Isolated Footing Design(ACI 318-11)

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
168	1	1.630m	1.630m	0.300m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
168	#12 @ 16 cm c/c	#12 @ 21 cm c/c	#12 @ 21 cm c/c	#12 @ 21 cm c/c	N/A	N/A

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
170	2	1.600m	1.600m	0.300m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
170	#12 @ 21 cm c/c	#12 @ 21 cm c/c	#12 @ 21 cm c/c	#12 @ 21 cm c/c	N/A	N/A

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
172	3	1.820m	1.820m	0.350m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
172	#12 @ 15 cm c/c	#12 @ 17 cm c/c	#16 @ 33 cm c/c	#16 @ 33 cm c/c	N/A	N/A

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
174	4	1.550m	1.550m	0.300m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
174	#12 @ 20 cm c/c	#12 @ 20 cm c/c	#12 @ 20 cm c/c	#12 @ 20 cm c/c	N/A	N/A

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
176	5	1.660m	1.660m	0.300m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
176	#12 @ 17 cm c/c	#16 @ 37 cm c/c	#12 @ 21 cm c/c	#12 @ 21 cm c/c	N/A	N/A

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
178	6	1.720m	1.720m	0.320m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
178	#12 @ 17 cm c/c	#12 @ 17 cm c/c	#16 @ 39 cm c/c	#16 @ 39 cm c/c	N/A	N/A

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
180	7	1.890m	1.890m	0.360m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
180	#16 @ 29 cm c/c	#12 @ 16 cm c/c	#12 @ 17 cm c/c	#12 @ 17 cm c/c	N/A	N/A

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
182	8	1.650m	1.650m	0.300m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
182	#12 @ 21 cm c/c	#12 @ 21 cm c/c	#12 @ 21 cm c/c	#12 @ 21 cm c/c	N/A	N/A

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
184	9	1.650m	1.650m	0.310m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
184	#16 @ 37 cm c/c	#16 @ 37 cm c/c	#20 @ 45 cm c/c	#20 @ 45 cm c/c	N/A	N/A

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
186	10	1.710m	1.710m	0.320m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel

186	#16 @ 31 cm c/c	#12 @ 17 cm c/c	#16 @ 39 cm c/c	#16 @ 39 cm c/c	N/A	N/A

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
188	11	1.590m	1.590m	0.310m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
188	#12 @ 16 cm c/c	#12 @ 20 cm c/c	#12 @ 20 cm c/c	#12 @ 20 cm c/c	N/A	N/A

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
190	12	1.550m	1.550m	0.300m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
190	#12 @ 15 cm c/c	#12 @ 20 cm c/c	#12 @ 20 cm c/c	#12 @ 20 cm c/c	N/A	N/A

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
192	13	1.780m	1.780m	0.360m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
192	#16 @ 27 cm c/c	#16 @ 32 cm c/c	#16 @ 32 cm c/c	#16 @ 32 cm c/c	N/A	N/A

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
193	14	1.520m	1.520m	0.300m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
193	#12 @ 19 cm c/c	#12 @ 19 cm c/c	#12 @ 19 cm c/c	#12 @ 19 cm c/c	N/A	N/A

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
195	15	1.840m	1.840m	0.340m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
195	#16 @ 28 cm c/c	#12 @ 15 cm c/c	#12 @ 19 cm c/c	#12 @ 19 cm c/c	N/A	N/A

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
197	16	1.640m	1.640m	0.300m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
197	#16 @ 37 cm c/c	#12 @ 21 cm c/c	#12 @ 21 cm c/c	#12 @ 21 cm c/c	N/A	N/A

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
199	17	1.630m	1.630m	0.310m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
199	#12 @ 16 cm c/c	#16 @ 37 cm c/c	#20 @ 45 cm c/c	#20 @ 45 cm c/c	N/A	N/A

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
201	18	1.700m	1.700m	0.320m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
201	#12 @ 17 cm c/c	#16 @ 38 cm c/c	#16 @ 38 cm c/c	#16 @ 38 cm c/c	N/A	N/A

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
203	19	1.530m	1.530m	0.300m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
203	#12 @ 20 cm c/c	#12 @ 20 cm c/c	#12 @ 20 cm c/c	#12 @ 20 cm c/c	N/A	N/A

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
205	20	1.690m	1.690m	0.310m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
205	#12 @ 19 cm c/c	#16 @ 38 cm c/c	#16 @ 38 cm c/c	#16 @ 38 cm c/c	N/A	N/A

Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
207	21	1.630m	1.630m	0.310m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
207	#16 @ 37 cm c/c	#16 @ 37 cm c/c	#20 @ 45 cm c/c	#20 @ 45 cm c/c	N/A	N/A

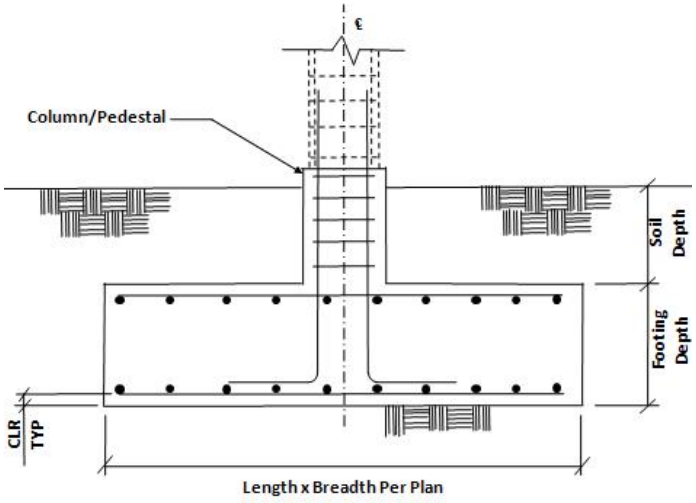
Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
209	22	1.680m	1.680m	0.310m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
209	#12 @ 17 cm c/c	#16 @ 38 cm c/c	#20 @ 45 cm c/c	#20 @ 45 cm c/c	N/A	N/A

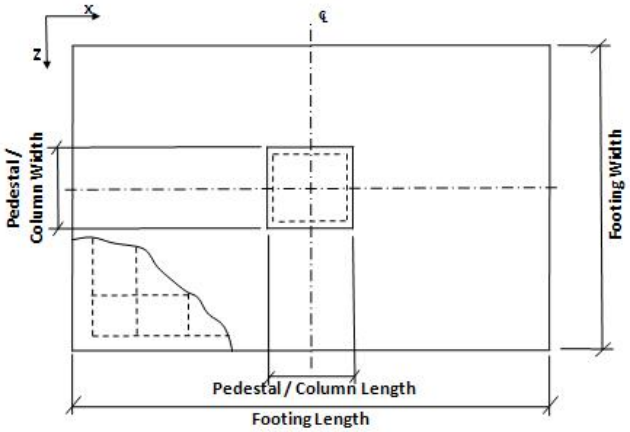
Footing No.	Group ID	Foundation Geometry		
-	-	Length	Width	Thickness
211	23	1.750m	1.750m	0.330m

Footing No.	Footing Reinforcement				Pedestal Reinforcement	
-	Bottom Reinforcement(M_z)	Bottom Reinforcement(M_x)	Top Reinforcement(M_z)	Top Reinforcement(M_x)	Main Steel	Trans Steel
211	#16 @ 32 cm c/c	#12 @ 18 cm c/c	#12 @ 18 cm c/c	#12 @ 18 cm c/c	N/A	N/A

Isolated Footing 168



ELEVATION



PLAN

Input Values

Footing Geomtery

Design Type :	Calculate Dimension
Footing Thickness (Ft) :	300.000mm
Footing Length - X (Fl) :	1000.000mm
Footing Width - Z (Fw) :	1000.000mm
Eccentricity along X (Oxd) :	0.000mm
Eccentricity along Z (Ozd) :	0.000mm

Column Dimensions

Column Shape :	Rectangular
Column Length - X (D_{col}) :	0.400m
Column Width - Z (B_{col}) :	0.400m

Pedestal

Include Pedestal?	No
Pedestal Shape :	N/A
Pedestal Height (Ph) :	N/A
Pedestal Length - X (Pl) :	N/A
Pedestal Width - Z (Pw) :	N/A

Design Parameters

Concrete and Rebar Properties

Unit Weight of Concrete :	24.000kN/m3
Strength of Concrete :	21.000N/mm2
Yield Strength of Steel :	420.000N/mm2
Minimum Bar Size :	#12
Maximum Bar Size :	#20
Pedestal Minimum Bar Size :	8
Pedestal Maximum Bar Size :	9
Minimum Bar Spacing :	50.000mm
Maximum Bar Spacing :	450.000mm
Pedestal Clear Cover (P, CL) :	75.000mm
Footing Clear Cover (F, CL) :	75.000mm

Soil Properties

Soil Type :	Drained
Unit Weight :	19.000kN/m3
Soil Bearing Capacity :	281.200kN/m2
Soil Bearing Capacity Type:	Gross Bearing Capacity
Soil Surcharge :	0.000kN/m2
Depth of Soil above Footing :	2.000m
Cohesion :	0.000kN/m2

Sliding and Overturning

Coefficient of Friction :	0.500
Factor of Safety Against Sliding :	1.500
Factor of Safety Against Overturning :	1.500

Design Calculations

Footing Size

Initial Length (L_o) =	1.000m
Initial Width (W_o) =	1.000m

Load Combination/ s- Service Stress Level				
Load		Load	Soil	Self

Combination Number	Load Combination Title	Combination Factor	Bearing Factor	Weight Factor
22	CM + CV	1.00	1.00	1.00
23	CM + 0,75 CV + 0.75 (0.7)(SX + 0,3 SZ)/R	1.00	1.00	1.00
24	CM + 0,75 CV - 0.75 (0.7)(SX - 0,3 SZ)/R	1.00	1.00	1.00
25	CM + 0,75 CV + 0.75 (0.7)(SX - 0,3 SZ)/R	1.00	1.00	1.00
26	CM + 0,75 CV - 0.75 (0.7)(SX + 0,3 SZ)/R	1.00	1.00	1.00
27	CM + 0,75 CV + 0.75 (0.7)(0,3 SX + SZ)/R	1.00	1.00	1.00
28	CM + 0,75 CV - 0.75 (0.7)(0.3 SX - SZ)/R	1.00	1.00	1.00
29	CM + 0,75 CV + 0.75 (0.7)(0.3 SX - SZ)/R	1.00	1.00	1.00
30	CM + 0,75 CV - 0.75 (0.7)(0.3 SX + SZ)/R	1.00	1.00	1.00
31	0.6 CM + 0.700 (SX + 0.3 SZ)/R	1.00	1.00	1.00
32	0.6 CM - 0.700 (SX - 0.3 SZ)/R	1.00	1.00	1.00
33	0.6 CM + 0.700 (SX - 0.3 SZ)/R	1.00	1.00	1.00
34	0.6 CM - 0.700 (SX + 0.3 SZ)/R	1.00	1.00	1.00
35	0.6 CM + 0.700 (0.3 SX + SZ)/R	1.00	1.00	1.00
36	0.6 CM - 0.700 (0.3 SX - SZ)/R	1.00	1.00	1.00
37	0.6 CM - 0.700 (0.3 SX + SZ)/R	1.00	1.00	1.00
38	0.6 CM + 0.700 (0.3 SX - SZ)/R	1.00	1.00	1.00

Load Combination Number	Load Combination Title	Load Combination Factor	Soil Bearing Factor	Self Weight Factor
5	1.2 CM + 1.600 CV	1.00	1.00	1.00
6	1.2 CM + CV + (SX/R + 0,30 SZ/R)	1.00	1.00	1.00
7	1.2 CM + CV - (SX/R - 0,30 SZ/R)	1.00	1.00	1.00
8	1.2 CM + CV + (SX/R - 0,30 SZ/R)	1.00	1.00	1.00
9	1.2 CM + CV - (SX/R + 0,30 SZ/R)	1.00	1.00	1.00
10	1.2 CM + CV + (0.3 SX/R + SZ/R)	1.00	1.00	1.00
11	1.2 CM + CV - (0.3 SX/R - SZ/R)	1.00	1.00	1.00
12	1.2 CM + CV + (0.3 SX/R - SZ/R)	1.00	1.00	1.00
13	1.2 CM + CV - (0.3 SX/R + SZ/R)	1.00	1.00	1.00
14	0.9 CM + (SX/R + 0,30 SZ/R)	1.00	1.00	1.00
15	0.9 CM - (SX/R - 0,30 SZ/R)	1.00	1.00	1.00
16	0.9 CM + (SX/R - 0,30 SZ/R)	1.00	1.00	1.00
17	0.9 CM - (SX/R + 0,30 SZ/R)	1.00	1.00	1.00
18	0.9 CM + (0.3 SX/R + SZ/R)	1.00	1.00	1.00
19	0.9 CM - (0.3 SX/R - SZ/R)	1.00	1.00	1.00
20	0.9 CM + (0.3 SX/R - SZ/R)	1.00	1.00	1.00
21	0.9 CM - (0.3 SX/R + SZ/R)	1.00	1.00	1.00

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
22	330.840	-0.193	-10.635	-11.480	1.545
23	298.842	19.573	-2.978	4.562	-40.862
24	335.403	-19.004	-9.097	-8.706	42.406
25	307.175	19.172	-10.967	-12.921	-40.002
26	343.736	-19.404	-17.086	-26.188	43.266
27	300.345	6.598	5.720	23.639	-12.850
28	312.830	-5.016	2.406	16.423	12.219
29	329.748	5.185	-22.469	-38.050	-9.814
30	340.686	-6.355	-24.300	-42.019	15.095
31	145.612	26.537	4.509	15.295	-55.985
32	194.361	-24.899	-3.650	-2.395	55.039

33	156.802	25.999	-6.219	-8.182	-54.829
34	205.551	-25.437	-14.377	-25.872	56.194
35	149.668	9.192	14.098	36.338	-18.537
36	164.355	-6.305	11.640	31.008	14.912
37	201.496	-8.091	-23.967	-46.915	18.747
38	186.809	7.406	-21.509	-41.585	-14.703

Applied Loads - Strength Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
5	412.290	-0.676	-13.726	-14.842	2.402
6	346.705	36.972	1.172	16.078	-78.241
7	416.078	-36.225	-10.438	-9.096	79.753
8	362.657	36.205	-14.120	-17.389	-76.594
9	432.030	-36.992	-25.731	-42.563	81.400
10	352.472	12.306	14.809	46.001	-24.991
11	373.409	-9.785	11.304	38.404	22.693
12	405.326	9.765	-35.863	-64.889	-19.534
13	426.263	-12.326	-39.367	-72.486	28.150
14	220.710	37.808	6.050	21.388	-79.664
15	290.083	-35.390	-5.560	-3.786	78.331
16	236.662	37.041	-9.242	-12.079	-78.017
17	306.035	-36.157	-20.853	-37.253	79.978
18	226.477	13.142	19.687	51.311	-26.413
19	247.414	-8.949	16.182	43.714	21.270
20	279.331	10.600	-30.985	-59.579	-20.956
21	300.268	-11.491	-34.489	-67.176	26.727

Reduction of force due to buoyancy = 0.000kN

Effect due to adhesion = 0.000kN

Area from initial length and width, $A_o = L_o \times W_o$ = 1.000m^2

Min. area required from bearing pressure, $A_{min} = P / q_{max}$ = 1.344m^2

Note: A_{min} is an initial estimation.
P = Critical Factored Axial Load(without self weight/ buoyancy/ soil).
q_{max} = Respective Factored Bearing Capacity.

Final Footing Size

Length (L_2) = 1.630 m Governing Load Case : # 26

Width (W_2) = 1.630 m Governing Load Case : # 26

Depth (D_2) = 0.300 m Governing Load Case : # 13

Depth is governed by Ultimate Load Case

(Service check is performed with footing thickness requirements from concrete check)

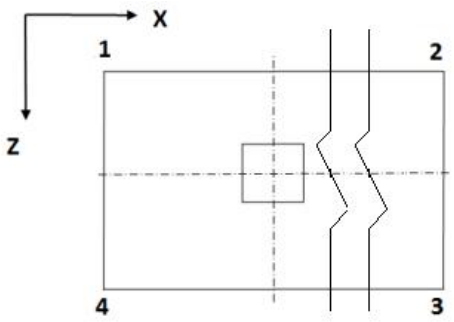
Area (A_2) = 2.657 m^2

Final Soil Height = 1.700 m

Footing Self Weight = 19.129 kN

Soil Weight On Top Of Footing = 80.647 kN

Pressures at Four Corners



Load Case	Pressure at corner 1 (q_1) (kN/ m2)	Pressure at corner 2 (q_2) (kN/ m2)	Pressure at corner 3 (q_3) (kN/ m2)	Pressure at corner 4 (q_4) (kN/ m2)	Area of footing in uplift (A_u) (m^2)
26	**278.3218**	142.3042	55.5353	191.5529	0.000
29	207.9670	**239.4722**	115.3605	83.8554	0.000
23	80.2008	209.6968	**219.8617**	90.3657	0.000
24	246.2849	112.9843	81.2995	**214.6001**	0.000

If A_u is zero, there is no uplift and no pressure adjustment is necessary. Otherwise, to account for uplift, areas of negative pressure will be set to zero and the pressure will be redistributed to remaining corners.

Summary of Adjusted Pressures at 4 corners Four Corners

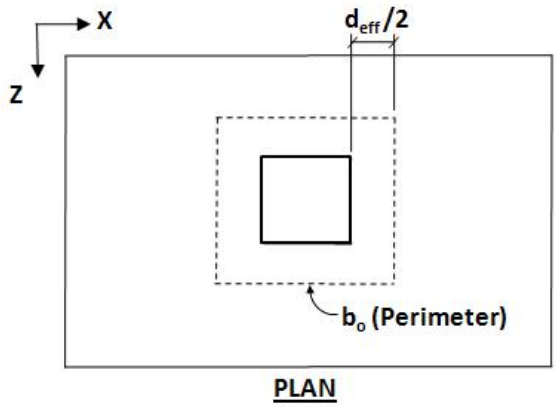
Load Case	Pressure at corner 1 (q_1) (kN/ m2)	Pressure at corner 2 (q_2) (kN/ m2)	Pressure at corner 3 (q_3) (kN/ m2)	Pressure at corner 4 (q_4) (kN/ m2)
26	**278.3218**	142.3042	55.5353	191.5529
29	207.9670	**239.4722**	115.3605	83.8554
23	80.2008	209.6968	**219.8617**	90.3657
24	246.2849	112.9843	81.2995	**214.6001**

Compression Development Length Check

Development length skipped as column reinforcement is not specified in input (Column Dimnesion Task Pane)

Shear Calculation

Punching Shear Check



PLAN

Total Footing Depth, D =	0.300m	
Calculated Effective Depth, d_{eff} =	D - C_{cover} - 0.5 * d_b =	0.219m
For rectangular column, β_c =	B_{col} / D_{col} =	1.000

Effective depth, d_{eff}, increased until $0.75XV_c \geq$ Punching Shear Force

Punching Shear Force, Vu = 455.112kN, Load Case # 9

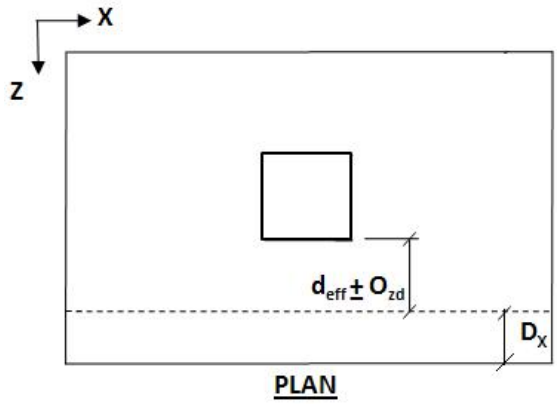
From ACI Cl.11.11.2, b_o for column=	$2 \times (B_{col} + D_{col} + 2 \times d_{eff})$ =	2.476m
Equation 11-31, V_{c1} =	$\left(2 + \frac{4}{\beta_c}\right) \times b_o \times d_{eff} \times \sqrt{1000 \times F_c'}$ =	1237.985kN
Equation 11-32, V_{c2} =	$\left(2 + 40 \times \frac{d_{eff}}{b_o}\right) \times b_o \times d_{eff} \times \sqrt{1000 \times F_c'}$ =	1142.652kN
Equation 11-33, V_{c3} =	$4 \times b_o \times d_{eff} \times \sqrt{1000 \times F_c'}$ =	825.323kN
Punching shear strength, V_c =	0.75 X minimum of (V_{c1}, V_{c2}, V_{c3}) =	618.992kN

0.75 X V_c > V_u hence, OK

One-Way Shear Check

Along X Direction

(Shear Plane Parallel to Global X Axis)



PLAN

From ACI Cl.11.2.1.1, V_c =	$2 \times L \times d_{eff} \times \sqrt{1000 \times F_c'}$ =	271.663kN

Distance along X to design for shear, D_x = $0.5 \times (W - D_{col}) - d_{eff} + O_{zd}$ = 0.396m

Check that 0.75 X V_c > V_{ux} where V_{ux} is the shear force for the critical load cases at a distance d_{eff} from the face of the column caused by bending about the X axis.

From above calculations, 0.75 X V_c = 203.747 kN

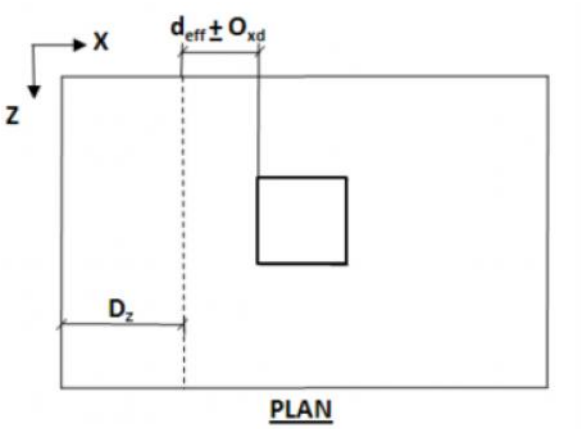
Critical load case for V_{ux} is # 13 $V_{ux} = V_{ux}|_{x=D_x}$ = 184.869 kN

0.75 X V_c > V_{ux} hence, OK

One-Way Shear Check

Along Z Direction

(Shear Plane Parallel to Global Z Axis)



From ACI Cl.11.2.1.1, V_c =

$2 \times W \times d_{eff} \times \sqrt{1000 \times F_c'}$ = 271.663 kN

Distance along X to design for shear, D_z = $0.5 \times (L - B_{col}) - d_{eff} + O_{xd}$ = 0.396 m

Check that **0.75 X V_c > V_{uz}** where V_{uz} is the shear force for the critical load cases at a distance d_{eff} from the face of the column caused by bending about the Z axis.

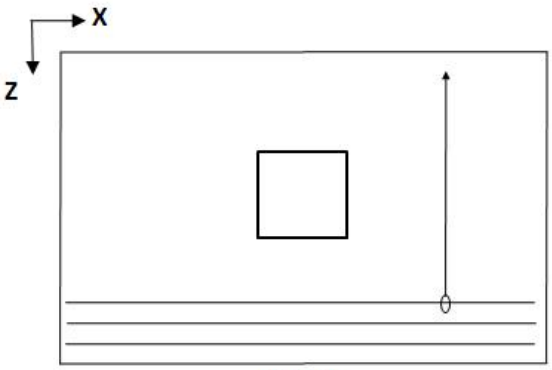
From above calculations, 0.75 X V_c = 203.747 kN

Critical load case for V_{uz} is # 9 $V_{uz} = V_{uz}|_{z=D_z}$ = 191.823 kN

0.75 X V_c > V_{uz} hence, OK

Design for Flexure about Z Axis

(For Reinforcement Parallel to X Axis)



PLAN

Calculate the flexural reinforcement along the X direction of the footing. Find the area of steel required, A, as per Section 3.8 of Reinforced Concrete Design (5th ed.) by Salmon and Wang (Ref. 1)

Critical Load Case # 9

The strength values of steel and concrete used in the formulae are in ksi

Bars parallel to X Direction are placed at bottom

Effective Depth d_{eff}=		0.217	m
Factor β_1 from ACI Cl.10.2.7.3 =		0.850	
From ACI Cl. 10.3.2, ρ_{bal} =	$0.85 \times \beta_1 \times F_c' \times \frac{87}{[f_y \times (87 + F_y)]}$ =	0.02125	
From ACI Cl. 10.3.3, ρ_{max} =	$0.75 \times \rho_{bal}$ =	0.01594	
From ACI Cl. 7.12.2, ρ_{min} =		0.00180	
From Ref. 1, Eq. 3.8.4a, constant m =	$\frac{F_y}{(0.85 \times F_c')}$ =	23.529	

Calculate reinforcement ratio ρ for critical load case

Design for flexure about Z axis is performed at the face of the column at a distance, D_x =	$0.5 \times L - 0.5 \times D_{col} + O_{xd}$ =	0.615	m
Ultimate moment,	$M_u\|_{z=D_z}$ =	91.258	kNm
Nominal moment capacity, M_n =	$\frac{M_u}{\Phi}$ =	101.397	kNm
(Based on effective depth) Required ρ =	$\frac{1}{m} \times \left[1 - \sqrt{1 - 2 \times m \times \frac{M_n}{(F_y \times W \times d_{eff}^2)}}\right]$ =	0.00321	
(Based on gross depth) ρ x d_{eff} / Depth =		0.00234	
Since	$\rho_{min} \leq \rho \leq \rho_{max}$	OK	
Area of Steel Required, A_s =	$\rho \times W \times d_{eff}$ =	1145.661	mm2

Selected bar Size = # 16

Minimum spacing allowed (S_{min}) = = 5.000cm

Selected spacing (S) = 29.280cm

S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...

The reinforcement is accepted.

According to ACI 318 Clause No- 10.6.4

Max spacing for Cracking Consideration = 18.777cm

Warning:Calculated spacing is more than maximum spacing cosidering cracking condition. Modify spacing manually if cracking consideration is necessary.

Based on spacing reinforcement increment; provided reinforcement is

16 @ 20.500cm o.c.

Required development length for bars = $\frac{0.87 \times d_b \times f_y}{4 \times \beta \times \sqrt{f_c}}$ = = 0.305 m

Available development length for bars, D_L = $0.5 \times (L - D_{col}) - C_{cover}$ = 0.540 m

Try bar size # 16 Area of one bar = 201.064 mm2

Number of bars required, N_{bar} = $\frac{A_s}{A_{bar}}$ = 6

Because the number of bars is rounded up, make sure new reinforcement ratio < ρ_{max}

Total reinforcement area, A_{s_total} = N_{bar} X (Area of one bar) = 1206.385 mm2

d_{eff} = D - C_{cover} - 0.5 X (dia. of one bar) = 0.217 m

Reinforcement ratio, ρ = $\frac{A_{s\_total}}{(d_{eff} \times W)}$ = 0.00341

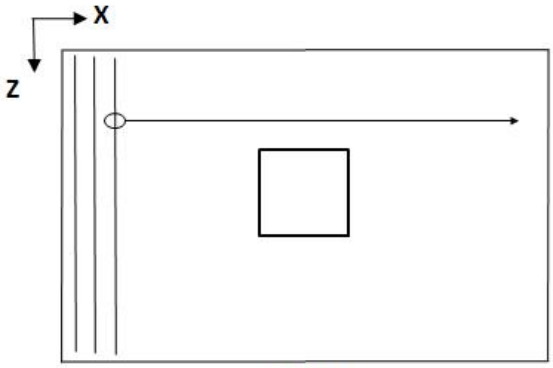
From ACI Cl.7.6.1, minimum req'd clear distance between bars

C_d = max (Diameter of one bar, 1.0" (25.4mm), Min. User Spacing) = 5.000cm

Check to see if width is sufficient to accomodate bars

Design for Flexure about X axis

(For Reinforcement Parallel to Z Axis)



PLAN

Calculate the flexural reinforcement along the Z direction of the footing. Find the area of steel required, A, as per Section 3.8 of Reinforced Concrete Design (5th ed.) by Salmon and Wang (Ref. 1)

Critical Load Case # 13

The strength values of steel and concrete used in the formulae are in ksi

Bars parallel to X Direction are placed at bottom

Effective Depth d_{eff}=		0.201	m
Factor β_1 from ACI Cl.10.2.7.3 =		0.850	
From ACI Cl. 10.3.2, ρ_{bal} =	$0.85 \times \beta_1 \times F_c' \times \frac{87}{[f_y \times (87 + F_y)]}$ =	0.02125	
From ACI Cl. 10.3.3, ρ_{max} =	$0.75 \times \rho_{bal}$ =	0.01594	
From ACI Cl.7.12.2, ρ_{min} =		0.00180	
From Ref. 1, Eq. 3.8.4a, constant m =	$\frac{F_y}{(0.85 \times F_c')}$ =	23.529	

Calculate reinforcement ratio ρ for critical load case

Design for flexure about X axis is performed at the face of the column at a distance, D_z =	$0.5 \times L + 0.5 \times B_{col} + O_{zd}$ =	0.615	m
Ultimate moment,	$M_u\|_{x=D_x}$ =	87.968	kNm
Nominal moment capacity, M_n =	$\frac{M_u}{\Phi}$ =	97.742	kNm
(Based on effective depth) Required ρ =	$\frac{1}{m} \times \left[1 - \sqrt{1 - 2 \times m \times \frac{M_n}{(F_y \times W \times d_{eff}^2)}}\right]$ =	0.00347	
(Based on gross depth) ρ x d_{eff} / Depth =		0.00240	
Since	$\rho_{min} \leq \rho \leq \rho_{max}$	OK	
Area of Steel Required, A_s =	$\rho \times W \times d_{eff}$ =	1172.172	mm2

Selected Bar Size = #16

Minimum spacing allowed (S_{min}) = 5.000cm

Selected spacing (S) = 29.280cm

S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...

The reinforcement is accepted.

According to ACI 318 Clause No- 10.6.4

Max spacing for Cracking Consideration = 18.777cm

Warning:Calculated spacing is more than maximum spacing cosidering cracking condition. Modify spacing manually if cracking consideration is necessary.

Based on spacing reinforcement increment; provided reinforcement is

#16 @16.000cm o.c.

Required development length for bars = 0.305 m

$$\frac{0.87 \times d_b \times f_y}{4 \times \beta \times \sqrt{f_c}} =$$

Available development length for bars, D_L = $0.5 \times (L - D_{col}) \cdot - C_{cover}$ = 0.540 m

Try bar size # 16 Area of one bar = 201.064 mm2

Number of bars required, N_{bar} = $\frac{A_s}{A_{bar}}$ = 6

Because the number of bars is rounded up, make sure new reinforcement ratio < ρ_{max}

Total reinforcement area, A_{s_total} = N_{bar} X (Area of one bar) = 1206.385 mm2

d_{eff} = D - C_{cover} - 1.5 X (dia. of one bar) = 0.201 m

Reinforcement ratio, ρ = $\frac{A_{s\_total}}{(d_{eff} \times W)}$ = 0.00368

From ACI Cl.7.6.1, minimum req'd clear distance between bars

C_d = max (Diameter of one bar, 1.0" (25.4mm), Min. User Spacing) = 5.000cm

Check to see if width is sufficient to accomodate bars

Isolated Footing 170