.969 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06414	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.25 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	207.79 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	207.79 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B48 / D22x30	-
Combination / Station	UCOMBO1 / 1,230.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	13.538 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07916	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.47 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	258.63 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	258.63 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B48 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	15.823 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09252	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	25.28 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	304.61 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	304.61 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B48 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	15.824 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09253	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	25.29 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	304.64 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	304.64 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B48 / D22x30	-
Combination / Station	UCOMBO1 / 2,050.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	13.571 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07935	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.52 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	259.28 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	259.28 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B48 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	11.032 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06450	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.35 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	209.03 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	209.03 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B48 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.620 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06210	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.68 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	200.95 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	200.95 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B48 / D22x30	-
Combination / Station	UCOMBO1 / 2,870.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.260 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01906	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.00 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	60.28 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	60.28 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B48 / D22x30	-
Combination / Station	UCOMBO1 / 3,170.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.306 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01348	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.53 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	42.53 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B49 / D22x40	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-16.742 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05896	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.37 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	245.44 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	245.44 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B49 / D22x40	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-1.469 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00518	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.74 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	20.94 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	73.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B49 / D22x40	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	15.967 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05624	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.40 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	233.73 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	233.73 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B49 / D22x40	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	16.430 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05787	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.98 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	240.73 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	240.73 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B49 / D22x40	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	27.010 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09513	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	33.55 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	404.18 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	404.18 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B49 / D22x40	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	34.426 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12125	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	43.43 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	523.27 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	523.27 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B49 / D22x40	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	34.559 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12172	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	43.61 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	525.45 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	525.45 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B49 / D22x40	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	35.270 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.12422	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	44.58 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	537.09 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	537.09 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B49 / D22x40	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	32.818 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11558	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	41.26 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	497.10 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	497.10 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B49 / D22x40	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	32.624 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11490	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	41.00 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	493.97 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	493.97 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B49 / D22x40	-
Combination / Station	UCOMBO1 / 3,150.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	23.545 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08293	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.04 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	349.85 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	349.85 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B49 / D22x40	-
Combination / Station	UCOMBO1 / 3,600.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	11.303 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03981	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.61 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	164.00 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	164.00 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B49 / D22x40	-
Combination / Station	UCOMBO1 / 3,600.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	10.762 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.03790	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.95 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	155.99 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	155.99 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B49 / D22x40	-
Combination / Station	UCOMBO1 / 4,050.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-7.998 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02817	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.57 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	115.33 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	115.33 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B49 / D22x40	-
Combination / Station	UCOMBO1 / 4,390.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-24.269 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08548	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.98 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	361.14 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	361.14 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B50 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-10.539 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06162	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.55 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	199.36 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	199.36 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B50 / D22x30	-
Combination / Station	UCOMBO1 / 453.3 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-3.916 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02290	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.02 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	72.56 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	72.56 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B50 / D22x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.122 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01241	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.25 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	39.11 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B50 / D22x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.211 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01293	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.38 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	40.76 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B50 / D22x30	-
Combination / Station	UCOMBO1 / 1,360.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.415 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01997	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.24 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	63.18 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	63.18 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B50 / D22x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.538 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00899	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.35 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	28.29 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B50 / D22x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.432 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00837	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.19 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	26.34 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B50 / D22x30	-
Combination / Station	UCOMBO1 / 2,266.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-5.313 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03107	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.21 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	98.88 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	98.88 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B50 / D22x30	-
Combination / Station	UCOMBO1 / 2,610.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-12.472 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07292	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.71 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	237.42 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	237.42 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B51 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-11.092 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06485	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.45 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	210.20 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	210.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B51 / D22x30	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-4.460 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02608	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.87 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	82.78 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	82.78 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B51 / D22x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.652 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00966	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.52 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	30.41 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B51 / D22x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.810 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01058	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.77 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	33.33 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B51 / D22x30	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.945 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01722	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.52 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	54.41 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B51 / D22x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.045 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00611	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.59 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	19.20 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B51 / D22x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.862 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00504	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.31 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	15.82 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B51 / D22x30	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.056 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03541	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.38 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	112.96 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	112.96 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B51 / D22x30	-
Combination / Station	UCOMBO1 / 2,590.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-13.296 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07774	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.07 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	253.81 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	253.81 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B52 / D22x40	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-17.623 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06207	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.48 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	258.81 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	258.81 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B52 / D22x40	-
Combination / Station	UCOMBO1 / 483.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-5.741 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02022	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.84 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	82.45 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	82.45 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B52 / D22x40	-
Combination / Station	UCOMBO1 / 966.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	8.307 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02926	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.95 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	119.87 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	119.87 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B52 / D22x40	-
Combination / Station	UCOMBO1 / 966.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	8.682 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03058	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.41 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	125.36 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	125.36 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B52 / D22x40	-
Combination / Station	UCOMBO1 / 1,449.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	17.145 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06038	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.88 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	251.55 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	251.55 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B52 / D22x40	-
Combination / Station	UCOMBO1 / 1,932.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	24.097 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08487	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.75 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	358.45 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	358.45 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B52 / D22x40	-
Combination / Station	UCOMBO1 / 1,932.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	24.209 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08527	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.90 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	360.20 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	360.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B52 / D22x40	-
Combination / Station	UCOMBO1 / 2,415.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	24.868 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08759	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	30.75 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	370.50 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	370.50 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B52 / D22x40	-
Combination / Station	UCOMBO1 / 2,898.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	24.017 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08459	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.65 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	357.20 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	357.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B52 / D22x40	-
Combination / Station	UCOMBO1 / 2,898.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	23.902 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08418	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	29.50 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	355.40 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	355.40 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B52 / D22x40	-
Combination / Station	UCOMBO1 / 3,381.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	16.719 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05888	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.34 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	245.09 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	245.09 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B52 / D22x40	-
Combination / Station	UCOMBO1 / 3,864.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	8.026 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02827	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.61 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	115.74 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	115.74 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B52 / D22x40	-
Combination / Station	UCOMBO1 / 3,864.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	7.651 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02695	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.15 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	110.26 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	110.26 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B52 / D22x40	-
Combination / Station	UCOMBO1 / 4,347.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-6.547 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02306	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	7.82 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	94.16 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	94.16 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B52 / D22x40	-
Combination / Station	UCOMBO1 / 4,720.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-18.545 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06531	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.65 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	272.83 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	272.83 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B53 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.957 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01729	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.53 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	54.63 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B53 / D22x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.077 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01799	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.72 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	56.88 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B53 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.472 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06123	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.44 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	198.05 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	198.05 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B53 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.797 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06313	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.97 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	204.41 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	204.41 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B53 / D22x30	-
Combination / Station	UCOMBO1 / 1,230.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.090 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08239	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.38 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	269.67 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	269.67 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B53 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
$b \times h$; h_0; a'	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	16.399 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: $\beta = 0.8$ up to B60; $\beta = 0.7$ for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.09589	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	26.26 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	316.32 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	316.32 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B53 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	16.401 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09590	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	26.26 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	316.37 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	316.37 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B53 / D22x30	-
Combination / Station	UCOMBO1 / 2,050.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.166 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08283	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.51 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	271.18 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	271.18 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B53 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.946 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06400	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.21 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	207.33 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	207.33 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B53 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.625 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06212	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.69 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	201.05 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	201.05 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B53 / D22x30	-
Combination / Station	UCOMBO1 / 2,870.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.317 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01940	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.09 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	61.35 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	61.35 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B53 / D22x30	-
Combination / Station	UCOMBO1 / 3,170.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.654 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01552	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.07 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	48.98 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B54 / D22x40	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-6.745 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02376	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.05 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	97.04 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	97.04 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B54 / D22x40	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	4.622 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01628	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.50 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	66.24 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	73.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B54 / D22x40	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	18.517 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06522	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.61 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	272.40 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	272.40 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B54 / D22x40	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	18.907 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06659	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	23.10 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	278.36 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	278.36 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B54 / D22x40	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	26.756 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09424	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	33.22 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	400.17 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	400.17 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B54 / D22x40	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	33.296 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11727	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	41.91 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	504.87 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	504.87 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B54 / D22x40	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	33.401 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11764	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	42.05 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	506.58 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	506.58 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B54 / D22x40	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	33.139 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11672	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	41.69 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	502.32 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	502.32 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B54 / D22x40	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	31.568 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11118	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	39.58 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	476.90 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	476.90 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B54 / D22x40	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	31.402 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11060	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	39.36 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	474.23 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	474.23 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B54 / D22x40	-
Combination / Station	UCOMBO1 / 3,150.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	23.165 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08159	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	28.55 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	343.93 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	343.93 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B54 / D22x40	-
Combination / Station	UCOMBO1 / 3,600.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	13.618 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04796	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.47 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	198.45 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	198.45 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B54 / D22x40	-
Combination / Station	UCOMBO1 / 3,600.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	13.149 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04631	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.89 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	191.46 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	191.46 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B54 / D22x40	-
Combination / Station	UCOMBO1 / 4,050.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-1.743 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00614	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.06 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	24.85 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	73.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B54 / D22x40	-
Combination / Station	UCOMBO1 / 4,390.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-13.862 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04882	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.78 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	202.11 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	202.11 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B55 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.955 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01728	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.53 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	54.59 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B55 / D22x30	-
Combination / Station	UCOMBO1 / 355.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.176 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01273	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.33 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	40.12 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B55 / D22x30	-
Combination / Station	UCOMBO1 / 710.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.431 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05514	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.76 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	177.78 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	177.78 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B55 / D22x30	-
Combination / Station	UCOMBO1 / 710.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.647 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.06226	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.72 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	201.49 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	201.49 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B55 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.886 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06365	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.11 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	206.17 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	206.17 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B55 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	11.610 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06788	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.29 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	220.39 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	220.39 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B55 / D22x30	-
Combination / Station	UCOMBO1 / 1,115.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	13.373 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07819	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.19 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	255.33 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	255.33 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B55 / D22x30	-
Combination / Station	UCOMBO1 / 1,410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.988 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08764	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	23.88 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	287.72 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	287.72 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B55 / D22x30	-
Combination / Station	UCOMBO1 / 1,410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	15.859 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09273	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	25.34 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	305.33 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	305.33 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B55 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	16.358 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09564	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	26.19 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	315.48 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	315.48 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B55 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	16.439 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09612	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	26.32 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	317.13 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	317.13 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B55 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.896 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08710	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	23.73 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	285.86 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	285.86 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B55 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.799 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08653	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	23.57 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	283.91 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	283.91 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B55 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	12.855 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07516	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.34 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	245.02 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	245.02 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B55 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	11.068 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06472	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.41 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	209.73 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	209.73 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B55 / D22x30	-
Combination / Station	UCOMBO1 / 2,695.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.353 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05469	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.63 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	176.26 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	176.26 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B55 / D22x30	-
Combination / Station	UCOMBO1 / 2,695.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.814 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03984	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.57 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	127.38 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	127.38 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B55 / D22x30	-
Combination / Station	UCOMBO1 / 2,987.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.930 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00544	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.42 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	17.09 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B55 / D22x30	-
Combination / Station	UCOMBO1 / 3,170.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.814 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01645	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.31 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	51.96 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B56 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-8.474 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04955	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.22 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	159.24 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	159.24 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B56 / D22x30	-
Combination / Station	UCOMBO1 / 453.3 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-4.430 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02590	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.82 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	82.22 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	82.22 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B56 / D22x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.144 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00084	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.22 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	2.63 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B56 / D22x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.049 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00029	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.07 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	0.89 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B56 / D22x30	-
Combination / Station	UCOMBO1 / 1,360.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.065 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00038	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.10 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	1.19 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B56 / D22x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.020 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00596	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.56 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	18.74 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B56 / D22x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.163 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00680	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.77 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	21.37 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B56 / D22x30	-
Combination / Station	UCOMBO1 / 2,266.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.421 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03755	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.95 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	119.90 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	119.90 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B56 / D22x30	-
Combination / Station	UCOMBO1 / 2,610.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-11.201 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06549	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.63 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	212.35 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	212.35 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B57 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-3.512 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02054	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.40 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	65.00 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	65.00 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B57 / D22x30	-
Combination / Station	UCOMBO1 / 355.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.573 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00920	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.40 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	28.95 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B57 / D22x30	-
Combination / Station	UCOMBO1 / 710.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	8.762 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05123	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.68 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	164.81 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	164.81 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B57 / D22x30	-
Combination / Station	UCOMBO1 / 710.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.941 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05813	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.58 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	187.70 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	187.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B57 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.165 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05943	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.94 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	192.05 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	192.05 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B57 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.821 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06327	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.01 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	204.88 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	204.88 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B57 / D22x30	-
Combination / Station	UCOMBO1 / 1,115.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	12.527 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07324	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.80 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	238.51 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	238.51 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B57 / D22x30	-
Combination / Station	UCOMBO1 / 1,410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.085 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08236	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.38 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	269.58 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	269.58 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B57 / D22x30	-
Combination / Station	UCOMBO1 / 1,410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.859 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08688	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	23.67 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	285.12 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	285.12 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B57 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	15.276 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08932	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	24.36 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	293.53 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	293.53 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B57 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	15.346 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08973	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	24.48 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	294.96 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	294.96 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B57 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.083 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08234	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.37 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	269.53 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	269.53 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B57 / D22x30	-
Combination / Station	UCOMBO1 / 2,110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	14.000 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08186	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.23 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	267.87 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	267.87 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B57 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	12.010 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07022	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.95 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	228.28 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	228.28 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B57 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.240 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05987	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.06 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	193.53 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	193.53 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B57 / D22x30	-
Combination / Station	UCOMBO1 / 2,695.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	8.583 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05019	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.39 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	161.36 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	161.36 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B57 / D22x30	-
Combination / Station	UCOMBO1 / 2,695.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.115 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03575	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.47 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	114.06 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	114.06 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B57 / D22x30	-
Combination / Station	UCOMBO1 / 2,987.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.298 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00174	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.45 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	5.46 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B57 / D22x30	-
Combination / Station	UCOMBO1 / 3,170.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-3.405 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01991	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.23 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	63.00 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	63.00 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B58 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-9.915 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05797	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.54 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	187.19 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	187.19 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B58 / D22x30	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-3.952 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02310	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.08 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	73.23 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	73.23 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B58 / D22x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.905 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01699	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.45 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	53.67 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B58 / D22x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.135 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01833	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.81 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	57.95 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.95 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B58 / D22x30	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	5.474 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03201	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.46 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	101.92 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	101.92 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B58 / D22x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.633 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03878	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.29 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	123.93 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	123.93 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B58 / D22x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.558 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03834	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.17 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	122.50 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	122.50 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B58 / D22x30	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.174 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01856	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.87 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	58.67 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	58.67 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B58 / D22x30	-
Combination / Station	UCOMBO1 / 2,590.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.166 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00097	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.25 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	3.05 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B59 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-3.852 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02252	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.92 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	71.36 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	71.36 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B59 / D22x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.547 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00905	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.36 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	28.47 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B59 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	8.074 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04721	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.58 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	151.54 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	151.54 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B59 / D22x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	8.352 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04883	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.02 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	156.89 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	156.89 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B59 / D22x30	-
Combination / Station	UCOMBO1 / 1,230.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	11.263 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06585	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.73 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	213.56 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	213.56 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B59 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	13.190 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07712	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.89 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	251.68 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	251.68 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B59 / D22x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	13.194 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07714	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.90 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	251.76 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	251.76 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B59 / D22x30	-
Combination / Station	UCOMBO1 / 2,050.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	11.384 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06656	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.92 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	215.94 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	215.94 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B59 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	8.590 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05023	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.40 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	161.50 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	161.50 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B59 / D22x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	8.323 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04866	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.98 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	156.33 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	156.33 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B59 / D22x30	-
Combination / Station	UCOMBO1 / 2,870.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.941 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01135	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.97 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	35.75 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B59 / D22x30	-
Combination / Station	UCOMBO1 / 3,170.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-3.352 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01960	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.15 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	62.01 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	62.01 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B62 / D22x40	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-6.586 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02320	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	7.86 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	94.73 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	94.73 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B62 / D22x40	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	4.740 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01669	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.64 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	67.94 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	73.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B62 / D22x40	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	18.580 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06544	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.69 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	273.37 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	273.37 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B62 / D22x40	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	18.969 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06681	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	23.18 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	279.30 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	279.30 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B62 / D22x40	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	26.778 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09431	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	33.24 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	400.51 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	400.51 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B62 / D22x40	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	33.278 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11720	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	41.88 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	504.57 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	504.57 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B62 / D22x40	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	33.381 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11757	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	42.02 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	506.26 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	506.26 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B62 / D22x40	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	33.088 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11654	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	41.63 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	501.50 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	501.50 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B62 / D22x40	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	31.486 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11090	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	39.48 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	475.59 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	475.59 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B62 / D22x40	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	31.319 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11031	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	39.25 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	472.89 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	472.89 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B62 / D22x40	-
Combination / Station	UCOMBO1 / 3,150.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	23.065 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08124	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	28.42 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	342.39 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	342.39 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B62 / D22x40	-
Combination / Station	UCOMBO1 / 3,600.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	13.502 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04756	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.33 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	196.73 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	196.73 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B62 / D22x40	-
Combination / Station	UCOMBO1 / 3,600.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	13.036 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04591	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.75 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	189.77 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	189.77 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B62 / D22x40	-
Combination / Station	UCOMBO1 / 4,050.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-1.921 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00676	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.27 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	27.39 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	73.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B62 / D22x40	-
Combination / Station	UCOMBO1 / 4,390.0 mm	-
b × h; h_0; a′	220.0 × 400.0; 335.0; 25.0 mm	Section geometry
Design moment M	-14.090 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	206.15 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	120.964 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04962	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.06 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	205.51 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 73.70 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	205.51 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B63 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-8.857 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05179	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.83 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	166.65 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	166.65 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B63 / D22x30	-
Combination / Station	UCOMBO1 / 453.3 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-4.534 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02651	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.99 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	84.17 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	84.17 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B63 / D22x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.122 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00071	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.19 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	2.23 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B63 / D22x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.211 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00124	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.32 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	3.88 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B63 / D22x30	-
Combination / Station	UCOMBO1 / 1,360.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.239 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00140	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.36 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	4.38 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B63 / D22x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.931 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00545	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.42 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	17.11 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B63 / D22x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.053 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00616	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.61 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	19.35 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B63 / D22x30	-
Combination / Station	UCOMBO1 / 2,266.7 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.830 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03993	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.60 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	127.69 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	127.69 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B63 / D22x30	-
Combination / Station	UCOMBO1 / 2,610.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-12.002 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07017	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.93 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	228.12 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	228.12 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B64 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-10.441 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06105	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.39 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	197.44 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	197.44 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B64 / D22x30	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-4.325 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02529	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.66 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	80.25 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	80.25 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B64 / D22x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.732 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01597	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.19 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	50.44 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B64 / D22x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.961 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01731	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.54 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	54.71 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B64 / D22x30	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	5.407 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03161	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.35 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	100.65 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	100.65 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B64 / D22x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.672 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03901	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.35 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	124.68 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	124.68 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B64 / D22x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.603 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03861	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.24 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	123.36 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	123.36 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B64 / D22x30	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.357 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01963	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.15 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	62.09 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	62.09 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B64 / D22x30	-
Combination / Station	UCOMBO1 / 2,590.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.121 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00071	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.18 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	2.21 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B66 / D11x30	-
Combination / Station	UCOMBO1 / 0.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-9.733 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11382	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	31.50 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	189.75 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	189.75 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B66 / D11x30	-
Combination / Station	UCOMBO1 / 453.3 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-3.688 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04313	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.47 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	69.08 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	69.08 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B66 / D11x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.863 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01009	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.64 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	15.88 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B66 / D11x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.947 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01108	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.90 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	17.44 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B66 / D11x30	-
Combination / Station	UCOMBO1 / 1,055.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.085 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02438	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.42 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	38.66 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	38.66 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B66 / D11x30	-
Combination / Station	UCOMBO1 / 1,360.0 mm	-
$b \times h$; h_0; a'	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.353 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: $\beta = 0.8$ up to B60; $\beta = 0.7$ for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.03921	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.40 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	62.67 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	62.67 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B66 / D11x30	-
Combination / Station	UCOMBO1 / 1,665.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.161 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03697	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.80 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	59.01 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	59.01 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B66 / D11x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.547 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02979	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	7.86 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	47.37 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	47.37 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B66 / D11x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.550 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02982	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	7.87 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	47.43 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	47.43 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B66 / D11x30	-
Combination / Station	UCOMBO1 / 2,266.7 mm	-
$b \times h$; h_0; a'	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.731 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: $\beta = 0.8$ up to B60; $\beta = 0.7$ for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.00854	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	2.23 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	13.44 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B66 / D11x30	-
Combination / Station	UCOMBO1 / 2,720.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-5.505 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06437	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.31 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	104.29 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	104.29 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B67 / D11x30	-
Combination / Station	UCOMBO1 / 0.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-8.456 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09889	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	27.13 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	163.40 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	163.40 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B67 / D11x30	-
Combination / Station	UCOMBO1 / 453.3 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.836 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03317	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.77 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	52.84 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	52.84 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B67 / D11x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.291 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01509	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.95 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	23.82 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B67 / D11x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.341 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01568	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.11 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	24.75 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B67 / D11x30	-
Combination / Station	UCOMBO1 / 1,055.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.309 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02700	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	7.12 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	42.88 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	42.88 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B67 / D11x30	-
Combination / Station	UCOMBO1 / 1,360.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.230 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03777	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.01 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	60.32 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	60.32 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B67 / D11x30	-
Combination / Station	UCOMBO1 / 1,665.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.690 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03146	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.31 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	50.07 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	50.07 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B67 / D11x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.907 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02230	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.86 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	35.33 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	35.33 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B67 / D11x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.884 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02203	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.79 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	34.89 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	34.89 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B67 / D11x30	-
Combination / Station	UCOMBO1 / 2,266.7 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.675 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01959	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.14 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	30.99 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	30.99 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B67 / D11x30	-
Combination / Station	UCOMBO1 / 2,720.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.728 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07868	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.33 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	128.49 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	128.49 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B68 / D11x30	-
Combination / Station	UCOMBO1 / 0.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-7.870 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.09203	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	25.14 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	151.46 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	151.46 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B68 / D11x30	-
Combination / Station	UCOMBO1 / 453.3 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.408 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02816	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	7.43 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	44.74 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	44.74 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B68 / D11x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.561 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01825	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.79 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	28.85 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.85 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B68 / D11x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.600 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01872	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.91 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	29.59 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	29.59 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B68 / D11x30	-
Combination / Station	UCOMBO1 / 1,055.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.504 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02929	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	7.73 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	46.56 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	46.56 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B68 / D11x30	-
Combination / Station	UCOMBO1 / 1,360.0 mm	-
$b \times h$; h_0; a'	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.293 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: $\beta = 0.8$ up to B60; $\beta = 0.7$ for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.03851	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.21 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	61.52 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	61.52 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B68 / D11x30	-
Combination / Station	UCOMBO1 / 1,665.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.621 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03065	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.09 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	48.76 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	48.76 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B68 / D11x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
$b \times h$; h_0; a'	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.773 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: $\beta = 0.8$ up to B60; $\beta = 0.7$ for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.02074	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.45 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	32.82 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	32.82 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B68 / D11x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.740 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02035	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.34 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	32.20 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	32.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B68 / D11x30	-
Combination / Station	UCOMBO1 / 2,266.7 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.986 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02323	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.11 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	36.81 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	36.81 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B68 / D11x30	-
Combination / Station	UCOMBO1 / 2,720.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-7.205 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08426	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.92 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	138.05 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	138.05 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B69 / D11x30	-
Combination / Station	UCOMBO1 / 0.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-7.015 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08203	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.28 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	134.23 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	134.23 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B69 / D11x30	-
Combination / Station	UCOMBO1 / 453.3 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.750 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02047	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.38 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	32.39 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	32.39 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B69 / D11x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.021 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02363	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.22 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	37.46 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	37.46 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B69 / D11x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.049 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02396	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.31 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	37.99 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	37.99 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B69 / D11x30	-
Combination / Station	UCOMBO1 / 1,055.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.891 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03381	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.95 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	53.88 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	53.88 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B69 / D11x30	-
Combination / Station	UCOMBO1 / 1,360.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.553 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04155	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.04 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	66.49 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	66.49 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B69 / D11x30	-
Combination / Station	UCOMBO1 / 1,665.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.754 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03220	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.51 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	51.28 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	51.28 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B69 / D11x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
$b \times h$; h_0; a'	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.845 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: $\beta = 0.8$ up to B60; $\beta = 0.7$ for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.02157	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.67 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	34.16 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	34.16 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B69 / D11x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.804 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02109	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.54 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	33.39 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	33.39 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B69 / D11x30	-
Combination / Station	UCOMBO1 / 2,266.7 mm	-
$b \times h$; h_0; a'	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.088 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: $\beta = 0.8$ up to B60; $\beta = 0.7$ for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.02441	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.43 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	38.72 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	38.72 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B69 / D11x30	-
Combination / Station	UCOMBO1 / 2,720.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-7.472 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08738	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	23.81 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	143.42 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	143.42 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B70 / D11x30	-
Combination / Station	UCOMBO1 / 0.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.517 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02944	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	7.77 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	46.80 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	46.80 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B70 / D11x30	-
Combination / Station	UCOMBO1 / 355.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.789 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02092	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.50 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	33.11 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	33.11 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B70 / D11x30	-
Combination / Station	UCOMBO1 / 710.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.175 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01374	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.60 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	21.66 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B70 / D11x30	-
Combination / Station	UCOMBO1 / 710.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.183 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01383	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.62 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	21.82 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B70 / D11x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.174 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01373	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.60 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	21.66 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B70 / D11x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.209 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01414	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.70 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	22.31 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B70 / D11x30	-
Combination / Station	UCOMBO1 / 1,360.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.429 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01672	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.38 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	26.40 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B70 / D11x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.836 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02147	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.64 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	34.00 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	34.00 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B70 / D11x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.899 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02221	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.84 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	35.17 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	35.17 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B70 / D11x30	-
Combination / Station	UCOMBO1 / 2,010.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.010 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02350	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.18 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	37.25 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	37.25 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B70 / D11x30	-
Combination / Station	UCOMBO1 / 2,010.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.012 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02353	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.19 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	37.30 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	37.30 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B70 / D11x30	-
Combination / Station	UCOMBO1 / 2,365.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.882 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03370	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.91 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	53.70 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	53.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B70 / D11x30	-
Combination / Station	UCOMBO1 / 2,720.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-3.865 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04520	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.03 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	72.47 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	72.47 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B71 / D11x30	-
Combination / Station	UCOMBO1 / 0.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-4.740 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05543	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.83 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	89.36 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	89.36 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B71 / D11x30	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.791 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02094	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.50 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	33.14 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	33.14 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B71 / D11x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.350 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00409	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.07 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	6.42 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B71 / D11x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.237 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00277	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.72 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	4.34 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B71 / D11x30	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.034 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00040	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.10 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	0.63 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B71 / D11x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.204 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01408	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.69 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	22.21 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B71 / D11x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.439 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01683	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.41 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	26.58 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B71 / D11x30	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-3.459 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04044	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.74 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	64.68 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	64.68 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B71 / D11x30	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
$b \times h$; h_0; a'	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.987 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: $\beta = 0.8$ up to B60; $\beta = 0.7$ for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.08171	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.19 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	133.68 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	133.68 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B72 / D11x30	-
Combination / Station	UCOMBO1 / 0.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-5.087 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05949	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.96 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	96.13 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	96.13 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B72 / D11x30	-
Combination / Station	UCOMBO1 / 450.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.081 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02434	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.41 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	38.59 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	38.59 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B72 / D11x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.584 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00683	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.78 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	10.73 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B72 / D11x30	-
Combination / Station	UCOMBO1 / 900.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.465 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00544	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.42 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	8.55 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B72 / D11x30	-
Combination / Station	UCOMBO1 / 1,350.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.145 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00170	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.44 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	2.67 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B72 / D11x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.334 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01561	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.09 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	24.63 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B72 / D11x30	-
Combination / Station	UCOMBO1 / 1,800.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.564 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01829	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.80 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	28.92 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.92 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B72 / D11x30	-
Combination / Station	UCOMBO1 / 2,250.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-3.541 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04141	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.00 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	66.26 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	66.26 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B72 / D11x30	-
Combination / Station	UCOMBO1 / 2,700.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-7.027 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08217	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	22.32 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	134.47 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	134.47 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B73 / D11x30	-
Combination / Station	UCOMBO1 / 0.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.299 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00350	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.91 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	5.49 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B73 / D11x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.680 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03134	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.28 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	49.88 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	49.88 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B73 / D11x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.406 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05153	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.76 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	82.89 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	82.89 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B73 / D11x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.517 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05282	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.12 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	85.03 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	85.03 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B73 / D11x30	-
Combination / Station	UCOMBO1 / 1,230.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.021 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07041	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.00 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	114.46 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	114.46 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B73 / D11x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.273 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07336	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.83 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	119.44 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	119.44 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B73 / D11x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
$b \times h$; h_0; a'	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.283 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: $\beta = 0.8$ up to B60; $\beta = 0.7$ for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.07348	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.86 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	119.65 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	119.65 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B73 / D11x30	-
Combination / Station	UCOMBO1 / 1,940.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	5.891 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06889	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.58 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	111.90 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	111.90 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B73 / D11x30	-
Combination / Station	UCOMBO1 / 2,240.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.829 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05647	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.12 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	91.08 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	91.08 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B74 / D11x30	-
Combination / Station	UCOMBO1 / 0.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.326 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00381	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.99 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	5.98 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B74 / D11x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.650 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03099	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.19 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	49.31 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	49.31 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B74 / D11x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.372 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05113	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.65 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	82.24 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	82.24 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B74 / D11x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.483 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05242	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.01 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	84.38 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	84.38 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B74 / D11x30	-
Combination / Station	UCOMBO1 / 1,230.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	5.988 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07003	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.89 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	113.81 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	113.81 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B74 / D11x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.241 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07298	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.72 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	118.81 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	118.81 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B74 / D11x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.251 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.07310	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.76 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	119.02 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	119.02 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B74 / D11x30	-
Combination / Station	UCOMBO1 / 1,940.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	5.859 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06852	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.47 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	111.26 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	111.26 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B74 / D11x30	-
Combination / Station	UCOMBO1 / 2,240.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.796 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05609	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.02 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	90.46 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	90.46 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B75 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-12.440 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07274	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.65 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	236.79 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	236.79 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B75 / D22x30	-
Combination / Station	UCOMBO1 / 252.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-9.602 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05614	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.03 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	181.10 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	181.10 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B75 / D22x30	-
Combination / Station	UCOMBO1 / 505.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-5.364 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03136	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.29 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	99.84 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	99.84 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B75 / D22x30	-
Combination / Station	UCOMBO1 / 505.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-4.887 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02858	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	7.54 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	90.83 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	90.83 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B75 / D22x30	-
Combination / Station	UCOMBO1 / 757.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.056 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01202	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.14 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	37.88 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B75 / D22x30	-
Combination / Station	UCOMBO1 / 1,010.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.235 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00137	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.36 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	4.30 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B76 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-12.457 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07284	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.68 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	237.13 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	237.13 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B76 / D22x30	-
Combination / Station	UCOMBO1 / 252.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-9.615 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05622	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.05 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	181.35 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	181.35 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B76 / D22x30	-
Combination / Station	UCOMBO1 / 505.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-5.370 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03140	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.30 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	99.95 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	99.95 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B76 / D22x30	-
Combination / Station	UCOMBO1 / 505.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-4.893 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02861	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	7.55 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	90.94 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	90.94 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B76 / D22x30	-
Combination / Station	UCOMBO1 / 757.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.059 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01204	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.15 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	37.95 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B76 / D22x30	-
Combination / Station	UCOMBO1 / 1,010.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.237 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00138	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.36 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	4.34 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B77 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-15.225 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08902	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	24.28 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	292.51 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	292.51 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B77 / D22x30	-
Combination / Station	UCOMBO1 / 252.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-11.961 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06993	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.87 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	227.31 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	227.31 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B77 / D22x30	-
Combination / Station	UCOMBO1 / 505.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.967 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04073	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.82 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	130.30 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	130.30 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B77 / D22x30	-
Combination / Station	UCOMBO1 / 505.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.385 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03733	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.90 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	119.21 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	119.21 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B77 / D22x30	-
Combination / Station	UCOMBO1 / 757.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.826 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01652	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.33 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	52.19 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B77 / D22x30	-
Combination / Station	UCOMBO1 / 1,010.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.277 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00162	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.42 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	5.08 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B78 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-15.239 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.08910	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	24.30 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	292.79 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	292.79 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B78 / D22x30	-
Combination / Station	UCOMBO1 / 252.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-11.971 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06999	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.88 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	227.51 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	227.51 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B78 / D22x30	-
Combination / Station	UCOMBO1 / 505.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.971 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04076	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	10.82 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	130.39 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	130.39 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B78 / D22x30	-
Combination / Station	UCOMBO1 / 505.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.389 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03736	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.90 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	119.29 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	119.29 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B78 / D22x30	-
Combination / Station	UCOMBO1 / 757.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.828 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01654	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.34 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	52.24 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B78 / D22x30	-
Combination / Station	UCOMBO1 / 1,010.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.278 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00163	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.42 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	5.10 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B81 / D11x30	-
Combination / Station	UCOMBO1 / 0.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.014 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00017	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.04 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	0.26 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B81 / D11x30	-
Combination / Station	UCOMBO1 / 410.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.807 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03282	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.68 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	52.28 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	52.28 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B81 / D11x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.747 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05551	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.86 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	89.49 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	89.49 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B81 / D11x30	-
Combination / Station	UCOMBO1 / 820.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.858 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05681	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.22 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	91.66 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	91.66 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B81 / D11x30	-
Combination / Station	UCOMBO1 / 1,230.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.217 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07271	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.65 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	118.34 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	118.34 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B81 / D11x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.724 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07863	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.32 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	128.42 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	128.42 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B81 / D11x30	-
Combination / Station	UCOMBO1 / 1,640.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.725 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07864	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	21.32 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	128.43 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	128.43 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B81 / D11x30	-
Combination / Station	UCOMBO1 / 2,050.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.225 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07280	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.67 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	118.49 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	118.49 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B81 / D11x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.873 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05699	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.26 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	91.95 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	91.95 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B81 / D11x30	-
Combination / Station	UCOMBO1 / 2,460.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.762 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05568	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.90 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	89.78 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	89.78 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B81 / D11x30	-
Combination / Station	UCOMBO1 / 2,870.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	2.820 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03298	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.72 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	52.53 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	52.53 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B81 / D11x30	-
Combination / Station	UCOMBO1 / 3,280.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.026 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00030	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.08 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	0.48 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B82 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-11.085 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06481	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.44 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	210.07 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	210.07 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B82 / D22x30	-
Combination / Station	UCOMBO1 / 252.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-8.903 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05206	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.91 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	167.54 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	167.54 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B82 / D22x30	-
Combination / Station	UCOMBO1 / 505.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-5.325 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03114	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.23 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	99.10 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	99.10 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B82 / D22x30	-
Combination / Station	UCOMBO1 / 505.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-4.913 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02872	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	7.58 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	91.31 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	91.31 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B82 / D22x30	-
Combination / Station	UCOMBO1 / 757.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.369 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01385	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.63 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	43.69 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B82 / D22x30	-
Combination / Station	UCOMBO1 / 1,010.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.194 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00113	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.29 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	3.55 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B83 / D22x30	-
Combination / Station	UCOMBO1 / 110.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-11.093 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06486	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.45 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	210.22 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	210.22 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B83 / D22x30	-
Combination / Station	UCOMBO1 / 252.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-8.910 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05210	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.92 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	167.67 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	167.67 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B83 / D22x30	-
Combination / Station	UCOMBO1 / 505.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-5.330 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03116	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.23 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	99.19 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	99.19 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B83 / D22x30	-
Combination / Station	UCOMBO1 / 505.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-4.917 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02875	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	7.59 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	91.39 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	91.39 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B83 / D22x30	-
Combination / Station	UCOMBO1 / 757.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.372 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01387	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.63 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	43.74 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B83 / D22x30	-
Combination / Station	UCOMBO1 / 1,010.0 mm	-
$b \times h$; h_0; a'	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.194 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0} \cdot \gamma_{b1} \cdot \gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: $\beta = 0.8$ up to B60; $\beta = 0.7$ for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R \cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R \cdot R_b \cdot b \cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M \rvert/(R_b \cdot b \cdot h_0^2)$	0.00114	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min} \cdot b \cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.30 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M \rvert/[R_s(h_0 - x/2)]$	3.56 mm^2	From equations (34)-(35)
$A_{sc,calc}$	0 mm^2	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm^2 (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm^2	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm^2	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B84 / D11x30	-
Combination / Station	UCOMBO1 / 0.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.893 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03383	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.95 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	53.90 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	53.90 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B84 / D11x30	-
Combination / Station	UCOMBO1 / 355.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.879 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02198	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.78 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	34.80 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	34.80 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B84 / D11x30	-
Combination / Station	UCOMBO1 / 710.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.980 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01146	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.00 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	18.06 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B84 / D11x30	-
Combination / Station	UCOMBO1 / 710.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.002 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01172	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.06 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	18.46 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B84 / D11x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.044 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01220	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.19 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	19.23 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B84 / D11x30	-
Combination / Station	UCOMBO1 / 906.7 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.188 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01389	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	3.64 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	21.91 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B84 / D11x30	-
Combination / Station	UCOMBO1 / 1,360.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.363 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01594	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	4.18 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	25.17 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B84 / D11x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.725 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02017	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.30 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	31.91 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	31.91 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B84 / D11x30	-
Combination / Station	UCOMBO1 / 1,813.4 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.695 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.01982	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.20 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	31.35 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	31.35 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B84 / D11x30	-
Combination / Station	UCOMBO1 / 2,010.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.730 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02023	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.31 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	32.01 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	32.01 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B84 / D11x30	-
Combination / Station	UCOMBO1 / 2,010.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-1.741 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02036	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.35 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	32.22 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	32.22 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B84 / D11x30	-
Combination / Station	UCOMBO1 / 2,365.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-2.835 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03315	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	8.77 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	52.81 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	52.81 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B84 / D11x30	-
Combination / Station	UCOMBO1 / 2,720.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-4.042 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04727	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.60 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	75.87 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	75.87 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B85 / D11x30	-
Combination / Station	UCOMBO1 / 0.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.919 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04582	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.20 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	73.49 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	73.49 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B85 / D11x30	-
Combination / Station	UCOMBO1 / 350.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	5.118 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05985	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.06 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	96.72 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	96.72 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B85 / D11x30	-
Combination / Station	UCOMBO1 / 700.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.206 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07257	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.61 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	118.11 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	118.11 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B85 / D11x30	-
Combination / Station	UCOMBO1 / 700.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.247 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07306	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	19.74 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	118.94 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	118.94 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B85 / D11x30	-
Combination / Station	UCOMBO1 / 1,050.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	5.950 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06957	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.77 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	113.05 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	113.05 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B85 / D11x30	-
Combination / Station	UCOMBO1 / 1,400.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	5.541 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06479	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.43 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	105.00 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	105.00 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B86 / D11x30	-
Combination / Station	UCOMBO1 / 0.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.873 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04529	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.05 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	72.61 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	72.61 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B86 / D11x30	-
Combination / Station	UCOMBO1 / 350.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.900 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05730	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.35 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	92.47 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	92.47 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B86 / D11x30	-
Combination / Station	UCOMBO1 / 700.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	5.816 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06801	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.33 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	110.41 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	110.41 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B86 / D11x30	-
Combination / Station	UCOMBO1 / 700.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	5.861 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06853	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	18.48 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	111.29 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	111.29 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B86 / D11x30	-
Combination / Station	UCOMBO1 / 1,050.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	5.696 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06661	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.94 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	108.05 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	108.05 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B86 / D11x30	-
Combination / Station	UCOMBO1 / 1,400.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	5.420 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06339	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.04 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	102.64 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	102.64 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B18 / D22x30	-
Combination / Station	UCOMBO1 / 0.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	19.720 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11531	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	31.94 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	384.82 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	384.82 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B18 / D22x30	-
Combination / Station	UCOMBO1 / 292.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	13.100 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07659	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.74 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	249.89 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	249.89 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B18 / D22x30	-
Combination / Station	UCOMBO1 / 585.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.338 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03706	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.82 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	118.31 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	118.31 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B18 / D22x30	-
Combination / Station	UCOMBO1 / 585.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.778 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02794	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	7.37 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	88.76 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	88.76 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B18 / D22x30	-
Combination / Station	UCOMBO1 / 877.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-4.133 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02416	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.36 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	76.63 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	76.63 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B18 / D22x30	-
Combination / Station	UCOMBO1 / 1,060.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-9.763 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05709	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.29 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	184.23 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	184.23 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B31 / D22x30	-
Combination / Station	UCOMBO1 / 0.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	19.861 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.11613	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	32.19 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	387.76 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	387.76 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B31 / D22x30	-
Combination / Station	UCOMBO1 / 292.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	13.163 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.07696	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	20.85 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	251.14 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	251.14 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B31 / D22x30	-
Combination / Station	UCOMBO1 / 585.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	6.323 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03697	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.80 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	118.04 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	118.04 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B31 / D22x30	-
Combination / Station	UCOMBO1 / 585.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.743 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02773	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	7.31 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	88.10 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	88.10 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B31 / D22x30	-
Combination / Station	UCOMBO1 / 877.5 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-4.303 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02516	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	6.63 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	79.82 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	79.82 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B31 / D22x30	-
Combination / Station	UCOMBO1 / 1,060.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-10.017 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05857	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.70 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	189.18 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	189.18 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B73 / D11x30	-
Combination / Station	UCOMBO1 / 0.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.480 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05239	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	14.00 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	84.33 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	84.33 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B73 / D11x30	-
Combination / Station	UCOMBO1 / 220.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.021 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04702	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.53 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	75.46 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	75.46 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B73 / D11x30	-
Combination / Station	UCOMBO1 / 220.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.683 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04307	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.45 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	68.98 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	68.98 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B73 / D11x30	-
Combination / Station	UCOMBO1 / 630.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.803 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02109	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.54 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	33.38 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	33.38 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B73 / D11x30	-
Combination / Station	UCOMBO1 / 1,040.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.230 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00268	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.70 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	4.21 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B74 / D11x30	-
Combination / Station	UCOMBO1 / 0.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	4.448 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05202	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	13.90 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	83.70 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	83.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B74 / D11x30	-
Combination / Station	UCOMBO1 / 220.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.989 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04664	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	12.42 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	74.84 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	74.84 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B74 / D11x30	-
Combination / Station	UCOMBO1 / 220.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	3.651 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.04269	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	11.35 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	68.36 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	68.36 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B74 / D11x30	-
Combination / Station	UCOMBO1 / 630.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.774 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.02074	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	5.45 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	32.83 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	32.83 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B74 / D11x30	-
Combination / Station	UCOMBO1 / 1,040.0 mm	-
b × h; h_0; a′	110.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-0.256 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	36.432 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00299	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	0.78 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	4.69 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 28.60 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	28.60 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B22 / D22x30	-
Combination / Station	UCOMBO1 / 0.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	11.246 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06575	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.70 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	213.22 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	213.22 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B22 / D22x30	-
Combination / Station	UCOMBO1 / 220.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.623 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06211	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.68 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	201.01 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	201.01 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B22 / D22x30	-
Combination / Station	UCOMBO1 / 220.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.818 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05740	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.38 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	185.29 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	185.29 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B22 / D22x30	-
Combination / Station	UCOMBO1 / 630.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	1.100 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00643	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.68 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	20.22 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B22 / D22x30	-
Combination / Station	UCOMBO1 / 930.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.148 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03595	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.52 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	114.70 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	114.70 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B35 / D22x30	-
Combination / Station	UCOMBO1 / 0.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	11.148 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06518	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	17.54 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	211.30 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	211.30 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B35 / D22x30	-
Combination / Station	UCOMBO1 / 220.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	10.524 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.06154	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	16.52 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	199.08 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	199.08 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B35 / D22x30	-
Combination / Station	UCOMBO1 / 220.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	9.719 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.05683	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	15.22 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	183.37 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	183.37 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B35 / D22x30	-
Combination / Station	UCOMBO1 / 630.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	0.984 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.00575	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	1.50 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	18.07 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	57.20 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)

BEAM REINFORCEMENT CALCULATION

TCVN 5574:2018 | Rectangular section - one force case

1. Identification and geometry

Parameter / Formula	Value	Equation / Clause
Member / Section	B35 / D22x30	-
Combination / Station	UCOMBO1 / 930.0 mm	-
b × h; h_0; a′	220.0 × 300.0; 260.0; 25.0 mm	Section geometry
Design moment M	-6.278 kN·m	Analysis results

2. Materials and factors

Parameter / Formula	Value	Equation / Clause
Concrete / Longitudinal steel	B20 / CB240-T	-
Stirrups	CB240-T	-
Base R_b; γ_{b1}; γ_{b3}	11.500 MPa; 1.00; 1.00	6.1.2
$R_b = R_{b,0}\cdot\gamma_{b1}\cdot\gamma_{b3}$	11.500 MPa	6.1.2
R_s; R_{sc}; E_s	210.0; 210.0; 200,000 MPa	6.2.2; 6.2.3
ε_{b2}; β	0.00350; 0.8	6.1.4.2; (31)

Heavy concrete: β = 0.8 up to B60; β = 0.7 for B70-B100. ε_{b2} follows 6.1.4.2 for short-term loading when determining ξ_R.

3. Compression-zone limit and reinforcement regime

Parameter / Formula	Value	Equation / Clause
$\varepsilon_{s,el} = R_s/E_s$	0.001050	8.1.2.2.3 - (32)
$\xi_R = \beta/(1 + \varepsilon_{s,el}/\varepsilon_{b2})$	0.61538	8.1.2.2.3 - (31)
$x_R = \xi_R\cdot h_0$	160.00 mm	8.1.2.3.5
$\alpha_R = \xi_R(1 - 0.5\xi_R)$	0.42604	From equations (34)-(35)
$M_R = \alpha_R\cdot R_b\cdot b\cdot h_0^2$	72.864 kN·m	From equations (34)-(35)
$\alpha_m = \lvert M\rvert/(R_b\cdot b\cdot h_0^2)$	0.03671	From equations (34)-(35)
Design regime	$\alpha_m \le \alpha_R$: singly reinforced	8.1.2.3.2; 8.1.2.3.5

4. Reinforcement area calculation

Notation: A_s is tension reinforcement; A_{sc} is reinforcement in the compression zone (A'_s in TCVN).

Per 10.3.3.1: $A_{s,min} = \mu_{min}\cdot b\cdot h_0$, $\mu_{min} \ge 0.1\%$. Compression reinforcement required by calculation also meets $A_{s,min}$; A_s is then determined from force equilibrium (35).

Parameter / Formula	Value	Equation / Clause
$x = h_0[1 - \sqrt{(1 - 2\alpha_m)}]$	9.73 mm	From equations (34)-(35)
$A_{s,calc} = \lvert M\rvert/[R_s(h_0 - x/2)]$	117.17 mm²	From equations (34)-(35)
$A_{sc,calc}$	0 mm²	From equations (34)-(35)
Reinforcement required by ratio	min = 57.20 mm² (μ_{min} = 0.1%)	10.3.3.1; Minimum
A_s	117.17 mm²	From equations (34)-(35)
A_{sc} (compression-zone reinforcement)	0.00 mm²	From equations (34)-(35)