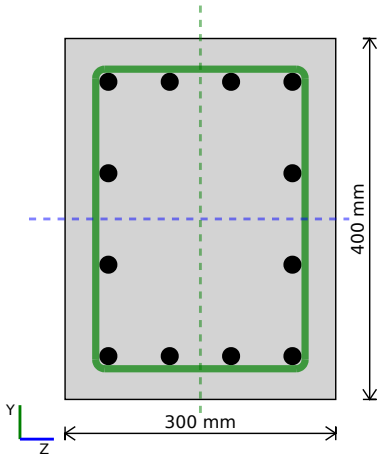
EN 1992-1-1:2004 Concrete Column Design

Input	Description	Value
Ref	Member Label	C1
Best Practice	Best Practice Values Applied as per Documentation	Applied
Shape	Section Shape	Rectangular



LOCATION	NO. BARS	DIAMETER	COVER	C/C SPACING
TOP & BOTTOM	4	20 mm	38 mm	68 mm
SIDES	2	20 mm	38 mm	101.3 mm
EXT. SHEAR LIGS	1	8 mm	30 mm	N/A

Material Properties

Input	Description	Value
f_{ck}	Concrete compression strength.	40 MPa
f_y	Yield strength of steel.	500 MPa

Span

Input	Description	Value
l_u	Unsupported length of column.	3000 mm
k_z	Effective length factor for compression members for buckling about Z-Axis direction (5.8.1).	1
k_y	Effective length factor for compression members for buckling about Y-Axis (5.8.1).	1

Partial Factors

Input	Description	Value
γ_c	Concrete Partial Factor	1.5
γ_s	Steel Partial Factor	1.15

Design Forces

Input	Description	Value
$V_{Ed,y}$	Factored design shear load in y-direction.	100 kN
$V_{Ed,z}$	Factored design shear load in z-direction.	50 kN
N_{Ed}	Factored design axial load. (+ve for compression)	1000 kN

Design Moments

Input	Description	Value
Moment Input Method	Provided moments for column design.	First-Order
Braced	Braced condition of column.	Z & Y Braced
$M_{Ed,z,top}$	Factored moment about the z-axis at the top of the column.	100 kN-m
$M_{Ed,z,bot}$	Factored moment about the z-axis at the bottom of the column.	50 kN-m
$M_{Ed,y,top}$	Factored moment about the y-axis at the top of the column.	50 kN-m
$M_{Ed,y,bot}$	Factored moment about the y-axis at the bottom of the column.	-50 kN-m
Effective Creep Ratio	Selected method for how to calculate effective creep ratio.	Default

Design Properties

Property	Symbol	Value
Gross Area Section	A_g	120e3 mm^2
Total Steel Area	A_{st}	3770 mm^2
Total Shear Reinforcement, Y	A_{vy}	100.5 mm^2
Total Shear Reinforcement, Z	A_{vz}	100.5 mm^2
Modulus of Elasticity, Steel	E_s	200e3 MPa
Ultimate Concrete Strain	ε_{cu3}	0.0035
Max Strength Concrete Strain	ε_{c3}	0.00175
Concrete Stress Block Depth Factor	λ	0.8
Second Moment of Area, Z	I_z	1.60e9 mm^4
Second Moment of Area, Y	I_y	900e6 mm^4
Radius of Gyration, Z	i_z	115.5 mm
Radius of Gyration, Y	i_y	86.6 mm
Plastic Centroid, Y	PC_y	150 mm
Plastic Centroid, Z	PC_z	200 mm
Concrete Design Strength	f_{cd}	22.67 MPa
Steel Design Yield Strength	f_{yd}	434.8 MPa

Detailing Checks

Detailing Check	Pass	Comments
Rectangular Column Dimension Ratio Check, *(9.5.1(1))*	Pass	The ratio of the larger dimension (400 mm) to the smaller dimension (300 mm) is less than 4.
Minimum Recommended Concrete Strength, *(IStructE)*	Pass	Recommended minimum concrete strength for detailing checks is 28 MPa. Provided strength is 40 MPa.
Maximum Reinforcement Area, *(9.5.2(3))*	Pass	Maximum reinforcement area is 4800 mm². Provided reinforcement area is 3770 mm².
Minimum Longitudinal Bar Diameter, *(9.5.2(1))*	Pass	Minimum longitudinal bar diameter is 12 mm. Provided diameter is 20 mm.
Minimum Shear Bar Diameter, *(9.5.3(1))*	Pass	Minimum shear bar diameter is 8 mm. Provided diameter is 8 mm.
Shear Bar Maximum Spacing, *(9.5.3(3))*	Pass	Maximum shear bar spacing is 300 mm. Provided spacing is 150 mm.
Shear Bar Minimum Spacing, *(8.2(2))*	Pass	Minimum shear bar spacing is 45 mm. Provided spacing is 150 mm.
Minimum Longitudinal Bar Number, *(9.5.2(4))*	Pass	Minimum number of longitudinal bars is 4. Provided number is 12.
Minimum Longitudinal Bar Spacing, *(Standard method of detailing structural concrete, 4th edition, Table 6.5)*	Pass	Minimum spacing is 50 mm, provided spacing is 68 mm.
Longitudinal Bar Maximum Spacing, *(Standard method of detailing structural concrete, 4th edition, 6.4.2)*	Pass	No bar spacing exceeds 175 mm.

Axial Capacity

A_c (mm²)	f_{cd} (MPa)	A_{st} (mm²)	f_{yd} (MPa)	$N_{Rd,c}$ (kN)	$N_{Ed,c}$ / $N_{Rd,c}$ (utility)	$N_{Rd,t}$ (kN)
116e3	22.67	3770	434.8	3954	0.253	-1639

Design Moments

Effective Creep Ratio (Clause 5.8.4 & Annex B)

Effective creep ratio, φ_{ef}, is calculated such that A = 0.7:

$$\varphi_{ef} = ((1/0.7) - 1)/0.2$$

Imperfection Eccentricity (Clause 5.2)

l (mm)	α_h	α_m	θ_0 (rad)	θ_i (rad)	$l_{0,z}$ (mm)	$l_{0,y}$ (mm)	$e_{i,y}$ (mm)	$e_{i,z}$ (mm)
3000	1	1	0.005	0.005	3000	3000	7.5	7.5

Slenderness (Clauses 5.8.3.1 & 5.8.3.2)

Axis	M_{01} (kNm)	M_{02} (kNm)	ω	φ_{ef}	A	B	C	n	λ_{lim}
z	57.5	107.5	0.603	2.143	0.7	1.485	1.2	0.368	30.48
y	-42.5	57.5	0.603	2.143	0.7	1.485	2.7	0.368	50

Axis	l_0 (mm)	i_z (mm)	λ	Slender?
z	3000	115.5	25.98	Not Slender
y	3000	86.6	34.64	Not Slender

Design Moment About Z-Axis, Non-Slender

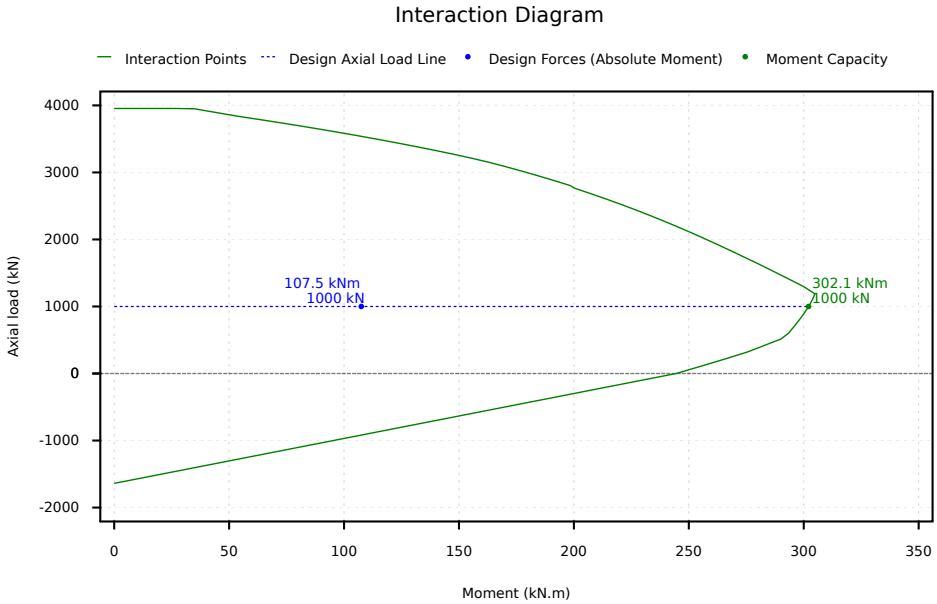
$M_{e,i}$ (kNm)	M_{02} (kNm)	M_{Min} (kNm)	M_{Ed} (kNm)	M_{Rd} (kNm)	M_{Ed}/M_{Rd} (utility)
7.5	107.5	20	107.5	302.1	0.356

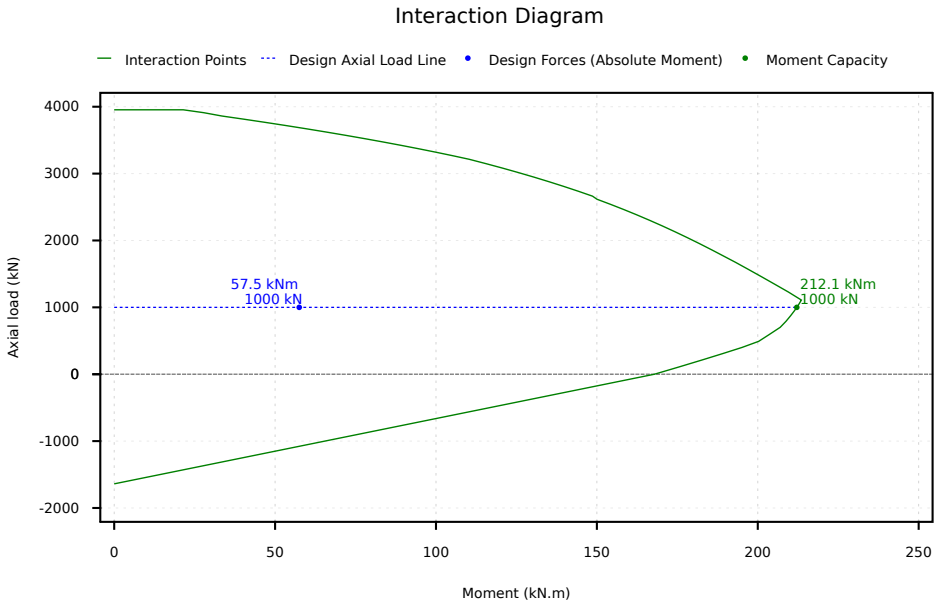
Design Moment About Y-Axis, Non-Slender

$M_{e,i}$ (kNm)	M_{02} (kNm)	M_{Min} (kNm)	M_{Ed} (kNm)	M_{Rd} (kNm)	M_{Ed}/M_{Rd} (utility)
7.5	57.5	20	57.5	212.1	0.271

Moment Capacity (Clause 6.1)

Interaction points are calculated for various depths of the neutral axis. Depth of concrete stress block calculated as λ.z, where λ = 0.8. Strength of concrete stress block calculated as $\eta.f_{cd}$, where η = 1, Clause 3.1.7(3).





Bi-Axial Check (Clause 5.8.9)

$M_{Ed,z}$ (kNm)	$M_{Ed,y}$ (kNm)	N_{Ed} (kN)	e_y (mm)	e_z (mm)	h_{eq} (mm)	b_{eq} (kNm)	λ_z	λ_y
107.5	57.5	1000	107.5	57.5	400	300	25.98	34.64

e_yb_{eq} / e_zh_{eq}	e_zh_{eq} / e_yb_{eq}	λ_z / λ_y	λ_y / λ_z	Biaxial Check	a	Biaxial Utility
1.402	0.713	0.75	1.333	Required	1.127	0.541

Shear Capacity

Y-Axis Shear Capacity Without Shear Reinforcement (Clause 6.2)

k	σ_{cp} (MPa)	d (mm)	$V_{Rd,c,min}$ (kN)	$C_{Rd,c}$	ρ_1	k_1	$V_{Rd,c}$ (kN)	V_{Ed}/V_{Rd} (utility)
1.793	4.533	318.2	115.6	0.12	0.02	0.15	153	0.653

Z-Axis Shear Capacity Without Shear Reinforcement (Clause 6.2)

k	σ_{cp} (MPa)	d (mm)	$V_{Rd,c,min}$ (kN)	$C_{Rd,c}$	ρ_1	k_1	$V_{Rd,c}$ (kN)	V_{Ed}/V_{Rd} (utility)
1.934	4.533	229.3	117	0.12	0.021	0.15	154.9	0.323

Results Summary

Result Name	Results
MEMBER UTILITIES	
Compression	0.25
Bending Z-Axis	0.36
Bending Y-Axis	0.27
Biaxial Bending	0.54
Shear Y-Axis	0.65
Shear Z-Axis	0.32
Biaxial Shear	0.73
MEMBER CAPACITIES	
$N_{Rd,t}$	-1639.09 kN
$N_{Rd,c}$	3954.02 kN
$M_{Rd,z}$	302.09 kN.m
$M_{Rd,y}$	212.12 kN.m
$V_{Rd,y}$	153.03 kN
$V_{Rd,z}$	154.94 kN
MEMBER DETAILING	
Aspect Ratio	PASS
Min Concrete Strength	PASS
Max Reinforcement	PASS
Min Long Bar Diameter	PASS
Min Shear Bar Diameter	PASS
Shear Bar Max Spacing	PASS
Shear Bar Min Spacing	PASS
Min Long Bars	PASS
Min Long Bar Spacing	PASS
Max Long Bar Spacing	PASS

About this Calculator

Calculator Name: EN 1992-1-1:2004 Concrete Column Design
Description: Design of reinforced concrete columns as per EN 1992-1-1:2004 for axial and flexural forces.

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URL: https://platform.skyciv.com/quick-design?uid=3025-eurocode-concrete-column#&member_label=C1&shape=rectangular&D=400&W=300&cover=30&pattern=standard&size_bars=20&angle=0&n_bars_z=4&n_bars_y=4&size_shear_bars=8&n_shear_bars_y=2&n_shear_bars_z=2&s=150&l_u=3000&k_y=1&k_z=1&concrete_strength=40&steel_yield_strength=500&V_y=100&V_z=50&N=1000&second_order=first&braced_or_unbraced=ZY&M_z_top=100&M_z_bot=50&M_y_top=50&M_y_bot=-50&creep=default&apply_best_practice=true&show_table=yes&report_detail=normal

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