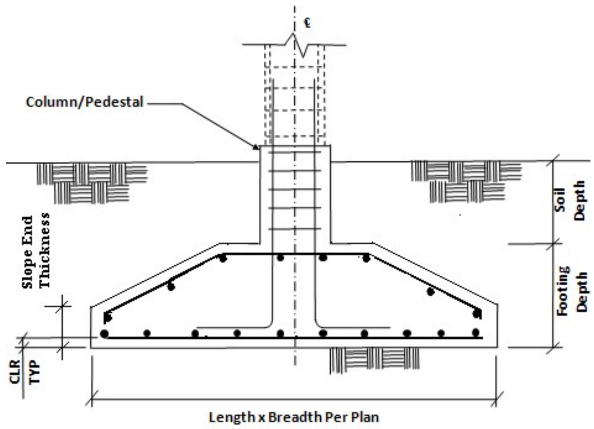
Isolated Footing Design (IS 456-2000)

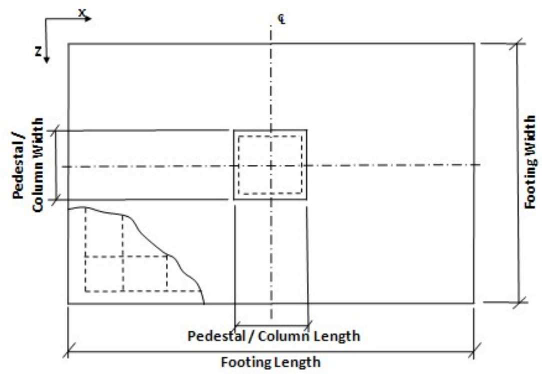
Footing No.	Group ID	Foundation Geometry			
-	-	Length	Width	Thickness	Slope End Thickness
27	1	1.600 m	1.600 m	0.250 m	0.150 m
28	2	1.750 m	1.750 m	0.300 m	0.200 m
29	3	1.750 m	1.750 m	0.250 m	0.150 m
30	4	1.600 m	1.600 m	0.250 m	0.150 m
31	5	1.750 m	1.750 m	0.250 m	0.150 m
32	6	2.300 m	2.300 m	0.350 m	0.250 m
33	7	2.200 m	2.200 m	0.350 m	0.250 m
34	8	1.650 m	1.650 m	0.250 m	0.150 m
35	9	1.650 m	1.650 m	0.250 m	0.150 m
36	10	1.650 m	1.650 m	0.250 m	0.150 m
37	11	1.600 m	1.600 m	0.250 m	0.150 m
38	12	1.600 m	1.600 m	0.250 m	0.150 m

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
27	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	N/A	N/A
28	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	N/A	N/A
29	Ø12 @ 230 mm c/c	Ø12 @ 230 mm c/c	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	N/A	N/A
30	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	N/A	N/A
31	Ø12 @ 230 mm c/c	Ø12 @ 230 mm c/c	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	N/A	N/A
32	Ø12 @ 195 mm c/c	Ø12 @ 195 mm c/c	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	N/A	N/A
33	Ø12 @ 230 mm c/c	Ø12 @ 230 mm c/c	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	N/A	N/A
34	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	N/A	N/A
35	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	N/A	N/A
36	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	N/A	N/A
37	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	N/A	N/A
38	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	Ø12 @ 250 mm c/c	N/A	N/A

Isolated Footing 27



ELEVATION



PLAN

Input Values

Footing Geomtery

Design Type :	Set Dimension
Footing Thickness (Ft) :	250.000 mm
Slope End Thickness (St) :	150.000 mm
Footing Length - X (Fl) :	1000.000 mm
Footing Width - Z (Fw) :	1000.000 mm
Eccentricity along X (Oxd) :	0.000 mm
Eccentricity along Z (Ozd) :	0.000 mm

Column Dimensions

Column Shape :	Rectangular
Column Length - X (Pl) :	0.300 m
Column Width - Z (Pw) :	0.300 m

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 :	25.000 kN/m3
Strength of Concrete :	25.000 N/mm2
Yield Strength of Steel :	500.000 N/mm2
Minimum Bar Size :	Ø12
Maximum Bar Size :	Ø25
Minimum Bar Spacing :	50.000 mm
Maximum Bar Spacing :	250.000 mm
Pedestal Clear Cover (P, CL) :	50.000 mm
Footing Clear Cover (F, CL) :	50.000 mm

Soil Properties

Soil Type :	Drained
Unit Weight :	18.000 kN/m3
Soil Bearing Capacity :	120.000 kN/m2
Soil Surcharge :	0.000 kN/m2
Depth of Soil above Footing :	1500.000 mm
Cohesion :	0.000 kN/m2
Min Percentage of Slab :	0.000

Sliding and Overturning

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

Footing Design Calculations

Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**
101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ
Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**
101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ
Load Combination/s- Strength Level	
Load Combination Number	**Load Combination Title**
201	1.500 x DL

202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	132.208	-10.876	-9.265	-4.533	4.754
102	146.353	-10.430	-8.933	-4.391	4.611
103	132.208	-10.876	-9.265	-4.533	4.754
104	132.208	-10.876	-9.265	-4.533	4.754
105	117.082	-8.344	-7.147	-3.513	3.689
106	117.082	-8.344	-7.147	-3.513	3.689
107	117.082	-8.344	-7.147	-3.513	3.689

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	132.208	-10.876	-9.265	-4.533	4.754
102	146.353	-10.430	-8.933	-4.391	4.611
103	132.208	-10.876	-9.265	-4.533	4.754
104	132.208	-10.876	-9.265	-4.533	4.754
105	117.082	-8.344	-7.147	-3.513	3.689
106	117.082	-8.344	-7.147	-3.513	3.689
107	117.082	-8.344	-7.147	-3.513	3.689

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	198.312	-16.314	-13.898	-6.799	7.131
202	219.529	-15.645	-13.400	-6.587	6.917
203	140.499	-10.013	-8.576	-4.216	4.427
204	140.499	-10.013	-8.576	-4.216	4.427
205	140.499	-10.013	-8.576	-4.216	4.427
206	158.650	-13.051	-11.118	-5.439	5.705
207	158.650	-13.051	-11.118	-5.439	5.705
208	158.650	-13.051	-11.118	-5.439	5.705
209	118.987	-9.788	-8.339	-4.079	4.278
210	118.987	-9.788	-8.339	-4.079	4.278
211	118.987	-9.788	-8.339	-4.079	4.278

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)

201	198.312	-16.314	-13.898	-6.799	7.131
202	219.529	-15.645	-13.400	-6.587	6.917
203	140.499	-10.013	-8.576	-4.216	4.427
204	140.499	-10.013	-8.576	-4.216	4.427
205	140.499	-10.013	-8.576	-4.216	4.427
206	158.650	-13.051	-11.118	-5.439	5.705
207	158.650	-13.051	-11.118	-5.439	5.705
208	158.650	-13.051	-11.118	-5.439	5.705
209	118.987	-9.788	-8.339	-4.079	4.278
210	118.987	-9.788	-8.339	-4.079	4.278
211	118.987	-9.788	-8.339	-4.079	4.278

Footing Size

Initial Length (L_o) = 1.000 m

Initial Width (W_o) = 1.000 m

Reduction of force due to buoyancy = 0.000 kN

Effect due to adhesion = 0.000 kN

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

Min. area required from bearing pressure, $A_{min} = P / q_{max}$ = 1.465 m^2

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

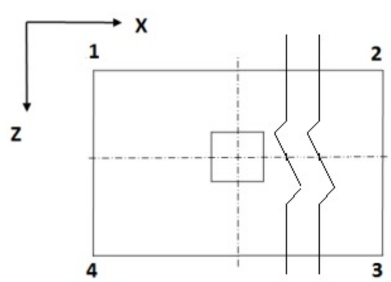
Final dimensions for design

Length (L_2) = 1.600 m   Governing Load Case : # 101

Width (W_2) = 1.600 m   Governing Load Case : # 101

Area (A_2) = 2.560 m^2

Pressures at Four Corner



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)
102	**108.2676**	87.1179	67.7100	88.8596	0.000
102	108.2676	**87.1179**	67.7100	88.8596	0.000
102	108.2676	87.1179	**67.7100**	88.8596	0.000
102	108.2676	87.1179	67.7100	**88.8596**	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 Four Corner

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)
102	**108.2676**	87.1179	67.7100	88.8596
102	108.2676	**87.1179**	67.7100	88.8596
102	108.2676	87.1179	**67.7100**	88.8596
102	108.2676	87.1179	67.7100	**88.8596**

Details of Out-of-Contact Area
(If Any)

Governing load case = N/A
Plan area of footing = 2.560 sq.m
Area not in contact with soil = 0.000 sq.m
% of total area not in contact = 0.000%

Detail of Out-of-contact Area

Governing load case = N/A
Plan area of footing = 2.560 sq.m
Area not in contact with soil = 0.000 sq.m
% of total area not in contact = 0.000%

Check For Stability Against Overturning And Sliding

-	Factor of safety against sliding		Factor of safety against overturning	
Load Case No.	Along X-Direction	Along Z-Direction	About X-Direction	About Z-Direction
101	9.879	11.597	25.101	23.006
102	10.980	12.820	27.660	25.382
103	9.879	11.597	25.101	23.006
104	9.879	11.597	25.101	23.006
105	11.971	13.977	30.156	27.673
106	11.971	13.977	30.156	27.673
107	11.971	13.977	30.156	27.673

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along X-Direction :	101	
Governing Disturbing Force :	-10.876	kN
Governing Restoring Force :	107.449	kN
Minimum Sliding Ratio for the Critical Load Case :	9.879	
Critical Load Case for Overturning about X-Direction :	101	
Governing Overturning Moment :	-6.849	kNm
Governing Resisting Moment :	171.915	kNm
Minimum Overturning Ratio for the Critical Load Case :	25.101	

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along Z-Direction : 101

Governing Disturbing Force :	-9.265	kN
Governing Restoring Force :	107.449	kN
Minimum Sliding Ratio for the Critical Load Case :	11.597	
Critical Load Case for Overturning about Z-Direction :	101	
Governing Overturning Moment :	7.473	kNm
Governing Resisting Moment :	171.915	kNm
Minimum Overturning Ratio for the Critical Load Case :	23.006	

Check Trial Depth against moment (w.r.t. X Axis)

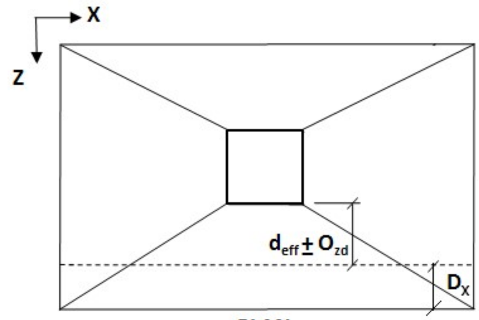
Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.194	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.094	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.463	m
Governing moment (M_u)		= 32.571	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 57.756761	kNm
$M_u <= M_{umax}$	hence, safe		

Check Trial Depth against moment (w.r.t. Z Axis)

Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.194	m
Effective End Depth		= 0.094	m
Effective Width		= 0.463	m
Governing moment (M_u) =		= 32.892	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 57.756761	kNm
$M_u <= M_{umax}$	hence, safe		

Check Trial Depth for one way shear (Along X Axis)

(Shear Plane Parallel To X axis)



Critical Load Case = #202

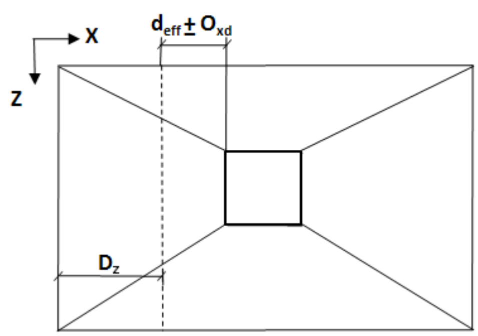
D_X = 0.194 m

Shear Force(S)	= 70.159	kN
Shear Stress(T_v)	= 257.289569	kN/m2
Percentage Of Steel(P_t)	= 0.5350	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 502.517	kN/m2

$T_v < T_c$ hence, safe

Check Trial Depth for one way shear (Along Z Axis)

(Shear Plane Parallel To Z axis)



Critical Load Case = #202

D_Z = 0.194 m

Shear Force(S)	= 70.841	kN
Shear Stress(T_v)	= 259.788530	kN/m2
Percentage Of Steel(P_t)	= 0.5350	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 502.517	kN/m2

$T_v < T_c$ hence, safe

Check Trial Depth for two way shear

Critical Load Case = #202

Shear Force(S)		= 198.602	kN
Shear Stress(T_v)		= 561.252	kN/m2

As Per IS 456 2000 Clause 31.6.3.1

K_s =	$\min[(0.5 + \beta), 1]$	= 1.000	
Shear Strength(T_c)=	$0.25 \times \sqrt{f_{ck}}$	= 1250.0000	kN/m2
K_s X T_c		= 1250.0000	kN/m2

T_v<= K_s X T_c hence, safe

Calculation of Maximum Bar Size

Along X Axis

Bar diameter corresponding to max bar size (d_b) = 12 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$	= 0.583 m
Allowable Length(l_{db}) =	$\left[\frac{(B - b)}{2} - cc\right]$	= 0.600 m

l_{db} >=l_d hence, safe

Along Z Axis

Bar diameter corresponding to max bar size(d_b) = 12 mm

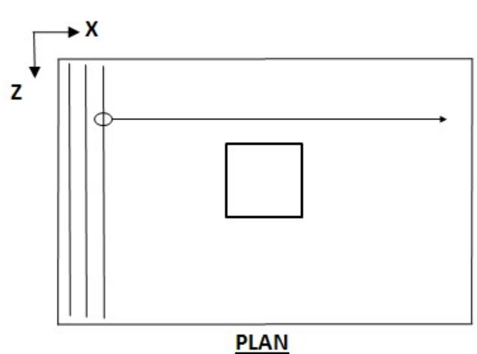
As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$	= 0.583 m
Allowable Length(l_{db}) =	$\left[\frac{(H - h)}{2} - cc\right]$	= 0.600 m

l_{db} >=l_d hence, safe

Selection of Reinforcement

Along Z Axis



As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = #202

Minimum Area of Steel (A_{stmin}) = 480.000 mm2

Calculated Area of Steel (A_{st}) = 426.507 mm2

Provided Area of Steel ($A_{st,Provided}$) = 480.000 mm2

A_{stmin}<= $A_{st,Provided}$ Steel area is accepted

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 52.000 mm

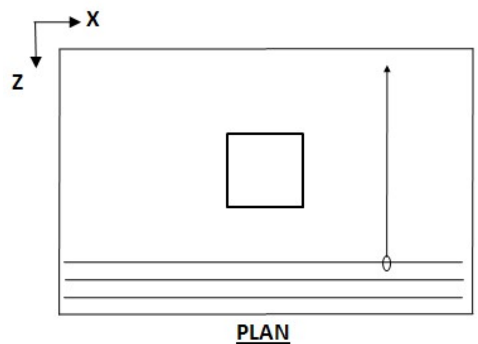
Selected spacing (S) = 250.000 mm

S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250.000 mm o.c.

Along X Axis



As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = #202

Minimum Area of Steel (A_{stmin}) = 480.000 mm2

Calculated Area of Steel (A_{st}) = 431.223 mm2

Provided Area of Steel ($A_{st,Provided}$) = 480.000 mm2

A_{stmin}<= $A_{st,Provided}$ Steel area is accepted

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 50.000 mm

Selected spacing (S) = 250.000 mm

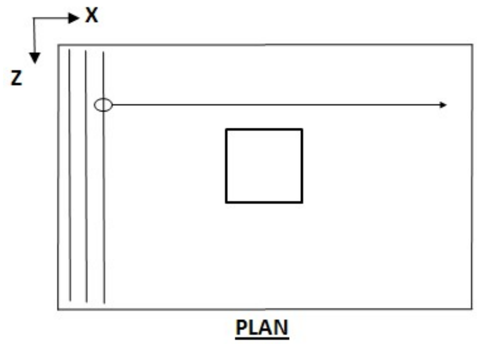
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250.000 mm o.c.

Reinforecement is provided at bottom.Provide minimum reinf at top if depth is considerable

Design for top reinforcement Along Z Axis



Calculate the flexural reinforcement along the X direction of the footing. Find the area of steel required

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

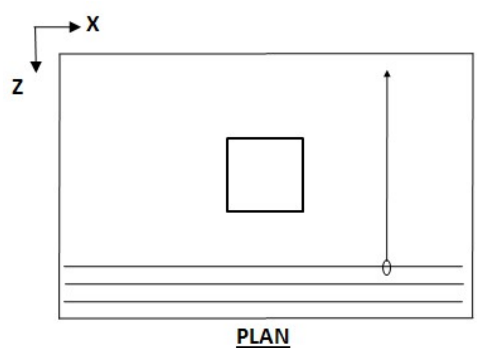
Minimum Area of Steel (A_{stmin})	= 480.000	mm2
Calculated Area of Steel (A_{st})	= 480.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 480.000	mm2
A_{stmin}<= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 52.000 mm
Selected spacing (S)	= 250.000mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Design for top reinforcement Along X Axis



Calculate the flexural reinforcement along the Z direction of the footing. Find the area of steel required

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

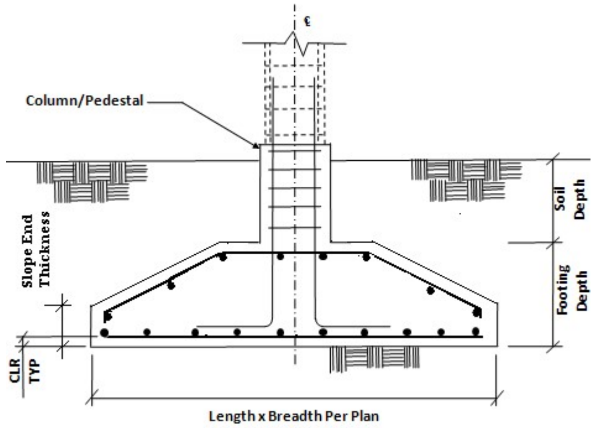
Minimum Area of Steel (A_{stmin})	= 480.000	mm2
Calculated Area of Steel (A_{st})	= 480.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 480.000	mm2
A_{stmin}<= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 50.000 mm
Selected spacing (S)	= 250.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

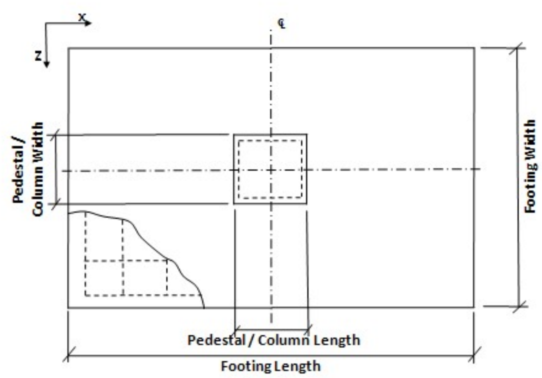
Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Isolated Footing 28



ELEVATION



PLAN

Input Values

Footing Geomtery

Design Type :	Set Dimension
Footing Thickness (Ft) :	250.000 mm
Slope End Thickness (St) :	150.000 mm
Footing Length - X (Fl) :	1000.000 mm
Footing Width - Z (Fw) :	1000.000 mm
Eccentricity along X (Oxd) :	0.000 mm
Eccentricity along Z (Ozd) :	0.000 mm

Column Dimensions

Column Shape :	Rectangular
Column Length - X (Pl) :	0.300 m

Column Width - Z (Pw) : 0.300 m

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 : 25.000 kN/m3
Strength of Concrete : 25.000 N/mm2
Yield Strength of Steel : 500.000 N/mm2
Minimum Bar Size : Ø12
Maximum Bar Size : Ø25
Minimum Bar Spacing : 50.000 mm
Maximum Bar Spacing : 250.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : Drained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 120.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 1500.000 mm
Cohesion : 0.000 kN/m2
Min Percentage of Slab : 0.000

Sliding and Overturning

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

Footing Design Calculations

Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**
101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**

101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	224.845	-2.264	-0.757	-1.023	0.787
102	264.160	-2.496	-0.239	-0.842	0.923
103	224.845	-2.264	-0.757	-1.023	0.787
104	224.845	-2.264	-0.757	-1.023	0.787
105	211.328	-1.997	-0.191	-0.674	0.738
106	211.328	-1.997	-0.191	-0.674	0.738
107	211.328	-1.997	-0.191	-0.674	0.738

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	224.845	-2.264	-0.757	-1.023	0.787
102	264.160	-2.496	-0.239	-0.842	0.923
103	224.845	-2.264	-0.757	-1.023	0.787
104	224.845	-2.264	-0.757	-1.023	0.787
105	211.328	-1.997	-0.191	-0.674	0.738
106	211.328	-1.997	-0.191	-0.674	0.738
107	211.328	-1.997	-0.191	-0.674	0.738

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	337.268	-3.396	-1.135	-1.534	1.181
202	396.240	-3.744	-0.358	-1.263	1.384

203	253.593	-2.396	-0.229	-0.809	0.886
204	253.593	-2.396	-0.229	-0.809	0.886
205	253.593	-2.396	-0.229	-0.809	0.886
206	269.815	-2.717	-0.908	-1.227	0.945
207	269.815	-2.717	-0.908	-1.227	0.945
208	269.815	-2.717	-0.908	-1.227	0.945
209	202.361	-2.038	-0.681	-0.921	0.709
210	202.361	-2.038	-0.681	-0.921	0.709
211	202.361	-2.038	-0.681	-0.921	0.709

Applied Loads - Strength Level					
LC	**Axial (kN)**	**Shear X (kN)**	**Shear Z (kN)**	**Moment X (kNm)**	**Moment Z (kNm)**
201	337.268	-3.396	-1.135	-1.534	1.181
202	396.240	-3.744	-0.358	-1.263	1.384
203	253.593	-2.396	-0.229	-0.809	0.886
204	253.593	-2.396	-0.229	-0.809	0.886
205	253.593	-2.396	-0.229	-0.809	0.886
206	269.815	-2.717	-0.908	-1.227	0.945
207	269.815	-2.717	-0.908	-1.227	0.945
208	269.815	-2.717	-0.908	-1.227	0.945
209	202.361	-2.038	-0.681	-0.921	0.709
210	202.361	-2.038	-0.681	-0.921	0.709
211	202.361	-2.038	-0.681	-0.921	0.709

Footing Size

Initial Length (L_o) = 1.000 m

Initial Width (W_o) = 1.000 m

Reduction of force due to buoyancy = 0.000 kN

Effect due to adhesion = 0.000 kN

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

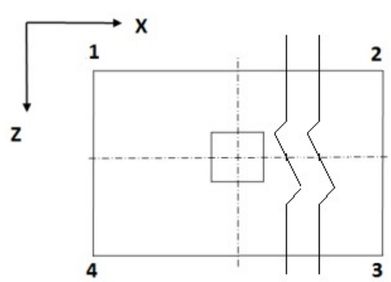
Min. area required from bearing pressure, $A_{min} = P / q_{max}$ = 2.447 m^2

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

Final dimensions for design

Length (L_2) =	1.750	m	Governing Load Case :	# 102
Width (W_2) =	1.750	m	Governing Load Case :	# 102
Area (A_2) =	3.063	m^2		

Pressures at Four Corner



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)
102	**119.9548**	116.4915	114.4722	117.9355	0.000
102	119.9548	**116.4915**	114.4722	117.9355	0.000
102	119.9548	116.4915	**114.4722**	117.9355	0.000
102	119.9548	116.4915	114.4722	**117.9355**	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 Four Corner

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)
102	**119.9548**	116.4915	114.4722	117.9355
102	119.9548	**116.4915**	114.4722	117.9355
102	119.9548	116.4915	**114.4722**	117.9355
102	119.9548	116.4915	114.4722	**117.9355**

Details of Out-of-Contact Area (If Any)

Governing load case = N/A

Plan area of footing = 3.063 sq.m

Area not in contact with soil = 0.000 sq.m

% of total area not in contact = 0.000%

Detail of Out-of-contact Area

Governing load case = N/A

Plan area of footing = 3.063 sq.m

Area not in contact with soil = 0.000 sq.m

% of total area not in contact = 0.000%

Check For Stability Against Overturning And Sliding

-	Factor of safety against sliding		Factor of safety against overturning	
Load Case No.	Along X-Direction	Along Z-Direction	About X-Direction	About Z-Direction
101	71.601	214.219	234.069	209.616
102	72.837	761.901	352.733	205.668
103	71.601	214.219	234.069	209.616
104	71.601	214.219	234.068	209.616
105	77.816	813.978	376.842	219.725
106	77.816	813.978	376.842	219.725
107	77.816	813.979	376.843	219.725

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along X-Direction : 101

Governing Disturbing Force : -2.264 kN

Governing Restoring Force :	162.122	kN
Minimum Sliding Ratio for the Critical Load Case :	71.601	
Critical Load Case for Overturning about X-Direction :	104	
Governing Overturning Moment :	-1.212	kNm
Governing Resisting Moment :	283.708	kNm
Minimum Overturning Ratio for the Critical Load Case :	234.068	

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along Z-Direction :	101	
Governing Disturbing Force :	-0.757	kN
Governing Restoring Force :	162.122	kN
Minimum Sliding Ratio for the Critical Load Case :	214.219	
Critical Load Case for Overturning about Z-Direction :	102	
Governing Overturning Moment :	1.547	kNm
Governing Resisting Moment :	318.107	kNm
Minimum Overturning Ratio for the Critical Load Case :	205.668	

Check Trial Depth against moment (w.r.t. X Axis)

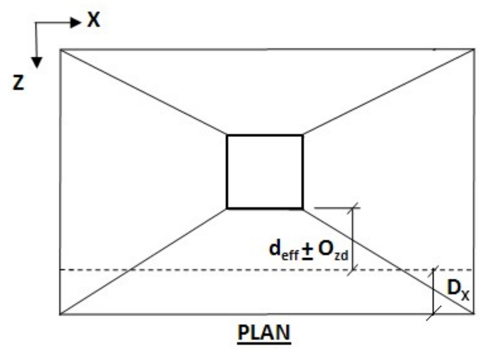
Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.244	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.144	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.481	m
Governing moment (M_u)		= 60.010	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 95.068804	kNm
M_u <= M_{umax}	hence, safe		

Check Trial Depth against moment (w.r.t. Z Axis)

Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.244	m
Effective End Depth		= 0.144	m
Effective Width		= 0.481	m
Governing moment (M_u) =		= 60.370	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 95.068804	kNm
M_u <= M_{umax}	hence, safe		

Check Trial Depth for one way shear (Along X Axis)

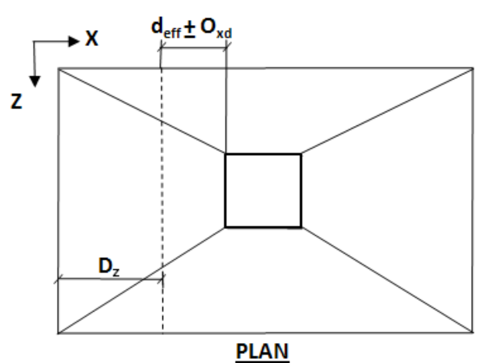
(Shear Plane Parallel To X axis)



Critical Load Case	**= #202**		
D_X =	0.244 m		
Shear Force(S)		= 109.834	kN
Shear Stress(T_v)		= 239.646375	kN/m2
Percentage Of Steel(P_t)		= 0.5435	
As Per IS 456 2000 Clause 40 Table 19			
Shear Strength Of Concrete(T_c)		= 505.733	kN/m2
$T_v < T_c$	hence, safe		

Check Trial Depth for one way shear (Along Z Axis)

(Shear Plane Parallel To Z axis)



Critical Load Case	**= #202**		
D_Z =	0.244 m		
Shear Force(S)		= 110.495	kN
Shear Stress(T_v)		= 241.088657	kN/m2
Percentage Of Steel(P_t)		= 0.5398	
As Per IS 456 2000 Clause 40 Table 19			
Shear Strength Of Concrete(T_c)		= 504.338	kN/m2
$T_v < T_c$	hence, safe		

Check Trial Depth for two way shear

Critical Load Case	**= #202**		
Shear Force(S)		= 357.950	kN
Shear Stress(T_v)		= 724.116	kN/m2
As Per IS 456 2000 Clause 31.6.3.1			
K_s =	$\min[(0.5+\beta),1]$	= 1.000	
Shear Strength(T_c)=	$0.25 \times \sqrt{f_{ck}}$	= 1250.0000	kN/m2
K_s X T_c		= 1250.0000	kN/m2
T_v<= K_s X T_c	hence, safe		

Calculation of Maximum Bar Size

Along X Axis

Bar diameter corresponding to max bar size (d_b) = 12 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \tau_{bd}}$	= 0.583	m
Allowable Length(l_{db}) =	$\left[\frac{(B-b)}{2} - cc\right]$	= 0.675	m
l_{db} >=l_d	hence, safe		

Along Z Axis

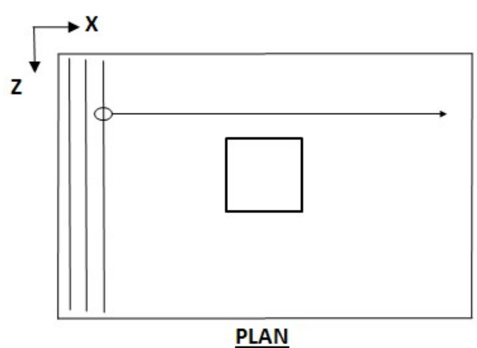
Bar diameter corresponding to max bar size(d_b) = 12 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \tau_{bd}}$	= 0.583	m
Allowable Length(l_{db}) =	$\left[\frac{(H-h)}{2} - cc\right]$	= 0.675	m
l_{db} >=l_d	hence, safe		

Selection of Reinforcement

Along Z Axis



As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = **#202**

Minimum Area of Steel (A_{stmin}) = 630.000 mm2

Calculated Area of Steel (A_{st}) = 633.814 mm2

Provided Area of Steel ($A_{st,Provided}$) = 633.814 mm2

$A_{stmin} <= A_{st,Provided}$ Steel area is accepted

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 52.000 mm

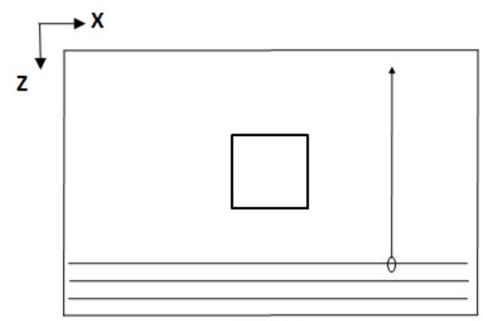
Selected spacing (S) = 250.000 mm

$S_{min} <= S <= S_{max}$ and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = **#202**

Minimum Area of Steel (A_{stmin}) = 630.000 mm2

Calculated Area of Steel (A_{st}) = 638.148 mm2

Provided Area of Steel ($A_{st,Provided}$) = 638.148 mm2

$A_{stmin} <= A_{st,Provided}$ Steel area is accepted

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 50.000 mm

Selected spacing (S) = 250.000 mm

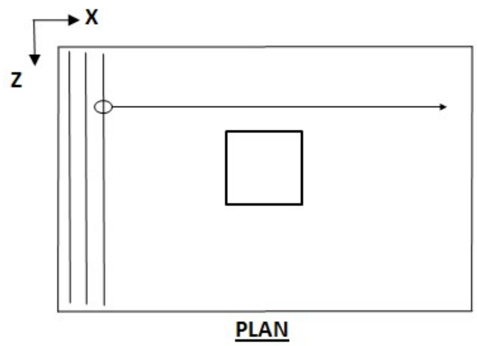
$S_{min} <= S <= S_{max}$ and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250.000 mm o.c.

Reinforecement is provided at bottom.Provide minimum reinf at top if depth is considerable

Design for top reinforcement Along Z Axis



Calculate the flexural reinforcement along the X direction of the footing. Find the area of steel required

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

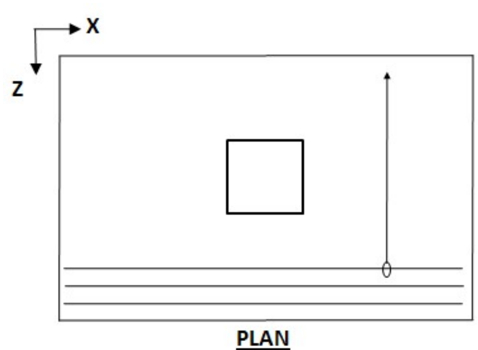
Minimum Area of Steel (A_{stmin})	= 630.000	mm2
Calculated Area of Steel (A_{st})	= 525.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 630.000	mm2
A_{stmin}<= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 52.000 mm
Selected spacing (S)	= 250.000mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Design for top reinforcement Along X Axis



Calculate the flexural reinforcement along the Z direction of the footing. Find the area of steel required

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

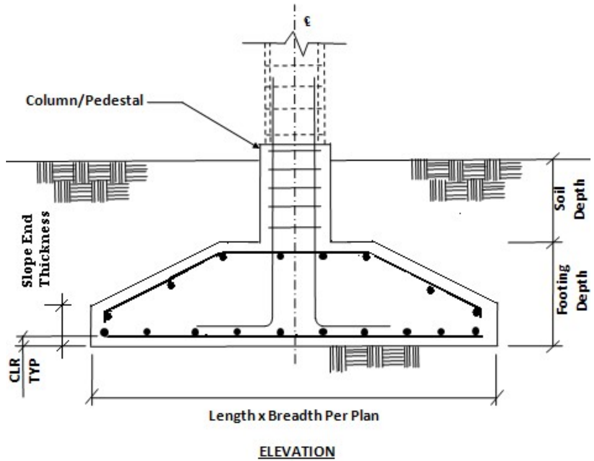
Minimum Area of Steel (A_{stmin})	= 630.000	mm2
Calculated Area of Steel (A_{st})	= 525.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 630.000	mm2
A_{stmin}<= $A_{st,Provided}$	Steel area is accepted	

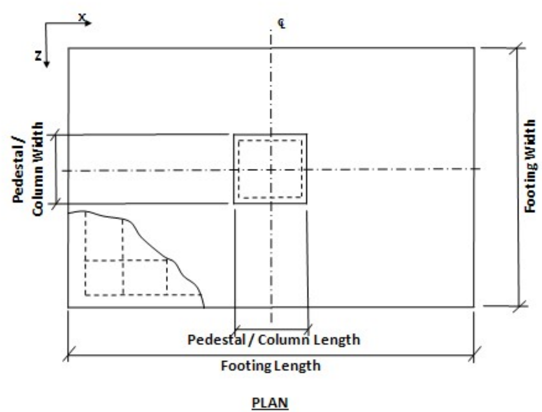
Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 50.000 mm
Selected spacing (S)	= 250.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Isolated Footing 29





Input Values

Footing Geomtery

Design Type :	Set Dimension
Footing Thickness (Ft) :	250.000 mm
Slope End Thickness (St) :	150.000 mm
Footing Length - X (Fl) :	1000.000 mm
Footing Width - Z (Fw) :	1000.000 mm
Eccentricity along X (Oxd) :	0.000 mm
Eccentricity along Z (Ozd) :	0.000 mm

Column Dimensions

Column Shape :	Rectangular
Column Length - X (Pl) :	0.300 m

Column Width - Z (Pw) : 0.300 m

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 : 25.000 kN/m3
Strength of Concrete : 25.000 N/mm2
Yield Strength of Steel : 500.000 N/mm2
Minimum Bar Size : Ø12
Maximum Bar Size : Ø25
Minimum Bar Spacing : 50.000 mm
Maximum Bar Spacing : 250.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : Drained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 120.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 1500.000 mm
Cohesion : 0.000 kN/m2
Min Percentage of Slab : 0.000

Sliding and Overturning

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

Footing Design Calculations

Load Combination/s- Service Stress Level

Load Combination Number	Load Combination Title
101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Service Stress Level

Load Combination Number	Load Combination Title

101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	206.659	5.874	-0.816	-1.032	-2.898
102	241.945	5.823	-0.294	-0.848	-2.893
103	206.659	5.874	-0.816	-1.032	-2.898
104	206.659	5.874	-0.816	-1.032	-2.898
105	193.556	4.658	-0.235	-0.678	-2.315
106	193.556	4.658	-0.235	-0.678	-2.315
107	193.556	4.658	-0.235	-0.678	-2.315

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	206.659	5.874	-0.816	-1.032	-2.898
102	241.945	5.823	-0.294	-0.848	-2.893
103	206.659	5.874	-0.816	-1.032	-2.898
104	206.659	5.874	-0.816	-1.032	-2.898
105	193.556	4.658	-0.235	-0.678	-2.315
106	193.556	4.658	-0.235	-0.678	-2.315
107	193.556	4.658	-0.235	-0.678	-2.315

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	309.988	8.811	-1.224	-1.548	-4.348
202	362.917	8.734	-0.441	-1.272	-4.340

203	232.267	5.590	-0.282	-0.814	-2.778
204	232.267	5.590	-0.282	-0.814	-2.778
205	232.267	5.590	-0.282	-0.814	-2.778
206	247.990	7.049	-0.980	-1.238	-3.478
207	247.990	7.049	-0.980	-1.238	-3.478
208	247.990	7.049	-0.980	-1.238	-3.478
209	185.993	5.287	-0.735	-0.929	-2.609
210	185.993	5.287	-0.735	-0.929	-2.609
211	185.993	5.287	-0.735	-0.929	-2.609

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	309.988	8.811	-1.224	-1.548	-4.348
202	362.917	8.734	-0.441	-1.272	-4.340
203	232.267	5.590	-0.282	-0.814	-2.778
204	232.267	5.590	-0.282	-0.814	-2.778
205	232.267	5.590	-0.282	-0.814	-2.778
206	247.990	7.049	-0.980	-1.238	-3.478
207	247.990	7.049	-0.980	-1.238	-3.478
208	247.990	7.049	-0.980	-1.238	-3.478
209	185.993	5.287	-0.735	-0.929	-2.609
210	185.993	5.287	-0.735	-0.929	-2.609
211	185.993	5.287	-0.735	-0.929	-2.609

Footing Size

Initial Length (L_o) = 1.000 m

Initial Width (W_o) = 1.000 m

Reduction of force due to buoyancy = 0.000 kN

Effect due to adhesion = 0.000 kN

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

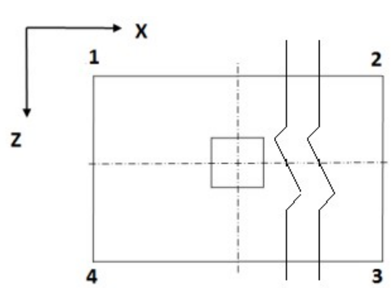
Min. area required from bearing pressure, $A_{min} = P / q_{max}$ = 2.262 m^2

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

Final dimensions for design

Length (L_2) =	1.750	m	Governing Load Case :	# 102
Width (W_2) =	1.750	m	Governing Load Case :	# 102
Area (A_2) =	3.063	m^2		

Pressures at Four Corner



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)
102	**106.1223**	115.8600	113.7969	104.0592	0.000
102	106.1223	**115.8600**	113.7969	104.0592	0.000
102	106.1223	115.8600	**113.7969**	104.0592	0.000
102	106.1223	115.8600	113.7969	**104.0592**	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 Four Corner

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)
102	**106.1223**	115.8600	113.7969	104.0592
102	106.1223	**115.8600**	113.7969	104.0592
102	106.1223	115.8600	**113.7969**	104.0592
102	106.1223	115.8600	113.7969	**104.0592**

Details of Out-of-Contact Area
(If Any)

Governing load case = N/A
Plan area of footing = 3.063 sq.m
Area not in contact with soil = 0.000 sq.m
% of total area not in contact = 0.000%

Detail of Out-of-contact Area

Governing load case = N/A
Plan area of footing = 3.063 sq.m
Area not in contact with soil = 0.000 sq.m
% of total area not in contact = 0.000%

Check For Stability Against Overturning And Sliding

-	Factor of safety against sliding		Factor of safety against overturning	
Load Case No.	Along X-Direction	Along Z-Direction	About X-Direction	About Z-Direction
101	26.052	187.474	216.706	61.324
102	29.311	581.094	324.143	68.677
103	26.052	187.474	216.706	61.324
104	26.052	187.474	216.706	61.324
105	31.445	623.397	347.741	73.676
106	31.445	623.397	347.741	73.676
107	31.445	623.396	347.741	73.676

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along X-Direction : 101
Governing Disturbing Force : 5.874 kN

Governing Restoring Force :	153.028	kN
Minimum Sliding Ratio for the Critical Load Case :	26.052	
Critical Load Case for Overturning about X-Direction :	101	
Governing Overturning Moment :	-1.236	kNm
Governing Resisting Moment :	267.795	kNm
Minimum Overturning Ratio for the Critical Load Case :	216.706	

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along Z-Direction :	101	
Governing Disturbing Force :	-0.816	kN
Governing Restoring Force :	153.028	kN
Minimum Sliding Ratio for the Critical Load Case :	187.474	
Critical Load Case for Overturning about Z-Direction :	101	
Governing Overturning Moment :	-4.367	kNm
Governing Resisting Moment :	267.795	kNm
Minimum Overturning Ratio for the Critical Load Case :	61.324	

Check Trial Depth against moment (w.r.t. X Axis)

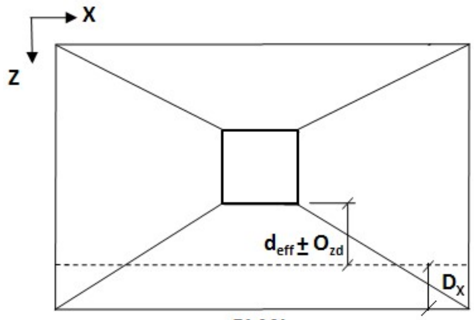
Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.194	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.094	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.481	m
Governing moment (M_u)		= 55.016	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 60.098251	kNm
M_u <= M_{umax}	hence, safe		

Check Trial Depth against moment (w.r.t. Z Axis)

Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.194	m
Effective End Depth		= 0.094	m
Effective Width		= 0.481	m
Governing moment (M_u) =		= 56.935	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 60.098251	kNm
M_u <= M_{umax}	hence, safe		

Check Trial Depth for one way shear (Along X Axis)

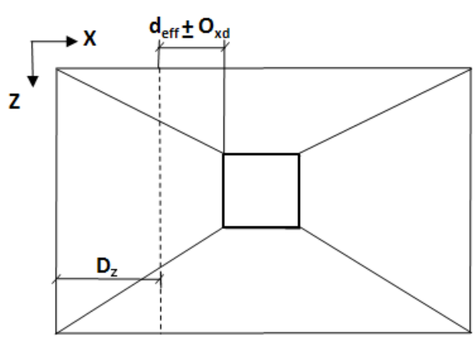
(Shear Plane Parallel To X axis)



Critical Load Case	**= #202**		
D_X =	0.194 m		
Shear Force(S)		= 111.121	kN
Shear Stress(T_v)		= 370.393270	kN/m2
Percentage Of Steel(P_t)		= 0.8762	
As Per IS 456 2000 Clause 40 Table 19			
Shear Strength Of Concrete(T_c)		= 610.235	kN/m2
$T_v < T_c$	hence, safe		

Check Trial Depth for one way shear (Along Z Axis)

(Shear Plane Parallel To Z axis)



Critical Load Case	**= #202**		
D_Z =	0.194 m		
Shear Force(S)		= 114.847	kN
Shear Stress(T_v)		= 382.812073	kN/m2
Percentage Of Steel(P_t)		= 0.8391	
As Per IS 456 2000 Clause 40 Table 19			
Shear Strength Of Concrete(T_c)		= 600.245	kN/m2
$T_v < T_c$	hence, safe		

Check Trial Depth for two way shear

Critical Load Case	**= #202**		
Shear Force(S)		= 333.998	kN
Shear Stress(T_v)		= 935.814	kN/m2
As Per IS 456 2000 Clause 31.6.3.1			
K_s =	$\min[(0.5+\beta),1]$	= 1.000	
Shear Strength(T_c)=	$0.25 \times \sqrt{f_{ck}}$	= 1250.0000	kN/m2
K_s X T_c		= 1250.0000	kN/m2
T_v<= K_s X T_c	hence, safe		

Calculation of Maximum Bar Size

Along X Axis

Bar diameter corresponding to max bar size (d_b) = 12 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$	= 0.583	m
Allowable Length(l_{db}) =	$\left[\frac{(B-b)}{2} - cc\right]$	= 0.675	m
l_{db} >=l_d	hence, safe		

Along Z Axis

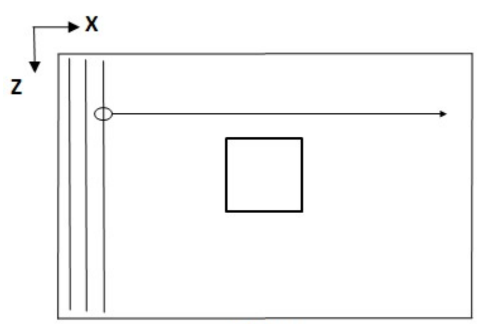
Bar diameter corresponding to max bar size(d_b) = 12 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$	= 0.583	m
Allowable Length(l_{db}) =	$\left[\frac{(H-h)}{2} - cc\right]$	= 0.675	m
l_{db} >=l_d	hence, safe		

Selection of Reinforcement

Along Z Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

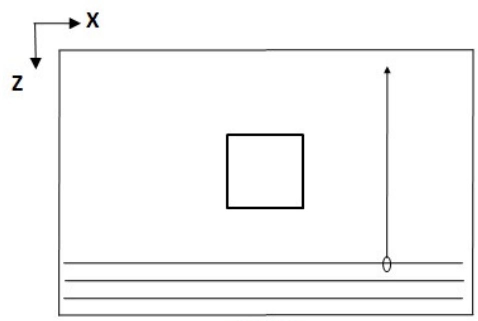
Critical Load Case	**= #202**	
Minimum Area of Steel (A_{stmin})	= 525.000	mm2
Calculated Area of Steel (A_{st})	= 783.416	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 783.416	mm2
A_{stmin}<= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 52.000 mm
Selected spacing (S)	= 250.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case	**= #202**	
Minimum Area of Steel (A_{stmin})	= 525.000	mm2
Calculated Area of Steel (A_{st})	= 818.019	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 818.019	mm2
A_{stmin}<= $A_{st,Provided}$	Steel area is accepted	

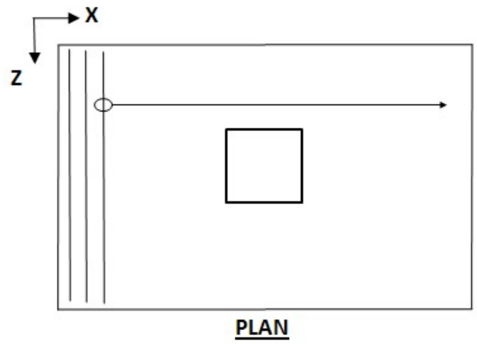
Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 50.000 mm
Selected spacing (S)	= 234.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 230.000 mm o.c.

Reinforecement is provided at bottom.Provide minimum reinf at top if depth is considerable

Design for top reinforcement Along Z Axis



Calculate the flexural reinforcement along the X direction of the footing. Find the area of steel required

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

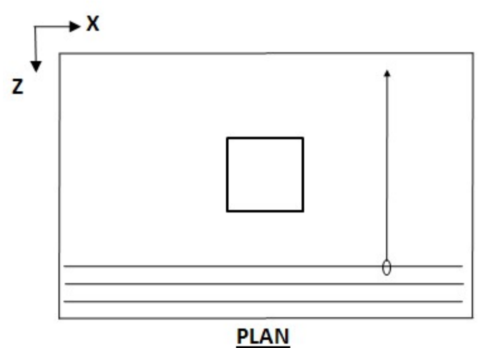
Minimum Area of Steel (A_{stmin})	= 525.000	mm2
Calculated Area of Steel (A_{st})	= 525.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 525.000	mm2
A_{stmin}<= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 52.000 mm
Selected spacing (S)	= 250.000mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Design for top reinforcement Along X Axis



Calculate the flexural reinforcement along the Z direction of the footing. Find the area of steel required

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

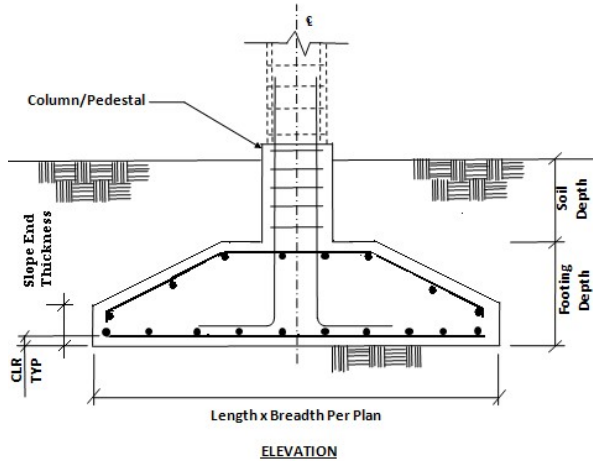
Minimum Area of Steel (A_{stmin})	= 525.000	mm2
Calculated Area of Steel (A_{st})	= 525.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 525.000	mm2
A_{stmin}<= $A_{st,Provided}$	Steel area is accepted	

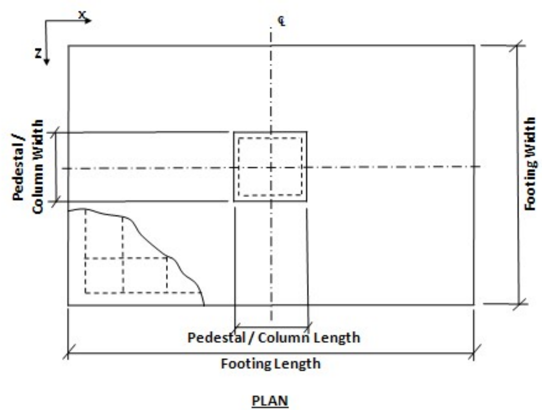
Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 50.000 mm
Selected spacing (S)	= 250.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Isolated Footing 30





Input Values

Footing Geomtery

Design Type :	Set Dimension
Footing Thickness (Ft) :	250.000 mm
Slope End Thickness (St) :	150.000 mm
Footing Length - X (Fl) :	1000.000 mm
Footing Width - Z (Fw) :	1000.000 mm
Eccentricity along X (Oxd) :	0.000 mm
Eccentricity along Z (Ozd) :	0.000 mm

Column Dimensions

Column Shape :	Rectangular
Column Length - X (Pl) :	0.300 m

Column Width - Z (Pw) : 0.300 m

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 : 25.000 kN/m3
Strength of Concrete : 25.000 N/mm2
Yield Strength of Steel : 500.000 N/mm2
Minimum Bar Size : Ø12
Maximum Bar Size : Ø25
Minimum Bar Spacing : 50.000 mm
Maximum Bar Spacing : 250.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : Drained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 120.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 1500.000 mm
Cohesion : 0.000 kN/m2
Min Percentage of Slab : 0.000

Sliding and Overturning

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

Footing Design Calculations

Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**
101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**

101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	116.685	7.176	-9.144	-4.451	-3.450
102	127.940	7.030	-8.786	-4.289	-3.418
103	116.685	7.176	-9.144	-4.451	-3.450
104	116.685	7.176	-9.144	-4.451	-3.450
105	102.352	5.624	-7.029	-3.431	-2.734
106	102.352	5.624	-7.029	-3.431	-2.734
107	102.352	5.624	-7.029	-3.431	-2.734

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	116.685	7.176	-9.144	-4.451	-3.450
102	127.940	7.030	-8.786	-4.289	-3.418
103	116.685	7.176	-9.144	-4.451	-3.450
104	116.685	7.176	-9.144	-4.451	-3.450
105	102.352	5.624	-7.029	-3.431	-2.734
106	102.352	5.624	-7.029	-3.431	-2.734
107	102.352	5.624	-7.029	-3.431	-2.734

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	175.027	10.764	-13.715	-6.676	-5.176
202	191.910	10.546	-13.179	-6.433	-5.127

203	122.823	6.749	-8.434	-4.117	-3.281
204	122.823	6.749	-8.434	-4.117	-3.281
205	122.823	6.749	-8.434	-4.117	-3.281
206	140.022	8.611	-10.972	-5.341	-4.141
207	140.022	8.611	-10.972	-5.341	-4.141
208	140.022	8.611	-10.972	-5.341	-4.141
209	105.016	6.458	-8.229	-4.006	-3.105
210	105.016	6.458	-8.229	-4.006	-3.105
211	105.016	6.458	-8.229	-4.006	-3.105

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	175.027	10.764	-13.715	-6.676	-5.176
202	191.910	10.546	-13.179	-6.433	-5.127
203	122.823	6.749	-8.434	-4.117	-3.281
204	122.823	6.749	-8.434	-4.117	-3.281
205	122.823	6.749	-8.434	-4.117	-3.281
206	140.022	8.611	-10.972	-5.341	-4.141
207	140.022	8.611	-10.972	-5.341	-4.141
208	140.022	8.611	-10.972	-5.341	-4.141
209	105.016	6.458	-8.229	-4.006	-3.105
210	105.016	6.458	-8.229	-4.006	-3.105
211	105.016	6.458	-8.229	-4.006	-3.105

Footing Size

Initial Length (L_o) = 1.000 m

Initial Width (W_o) = 1.000 m

Reduction of force due to buoyancy = 0.000 kN

Effect due to adhesion = 0.000 kN

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

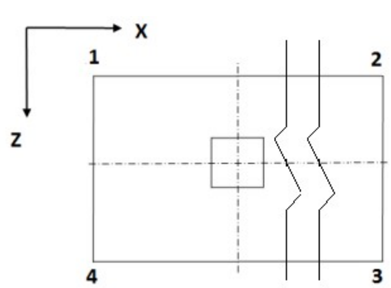
Min. area required from bearing pressure, $A_{min} = P / q_{max}$ = 1.312 m^2

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

Final dimensions for design

Length (L_2) =	1.600	m	Governing Load Case :	# 101
Width (W_2) =	1.600	m	Governing Load Case :	# 101
Area (A_2) =	2.560	m^2		

Pressures at Four Corner



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)
102	**82.7146**	97.8775	78.8780	63.7151	0.000
102	82.7146	**97.8775**	78.8780	63.7151	0.000
102	82.7146	97.8775	**78.8780**	63.7151	0.000
102	82.7146	97.8775	78.8780	**63.7151**	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 Four Corner

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)
102	**82.7146**	97.8775	78.8780	63.7151
102	82.7146	**97.8775**	78.8780	63.7151
102	82.7146	97.8775	**78.8780**	63.7151
102	82.7146	97.8775	78.8780	**63.7151**

Details of Out-of-Contact Area
(If Any)

Governing load case = N/A
Plan area of footing = 2.560 sq.m
Area not in contact with soil = 0.000 sq.m
% of total area not in contact = 0.000%

Detail of Out-of-contact Area

Governing load case = N/A
Plan area of footing = 2.560 sq.m
Area not in contact with soil = 0.000 sq.m
% of total area not in contact = 0.000%

Check For Stability Against Overturning And Sliding

-	Factor of safety against sliding		Factor of safety against overturning	
Load Case No.	Along X-Direction	Along Z-Direction	About X-Direction	About Z-Direction
101	13.892	10.903	23.676	30.413
102	14.980	11.987	25.983	32.557
103	13.892	10.903	23.676	30.413
104	13.892	10.903	23.676	30.413
105	16.450	13.163	28.533	35.753
106	16.450	13.163	28.533	35.753
107	16.450	13.163	28.533	35.753

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along X-Direction : 103
Governing Disturbing Force : 7.176 kN

Governing Restoring Force :	99.687	kN
Minimum Sliding Ratio for the Critical Load Case :	13.892	
Critical Load Case for Overturning about X-Direction :	101	
Governing Overturning Moment :	-6.737	kNm
Governing Resisting Moment :	159.497	kNm
Minimum Overturning Ratio for the Critical Load Case :	23.676	

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along Z-Direction :	101	
Governing Disturbing Force :	-9.144	kN
Governing Restoring Force :	99.687	kN
Minimum Sliding Ratio for the Critical Load Case :	10.903	
Critical Load Case for Overturning about Z-Direction :	101	
Governing Overturning Moment :	-5.244	kNm
Governing Resisting Moment :	159.497	kNm
Minimum Overturning Ratio for the Critical Load Case :	30.413	

Check Trial Depth against moment (w.r.t. X Axis)

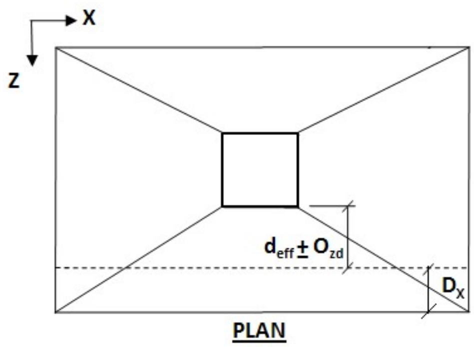
Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.194	m
Effective End Depth =	Initial End Depth -$D - (cc + 0.5 \times d_b)$	= 0.094	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.463	m
Governing moment (M_u)		= 28.849	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 57.756761	kNm
M_u <= M_{umax}	hence, safe		

Check Trial Depth against moment (w.r.t. Z Axis)

Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.194	m
Effective End Depth		= 0.094	m
Effective Width		= 0.463	m
Governing moment (M_u) =		= 28.143	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 57.756761	kNm
M_u <= M_{umax}	hence, safe		

Check Trial Depth for one way shear (Along X Axis)

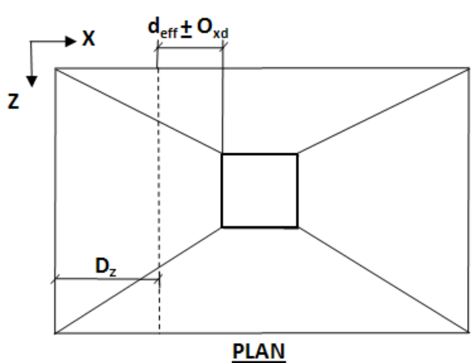
(Shear Plane Parallel To X axis)



Critical Load Case	**= #202**		
D_X =	0.194 m		
Shear Force(S)		= 62.128	kN
Shear Stress(T_v)		= 227.837270	kN/m2
Percentage Of Steel(P_t)		= 0.5350	
As Per IS 456 2000 Clause 40 Table 19			
Shear Strength Of Concrete(T_c)		= 502.517	kN/m2
$T_v < T_c$	hence, safe		

Check Trial Depth for one way shear (Along Z Axis)

(Shear Plane Parallel To Z axis)



Critical Load Case	**= #202**		
D_Z =	0.194 m		
Shear Force(S)		= 60.627	kN
Shear Stress(T_v)		= 222.332596	kN/m2
Percentage Of Steel(P_t)		= 0.5350	
As Per IS 456 2000 Clause 40 Table 19			
Shear Strength Of Concrete(T_c)		= 502.517	kN/m2
$T_v < T_c$	hence, safe		

Check Trial Depth for two way shear

Critical Load Case	**= #202**		
Shear Force(S)		= 173.616	kN
Shear Stress(T_v)		= 490.641	kN/m2
As Per IS 456 2000 Clause 31.6.3.1			
K_s =	$\min[(0.5 + \beta), 1]$	= 1.000	
Shear Strength(T_c)=	$0.25 \times \sqrt{f_{ck}}$	= 1250.0000	kN/m2
K_s X T_c		= 1250.0000	kN/m2
T_v<= K_s X T_c	hence, safe		

Calculation of Maximum Bar Size

Along X Axis

Bar diameter corresponding to max bar size (d_b) = 12 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$	= 0.583	m
Allowable Length(l_{db}) =	$\left[\frac{(B - b)}{2} - cc\right]$	= 0.600	m
l_{db} >=l_d	hence, safe		

Along Z Axis

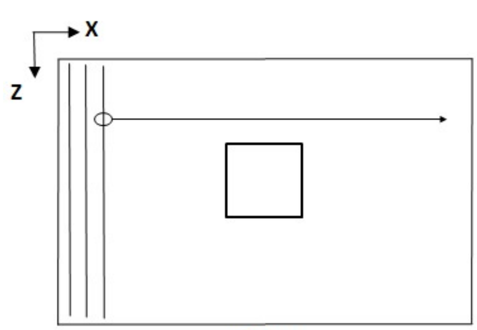
Bar diameter corresponding to max bar size(d_b) = 12 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$	= 0.583	m
Allowable Length(l_{db}) =	$\left[\frac{(H - h)}{2} - cc\right]$	= 0.600	m
l_{db} >=l_d	hence, safe		

Selection of Reinforcement

Along Z Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

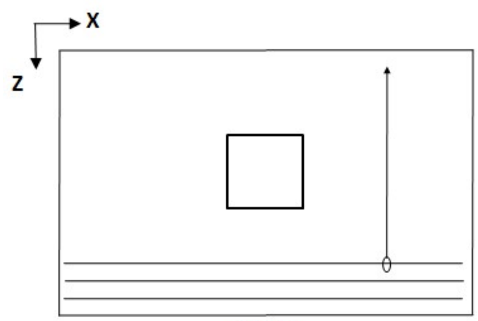
Critical Load Case	**= #202**	
Minimum Area of Steel (A_{stmin})	= 480.000	mm2
Calculated Area of Steel (A_{st})	= 372.840	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 480.000	mm2
A_{stmin} <= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 52.000 mm
Selected spacing (S)	= 250.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case	**= #202**	
Minimum Area of Steel (A_{stmin})	= 480.000	mm2
Calculated Area of Steel (A_{st})	= 362.840	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 480.000	mm2
A_{stmin} <= $A_{st,Provided}$	Steel area is accepted	

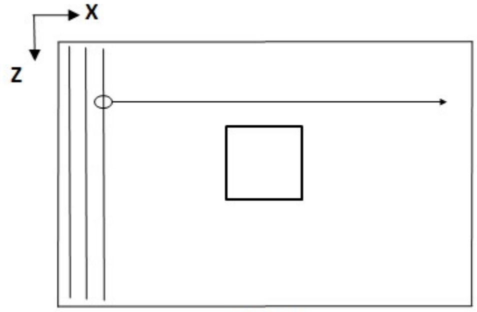
Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 50.000 mm
Selected spacing (S)	= 250.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250.000 mm o.c.

Reinforecement is provided at bottom.Provide minimum reinf at top if depth is considerable

Design for top reinforcement Along Z Axis



PLAN

Calculate the flexural reinforcement along the X direction of the footing. Find the area of steel required

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

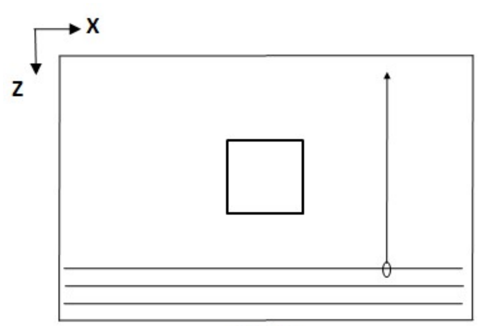
Minimum Area of Steel (A_{stmin})	= 480.000	mm2
Calculated Area of Steel (A_{st})	= 480.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 480.000	mm2
A_{stmin}<= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 52.000 mm
Selected spacing (S)	= 250.000mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Design for top reinforcement Along X Axis



PLAN

Calculate the flexural reinforcement along the Z direction of the footing. Find the area of steel required

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

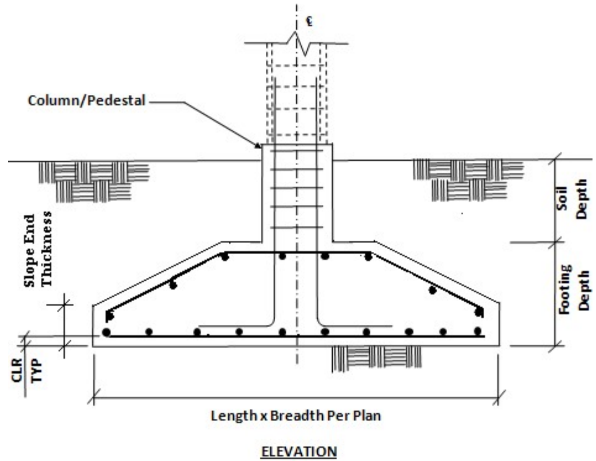
Minimum Area of Steel (A_{stmin})	= 480.000	mm2
Calculated Area of Steel (A_{st})	= 480.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 480.000	mm2
A_{stmin}<= $A_{st,Provided}$	Steel area is accepted	

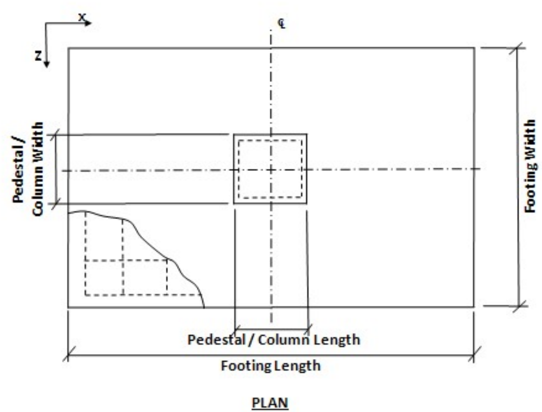
Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 50.000 mm
Selected spacing (S)	= 250.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Isolated Footing 31





Input Values

Footing Geomtery

Design Type :	Set Dimension
Footing Thickness (Ft) :	250.000 mm
Slope End Thickness (St) :	150.000 mm
Footing Length - X (Fl) :	1000.000 mm
Footing Width - Z (Fw) :	1000.000 mm
Eccentricity along X (Oxd) :	0.000 mm
Eccentricity along Z (Ozd) :	0.000 mm

Column Dimensions

Column Shape :	Rectangular
Column Length - X (Pl) :	0.300 m

Column Width - Z (Pw) : 0.300 m

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 : 25.000 kN/m3
Strength of Concrete : 25.000 N/mm2
Yield Strength of Steel : 500.000 N/mm2
Minimum Bar Size : Ø12
Maximum Bar Size : Ø25
Minimum Bar Spacing : 50.000 mm
Maximum Bar Spacing : 250.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : Drained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 120.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 1500.000 mm
Cohesion : 0.000 kN/m2
Min Percentage of Slab : 0.000

Sliding and Overturning

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

Footing Design Calculations

Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**
101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**

101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	210.332	0.917	-2.329	-1.342	-0.410
102	248.326	1.790	-2.210	-1.274	-0.688
103	210.332	0.917	-2.329	-1.342	-0.410
104	210.332	0.917	-2.329	-1.342	-0.410
105	198.661	1.432	-1.768	-1.019	-0.550
106	198.661	1.432	-1.768	-1.019	-0.550
107	198.661	1.432	-1.768	-1.019	-0.550

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	210.332	0.917	-2.329	-1.342	-0.410
102	248.326	1.790	-2.210	-1.274	-0.688
103	210.332	0.917	-2.329	-1.342	-0.410
104	210.332	0.917	-2.329	-1.342	-0.410
105	198.661	1.432	-1.768	-1.019	-0.550
106	198.661	1.432	-1.768	-1.019	-0.550
107	198.661	1.432	-1.768	-1.019	-0.550

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	315.498	1.376	-3.493	-2.014	-0.615
202	372.489	2.685	-3.314	-1.911	-1.032

203	238.393	1.719	-2.121	-1.223	-0.661
204	238.393	1.719	-2.121	-1.223	-0.661
205	238.393	1.719	-2.121	-1.223	-0.661
206	252.398	1.101	-2.794	-1.611	-0.492
207	252.398	1.101	-2.794	-1.611	-0.492
208	252.398	1.101	-2.794	-1.611	-0.492
209	189.299	0.826	-2.096	-1.208	-0.369
210	189.299	0.826	-2.096	-1.208	-0.369
211	189.299	0.826	-2.096	-1.208	-0.369

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	315.498	1.376	-3.493	-2.014	-0.615
202	372.489	2.685	-3.314	-1.911	-1.032
203	238.393	1.719	-2.121	-1.223	-0.661
204	238.393	1.719	-2.121	-1.223	-0.661
205	238.393	1.719	-2.121	-1.223	-0.661
206	252.398	1.101	-2.794	-1.611	-0.492
207	252.398	1.101	-2.794	-1.611	-0.492
208	252.398	1.101	-2.794	-1.611	-0.492
209	189.299	0.826	-2.096	-1.208	-0.369
210	189.299	0.826	-2.096	-1.208	-0.369
211	189.299	0.826	-2.096	-1.208	-0.369

Footing Size

Initial Length (L_o) = 1.000 m

Initial Width (W_o) = 1.000 m

Reduction of force due to buoyancy = 0.000 kN

Effect due to adhesion = 0.000 kN

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

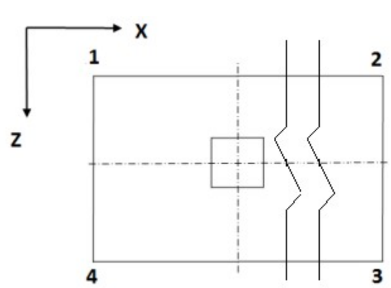
Min. area required from bearing pressure, $A_{min} = P / q_{max}$ = 2.315 m^2

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

Final dimensions for design

Length (L_2) =	1.750	m	Governing Load Case :	# 102
Width (W_2) =	1.750	m	Governing Load Case :	# 102
Area (A_2) =	3.063	m^2		

Pressures at Four Corner



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)
102	**112.8167**	115.3593	111.2696	108.7270	0.000
102	112.8167	**115.3593**	111.2696	108.7270	0.000
102	112.8167	115.3593	**111.2696**	108.7270	0.000
102	112.8167	115.3593	111.2696	**108.7270**	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 Four Corner

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)
102	**112.8167**	115.3593	111.2696	108.7270
102	112.8167	**115.3593**	111.2696	108.7270
102	112.8167	115.3593	**111.2696**	108.7270
102	112.8167	115.3593	111.2696	**108.7270**

Details of Out-of-Contact Area
(If Any)

Governing load case = N/A
Plan area of footing = 3.063 sq.m
Area not in contact with soil = 0.000 sq.m
% of total area not in contact = 0.000%

Detail of Out-of-contact Area

Governing load case = N/A
Plan area of footing = 3.063 sq.m
Area not in contact with soil = 0.000 sq.m
% of total area not in contact = 0.000%

Check For Stability Against Overturning And Sliding

-	Factor of safety against sliding		Factor of safety against overturning	
Load Case No.	Along X-Direction	Along Z-Direction	About X-Direction	About Z-Direction
101	168.836	66.506	140.823	423.805
102	97.124	78.686	166.578	267.935
103	168.836	66.506	140.823	423.805
104	168.836	66.506	140.823	423.805
105	104.064	84.310	178.482	287.083
106	104.064	84.310	178.482	287.083
107	104.064	84.310	178.482	287.083

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along X-Direction : 102
Governing Disturbing Force : 1.790 kN

Governing Restoring Force :	173.862	kN
Minimum Sliding Ratio for the Critical Load Case :	97.124	
Critical Load Case for Overturning about X-Direction :	101	
Governing Overturning Moment :	-1.924	kNm
Governing Resisting Moment :	271.009	kNm
Minimum Overturning Ratio for the Critical Load Case :	140.823	

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along Z-Direction :	101	
Governing Disturbing Force :	-2.329	kN
Governing Restoring Force :	154.865	kN
Minimum Sliding Ratio for the Critical Load Case :	66.506	
Critical Load Case for Overturning about Z-Direction :	102	
Governing Overturning Moment :	-1.136	kNm
Governing Resisting Moment :	304.253	kNm
Minimum Overturning Ratio for the Critical Load Case :	267.935	

Check Trial Depth against moment (w.r.t. X Axis)

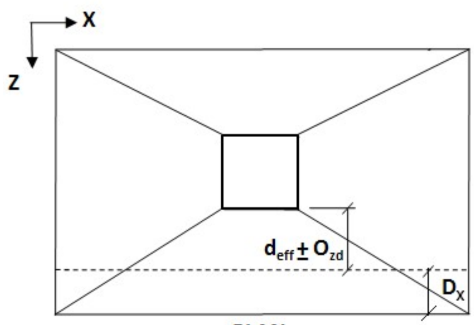
Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.194	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.094	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.481	m
Governing moment (M_u)		= 56.960	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 60.098251	kNm
$M_u <= M_{umax}$	hence, safe		

Check Trial Depth against moment (w.r.t. Z Axis)

Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.194	m
Effective End Depth		= 0.094	m
Effective Width		= 0.481	m
Governing moment (M_u) =		= 56.574	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 60.098251	kNm
$M_u <= M_{umax}$	hence, safe		

Check Trial Depth for one way shear (Along X Axis)

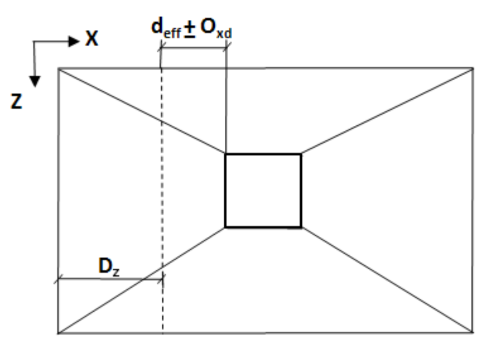
(Shear Plane Parallel To X axis)



Critical Load Case	**= #202**		
D_X =	0.194 m		
Shear Force(S)		= 115.009	kN
Shear Stress(T_v)		= 383.353287	kN/m2
Percentage Of Steel(P_t)		= 0.8691	
As Per IS 456 2000 Clause 40 Table 19			
Shear Strength Of Concrete(T_c)		= 608.365	kN/m2
$T_v < T_c$	hence, safe		

Check Trial Depth for one way shear (Along Z Axis)

(Shear Plane Parallel To Z axis)



Critical Load Case	**= #202**		
D_Z =	0.194 m		
Shear Force(S)		= 114.258	kN
Shear Stress(T_v)		= 380.849798	kN/m2
Percentage Of Steel(P_t)		= 0.8767	
As Per IS 456 2000 Clause 40 Table 19			
Shear Strength Of Concrete(T_c)		= 610.364	kN/m2
$T_v < T_c$	hence, safe		

Check Trial Depth for two way shear

Critical Load Case	**= #202**		
Shear Force(S)		= 342.807	kN
Shear Stress(T_v)		= 960.495	kN/m2
As Per IS 456 2000 Clause 31.6.3.1			
K_s =	$\min[(0.5+\beta),1]$	= 1.000	
Shear Strength(T_c)=	$0.25 \times \sqrt{f_{ck}}$	= 1250.0000	kN/m2
K_s X T_c		= 1250.0000	kN/m2
T_v<= K_s X T_c	hence, safe		

Calculation of Maximum Bar Size

Along X Axis

Bar diameter corresponding to max bar size (d_b) = 12 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$	= 0.583 m
Allowable Length(l_{db}) =	$\left[\frac{(B-b)}{2} - cc\right]$	= 0.675 m
l_{db} >=l_d	hence, safe	

Along Z Axis

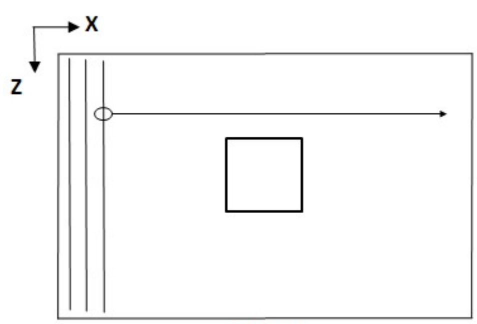
Bar diameter corresponding to max bar size(d_b) = 12 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$	= 0.583 m
Allowable Length(l_{db}) =	$\left[\frac{(H-h)}{2} - cc\right]$	= 0.675 m
l_{db} >=l_d	hence, safe	

Selection of Reinforcement

Along Z Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

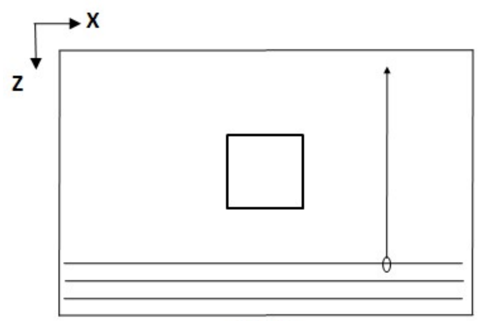
Critical Load Case	**= #202**	
Minimum Area of Steel (A_{stmin})	= 525.000	mm2
Calculated Area of Steel (A_{st})	= 818.473	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 818.473	mm2
A_{stmin} <= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 52.000 mm
Selected spacing (S)	= 234.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 230.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case	**= #202**	
Minimum Area of Steel (A_{stmin})	= 525.000	mm2
Calculated Area of Steel (A_{st})	= 811.456	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 811.456	mm2
A_{stmin} <= $A_{st,Provided}$	Steel area is accepted	

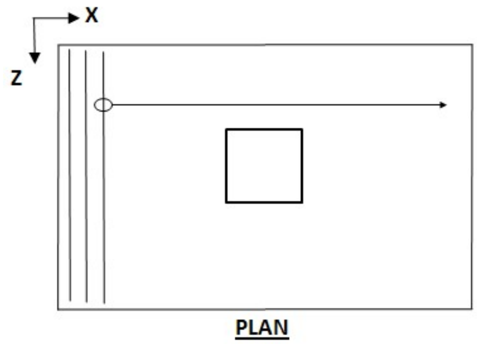
Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 50.000 mm
Selected spacing (S)	= 234.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 230.000 mm o.c.

Reinforecement is provided at bottom.Provide minimum reinf at top if depth is considerable

Design for top reinforcement Along Z Axis



Calculate the flexural reinforcement along the X direction of the footing. Find the area of steel required

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

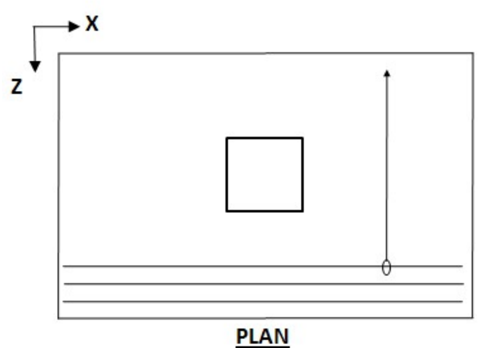
Minimum Area of Steel (A_{stmin})	= 525.000	mm2
Calculated Area of Steel (A_{st})	= 525.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 525.000	mm2
A_{stmin} <= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 52.000 mm
Selected spacing (S)	= 250.000mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Design for top reinforcement Along X Axis



Calculate the flexural reinforcement along the Z direction of the footing. Find the area of steel required

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

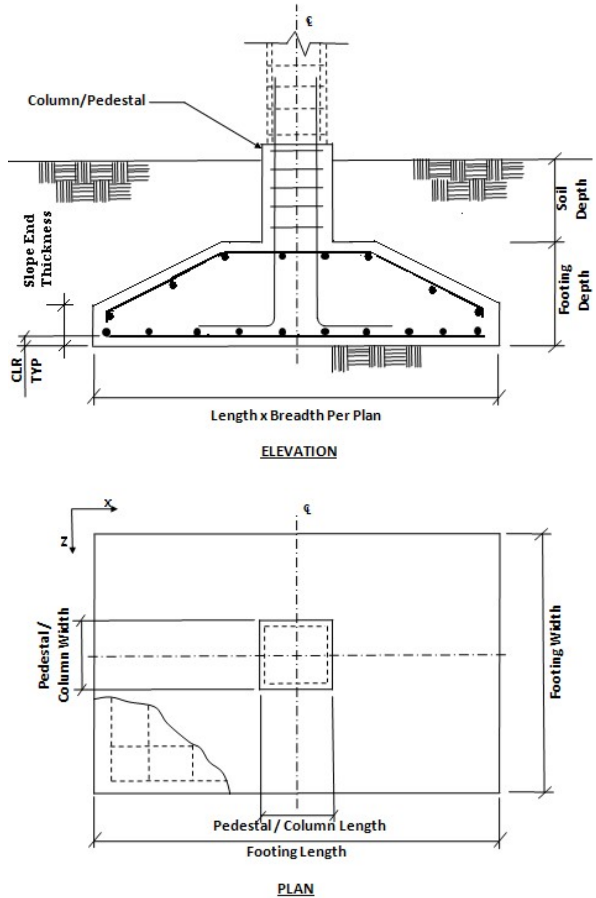
Minimum Area of Steel (A_{stmin})	= 525.000	mm2
Calculated Area of Steel (A_{st})	= 525.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 525.000	mm2
A_{stmin} <= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 50.000 mm
Selected spacing (S)	= 250.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Isolated Footing 32



Input Values

Footing Geomtery

Design Type :	Set Dimension
Footing Thickness (Ft) :	250.000 mm
Slope End Thickness (St) :	150.000 mm
Footing Length - X (Fl) :	1000.000 mm
Footing Width - Z (Fw) :	1000.000 mm
Eccentricity along X (Oxd) :	0.000 mm
Eccentricity along Z (Ozd) :	0.000 mm

Column Dimensions

Column Shape :	Rectangular
Column Length - X (Pl) :	0.300 m

Column Width - Z (Pw) : 0.300 m

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 : 25.000 kN/m3
Strength of Concrete : 25.000 N/mm2
Yield Strength of Steel : 500.000 N/mm2
Minimum Bar Size : Ø12
Maximum Bar Size : Ø25
Minimum Bar Spacing : 50.000 mm
Maximum Bar Spacing : 250.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : Drained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 120.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 1500.000 mm
Cohesion : 0.000 kN/m2
Min Percentage of Slab : 0.000

Sliding and Overturning

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

Footing Design Calculations

Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**
101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**

101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	331.013	-13.098	-10.558	-5.580	6.042
102	410.405	-13.805	-10.671	-5.649	6.429
103	331.013	-13.098	-10.558	-5.580	6.042
104	331.013	-13.098	-10.558	-5.580	6.042
105	328.324	-11.044	-8.537	-4.520	5.143
106	328.324	-11.044	-8.537	-4.520	5.143
107	328.324	-11.044	-8.537	-4.520	5.143

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	331.013	-13.098	-10.558	-5.580	6.042
102	410.405	-13.805	-10.671	-5.649	6.429
103	331.013	-13.098	-10.558	-5.580	6.042
104	331.013	-13.098	-10.558	-5.580	6.042
105	328.324	-11.044	-8.537	-4.520	5.143
106	328.324	-11.044	-8.537	-4.520	5.143
107	328.324	-11.044	-8.537	-4.520	5.143

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	496.519	-19.647	-15.837	-8.370	9.063
202	615.608	-20.708	-16.007	-8.474	9.643

203	393.989	-13.253	-10.244	-5.423	6.172
204	393.989	-13.253	-10.244	-5.423	6.172
205	393.989	-13.253	-10.244	-5.423	6.172
206	397.215	-15.718	-12.669	-6.696	7.251
207	397.215	-15.718	-12.669	-6.696	7.251
208	397.215	-15.718	-12.669	-6.696	7.251
209	297.911	-11.788	-9.502	-5.022	5.438
210	297.911	-11.788	-9.502	-5.022	5.438
211	297.911	-11.788	-9.502	-5.022	5.438

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	496.519	-19.647	-15.837	-8.370	9.063
202	615.608	-20.708	-16.007	-8.474	9.643
203	393.989	-13.253	-10.244	-5.423	6.172
204	393.989	-13.253	-10.244	-5.423	6.172
205	393.989	-13.253	-10.244	-5.423	6.172
206	397.215	-15.718	-12.669	-6.696	7.251
207	397.215	-15.718	-12.669	-6.696	7.251
208	397.215	-15.718	-12.669	-6.696	7.251
209	297.911	-11.788	-9.502	-5.022	5.438
210	297.911	-11.788	-9.502	-5.022	5.438
211	297.911	-11.788	-9.502	-5.022	5.438

Footing Size

Initial Length (L_o) = 1.000 m

Initial Width (W_o) = 1.000 m

Reduction of force due to buoyancy = 0.000 kN

Effect due to adhesion = 0.000 kN

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

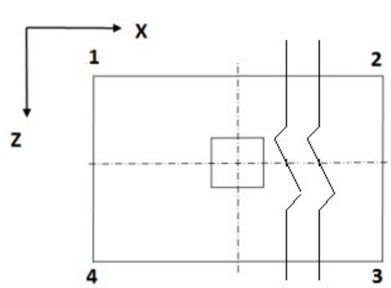
Min. area required from bearing pressure, $A_{min} = P / q_{max}$ = 3.666 m^2

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

Final dimensions for design

Length (L_2) =	2.300	m	Governing Load Case :	# 102
Width (W_2) =	2.300	m	Governing Load Case :	# 102
Area (A_2) =	5.290	m^2		

Pressures at Four Corner



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)
102	**117.8022**	108.0574	99.8542	109.5990	0.000
102	117.8022	**108.0574**	99.8542	109.5990	0.000
102	117.8022	108.0574	**99.8542**	109.5990	0.000
102	117.8022	108.0574	99.8542	**109.5990**	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 Four Corner

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)
102	**117.8022**	108.0574	99.8542	109.5990
102	117.8022	**108.0574**	99.8542	109.5990
102	117.8022	108.0574	**99.8542**	109.5990
102	117.8022	108.0574	99.8542	**109.5990**

Details of Out-of-Contact Area
(If Any)

Governing load case = N/A

Plan area of footing = 5.290 sq.m

Area not in contact with soil = 0.000 sq.m

% of total area not in contact = 0.000%

Detail of Out-of-contact Area

Governing load case = N/A

Plan area of footing = 5.290 sq.m

Area not in contact with soil = 0.000 sq.m

% of total area not in contact = 0.000%

Check For Stability Against Overturning And Sliding

-	Factor of safety against sliding		Factor of safety against overturning	
Load Case No.	Along X-Direction	Along Z-Direction	About X-Direction	About Z-Direction
101	19.257	23.891	70.579	62.268
102	21.146	27.357	80.728	67.957
103	19.257	23.891	70.579	62.268
104	19.257	23.891	70.579	62.268
105	22.717	29.389	86.724	73.005
106	22.717	29.389	86.724	73.005
107	22.717	29.389	86.724	73.005

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along X-Direction : 101

Governing Disturbing Force : -13.098 kN

Governing Restoring Force :	252.238	kN
Minimum Sliding Ratio for the Critical Load Case :	19.257	
Critical Load Case for Overturning about X-Direction :	104	
Governing Overturning Moment :	-8.220	kNm
Governing Resisting Moment :	580.136	kNm
Minimum Overturning Ratio for the Critical Load Case :	70.579	

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along Z-Direction :	101	
Governing Disturbing Force :	-10.558	kN
Governing Restoring Force :	252.238	kN
Minimum Sliding Ratio for the Critical Load Case :	23.891	
Critical Load Case for Overturning about Z-Direction :	103	
Governing Overturning Moment :	9.317	kNm
Governing Resisting Moment :	580.136	kNm
Minimum Overturning Ratio for the Critical Load Case :	62.268	

Check Trial Depth against moment (w.r.t. X Axis)

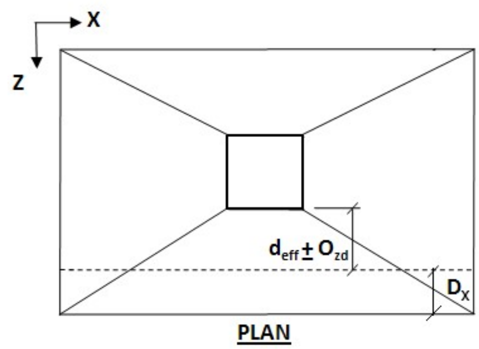
Critical Load Case	**= #202**		
Effective Depth =	$D-(cc+0.5\times d_b)$	= 0.294	m
Effective End Depth =	Initial End Depth - $D-(cc+0.5\times d_b)$	= 0.194	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.550	m
Governing moment (M_u)		= 138.848	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100+0.87\times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36\times f_{ck}\times k_{umax}\times(1-0.42\times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax}\times B\times d_e^2$	= 157.741143	kNm
M_u <= M_{umax}	hence, safe		

Check Trial Depth against moment (w.r.t. Z Axis)

Critical Load Case	**= #202**		
Effective Depth =	$D-(cc+0.5\times d_b)$	= 0.294	m
Effective End Depth		= 0.194	m
Effective Width		= 0.550	m
Governing moment (M_u) =		= 139.792	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100+0.87\times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36\times f_{ck}\times k_{umax}\times(1-0.42\times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax}\times B\times d_e^2$	= 157.741143	kNm
M_u <= M_{umax}	hence, safe		

Check Trial Depth for one way shear (Along X Axis)

(Shear Plane Parallel To X axis)

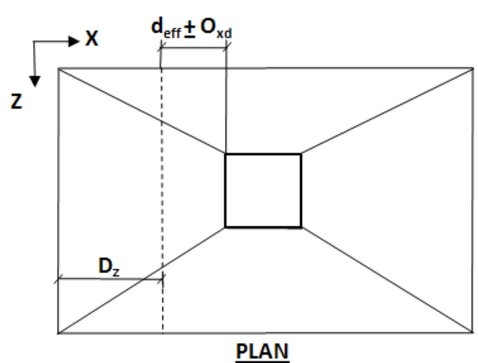


Critical Load Case = #202

D_X =	0.294 m		
Shear Force(S)		= 195.889	kN
Shear Stress(T_v)		= 224.251574	kN/m2
Percentage Of Steel(P_t)		= 0.8059	
As Per IS 456 2000 Clause 40 Table 19			
Shear Strength Of Concrete(T_c)		= 590.999	kN/m2
$T_v < T_c$	hence, safe		

Check Trial Depth for one way shear (Along Z Axis)

(Shear Plane Parallel To Z axis)



Critical Load Case = #202

D_Z =	0.294 m		
Shear Force(S)		= 197.190	kN
Shear Stress(T_v)		= 225.741102	kN/m2
Percentage Of Steel(P_t)		= 0.7992	
As Per IS 456 2000 Clause 40 Table 19			
Shear Strength Of Concrete(T_c)		= 589.093	kN/m2
$T_v < T_c$	hence, safe		

Check Trial Depth for two way shear

Critical Load Case	**= #202**		
Shear Force(S)		= 574.548	kN
Shear Stress(T_v)		= 865.782	kN/m2
As Per IS 456 2000 Clause 31.6.3.1			
K_s =	$\min[(0.5+\beta),1]$	= 1.000	
Shear Strength(T_c)=	$0.25 \times \sqrt{f_{ck}}$	= 1250.0000	kN/m2
K_s X T_c		= 1250.0000	kN/m2
T_v<= K_s X T_c	hence, safe		

Calculation of Maximum Bar Size

Along X Axis

Bar diameter corresponding to max bar size (d_b) = 16 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$	= 0.777	m
Allowable Length(l_{db}) =	$\left[\frac{(B-b)}{2} - cc\right]$	= 0.950	m
l_{db} >=l_d	hence, safe		

Along Z Axis

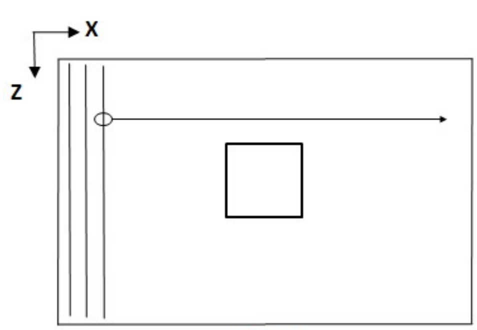
Bar diameter corresponding to max bar size(d_b) = 16 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$	= 0.777	m
Allowable Length(l_{db}) =	$\left[\frac{(H-h)}{2} - cc\right]$	= 0.950	m
l_{db} >=l_d	hence, safe		

Selection of Reinforcement

Along Z Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = **#202**

Minimum Area of Steel (A_{stmin}) = 966.000 mm2

Calculated Area of Steel (A_{st}) = 1292.247 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1292.247 mm2

A_{stmin} <= $A_{st,Provided}$ Steel area is accepted

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 52.000 mm

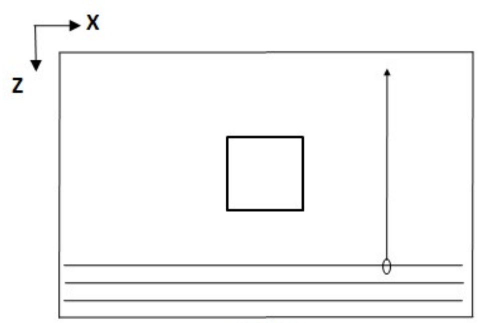
Selected spacing (S) = 198.909 mm

S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 195.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = **#202**

Minimum Area of Steel (A_{stmin}) = 966.000 mm2

Calculated Area of Steel (A_{st}) = 1303.117 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1303.117 mm2

A_{stmin} <= $A_{st,Provided}$ Steel area is accepted

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 50.000 mm

Selected spacing (S) = 198.909 mm

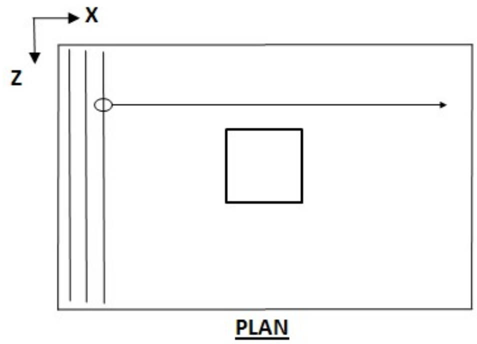
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 195.000 mm o.c.

Reinforecement is provided at bottom.Provide minimum reinf at top if depth is considerable

Design for top reinforcement Along Z Axis



Calculate the flexural reinforcement along the X direction of the footing. Find the area of steel required

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

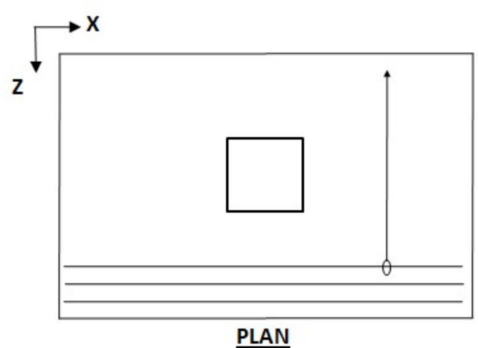
Minimum Area of Steel (A_{stmin})	= 966.000	mm2
Calculated Area of Steel (A_{st})	= 690.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 966.000	mm2
A_{stmin}<= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 52.000 mm
Selected spacing (S)	= 250.000mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Design for top reinforcement Along X Axis



Calculate the flexural reinforcement along the Z direction of the footing. Find the area of steel required

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

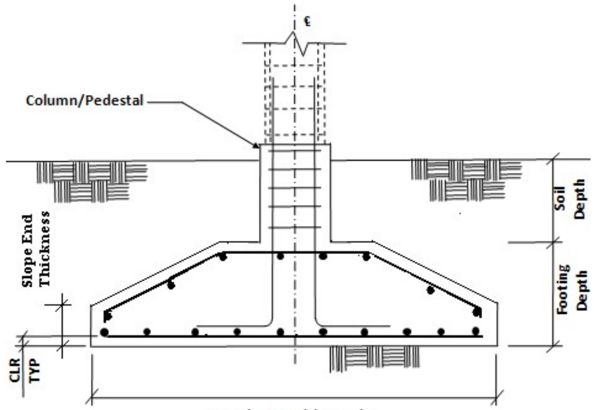
Minimum Area of Steel (A_{stmin})	= 966.000	mm2
Calculated Area of Steel (A_{st})	= 991.819	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 991.819	mm2
A_{stmin}<= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 50.000 mm
Selected spacing (S)	= 250.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

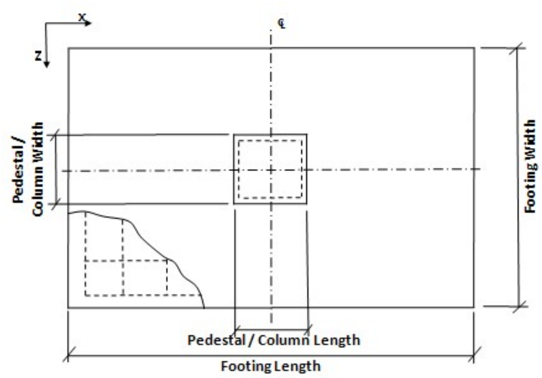
Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Isolated Footing 33



ELEVATION



PLAN

Input Values

Footing Geomtery

Design Type :	Set Dimension
Footing Thickness (Ft) :	250.000 mm
Slope End Thickness (St) :	150.000 mm
Footing Length - X (Fl) :	1000.000 mm
Footing Width - Z (Fw) :	1000.000 mm
Eccentricity along X (Oxd) :	0.000 mm
Eccentricity along Z (Ozd) :	0.000 mm

Column Dimensions

Column Shape :	Rectangular
Column Length - X (Pl) :	0.300 m

Column Width - Z (Pw) : 0.300 m

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 : 25.000 kN/m3
Strength of Concrete : 25.000 N/mm2
Yield Strength of Steel : 500.000 N/mm2
Minimum Bar Size : Ø12
Maximum Bar Size : Ø25
Minimum Bar Spacing : 50.000 mm
Maximum Bar Spacing : 250.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : Drained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 120.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 1500.000 mm
Cohesion : 0.000 kN/m2
Min Percentage of Slab : 0.000

Sliding and Overturning

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

Footing Design Calculations

Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**
101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**

101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	312.743	13.049	-10.478	-5.526	-6.183
102	383.917	13.199	-10.595	-5.596	-6.261
103	312.743	13.049	-10.478	-5.526	-6.183
104	312.743	13.049	-10.478	-5.526	-6.183
105	307.133	10.559	-8.476	-4.477	-5.009
106	307.133	10.559	-8.476	-4.477	-5.009
107	307.133	10.559	-8.476	-4.477	-5.009

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	312.743	13.049	-10.478	-5.526	-6.183
102	383.917	13.199	-10.595	-5.596	-6.261
103	312.743	13.049	-10.478	-5.526	-6.183
104	312.743	13.049	-10.478	-5.526	-6.183
105	307.133	10.559	-8.476	-4.477	-5.009
106	307.133	10.559	-8.476	-4.477	-5.009
107	307.133	10.559	-8.476	-4.477	-5.009

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	469.114	19.574	-15.717	-8.288	-9.275
202	575.875	19.798	-15.893	-8.394	-9.392

203	368.560	12.671	-10.171	-5.372	-6.011
204	368.560	12.671	-10.171	-5.372	-6.011
205	368.560	12.671	-10.171	-5.372	-6.011
206	375.291	15.659	-12.574	-6.631	-7.420
207	375.291	15.659	-12.574	-6.631	-7.420
208	375.291	15.659	-12.574	-6.631	-7.420
209	281.469	11.744	-9.430	-4.973	-5.565
210	281.469	11.744	-9.430	-4.973	-5.565
211	281.469	11.744	-9.430	-4.973	-5.565

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	469.114	19.574	-15.717	-8.288	-9.275
202	575.875	19.798	-15.893	-8.394	-9.392
203	368.560	12.671	-10.171	-5.372	-6.011
204	368.560	12.671	-10.171	-5.372	-6.011
205	368.560	12.671	-10.171	-5.372	-6.011
206	375.291	15.659	-12.574	-6.631	-7.420
207	375.291	15.659	-12.574	-6.631	-7.420
208	375.291	15.659	-12.574	-6.631	-7.420
209	281.469	11.744	-9.430	-4.973	-5.565
210	281.469	11.744	-9.430	-4.973	-5.565
211	281.469	11.744	-9.430	-4.973	-5.565

Footing Size

Initial Length (L_o) = 1.000 m

Initial Width (W_o) = 1.000 m

Reduction of force due to buoyancy = 0.000 kN

Effect due to adhesion = 0.000 kN

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

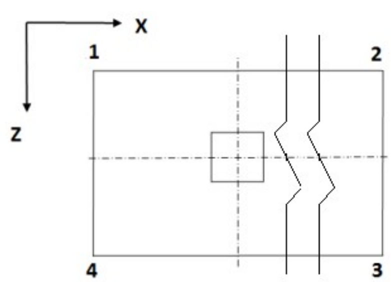
Min. area required from bearing pressure, $A_{min} = P / q_{max}$ = 3.445 m^2

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

Final dimensions for design

Length (L_2) =	2.200	m	Governing Load Case :	# 102
Width (W_2) =	2.200	m	Governing Load Case :	# 102
Area (A_2) =	4.840	m^2		

Pressures at Four Corner



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)
102	**106.2443**	116.3169	107.6311	97.5584	0.000
102	106.2443	**116.3169**	107.6311	97.5584	0.000
102	106.2443	116.3169	**107.6311**	97.5584	0.000
102	106.2443	116.3169	107.6311	**97.5584**	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 Four Corner

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)
102	**106.2443**	116.3169	107.6311	97.5584
102	106.2443	**116.3169**	107.6311	97.5584
102	106.2443	116.3169	**107.6311**	97.5584
102	106.2443	116.3169	107.6311	**97.5584**

Details of Out-of-Contact Area
(If Any)

Governing load case = N/A
Plan area of footing = 4.840 sq.m
Area not in contact with soil = 0.000 sq.m
% of total area not in contact = 0.000%

Detail of Out-of-contact Area

Governing load case = N/A
Plan area of footing = 4.840 sq.m
Area not in contact with soil = 0.000 sq.m
% of total area not in contact = 0.000%

Check For Stability Against Overturning And Sliding

-	Factor of safety against sliding		Factor of safety against overturning	
Load Case No.	Along X-Direction	Along Z-Direction	About X-Direction	About Z-Direction
101	18.056	22.487	63.641	54.877
102	20.548	25.598	72.368	62.404
103	18.056	22.487	63.641	54.877
104	18.056	22.487	63.641	54.877
105	22.049	27.468	77.655	66.963
106	22.049	27.468	77.655	66.963
107	22.049	27.468	77.655	66.963

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along X-Direction : 103
Governing Disturbing Force : 13.049 kN

Governing Restoring Force :	235.621	kN
Minimum Sliding Ratio for the Critical Load Case :	18.056	
Critical Load Case for Overturning about X-Direction :	104	
Governing Overturning Moment :	-8.145	kNm
Governing Resisting Moment :	518.358	kNm
Minimum Overturning Ratio for the Critical Load Case :	63.641	

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along Z-Direction :	101	
Governing Disturbing Force :	-10.478	kN
Governing Restoring Force :	235.621	kN
Minimum Sliding Ratio for the Critical Load Case :	22.487	
Critical Load Case for Overturning about Z-Direction :	103	
Governing Overturning Moment :	-9.446	kNm
Governing Resisting Moment :	518.358	kNm
Minimum Overturning Ratio for the Critical Load Case :	54.877	

Check Trial Depth against moment (w.r.t. X Axis)

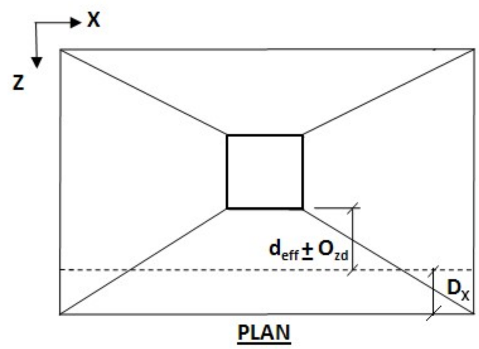
Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.294	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.194	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.538	m
Governing moment (M_u)		= 123.043	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 154.156117	kNm
$M_u <= M_{umax}$	hence, safe		

Check Trial Depth against moment (w.r.t. Z Axis)

Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.294	m
Effective End Depth		= 0.194	m
Effective Width		= 0.538	m
Governing moment (M_u) =		= 123.835	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 154.156117	kNm
$M_u <= M_{umax}$	hence, safe		

Check Trial Depth for one way shear (Along X Axis)

(Shear Plane Parallel To X axis)

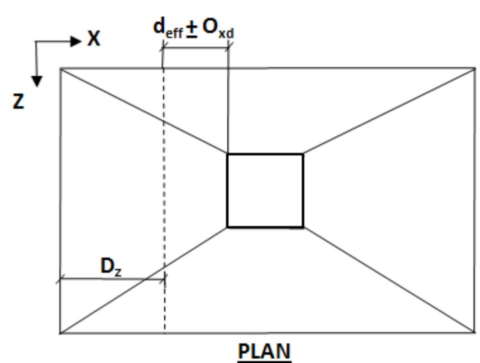


Critical Load Case = #202

D_X = 0.294 m		
Shear Force(S)	= 178.774	kN
Shear Stress(T_v)	= 214.577085	kN/m2
Percentage Of Steel(P_t)	= 0.7150	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 564.154	kN/m2
$T_v < T_c$ hence, safe		

Check Trial Depth for one way shear (Along Z Axis)

(Shear Plane Parallel To Z axis)



Critical Load Case = #202

D_Z = 0.294 m		
Shear Force(S)	= 179.901	kN
Shear Stress(T_v)	= 215.929731	kN/m2
Percentage Of Steel(P_t)	= 0.7095	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 562.454	kN/m2
$T_v < T_c$ hence, safe		

Check Trial Depth for two way shear

Critical Load Case	**= #202**		
Shear Force(S)		= 533.894	kN
Shear Stress(T_v)		= 806.756	kN/m2
As Per IS 456 2000 Clause 31.6.3.1			
K_s =	$\min[(0.5+\beta),1]$	= 1.000	
Shear Strength(T_c)=	$0.25 \times \sqrt{f_{ck}}$	= 1250.0000	kN/m2
K_s X T_c		= 1250.0000	kN/m2
T_v<= K_s X T_c	hence, safe		

Calculation of Maximum Bar Size

Along X Axis

Bar diameter corresponding to max bar size (d_b)	= 16	mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$	= 0.777	m
Allowable Length(l_{db}) =	$\left[\frac{(B-b)}{2} - cc\right]$	= 0.900	m
l_{db} >=l_d	hence, safe		

Along Z Axis

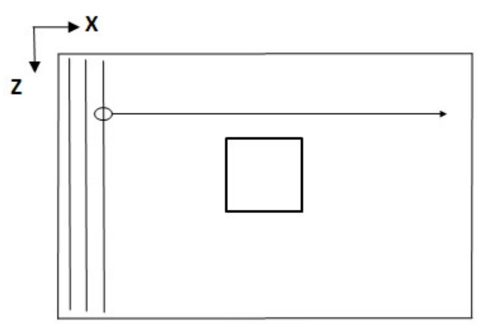
Bar diameter corresponding to max bar size(d_b)	= 16	mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$	= 0.777	m
Allowable Length(l_{db}) =	$\left[\frac{(H-h)}{2} - cc\right]$	= 0.900	m
l_{db} >=l_d	hence, safe		

Selection of Reinforcement

Along Z Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = #202

Minimum Area of Steel (A_{stmin}) = 924.000 mm2

Calculated Area of Steel (A_{st}) = 1121.220 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1121.220 mm2

A_{stmin} <= $A_{st,Provided}$ Steel area is accepted

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 52.000 mm

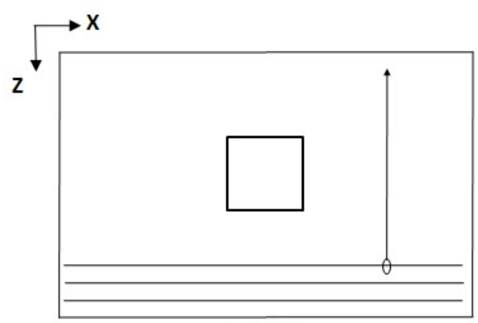
Selected spacing (S) = 232.000 mm

S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 230.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = #202

Minimum Area of Steel (A_{stmin}) = 924.000 mm2

Calculated Area of Steel (A_{st}) = 1129.885 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1129.885 mm2

A_{stmin} <= $A_{st,Provided}$ Steel area is accepted

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 50.000 mm

Selected spacing (S) = 232.000 mm

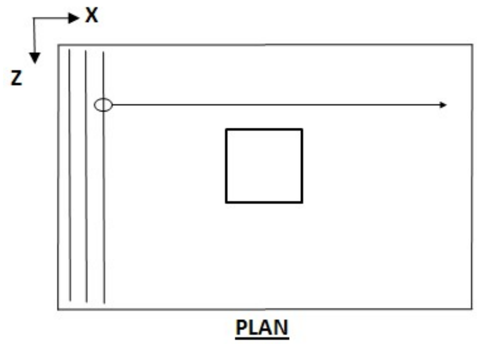
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 230.000 mm o.c.

Reinforecement is provided at bottom.Provide minimum reinf at top if depth is considerable

Design for top reinforcement Along Z Axis



Calculate the flexural reinforcement along the X direction of the footing. Find the area of steel required

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

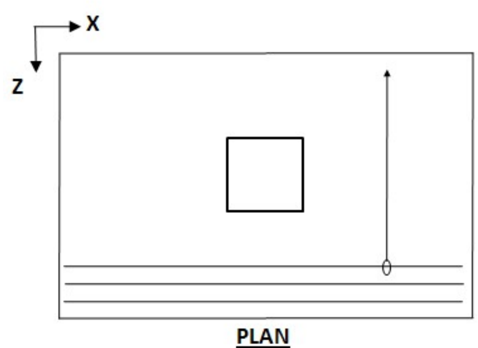
Minimum Area of Steel (A_{stmin})	= 924.000	mm2
Calculated Area of Steel (A_{st})	= 660.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 924.000	mm2
A_{stmin}<= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 52.000 mm
Selected spacing (S)	= 250.000mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Design for top reinforcement Along X Axis



Calculate the flexural reinforcement along the Z direction of the footing. Find the area of steel required

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

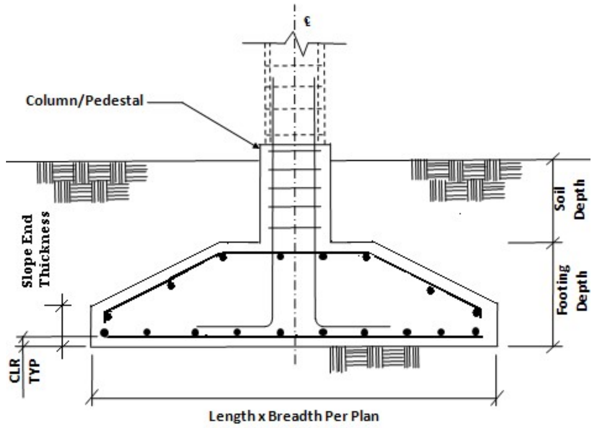
Minimum Area of Steel (A_{stmin})	= 924.000	mm2
Calculated Area of Steel (A_{st})	= 869.183	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 924.000	mm2
A_{stmin}<= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 50.000 mm
Selected spacing (S)	= 250.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

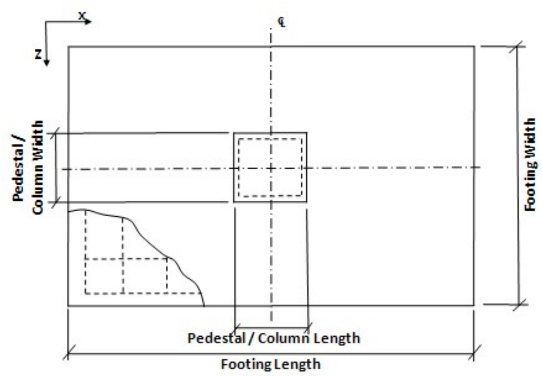
Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Isolated Footing 34



ELEVATION



PLAN

Input Values

Footing Geomtery

Design Type :	Set Dimension
Footing Thickness (Ft) :	250.000 mm
Slope End Thickness (St) :	150.000 mm
Footing Length - X (Fl) :	1000.000 mm
Footing Width - Z (Fw) :	1000.000 mm
Eccentricity along X (Oxd) :	0.000 mm
Eccentricity along Z (Ozd) :	0.000 mm

Column Dimensions

Column Shape :	Rectangular
Column Length - X (Pl) :	0.300 m

Column Width - Z (Pw) : 0.300 m

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 : 25.000 kN/m3
Strength of Concrete : 25.000 N/mm2
Yield Strength of Steel : 500.000 N/mm2
Minimum Bar Size : Ø12
Maximum Bar Size : Ø25
Minimum Bar Spacing : 50.000 mm
Maximum Bar Spacing : 250.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : Drained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 120.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 1500.000 mm
Cohesion : 0.000 kN/m2
Min Percentage of Slab : 0.000

Sliding and Overturning

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

Footing Design Calculations

Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**
101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**

101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	195.254	-1.067	-2.348	-1.326	0.396
102	227.299	-1.484	-2.222	-1.246	0.549
103	195.254	-1.067	-2.348	-1.326	0.396
104	195.254	-1.067	-2.348	-1.326	0.396
105	181.839	-1.187	-1.778	-0.997	0.440
106	181.839	-1.187	-1.778	-0.997	0.440
107	181.839	-1.187	-1.778	-0.997	0.440

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	195.254	-1.067	-2.348	-1.326	0.396
102	227.299	-1.484	-2.222	-1.246	0.549
103	195.254	-1.067	-2.348	-1.326	0.396
104	195.254	-1.067	-2.348	-1.326	0.396
105	181.839	-1.187	-1.778	-0.997	0.440
106	181.839	-1.187	-1.778	-0.997	0.440
107	181.839	-1.187	-1.778	-0.997	0.440

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	292.881	-1.601	-3.522	-1.989	0.595
202	340.948	-2.225	-3.333	-1.869	0.824

203	218.207	-1.424	-2.133	-1.196	0.528
204	218.207	-1.424	-2.133	-1.196	0.528
205	218.207	-1.424	-2.133	-1.196	0.528
206	234.305	-1.281	-2.817	-1.591	0.476
207	234.305	-1.281	-2.817	-1.591	0.476
208	234.305	-1.281	-2.817	-1.591	0.476
209	175.729	-0.961	-2.113	-1.193	0.357
210	175.729	-0.961	-2.113	-1.193	0.357
211	175.729	-0.961	-2.113	-1.193	0.357

Applied Loads - Strength Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	292.881	-1.601	-3.522	-1.989	0.595
202	340.948	-2.225	-3.333	-1.869	0.824
203	218.207	-1.424	-2.133	-1.196	0.528
204	218.207	-1.424	-2.133	-1.196	0.528
205	218.207	-1.424	-2.133	-1.196	0.528
206	234.305	-1.281	-2.817	-1.591	0.476
207	234.305	-1.281	-2.817	-1.591	0.476
208	234.305	-1.281	-2.817	-1.591	0.476
209	175.729	-0.961	-2.113	-1.193	0.357
210	175.729	-0.961	-2.113	-1.193	0.357
211	175.729	-0.961	-2.113	-1.193	0.357

Footing Size

Initial Length (L_o) = 1.000 m

Initial Width (W_o) = 1.000 m

Reduction of force due to buoyancy = 0.000 kN

Effect due to adhesion = 0.000 kN

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

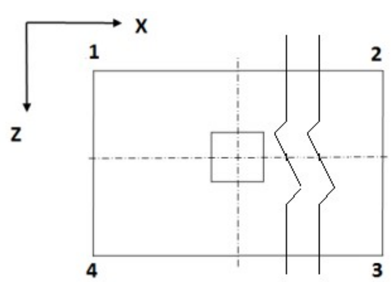
Min. area required from bearing pressure, $A_{min} = P / q_{max}$ = 2.140 m^2

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

Final dimensions for design

Length (L_2) =	1.650	m	Governing Load Case :	# 102
Width (W_2) =	1.650	m	Governing Load Case :	# 102
Area (A_2) =	2.723	m^2		

Pressures at Four Corner



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)
102	**117.9943**	115.5356	110.7234	113.1822	0.000
102	117.9943	**115.5356**	110.7234	113.1822	0.000
102	117.9943	115.5356	**110.7234**	113.1822	0.000
102	117.9943	115.5356	110.7234	**113.1822**	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 Four Corner

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)
102	**117.9943**	115.5356	110.7234	113.1822
102	117.9943	**115.5356**	110.7234	113.1822
102	117.9943	115.5356	**110.7234**	113.1822
102	117.9943	115.5356	110.7234	**113.1822**

Details of Out-of-Contact Area
(If Any)

Governing load case = N/A

Plan area of footing = 2.723 sq.m

Area not in contact with soil = 0.000 sq.m

% of total area not in contact = 0.000%

Detail of Out-of-contact Area

Governing load case = N/A

Plan area of footing = 2.723 sq.m

Area not in contact with soil = 0.000 sq.m

% of total area not in contact = 0.000%

Check For Stability Against Overturning And Sliding

-	Factor of safety against sliding		Factor of safety against overturning	
Load Case No.	Along X-Direction	Along Z-Direction	About X-Direction	About Z-Direction
101	132.730	60.342	122.197	352.411
102	106.289	70.973	144.442	282.698
103	132.730	60.342	122.197	352.411
104	132.730	60.342	122.197	352.411
105	113.711	75.929	154.528	302.438
106	113.711	75.929	154.528	302.438
107	113.711	75.929	154.528	302.438

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along X-Direction : 102

Governing Disturbing Force : -1.484 kN

Governing Restoring Force :	157.696	kN
Minimum Sliding Ratio for the Critical Load Case :	106.289	
Critical Load Case for Overturning about X-Direction :	101	
Governing Overturning Moment :	-1.913	kNm
Governing Resisting Moment :	233.757	kNm
Minimum Overturning Ratio for the Critical Load Case :	122.197	

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along Z-Direction :	101	
Governing Disturbing Force :	-2.348	kN
Governing Restoring Force :	141.674	kN
Minimum Sliding Ratio for the Critical Load Case :	60.342	
Critical Load Case for Overturning about Z-Direction :	102	
Governing Overturning Moment :	0.920	kNm
Governing Resisting Moment :	260.194	kNm
Minimum Overturning Ratio for the Critical Load Case :	282.698	

Check Trial Depth against moment (w.r.t. X Axis)

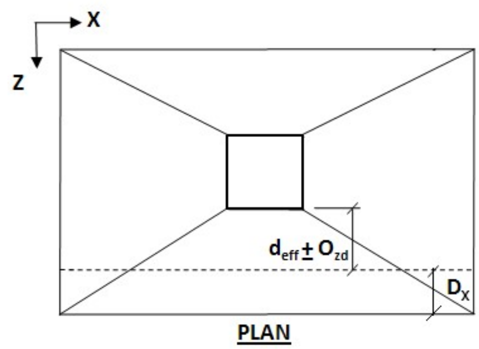
Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.194	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.094	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.469	m
Governing moment (M_u)		= 48.060	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 58.537258	kNm
$M_u <= M_{umax}$	hence, safe		

Check Trial Depth against moment (w.r.t. Z Axis)

Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.194	m
Effective End Depth		= 0.094	m
Effective Width		= 0.469	m
Governing moment (M_u) =		= 47.577	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 58.537258	kNm
$M_u <= M_{umax}$	hence, safe		

Check Trial Depth for one way shear (Along X Axis)

(Shear Plane Parallel To X axis)

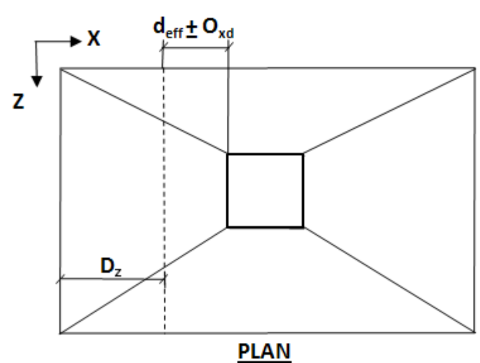


Critical Load Case = #202

D_X = 0.194 m		
Shear Force(S)	= 101.421	kN
Shear Stress(T_v)	= 359.862996	kN/m2
Percentage Of Steel(P_t)	= 0.7251	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 567.269	kN/m2
$T_v < T_c$ hence, safe		

Check Trial Depth for one way shear (Along Z Axis)

(Shear Plane Parallel To Z axis)



Critical Load Case = #202

D_Z = 0.194 m		
Shear Force(S)	= 100.428	kN
Shear Stress(T_v)	= 356.341464	kN/m2
Percentage Of Steel(P_t)	= 0.7340	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 569.971	kN/m2
$T_v < T_c$ hence, safe		

Check Trial Depth for two way shear

Critical Load Case	**= #202**		
Shear Force(S)		= 310.387	kN
Shear Stress(T_v)		= 874.457	kN/m2
As Per IS 456 2000 Clause 31.6.3.1			
K_s =	$\min[(0.5+\beta),1]$	= 1.000	
Shear Strength(T_c)=	$0.25 \times \sqrt{f_{ck}}$	= 1250.0000	kN/m2
K_s X T_c		= 1250.0000	kN/m2
T_v<= K_s X T_c	hence, safe		

Calculation of Maximum Bar Size

Along X Axis

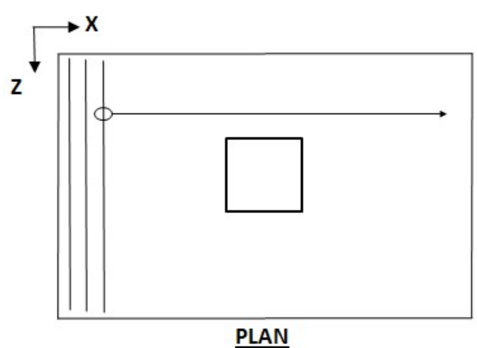
Bar diameter corresponding to max bar size (d_b)		= 12	mm
As Per IS 456 2000 Clause 26.2.1			
Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$	= 0.583	m
Allowable Length(l_{db}) =	$\left[\frac{(B-b)}{2} - cc\right]$	= 0.625	m
l_{db} >=l_d	hence, safe		

Along Z Axis

Bar diameter corresponding to max bar size(d_b)		= 12	mm
As Per IS 456 2000 Clause 26.2.1			
Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$	= 0.583	m
Allowable Length(l_{db}) =	$\left[\frac{(H-h)}{2} - cc\right]$	= 0.625	m
l_{db} >=l_d	hence, safe		

Selection of Reinforcement

Along Z Axis



As Per IS 456 2000 Clause 26.5.2.1

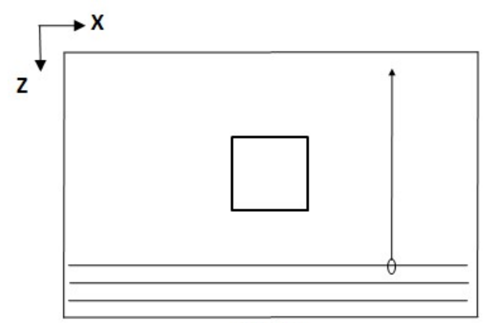
Critical Load Case	**= #202**
Minimum Area of Steel (A_{stmin})	= 495.000 mm2
Calculated Area of Steel (A_{st})	= 667.494 mm2
Provided Area of Steel ($A_{st,Provided}$)	= 667.494 mm2
A_{stmin}<= $A_{st,Provided}$	Steel area is accepted

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 52.000 mm
Selected spacing (S)	= 250.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250.000 mm o.c.

Along X Axis



As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case	**= #202**
Minimum Area of Steel (A_{stmin})	= 495.000 mm2
Calculated Area of Steel (A_{st})	= 659.423 mm2
Provided Area of Steel ($A_{st,Provided}$)	= 659.423 mm2
A_{stmin}<= $A_{st,Provided}$	Steel area is accepted

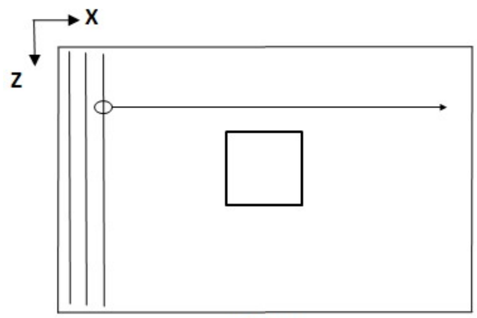
Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 50.000 mm
Selected spacing (S)	= 250.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250.000 mm o.c.

Reinforecement is provided at bottom.Provide minimum reinf at top if depth is considerable

Design for top reinforcement Along Z Axis



PLAN

Calculate the flexural reinforcement along the X direction of the footing. Find the area of steel required

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

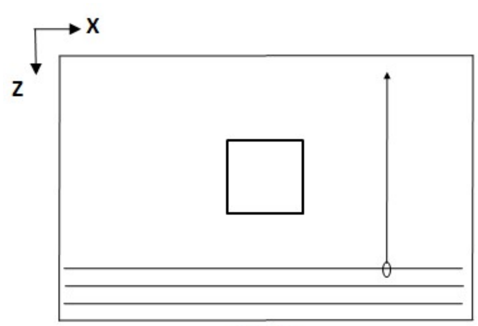
Minimum Area of Steel (A_{stmin})	= 495.000	mm2
Calculated Area of Steel (A_{st})	= 495.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 495.000	mm2
A_{stmin} <= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 52.000 mm
Selected spacing (S)	= 250.000mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Design for top reinforcement Along X Axis



PLAN

Calculate the flexural reinforcement along the Z direction of the footing. Find the area of steel required

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

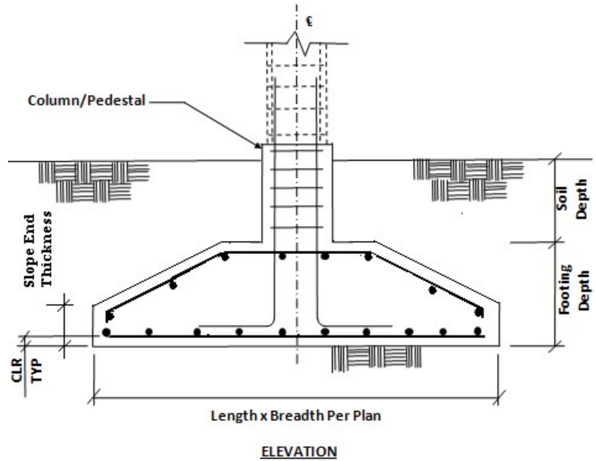
Minimum Area of Steel (A_{stmin})	= 495.000	mm2
Calculated Area of Steel (A_{st})	= 495.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 495.000	mm2
A_{stmin} <= $A_{st,Provided}$	Steel area is accepted	

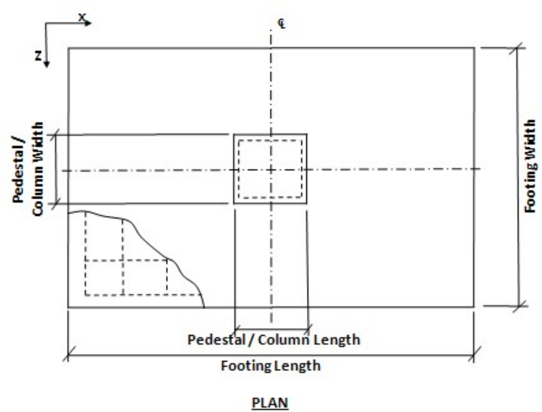
Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 50.000 mm
Selected spacing (S)	= 250.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Isolated Footing 35





Input Values

Footing Geomtery

Design Type :	Set Dimension
Footing Thickness (Ft) :	250.000 mm
Slope End Thickness (St) :	150.000 mm
Footing Length - X (Fl) :	1000.000 mm
Footing Width - Z (Fw) :	1000.000 mm
Eccentricity along X (Oxd) :	0.000 mm
Eccentricity along Z (Ozd) :	0.000 mm

Column Dimensions

Column Shape :	Rectangular
Column Length - X (Pl) :	0.300 m

Column Width - Z (Pw) : 0.300 m

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 : 25.000 kN/m3
Strength of Concrete : 25.000 N/mm2
Yield Strength of Steel : 500.000 N/mm2
Minimum Bar Size : Ø12
Maximum Bar Size : Ø25
Minimum Bar Spacing : 50.000 mm
Maximum Bar Spacing : 250.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : Drained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 120.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 1500.000 mm
Cohesion : 0.000 kN/m2
Min Percentage of Slab : 0.000

Sliding and Overturning

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

Footing Design Calculations

Load Combination/s- Service Stress Level

Load Combination Number	Load Combination Title
101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Service Stress Level

Load Combination Number	Load Combination Title

101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	149.726	-13.556	11.230	4.949	6.201
102	167.558	-12.411	10.813	4.801	5.699
103	149.726	-13.556	11.230	4.949	6.201
104	149.726	-13.556	11.230	4.949	6.201
105	134.047	-9.929	8.650	3.841	4.559
106	134.047	-9.929	8.650	3.841	4.559
107	134.047	-9.929	8.650	3.841	4.559

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	149.726	-13.556	11.230	4.949	6.201
102	167.558	-12.411	10.813	4.801	5.699
103	149.726	-13.556	11.230	4.949	6.201
104	149.726	-13.556	11.230	4.949	6.201
105	134.047	-9.929	8.650	3.841	4.559
106	134.047	-9.929	8.650	3.841	4.559
107	134.047	-9.929	8.650	3.841	4.559

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	224.590	-20.334	16.845	7.423	9.302
202	251.338	-18.617	16.219	7.201	8.548

203	160.856	-11.915	10.380	4.609	5.471
204	160.856	-11.915	10.380	4.609	5.471
205	160.856	-11.915	10.380	4.609	5.471
206	179.672	-16.267	13.476	5.939	7.441
207	179.672	-16.267	13.476	5.939	7.441
208	179.672	-16.267	13.476	5.939	7.441
209	134.754	-12.200	10.107	4.454	5.581
210	134.754	-12.200	10.107	4.454	5.581
211	134.754	-12.200	10.107	4.454	5.581

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	224.590	-20.334	16.845	7.423	9.302
202	251.338	-18.617	16.219	7.201	8.548
203	160.856	-11.915	10.380	4.609	5.471
204	160.856	-11.915	10.380	4.609	5.471
205	160.856	-11.915	10.380	4.609	5.471
206	179.672	-16.267	13.476	5.939	7.441
207	179.672	-16.267	13.476	5.939	7.441
208	179.672	-16.267	13.476	5.939	7.441
209	134.754	-12.200	10.107	4.454	5.581
210	134.754	-12.200	10.107	4.454	5.581
211	134.754	-12.200	10.107	4.454	5.581

Footing Size

Initial Length (L_o) = 1.000 m

Initial Width (W_o) = 1.000 m

Reduction of force due to buoyancy = 0.000 kN

Effect due to adhesion = 0.000 kN

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

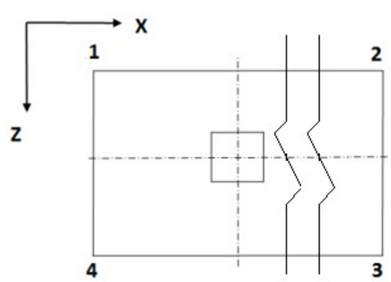
Min. area required from bearing pressure, $A_{min} = P / q_{max}$ = 1.642 m^2

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

Final dimensions for design

Length (L_2) =	1.650	m	Governing Load Case :	# 102
Width (W_2) =	1.650	m	Governing Load Case :	# 102
Area (A_2) =	2.723	m^2		

Pressures at Four Corner



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)
102	**94.1488**	70.6365	90.6824	114.1947	0.000
102	94.1488	**70.6365**	90.6824	114.1947	0.000
102	94.1488	70.6365	**90.6824**	114.1947	0.000
102	94.1488	70.6365	90.6824	**114.1947**	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 Four Corner

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)
102	**94.1488**	70.6365	90.6824	114.1947
102	94.1488	**70.6365**	90.6824	114.1947
102	94.1488	70.6365	**90.6824**	114.1947
102	94.1488	70.6365	90.6824	**114.1947**

Details of Out-of-Contact Area
(If Any)

Governing load case = N/A
Plan area of footing = 2.723 sq.m
Area not in contact with soil = 0.000 sq.m
% of total area not in contact = 0.000%

Detail of Out-of-contact Area

Governing load case = N/A
Plan area of footing = 2.723 sq.m
Area not in contact with soil = 0.000 sq.m
% of total area not in contact = 0.000%

Check For Stability Against Overturning And Sliding

-	Factor of safety against sliding		Factor of safety against overturning	
Load Case No.	Along X-Direction	Along Z-Direction	About X-Direction	About Z-Direction
101	8.772	10.588	25.295	20.458
102	10.299	11.822	28.106	23.963
103	8.772	10.588	25.295	20.458
104	8.772	10.588	25.295	20.458
105	11.186	12.840	30.528	26.027
106	11.186	12.840	30.528	26.027
107	11.186	12.840	30.528	26.027

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along X-Direction : 101
Governing Disturbing Force : -13.556 kN

Governing Restoring Force :	118.910	kN
Minimum Sliding Ratio for the Critical Load Case :	8.772	
Critical Load Case for Overturning about X-Direction :	101	
Governing Overturning Moment :	7.756	kNm
Governing Resisting Moment :	196.198	kNm
Minimum Overturning Ratio for the Critical Load Case :	25.295	

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along Z-Direction :	101	
Governing Disturbing Force :	11.230	kN
Governing Restoring Force :	118.910	kN
Minimum Sliding Ratio for the Critical Load Case :	10.588	
Critical Load Case for Overturning about Z-Direction :	101	
Governing Overturning Moment :	9.590	kNm
Governing Resisting Moment :	196.198	kNm
Minimum Overturning Ratio for the Critical Load Case :	20.458	

Check Trial Depth against moment (w.r.t. X Axis)

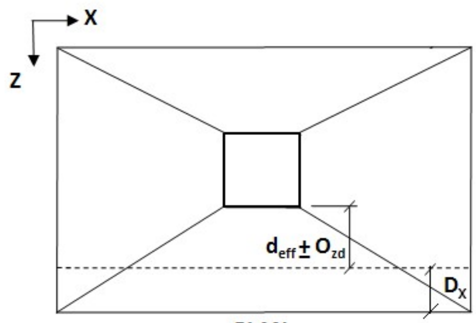
Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.194	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.094	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.469	m
Governing moment (M_u)		= 38.815	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 58.537258	kNm
M_u <= M_{umax}	hence, safe		

Check Trial Depth against moment (w.r.t. Z Axis)

Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.194	m
Effective End Depth		= 0.094	m
Effective Width		= 0.469	m
Governing moment (M_u) =		= 39.520	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 58.537258	kNm
M_u <= M_{umax}	hence, safe		

Check Trial Depth for one way shear (Along X Axis)

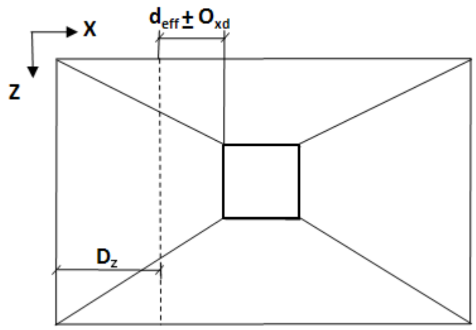
(Shear Plane Parallel To X axis)



Critical Load Case	**= #202**		
D_X =	0.194 m		
Shear Force(S)		= 81.722	kN
Shear Stress(T_v)		= 289.968406	kN/m2
Percentage Of Steel(P_t)		= 0.5830	
As Per IS 456 2000 Clause 40 Table 19			
Shear Strength Of Concrete(T_c)		= 520.250	kN/m2
$T_v < T_c$	hence, safe		

Check Trial Depth for one way shear (Along Z Axis)

(Shear Plane Parallel To Z axis)



Critical Load Case	**= #202**		
D_Z =	0.194 m		
Shear Force(S)		= 83.184	kN
Shear Stress(T_v)		= 295.155281	kN/m2
Percentage Of Steel(P_t)		= 0.5710	
As Per IS 456 2000 Clause 40 Table 19			
Shear Strength Of Concrete(T_c)		= 515.933	kN/m2
$T_v < T_c$	hence, safe		

Check Trial Depth for two way shear

Critical Load Case	**= #202**		
Shear Force(S)		= 228.809	kN
Shear Stress(T_v)		= 644.625	kN/m2
As Per IS 456 2000 Clause 31.6.3.1			
K_s =	$\min[(0.5+\beta),1]$	= 1.000	
Shear Strength(T_c)=	$0.25 \times \sqrt{f_{ck}}$	= 1250.0000	kN/m2
K_s X T_c		= 1250.0000	kN/m2
T_v<= K_s X T_c	hence, safe		

Calculation of Maximum Bar Size

Along X Axis

Bar diameter corresponding to max bar size (d_b) = 12 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$	= 0.583	m
Allowable Length(l_{db}) =	$\left[\frac{(B-b)}{2} - cc\right]$	= 0.625	m
l_{db} >=l_d	hence, safe		

Along Z Axis

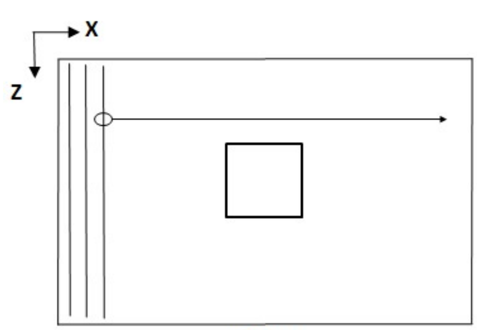
Bar diameter corresponding to max bar size(d_b) = 12 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$	= 0.583	m
Allowable Length(l_{db}) =	$\left[\frac{(H-h)}{2} - cc\right]$	= 0.625	m
l_{db} >=l_d	hence, safe		

Selection of Reinforcement

Along Z Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

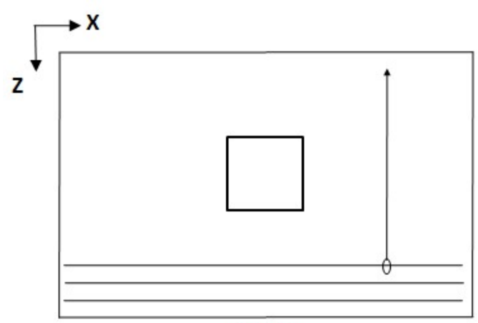
Critical Load Case	**= #202**	
Minimum Area of Steel (A_{stmin})	= 495.000	mm2
Calculated Area of Steel (A_{st})	= 519.252	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 519.252	mm2
A_{stmin} <= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 52.000 mm
Selected spacing (S)	= 250.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case	**= #202**	
Minimum Area of Steel (A_{stmin})	= 495.000	mm2
Calculated Area of Steel (A_{st})	= 530.121	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 530.121	mm2
A_{stmin} <= $A_{st,Provided}$	Steel area is accepted	

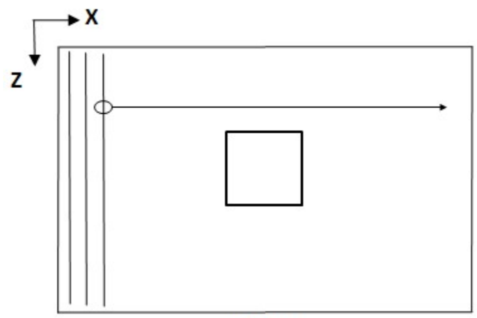
Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 50.000 mm
Selected spacing (S)	= 250.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250.000 mm o.c.

Reinforecement is provided at bottom.Provide minimum reinf at top if depth is considerable

Design for top reinforcement Along Z Axis



PLAN

Calculate the flexural reinforcement along the X direction of the footing. Find the area of steel required

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

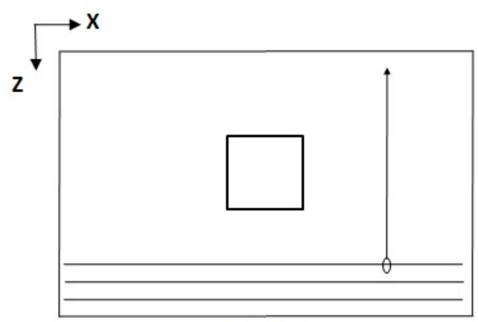
Minimum Area of Steel (A_{stmin})	= 495.000	mm2
Calculated Area of Steel (A_{st})	= 495.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 495.000	mm2
A_{stmin} <= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 52.000 mm
Selected spacing (S)	= 250.000mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Design for top reinforcement Along X Axis



PLAN

Calculate the flexural reinforcement along the Z direction of the footing. Find the area of steel required

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

Minimum Area of Steel (A_{stmin})	= 495.000	mm2
Calculated Area of Steel (A_{st})	= 495.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 495.000	mm2
A_{stmin} <= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 50.000 mm

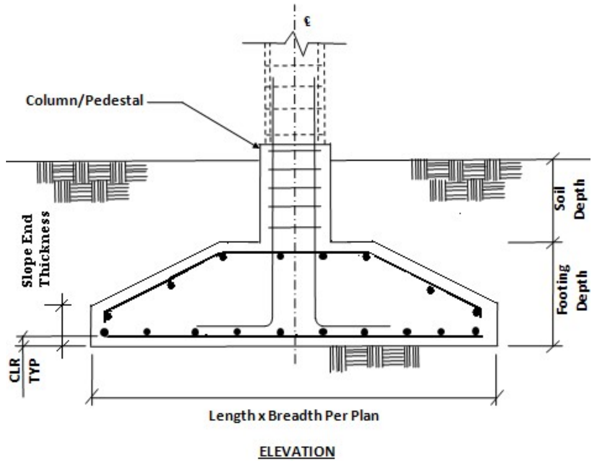
Selected spacing (S) = 250.000 mm

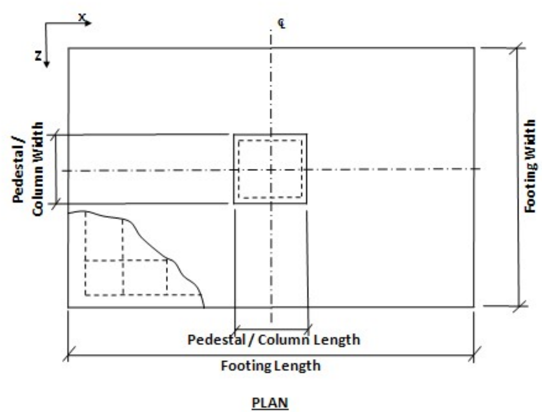
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Isolated Footing 36





Input Values

Footing Geomtery

Design Type : Set Dimension

Footing Thickness (Ft) : 250.000 mm

Slope End Thickness (St) : 150.000 mm

Footing Length - X (Fl) : 1000.000 mm

Footing Width - Z (Fw) : 1000.000 mm

Eccentricity along X (Oxd) : 0.000 mm

Eccentricity along Z (Ozd) : 0.000 mm

Column Dimensions

Column Shape : Rectangular

Column Length - X (Pl) : 0.300 m

Column Width - Z (Pw) : 0.300 m

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 : 25.000 kN/m3

Strength of Concrete : 25.000 N/mm2

Yield Strength of Steel : 500.000 N/mm2

Minimum Bar Size : Ø12

Maximum Bar Size : Ø25

Minimum Bar Spacing : 50.000 mm

Maximum Bar Spacing : 250.000 mm

Pedestal Clear Cover (P, CL) : 50.000 mm

Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : Drained

Unit Weight : 18.000 kN/m3

Soil Bearing Capacity : 120.000 kN/m2

Soil Surcharge : 0.000 kN/m2

Depth of Soil above Footing : 1500.000 mm

Cohesion : 0.000 kN/m2

Min Percentage of Slab : 0.000

Sliding and Overturning

Coefficient of Friction : 0.500

Factor of Safety Against Sliding : 1.500

Factor of Safety Against Overturning : 1.500

Footing Design Calculations

Load Combination/s- Service Stress Level

Load Combination Number	Load Combination Title
101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Service Stress Level

Load Combination Number	Load Combination Title

101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	159.264	13.599	11.563	4.784	-6.513
102	178.748	12.433	11.099	4.595	-5.997
103	159.264	13.599	11.563	4.784	-6.513
104	159.264	13.599	11.563	4.784	-6.513
105	142.998	9.946	8.879	3.676	-4.798
106	142.998	9.946	8.879	3.676	-4.798
107	142.998	9.946	8.879	3.676	-4.798

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	159.264	13.599	11.563	4.784	-6.513
102	178.748	12.433	11.099	4.595	-5.997
103	159.264	13.599	11.563	4.784	-6.513
104	159.264	13.599	11.563	4.784	-6.513
105	142.998	9.946	8.879	3.676	-4.798
106	142.998	9.946	8.879	3.676	-4.798
107	142.998	9.946	8.879	3.676	-4.798

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	238.896	20.398	17.345	7.177	-9.770
202	268.122	18.649	16.649	6.892	-8.996

203	171.598	11.936	10.655	4.411	-5.757
204	171.598	11.936	10.655	4.411	-5.757
205	171.598	11.936	10.655	4.411	-5.757
206	191.117	16.319	13.876	5.741	-7.816
207	191.117	16.319	13.876	5.741	-7.816
208	191.117	16.319	13.876	5.741	-7.816
209	143.338	12.239	10.407	4.306	-5.862
210	143.338	12.239	10.407	4.306	-5.862
211	143.338	12.239	10.407	4.306	-5.862

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	238.896	20.398	17.345	7.177	-9.770
202	268.122	18.649	16.649	6.892	-8.996
203	171.598	11.936	10.655	4.411	-5.757
204	171.598	11.936	10.655	4.411	-5.757
205	171.598	11.936	10.655	4.411	-5.757
206	191.117	16.319	13.876	5.741	-7.816
207	191.117	16.319	13.876	5.741	-7.816
208	191.117	16.319	13.876	5.741	-7.816
209	143.338	12.239	10.407	4.306	-5.862
210	143.338	12.239	10.407	4.306	-5.862
211	143.338	12.239	10.407	4.306	-5.862

Footing Size

Initial Length (L_o) = 1.000 m

Initial Width (W_o) = 1.000 m

Reduction of force due to buoyancy = 0.000 kN

Effect due to adhesion = 0.000 kN

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

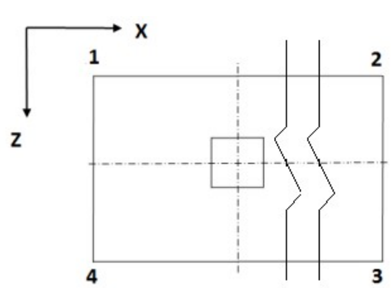
Min. area required from bearing pressure, $A_{min} = P / q_{max}$ = 1.735 m^2

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

Final dimensions for design

Length (L_2) =	1.650	m	Governing Load Case :	# 102
Width (W_2) =	1.650	m	Governing Load Case :	# 102
Area (A_2) =	2.723	m^2		

Pressures at Four Corner



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)
102	**74.5201**	98.8438	118.5311	94.2074	0.000
102	74.5201	**98.8438**	118.5311	94.2074	0.000
102	74.5201	98.8438	**118.5311**	94.2074	0.000
102	74.5201	98.8438	118.5311	**94.2074**	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 Four Corner

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)
102	**74.5201**	98.8438	118.5311	94.2074
102	74.5201	**98.8438**	118.5311	94.2074
102	74.5201	98.8438	**118.5311**	94.2074
102	74.5201	98.8438	118.5311	**94.2074**

Details of Out-of-Contact Area (If Any)

Governing load case = N/A

Plan area of footing = 2.723 sq.m

Area not in contact with soil = 0.000 sq.m

% of total area not in contact = 0.000%

Detail of Out-of-contact Area

Governing load case = N/A

Plan area of footing = 2.723 sq.m

Area not in contact with soil = 0.000 sq.m

% of total area not in contact = 0.000%

Check For Stability Against Overturning And Sliding

-	Factor of safety against sliding		Factor of safety against overturning	
Load Case No.	Along X-Direction	Along Z-Direction	About X-Direction	About Z-Direction
101	9.095	10.696	26.588	20.585
102	10.731	12.021	29.871	24.177
103	9.095	10.696	26.588	20.585
104	9.095	10.696	26.588	20.585
105	11.617	13.013	32.336	26.173
106	11.617	13.013	32.336	26.173
107	11.617	13.013	32.336	26.173

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along X-Direction : 101

Governing Disturbing Force : 13.599 kN

Governing Restoring Force :	123.679 kN
Minimum Sliding Ratio for the Critical Load Case :	9.095
Critical Load Case for Overturning about X-Direction :	101
Governing Overturning Moment :	7.675 kNm
Governing Resisting Moment :	204.066 kNm
Minimum Overturning Ratio for the Critical Load Case :	26.588

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along Z-Direction :	101
Governing Disturbing Force :	11.563 kN
Governing Restoring Force :	123.679 kN
Minimum Sliding Ratio for the Critical Load Case :	10.696
Critical Load Case for Overturning about Z-Direction :	101
Governing Overturning Moment :	-9.913 kNm
Governing Resisting Moment :	204.066 kNm
Minimum Overturning Ratio for the Critical Load Case :	20.585

Check Trial Depth against moment (w.r.t. X Axis)

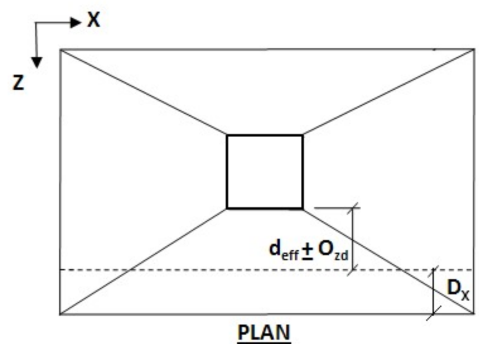
Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.194	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.094	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.469	m
Governing moment (M_u)		= 41.059	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^{2}$	= 58.537258	kNm
M_u <= M_{umax}	hence, safe		

Check Trial Depth against moment (w.r.t. Z Axis)

Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.194	m
Effective End Depth		= 0.094	m
Effective Width		= 0.469	m
Governing moment (M_u) =		= 42.010	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^{2}$	= 58.537258	kNm
M_u <= M_{umax}	hence, safe		

Check Trial Depth for one way shear (Along X Axis)

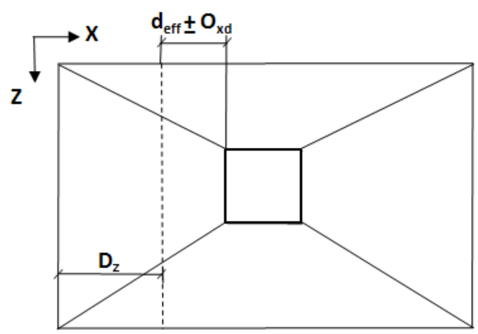
(Shear Plane Parallel To X axis)



Critical Load Case	**= #202**		
D_X =	0.194 m		
Shear Force(S)		= 86.464	kN
Shear Stress(T_v)		= 306.792664	kN/m2
Percentage Of Steel(P_t)		= 0.6257	
As Per IS 456 2000 Clause 40 Table 19			
Shear Strength Of Concrete(T_c)		= 535.202	kN/m2
$T_v < T_c$	hence, safe		

Check Trial Depth for one way shear (Along Z Axis)

(Shear Plane Parallel To Z axis)



Critical Load Case	**= #202**		
D_Z =	0.194 m		
Shear Force(S)		= 88.419	kN
Shear Stress(T_v)		= 313.730266	kN/m2
Percentage Of Steel(P_t)		= 0.6093	
As Per IS 456 2000 Clause 40 Table 19			
Shear Strength Of Concrete(T_c)		= 529.538	kN/m2
$T_v < T_c$	hence, safe		

Check Trial Depth for two way shear

Critical Load Case	**= #202**		
Shear Force(S)		= 244.088	kN
Shear Stress(T_v)		= 687.673	kN/m2
As Per IS 456 2000 Clause 31.6.3.1			
K_s =	$\min[(0.5+\beta),1]$	= 1.000	
Shear Strength(T_c)=	$0.25 \times \sqrt{f_{ck}}$	= 1250.0000	kN/m2
K_s X T_c		= 1250.0000	kN/m2
T_v<= K_s X T_c	hence, safe		

Calculation of Maximum Bar Size

Along X Axis

Bar diameter corresponding to max bar size (d_b) = 12 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$	= 0.583	m
Allowable Length(l_{db}) =	$\left[\frac{(B-b)}{2} - cc\right]$	= 0.625	m
l_{db} >=l_d	hence, safe		

Along Z Axis

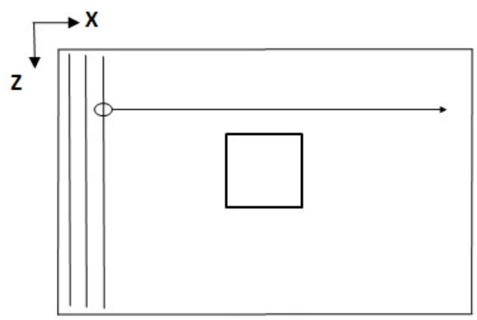
Bar diameter corresponding to max bar size(d_b) = 12 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$	= 0.583	m
Allowable Length(l_{db}) =	$\left[\frac{(H-h)}{2} - cc\right]$	= 0.625	m
l_{db} >=l_d	hence, safe		

Selection of Reinforcement

Along Z Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = #202

Minimum Area of Steel (A_{stmin}) = 495.000 mm2

Calculated Area of Steel (A_{st}) = 554.056 mm2

Provided Area of Steel ($A_{st,Provided}$) = 554.056 mm2

$A_{stmin} <= A_{st,Provided}$ Steel area is accepted

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 52.000 mm

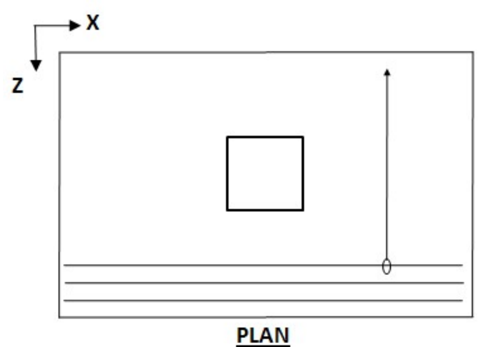
Selected spacing (S) = 250.000 mm

$S_{min} <= S <= S_{max}$ and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250.000 mm o.c.

Along X Axis



As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = #202

Minimum Area of Steel (A_{stmin}) = 495.000 mm2

Calculated Area of Steel (A_{st}) = 569.029 mm2

Provided Area of Steel ($A_{st,Provided}$) = 569.029 mm2

$A_{stmin} <= A_{st,Provided}$ Steel area is accepted

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 50.000 mm

Selected spacing (S) = 250.000 mm

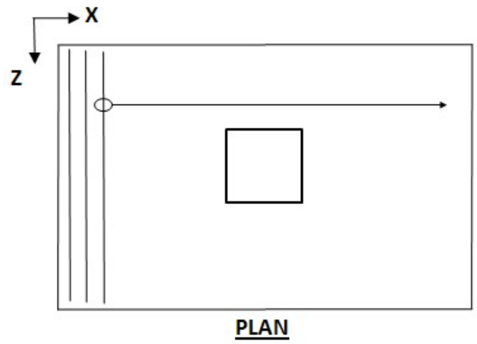
$S_{min} <= S <= S_{max}$ and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250.000 mm o.c.

Reinforecement is provided at bottom.Provide minimum reinf at top if depth is considerable

Design for top reinforcement Along Z Axis



Calculate the flexural reinforcement along the X direction of the footing. Find the area of steel required

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

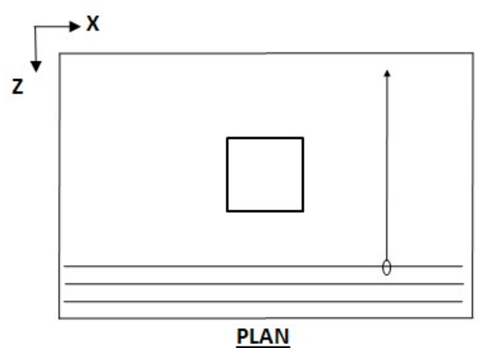
Minimum Area of Steel (A_{stmin})	= 495.000	mm2
Calculated Area of Steel (A_{st})	= 495.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 495.000	mm2
A_{stmin}<= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 52.000 mm
Selected spacing (S)	= 250.000mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Design for top reinforcement Along X Axis



Calculate the flexural reinforcement along the Z direction of the footing. Find the area of steel required

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

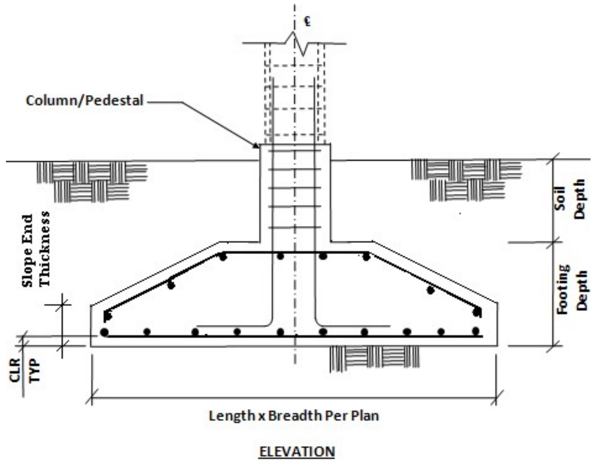
Minimum Area of Steel (A_{stmin})	= 495.000	mm2
Calculated Area of Steel (A_{st})	= 495.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 495.000	mm2
A_{stmin}<= $A_{st,Provided}$	Steel area is accepted	

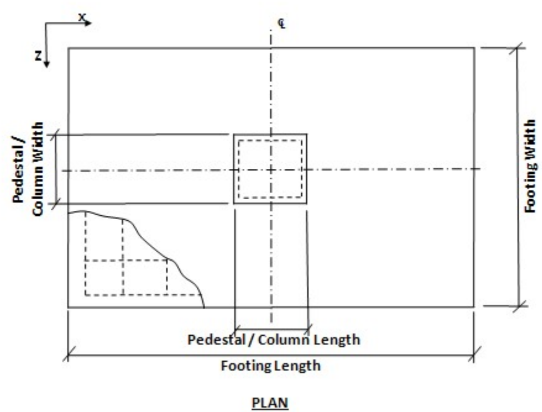
Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 50.000 mm
Selected spacing (S)	= 250.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Isolated Footing 37





Input Values

Footing Geomtery

Design Type :	Set Dimension
Footing Thickness (Ft) :	250.000 mm
Slope End Thickness (St) :	150.000 mm
Footing Length - X (Fl) :	1000.000 mm
Footing Width - Z (Fw) :	1000.000 mm
Eccentricity along X (Oxd) :	0.000 mm
Eccentricity along Z (Ozd) :	0.000 mm

Column Dimensions

Column Shape :	Rectangular
Column Length - X (Pl) :	0.300 m

Column Width - Z (Pw) : 0.300 m

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 : 25.000 kN/m3
Strength of Concrete : 25.000 N/mm2
Yield Strength of Steel : 500.000 N/mm2
Minimum Bar Size : Ø12
Maximum Bar Size : Ø25
Minimum Bar Spacing : 50.000 mm
Maximum Bar Spacing : 250.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : Drained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 120.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 1500.000 mm
Cohesion : 0.000 kN/m2
Min Percentage of Slab : 0.000

Sliding and Overturning

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

Footing Design Calculations

Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**
101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**

101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	143.300	-9.200	11.600	4.817	4.336
102	159.382	-8.591	11.140	4.628	4.035
103	143.300	-9.200	11.600	4.817	4.336
104	143.300	-9.200	11.600	4.817	4.336
105	127.505	-6.873	8.912	3.702	3.228
106	127.505	-6.873	8.912	3.702	3.228
107	127.505	-6.873	8.912	3.702	3.228

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	143.300	-9.200	11.600	4.817	4.336
102	159.382	-8.591	11.140	4.628	4.035
103	143.300	-9.200	11.600	4.817	4.336
104	143.300	-9.200	11.600	4.817	4.336
105	127.505	-6.873	8.912	3.702	3.228
106	127.505	-6.873	8.912	3.702	3.228
107	127.505	-6.873	8.912	3.702	3.228

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	214.949	-13.799	17.401	7.225	6.504
202	239.072	-12.887	16.709	6.942	6.053

203	153.006	-8.248	10.694	4.443	3.874
204	153.006	-8.248	10.694	4.443	3.874
205	153.006	-8.248	10.694	4.443	3.874
206	171.959	-11.039	13.921	5.780	5.203
207	171.959	-11.039	13.921	5.780	5.203
208	171.959	-11.039	13.921	5.780	5.203
209	128.970	-8.280	10.440	4.335	3.902
210	128.970	-8.280	10.440	4.335	3.902
211	128.970	-8.280	10.440	4.335	3.902

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	214.949	-13.799	17.401	7.225	6.504
202	239.072	-12.887	16.709	6.942	6.053
203	153.006	-8.248	10.694	4.443	3.874
204	153.006	-8.248	10.694	4.443	3.874
205	153.006	-8.248	10.694	4.443	3.874
206	171.959	-11.039	13.921	5.780	5.203
207	171.959	-11.039	13.921	5.780	5.203
208	171.959	-11.039	13.921	5.780	5.203
209	128.970	-8.280	10.440	4.335	3.902
210	128.970	-8.280	10.440	4.335	3.902
211	128.970	-8.280	10.440	4.335	3.902

Footing Size

Initial Length (L_o) = 1.000 m

Initial Width (W_o) = 1.000 m

Reduction of force due to buoyancy = 0.000 kN

Effect due to adhesion = 0.000 kN

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

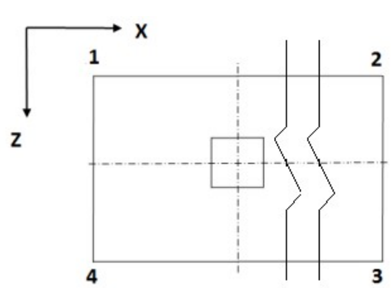
Min. area required from bearing pressure, $A_{min} = P / q_{max}$ = 1.574 m^2

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

Final dimensions for design

Length (L_2) =	1.600	m	Governing Load Case :	# 101
Width (W_2) =	1.600	m	Governing Load Case :	# 101
Area (A_2) =	2.560	m^2		

Pressures at Four Corner



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)
102	**91.2764**	73.1618	94.8798	112.9944	0.000
102	91.2764	**73.1618**	94.8798	112.9944	0.000
102	91.2764	73.1618	**94.8798**	112.9944	0.000
102	91.2764	73.1618	94.8798	**112.9944**	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 Four Corner

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)
102	**91.2764**	73.1618	94.8798	112.9944
102	91.2764	**73.1618**	94.8798	112.9944
102	91.2764	73.1618	**94.8798**	112.9944
102	91.2764	73.1618	94.8798	**112.9944**

Details of Out-of-Contact Area (If Any)

Governing load case = N/A

Plan area of footing = 2.560 sq.m

Area not in contact with soil = 0.000 sq.m

% of total area not in contact = 0.000%

Detail of Out-of-contact Area

Governing load case = N/A

Plan area of footing = 2.560 sq.m

Area not in contact with soil = 0.000 sq.m

% of total area not in contact = 0.000%

Check For Stability Against Overturning And Sliding

-	Factor of safety against sliding		Factor of safety against overturning	
Load Case No.	Along X-Direction	Along Z-Direction	About X-Direction	About Z-Direction
101	12.283	9.741	23.428	27.245
102	14.088	10.865	26.124	31.320
103	12.283	9.741	23.428	27.245
104	12.283	9.741	23.428	27.245
105	15.291	11.793	28.355	33.995
106	15.291	11.793	28.355	33.995
107	15.291	11.793	28.355	33.995

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along X-Direction : 101

Governing Disturbing Force : -9.200 kN

Governing Restoring Force :	112.995	kN
Minimum Sliding Ratio for the Critical Load Case :	12.283	
Critical Load Case for Overturning about X-Direction :	101	
Governing Overturning Moment :	7.717	kNm
Governing Resisting Moment :	180.788	kNm
Minimum Overturning Ratio for the Critical Load Case :	23.428	

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along Z-Direction :	101	
Governing Disturbing Force :	11.600	kN
Governing Restoring Force :	112.995	kN
Minimum Sliding Ratio for the Critical Load Case :	9.741	
Critical Load Case for Overturning about Z-Direction :	101	
Governing Overturning Moment :	6.636	kNm
Governing Resisting Moment :	180.788	kNm
Minimum Overturning Ratio for the Critical Load Case :	27.245	

Check Trial Depth against moment (w.r.t. X Axis)

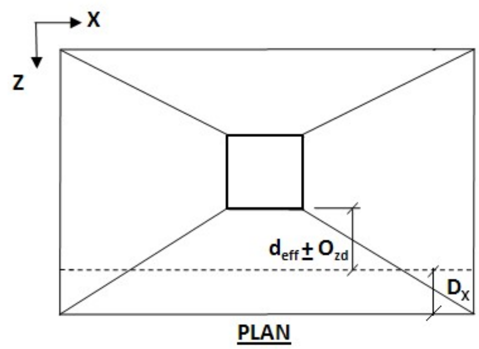
Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.194	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.094	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.463	m
Governing moment (M_u)		= 35.583	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 57.756761	kNm
$M_u <= M_{umax}$	hence, safe		

Check Trial Depth against moment (w.r.t. Z Axis)

Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.194	m
Effective End Depth		= 0.094	m
Effective Width		= 0.463	m
Governing moment (M_u) =		= 34.912	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 57.756761	kNm
$M_u <= M_{umax}$	hence, safe		

Check Trial Depth for one way shear (Along X Axis)

(Shear Plane Parallel To X axis)

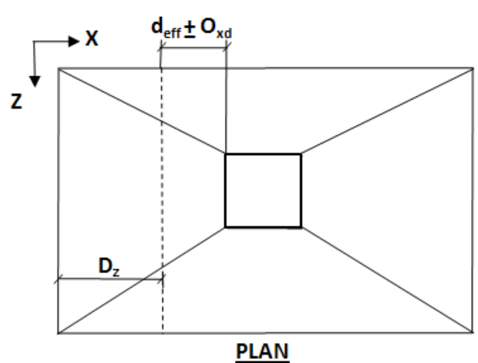


Critical Load Case = #202

D_X = 0.194 m		
Shear Force(S)	= 76.633	kN
Shear Stress(T_v)	= 281.029559	kN/m2
Percentage Of Steel(P_t)	= 0.5350	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 502.517	kN/m2
$T_v < T_c$ hence, safe		

Check Trial Depth for one way shear (Along Z Axis)

(Shear Plane Parallel To Z axis)



Critical Load Case = #202

D_Z = 0.194 m		
Shear Force(S)	= 75.223	kN
Shear Stress(T_v)	= 275.859380	kN/m2
Percentage Of Steel(P_t)	= 0.5350	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 502.517	kN/m2
$T_v < T_c$ hence, safe		

Check Trial Depth for two way shear

Critical Load Case	**= #202**		
Shear Force(S)		= 216.282	kN
Shear Stress(T_v)		= 611.216	kN/m2
As Per IS 456 2000 Clause 31.6.3.1			
K_s =	$\min[(0.5+\beta),1]$	= 1.000	
Shear Strength(T_c)=	$0.25 \times \sqrt{f_{ck}}$	= 1250.0000	kN/m2
K_s X T_c		= 1250.0000	kN/m2
T_v<= K_s X T_c	hence, safe		

Calculation of Maximum Bar Size

Along X Axis

Bar diameter corresponding to max bar size (d_b) = 12 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$	= 0.583	m
Allowable Length(l_{db}) =	$\left[\frac{(B-b)}{2} - cc\right]$	= 0.600	m
l_{db} >=l_d	hence, safe		

Along Z Axis

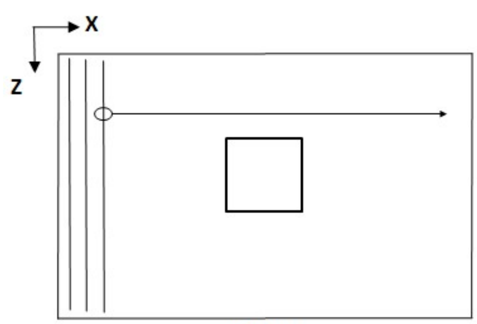
Bar diameter corresponding to max bar size(d_b) = 12 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$	= 0.583	m
Allowable Length(l_{db}) =	$\left[\frac{(H-h)}{2} - cc\right]$	= 0.600	m
l_{db} >=l_d	hence, safe		

Selection of Reinforcement

Along Z Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = **#202**

Minimum Area of Steel (A_{stmin}) = 480.000 mm2

Calculated Area of Steel (A_{st}) = 471.128 mm2

Provided Area of Steel ($A_{st,Provided}$) = 480.000 mm2

A_{stmin} <= $A_{st,Provided}$ Steel area is accepted

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 52.000 mm

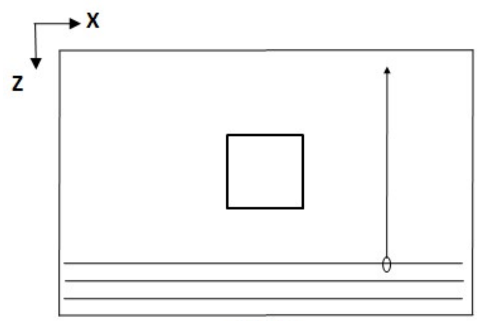
Selected spacing (S) = 250.000 mm

S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = **#202**

Minimum Area of Steel (A_{stmin}) = 480.000 mm2

Calculated Area of Steel (A_{st}) = 461.094 mm2

Provided Area of Steel ($A_{st,Provided}$) = 480.000 mm2

A_{stmin} <= $A_{st,Provided}$ Steel area is accepted

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 50.000 mm

Selected spacing (S) = 250.000 mm

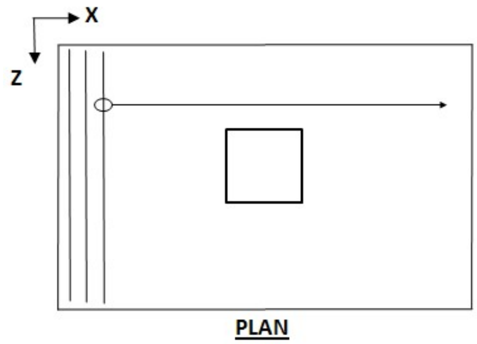
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250.000 mm o.c.

Reinforecement is provided at bottom.Provide minimum reinf at top if depth is considerable

Design for top reinforcement Along Z Axis



Calculate the flexural reinforcement along the X direction of the footing. Find the area of steel required

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

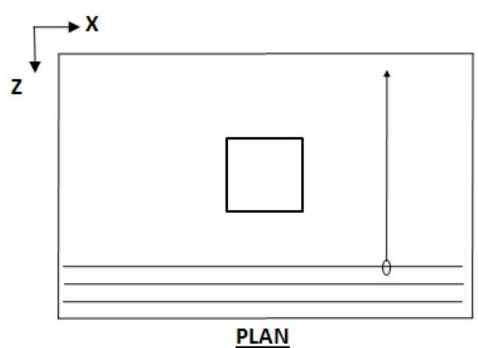
Minimum Area of Steel (A_{stmin})	= 480.000	mm2
Calculated Area of Steel (A_{st})	= 480.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 480.000	mm2
A_{stmin}<= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 52.000 mm
Selected spacing (S)	= 250.000mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Design for top reinforcement Along X Axis



Calculate the flexural reinforcement along the Z direction of the footing. Find the area of steel required

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

Minimum Area of Steel (A_{stmin})	= 480.000	mm2
Calculated Area of Steel (A_{st})	= 480.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 480.000	mm2
A_{stmin}<= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 50.000 mm

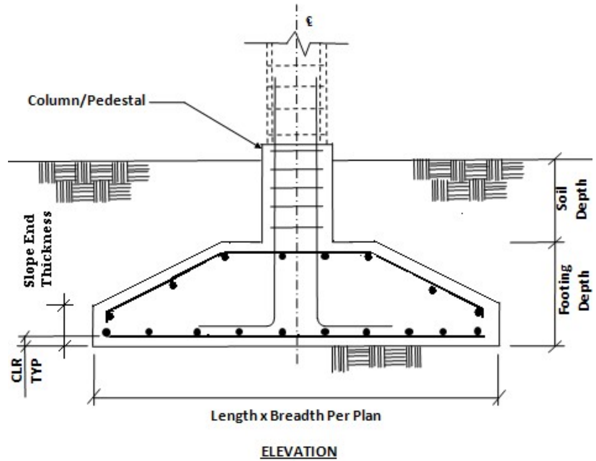
Selected spacing (S) = 250.000 mm

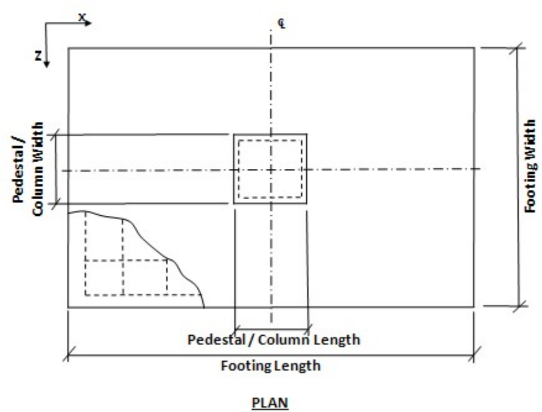
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Isolated Footing 38





Input Values

Footing Geomtery

Design Type : Set Dimension

Footing Thickness (Ft) : 250.000 mm

Slope End Thickness (St) : 150.000 mm

Footing Length - X (Fl) : 1000.000 mm

Footing Width - Z (Fw) : 1000.000 mm

Eccentricity along X (Oxd) : 0.000 mm

Eccentricity along Z (Ozd) : 0.000 mm

Column Dimensions

Column Shape : Rectangular

Column Length - X (Pl) : 0.300 m

Column Width - Z (Pw) : 0.300 m

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 : 25.000 kN/m3
Strength of Concrete : 25.000 N/mm2
Yield Strength of Steel : 500.000 N/mm2
Minimum Bar Size : Ø12
Maximum Bar Size : Ø25
Minimum Bar Spacing : 50.000 mm
Maximum Bar Spacing : 250.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : Drained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 120.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 1500.000 mm
Cohesion : 0.000 kN/m2
Min Percentage of Slab : 0.000

Sliding and Overturning

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

Footing Design Calculations

Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**
101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**

101	1.000 x DL
102	1.000 x DL+1.000 x LL
103	1.000 x DL+1.000 x ELX+1.000 x ELX
104	1.000 x DL+1.000 x ELZ+1.000 x ELZ
105	0.800 x DL+0.800 x LL
106	0.800 x DL+0.800 x LL+0.800 x ELX+0.800 x ELX
107	0.800 x DL+0.800 x LL+0.800 x ELZ+0.800 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
201	1.500 x DL
202	1.500 x DL+1.500 x LL
203	0.960 x DL+0.960 x LL
204	0.960 x DL+0.960 x LL+0.960 x ELX+0.960 x ELX
205	0.960 x DL+0.960 x LL+0.960 x ELZ+0.960 x ELZ
206	1.200 x DL
207	1.200 x DL+1.200 x ELX+1.200 x ELX
208	1.200 x DL+1.200 x ELZ+1.200 x ELZ
209	0.900 x DL
210	0.900 x DL+1.200 x ELX+1.200 x ELX
211	0.900 x DL+1.200 x ELZ+1.200 x ELZ

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	134.455	9.446	11.301	5.006	-4.392
102	149.161	8.943	10.898	4.873	-4.197
103	134.455	9.446	11.301	5.006	-4.392
104	134.455	9.446	11.301	5.006	-4.392
105	119.328	7.155	8.718	3.898	-3.358
106	119.328	7.155	8.718	3.898	-3.358
107	119.328	7.155	8.718	3.898	-3.358

Applied Loads - Service Stress Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
101	134.455	9.446	11.301	5.006	-4.392
102	149.161	8.943	10.898	4.873	-4.197
103	134.455	9.446	11.301	5.006	-4.392
104	134.455	9.446	11.301	5.006	-4.392
105	119.328	7.155	8.718	3.898	-3.358
106	119.328	7.155	8.718	3.898	-3.358
107	119.328	7.155	8.718	3.898	-3.358

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	201.683	14.170	16.951	7.509	-6.587
202	223.741	13.415	16.347	7.309	-6.296

203	143.194	8.585	10.462	4.678	-4.030
204	143.194	8.585	10.462	4.678	-4.030
205	143.194	8.585	10.462	4.678	-4.030
206	161.346	11.336	13.561	6.007	-5.270
207	161.346	11.336	13.561	6.007	-5.270
208	161.346	11.336	13.561	6.007	-5.270
209	121.010	8.502	10.171	4.506	-3.952
210	121.010	8.502	10.171	4.506	-3.952
211	121.010	8.502	10.171	4.506	-3.952

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
201	201.683	14.170	16.951	7.509	-6.587
202	223.741	13.415	16.347	7.309	-6.296
203	143.194	8.585	10.462	4.678	-4.030
204	143.194	8.585	10.462	4.678	-4.030
205	143.194	8.585	10.462	4.678	-4.030
206	161.346	11.336	13.561	6.007	-5.270
207	161.346	11.336	13.561	6.007	-5.270
208	161.346	11.336	13.561	6.007	-5.270
209	121.010	8.502	10.171	4.506	-3.952
210	121.010	8.502	10.171	4.506	-3.952
211	121.010	8.502	10.171	4.506	-3.952

Footing Size

Initial Length (L_o) = 1.000 m

Initial Width (W_o) = 1.000 m

Reduction of force due to buoyancy = 0.000 kN

Effect due to adhesion = 0.000 kN

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

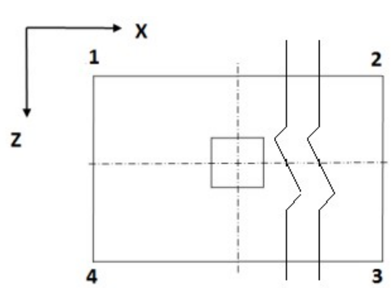
Min. area required from bearing pressure, $A_{min} = P / q_{max}$ = 1.489 m^2

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

Final dimensions for design

Length (L_2) =	1.600	m	Governing Load Case :	# 101
Width (W_2) =	1.600	m	Governing Load Case :	# 101
Area (A_2) =	2.560	m^2		

Pressures at Four Corner



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)
102	**68.5326**	87.3801	109.6385	90.7909	0.000
102	68.5326	**87.3801**	109.6385	90.7909	0.000
102	68.5326	87.3801	**109.6385**	90.7909	0.000
102	68.5326	87.3801	109.6385	**90.7909**	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 Four Corner

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)
102	**68.5326**	87.3801	109.6385	90.7909
102	68.5326	**87.3801**	109.6385	90.7909
102	68.5326	87.3801	**109.6385**	90.7909
102	68.5326	87.3801	109.6385	**90.7909**

Details of Out-of-Contact Area
(If Any)

Governing load case = N/A
Plan area of footing = 2.560 sq.m
Area not in contact with soil = 0.000 sq.m
% of total area not in contact = 0.000%

Detail of Out-of-contact Area

Governing load case = N/A
Plan area of footing = 2.560 sq.m
Area not in contact with soil = 0.000 sq.m
% of total area not in contact = 0.000%

Check For Stability Against Overturning And Sliding

-	Factor of safety against sliding		Factor of safety against overturning	
Load Case No.	Along X-Direction	Along Z-Direction	About X-Direction	About Z-Direction
101	11.494	9.608	22.182	25.723
102	12.962	10.638	24.413	28.831
103	11.494	9.608	22.182	25.723
104	11.494	9.608	22.182	25.723
105	14.118	11.586	26.590	31.402
106	14.118	11.586	26.590	31.402
107	14.118	11.586	26.590	31.402

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along X-Direction : 101
Governing Disturbing Force : 9.446 kN

Governing Restoring Force :	108.573	kN
Minimum Sliding Ratio for the Critical Load Case :	11.494	
Critical Load Case for Overturning about X-Direction :	104	
Governing Overturning Moment :	7.831	kNm
Governing Resisting Moment :	173.713	kNm
Minimum Overturning Ratio for the Critical Load Case :	22.182	

Critical load case and the governing factor of safety for overturning and sliding

Critical Load Case for Sliding along Z-Direction :	101	
Governing Disturbing Force :	11.301	kN
Governing Restoring Force :	108.573	kN
Minimum Sliding Ratio for the Critical Load Case :	9.608	
Critical Load Case for Overturning about Z-Direction :	101	
Governing Overturning Moment :	-6.753	kNm
Governing Resisting Moment :	173.713	kNm
Minimum Overturning Ratio for the Critical Load Case :	25.723	

Check Trial Depth against moment (w.r.t. X Axis)

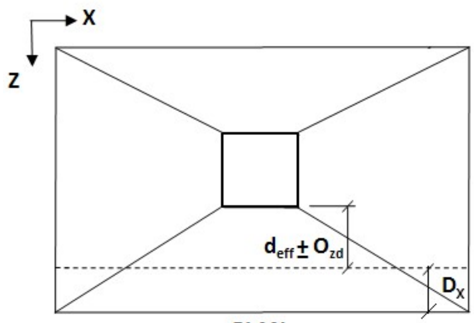
Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.194	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.094	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.463	m
Governing moment (M_u)		= 33.658	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 57.756761	kNm
$M_u <= M_{umax}$	hence, safe		

Check Trial Depth against moment (w.r.t. Z Axis)

Critical Load Case	**= #202**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.194	m
Effective End Depth		= 0.094	m
Effective Width		= 0.463	m
Governing moment (M_u) =		= 33.027	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.456026	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 3318.146612	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 57.756761	kNm
$M_u <= M_{umax}$	hence, safe		

Check Trial Depth for one way shear (Along X Axis)

(Shear Plane Parallel To X axis)

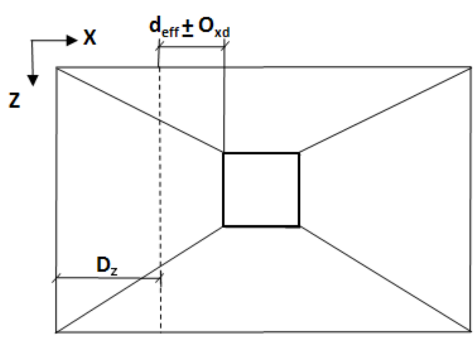


Critical Load Case = #202

D_X = 0.194 m		
Shear Force(S)	= 72.475	kN
Shear Stress(T_v)	= 265.781008	kN/m2
Percentage Of Steel(P_t)	= 0.5350	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 502.517	kN/m2
$T_v < T_c$ hence, safe		

Check Trial Depth for one way shear (Along Z Axis)

(Shear Plane Parallel To Z axis)



Critical Load Case = #202

D_Z = 0.194 m		
Shear Force(S)	= 71.140	kN
Shear Stress(T_v)	= 260.887124	kN/m2
Percentage Of Steel(P_t)	= 0.5350	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 502.517	kN/m2
$T_v < T_c$ hence, safe		

Check Trial Depth for two way shear

Critical Load Case **= #202**

Shear Force(S) = 202.412 kN

Shear Stress(T_v) = 572.019 kN/m2

As Per IS 456 2000 Clause 31.6.3.1

K_s = $\min[(0.5+\beta),1]$ = 1.000

Shear Strength(T_c)= $0.25 \times \sqrt{f_{ck}}$ = 1250.0000 kN/m2

K_s X T_c = 1250.0000 kN/m2

T_v<= K_s X T_c hence, safe

Calculation of Maximum Bar Size

Along X Axis

Bar diameter corresponding to max bar size (d_b) = 12 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) = $\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$ = 0.583 m

Allowable Length(l_{db}) = $\left[\frac{(B-b)}{2} - cc\right]$ = 0.600 m

l_{db} >=l_d hence, safe

Along Z Axis

Bar diameter corresponding to max bar size(d_b) = 12 mm

As Per IS 456 2000 Clause 26.2.1

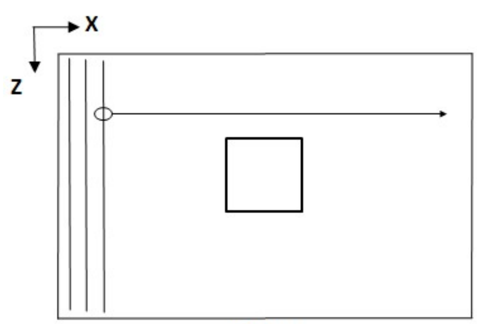
Development Length(l_d) = $\frac{d_b \times 0.87 \times f_y}{4 \times \Gamma_{bd}}$ = 0.583 m

Allowable Length(l_{db}) = $\left[\frac{(H-h)}{2} - cc\right]$ = 0.600 m

l_{db} >=l_d hence, safe

Selection of Reinforcement

Along Z Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

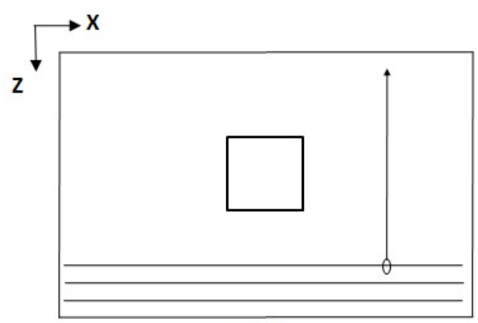
Critical Load Case	**= #202**	
Minimum Area of Steel (A_{stmin})	= 480.000	mm2
Calculated Area of Steel (A_{st})	= 442.494	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 480.000	mm2
A_{stmin} <= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 52.000 mm
Selected spacing (S)	= 250.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case	**= #202**	
Minimum Area of Steel (A_{stmin})	= 480.000	mm2
Calculated Area of Steel (A_{st})	= 433.203	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 480.000	mm2
A_{stmin} <= $A_{st,Provided}$	Steel area is accepted	

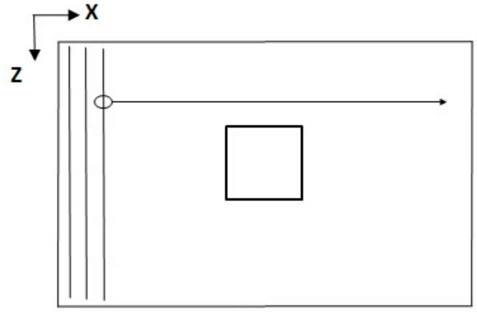
Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 50.000 mm
Selected spacing (S)	= 250.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250.000 mm o.c.

Reinforecement is provided at bottom.Provide minimum reinf at top if depth is considerable

Design for top reinforcement Along Z Axis



PLAN

Calculate the flexural reinforcement along the X direction of the footing. Find the area of steel required

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

Minimum Area of Steel (A_{stmin}) = 480.000 mm2

Calculated Area of Steel (A_{st}) = 480.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 480.000 mm2

A_{stmin}<= $A_{st,Provided}$ Steel area is accepted

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 52.000 mm

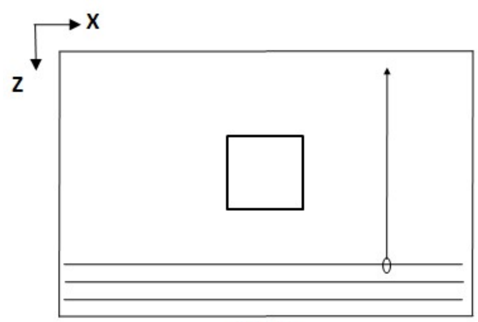
Selected spacing (S) = 250.000mm

S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Design for top reinforcement Along X Axis



PLAN

Calculate the flexural reinforcement along the Z direction of the footing. Find the area of steel required

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

Minimum Area of Steel (A_{stmin}) = 480.000 mm2

Calculated Area of Steel (A_{st}) = 480.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 480.000 mm2

A_{stmin}<= $A_{st,Provided}$ Steel area is accepted

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 50.000 mm
Selected spacing (S)	= 250.000 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 250 mm o.c.

Print Calculation Sheet