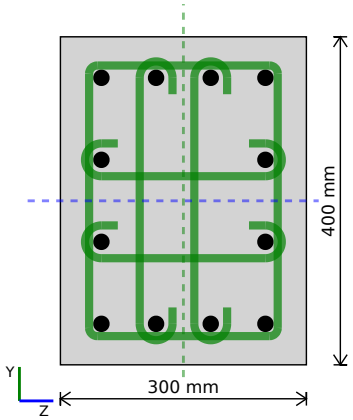
NZS 3101:2006 Concrete Column Design

Input	Description	Value
Ref	Member Label	C1
Shape	Section Shape	Rectangular



LOCATION	NO. BARS	DIAMETER	COVER	C/C SPACING
TOP & BOTTOM	4	20 mm	40 mm	66.7 mm
SIDES	2	20 mm	40 mm	100 mm
EXT. SHEAR LIGS	1	10 mm	30 mm	N/A
SHEAR LIGS (Z)	2	10 mm	40 mm	100 mm
SHEAR LIGS (Y)	2	10 mm	40 mm	66.7 mm

Material Properties

Input	Description	Value
f_c'	Concrete characteristic compression strength.	40 MPa
f_y	Characteristic 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 buckling about Z-axis (10.3.2.3.2).	1
k_y	Effective length factor for compression buckling about Y-axis (10.3.2.3.2).	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
β_d	Ratio of the maximum factored long-term axial load (permanent action) to maximum factored design axial load, due to the same load combination (cl. 10.3.2.3.5).	0.5

Design Moments

Input	Description	Value
Design Moments	Provided moments for column design.	First-Order
$M_{z,top}^*$	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}	314.2 mm^2
Total Shear Reinforcement, Z	A_{vz}	314.2 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
Minimum Reinforcement Area, *(cl.10.3.8.1)*	Pass	Minimum reinforcement area is 960 mm². Provided reinforcement area is 3770 mm².
Maximum Reinforcement Area, *(cl.10.3.8.1)*	Pass	Maximum reinforcement area is 4800 mm² (8% / 2 to allow for laps). Provided reinforcement area is 3770 mm².
Minimum Number of Longitudinal Bars, *(cl.10.3.8.2)*	Pass	Minimum number of longitudinal bars is 8. Provided number of bars is 12.
Maximum Spacing of Longitudinal Bars, *(cl.10.3.8.3)*	Pass	Maximum spacing of longitudinal bars is 200 mm. Provided minimum spacing is 100 mm.
Minimum Shear Reinforcement Area (Y), *(cl.10.3.10.4.4)*	Pass	Minimum shear reinforcement area is 24 mm². Provided shear reinforcement area is 314 mm².
Minimum Shear Reinforcement Area (Z), *(cl.10.3.10.4.4)*	Pass	Minimum shear reinforcement area is 32 mm². Provided shear reinforcement area is 314 mm².
Maximum Spacing of Tie Sets, *(cl.10.3.10.6.2)*	Pass	Maximum spacing of tie sets is 100 mm. Provided spacing is 100 mm.
Minimum Tie Diameter, *(cl.10.3.10.7.1)*	Pass	Minimum tie diameter is 10 mm. Provided tie diameter is 10 mm.
Maximum Spacing of Shear Reinforcement (Y-Direction), *(cl.10.3.10.4.3)*	Pass	Shear force resisted by reinforcement in y-direction is 0 kN which is less than the limit of 219 kN. Therefore, maximum spacing of shear reinforcement check is not required.

Detailing Check	Pass	Comments
Maximum Spacing of Shear Reinforcement (Z-Direction), *(cl.10.3.10.4.3)*	Pass	Shear force resisted by reinforcement in z-direction is 0 kN which is less than the limit of 209 kN. Therefore, maximum spacing of shear reinforcement check is not required.
Rectangular Concrete Confinement Check (Y-Direction), *(cl.10.3.10.6.1)*	Pass	A_g / A_c is 1.471. Limit is 1.5. Minimum confining reinforcement area is 19.64 mm². Provided confining reinforcement area is 314.2 mm².
Rectangular Concrete Confinement Check (Z-Direction), *(cl.10.3.10.6.1)*	Pass	A_g / A_c is 1.471. Limit is 1.5. Minimum confining reinforcement area is 13.86 mm². Provided confining reinforcement area is 314.2 mm².
Rectangular Longitudinal Bar Buckling Check, *(cl.10.3.10.6.1)*	Pass	Minimum leg area is 46.54 mm². Provided leg area is 78.54 mm².

Axial Capacity (Clause 10.3.4.2)

A_c (mm²)	f'_c (MPa)	α_1	A_{st} (mm²)	f_{sy} (MPa)
116e3	40	0.85	3770	500

Φ_c	$0.85\Phi N_{n,max}$ (kN)	$N^* / \Phi N_{n,c}$ (utility)	Φ_t	$\Phi N_{n,t}$ (kN)
0.85	4217	0.32	0.85	-1602

Design Moments, Z-Axis

Define M2 (Eq.10-9)

M1 (kNm)	M2 (kNm)	$M2_{min}$ (kNm)
50	100	36.45

Slenderness 10.3.2

Note: Slenderness criteria is adopted from 10.3.2.3.4, which assumes members braced against sidesway.

M1 / M2	limit (Eq.10-2)	L_e / r	Slender?	M^*_z (kNm)
0.5	28	25.98	Not Slender	100

Design Moments, Y-Axis

Define M2 (Eq.10-9)

M1 (kNm)	M2 (kNm)	$M2_{min}$ (kNm)
-50	50	32.4

Slenderness 10.3.2

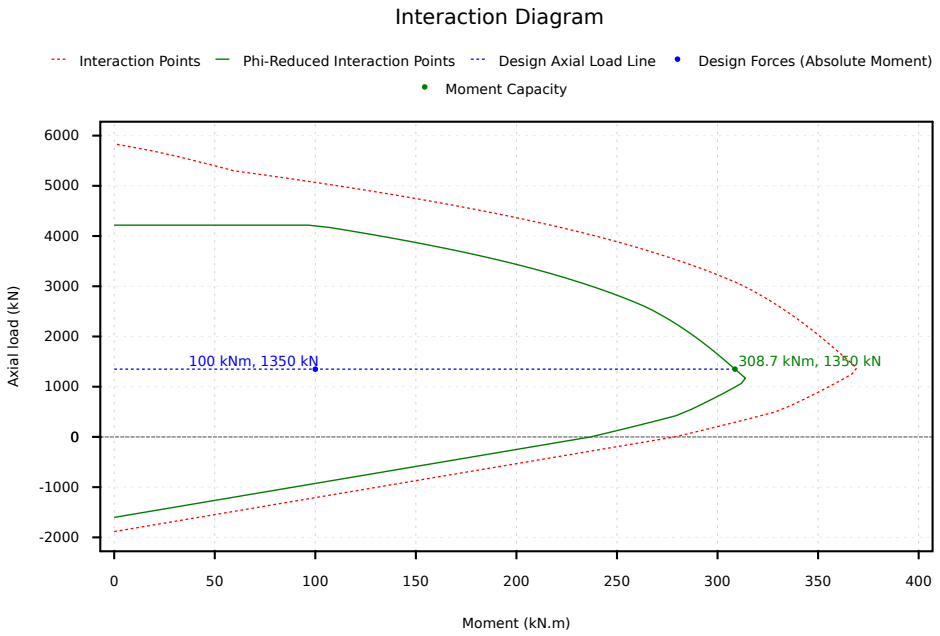
Note: Slenderness criteria is adopted from 10.3.2.3.4, which assumes members braced against sidesway.

M1 / M2	limit (Eq.10-2)	L_e / r	Slender?	M^*_y (kNm)
-1	40	34.64	Not Slender	50

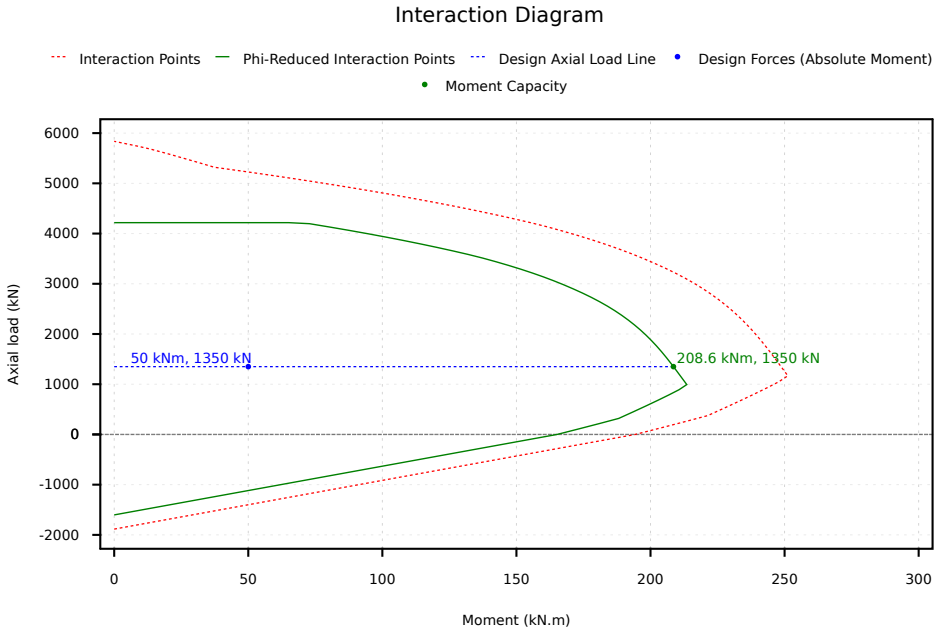
Moment Capacity (Clause 10.3.4)

Interaction points are calculated for various depths of the neutral axis, "c". Depth of concrete stress block, "a", calculated as $\beta_1 c$, where β_1 = 0.77. Strength of concrete stress block calculated as $\alpha_1 f'_c$, where α_1 = 0.85.

Z-Axis Interaction Diagram

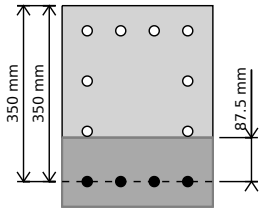


Y-Axis Interaction Diagram



Shear Capacity, Y-Axis

Section Shear Geometric Properties



Symbol	Description	Value
d_{eff}	Effective depth	350 mm
d_{eff} / 4	Quarter effective depth	87.5 mm
$d_{eff,v}$	Effective depth (shear)	350 mm

As flexural reinforcement for shear calculation = 1257 mm^2

Concrete Shear Capacity (Clause 10.3.10.3)

stress limit (MPa)	$A_{c,v}$ (mm^2)	V^* (kN)	v_n (MPa)
6	105e3	100	0.952

Concrete Shear Capacity (Clause 10.3.10.3)

p_w	v_b (MPa)	k_a	k_n	V_c (kN)
0.012	1.2	1	1.844	232.2

Steel Shear Capacity (Clause 10.3.10.4, Eq. 10-17)

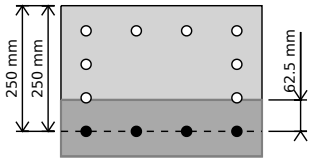
A_v (mm^2)	f_{yt} (MPa)	d (mm)	s (mm)	V_s (kN)
314.2	500	350	100	549.8

Y-Axis Shear Capacity

V_n (kN)	Φ	$ΦV_n$ (kN)	V^* (kN)	$V^* / ΦV_n$ (utility)
782	0.75	586.5	100	0.17

Shear Capacity, Z-Axis

Section Shear Geometric Properties



Symbol	Description	Value
d_{eff}	Effective depth	250 mm
d_{eff} / 4	Quarter effective depth	62.5 mm
$d_{eff,v}$	Effective depth (shear)	250 mm

As flexural reinforcement for shear calculation = 1257 mm^2

Concrete Shear Capacity (Clause 10.3.10.3)

stress limit (MPa)	$A_{c,v}$ (mm^2)	V^* (kN)	v_n (MPa)
6	100e3	50	0.5

Concrete Shear Capacity (Clause 10.3.10.3)

p_w	v_b (MPa)	k_a	k_n	V_c (kN)
0.013	1.237	1	1.844	228.2

Steel Shear Capacity (Clause 10.3.10.4, Eq. 10-17)

A_v (mm^2)	f_{yt} (MPa)	d (mm)	s (mm)	V_s (kN)
314.2	500	250	100	392.7

Z-Axis Shear Capacity

V_n (kN)	Φ	$ΦV_n$ (kN)	V^* (kN)	$V^* / ΦV_n$ (utility)
620.9	0.75	465.6	50	0.107

Results Summary

Result Name	Results
MEMBER UTILITIES	
Compression	0.32
Bending Z-Axis	0.32
Bending Y-Axis	0.24
Shear Y-Axis	0.17
Shear Z-Axis	0.11
MEMBER CAPACITIES	
$ΦN_{n,t}$	-1602.21 kN
$ΦN_{n,c}$	4217.07 kN
$ΦM_{n,z}$	308.66 kN.m

Result Name	Results
$\Phi M_{n,y}$	208.55 kN.m
$\Phi V_{n,y}$	586.52 kN
$\Phi V_{n,z}$	465.65 kN
MEMBER DETAILING	
Min Reinforcement	PASS
Max Reinforcement	PASS
Min Long Bars	PASS
Max Long Bar Spacing	PASS
Min Shear Reo Area (Y)	PASS
Min Shear Reo Area (Z)	PASS
Max Tie Set Spacing	PASS
Minimum Tie Diameter	PASS
Max Shear Reo Spacing (Y)	PASS
Max Shear Reo Spacing (Z)	PASS
Rect Conc Conf Check (Y)	PASS
Rect Conc Conf Check (Z)	PASS
Rect Long Bar Buckle Check	PASS

About this Calculator

Calculator Name: NZS 3101:2006 Concrete Column Design
Description: Design of reinforced concrete columns as per NZS 3101:2006 for axial and flexural forces.

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URL: https://platform.skyciv.com/quick-design?uid=3029-nz3101-concrete-column&member_label=C1&shape=rectangular&D=400&W=300&cover=30&size_bars=20&n_bars_z=4&n_bars_y=4&size_shear_bars=10&n_shear_bars_y=4&n_shear_bars_z=4&s=100&L=3000&k_y=1&k_z=1&f_c=40&f_y=500&V_y=100&V_z=50&N=1350&beta_d=0.5&second_order=first&M_z_top=100&M_z_bot=50&M_y_top=50&M_y_bot=-50

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