

30 m³ RAISED PLATFORM STORAGE WATER TANK DESIGN REPORT

30th OCTOBER 2023

Prepared by: Sheilla Constance Apio

Design Information

The table below indicates the design data used in the design of the structure. The information was fed in the modelling, analysis and design software (Protastructure ®2018).

Table 1: Design Assumptions considered

Design Codes and References	BS EN 1992-1: Design of Concrete Structures BS EN 1991-1: Action on Structures BS EN 1997-1: Geotechnical Design BS 8666: 2000: Specification for scheduling, dimensioning, bending and cutting of steel reinforcement for concrete Manual for the Design of Reinforced Concrete Structures to EC2	
Design Loads	Imposed Loads (Qk): Dead load: 2.5kN/m ² Roof Load: 1.5kN/m ² Slab: 1.5kN/m ² Dead Loads (Gk): Self-weight of Concrete: 25kN/m ³ Water Load Unit weight: 10kN/m ³	BS EN 1991-1
Fire Resistance Requirements	1-hour Fire Period 25mm minimum Concrete Cover (Beams, Walls & Slabs), 30mm for Columns and 50mm for foundation.	BS EN 1992
Sub-Soil Conditions/ Bearing Capacity	Design Allowable Bearing capacity of 200kPa	From the Geo-technical Report
Concrete Data	Design Strength C20/25 (Cube Strength 25N/mm ²) for beams, slabs, columns and foundations.	BS EN 1992

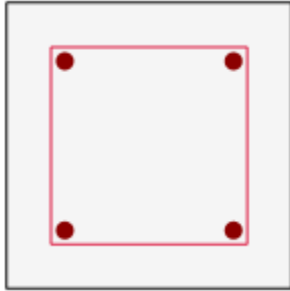
	Well graded Aggregate (Maximum Aggregate Size = 20mm)	
Reinforcement Data	High Yield Strength bars (type H) = Min. 500N/mm ²	
Wind velocity	35m/s	

Column Reinforcement Design

1C1 (B-1) (250/250)

Materials: C25/30 / Grade 500 (Type 2) (Links: Grade 500 (Type 2))

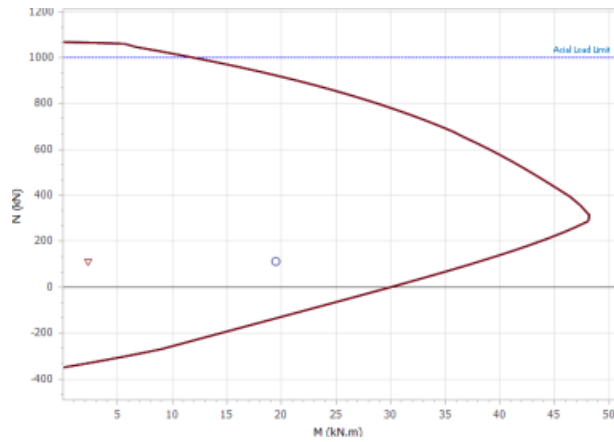
Section



Combinations

No	N _{Top} (kN)	M _{1 Top} (kN.m)	M _{2 Top} (kN.m)	N _{Bot} (kN)	M _{1 Bot} (kN.m)	M _{2 Bot} (kN.m)
1	161.3	0.0	0.0	167.9	0.0	0.0
2	159.5	0.0	0.0	166.0	0.0	0.0
3	136.7	0.0	0.0	143.3	0.0	0.0
4	153.9	0.0	-11.7	160.5	0.0	11.8
5	141.5	0.0	-18.9	148.1	0.0	19.0
6	106.9	0.0	-18.8	112.7	0.0	18.9
7	168.8	0.0	11.8	175.3	0.0	-11.8
8	165.3	0.0	19.0	171.8	0.0	-19.0
9	130.5	0.0	18.8	136.2	0.0	-18.9
10	168.8	-11.8	0.0	175.3	11.8	0.0
11	165.3	-19.0	0.0	171.8	19.0	0.0
12	130.5	-18.8	0.0	136.2	18.9	0.0
13	153.9	11.7	0.0	160.5	-11.8	0.0
14	141.5	18.9	0.0	148.1	-19.0	0.0
15	106.9	18.8	0.0	112.7	-18.9	0.0

Interaction Diagram



Critical Loading: 6 - (G+Wx+Nx)

		Min	Design	
N	112.7	-	112.7	kN
M ₁₁	0.0	-2.3	-2.3	kN.m
M ₂₂	18.9	2.3	19.5	kN.m
N _{Max}	816.1			

Concrete Cover = 35.0 mm

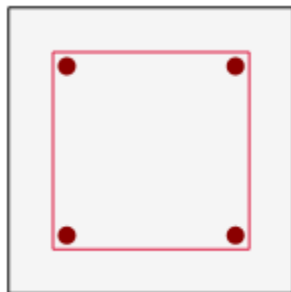
Neutral Axis: 76.8 mm / 6.75 °

Shear				Rebars	
V _{Ed(1/2)} =	10.8 / 10.8 kN	Short Column...		As (Req):	%0.35 219.39 mm²
V _{Ed} =	0.18 / 0.18 N/mm²	λ ₁ /Lim ₁ =	31.6 < 32.4 ✓	As (Sup):	%1.29 804.25 mm²
V _{Rdc} =	0.79 / 0.79 N/mm²	λ ₂ /Lim ₂ =	29.8 < 32.4 ✓	4H16	
V _{Rd Max} =	4.47 / 4.47 N/mm²	M _{Add(1/2)} =	0.0 / 0.0 kN.m		
Links = H8-225					

1C2 (B-2) (250/250)

Materials: C25/30 / Grade 500 (Type 2) (Links: Grade 500 (Type 2))

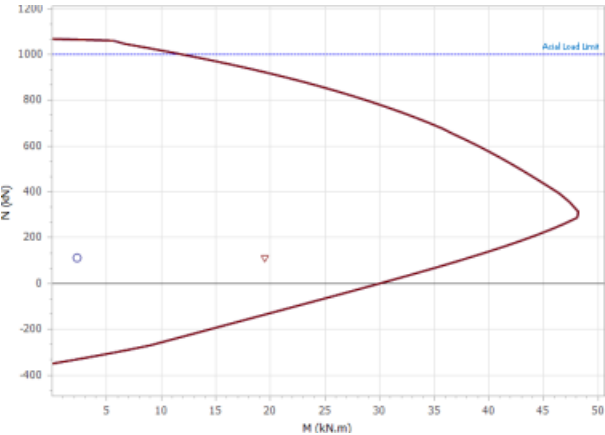
Section



Combinations

No	N _{Top} (kN)	M _{1 Top} (kN.m)	M _{2 Top} (kN.m)	N _{Bot} (kN)	M _{1 Bot} (kN.m)	M _{2 Bot} (kN.m)
1	161.3	0.0	0.0	167.9	0.0	0.0
2	157.6	0.0	0.0	164.2	0.0	0.0
3	138.5	0.0	0.0	145.1	0.0	0.0
4	168.7	0.0	-11.8	175.3	0.0	11.8
5	165.2	0.0	-19.0	171.8	0.0	19.0
6	130.4	0.0	-18.8	136.2	0.0	18.9
7	153.9	0.0	11.7	160.4	0.0	-11.8
8	141.5	0.0	18.9	148.0	0.0	-19.0
9	106.9	0.0	18.8	112.7	0.0	-18.9
10	168.7	-11.8	0.0	175.3	11.8	0.0
11	165.2	-19.0	0.0	171.8	19.0	0.0
12	130.4	-18.8	0.0	136.2	18.9	0.0
13	153.9	11.7	0.0	160.4	-11.8	0.0
14	141.5	18.9	0.0	148.0	-19.0	0.0
15	106.9	18.8	0.0	112.7	-18.9	0.0

Interaction Diagram



Critical Loading: 15 - (G-Wy-Ny)

		Min	Design	
N	112.7	-	112.7	kN
M ₁₁	-18.9	-2.3	-19.5	kN.m
M ₂₂	0.0	-2.3	-2.3	kN.m
N _{Max}	816.1			

Concrete Cover = 35.0 mm

Neutral Axis: 78.6 mm / 7.43 °

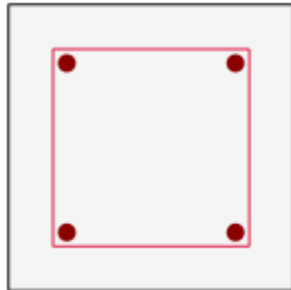
Shear			Rebars		
V _{Ed(1/2)} =	10.8 / 10.8	kN	Short Column...		
V _{Ed} =	0.18 / 0.18	N/mm ²	λ ₁ /Lim ₁ =	31.6 < 32.4	✓
V _{Rdc} =	0.79 / 0.79	N/mm ²	λ ₂ /Lim ₂ =	29.1 < 32.4	✓
			As (Req):	%0.35	218.77 mm ²
			As (Sup):	%1.29	804.25 mm ²

$V_{Rd\ Max} =$ Links = H8-225	4.47 / 4.47 N/mm ²	$M_{Add(1)/2} =$ 0.0 / 0.0 kN.m	4H16
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1C3 (A-2) (250/250)

Materials: C25/30 / Grade 500 (Type 2) (Links: Grade 500 (Type 2))

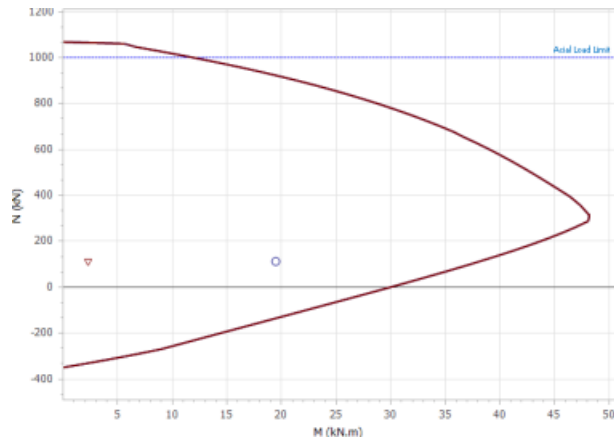
Section



Combinations

No	N_{Top} (kN)	$M_{1\ Top}$ (kN.m)	$M_{2\ Top}$ (kN.m)	N_{Bot} (kN)	$M_{1\ Bot}$ (kN.m)	$M_{2\ Bot}$ (kN.m)
1	161.3	0.0	0.0	167.9	0.0	0.0
2	159.5	0.0	0.0	166.0	0.0	0.0
3	136.7	0.0	0.0	143.3	0.0	0.0
4	168.8	0.0	-11.8	175.3	0.0	11.8
5	165.3	0.0	-19.0	171.8	0.0	19.0
6	130.5	0.0	-18.8	136.2	0.0	18.9
7	153.9	0.0	11.7	160.5	0.0	-11.8
8	141.5	0.0	18.9	148.1	0.0	-19.0
9	106.9	0.0	18.8	112.7	0.0	-18.9
10	153.9	-11.7	0.0	160.5	11.8	0.0
11	141.5	-18.9	0.0	148.1	19.0	0.0
12	106.9	-18.8	0.0	112.7	18.9	0.0
13	168.8	11.8	0.0	175.3	-11.8	0.0
14	165.3	19.0	0.0	171.8	-19.0	0.0
15	130.5	18.8	0.0	136.2	-18.9	0.0

Interaction Diagram



Critical Loading: 9 - (G-Wx-Nx)

		Min	Design	
N	112.7	-	112.7	kN
M ₁₁	0.0	2.3	2.3	kN.m
M ₂₂	-18.9	-2.3	-19.5	kN.m
N _{Max}	816.1			

Concrete Cover = 35.0 mm

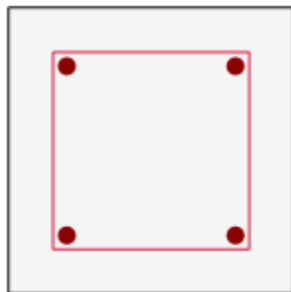
Neutral Axis: 76.8 mm / 6.75 °

Shear				Rebars	
V _{Ed(1/2)} =	10.8 / 10.8 kN	Short Column...		As (Req):	%0.35 219.39 mm²
V _{Ed} =	0.18 / 0.18 N/mm²	λ ₁ /Lim ₁ =	31.6 < 32.4 ✓	As (Sup):	%1.29 804.25 mm²
V _{Rdc} =	0.79 / 0.79 N/mm²	λ ₂ /Lim ₂ =	29.8 < 32.4 ✓	4H16	
V _{Rd Max} =	4.47 / 4.47 N/mm²	M _{Add(1/2)} =	0.0 / 0.0 kN.m		
Links = H8-225					

1C4 (A-1) (250/250)

Materials: C25/30 / Grade 500 (Type 2) (Links: Grade 500 (Type 2))

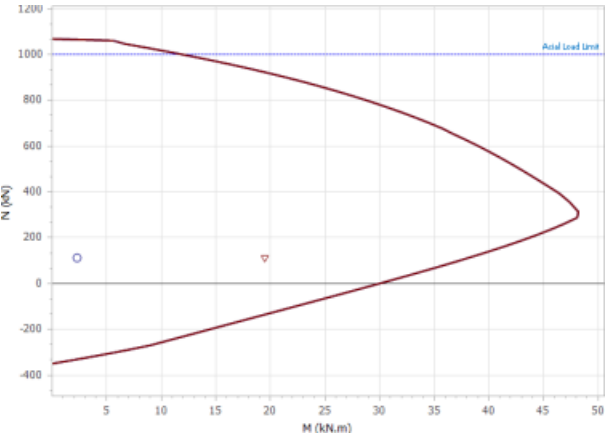
Section



Combinations

No	N _{Top} (kN)	M _{1 Top} (kN.m)	M _{2 Top} (kN.m)	N _{Bot} (kN)	M _{1 Bot} (kN.m)	M _{2 Bot} (kN.m)
1	161.3	0.0	0.0	167.9	0.0	0.0
2	161.0	0.0	0.0	167.5	0.0	0.0
3	135.2	0.0	0.0	141.7	0.0	0.0
4	153.9	0.0	-11.7	160.4	0.0	11.8
5	141.5	0.0	-18.9	148.0	0.0	19.0
6	106.9	0.0	-18.8	112.7	0.0	18.9
7	168.7	0.0	11.8	175.3	0.0	-11.8
8	165.2	0.0	19.0	171.8	0.0	-19.0
9	130.4	0.0	18.8	136.2	0.0	-18.9
10	153.9	-11.7	0.0	160.4	11.8	0.0
11	141.5	-18.9	0.0	148.0	19.0	0.0
12	106.9	-18.8	0.0	112.7	18.9	0.0
13	168.7	11.8	0.0	175.3	-11.8	0.0
14	165.2	19.0	0.0	171.8	-19.0	0.0
15	130.4	18.8	0.0	136.2	-18.9	0.0

Interaction Diagram



Critical Loading: 12 - (G+Wy+Ny)

		Min	Design
N	112.7	-	112.7 kN
M ₁₁	18.9	2.3	19.5 kN.m
M ₂₂	0.0	2.3	2.3 kN.m
N _{Max}	816.1		

Concrete Cover = 35.0 mm

Neutral Axis: 78.6 mm / 7.43 °

Shear			Rebars		
V _{Ed(1/2)} =	10.8 / 10.8 kN	Short Column...	As (Req):	%0.35	218.77 mm ²
V _{Ed} =	0.18 / 0.18 N/mm ²	λ ₁ /Lim ₁ =	As (Sup):	%1.29	804.25 mm ²
V _{Rdc} =	0.79 / 0.79 N/mm ²	λ ₂ /Lim ₂ =			

31.6 < 32.4 ✓
29.1 < 32.4 ✓

$V_{Rd\ Max} = 4.47 / 4.47\ \text{N/mm}^2$ Links = H8-225	$M_{Add(1)/2} = 0.0 / 0.0\ \text{kN.m}$	4H16
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2W1 (B-1) (4400/200)

Materials: C25/30 / Grade 500 (Type 2) Web: Grade 500 (Type 2) (Links: Grade 500 (Type 2))

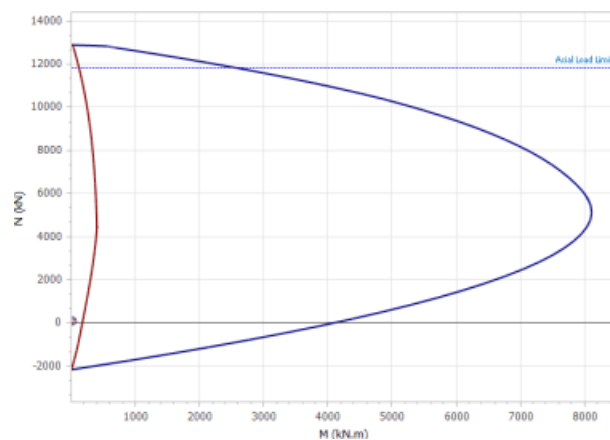
Section



Combinations

No	N_{Top} (kN)	$M_{1\ Top}$ (kN.m)	$M_{2\ Top}$ (kN.m)	N_{Bot} (kN)	$M_{1\ Bot}$ (kN.m)	$M_{2\ Bot}$ (kN.m)
1	43.2	0.0	0.0	96.0	0.0	0.1
2	43.2	0.0	0.0	96.0	0.0	0.9
3	30.0	0.0	0.0	82.8	0.0	-0.6
4	43.2	0.0	-2.4	96.0	0.0	5.4
5	39.2	0.0	-3.8	92.0	0.0	8.4
6	26.4	0.0	-3.7	72.8	0.0	8.2
7	43.2	0.0	2.4	96.0	0.0	-5.1
8	39.2	0.0	3.8	92.0	0.0	-8.1
9	26.4	0.0	3.7	72.8	0.0	-8.0
10	44.4	0.0	0.0	97.2	0.0	0.1
11	41.0	0.0	0.0	93.8	0.0	0.1
12	28.2	0.0	0.0	74.6	0.0	0.1
13	42.0	0.0	0.0	94.8	0.0	0.1
14	37.4	0.0	0.0	90.2	0.0	0.1
15	24.6	0.0	0.0	71.1	0.0	0.1

Interaction Diagram



Critical Loading: 1 - (G+Q)

Min Design

N	96.0	-	96.0 kN
M ₁₁	0.0	-1.9	-1.9 kN.m
M ₂₂	0.1	14.1	14.1 kN.m
N _{Max}	7969.2		

Concrete Cover = 25.0 mm

Neutral Axis: 237.8 mm / 12.12 °

Shear		Rebars	
V _{Ed(1/2)} =	6.1 / 0.0 kN	Short Column...	As (Req): %0.20 _(min) 1760.00 mm ²
V _{Ed} =	0.01 / 0.01 N/mm ²	λ ₁ /Lim ₁ = 33.9 < 123.2 ✓	As (Sup): %0.57 4976.28 mm ²
V _{Rdc} =	0.29 / 0.50 N/mm ²	λ ₂ /Lim ₂ = 4.0 < 123.2 ✓	
V _{Rd Max} =	4.06 / 4.06 N/mm ²	M _{Add(1/2)} = 0.0 / 2.6 kN.m	
Lat. Steel = H8-300			44H12

2W2 (A-2) (4400/200)

Materials: C25/30 / Grade 500 (Type 2) Web: Grade 500 (Type 2) (Links: Grade 500 (Type 2))

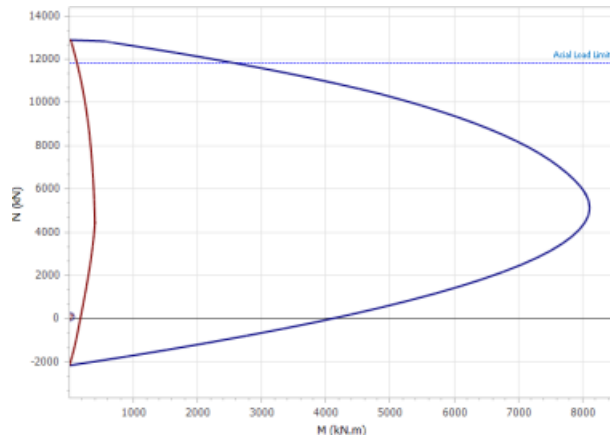
Section



Combinations

No	N _{Top} (kN)	M _{1 Top} (kN.m)	M _{2 Top} (kN.m)	N _{Bot} (kN)	M _{1 Bot} (kN.m)	M _{2 Bot} (kN.m)
1	43.2	0.0	0.0	96.0	0.0	0.1
2	43.2	0.0	0.0	96.0	0.0	0.9
3	30.0	0.0	0.0	82.8	0.0	-0.6
4	44.4	0.0	0.0	97.2	0.0	0.1
5	41.0	0.0	0.0	93.8	0.0	0.1
6	28.2	0.0	0.0	74.6	0.0	0.1
7	42.0	0.0	0.0	94.8	0.0	0.1
8	37.4	0.0	0.0	90.2	0.0	0.1
9	24.6	0.0	0.0	71.1	0.0	0.1
10	43.2	0.0	-2.4	96.0	0.0	5.4
11	39.2	0.0	-3.8	92.0	0.0	8.4
12	26.4	0.0	-3.7	72.8	0.0	8.2
13	43.2	0.0	2.4	96.0	0.0	-5.1
14	39.2	0.0	3.8	92.0	0.0	-8.1
15	26.4	0.0	3.7	72.8	0.0	-8.0

Interaction Diagram



Critical Loading: 1 - (G+Q)

		Min	Design
N	96.0	-	96.0 kN
M ₁₁	0.0	1.9	1.9 kN.m
M ₂₂	0.1	14.1	14.1 kN.m
N _{Max}	7969.2		

Concrete Cover = 25.0 mm

Neutral Axis: 11.1 mm / 0.01 °

Shear

$V_{Ed(1/2)} = 6.1 / 0.0$ kN
 $V_{Ed} = 0.01 / 0.01$ N/mm²
 $V_{Rdc} = 0.29 / 0.50$ N/mm²
 $V_{Rd Max} = 4.06 / 4.06$ N/mm²

Lat. Steel = H8-300

Short Column...

$\lambda_1 / \text{Lim}_1 = 33.9 < 123.2$ ✓
 $\lambda_2 / \text{Lim}_2 = 4.4 < 123.2$ ✓
 $M_{Add(1/2)} = 0.0 / 0.0$ kN.m

Rebars

As (Req): %0.20_(min) 1760.00 mm²
 As (Sup): %0.57 4976.28 mm²

44H12

2W3 (A-1) (4400/200)

Materials: C25/30 / Grade 500 (Type 2) Web: Grade 500 (Type 2) (Links: Grade 500 (Type 2))

Section

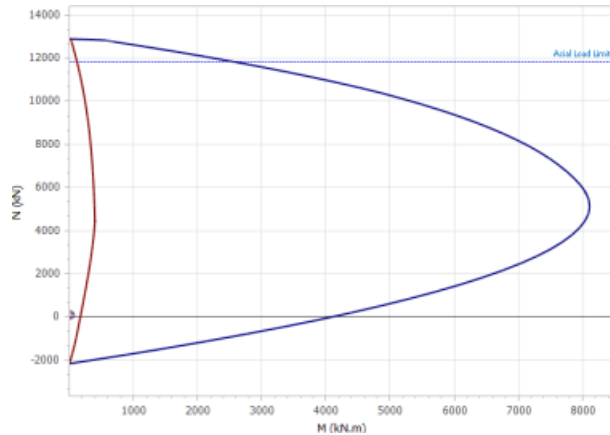


Combinations

No	N _{Top} (kN)	M _{1 Top} (kN.m)	M _{2 Top} (kN.m)	N _{Bot} (kN)	M _{1 Bot} (kN.m)	M _{2 Bot} (kN.m)
1	43.2	0.0	0.0	96.0	0.0	-0.1
2	43.2	0.0	0.0	96.0	0.0	-1.0
3	30.0	0.0	0.0	82.8	0.0	0.7
4	43.2	0.0	-2.4	96.0	0.0	5.1
5	39.2	0.0	-3.8	92.0	0.0	8.1
6	26.4	0.0	-3.7	72.8	0.0	8.0

7	43.2	0.0	2.4	96.0	0.0	-5.4
8	39.2	0.0	3.8	92.0	0.0	-8.4
9	26.4	0.0	3.7	72.8	0.0	-8.2
10	42.0	0.0	0.0	94.8	0.0	-0.1
11	37.4	0.0	0.0	90.2	0.0	-0.1
12	24.6	0.0	0.0	71.1	0.0	-0.1
13	44.4	0.0	0.0	97.2	0.0	-0.1
14	41.0	0.0	0.0	93.8	0.0	-0.1
15	28.2	0.0	0.0	74.6	0.0	-0.1

Interaction Diagram



Critical Loading: 1 - (G+Q)

		Min	Design
N	96.0	-	96.0 kN
M ₁₁	0.0	1.9	1.9 kN.m
M ₂₂	-0.1	-14.1	-14.1 kN.m
N _{Max}	7969.2		

Concrete Cover = 25.0 mm

Neutral Axis: 237.8 mm / 12.12 °

Shear		Short Column...	Rebars	
V _{Ed(1/2)} =	6.1 / 0.0 kN		As (Req):	%0.20 _(min) 1760.00 mm ²
V _{Ed} =	0.01 / 0.01 N/mm ²		As (Sup):	%0.57 4976.28 mm ²
V _{Rdc} =	0.29 / 0.50 N/mm ²		44H12	
V _{Rd Max} =	4.06 / 4.06 N/mm ²			
Lat. Steel = H8-300		M _{Add(1/2)} =	0.0 / 2.6 kN.m	

2W4 (A-1) (4400/200)

Materials: C25/30 / Grade 500 (Type 2) Web: Grade 500 (Type 2) (Links: Grade 500 (Type 2))

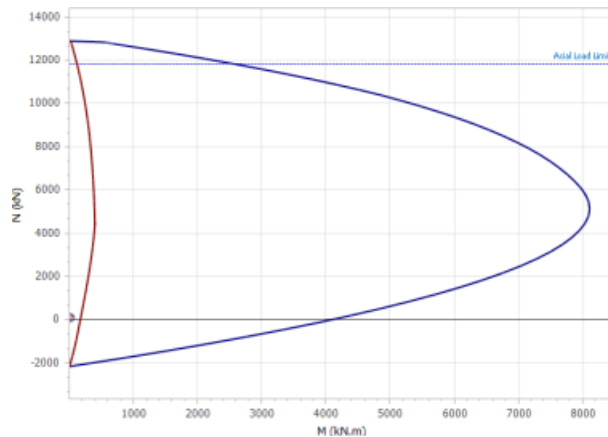
Section



Combinations

No	N _{Top} (kN)	M _{1 Top} (kN.m)	M _{2 Top} (kN.m)	N _{Bot} (kN)	M _{1 Bot} (kN.m)	M _{2 Bot} (kN.m)
1	43.2	0.0	0.0	96.0	0.0	-0.1
2	43.2	0.0	0.0	96.0	0.0	-1.0
3	30.0	0.0	0.0	82.8	0.0	0.7
4	42.0	0.0	0.0	94.8	0.0	-0.1
5	37.4	0.0	0.0	90.2	0.0	-0.1
6	24.6	0.0	0.0	71.1	0.0	-0.1
7	44.4	0.0	0.0	97.2	0.0	-0.1
8	41.0	0.0	0.0	93.8	0.0	-0.1
9	28.2	0.0	0.0	74.6	0.0	-0.1
10	43.2	0.0	-2.4	96.0	0.0	5.1
11	39.2	0.0	-3.8	92.0	0.0	8.1
12	26.4	0.0	-3.7	72.8	0.0	8.0
13	43.2	0.0	2.4	96.0	0.0	-5.4
14	39.2	0.0	3.8	92.0	0.0	-8.4
15	26.4	0.0	3.7	72.8	0.0	-8.2

Interaction Diagram



Critical Loading: 1 - (G+Q)

	Min	Design
N	96.0	- 96.0 kN
M ₁₁	0.0	-1.9 kN.m
M ₂₂	-0.1	-14.1 kN.m
N _{Max}	7969.2	

Concrete Cover = 25.0 mm

Neutral Axis: 11.1 mm / 0.01 °

Shear

Rebars

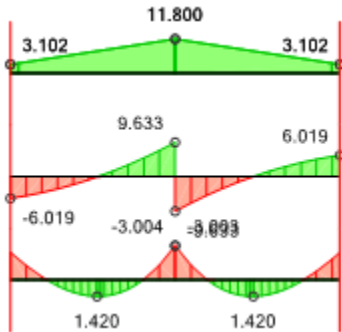
$V_{Ed(1/2)} =$	6.1 / 0.0	kN	Short Column...			$A_s \text{ (Req):}$	$\%0.20_{(min)}$	1760.00 mm ²
$V_{Ed} =$	0.01 / 0.01	N/mm ²	$\lambda_1/Lim_1 =$	33.9 < 123.2	✓	$A_s \text{ (Sup):}$	$\%0.57$	4976.28 mm ²
$V_{Rdc} =$	0.29 / 0.50	N/mm ²	$\lambda_2/Lim_2 =$	4.0 < 123.2	✓			
$V_{Rd \text{ Max}} =$	4.06 / 4.06	N/mm ²	$M_{Add(1/2)} =$	0.0 / 0.0	kN.m			
Lat. Steel = H8-300						44H12		

Beam Reinforcement Design

Axis: B Storey: 1

Materials: C25/30 / Grade 500 (Type 2) (Links: Grade 500 (Type 2)) Concrete Cover: 35.0 mm

Diagrams



Bending

B _w / H (mm)	1B1 L= 4200mm 250 / 500		
Flange B _f / H _f (Left) (Right)	---		
Top Edge			
M (kN.m)	2.4	3.0	2.4
d (mm)	449.0	449.0	449.0
K/K'	0.01	0.01	0.01
x (mm)	56.1	56.1	56.1
A _{sm} (mm ²)	56.1	56.1	56.1
A _{sv} (mm ²)	17.30	27.70	17.30
A _s (mm ²)	16.20	16.20	16.20
A _s ' (mm ²)	0.00	0.00	0.00
A _{s,min} (mm ²)	149.72	149.72	149.72
Bottom Edge			
M (kN.m)	0.9	1.4	0.9
d (mm)	449.0	449.0	449.0
K/K'	0.00	0.01	0.00
x (mm)	56.1	56.1	56.1
A _{sm} (mm ²)	56.1	56.1	56.1
A _{sv} (mm ²)	17.30	27.70	17.30
A _s (mm ²)	7.66	7.66	7.66
A _s ' (mm ²)	0.00	0.00	0.00
A _{s,min} (mm ²)	149.72	149.72	149.72

Shear And Torsion Design

V _d (kN)	6.0	6.0
v (MPa)	0.05	0.05
V _{Rdc} (MPa)	0.48	0.48

V _{Rd,max} (MPa)	4.05		4.05
V _{Rd} (kN)			147.2
V _{nom} (kN)		152.4	
T _d (kN.m)		0.0	≤T _{Min}
T _{Min} (kN.m)		4.9	
b _{support} (mm)	0.0		0.0
Links	1H8-300	1H8-300	1H8-300

Deflection Check

L/d	9.35 ≤ 15587.68 ✓
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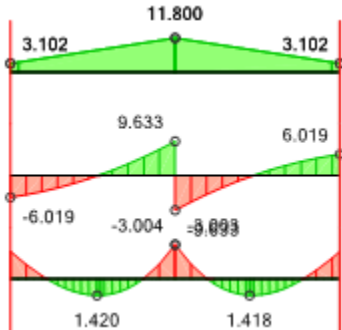
Steel Areas (mm²)

Required			
Top Edge	16.20	16.20	16.20
Bottom Edge	7.66	7.66	7.66
Supplied			
Top Edge	402.12	402.12	402.12
Bottom Edge	603.19	603.19	603.19
Steel Bars			
Top Bars	2H16		
Top.Sup.Bars			
Top.Sup.Bars			
Bottom Bars	3H16		
Bottom Bars			
Bot.Sup.Bars			
Side Bars			

Axis: 2 Storey: 1

Materials: C25/30 / Grade 500 (Type 2) (Links: Grade 500 (Type 2)) Concrete Cover: 35.0 mm

Diagrams



Bending

	1B2 L= 4200mm 250 / 500		
B _w / H (mm)			
Flange B _f / H _f (Left) (Right)	---		
Top Edge			
M (kN.m)	2.4	3.0	2.4
d (mm)	449.0	449.0	449.0
K/K'	0.01	0.01	0.01
x (mm)	56.1	56.1	56.1
A _{sm} (mm ²)	56.1	56.1	56.1
A _{sv} (mm ²)	17.30	27.70	17.30
A _s (mm ²)	16.20	16.20	16.20
A _s ' (mm ²)	0.00	0.00	0.00
A _{s,min} (mm ²)	149.72	149.72	149.72
Bottom Edge			
M (kN.m)	0.9	1.4	0.9
d (mm)	449.0	449.0	449.0
K/K'	0.00	0.01	0.00
x (mm)	56.1	56.1	56.1
A _{sm} (mm ²)	56.1	56.1	56.1
A _{sv} (mm ²)	17.30	27.70	17.30
A _s (mm ²)	7.66	7.66	7.66
A _s ' (mm ²)	0.00	0.00	0.00
A _{s,min} (mm ²)	149.72	149.72	149.72

Shear And Torsion Design

V _d (kN)	6.0	6.0
v (MPa)	0.05	0.05
V _{Rdc} (MPa)	0.48	0.48
V _{Rd,max} (MPa)	4.05	4.05
V _{Rd} (kN)		147.2
V _{nom} (kN)	152.4	

T _d (kN.m)	0.0 ≤ T _{Min}		
T _{Min} (kN.m)	4.9		
b _{support} (mm)	0.0		0.0
Links	1H8-300	1H8-300	1H8-300

Deflection Check

L/d	9.35 ≤ 15588.27 ✓
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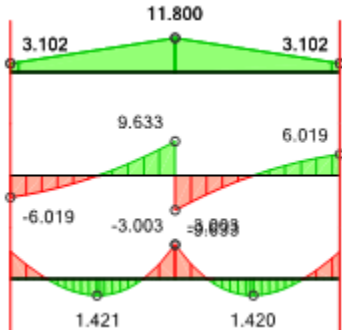
Steel Areas (mm²)

Required			
Top Edge	16.20	16.20	16.20
Bottom Edge	7.66	7.66	7.66
Supplied			
Top Edge	402.12	402.12	402.12
Bottom Edge	603.19	603.19	603.19
Steel Bars			
Top Bars	2H16		
Top.Sup.Bars			
Top.Sup.Bars			
Bottom Bars	3H16		
Bottom Bars			
Bot.Sup.Bars			
Side Bars			

Axis: A Storey: 1

Materials: C25/30 / Grade 500 (Type 2) (Links: Grade 500 (Type 2)) Concrete Cover: 35.0 mm

Diagrams



Bending

	1B3 L= 4200mm 250 / 500		
B _w / H (mm)			
Flange B _f / H _f (Left) (Right)	---		
Top Edge			
M (kN.m)	2.4	3.0	2.4
d (mm)	449.0	449.0	449.0
K/K'	0.01	0.01	0.01
x (mm)	56.1	56.1	56.1
A _{sm} (mm ²)	56.1	56.1	56.1
A _{sv} (mm ²)	17.30	27.70	17.30
A _s (mm ²)	16.19	16.19	16.19
A _s ' (mm ²)	0.00	0.00	0.00
A _{s,min} (mm ²)	149.72	149.72	149.72
Bottom Edge			
M (kN.m)	0.9	1.4	0.9
d (mm)	449.0	449.0	449.0
K/K'	0.00	0.01	0.00
x (mm)	56.1	56.1	56.1
A _{sm} (mm ²)	56.1	56.1	56.1
A _{sv} (mm ²)	17.30	27.70	17.30
A _s (mm ²)	7.66	7.66	7.66
A _s ' (mm ²)	0.00	0.00	0.00
A _{s,min} (mm ²)	149.72	149.72	149.72

Shear And Torsion Design

V _d (kN)	6.0	6.0
v (MPa)	0.05	0.05
V _{Rdc} (MPa)	0.48	0.48
V _{Rd,max} (MPa)	4.05	4.05
V _{Rd} (kN)		147.2
V _{nom} (kN)	152.4	

T _d (kN.m)	0.0 ≤ T _{Min}		
T _{Min} (kN.m)	4.9		
b _{support} (mm)	0.0		0.0
Links	1H8-300	1H8-300	1H8-300

Deflection Check

L/d	9.35 ≤ 15574.5 ✓
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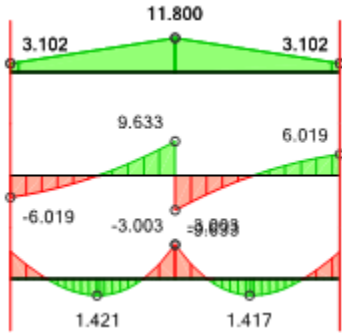
Steel Areas (mm²)

Required			
Top Edge	16.19	16.19	16.19
Bottom Edge	7.66	7.66	7.66
Supplied			
Top Edge	402.12	402.12	402.12
Bottom Edge	603.19	603.19	603.19
Steel Bars			
Top Bars	2H16		
Top.Sup.Bars			
Top.Sup.Bars			
Bottom Bars	3H16		
Bottom Bars			
Bot.Sup.Bars			
Side Bars			

Axis: 1 Storey: 1

Materials: C25/30 / Grade 500 (Type 2) (Links: Grade 500 (Type 2)) Concrete Cover: 35.0 mm

Diagrams



Bending

	1B4 L= 4200mm 250 / 500		
B _w / H (mm)			
Flange B _f / H _f (Left) (Right)	---		
Top Edge			
M (kN.m)	2.4	3.0	2.4
d (mm)	449.0	449.0	449.0
K/K'	0.01	0.01	0.01
x (mm)	56.1	56.1	56.1
A _{sm} (mm ²)	56.1	56.1	56.1
A _{sv} (mm ²)	17.30	27.70	17.30
A _s (mm ²)	16.19	16.19	16.19
A _s ' (mm ²)	0.00	0.00	0.00
A _{s,min} (mm ²)	149.72	149.72	149.72
Bottom Edge			
M (kN.m)	0.9	1.4	0.9
d (mm)	449.0	449.0	449.0
K/K'	0.00	0.01	0.00
x (mm)	56.1	56.1	56.1
A _{sm} (mm ²)	56.1	56.1	56.1
A _{sv} (mm ²)	17.30	27.70	17.30
A _s (mm ²)	7.66	7.66	7.66
A _s ' (mm ²)	0.00	0.00	0.00
A _{s,min} (mm ²)	149.72	149.72	149.72

Shear And Torsion Design

V _d (kN)	6.0	6.0
v (MPa)	0.05	0.05
V _{Rdc} (MPa)	0.48	0.48
V _{Rd,max} (MPa)	4.05	4.05
V _{Rd} (kN)		147.2
V _{nom} (kN)	152.4	

T _d (kN.m)	0.0 ≤ T _{Min}		
T _{Min} (kN.m)	4.9		
b _{support} (mm)	0.0		0.0
Links	1H8-300	1H8-300	1H8-300

Deflection Check

L/d	9.35 ≤ 15574.87 ✓
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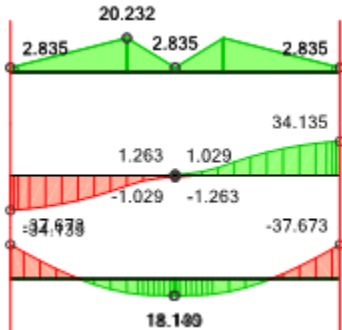
Steel Areas (mm²)

Required			
Top Edge	16.19	16.19	16.19
Bottom Edge	7.66	7.66	7.66
Supplied			
Top Edge	402.12	402.12	402.12
Bottom Edge	603.19	603.19	603.19
Steel Bars			
Top Bars	2H16		
Top.Sup.Bars			
Top.Sup.Bars			
Bottom Bars	3H16		
Bottom Bars			
Bot.Sup.Bars			
Side Bars			

Storey: 1

Materials: C25/30 / Grade 500 (Type 2) (Links: Grade 500 (Type 2)) Concrete Cover: 35.0 mm

Diagrams



Bending

	1B5 L= 5939.7mm		
B _w / H (mm)	250 / 500		
Flange B _f / H _f (Left) (Right)	---		
Top Edge			
M (kN.m)	37.7	0.0	37.7
d (mm)	449.0	449.0	449.0
K/K'	0.14	0.00	0.14
x (mm)	56.1	56.1	56.1
A _{sm} (mm ²)	56.1	56.1	56.1
A _{sv} (mm ²)	98.14	55.82	98.14
A _s (mm ²)	203.13	55.82	203.13
A _s ' (mm ²)	0.00	0.00	0.00
A _{s,min} (mm ²)	149.72	149.72	149.72
Bottom Edge			
M (kN.m)	0.0	18.1	0.0
d (mm)	449.0	449.0	449.0
K/K'	0.00	0.07	0.00
x (mm)	56.1	56.1	56.1
A _{sm} (mm ²)	56.1	56.1	56.1
A _{sv} (mm ²)	98.14	55.82	98.14
A _s (mm ²)	97.81	97.81	97.81
A _s ' (mm ²)	0.00	0.00	0.00
A _{s,min} (mm ²)	149.72	149.72	149.72

Shear And Torsion Design

V _d (kN)	34.1	34.1
v (MPa)	0.30	0.30
V _{Rdc} (MPa)	0.48	0.48
V _{Rd,max} (MPa)	4.05	4.05
V _{Rd} (kN)		147.2
V _{nom} (kN)	152.4	

T _d (kN.m)	0.0 ≤ T _{Min}		
T _{Min} (kN.m)	4.9		
b _{support} (mm)	0.0		0.0
Links	1H8-300	1H8-300	1H8-300

Deflection Check

L/d	13.23 ≤ 328.57 ✓
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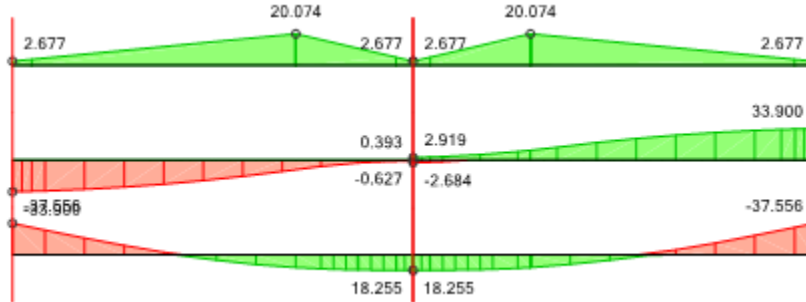
Steel Areas (mm²)

Required			
Top Edge	203.13	55.82	203.13
Bottom Edge	97.81	97.81	97.81
Supplied			
Top Edge	402.12	402.12	402.12
Bottom Edge	603.19	603.19	603.19
Steel Bars			
Top Bars	2H16		
Top.Sup.Bars			
Top.Sup.Bars			
Bottom Bars	3H16		
Bottom Bars			
Bot.Sup.Bars			
Side Bars			

Storey: 1

Materials: C25/30 / Grade 500 (Type 2) (Links: Grade 500 (Type 2)) Concrete Cover: 35.0 mm

Diagrams



Bending

B _w / H (mm)	1B6 L= 2969.8mm 250 / 500			1B7 L= 2969.8mm 250 / 500		
Flange B _f / H _f (Left) (Right)	---			---		
Top Edge						
M (kN.m)	37.6	10.7	4.3	4.3	10.7	37.6
d (mm)	449.0	449.0	449.0	449.0	449.0	449.0
K/K'	0.14	0.04	0.02	0.02	0.04	0.14
x (mm)	56.1	56.1	56.1	56.1	56.1	56.1
A _{sm} (mm ²)	56.1	56.1	56.1	56.1	56.1	56.1
A _{sv} (mm ²)	97.47	82.48	31.93	32.64	82.48	97.47
A _s (mm ²)	202.50	140.42	55.28	55.99	140.42	202.50
A _s ' (mm ²)	0.00	0.00	0.00	0.00	0.00	0.00
A _{s,min} (mm ²)	149.72	149.72	149.72	149.72	149.72	149.72
Bottom Edge						
M (kN.m)	0.0	17.3	18.3	18.3	17.3	0.0
d (mm)	449.0	449.0	432.0	432.0	449.0	449.0
K/K'	0.00	0.07	0.08	0.08	0.07	0.00
x (mm)	56.1	56.1	54.0	54.0	56.1	56.1
A _{sm} (mm ²)	54.0	56.1	56.1	54.0	56.1	56.1
A _{sv} (mm ²)	97.47	82.48	31.93	32.64	82.48	97.47
A _s (mm ²)	93.41	102.31	102.31	102.31	102.31	93.41
A _s ' (mm ²)	0.00	0.00	0.00	0.00	0.00	0.00
A _{s,min} (mm ²)	149.72	149.72	144.05	144.05	149.72	149.72

Shear And Torsion Design

V _d (kN)	33.9	11.1	11.4	33.9
v (MPa)	0.30	0.10	0.10	0.30
V _{Rdc} (MPa)	0.48	0.48	0.48	0.48
V _{Rd,max} (MPa)	4.05	4.05	4.05	4.05
V _{Rd} (kN)		141.6		147.2
V _{nom} (kN)	152.4		152.4	

T _d (kN.m)	0.0 ≤ T _{Min}			0.0 ≤ T _{Min}		
T _{Min} (kN.m)	4.9			4.9		
b _{support} (mm)	0.0		0.0	0.0		0.0
Links	1H8-300	1H8-300	1H8-300	1H8-300	1H8-300	1H8-300

Deflection Check

L/d	6.61 ≤ 398.12 ✓	6.61 ≤ 398.12 ✓
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Steel Areas (mm²)

Required						
Top Edge	202.50	140.42	55.28	55.99	140.42	202.50
Bottom Edge	93.41	102.31	102.31	102.31	102.31	93.41
Supplied						
Top Edge	402.12	402.12	603.19	603.19	402.12	402.12
Bottom Edge	603.19	603.19	603.19	603.19	603.19	603.19
Steel Bars						
Top Bars	2H16			2H16		
Top.Sup.Bars	3H16			3H16		
Top.Sup.Bars						
Bottom Bars	3H16			3H16		
Bottom Bars						
Bot.Sup.Bars						
Side Bars						

Batch Pad Footing Report

Symbols and Abbreviations

N	: Axial Load Of Combination
$\sum N$: Total Axial Load
TW	: Total Weight of Footing
h	: Footing Depth
h_{taper}	: Taper Height
Ecc_1	: Column Eccentricity in X Direction
Ecc_2	: Column Eccentricity in Y Direction
$\sum M_x$: Total Moment in X Direction
$\sum M_y$: Total Moment in Y Direction
V_{pd} : Punching Demand	
V_{pc}	: Punching Capacity
V_{pd-cf}	: Punching Demand(On Column Face)
V_{pc-cf}	: Punching Capacity(On Column Face)
V_{pd-ep}	: Punching Demand(On Effective Perimeter)
V_{pc-ep}	: Punching Capacity(On Effective Perimeter)
σ_{soil}	: Soil Stress
$V_{Rd,c1}$: Design Shear Resistance
ρ_l	: Flexural Reinforcement Ratio
f_{ck}	: Concrete Characteristic Compressive Strength
$C_{Rd,c}$: Parameter based on selected National Annex, (Suggested value : 0.12)
σ_{cp}	: Stress Caused by Loading
γ	: Factor which reflects the effect of bending
k_1	: National Annex Parameter, (Suggested value: 0.10)
u_p	: Effective Perimeter
B_{EPx}	: Width of effective perimeter in X direction
B_{EPy}	: Width of effective perimeter in Y direction
d_{sect}	: Distance from column face to effective perimeter edge
d	: Effective Depth
V_{dx-cf} : Shear Force On Column Face, X-Direction	
V_{dy-cf}	: Shear Force On Column Face, Y-Direction
V_{dx-d}	: Shear Force On Location d Away From Column Face, X-Direction
V_{dy-d}	: Shear Force On Location d Away From Column Face, Y-Direction
d_{v1}	: Distance from Column Face to Footing Edge
d_{v2}	: Distance from Location d Away From Column Face to Footing Edge
σ_{cf}	: Soil stress on column face
σ_c	: Soil stress at nearest corner
σ_{max}	: Max. corner stress

F-1C2 Design Summary

Geometric Properties and Materials

Footing Materials

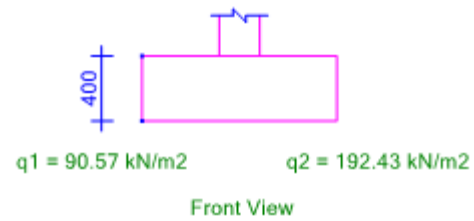
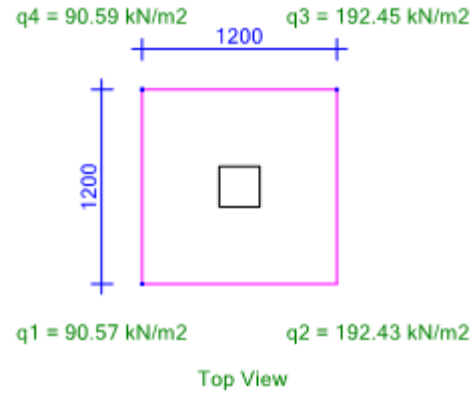
Concrete Material	C25/30
Rebar Material	Grade 410 (Type 2)

Geometric Properties

B _x	1200.00 mm
B _y	1200.00 mm
Height	400.00 mm
Taper Height	0.00 mm

Corner Stresses

Lower-Left Corner	90.57 kN/m ²
Lower-Right Corner	192.43 kN/m ²
Upper-Right Corner	192.45 kN/m ²
Upper-Left Corner	90.59 kN/m ²



Loading Info

Combinations	N	V _x	V _y	M _x	M _y
Comb #1	167.9 kN	0.0 kN	0.0 kN	0.0 kN.m	0.0 kN.m
Comb #2	164.2 kN	0.0 kN	0.0 kN	0.0 kN.m	0.0 kN.m
Comb #3	145.1 kN	0.0 kN	0.0 kN	0.0 kN.m	0.0 kN.m
Comb #4	175.3 kN	-6.7 kN	0.0 kN	11.8 kN.m	0.0 kN.m
Comb #5	171.8 kN	-10.8 kN	0.0 kN	19.0 kN.m	0.0 kN.m
Comb #6	136.2 kN	-10.8 kN	0.0 kN	18.9 kN.m	0.0 kN.m
Comb #7	160.4 kN	6.7 kN	0.0 kN	-11.8 kN.m	0.0 kN.m
Comb #8	148.0 kN	10.8 kN	0.0 kN	-19.0 kN.m	0.0 kN.m
Comb #9	112.7 kN	10.8 kN	0.0 kN	-18.9 kN.m	0.0 kN.m
Comb #10	175.3 kN	0.0 kN	-6.7 kN	0.0 kN.m	11.8 kN.m
Comb #11	171.8 kN	0.0 kN	-10.8 kN	0.0 kN.m	19.0 kN.m
Comb #12	136.2 kN	0.0 kN	-10.8 kN	0.0 kN.m	18.9 kN.m
Comb #13	160.4 kN	0.0 kN	6.7 kN	0.0 kN.m	-11.8 kN.m
Comb #14	148.0 kN	0.0 kN	10.8 kN	0.0 kN.m	-19.0 kN.m
Comb #15	112.7 kN	0.0 kN	10.8 kN	0.0 kN.m	-18.9 kN.m

Soil Stress Check

Total footing, soil and pedestal weight is calculated.

Member	Volume (m3)	Unit Weight (kN/m3)	Weight (kN)
Pad Footing	: 0.576	24	13.824
Soil	: 1.008	18	18.144
Total	:		31.968

In order to calculate total axial load, weights are added to axial loads,

$$\Sigma N = N + TW$$

Total moments are calculated using the equation below,

$$\Sigma M_x = M_x + V_x (h - h_{taper}) + Ecc_1 N$$

$$\Sigma M_y = M_y + V_y (h - h_{taper}) + Ecc_2 N$$

Corner stresses,

$$\sigma_1 = \Sigma N / L_x L_y - 6 \Sigma M_x / (L_x L_y^2) - 6 \Sigma M_y / (L_x^2 L_y)$$

$$\sigma_2 = \Sigma N / L_x L_y + 6 \Sigma M_x / (L_x L_y^2) - 6 \Sigma M_y / (L_x^2 L_y)$$

$$\sigma_3 = \Sigma N / L_x L_y + 6 \Sigma M_x / (L_x L_y^2) + 6 \Sigma M_y / (L_x^2 L_y)$$

$$\sigma_4 = \Sigma N / L_x L_y - 6 \Sigma M_x / (L_x L_y^2) + 6 \Sigma M_y / (L_x^2 L_y)$$

Comb	ΣN (kN)	ΣM_x (kN.m)	ΣM_y (kN.m)	σ_1 (kN/m ²)	σ_2 (kN/m ²)	σ_3 (kN/m ²)	σ_4 (kN/m ²)
Comb #1	199.83	0.00	0.00	138.75	138.77	138.80	138.77
Comb #2	196.16	0.00	0.00	136.21	136.22	136.23	136.22
Comb #3	177.04	0.00	0.00	122.91	122.95	122.98	122.95
Comb #4	207.27	9.10	0.00	112.31	175.54	175.56	112.34
Comb #5	203.78	14.67	0.00	90.57	192.43	192.45	90.59
Comb #6	168.19	14.56	0.00	66.22	167.36	167.38	66.23
Comb #7	192.40	-9.10	0.00	165.18	102.01	102.03	165.21
Comb #8	180.01	-14.66	0.00	175.90	74.09	74.11	175.93
Comb #9	144.62	-14.56	0.00	150.98	49.87	49.88	150.99
Comb #10	207.27	0.00	9.10	112.31	112.34	175.56	175.54
Comb #11	203.78	0.00	14.67	90.57	90.59	192.45	192.43
Comb #12	168.19	0.00	14.56	66.22	66.23	167.38	167.36
Comb #13	192.40	0.00	-9.10	165.18	165.21	102.03	102.01
Comb #14	180.01	0.00	-14.66	175.90	175.93	74.11	74.09
Comb #15	144.62	0.00	-14.56	150.98	150.99	49.88	49.87

Demand	Capacity	Status
Maximum Soil Stress: 192.45 kN/m ²	Allowable Maximum Soil Stress: 250.00 kN/m ²	✓

Eccentricity Check

Comb	Direction	Moment (kN.m)	Axial Load (kN)	Eccentricity (M/N)	Limit (L/6)	Status
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Comb #1	X	0	199.83	0.02 mm	200 mm	✓
	Y	0	199.83	0.02 mm	200 mm	✓
Comb #2	X	0	196.16	0.01 mm	200 mm	✓
	Y	0	196.16	0.01 mm	200 mm	✓
Comb #3	X	0	177.04	0.03 mm	200 mm	✓
	Y	0	177.04	0.03 mm	200 mm	✓
Comb #4	X	9.1	207.27	43.92 mm	200 mm	✓
	Y	0	207.27	0.02 mm	200 mm	✓
Comb #5	X	14.67	203.78	71.98 mm	200 mm	✓
	Y	0	203.78	0.02 mm	200 mm	✓
Comb #6	X	14.56	168.19	86.6 mm	200 mm	✓
	Y	0	168.19	0.01 mm	200 mm	✓
Comb #7	X	-9.1	192.4	47.28 mm	200 mm	✓
	Y	0	192.4	0.02 mm	200 mm	✓
Comb #8	X	-14.66	180.01	81.44 mm	200 mm	✓
	Y	0	180.01	0.02 mm	200 mm	✓
Comb #9	X	-14.56	144.62	100.68 mm	200 mm	✓
	Y	0	144.62	0.02 mm	200 mm	✓
Comb #10	X	0	207.27	0.02 mm	200 mm	✓
	Y	9.1	207.27	43.92 mm	200 mm	✓
Comb #11	X	0	203.78	0.02 mm	200 mm	✓
	Y	14.67	203.78	71.98 mm	200 mm	✓
Comb #12	X	0	168.19	0.01 mm	200 mm	✓
	Y	14.56	168.19	86.6 mm	200 mm	✓
Comb #13	X	0	192.4	0.02 mm	200 mm	✓
	Y	-9.1	192.4	47.28 mm	200 mm	✓
Comb #14	X	0	180.01	0.02 mm	200 mm	✓
	Y	-14.66	180.01	81.44 mm	200 mm	✓
Comb #15	X	0	144.62	0.02 mm	200 mm	✓
	Y	-14.56	144.62	100.68 mm	200 mm	✓

Punching Check

Punching force will be calculated according to EN 1992-1-1:2004 (6.4.3)

$$V_{pd} = \sigma_{soil} * A_{eff} * \beta$$

$$\sigma_{soil} = \Sigma N / L_x L_y$$

$$A_{eff} = L_x L_y - B_x B_y$$

$$\beta = 1.166$$

Punching capacity will be calculated according to EN 1992-1-1:2004 (6.4.4)

$$(6.47) v_{Rd,c1} = C_{Rd,c} k (100 \rho_l f_{ck})^{1/3} + k_1 \sigma_{cp}$$

$$k = 1 + (200/d)^{1/2}$$

$$k = 1.78,$$

$$\rho_l = (\rho_{lx} \rho_{ly})^{1/2} * \rho_f, \rho_{lmin} = 0.02$$

$$\rho_{lx} = 0.0031, \rho_{ly} = 0.0031, \rho_f = 1,$$

$$\rho_l = 0.0031,$$

$$\sigma_{cp} = \Sigma N / L_x L_y = 0.1 \text{ N/mm}^2$$

$$C_{Rd,c} = 0.12, k_1 = 0.10$$

$$v_{Rd,c1} = 0.43 \text{ N/mm}^2$$

$$v_{min} = 0.035 k^{3/2} f_{ck}^{1/2} + k_1 \sigma_{cp}$$

$$v_{min} = 0.43 \text{ N/mm}^2$$

$$v_{Rd,c} = \text{Max}(v_{Rd,c1}, v_{min}) = 0.43 \text{ N/mm}^2$$

$$v_{Rdmax} = 0.5 (0.6 (1 - (f_{ck} / 250))) f_{cd}$$

$$V_{pc-cf} = v_{Rdmax} u_p d,$$

$$V_{pc-ep} = v_{Rd,c} u_p d,$$

$$u_p = 2(B_{EPx} + B_{EPy}) = 9293.80460547705$$

$$B_{EPx} = B_x + 2d_{sect} = 1570$$

$$B_{EPy} = B_y + 2d_{sect} = 1570$$

$$d_{sect} = 2d_{eff} = 660$$

$$V_{pc-cf} = 1485 \text{ kN}$$

$$V_{pc-ep} = 1614 \text{ kN}$$

Comb	ΣN (kN)	σ _{soil} (kN/m2)	V _{pc-cf} (kN)	V _{pd-cf} (kN)	D/C-cf	V _{pc-ep} (kN)	V _{pd-ep} (kN)	D/C-ep
Comb #1	199.83	138.77	1485.00	222.88	0.15	1628.66	165.83	0.10
Comb #2	196.16	136.22	1485.00	218.79	0.15	1628.66	162.78	0.10
Comb #3	177.04	122.95	1485.00	197.46	0.13	1628.66	146.92	0.09
Comb #4	207.27	143.94	1485.00	231.17	0.16	1628.66	172.00	0.11
Comb #5	203.78	141.51	1485.00	227.28	0.15	1628.66	169.10	0.10
Comb #6	168.19	116.80	1485.00	187.58	0.13	1628.66	139.57	0.09
Comb #7	192.40	133.61	1485.00	214.58	0.14	1628.66	159.66	0.10
Comb #8	180.01	125.01	1485.00	200.77	0.14	1628.66	149.38	0.09
Comb #9	144.62	100.43	1485.00	161.30	0.11	1628.66	120.01	0.07

Comb #10	207.27	143.94	1485.00	231.17	0.16	1628.66	172.00	0.11
Comb #11	203.78	141.51	1485.00	227.28	0.15	1628.66	169.10	0.10
Comb #12	168.19	116.80	1485.00	187.58	0.13	1628.66	139.57	0.09
Comb #13	192.40	133.61	1485.00	214.58	0.14	1628.66	159.66	0.10
Comb #14	180.01	125.01	1485.00	200.77	0.14	1628.66	149.38	0.09
Comb #15	144.62	100.43	1485.00	161.30	0.11	1628.66	120.01	0.07

Comparison at	Demand / Capacity	Status
Effective Perimeter	172.0 kN / 1628.7 kN	✓
Column Face	231.2 kN / 1485.0 kN	✓

Shear Check

Shear capacity is calculated according to EC-2,

$$(6.2.a) \quad V_{rdc1} = 0.12 k (100 \rho f_{ck})^{1/3} + (0.15 * 0.2 * f_{cd} * d_y * d = 142.2 \text{ kN}$$

$$(6.3N) \quad V_{rdc2} = 0.035 (k^{1.5}) (f_{ck}^{0.5}) + (0.15 * 0.2 * f_{cd} * d_y * d = 139.56 \text{ kN}$$

$$V_{rdc} = \text{Max}(V_{rdc1}, V_{rdc2}) = 142.2 \text{ kN}$$

$$V_{dx-cf} = \sigma_{cf} d_{vx1} L_y + ((\sigma_{\max} - \sigma_{cf}) d_{vx1} L_y / 2)$$

$$V_{dy-cf} = \sigma_{cf} d_{vy1} L_x + ((\sigma_{\max} - \sigma_{cf}) d_{vy1} L_x / 2)$$

$$V_{dx-d} = \sigma_{cf} d_{vx2} L_y + ((\sigma_{\max} - \sigma_{cf}) d_{vx2} L_y / 2)$$

$$V_{dy-d} = \sigma_{cf} d_{vy2} L_x + ((\sigma_{\max} - \sigma_{cf}) d_{vy2} L_x / 2)$$

On Column Face,

Comb	Demand (kN)	X-Direction Capacity (kN)	Status (kN)	Demand (kN)	Y-Direction Capacity (kN)	Status (kN)
Comb #1	79.11	133.58	✓	79.11	133.58	✓
Comb #2	77.65	133.58	✓	77.65	133.58	✓
Comb #3	70.09	133.58	✓	70.09	133.58	✓
Comb #4	100.07	133.58	✓	92.94	133.58	✓
Comb #5	109.69	133.58	✓	98.21	133.58	✓
Comb #6	95.40	133.58	✓	83.99	133.58	✓
Comb #7	94.17	133.58	✓	87.04	133.58	✓
Comb #8	100.28	133.58	✓	88.79	133.58	✓
Comb #9	86.07	133.58	✓	74.66	133.58	✓
Comb #10	92.94	133.58	✓	100.07	133.58	✓
Comb #11	98.21	133.58	✓	109.69	133.58	✓
Comb #12	83.99	133.58	✓	95.40	133.58	✓
Comb #13	87.04	133.58	✓	94.17	133.58	✓
Comb #14	88.79	133.58	✓	100.28	133.58	✓

Comb #15	74.66	133.58	✓	86.07	133.58	✓
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**On "d" Distance Away
From Column Face,**

Comb	Demand (kN)	X-Direction Capacity (kN)	Status (kN)	Demand (kN)	Y-Direction Capacity (kN)	Status (kN)
Comb #1	50.80	142.20	✓	52.46	142.20	✓
Comb #2	49.86	142.20	✓	51.50	142.20	✓
Comb #3	45.01	142.20	✓	46.48	142.20	✓
Comb #4	64.25	142.20	✓	63.23	142.20	✓
Comb #5	70.44	142.20	✓	67.69	142.20	✓
Comb #6	61.26	142.20	✓	58.25	142.20	✓
Comb #7	60.46	142.20	✓	59.31	142.20	✓
Comb #8	64.39	142.20	✓	61.45	142.20	✓
Comb #9	55.26	142.20	✓	52.06	142.20	✓
Comb #10	61.31	142.20	✓	66.36	142.20	✓
Comb #11	65.70	142.20	✓	72.75	142.20	✓
Comb #12	56.56	142.20	✓	63.27	142.20	✓
Comb #13	57.53	142.20	✓	62.45	142.20	✓
Comb #14	59.65	142.20	✓	66.50	142.20	✓
Comb #15	50.56	142.20	✓	57.08	142.20	✓

Comparison at	Demand / Capacity	Status
Column Face in X-Direction	109.7 kN / 133.6 kN	✓
Column Face in Y-Direction	109.7 kN / 133.6 kN	✓
Effective Perimeter in X-Direction	70.4 kN / 142.2 kN	✓
Effective Perimeter in Y-Direction	72.7 kN / 142.2 kN	✓

Bending Reinforcement Check

Comb	Md _x (kN.m)	Required As _x (mm ²)	Md _y (kN.m)	Required As _y (mm ²)
Comb #1	187.89	712.43	187.89	712.43
Comb #2	184.43	712.43	184.43	712.43
Comb #3	166.48	712.43	166.48	712.43
Comb #4	237.66	712.43	226.37	712.43
Comb #5	260.53	712.43	242.34	712.43
Comb #6	226.58	712.43	208.52	712.43
Comb #7	223.65	712.43	212.37	712.43
Comb #8	238.16	712.43	219.97	712.43
Comb #9	204.41	712.43	186.35	712.43
Comb #10	226.37	712.43	237.66	712.43
Comb #11	242.34	712.43	260.53	712.43
Comb #12	208.52	712.43	226.58	712.43
Comb #13	212.37	712.43	223.65	712.43
Comb #14	219.97	712.43	238.16	712.43

Comb #15	186.35	712.43	204.41	712.43
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Comparison of	Design Moment	Selected Rebar	Required / Provided	Status
Reinforcement Area in X-Direction	26.1 kN.m	6 ϕ 20 / 250.0 mm	712.43 mm ² /1507.96 mm ²	✓
Reinforcement Area in Y-Direction	26.1 kN.m	6 ϕ 20 / 250.0 mm	712.43 mm ² /1507.96 mm ²	✓

F-1C3 Design Summary

Geometric Properties and Materials

Footing Materials

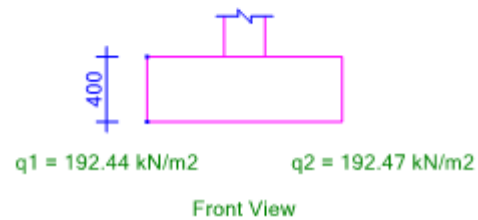
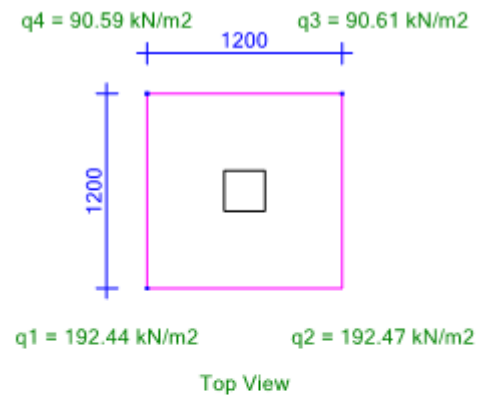
Concrete Material	C25/30
Rebar Material	Grade 410 (Type 2)

Geometric Properties

B _x	1200.00 mm
B _y	1200.00 mm
Height	400.00 mm
Taper Height	0.00 mm

Corner Stresses

Lower-Left Corner	192.44 kN/m ²
Lower-Right Corner	192.47 kN/m ²
Upper-Right Corner	90.61 kN/m ²
Upper-Left Corner	90.59 kN/m ²



Loading Info

Combinations	N	V _x	V _y	M _x	M _y
Comb #1	167.9 kN	0.0 kN	0.0 kN	0.0 kN.m	0.0 kN.m
Comb #2	166.0 kN	0.0 kN	0.0 kN	0.0 kN.m	0.0 kN.m
Comb #3	143.3 kN	0.0 kN	0.0 kN	0.0 kN.m	0.0 kN.m
Comb #4	175.3 kN	-6.7 kN	0.0 kN	11.8 kN.m	0.0 kN.m
Comb #5	171.8 kN	-10.8 kN	0.0 kN	19.0 kN.m	0.0 kN.m

Comb #6	136.2 kN	-10.8 kN	0.0 kN	18.9 kN.m	0.0 kN.m
Comb #7	160.5 kN	6.7 kN	0.0 kN	-11.8 kN.m	0.0 kN.m
Comb #8	148.1 kN	10.8 kN	0.0 kN	-19.0 kN.m	0.0 kN.m
Comb #9	112.7 kN	10.8 kN	0.0 kN	-18.9 kN.m	0.0 kN.m
Comb #10	160.5 kN	0.0 kN	-6.7 kN	0.0 kN.m	11.8 kN.m
Comb #11	148.1 kN	0.0 kN	-10.8 kN	0.0 kN.m	19.0 kN.m
Comb #12	112.7 kN	0.0 kN	-10.8 kN	0.0 kN.m	18.9 kN.m
Comb #13	175.3 kN	0.0 kN	6.7 kN	0.0 kN.m	-11.8 kN.m
Comb #14	171.8 kN	0.0 kN	10.8 kN	0.0 kN.m	-19.0 kN.m
Comb #15	136.2 kN	0.0 kN	10.8 kN	0.0 kN.m	-18.9 kN.m

Soil Stress Check

Total footing, soil and pedestal weight is calculated.

Member	Volume (m3)	Unit Weight (kN/m3)	Weight (kN)
Pad Footing	: 0.576	24	13.824
Soil	: 1.008	18	18.144
Total	:		31.968

In order to calculate total axial load, weights are added to axial loads,

$$\Sigma N = N + TW$$

Total moments are calculated using the equation below,

$$\Sigma M_x = M_x + V_x (h - h_{\text{taper}}) + Ecc_1 N$$

$$\Sigma M_y = M_y + V_y (h - h_{\text{taper}}) + Ecc_2 N$$

Corner stresses,

$$\sigma_1 = \Sigma N / L_x L_y - 6 \Sigma M_x / (L_x L_y^2) - 6 \Sigma M_y / (L_x^2 L_y)$$

$$\sigma_2 = \Sigma N / L_x L_y + 6 \Sigma M_x / (L_x L_y^2) - 6 \Sigma M_y / (L_x^2 L_y)$$

$$\sigma_3 = \Sigma N / L_x L_y + 6 \Sigma M_x / (L_x L_y^2) + 6 \Sigma M_y / (L_x^2 L_y)$$

$$\sigma_4 = \Sigma N / L_x L_y - 6 \Sigma M_x / (L_x L_y^2) + 6 \Sigma M_y / (L_x^2 L_y)$$

Comb	ΣN (kN)	ΣM_x (kN.m)	ΣM_y (kN.m)	σ_1 (kN/m ²)	σ_2 (kN/m ²)	σ_3 (kN/m ²)	σ_4 (kN/m ²)
Comb #1	199.86	0.00	0.00	138.79	138.81	138.79	138.77
Comb #2	197.98	0.00	-0.01	137.50	137.51	137.47	137.47
Comb #3	175.27	0.01	0.00	121.70	121.74	121.73	121.69
Comb #4	207.29	9.10	0.00	112.35	175.58	175.55	112.33
Comb #5	203.80	14.67	0.00	90.61	192.47	192.44	90.59
Comb #6	168.21	14.56	0.00	66.25	167.39	167.37	66.23
Comb #7	192.42	-9.10	0.00	165.22	102.05	102.02	165.20
Comb #8	180.04	-14.66	0.00	175.94	74.13	74.11	175.92
Comb #9	144.64	-14.56	0.00	151.01	49.90	49.88	150.99
Comb #10	192.42	0.00	9.10	102.02	102.05	165.22	165.20

Comb #11	180.04	0.00	14.66	74.11	74.13	175.94	175.92
Comb #12	144.64	0.00	14.56	49.88	49.90	151.01	150.99
Comb #13	207.29	0.00	-9.10	175.55	175.58	112.35	112.33
Comb #14	203.80	0.00	-14.67	192.44	192.47	90.61	90.59
Comb #15	168.21	0.00	-14.56	167.37	167.39	66.25	66.23

Demand	Capacity	Status
Maximum Soil Stress: 192.47 kN/m2	Allowable Maximum Soil Stress: 250.00 kN/m2	✓

Eccentricity Check

Comb	Direction	Moment (kN.m)	Axial Load (kN)	Eccentricity (M/N)	Limit (L/6)	Status
Comb #1	X	0	199.86	0.02 mm	200 mm	✓
	Y	0	199.86	0.02 mm	200 mm	✓
Comb #2	X	0	197.98	0.01 mm	200 mm	✓
	Y	-0.01	197.98	0.03 mm	200 mm	✓
Comb #3	X	0.01	175.27	0.03 mm	200 mm	✓
	Y	0	175.27	0.01 mm	200 mm	✓
Comb #4	X	9.1	207.29	43.92 mm	200 mm	✓
	Y	0	207.29	0.02 mm	200 mm	✓
Comb #5	X	14.67	203.8	71.97 mm	200 mm	✓
	Y	0	203.8	0.02 mm	200 mm	✓
Comb #6	X	14.56	168.21	86.59 mm	200 mm	✓
	Y	0	168.21	0.01 mm	200 mm	✓
Comb #7	X	-9.1	192.42	47.28 mm	200 mm	✓
	Y	0	192.42	0.02 mm	200 mm	✓
Comb #8	X	-14.66	180.04	81.43 mm	200 mm	✓
	Y	0	180.04	0.02 mm	200 mm	✓
Comb #9	X	-14.56	144.64	100.66 mm	200 mm	✓
	Y	0	144.64	0.02 mm	200 mm	✓
Comb #10	X	0	192.42	0.02 mm	200 mm	✓
	Y	9.1	192.42	47.28 mm	200 mm	✓
Comb #11	X	0	180.04	0.02 mm	200 mm	✓
	Y	14.66	180.04	81.43 mm	200 mm	✓
Comb #12	X	0	144.64	0.02 mm	200 mm	✓
	Y	14.56	144.64	100.66 mm	200 mm	✓
Comb #13	X	0	207.29	0.02 mm	200 mm	✓
	Y	-9.1	207.29	43.92 mm	200 mm	✓

Comb #14	X	0	203.8	0.02 mm	200 mm	✓
	Y	-14.67	203.8	71.97 mm	200 mm	✓
Comb #15	X	0	168.21	0.01 mm	200 mm	✓
	Y	-14.56	168.21	86.59 mm	200 mm	✓

Punching Check

Punching force will be calculated according to EN 1992-1-1:2004 (6.4.3)

$$V_{pd} = \sigma_{soil} * A_{eff} * \beta$$

$$\sigma_{soil} = \Sigma N / L_x L_y$$

$$A_{eff} = L_x L_y - B_x B_y$$

$$\beta = 1.166$$

Punching capacity will be calculated according to EN 1992-1-1:2004 (6.4.4)

$$(6.47) \quad v_{Rd,c1} = C_{Rd,c} k (100 \rho_l f_{ck})^{1/3} + k_1 \sigma_{cp}$$

$$k = 1 + (200/d)^{1/2}$$

$$k = 1.78,$$

$$\rho_l = (\rho_{lx} \rho_{ly})^{1/2} * \rho_f, \rho_{lmin} = 0.02$$

$$\rho_{lx} = 0.0031, \rho_{ly} = 0.0031, \rho_f = 1,$$

$$\rho_l = 0.0031,$$

$$\sigma_{cp} = \Sigma N / L_x L_y = 0.12 \text{ N/mm}^2$$

$$C_{Rd,c} = 0.12, k_1 = 0.10$$

$$v_{Rd,c1} = 0.44 \text{ N/mm}^2$$

$$v_{min} = 0.035 k^{3/2} f_{ck}^{1/2} + k_1 \sigma_{cp}$$

$$v_{min} = 0.43 \text{ N/mm}^2$$

$$v_{Rd,c} = \text{Max}(v_{Rd,c1}, v_{min}) = 0.44 \text{ N/mm}^2$$

$$v_{Rdmax} = 0.5 (0.6 (1 - (f_{ck} / 250))) f_{cd}$$

$$V_{pc-cf} = v_{Rdmax} u_p d,$$

$$V_{pc-ep} = v_{Rd,c} u_p d,$$

$$u_p = 2(B_{EPx} + B_{EPy}) = 9293.80460547705$$

$$B_{EPx} = B_x + 2d_{sect} = 1570$$

$$B_{EPy} = B_y + 2d_{sect} = 1570$$

$$d_{sect} = 2d_{eff} = 660$$

$$V_{pc-cf} = 1485 \text{ kN}$$

$$V_{pc-ep} = 1620 \text{ kN}$$

Comb	ΣN (kN)	σ_{soil} (kN/m ²)	Vpc-cf (kN)	Vpd-cf (kN)	D/C-cf	Vpc-ep (kN)	Vpd-ep (kN)	D/C-ep
Comb #1	199.86	138.79	1485.00	222.90	0.15	1628.67	165.85	0.10
Comb #2	197.98	137.49	1485.00	220.81	0.15	1628.67	164.29	0.10
Comb #3	175.27	121.71	1485.00	195.48	0.13	1628.67	145.44	0.09
Comb #4	207.29	143.95	1485.00	231.20	0.16	1628.67	172.02	0.11
Comb #5	203.80	141.53	1485.00	227.30	0.15	1628.67	169.12	0.10
Comb #6	168.21	116.81	1485.00	187.61	0.13	1628.67	139.58	0.09
Comb #7	192.42	133.62	1485.00	214.61	0.14	1628.67	159.68	0.10
Comb #8	180.04	125.02	1485.00	200.80	0.14	1628.67	149.40	0.09
Comb #9	144.64	100.44	1485.00	161.32	0.11	1628.67	120.03	0.07
Comb #10	192.42	133.62	1485.00	214.61	0.14	1628.67	159.68	0.10
Comb #11	180.04	125.02	1485.00	200.80	0.14	1628.67	149.40	0.09
Comb #12	144.64	100.44	1485.00	161.32	0.11	1628.67	120.03	0.07
Comb #13	207.29	143.95	1485.00	231.20	0.16	1628.67	172.02	0.11
Comb #14	203.80	141.53	1485.00	227.30	0.15	1628.67	169.12	0.10
Comb #15	168.21	116.81	1485.00	187.61	0.13	1628.67	139.58	0.09

Comparison at	Demand / Capacity	Status
Effective Perimeter	172.0 kN / 1628.7 kN	✓
Column Face	231.2 kN / 1485.0 kN	✓

Shear Check

Shear capacity is calculated according to EC-2,

$$(6.2.a) \quad V_{rdc1} = 0.12 k (100 \rho f_{ck})^{1/3} + (0.15 * 0.2 * f_{cd} * d_y * d = 142.2 \text{ kN}$$

$$(6.3N) \quad V_{rdc2} = 0.035 (k^{1.5}) (f_{ck}^{0.5}) + (0.15 * 0.2 * f_{cd} * d_y * d = 139.56 \text{ kN}$$

$$V_{rdc} = \text{Max}(V_{rdc1}, V_{rdc2}) = 142.2 \text{ kN}$$

$$V_{dx-cf} = \sigma_{cf} d_{vx1} L_y + ((\sigma_{max} - \sigma_{cf}) d_{vx1} L_y / 2)$$

$$V_{dy-cf} = \sigma_{cf} d_{vy1} L_x + ((\sigma_{max} - \sigma_{cf}) d_{vy1} L_x / 2)$$

$$V_{dx-d} = \sigma_{cf} d_{vx2} L_y + ((\sigma_{max} - \sigma_{cf}) d_{vx2} L_y / 2)$$

$$V_{dy-d} = \sigma_{cf} d_{vy2} L_x + ((\sigma_{max} - \sigma_{cf}) d_{vy2} L_x / 2)$$

On Column Face,

Comb	Demand (kN)	X-Direction Capacity (kN)	Status (kN)	Demand (kN)	Y-Direction Capacity (kN)	Status (kN)
Comb #1	79.12	133.58	✓	79.12	133.58	✓
Comb #2	78.38	133.58	✓	78.38	133.58	✓

Comb #3	69.39	133.58	✓	69.39	133.58	✓
Comb #4	100.08	133.58	✓	92.95	133.58	✓
Comb #5	109.70	133.58	✓	98.21	133.58	✓
Comb #6	95.41	133.58	✓	84.00	133.58	✓
Comb #7	94.17	133.58	✓	87.05	133.58	✓
Comb #8	100.28	133.58	✓	88.80	133.58	✓
Comb #9	86.07	133.58	✓	74.67	133.58	✓
Comb #10	87.05	133.58	✓	94.17	133.58	✓
Comb #11	88.80	133.58	✓	100.28	133.58	✓
Comb #12	74.67	133.58	✓	86.07	133.58	✓
Comb #13	92.95	133.58	✓	100.08	133.58	✓
Comb #14	98.21	133.58	✓	109.70	133.58	✓
Comb #15	84.00	133.58	✓	95.41	133.58	✓

**On "d" Distance Away
From Column Face,**

Comb	Demand (kN)	X-Direction Capacity (kN)	Status (kN)	Demand (kN)	Y-Direction Capacity (kN)	Status (kN)
Comb #1	50.80	142.20	✓	52.47	142.20	✓
Comb #2	50.33	142.20	✓	51.98	142.20	✓
Comb #3	44.55	142.20	✓	46.01	142.20	✓
Comb #4	64.26	142.20	✓	63.23	142.20	✓
Comb #5	70.44	142.20	✓	67.70	142.20	✓
Comb #6	61.26	142.20	✓	58.26	142.20	✓
Comb #7	60.47	142.20	✓	59.32	142.20	✓
Comb #8	64.39	142.20	✓	61.45	142.20	✓
Comb #9	55.27	142.20	✓	52.06	142.20	✓
Comb #10	57.53	142.20	✓	62.45	142.20	✓
Comb #11	59.66	142.20	✓	66.50	142.20	✓
Comb #12	50.57	142.20	✓	57.08	142.20	✓
Comb #13	61.32	142.20	✓	66.37	142.20	✓
Comb #14	65.70	142.20	✓	72.75	142.20	✓
Comb #15	56.56	142.20	✓	63.27	142.20	✓

Comparison at

Column Face in X-Direction	Demand / Capacity	Status
Column Face in Y-Direction	109.7 kN / 133.6 kN	✓
Effective Perimeter in X-Direction	109.7 kN / 133.6 kN	✓
Effective Perimeter in Y-Direction	70.4 kN / 142.2 kN	✓
	72.8 kN / 142.2 kN	✓

Bending Reinforcement Check

Comb	Md _x (kN.m)	Required As _x (mm ²)	Md _y (kN.m)	Required As _y (mm ²)
Comb #1	187.91	712.43	187.91	712.43
Comb #2	186.15	712.43	186.15	712.43
Comb #3	164.80	712.43	164.79	712.43
Comb #4	237.68	712.43	226.39	712.43
Comb #5	260.55	712.43	242.36	712.43
Comb #6	226.60	712.43	208.54	712.43
Comb #7	223.67	712.43	212.39	712.43
Comb #8	238.18	712.43	220.00	712.43
Comb #9	204.42	712.43	186.37	712.43
Comb #10	212.39	712.43	223.67	712.43
Comb #11	220.00	712.43	238.18	712.43
Comb #12	186.37	712.43	204.42	712.43
Comb #13	226.39	712.43	237.68	712.43
Comb #14	242.36	712.43	260.55	712.43
Comb #15	208.54	712.43	226.60	712.43

Comparison of	Design Moment	Selected Rebar	Required / Provided	Status
Reinforcement Area in X-Direction	26.1 kN.m	6φ20 / 250.0 mm	712.43 mm ² /1507.96 mm ²	✓
Reinforcement Area in Y-Direction	26.1 kN.m	6φ20 / 250.0 mm	712.43 mm ² /1507.96 mm ²	✓

F-1C4 Design Summary

Geometric Properties and Materials

Footing Materials

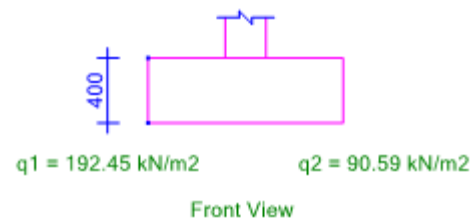
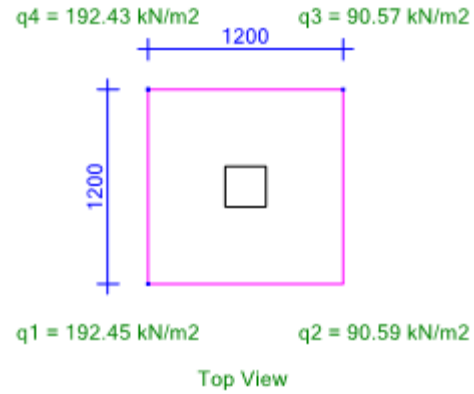
Concrete Material	C25/30
Rebar Material	Grade 410 (Type 2)

Geometric Properties

B _x	1200.00 mm
B _y	1200.00 mm
Height	400.00 mm
Taper Height	0.00 mm

Corner Stresses

Lower-Left Corner	192.45 kN/m ²
Lower-Right Corner	90.59 kN/m ²
Upper-Right Corner	90.57 kN/m ²
Upper-Left Corner	192.43 kN/m ²



Loading Info

Combinations	N	Vx	Vy	Mx	My
Comb #1	167.9 kN	0.0 kN	0.0 kN	0.0 kN.m	0.0 kN.m
Comb #2	167.5 kN	0.0 kN	0.0 kN	0.0 kN.m	0.0 kN.m
Comb #3	141.7 kN	0.0 kN	0.0 kN	0.0 kN.m	0.0 kN.m
Comb #4	160.4 kN	-6.7 kN	0.0 kN	11.8 kN.m	0.0 kN.m
Comb #5	148.0 kN	-10.8 kN	0.0 kN	19.0 kN.m	0.0 kN.m
Comb #6	112.7 kN	-10.8 kN	0.0 kN	18.9 kN.m	0.0 kN.m
Comb #7	175.3 kN	6.7 kN	0.0 kN	-11.8 kN.m	0.0 kN.m
Comb #8	171.8 kN	10.8 kN	0.0 kN	-19.0 kN.m	0.0 kN.m
Comb #9	136.2 kN	10.8 kN	0.0 kN	-18.9 kN.m	0.0 kN.m
Comb #10	160.4 kN	0.0 kN	-6.7 kN	0.0 kN.m	11.8 kN.m
Comb #11	148.0 kN	0.0 kN	-10.8 kN	0.0 kN.m	19.0 kN.m
Comb #12	112.7 kN	0.0 kN	-10.8 kN	0.0 kN.m	18.9 kN.m
Comb #13	175.3 kN	0.0 kN	6.7 kN	0.0 kN.m	-11.8 kN.m
Comb #14	171.8 kN	0.0 kN	10.8 kN	0.0 kN.m	-19.0 kN.m
Comb #15	136.2 kN	0.0 kN	10.8 kN	0.0 kN.m	-18.9 kN.m

Soil Stress Check

Total footing, soil and pedestal weight is calculated.

Member	Volume (m3)	Unit Weight (kN/m3)	Weight (kN)
Pad Footing	: 0.576	24	13.824
Soil	: 1.008	18	18.144
Total	:		31.968

In order to calculate total axial load, weights are added to axial loads,

$$\Sigma N = N + TW$$

Total moments are calculated using the equation below,

$$\Sigma M_x = M_x + V_x (h - h_{taper}) + Ecc_1 N$$

$$\Sigma M_y = M_y + V_y (h - h_{taper}) + Ecc_2 N$$

Corner stresses,

$$\sigma_1 = \Sigma N / L_x L_y - 6 \Sigma M_x / (L_x L_y^2) - 6 \Sigma M_y / (L_x^2 L_y)$$

$$\sigma_2 = \Sigma N / L_x L_y + 6 \Sigma M_x / (L_x L_y^2) - 6 \Sigma M_y / (L_x^2 L_y)$$

$$\sigma_3 = \Sigma N / L_x L_y + 6 \Sigma M_x / (L_x L_y^2) + 6 \Sigma M_y / (L_x^2 L_y)$$

$$\sigma_4 = \Sigma N / L_x L_y - 6 \Sigma M_x / (L_x L_y^2) + 6 \Sigma M_y / (L_x^2 L_y)$$

Comb	ΣN (kN)	ΣM_x (kN.m)	ΣM_y (kN.m)	σ_1 (kN/m ²)	σ_2 (kN/m ²)	σ_3 (kN/m ²)	σ_4 (kN/m ²)
Comb #1	199.83	0.00	0.00	138.80	138.77	138.75	138.77
Comb #2	199.50	-0.01	-0.01	138.58	138.54	138.50	138.54
Comb #3	173.71	0.00	0.00	120.63	120.63	120.63	120.63
Comb #4	192.40	9.10	0.00	102.03	165.21	165.18	102.01
Comb #5	180.01	14.66	0.00	74.11	175.93	175.90	74.09
Comb #6	144.62	14.56	0.00	49.88	150.99	150.98	49.87
Comb #7	207.27	-9.10	0.00	175.56	112.34	112.31	175.54
Comb #8	203.78	-14.67	0.00	192.45	90.59	90.57	192.43
Comb #9	168.19	-14.56	0.00	167.38	66.23	66.22	167.36
Comb #10	192.40	0.00	9.10	102.03	102.01	165.18	165.21
Comb #11	180.01	0.00	14.66	74.11	74.09	175.90	175.93
Comb #12	144.62	0.00	14.56	49.88	49.87	150.98	150.99
Comb #13	207.27	0.00	-9.10	175.56	175.54	112.31	112.34
Comb #14	203.78	0.00	-14.67	192.45	192.43	90.57	90.59
Comb #15	168.19	0.00	-14.56	167.38	167.36	66.22	66.23

Demand	Capacity	Status
Maximum Soil Stress: 192.45 kN/m ²	Allowable Maximum Soil Stress: 250.00 kN/m ²	✓

Eccentricity Check

Comb	Direction	Moment (kN.m)	Axial Load (kN)	Eccentricity (M/N)	Limit (L/6)	Status
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Comb #1	X	0	199.83	0.02 mm	200 mm	✓
	Y	0	199.83	0.02 mm	200 mm	✓
Comb #2	X	-0.01	199.5	0.03 mm	200 mm	✓
	Y	-0.01	199.5	0.03 mm	200 mm	✓
Comb #3	X	0	173.71	0 mm	200 mm	✓
	Y	0	173.71	0 mm	200 mm	✓
Comb #4	X	9.1	192.4	47.28 mm	200 mm	✓
	Y	0	192.4	0.02 mm	200 mm	✓
Comb #5	X	14.66	180.01	81.44 mm	200 mm	✓
	Y	0	180.01	0.02 mm	200 mm	✓
Comb #6	X	14.56	144.62	100.68 mm	200 mm	✓
	Y	0	144.62	0.02 mm	200 mm	✓
Comb #7	X	-9.1	207.27	43.92 mm	200 mm	✓
	Y	0	207.27	0.02 mm	200 mm	✓
Comb #8	X	-14.67	203.78	71.98 mm	200 mm	✓
	Y	0	203.78	0.02 mm	200 mm	✓
Comb #9	X	-14.56	168.19	86.6 mm	200 mm	✓
	Y	0	168.19	0.01 mm	200 mm	✓
Comb #10	X	0	192.4	0.02 mm	200 mm	✓
	Y	9.1	192.4	47.28 mm	200 mm	✓
Comb #11	X	0	180.01	0.02 mm	200 mm	✓
	Y	14.66	180.01	81.44 mm	200 mm	✓
Comb #12	X	0	144.62	0.02 mm	200 mm	✓
	Y	14.56	144.62	100.68 mm	200 mm	✓
Comb #13	X	0	207.27	0.02 mm	200 mm	✓
	Y	-9.1	207.27	43.92 mm	200 mm	✓
Comb #14	X	0	203.78	0.02 mm	200 mm	✓
	Y	-14.67	203.78	71.98 mm	200 mm	✓
Comb #15	X	0	168.19	0.01 mm	200 mm	✓
	Y	-14.56	168.19	86.6 mm	200 mm	✓

Punching Check

Punching force will be calculated according to EN 1992-1-1:2004 (6.4.3)

$$V_{pd} = \sigma_{soil} * A_{eff} * \beta$$

$$\sigma_{soil} = \Sigma N / L_x L_y$$

$$A_{eff} = L_x L_y - B_x B_y$$

$$\beta = 1.166$$

Punching capacity will be calculated according to EN 1992-1-1:2004 (6.4.4)

$$(6.47) v_{Rd,c1} = C_{Rd,c} k (100 \rho_l f_{ck})^{1/3} + k_1 \sigma_{cp}$$

$$k = 1 + (200/d)^{1/2}$$

$$k = 1.78,$$

$$\rho_l = (\rho_{lx} \rho_{ly})^{1/2} * \rho_f, \rho_{lmin} = 0.02$$

$$\rho_{lx} = 0.0031, \rho_{ly} = 0.0031, \rho_f = 1,$$

$$\rho_l = 0.0031,$$

$$\sigma_{cp} = \Sigma N / L_x L_y = 0.12 \text{ N/mm}^2$$

$$C_{Rd,c} = 0.12, k_1 = 0.10$$

$$v_{Rd,c1} = 0.44 \text{ N/mm}^2$$

$$v_{min} = 0.035 k^{3/2} f_{ck}^{1/2} + k_1 \sigma_{cp}$$

$$v_{min} = 0.43 \text{ N/mm}^2$$

$$v_{Rd,c} = \text{Max}(v_{Rd,c1}, v_{min}) = 0.44 \text{ N/mm}^2$$

$$v_{Rdmax} = 0.5 (0.6 (1 - (f_{ck} / 250))) f_{cd}$$

$$V_{pc-cf} = v_{Rdmax} u_p d,$$

$$V_{pc-ep} = v_{Rd,c} u_p d,$$

$$u_p = 2(B_{EPx} + B_{EPy}) = 9293.80460547705$$

$$B_{EPx} = B_x + 2d_{sect} = 1570$$

$$B_{EPy} = B_y + 2d_{sect} = 1570$$

$$d_{sect} = 2d_{eff} = 660$$

$$V_{pc-cf} = 1485 \text{ kN}$$

$$V_{pc-ep} = 1620 \text{ kN}$$

Comb	ΣN (kN)	σ _{soil} (kN/m2)	V _{pc-cf} (kN)	V _{pd-cf} (kN)	D/C-cf	V _{pc-ep} (kN)	V _{pd-ep} (kN)	D/C-ep
Comb #1	199.83	138.77	1485.00	222.88	0.15	1628.66	165.83	0.10
Comb #2	199.50	138.54	1485.00	222.51	0.15	1628.66	165.55	0.10
Comb #3	173.71	120.63	1485.00	193.74	0.13	1628.66	144.15	0.09
Comb #4	192.40	133.61	1485.00	214.58	0.14	1628.66	159.66	0.10
Comb #5	180.01	125.01	1485.00	200.77	0.14	1628.66	149.38	0.09
Comb #6	144.62	100.43	1485.00	161.30	0.11	1628.66	120.01	0.07
Comb #7	207.27	143.94	1485.00	231.17	0.16	1628.66	172.00	0.11
Comb #8	203.78	141.51	1485.00	227.28	0.15	1628.66	169.10	0.10
Comb #9	168.19	116.80	1485.00	187.58	0.13	1628.66	139.57	0.09

Comb #10	192.40	133.61	1485.00	214.58	0.14	1628.66	159.66	0.10
Comb #11	180.01	125.01	1485.00	200.77	0.14	1628.66	149.38	0.09
Comb #12	144.62	100.43	1485.00	161.30	0.11	1628.66	120.01	0.07
Comb #13	207.27	143.94	1485.00	231.17	0.16	1628.66	172.00	0.11
Comb #14	203.78	141.51	1485.00	227.28	0.15	1628.66	169.10	0.10
Comb #15	168.19	116.80	1485.00	187.58	0.13	1628.66	139.57	0.09

Comparison at	Demand / Capacity	Status
Effective Perimeter	172.0 kN / 1628.7 kN	✓
Column Face	231.2 kN / 1485.0 kN	✓

Shear Check

Shear capacity is calculated according to EC-2,

$$(6.2.a) \quad V_{rdc1} = 0.12 k (100 \rho f_{ck})^{1/3} + (0.15 * 0.2 * f_{cd} * d_y * d = 142.2 \text{ kN}$$

$$(6.3N) \quad V_{rdc2} = 0.035 (k^{1.5}) (f_{ck}^{0.5}) + (0.15 * 0.2 * f_{cd} * d_y * d = 139.56 \text{ kN}$$

$$V_{rdc} = \text{Max}(V_{rdc1}, V_{rdc2}) = 142.2 \text{ kN}$$

$$V_{dx-cf} = \sigma_{cf} d_{vx1} L_y + ((\sigma_{max} - \sigma_{cf}) d_{vx1} L_y / 2)$$

$$V_{dy-cf} = \sigma_{cf} d_{vy1} L_x + ((\sigma_{max} - \sigma_{cf}) d_{vy1} L_x / 2)$$

$$V_{dx-d} = \sigma_{cf} d_{vx2} L_y + ((\sigma_{max} - \sigma_{cf}) d_{vx2} L_y / 2)$$

$$V_{dy-d} = \sigma_{cf} d_{vy2} L_x + ((\sigma_{max} - \sigma_{cf}) d_{vy2} L_x / 2)$$

On Column Face,

Comb	Demand (kN)	X-Direction Capacity (kN)	Status (kN)	Demand (kN)	Y-Direction Capacity (kN)	Status (kN)
Comb #1	79.11	133.58	✓	79.11	133.58	✓
Comb #2	78.99	133.58	✓	78.99	133.58	✓
Comb #3	68.76	133.58	✓	68.76	133.58	✓
Comb #4	94.17	133.58	✓	87.04	133.58	✓
Comb #5	100.28	133.58	✓	88.79	133.58	✓
Comb #6	86.07	133.58	✓	74.66	133.58	✓
Comb #7	100.07	133.58	✓	92.94	133.58	✓
Comb #8	109.69	133.58	✓	98.21	133.58	✓
Comb #9	95.40	133.58	✓	83.99	133.58	✓
Comb #10	87.04	133.58	✓	94.17	133.58	✓
Comb #11	88.79	133.58	✓	100.28	133.58	✓
Comb #12	74.66	133.58	✓	86.07	133.58	✓
Comb #13	92.94	133.58	✓	100.07	133.58	✓
Comb #14	98.21	133.58	✓	109.69	133.58	✓

Comb #15	83.99	133.58	✓	95.40	133.58	✓
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**On "d" Distance Away
From Column Face,**

Comb	Demand (kN)	X-Direction Capacity (kN)	Status (kN)	Demand (kN)	Y-Direction Capacity (kN)	Status (kN)
Comb #1	50.80	142.20	✓	52.46	142.20	✓
Comb #2	50.72	142.20	✓	52.38	142.20	✓
Comb #3	44.15	142.20	✓	45.60	142.20	✓
Comb #4	60.46	142.20	✓	59.31	142.20	✓
Comb #5	64.39	142.20	✓	61.45	142.20	✓
Comb #6	55.26	142.20	✓	52.06	142.20	✓
Comb #7	64.25	142.20	✓	63.23	142.20	✓
Comb #8	70.44	142.20	✓	67.69	142.20	✓
Comb #9	61.26	142.20	✓	58.25	142.20	✓
Comb #10	57.53	142.20	✓	62.45	142.20	✓
Comb #11	59.65	142.20	✓	66.50	142.20	✓
Comb #12	50.56	142.20	✓	57.08	142.20	✓
Comb #13	61.31	142.20	✓	66.36	142.20	✓
Comb #14	65.70	142.20	✓	72.75	142.20	✓
Comb #15	56.56	142.20	✓	63.27	142.20	✓

Comparison at	Demand / Capacity	Status
Column Face in X-Direction	109.7 kN / 133.6 kN	✓
Column Face in Y-Direction	109.7 kN / 133.6 kN	✓
Effective Perimeter in X-Direction	70.4 kN / 142.2 kN	✓
Effective Perimeter in Y-Direction	72.7 kN / 142.2 kN	✓

Bending Reinforcement Check

Comb	Md _x (kN.m)	Required As _x (mm ²)	Md _y (kN.m)	Required As _y (mm ²)
Comb #1	187.89	712.43	187.89	712.43
Comb #2	187.60	712.43	187.60	712.43
Comb #3	163.31	712.43	163.31	712.43
Comb #4	223.65	712.43	212.37	712.43
Comb #5	238.16	712.43	219.97	712.43
Comb #6	204.41	712.43	186.35	712.43
Comb #7	237.66	712.43	226.37	712.43
Comb #8	260.53	712.43	242.34	712.43
Comb #9	226.58	712.43	208.52	712.43
Comb #10	212.37	712.43	223.65	712.43
Comb #11	219.97	712.43	238.16	712.43
Comb #12	186.35	712.43	204.41	712.43
Comb #13	226.37	712.43	237.66	712.43
Comb #14	242.34	712.43	260.53	712.43

Comb #15	208.52	712.43	226.58	712.43
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Comparison of	Design Moment	Selected Rebar	Required / Provided	Status
Reinforcement Area in X-Direction	26.1 kN.m	6 ϕ 20 / 250.0 mm	712.43 mm ² /1507.96 mm ²	✓
Reinforcement Area in Y-Direction	26.1 kN.m	6 ϕ 20 / 250.0 mm	712.43 mm ² /1507.96 mm ²	✓

F-1C1 Design Summary

Geometric Properties and Materials

Footing Materials

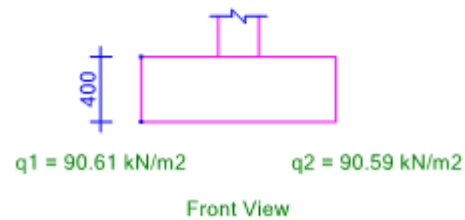
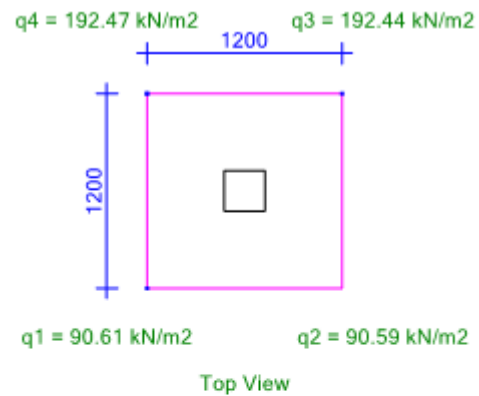
Concrete Material	C25/30
Rebar Material	Grade 410 (Type 2)

Geometric Properties

B _x	1200.00 mm
B _y	1200.00 mm
Height	400.00 mm
Taper Height	0.00 mm

Corner Stresses

Lower-Left Corner	90.61 kN/m ²
Lower-Right Corner	90.59 kN/m ²
Upper-Right Corner	192.44 kN/m ²
Upper-Left Corner	192.47 kN/m ²



Loading Info

Combinations	N	V _x	V _y	M _x	M _y
Comb #1	167.9 kN	0.0 kN	0.0 kN	0.0 kN.m	0.0 kN.m
Comb #2	166.0 kN	0.0 kN	0.0 kN	0.0 kN.m	0.0 kN.m
Comb #3	143.3 kN	0.0 kN	0.0 kN	0.0 kN.m	0.0 kN.m
Comb #4	160.5 kN	-6.7 kN	0.0 kN	11.8 kN.m	0.0 kN.m
Comb #5	148.1 kN	-10.8 kN	0.0 kN	19.0 kN.m	0.0 kN.m

Comb #6	112.7 kN	-10.8 kN	0.0 kN	18.9 kN.m	0.0 kN.m
Comb #7	175.3 kN	6.7 kN	0.0 kN	-11.8 kN.m	0.0 kN.m
Comb #8	171.8 kN	10.8 kN	0.0 kN	-19.0 kN.m	0.0 kN.m
Comb #9	136.2 kN	10.8 kN	0.0 kN	-18.9 kN.m	0.0 kN.m
Comb #10	175.3 kN	0.0 kN	-6.7 kN	0.0 kN.m	11.8 kN.m
Comb #11	171.8 kN	0.0 kN	-10.8 kN	0.0 kN.m	19.0 kN.m
Comb #12	136.2 kN	0.0 kN	-10.8 kN	0.0 kN.m	18.9 kN.m
Comb #13	160.5 kN	0.0 kN	6.7 kN	0.0 kN.m	-11.8 kN.m
Comb #14	148.1 kN	0.0 kN	10.8 kN	0.0 kN.m	-19.0 kN.m
Comb #15	112.7 kN	0.0 kN	10.8 kN	0.0 kN.m	-18.9 kN.m

Soil Stress Check

Total footing, soil and pedestal weight is calculated.

Member	Volume (m3)	Unit Weight (kN/m3)	Weight (kN)
Pad Footing	: 0.576	24	13.824
Soil	: 1.008	18	18.144
Total	:		31.968

In order to calculate total axial load, weights are added to axial loads,

$$\Sigma N = N + TW$$

Total moments are calculated using the equation below,

$$\Sigma M_x = M_x + V_x (h - h_{taper}) + Ecc_1 N$$

$$\Sigma M_y = M_y + V_y (h - h_{taper}) + Ecc_2 N$$

Corner stresses,

$$\sigma_1 = \Sigma N / L_x L_y - 6 \Sigma M_x / (L_x L_y^2) - 6 \Sigma M_y / (L_x^2 L_y)$$

$$\sigma_2 = \Sigma N / L_x L_y + 6 \Sigma M_x / (L_x L_y^2) - 6 \Sigma M_y / (L_x^2 L_y)$$

$$\sigma_3 = \Sigma N / L_x L_y + 6 \Sigma M_x / (L_x L_y^2) + 6 \Sigma M_y / (L_x^2 L_y)$$

$$\sigma_4 = \Sigma N / L_x L_y - 6 \Sigma M_x / (L_x L_y^2) + 6 \Sigma M_y / (L_x^2 L_y)$$

Comb	ΣN (kN)	ΣM_x (kN.m)	ΣM_y (kN.m)	σ_1 (kN/m ²)	σ_2 (kN/m ²)	σ_3 (kN/m ²)	σ_4 (kN/m ²)
Comb #1	199.86	0.00	0.00	138.79	138.77	138.79	138.81
Comb #2	197.98	-0.01	0.00	137.50	137.47	137.47	137.51
Comb #3	175.27	0.00	0.01	121.70	121.69	121.73	121.74
Comb #4	192.42	9.10	0.00	102.02	165.20	165.22	102.05
Comb #5	180.04	14.66	0.00	74.11	175.92	175.94	74.13
Comb #6	144.64	14.56	0.00	49.88	150.99	151.01	49.90
Comb #7	207.29	-9.10	0.00	175.55	112.33	112.35	175.58
Comb #8	203.80	-14.67	0.00	192.44	90.59	90.61	192.47
Comb #9	168.21	-14.56	0.00	167.37	66.23	66.25	167.39
Comb #10	207.29	0.00	9.10	112.35	112.33	175.55	175.58

Comb #11	203.80	0.00	14.67	90.61	90.59	192.44	192.47
Comb #12	168.21	0.00	14.56	66.25	66.23	167.37	167.39
Comb #13	192.42	0.00	-9.10	165.22	165.20	102.02	102.05
Comb #14	180.04	0.00	-14.66	175.94	175.92	74.11	74.13
Comb #15	144.64	0.00	-14.56	151.01	150.99	49.88	49.90

Demand	Capacity	Status
Maximum Soil Stress: 192.47 kN/m2	Allowable Maximum Soil Stress: 250.00 kN/m2	✓

Eccentricity Check

Comb	Direction	Moment (kN.m)	Axial Load (kN)	Eccentricity (M/N)	Limit (L/6)	Status
Comb #1	X	0	199.86	0.02 mm	200 mm	✓
	Y	0	199.86	0.02 mm	200 mm	✓
Comb #2	X	-0.01	197.98	0.03 mm	200 mm	✓
	Y	0	197.98	0.01 mm	200 mm	✓
Comb #3	X	0	175.27	0.01 mm	200 mm	✓
	Y	0.01	175.27	0.03 mm	200 mm	✓
Comb #4	X	9.1	192.42	47.28 mm	200 mm	✓
	Y	0	192.42	0.02 mm	200 mm	✓
Comb #5	X	14.66	180.04	81.43 mm	200 mm	✓
	Y	0	180.04	0.02 mm	200 mm	✓
Comb #6	X	14.56	144.64	100.66 mm	200 mm	✓
	Y	0	144.64	0.02 mm	200 mm	✓
Comb #7	X	-9.1	207.29	43.92 mm	200 mm	✓
	Y	0	207.29	0.02 mm	200 mm	✓
Comb #8	X	-14.67	203.8	71.97 mm	200 mm	✓
	Y	0	203.8	0.02 mm	200 mm	✓
Comb #9	X	-14.56	168.21	86.59 mm	200 mm	✓
	Y	0	168.21	0.01 mm	200 mm	✓
Comb #10	X	0	207.29	0.02 mm	200 mm	✓
	Y	9.1	207.29	43.92 mm	200 mm	✓
Comb #11	X	0	203.8	0.02 mm	200 mm	✓
	Y	14.67	203.8	71.97 mm	200 mm	✓
Comb #12	X	0	168.21	0.01 mm	200 mm	✓
	Y	14.56	168.21	86.59 mm	200 mm	✓
Comb #13	X	0	192.42	0.02 mm	200 mm	✓
	Y	-9.1	192.42	47.28 mm	200 mm	✓

Comb #14	X	0	180.04	0.02 mm	200 mm	✓
	Y	-14.66	180.04	81.43 mm	200 mm	✓
Comb #15	X	0	144.64	0.02 mm	200 mm	✓
	Y	-14.56	144.64	100.66 mm	200 mm	✓

Punching Check

Punching force will be calculated according to EN 1992-1-1:2004 (6.4.3)

$$V_{pd} = \sigma_{soil} * A_{eff} * \beta$$

$$\sigma_{soil} = \Sigma N / L_x L_y$$

$$A_{eff} = L_x L_y - B_x B_y$$

$$\beta = 1.166$$

Punching capacity will be calculated according to EN 1992-1-1:2004 (6.4.4)

$$(6.47) \quad v_{Rd,c1} = C_{Rd,c} k (100 \rho_l f_{ck})^{1/3} + k_1 \sigma_{cp}$$

$$k = 1 + (200/d)^{1/2}$$

$$k = 1.78,$$

$$\rho_l = (\rho_{lx} \rho_{ly})^{1/2} * \rho_f, \rho_{lmin} = 0.02$$

$$\rho_{lx} = 0.0031, \rho_{ly} = 0.0031, \rho_f = 1,$$

$$\rho_l = 0.0031,$$

$$\sigma_{cp} = \Sigma N / L_x L_y = 0.1 \text{ N/mm}^2$$

$$C_{Rd,c} = 0.12, k_1 = 0.10$$

$$v_{Rd,c1} = 0.43 \text{ N/mm}^2$$

$$v_{min} = 0.035 k^{3/2} f_{ck}^{1/2} + k_1 \sigma_{cp}$$

$$v_{min} = 0.43 \text{ N/mm}^2$$

$$v_{Rd,c} = \text{Max}(v_{Rd,c1}, v_{min}) = 0.43 \text{ N/mm}^2$$

$$v_{Rdmax} = 0.5 (0.6 (1 - (f_{ck} / 250))) f_{cd}$$

$$V_{pc-cf} = v_{Rdmax} u_p d,$$

$$V_{pc-ep} = v_{Rd,c} u_p d,$$

$$u_p = 2(B_{EPx} + B_{EPy}) = 9293.80460547705$$

$$B_{EPx} = B_x + 2d_{sect} = 1570$$

$$B_{EPy} = B_y + 2d_{sect} = 1570$$

$$d_{sect} = 2d_{eff} = 660$$

$$V_{pc-cf} = 1485 \text{ kN}$$

$$V_{pc-ep} = 1614 \text{ kN}$$

Comb	ΣN (kN)	σ_{soil} (kN/m ²)	Vpc-cf (kN)	Vpd-cf (kN)	D/C-cf	Vpc-ep (kN)	Vpd-ep (kN)	D/C-ep
Comb #1	199.86	138.79	1485.00	222.90	0.15	1628.67	165.85	0.10
Comb #2	197.98	137.49	1485.00	220.81	0.15	1628.67	164.29	0.10
Comb #3	175.27	121.71	1485.00	195.48	0.13	1628.67	145.44	0.09
Comb #4	192.42	133.62	1485.00	214.61	0.14	1628.67	159.68	0.10
Comb #5	180.04	125.02	1485.00	200.80	0.14	1628.67	149.40	0.09
Comb #6	144.64	100.44	1485.00	161.32	0.11	1628.67	120.03	0.07
Comb #7	207.29	143.95	1485.00	231.20	0.16	1628.67	172.02	0.11
Comb #8	203.80	141.53	1485.00	227.30	0.15	1628.67	169.12	0.10
Comb #9	168.21	116.81	1485.00	187.61	0.13	1628.67	139.58	0.09
Comb #10	207.29	143.95	1485.00	231.20	0.16	1628.67	172.02	0.11
Comb #11	203.80	141.53	1485.00	227.30	0.15	1628.67	169.12	0.10
Comb #12	168.21	116.81	1485.00	187.61	0.13	1628.67	139.58	0.09
Comb #13	192.42	133.62	1485.00	214.61	0.14	1628.67	159.68	0.10
Comb #14	180.04	125.02	1485.00	200.80	0.14	1628.67	149.40	0.09
Comb #15	144.64	100.44	1485.00	161.32	0.11	1628.67	120.03	0.07

Comparison at	Demand / Capacity	Status
Effective Perimeter	172.0 kN / 1628.7 kN	✓
Column Face	231.2 kN / 1485.0 kN	✓

Shear Check

Shear capacity is calculated according to EC-2,

$$(6.2.a) \quad V_{rdc1} = 0.12 k (100 \rho f_{ck})^{1/3} + (0.15 * 0.2 * f_{cd} * d_y * d = 142.2 \text{ kN}$$

$$(6.3N) \quad V_{rdc2} = 0.035 (k^{1.5}) (f_{ck}^{0.5}) + (0.15 * 0.2 * f_{cd} * d_y * d = 139.56 \text{ kN}$$

$$V_{rdc} = \text{Max}(V_{rdc1}, V_{rdc2}) = 142.2 \text{ kN}$$

$$V_{dx-cf} = \sigma_{cf} d_{vx1} L_y + ((\sigma_{max} - \sigma_{cf}) d_{vx1} L_y / 2)$$

$$V_{dy-cf} = \sigma_{cf} d_{vy1} L_x + ((\sigma_{max} - \sigma_{cf}) d_{vy1} L_x / 2)$$

$$V_{dx-d} = \sigma_{cf} d_{vx2} L_y + ((\sigma_{max} - \sigma_{cf}) d_{vx2} L_y / 2)$$

$$V_{dy-d} = \sigma_{cf} d_{vy2} L_x + ((\sigma_{max} - \sigma_{cf}) d_{vy2} L_x / 2)$$

On Column Face,

Comb	Demand (kN)	X-Direction Capacity (kN)	Status (kN)	Demand (kN)	Y-Direction Capacity (kN)	Status (kN)
Comb #1	79.12	133.58	✓	79.12	133.58	✓
Comb #2	78.38	133.58	✓	78.38	133.58	✓

Comb #3	69.39	133.58	✓	69.39	133.58	✓
Comb #4	94.17	133.58	✓	87.05	133.58	✓
Comb #5	100.28	133.58	✓	88.80	133.58	✓
Comb #6	86.07	133.58	✓	74.67	133.58	✓
Comb #7	100.08	133.58	✓	92.95	133.58	✓
Comb #8	109.70	133.58	✓	98.21	133.58	✓
Comb #9	95.41	133.58	✓	84.00	133.58	✓
Comb #10	92.95	133.58	✓	100.08	133.58	✓
Comb #11	98.21	133.58	✓	109.70	133.58	✓
Comb #12	84.00	133.58	✓	95.41	133.58	✓
Comb #13	87.05	133.58	✓	94.17	133.58	✓
Comb #14	88.80	133.58	✓	100.28	133.58	✓
Comb #15	74.67	133.58	✓	86.07	133.58	✓

**On "d" Distance Away
From Column Face,**

Comb	Demand (kN)	X-Direction Capacity (kN)	Status (kN)	Demand (kN)	Y-Direction Capacity (kN)	Status (kN)
Comb #1	50.80	142.20	✓	52.47	142.20	✓
Comb #2	50.33	142.20	✓	51.98	142.20	✓
Comb #3	44.55	142.20	✓	46.02	142.20	✓
Comb #4	60.47	142.20	✓	59.32	142.20	✓
Comb #5	64.39	142.20	✓	61.45	142.20	✓
Comb #6	55.27	142.20	✓	52.06	142.20	✓
Comb #7	64.26	142.20	✓	63.23	142.20	✓
Comb #8	70.44	142.20	✓	67.70	142.20	✓
Comb #9	61.26	142.20	✓	58.26	142.20	✓
Comb #10	61.32	142.20	✓	66.37	142.20	✓
Comb #11	65.70	142.20	✓	72.75	142.20	✓
Comb #12	56.56	142.20	✓	63.27	142.20	✓
Comb #13	57.53	142.20	✓	62.45	142.20	✓
Comb #14	59.66	142.20	✓	66.50	142.20	✓
Comb #15	50.57	142.20	✓	57.08	142.20	✓

Comparison at

Column Face in X-Direction	Demand / Capacity	Status
Column Face in Y-Direction	109.7 kN / 133.6 kN	✓
Effective Perimeter in X-Direction	109.7 kN / 133.6 kN	✓
Effective Perimeter in Y-Direction	70.4 kN / 142.2 kN	✓
	72.8 kN / 142.2 kN	✓

Bending Reinforcement Check

Comb	Md _x (kN.m)	Required As _x (mm ²)	Md _y (kN.m)	Required As _y (mm ²)
Comb #1	187.91	712.43	187.91	712.43
Comb #2	186.15	712.43	186.15	712.43
Comb #3	164.79	712.43	164.80	712.43
Comb #4	223.67	712.43	212.39	712.43
Comb #5	238.18	712.43	220.00	712.43
Comb #6	204.42	712.43	186.37	712.43
Comb #7	237.68	712.43	226.39	712.43
Comb #8	260.55	712.43	242.36	712.43
Comb #9	226.60	712.43	208.54	712.43
Comb #10	226.39	712.43	237.68	712.43
Comb #11	242.36	712.43	260.55	712.43
Comb #12	208.54	712.43	226.60	712.43
Comb #13	212.39	712.43	223.67	712.43
Comb #14	220.00	712.43	238.18	712.43
Comb #15	186.37	712.43	204.42	712.43

Comparison of	Design Moment	Selected Rebar	Required / Provided	Status
Reinforcement Area in X-Direction	26.1 kN.m	6φ20 / 250.0 mm	712.43 mm ² /1507.96 mm ²	✓
Reinforcement Area in Y-Direction	26.1 kN.m	6φ20 / 250.0 mm	712.43 mm ² /1507.96 mm ²	✓