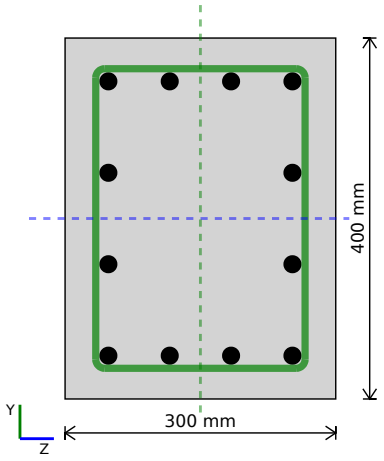
AS 3600:2018 Concrete Column Design

Input	Description	Value
Ref	Member Label	C1
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_c'	Concrete characteristic compression strength.	40 MPa
f_{sy}	Characteristic yield strength of steel.	500 MPa

Span

Input	Description	Value
L	Unsupported length of column.	3000 mm
k_z	Effective length factor for compression buckling about Z-axis (10.5.3).	1
k_y	Effective length factor for compression buckling about Y-axis (10.5.3).	1

Design Forces

Input	Description	Value
V_y^*	Factored design shear load in y-direction.	100 kN
V_z^*	Factored design shear load in z-direction.	50 kN
N^*	Factored design axial load. (+ve for compression)	1350 kN
G	Unfactored permanent axial load. (+ve for compression)	500 kN
Q	Unfactored variable axial load. (+ve for compression)	500 kN

Design Moments

Input	Description	Value
Design Moments	Provided moments for column design.	First-Order
Braced	Braced condition of column.	Z & Y Braced
$M_{z,top}^*$	Factored moment about the z-axis at the top of the column.	100 kN-m
$M_{z,bot}^*$	Factored moment about the z-axis at the bottom of the column.	50 kN-m
$M_{y,top}^*$	Factored moment about the y-axis at the top of the column.	50 kN-m
$M_{y,bot}^*$	Factored moment about the y-axis at the bottom of the column.	-50 kN-m

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
Max Concrete Compression Strain	ε_c	0.003
Max Steel Strain	ε_s	0.0025
Second Moment of Area, Z	I_z	1.60e9 mm^4
Second Moment of Area, Y	I_y	900e6 mm^4
Effective Length About Z-Axis	$L_{e,z}$	3000 mm
Effective Length About Y-Axis	$L_{e,y}$	3000 mm
Radius of Gyration, Z	r_z	115.5 mm
Radius of Gyration, Y	r_y	86.6 mm
Plastic Centroid, Y	PC_y	150 mm
Plastic Centroid, Z	PC_z	200 mm

Detailing Checks

Detailing Check	Pass	Comments
Core Confinement Check, *(cl.10.7.3)*	Pass	Core confinement not required for concrete strengths 50 MPa or less.
Minimum Reinforcement Area, *(cl.10.7.1(a))*	Pass	Minimum reinforcement area is 1200 mm^2. Provided reinforcement area is 3770 mm^2.
Maximum Reinforcement Area, *(cl.10.7.1(b))*	Pass	Maximum reinforcement area is 4800 mm^2. Provided reinforcement area is 3770 mm^2.
Minimum Shear Reinforcement Ratio, *(cl.8.2.1.7)*	Pass	Y-axis ratio calculated as 304 mm^2/m. Provided ratio is 670 mm^2/m. Z-axis ratio calculated as 405 mm^2/m. Provided ratio is 670 mm^2/m.
Minimum Shear Bar Diameter, *(cl.10.7.4.3)*	Pass	Minimum shear bar diameter is 6 mm. Provided diameter is 8 mm.
Shear Bar Maximum Spacing, *(cl.10.7.4.3(b))*	Pass	Maximum shear bar spacing is 300 mm. Provided spacing is 150 mm.
Shear Bar Minimum Spacing	Pass	Minimum shear bar spacing is 28 mm. Provided spacing is 150 mm.
Minimum Longitudinal Bar Number	Pass	Minimum number of longitudinal bars is 4. Provided number is 12.
Minimum Longitudinal Bar Restraint, *(cl.10.7.4)*	Pass	Bars along z-axis & y-axis need to be restrained at alternate bar locations.

Axial Capacity (Clause 10.6.2.2)

A_c (mm^2)	f'_c (MPa)	α_1	A_{st} (mm^2)	f_{sy} (MPa)
116e3	40	0.85	3770	500

Φ_c	ΦN_{uo} (kN)	$N^* / \Phi N_{uo}$ (utility)	Φ_t	ΦN_{ut} (kN)
0.65	3794	0.356	0.85	-1602

Design Moments, Z-Axis

First Order Moments (Clauses 10.1.2 & 10.3.1(b))

M_{Min} (kNm)	M^*_1 (kNm)	M^*_2 (kNm)	M^*_1 / M^*_2
27	50	100	-0.5

Slenderness (Clause 10.5)

α_c	Limit 10.3.1(1)	Adopted Limit	L_e / r	Slender?
1.166	20.61	25	25.98	Slender

Moment Magnification (Clause 10.4)

k_{uo}	Φ	ΦM_c (kNm)	β_d	d_0 (mm)	L_e (mm)	N_c (kN)
0.545	0.65	240e6	0.5	352	3000	11244

$M^*_z / M_{c,z}$ (utility)	k_m	δ_b	M^*_z (kNm)
0.12	0.8	1	100

Design Moments, Y-Axis

First Order Moments (Clauses 10.1.2 & 10.3.1(b))

M_{Min} (kNm)	M^*_1 (kNm)	M^*_2 (kNm)	M^*_1 / M^*_2
20.25	-50	50	1

Slenderness (Clause 10.5)

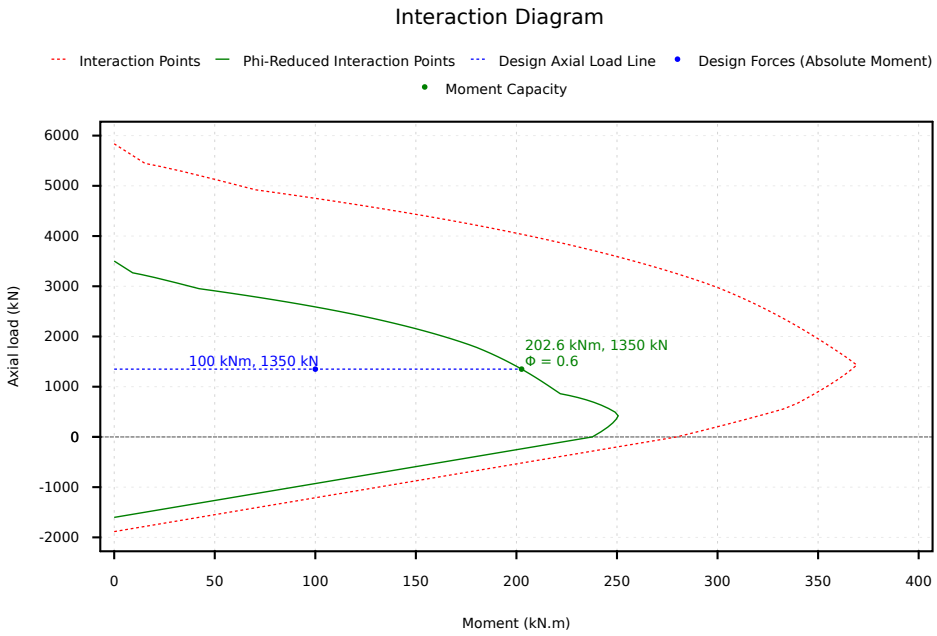
α_c	Limit 10.3.1(1)	Adopted Limit	L_e / r	Slender?	M^*_y (kNm)
1.166	82.42	82.42	34.64	Not Slender	50

Moment Capacity (Clause 10.6)

Interaction points are calculated for various depths of the neutral axis, $k_u d$. Depth of concrete stress block calculated as $\gamma k_u d$, where $\gamma = 0.87$. Strength of concrete stress block calculated as $\alpha_2 f_c'$, where $\alpha_2 = 0.79$.

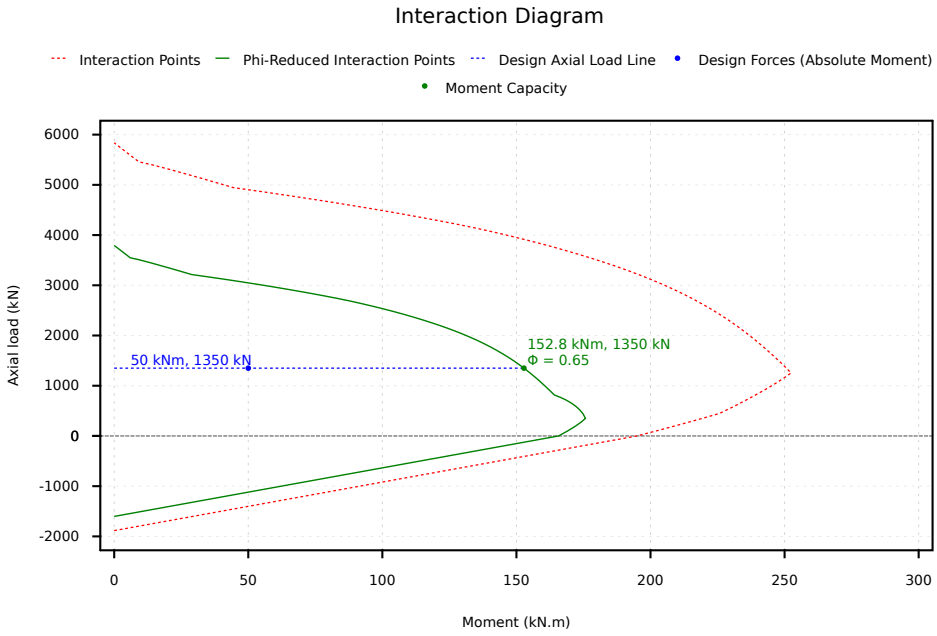
Z-Axis Interaction Diagram

k_{uo}	Φ_b	k_Φ	N_u	N_u / N_{ub}	Φ_z
0.276	0.85	0.923	1350	0.939	0.6



Y-Axis Interaction Diagram

k_{uo}	Φ_b	k_Φ	N_u	N_u / N_{ub}	Φ_y
0.312	0.85	1	1350	1.075	0.65



Bi-Axial Check (Clause 10.6.4)

M^*_z (kNm)	$\Phi M_{u.z}$ (kNm)	M^*_z / $\Phi M_{u.z}$ (utility)	M^*_y (kNm)	$\Phi M_{u.y}$ (kNm)	M^*_y / $\Phi M_{u.y}$ (utility)	α_n	$M_{Biaxial}$ (utility)
100	202.6	0.494	50	152.8	0.327	1.305	0.631

Shear Capacity, Y-Axis

Mid-Depth Strain (Clause 8.2.4.2.2)

M^* (kNm)	d_v (mm)	V^* (kN)	N^* (kN)	E_s (MPa)	A_{st} (mm^2)	ε_x	E_c (MPa)	A_{ct} (mm^2)	ε_x
100	288	100	1350	200e3	1885	-0.0003	32800	60000	-4.857e-5

Shear Web Crushing Strength (Clause 8.2.3.3)

k_v	θ_v	b_v (mm)	$\cot(\theta_v)$	$\cot(\alpha_v)$	$V_{u,max}$ (kN)
0.431	28.66	300	1.83	0	720

Concrete and Reinforcement Shear Capacity (Clauses 8.2.4 & 8.2.5)

V_{uc} (kN)	A_{sv} (mm^2)	f_{sy} (MPa)	s (mm)	V_{us} (kN)
235.8	100.5	500	150	176.6

Column Shear Capacity (Clause 8.2.3)

V^* (kN)	s_{max} (mm)	Φ	V_u (kN)	ΦV_u (kN)	$V^*_y / \Phi V_{u.y}$ (utility)
100	331.2	0.75	412.3	309.2	0.323

Shear Capacity, Z-Axis

Mid-Depth Strain (Clause 8.2.4.2.2)

M^* (kNm)	d_v (mm)	V^* (kN)	N^* (kN)	E_s (MPa)	A_{st} (mm^2)	ε_x	E_c (MPa)	A_{ct} (mm^2)	ε_x
50	216	50	1350	200e3	1885	-0.00052	32800	60000	-8.391e-5

Shear Web Crushing Strength (Clause 8.2.3.3)

k_v	θ_v	b_v (mm)	$\cot(\theta_v)$	$\cot(\alpha_v)$	$V_{u,max}$ (kN)
0.458	28.41	400	1.848	0	715.9

Concrete and Reinforcement Shear Capacity (Clauses 8.2.4 & 8.2.5)

V_{uc} (kN)	A_{sv} (mm^2)	f_{sy} (MPa)	s (mm)	V_{us} (kN)
250	100.5	500	150	133.8

Column Shear Capacity (Clause 8.2.3)

V^* (kN)	s_{max} (mm)	Φ	V_u (kN)	ΦV_u (kN)	$V^*_z / \Phi V_{u.z}$ (utility)
50	248.4	0.75	383.8	287.9	0.174

Results Summary

Result Name	Results
MEMBER UTILITIES	
Compression	0.36
Bending Z-Axis	0.49
Bending Y-Axis	0.33
Biaxial Bending	0.63
Shear Y-Axis	0.32
Shear Z-Axis	0.17
Biaxial Shear	0.37
MEMBER CAPACITIES	
$\Phi N_{u,t}$	-1602.21 kN
ΦN_{uo}	3793.91 kN
$\Phi M_{u.z}$	202.57 kN.m
$\Phi M_{u.y}$	152.80 kN.m
$\Phi V_{u.y}$	309.24 kN
$\Phi V_{u.z}$	287.88 kN
MEMBER DETAILING	
Core Confinement	PASS
Min Reinforcement	PASS
Max Reinforcement	PASS
Min Shear Reinforcement Ratio	PASS
Min Shear Bar Diameter	PASS

Result Name	Results
Shear Bar Max Spacing	PASS
Shear Bar Min Spacing	PASS
Min Long Bars	PASS
Min Long Bar Restraint	PASS
design_axial	1350.00
is_slender_z	1.00
is_slender_y	0.00
critical_axial_z	11244.18
critical_axial_y	5502.50

About this Calculator

Calculator Name: AS 3600:2018 Concrete Column Design
Description: Design of reinforced concrete columns as per AS 3600:2018 for axial and flexural forces.

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URL: https://platform.skyciv.com/quick-design?uid=3027-au-concrete-column#&member_label=C1&shape=rectangular&D=400&W=300&cover=30&size_bars=20&n_bars_z=4&n_bars_y=4&reinforcement_class_long=N&size_shear_bars=8&n_shear_bars_y=2&n_shear_bars_z=2&s=150&reinforcement_class_shear=N&L=3000&k_y=1&k_z=1&f_c=40&f_y=500&V_y=100&V_z=50&N=1350&G=500&Q=500&second_order=first&braced_or_unbraced=ZY&M_z_top=100&M_z_bot=50&M_y_top=50&M_y_bot=-50

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