Submitted sir,

Sub: RWS&S-TDWSP- Design of Backwash Tank at WTP Dhanora –Komarambheem Asifabad Segment - AdilabadDistrict-Designs -Approval-Reg.

*****

Kindly pursue theDesigns of the following Type Design of Backwash Tank at WTP Dhanora, submitted by the Executive Engineer TDWSP Asifabad Division, Adilabad district for approval.

1. **Backwash Tank at WTP Dhanora.**

The Executive Engineer TDWSP Asifabad Division has submitted Structural Designs & Drawings of Backwash Tank at WTP Dhanora based on the field conditions vetted by consultant (third party) as well as WAPCOS and as per the estimate provisions, the structural designs & drawings for the above structure is verified and submitted for approval.

The following design parameters were considered:

- Net SBC of Soil : 15.0 t/sqm
- Grade of concrete & Steel : M 30 & Fe 500
- Tank Diameter of inner to inner: 13.8mtr
- No of Column: 12 nos
- Height of tank: 3.45 mtr
- Staging : 10 mtr

As per the above parameters the structural design and drawings of the Backwash Tank at WTP Dhanora is verified, duly following IS codes, IS: 456-2000, SP:16, 34, IS:3370 and IS 1893-2002 (seismic codes).The sizes and steel proposed in the designs and drawings of all components are safe and sufficient.

The additional points noted after checking the designs are:

- Detailed Estimate of the Structure with these specifications has to be prepared and compared with the provision made in sanctioned estimate. Such that deviation if any is within authorized limits. If any deviations noticed, the Estimate should be submitted for obtaining approval from the Competent Authority.

Subject to approval a draft memo addressed to the EE, TDWSP Asifabad Division , for communicating approved Structure is put up for kind perusal and approval.

30/4/16

AEE (Designs)	DEE (Designs)	Superintending Engineer,
TDWSP,Nirmal Circle	TDWSP,Nirmal Circle	TDWSP,Nirmal Circle

23/02/16	R0	FOR APPROVAL	DVJ	RMM	
DATE	**REV.NO.**	**DESCRIPTION**	**Designed**	**Checked**	**Approved**

REVISIONS

L&T Construction
Water & Renewable energy

CLIENT:
GOVERENMENT OF TELANGANA, RURAL WATER SUPPLY AND SANITATION DEPARTMENT

PROJECT:
PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)

SUPPLIER / CONTRACTOR:
L & T Construction, Water & Effluent treatment SBG

JOB No.

TOTAL NO. OF PAGES			
	NAME	**SIGN**	**DATE**
DSGN	DVJ	DVJ	23/02/16
CHKD	RMM	RMM	23/02/16
APPD			

TITLE :

BACK WASH TANK - DESIGN CALCULATIONS

DOC NO. LE150883-C-WS-WT-DC-1093

CODE: IS

REV.: R0

RELEASED FOR

PRELIMINARY	TENDER	INFORMATION	√ **APPROVAL**	CONSTRUCTION

PROJECT:	**PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)**	Document LE150883-C-WS-WT-DC-1093		DATE 23.02.16
TITLE	**BACK WASH TANK**	DESIGNED DVJ	CHECKED RMM	PAGE

	CONTENTS	PAGE NO
	DESIGN DATA	1
	CYLINDRICAL WALL DESIGN	2
	STAGING DESIGN	9
	FOOTING DESIGN	29
	COLUMN DESIGN	30
	BEAM DESIGN	36
	SLAB DESIGN	47
	ANNEXTURE A	52

PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)

1.0 DESIGN DATA

Diameter = 13.8 m
Height of staging = 10 m
Earthquake zone – II
Wind speed = 44 m/s

Levels:
Finish ground level = 0.00
Top of bottom slab = 10.00
Top of top slab = 13.60

Concrete grade = M 30
Clear cover to main steel = 45.0 mm for water retaining structure

Design as per IS 456-2000, IS 3370-2009, IS 875-1987, IS 11682-1985, IS 1893-DRAFT, IS 13920-1993

2.0 CYLINDRICAL WALL DESIGN

A>DESIGN DATA

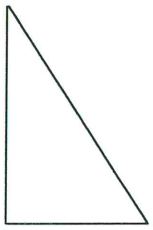
Diameter = 13.8 m
Water depth = 3.15 m
Free board = 0.3 m

Concrete grade = M 30
Clear cover to main steel = 45.0 mm for water retaining structure

Design as per IS 456-2000, IS 3370-2009

Support condition

- Circular ring wall, fixed base, free top and subjected to triangular loading



Analysis of structure is done using STAAD – Program

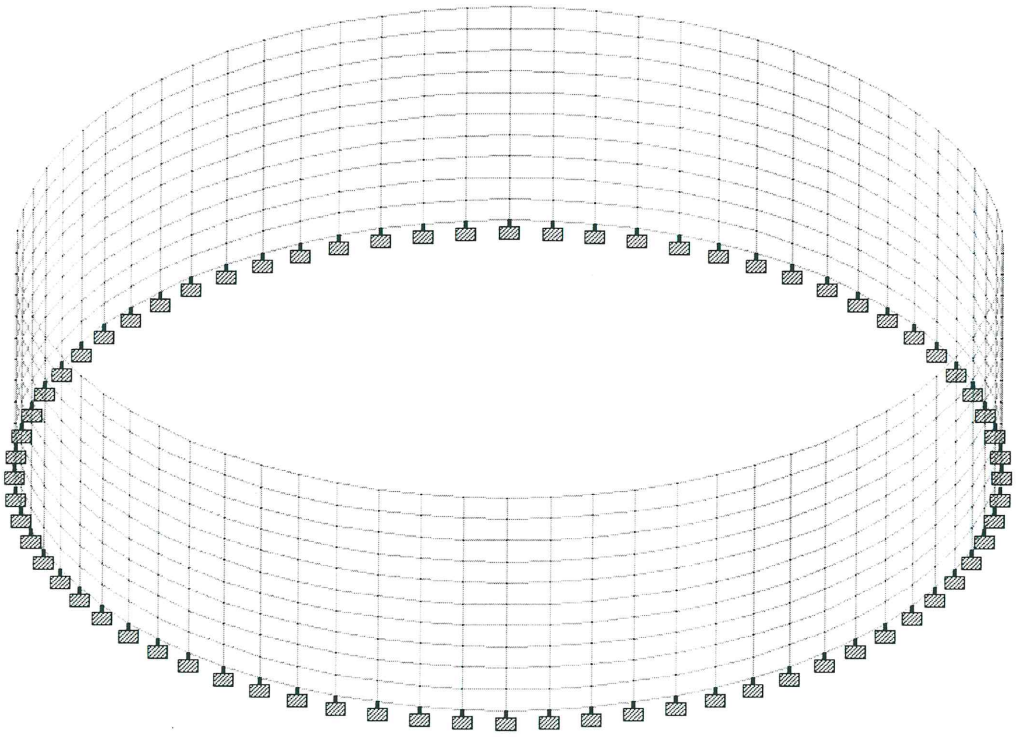
Maximum pressure at bottom = 10 kN/m^3 x 3.45 m = 34.5 kN/m^2

B> STAAD INPUT

```
STAAD SPACE
START JOB INFORMATION
JOB NAME Back wash tank
JOB PART Container wall
ENGINEER DATE 16-Feb-16
END JOB INFORMATION
INPUT WIDTH 79
UNIT METER KN
JOINT COORDINATES
JOINT COORDIANTE CYL REV
1 6.9 0 0 72 6.9 0 355
REPEAT 10 0 0.345 0
ELEMENT INCIDENCES
1 1 2 74 73  TO 71 1 1
72 72 1 73 144
REPEAT ALL 9 72 72
DEFINE MATERIAL START
ISOTROPIC M30
E 2.73e+007
POISSON 0.17
DENSITY 25
ALPHA 1.2e-011
DAMP 7.9006e+033
END DEFINE MATERIAL
ELEMENT PROPERTY
1 TO 72 THICKNESS 0.2
73 TO 144 THICKNESS 0.2
145 TO 216 THICKNESS 0.2
217 TO 288 THICKNESS 0.2
289 TO 360 THICKNESS 0.2
361 TO 432 THICKNESS 0.2
433 TO 504 THICKNESS 0.2
505 TO 576 THICKNESS 0.2
577 TO 648 THICKNESS 0.2
649 TO 720 THICKNESS 0.2
CONSTANTS
MATERIAL M30 ALL
SUPPORTS
1 TO 72 FIXED
LOAD 1 WATER
ELEMENT LOAD
1 TO 72 TRAP Y 34.5 31.05
73 TO 144 TRAP Y 31.05 27.6
145 TO 216 TRAP Y 27.6 24.15
217 TO 288 TRAP Y 24.15 20.7
289 TO 360 TRAP Y 20.7 17.25
361 TO 432 TRAP Y 17.25 13.8
433 TO 504 TRAP Y 13.8 10.35
505 TO 576 TRAP Y 10.35 6.9
577 TO 648 TRAP Y 6.9 3.45
649 TO 720 TRAP Y 3.45 0
PERFORM ANALYSIS
PRINT ELEMENT FORCE LIST 1 73 145 217 289 361 433 505 577 649
FINISH
```

PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)

C> STAAD DIAGRAM



PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)

D> PLATE NUMBERS

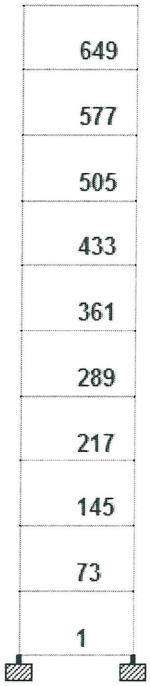


PLATE NUMBERS

E> EXCEL SHEET FOR WALL DESIGN

Reinforcement Calculation of Cylindrical wall			
Circular wall			
Load case : Water + Seismic			
BASIC DATA			
Diameter - in to in	Diain	**13.8**	m
Maximum wall thickness	wthk	**0.2**	m
Clear cover to main steel	Cv	**45**	mm
Maximum dia of bar	mdbar	**12**	mm
Concrete grade	Fck	**30**	N/mm2
Allowable crack width	Acw	**0.2**	mm
GENERAL DATA			
As per IS 3370-2009	Dmin	15	m
steel grade	Fy	**415**	N/mm2
Modulus of Elasiticity of Concrete	Ec	27386	N/mm2
Modulus of Elasiticity of reinforcement	Es	200000	N/mm2
Maximum out to out Dia	Maxdia	14.20	m
Permissible stress in direct tension	fyuc	130	N/mm2
Permissible stress in tension due to bending	fyucb	130	N/mm2
Minimum % steel as per IS 3370-2009	ptmin	**0.24**	%
per. stress in con. for direct comp	fckc	8.0	N/mm2
per. stress in con in com.due to bending	fckbc	10.0	N/mm2
per. stress in con. for direct tension	fckt	1.5	N/mm2
per. stress in con. In ten due to bending	fcktb	2.0	N/mm2
Modular ratio	m	9.33	
	k	0.418	
	j	0.861	
As maximum diameter is less than 15 m , minimum steel = 0.24 %			

Paste data from STADD

Plate	L/C	SQX kN/m2	SQY kN/m2	MX kNm/m	MY kNm/m	MXY kNm/m	SX kN/m2	SY kN/m2	SXY kN/m2
1	1	0	104.3	-1.0	-6.2	0	39	0	0
73	1	0	56.3	-0.1	-0.7	0	190	0	0
145	1	0	22.6	0.3	2.0	0	360	0	0
217	1	0	2.3	0.5	2.8	0	481	0	0
289	1	0	-7.8	0.4	2.6	0	532	0	0
361	1	0	-11.1	0.3	2.0	0	517	0	0
433	1	0	-10.5	0.2	1.2	0	452	0	0
505	1	0	-8.1	0.1	0.6	0	356	0	0
577	1	0	-5.0	0.0	0.2	0	243	0	0
649	1	0	-1.7	0.0	0.0	0	126	0	0

OUTPUT

Calculation for hoop steel

PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)

Sr.no	Plate no	Sx - Str. Stress	Thk	Axial Force	Steel reqd Design	Steel reqd Minimum	Dia. mm	spc mm	Astp mm2
		Kn/m2		kn	mm2	mm2	Provided steel mm2		
1	1	39	**200**	7.7	59	480	**10**	**200**	785
2	73	190	**200**	38.0	293	480	**10**	**200**	785
3	145	360	**200**	72.1	555	480	**10**	**200**	785
4	217	481	**200**	96.3	741	480	**10**	**175**	898
5	289	532	**200**	106.4	818	480	**10**	**175**	898
6	361	517	**200**	103.3	795	480	**10**	**175**	898
7	433	452	**200**	90.3	695	480	**10**	**175**	898
8	505	356	**200**	71.1	547	480	**10**	**200**	785
9	577	243	**200**	48.7	374	480	**10**	**200**	785
10	649	126	**200**	25.1	193	480	**10**	**200**	785

Check for hoop steel and stress

	steel			Concrete stress		
	Steel reqd mm2	Steel Prov mm2	check	perm. stress N/mm2	Actual stress N/mm2	check
1	480	785	O.K	1.5	0.04	O.K
2	480	785	O.K	1.5	0.18	O.K
3	555	785	O.K	1.5	0.35	O.K
4	741	898	O.K	1.5	0.46	O.K
5	818	898	O.K	1.5	0.51	O.K
6	795	898	O.K	1.5	0.50	O.K
7	695	898	O.K	1.5	0.44	O.K
8	547	785	O.K	1.5	0.34	O.K
9	480	785	O.K	1.5	0.24	O.K
10	480	785	O.K	1.5	0.12	O.K

Calculation Vertical steel

Sr.no	Plate no	My Stress	Thk	Effective Depth	Steel reqd	Steel			
						Water face		Other face	
						Design	Min	Design	Min
		Kn-m	mm	mm	mm2	mm2	mm2	mm2	mm2
1	1	6.2	200	149	-370	370	240	0	240
2	73	0.7	200	149	-40	40	240	0	240
3	145	2.0	200	149	120	0	240	120	240
4	217	2.8	200	149	170	0	240	170	240
5	289	2.6	200	149	157	0	240	157	240
6	361	2.0	200	149	118	0	240	118	240
7	433	1.2	200	149	75	0	240	75	240
8	505	0.6	200	149	38	0	240	38	240
9	577	0.2	200	149	13	0	240	13	240
10	649	0.0	200	149	1	0	240	1	240

Check for Vertical steel

Sr.no	Plate no	Steel provd.				Steel required	Steel Provided	check
		Water side						
		Dia	mm	Dia	mm	mm2	mm2	

1	1	**10**	**200**	**8**	**200**	370	644	O.K
2	73	**10**	**200**	**8**	**200**	240	644	O.K
3	145	**10**	**200**			240	393	O.K
4	217	**10**	**200**			240	393	O.K
5	289	**10**	**200**			240	393	O.K
6	361	**10**	**200**			240	393	O.K
7	433	**10**	**200**			240	393	O.K
8	505	**10**	**200**			240	393	O.K
9	577	**10**	**200**			240	393	O.K
10	649	**10**	**200**			240	393	O.K

Check for Vertical steel

Sr.no	Plate no	Steel provd.				Steel required	Steel Provided	check
		Outer side						
		Dia	mm	Dia	mm	mm2	mm2	
1	1	**10**	**200**			240	393	O.K
2	73	**10**	**200**			240	393	O.K
3	145	**10**	**200**			240	393	O.K
4	217	**10**	**200**			240	393	O.K
5	289	**10**	**200**			240	393	O.K
6	361	**10**	**200**			240	393	O.K
7	433	**10**	**200**			240	393	O.K
8	505	**10**	**200**			240	393	O.K
9	577	**10**	**200**			240	393	O.K
10	649	**10**	**200**			240	393	O.K

3.0 STAGING DESIGN

A> DESIGN DATA

Tank type : Elevated storage reservoir				
Tank Geometry : Rectangular Staging + Circular tank + top slab				
13.8 m dia back wash tank				
Basic data				
General				
No	Description	Notation	Value	Unit
(A)	Unit weight			
	Unit weight of concrete	Uwc	25.0	kN/m3
	Unit weight of water	Uww	9.81	kN/m3
	Unit weight of plaster	Uwp	21.0	kN/m3
	Unit weight of IPS	Uips	21.0	kN/m3
	Unit weight of soil	Uws	18.0	kN/m3
(B)	Material			
	Grade of concrete of container	Fck	30	N/mm2
	Grade of concrete of Staging : column	Fckc	30	N/mm2
	Grade of concrete of Staging : Beam	Fckb	30	N/mm2
	Grade of Steel	Fy	415	N/mm2
	Mass & Wt relation factor	g	9.81	
(C)	Loading			
	Finishing load on top slab	Fl	0.50	kN/m2
	Live load on top slab	Ll	0.750	kN/m2
	Finishing load on walk way	Flwy	0.00	kN/m2
	Live load on walk way	Llwy	0.00	kN/m2
	Other			
(D)	Plaster thickness	Pt	20	mm
	Bottom IPS thickness	Bips	20	mm
	Free board + Dead storage	Fb	450	mm
(E)	Capacity			
	Required volume of water	Vw	516	m3
		Vwl	516000	liter
(F)	Geometry data : Container			
	Height between Bottom slab & FSl	Hw	3	m
	Water depth	Wd	3.45	m
	Diameter of tank in to in	Dtank	13.8	m
	Actual capacity of tank	Tcap	515.27	m3
		Tcapl	515273	liter
(G)	Geometry data : Staging			
	Staging height	stgh	10	m
	Depth of foundation	dbg	as per design	m
	Footing thickness	ftthk	as per design	m
	Nos of column	noscol	12	

	Nos of Tie level	nostie	3	
(H)	RCC geometry data :container			
	Bottom slab thickness	Thkbs	250	mm
	Top Dome thickness	Thkts	150	mm
	Central rise	Crd	0	mm
	Wall thickness	Thkw	200	mm
	Depth of ring beam	Drb	0	mm
	Width of ring beam	Wrb	0	mm
	Floor beam at bottom slab	350	1000	mm
(J)	Earthquake data			
	Zone	Eqzone	2	
	Soil type (1,2,3)	type soil	3	
	soft soil : Soil type 1			
	Medium soil : Soil type 2			
	Hard soil : soil type 3			
	Importance Factor	Impfac	1.5	

B> STAAD INPUT

```
STAAD SPACE
START JOB INFORMATION
ENGINEER DATE 17-Feb-16
END JOB INFORMATION
INPUT WIDTH 79
UNIT METER KN
JOINT COORDINATES
1 3.829 0 0; 2 9.129 0 0; 3 0 0 3.829; 4 3.829 0 3.829; 5 9.129 0 3.829;
6 12.958 0 3.829; 7 0 0 9.129; 8 3.829 0 9.129; 9 9.129 0 9.129;
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14 9.129 -2 0; 15 0 -2 3.829; 16 3.829 -2 3.829; 17 9.129 -2 3.829;
18 12.958 -2 3.829; 19 0 -2 9.129; 20 3.829 -2 9.129; 21 9.129 -2 9.129;
22 12.958 -2 9.129; 23 3.829 -2 12.958; 24 9.129 -2 12.958; 25 3.829 3.3
0;
26 9.129 3.3 0; 27 0 3.3 3.829; 28 3.829 3.3 3.829; 29 9.129 3.3 3.829;
30 12.958 3.3 3.829; 31 0 3.3 9.129; 32 3.829 3.3 9.129; 33 9.129 3.3
9.129;
34 12.958 3.3 9.129; 35 3.829 3.3 12.958; 36 9.129 3.3 12.958; 37 3.829
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9.129;
46 12.958 6.6 9.129; 47 3.829 6.6 12.958; 48 9.129 6.6 12.958; 49 3.829
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54 12.958 10 3.829; 55 0 10 9.129; 56 3.829 10 9.129; 57 9.129 10 9.129;
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2.176;
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10.782;
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35 36;
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244 123 95; 245 124 114; 246 125 115; 252 49 88; 253 50 89; 254 54 91;
255 51 90; 256 55 92; 257 59 94; 258 60 95; 259 58 93;
DEFINE MATERIAL START
ISOTROPIC CONCRETE
E 2.73e+007
POISSON 0.17
DENSITY 25
ALPHA 1e-005
DAMP 0.05
TYPE CONCRETE
STRENGTH FCU 27579
END DEFINE MATERIAL
MEMBER PROPERTY AMERICAN
1 TO 12 69 TO 80 101 TO 112 133 TO 144 221 TO 224 252 TO 259 PRIS YD 0.4
ZD 0.4
MEMBER PROPERTY AMERICAN
49 TO 68 PRIS YD 0.6 ZD 0.23
81 TO 100 113 TO 132 PRIS YD 0.45 ZD 0.23
146 TO 191 PRIS YD 1 ZD 0.35
192 TO 196 PRIS YD 0.8 ZD 0.3
MEMBER PROPERTY AMERICAN
225 TO 246 PRIS YD 0.45 ZD 0.3
CONSTANTS
MATERIAL CONCRETE ALL
SUPPORTS
```
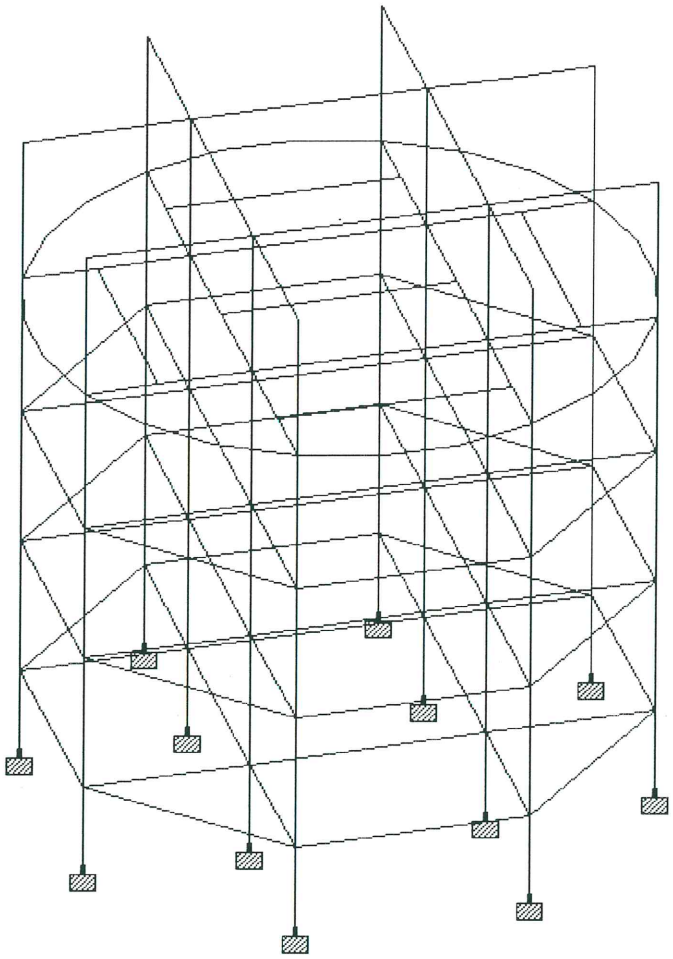

```
13 TO 24 FIXED
SLAVE RIGID MASTER 87 JOINT 49 TO 60
LOAD 1 LOADTYPE Dead  TITLE DL
SELFWEIGHT Y -1
LOAD 2 LOADTYPE Dead  TITLE STIFFNESS X
JOINT LOAD
87 FX 10
LOAD 3 LOADTYPE Dead  TITLE STIFFNESS Z
JOINT LOAD
87 FZ 10
PERFORM ANALYSIS
FINISH
```

PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)

C>STAAD DIAGRAM



PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)

D>SELF WEIGHT

Node	L/C	Force-X kN	Force-Y kN	Force-Z kN	Moment-X kNm	Moment-Y kNm	Moment-Z kNm
13	1	0.8	222.6	2.3	1.5	0.0	-0.5
14	1	-0.8	222.6	2.3	1.5	0.0	0.5
15	1	2.3	222.6	0.8	0.5	0.0	-1.5
16	1	0.5	237.3	0.5	0.3	0.0	-0.3
17	1	-0.5	237.3	0.5	0.3	0.0	0.3
18	1	-2.3	222.6	0.8	0.5	0.0	1.5
19	1	2.3	222.6	-0.8	-0.5	0.0	-1.5
20	1	0.5	237.3	-0.5	-0.3	0.0	-0.3
21	1	-0.5	237.3	-0.5	-0.3	0.0	0.3
22	1	-2.3	222.6	-0.8	-0.5	0.0	1.5
23	1	0.8	222.6	-2.3	-1.5	0.0	-0.5
24	1	-0.8	222.6	-2.3	-1.5	0.0	0.5
			2729.508				
		say	2730				

Tank Geometry : Rectangular Staging + Circular tank + top slab				
13.8 m dia back wash tank				
Weight calculation				
Container				
(A)	Top slab : Self wt			
	Out to out Dia of top slab	ltop	14.20	m
	Center to center dia of dome	cendia	14.00	m
	Thickness of top slab		0.15	m
	Weight of top slab	Wts	593.88	kn
(B)	Wall			
	Center to center length		14.00	m
	Total length		43.98	m
	Thickness of wall		0.2	m
	Height of wall	Thw	3.45	m
	Volume	Vwall	30.35	m3
		Wwall	759	kn
(C)	Bottom slab & Walk way			
	out to out length of bottom slab		14.20	m
	Thickness of bottom slab		0.25	m
	out to out length of walkway		14.20	m
	Volume of bottom slab	Vbs	39.59	m3
	Wt of bottom slab	Wbs	990	kn
(D)	Wt of IPS	Wips	62.82	kn
(E)	Wt of plaster	Wpl	15.70	kn

Container Summary				
(A)	top slab		594	kn
(B)	cylindrical wall		760	kn
(C)	bottom slab		1000	kn
(D)	Wt of IPS		63	
(E)	Wt of plaster		16	
			2433	kn
Water				
	Weight of water upto FSL	Wwfsl	5152.73	kN
	Mass of water upto FSL	Mwfsl	525253	kg
	Weight of water in free board	Wwfb	669.17	kN
	Mass of water in free board	Mwfb	68213	kg
	Total weight of water	Tww	5821.91	kN
	Total mass of water	Tmw	593466	kg
Mass				
	Weight of staging from staad	ws	2730	kn
	Ms = mass of empty container + 1/3 mass of staging	Ms	340726	kg

Tank Geometry : Rectangular Staging + Circular tank + top slab			
13.8 m dia back wash tank			
Spring mass Parameter			
(A)	H/L calculation		
	Height of tank including Freeboard		
	Inside Diameter of tank		
	H/D ratio - Ra	Ra	0.250
	D/H ratio Rb	Rb	4.000
(B)	Mass calculation		
	Total mass of water	M	593466
	Calculation of Impulsive mass		
	$mi/m = \frac{\tanh(0.866d/h)}{0.866\ d/h}$		
	Mi/m - Ratio Rd	Rd	0.288
		Mi	170989
	Calculation of Convective mass		
	$mc/m = 0.23 * \frac{\tanh(3.68h/d)}{h/d}$		
	Mc/m - Ratio Re	Re	0.668
		Mc	396332

	Total mass of water	Tm	567321
(C)	Calculation of Height Hi & Hc for hydrodynamic pressure on tank wall only For H/D < 0.75 , hi = 0.375 For H/D > 0.75		
	hi/h = 0.5 - 0.09375/ (h/d) -Ratio Rf	Rf hia	0.375 1.29
	hc/h = 1-cosh(3.68 h/d)-1 3.68 h/d sinh(3.68 h/d)	Rg hca	0.533 1.84
(D)	Calculation of Height Hi* & Hc* Hi for hydrodynamic pressure on tank wall and base slab For H/D < 1.33 hi*/h = 0.866d/h *0.125 2tanh(0.866 d/h)		
	For H/D > 1.33		
	hi*/h =0.45	Rh hib	1.610 5.556
	hc*/h = 1-cosh(3.68 h/d)-2.01 3.68 h/d sinh(3.68 h/d)	Ri Hcb	1.573 5.426
(E)	Calculation of spring stiffness		
	kc = 0.836*mg/h*tanh^2(3.68 h/d)	kc	740699

Node	L/C	X-Trans mm	Y-Trans mm	Z-Trans mm	Absolute mm	X-Rotan rad	Y-Rotan rad	Z-Rotan rad
87	2	0.35	0	0	0.35	0	0	0
	3	0	0	0.35	0.35	0	0	0

Tank Geometry : Rectangular Staging + Circular tank + top slab				
13.8 m dia back wash tank				
Time period				
(A)	Time period in impulsive mode			
	Ti = 2 * pi * ((Mi+ms)/ks)^0.5			
	Mass Ms		340726	
	mass Mi		170989	
	Deflection due to 10 kn	defl	0.350	mm
	Lateral stiffness	Ks	28571	kn/m
		Ti (full condition	0.841	sec

		Ti (empty	0.686	sec
(B)	Time period in Convective mode			
	Tc = Cc * (D/g)^0.5			
	h/l		0.250	
	Cc = 2 * pi / (3.68*tanh(3.68h/d))^0.5	Cc	3.844	
		Tc	4.560	sec

SESMIC FORCE FOR TANK FULL CONDITION

	Tank type : Elevated storage reservoir			
	13.8 m dia back wash tank			
	Horizontal seismic coefficient _ Full condition			
(A)	Zone factor Z			
	Earthquake zone		2	
	Zone Factor : Z	Z	0.1	
	Importance factor	I	1.5	
	Soil type	st	3	
(B)	Response reduction factor	Rrf	4	
(C)	Calculation for Sa/g : for impulsive mode			
	Time Period Ti		0.84	seconds
	Sa/g : For Soft soil	saga	1.986	
	Sa/g : For Medium soil	sagb	1.617	
	Sa/g : For hard soil	sagc	1.189	
		sag	1.189	
(D)	Seismic coefficient for impulsive mode			
	Ahi = Z / 2 * I /R * Sa/g	Ahi	0.022	
(E)	Calculation for Sa/g : for convective			
	Time Period Tc		4.56	seconds
	Sa/g : For Soft soil	saga1	0.366	
	Sa/g : For Medium soil	sagb1	0.298	
	Sa/g : For hard soil	sagc1	0.219	
	Sag for 0.5 % damping = sag * 1.75	sag1	0.384	
(F)	Seismic coefficient for impulsive mode			
	Ahc = Z / 2 * I /R * Sa/g	Ahc	0.007	
(G)	Vi = Ahi*(Mi+ms)*g			
	mi		170989	kg
	ms		340726	kg
		Vi	112	kn
(H)	Vc = Ahc*mc*G			
	mc		396332	kg
		Vc	28	kn

(I)	Total base shear V= (vi^2+vc^2)^0.5	Vt	115	kn
	Total seismic wt =(Mi+mc+ms)*g		8908	kn
	% lateral base shear		1.30	%

SESMIC FORCE FOR TANK EMPTY CONDITION

Tank type : Elevated storage reservoir				
13.8 m dia back wash tank				
Horizontal seismic coefficient _empty condition				
(A)	Zone factor Z Earthquake zone		2	
	Zone Factor : Z	Z	0.1	
	Importance factor	I	1.5	
	Soil type	st	3	
(B)	Response reduction factor	Rrf	4	
(C)	Calculation for Sa/g : for impulsive mode			
	Time Period Ti	0.69	seconds	
	Sa/g : For Soft soil	sagaa	2.434	
	Sa/g : For Medium soil	sagba	1.982	
	Sa/g : For hard soil	sagca	1.457	
		saga	1.457	
(D)	Seismic coefficient for impulsive mode			
	Ahi = Z / 2 * I /R * Sa/g	Ahia	0.027	
(G)	Vi = Ahi*(ms)*g			
	ms		340726	kg
		Vi	91	kn

E> WIND CALCULATION FOR TANK AT 10 m HEIGHT

Vz= Vb *k1*K2*k3
Vb= Basic wind speed (Rf. IS-875, Part-3, Appendix-A)
K1= Risk Coefficient (Rf. IS-875, Part-3, 5.3.1, & Table-1)
K2= Terrain height & structural size (Rf. IS-875, Part-3, 5.3.2 & Table-2)
K3= Topography Factor (Rf. IS-875, Part-3, 5.3.3)
Vz= 44 *1*0.98*1
= 43.12 m/s^2
$Pz=0.6*Vz^2/1000$
$Pz= 0.6*43.12^2/1000$
$Pz=1.12KN/m^2$
Force Calculation

1) For Container

   Area = (3.6X14.2) = 52 m^2

   Cf= Force Coefficient for clad Building (Rf. IS-875, Part-3, Table-23)
   Cf=0.7
   Force= Cf*Vz*Area
   Force=0.7*1.12*52 = 41 KN

2) For 0.4X0.4 column
   Size= 0.4*0.4 m^2
   Cf= Force Coefficient for individual structural members of infinite length (Rf.IS-875, Part-3 Table-26)
   Cfn=2(Considering angle=0 and unclad Buildings)

   K= Reduction Factor For individual members(IS-8756, Part-3, Table-25)
   K=0.81(Considering maximum L/D Ratio for the Individual element)
   Force= 1.12*2*0.81*0.4
   Force=0.73 KN/m

3) For 0.25X0.45 Beam
   Size= 0.25*0.45 m^2
   Cf= Force Coefficient for individual structural members of infinite length (Rf.IS-875, Part-3 Table-26)
   Cfn=2(Considering angle=0 and unclad Buildings)

   K= Reduction Factor For individual members(IS-8756, Part-3, Table-25)
   K=0.81(Considering maximum L/D Ratio for the building)
   Force= 1.12*2*0.81*0.45
   Force=0.82 KN/m

4) For 0.3*0.8 m^2 Beam
   Size= 0.3*0.8 m^2
   Cf= Force Coefficient for individual structural members of infinite length (Rf.IS-875, Part-3 Table-26)
   Cfn=2(Considering angle=0 and unclad Buildings)

   K= Reduction Factor For individual members(IS-8756, Part-3, Table-25)
   K=0.81(Considering maximum L/D Ratio for the building)
   Force= 1.12*2*0.81*0.8
   Force=1.45 KN/m

5) For 0.35*1.0 m^2 Beam
Size= 0.3*1.0 m^2
Cf= Force Coefficient for individual structural members of infinite length (Rf.IS-875, Part-3 Table-26)
Cfn=2(Considering angle=0 and unclad Buildings)

K= Reduction Factor For individual members(IS-8756, Part-3, Table-25)
K=0.81(Considering maximum L/D Ratio for the building)
Force= 1.12*2*0.81*1.0
Force=1.82 KN/m

F> STAAD INPUT FOR 3D MODEL

```
STAAD SPACE
START JOB INFORMATION
ENGINEER DATE 17-Feb-16
END JOB INFORMATION
INPUT WIDTH 79
UNIT METER KN
JOINT COORDINATES
1 3.829 0 0; 2 9.129 0 0; 3 0 0 3.829; 4 3.829 0 3.829; 5 9.129 0 3.829;
6 12.958 0 3.829; 7 0 0 9.129; 8 3.829 0 9.129; 9 9.129 0 9.129;
10 12.958 0 9.129; 11 3.829 0 12.958; 12 9.129 0 12.958; 13 3.829 -2 0;
14 9.129 -2 0; 15 0 -2 3.829; 16 3.829 -2 3.829; 17 9.129 -2 3.829;
18 12.958 -2 3.829; 19 0 -2 9.129; 20 3.829 -2 9.129; 21 9.129 -2 9.129;
22 12.958 -2 9.129; 23 3.829 -2 12.958; 24 9.129 -2 12.958; 25 3.829 3.3
0;
26 9.129 3.3 0; 27 0 3.3 3.829; 28 3.829 3.3 3.829; 29 9.129 3.3 3.829;
30 12.958 3.3 3.829; 31 0 3.3 9.129; 32 3.829 3.3 9.129; 33 9.129 3.3
9.129;
34 12.958 3.3 9.129; 35 3.829 3.3 12.958; 36 9.129 3.3 12.958; 37 3.829
6.6 0;
38 9.129 6.6 0; 39 0 6.6 3.829; 40 3.829 6.6 3.829; 41 9.129 6.6 3.829;
42 12.958 6.6 3.829; 43 0 6.6 9.129; 44 3.829 6.6 9.129; 45 9.129 6.6
9.129;
46 12.958 6.6 9.129; 47 3.829 6.6 12.958; 48 9.129 6.6 12.958; 49 3.829
10 0;
50 9.129 10 0; 51 0 10 3.829; 52 3.829 10 3.829; 53 9.129 10 3.829;
54 12.958 10 3.829; 55 0 10 9.129; 56 3.829 10 9.129; 57 9.129 10 9.129;
58 12.958 10 9.129; 59 3.829 10 12.958; 60 9.129 10 12.958; 61 0.958 10
2.176;
62 2.176 10 0.958; 63 10.782 10 0.958; 64 12 10 2.176; 65 0.958 10
10.782;
66 2.176 10 12; 67 12 10 10.782; 68 10.782 10 12; 69 5.638 10 -0.47;
70 7.32 10 -0.47; 71 5.638 10 13.428; 72 7.32 10 13.428; 73 -0.47 10
5.638;
74 -0.47 10 7.32; 75 13.428 10 5.638; 76 13.428 10 7.32; 77 3.829 10
1.679;
78 9.129 10 1.679; 79 1.679 10 3.829; 80 1.679 10 9.129; 81 11.279 10
3.829;
82 11.279 10 9.129; 83 3.829 10 11.279; 84 9.129 10 11.279; 85 3.829 10
6.479;
86 9.129 10 6.479; 87 6.479 12 6.479; 88 3.829 13.45 0; 89 9.129 13.45 0;
90 0 13.45 3.829; 91 12.958 13.45 3.829; 92 0 13.45 9.129;
```

93 12.958 13.45 9.129; 94 3.829 13.45 12.958; 95 9.129 13.45 12.958;
96 0.958 13.45 2.176; 97 2.176 13.45 0.958; 98 10.782 13.45 0.958;
99 12 13.45 2.176; 100 0.958 13.45 10.782; 101 2.176 13.45 12;
102 12 13.45 10.782; 103 10.782 13.45 12; 104 5.638 13.45 -0.47;
105 7.32 13.45 -0.47; 106 5.638 13.45 13.428; 107 7.32 13.45 13.428;
108 -0.47 13.45 5.638; 109 -0.47 13.45 7.32; 110 13.428 13.45 5.638;
111 13.428 13.45 7.32; 112 3.829 13.45 3.829; 113 9.129 13.45 3.829;
114 3.829 13.45 9.129; 115 9.129 13.45 9.129;
****

MEMBER INCIDENCES
1 13 1; 2 1 25; 3 25 37; 4 37 49; 5 49 88; 6 14 2; 7 2 26; 8 26 38; 9 38
50;
10 50 89; 11 15 3; 12 3 27; 13 27 39; 14 39 51; 15 51 90; 16 16 4; 17 4
28;
18 28 40; 19 40 52; 20 52 112; 21 17 5; 22 5 29; 23 29 41; 24 41 53; 25
53 113;
26 18 6; 27 6 30; 28 30 42; 29 42 54; 30 54 91; 31 19 7; 32 7 31; 33 31
43;
34 43 55; 35 55 92; 36 20 8; 37 8 32; 38 32 44; 39 44 56; 40 56 114; 41
21 9;
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8;
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8;
114 8 11; 115 2 5; 116 5 9; 117 9 12; 118 2 6; 119 6 10; 120 10 12; 121
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122 27 28; 123 28 29; 124 29 30; 125 31 32; 126 32 33; 127 33 34; 128 35
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150 39 43; 151 43 47; 152 37 40; 153 40 44; 154 44 47; 155 38 41; 156 41
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157 45 48; 158 38 42; 159 42 46; 160 46 48; 161 77 78; 162 51 79; 163 79
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171 57 82; 172 82 58; 173 83 84; 174 79 80; 175 49 77; 176 77 52; 177 52
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178 85 56; 179 56 83; 180 83 59; 181 50 78; 182 78 53; 183 53 86; 184 86
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185 57 84; 186 84 60; 187 81 82; 251 49 69; 252 69 70; 253 70 50; 254 50
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255 63 64; 256 64 54; 257 54 75; 258 75 76; 259 76 58; 260 58 67; 261 67
68;

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262 68 60; 263 60 72; 264 72 71; 265 71 59; 266 59 66; 267 66 65; 268 65
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269 55 74; 270 74 73; 271 73 51; 272 51 61; 273 61 62; 274 62 49; 301 90
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302 112 113; 303 113 91; 304 92 114; 305 114 115; 306 115 93; 307 88 112;
308 112 114; 309 114 94; 310 89 113; 311 113 115; 312 115 95; 1191 88
104;
1192 104 105; 1193 105 89; 1194 89 98; 1195 98 99; 1196 99 91; 1197 91
110;
1198 110 111; 1199 111 93; 1200 93 102; 1201 102 103; 1202 103 95; 1203
95 107;
1204 107 106; 1205 106 94; 1206 94 101; 1207 101 100; 1208 100 92; 1209
92 109;
1210 109 108; 1211 108 90; 1212 90 96; 1213 96 97; 1214 97 88;
*********************************************************************
DEFINE MATERIAL START
ISOTROPIC CONCRETE
E 2.73e+007
POISSON 0.17
DENSITY 25
ALPHA 1e-005
DAMP 0.05
TYPE CONCRETE
STRENGTH FCU 27579
END DEFINE MATERIAL
*********************************************************************
MEMBER PROPERTY AMERICAN
1 TO 60 PRIS YD 0.4 ZD 0.4
MEMBER PROPERTY AMERICAN
101 TO 120 PRIS YD 0.6 ZD 0.23
121 TO 160 PRIS YD 0.45 ZD 0.23
162 TO 166 168 TO 172 175 TO 186 251 TO 274 PRIS YD 1 ZD 0.35
161 167 173 174 187 PRIS YD 0.8 ZD 0.3
MEMBER PROPERTY AMERICAN
301 TO 312 PRIS YD 0.45 ZD 0.3
1191 TO 1214 PRIS YD 0.1 ZD 0.1
CONSTANTS
MATERIAL CONCRETE ALL
*********************************************************************
SUPPORTS
13 TO 24 FIXED
*********************************************************************
MEMBER RELEASE
101 TO 187 301 TO 312 START MX
101 TO 187 301 TO 312 END MX
*********************************************************************
SLAVE FX FZ MASTER 87 JOINT 49 TO 60
*********************************************************************
LOAD 1 LOADTYPE Dead  TITLE DL
SELFWEIGHT Y -1
FLOOR LOAD
**150 THICK SLAB, (0.15*25)+1.25 = 5
YRANGE 13.449 13.451 FLOAD -5 XRANGE -0.47 13.428  ZRANGE -0.47 13.428 GY
```

```
**250 THICK SLAB, (0.25*25)+1.0 = 7.25
YRANGE 9.999 10.001 FLOAD -7.25 XRANGE -0.47 13.428  ZRANGE -0.47 13.428
GY
*********************************************************************
LOAD 2 LOADTYPE Dead  TITLE WALL
MEMBER LOAD
**WALL LOAD, 0.2*25*3.45= 17.25
251 TO 274 UNI GY -17.25
*********************************************************************
LOAD 3 LOADTYPE Fluids  TITLE WATER
FLOOR LOAD
**WATER LOAD = 3.45*10 = 34.5 kN/m
YRANGE 9.999 10.001 FLOAD -34.5 XRANGE -0.47 13.428  ZRANGE -0.47 13.428
GY
*********************************************************************
*Earthquake - Tank Full Condtion
LOAD 4 EQLOAD - X DIRECTION
JOINT LOAD
87 FX 157
LOAD 5 EQLOAD - Z DIRECTION
JOINT LOAD
87 FZ 157
LOAD 6 EQLOAD - X DIRECTION (REV)
JOINT LOAD
87 FX -157
LOAD 7 EQLOAD - Z DIRECTION (REV)
JOINT LOAD
87 FZ -157
*********************************************************************
*Earthquake - Tank Empty Condtion
LOAD 8 EQLOAD - X DIRECTION
JOINT LOAD
87 FX 124
LOAD 9 EQLOAD - Z DIRECTION
JOINT LOAD
87 FZ 124
LOAD 10 7 EQLOAD - X DIRECTION (REV)
JOINT LOAD
87 FX -124
LOAD 11 EQLOAD - Z DIRECTION (REV)
JOINT LOAD
87 FZ -124
*********************************************************************
LOAD 12 WIND LOAD - X DIRECTION
JOINT LOAD
87 FX 41
MEMBER LOAD
2 TO 4 7 TO 9 12 TO 14 17 TO 19 22 TO 24 27 TO 29 32 TO 34 37 TO 39 -
42 TO 44 47 TO 49 52 TO 54 57 TO 59 UNI GX 0.73
129 TO 140 149 TO 160 UNI GX 0.82
174 187 UNI GX 1.45
175 TO 186 251 TO 274 UNI GX 1.82
LOAD 13 WIND LOAD - Z DIRECTION
```

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JOINT LOAD
87 FZ 41
MEMBER LOAD
2 TO 4 7 TO 9 12 TO 14 17 TO 19 22 TO 24 27 TO 29 32 TO 34 37 TO 39 -
42 TO 44 47 TO 49 52 TO 54 57 TO 59 UNI GZ 0.73
121 TO 129 131 138 140 TO 149 151 158 160 UNI GZ 0.82
161 167 173 UNI GZ 1.45
162 TO 166 168 TO 172 251 TO 274 UNI GZ 1.82
LOAD 14 WIND LOAD - X DIRECTION (REV.)
JOINT LOAD
87 FX -41
MEMBER LOAD
2 TO 4 7 TO 9 12 TO 14 17 TO 19 22 TO 24 27 TO 29 32 TO 34 37 TO 39 -
42 TO 44 47 TO 49 52 TO 54 57 TO 59 UNI GX -0.73
129 TO 140 149 TO 160 UNI GX -0.82
174 187 UNI GX -1.45
175 TO 186 251 TO 274 UNI GX -1.82
LOAD 15 WIND LOAD - Z DIRECTION (REV.)
JOINT LOAD
87 FZ -41
MEMBER LOAD
2 TO 4 7 TO 9 12 TO 14 17 TO 19 22 TO 24 27 TO 29 32 TO 34 37 TO 39 -
42 TO 44 47 TO 49 52 TO 54 57 TO 59 UNI GZ -0.73
121 TO 129 131 138 140 TO 149 151 158 160 UNI GZ -0.82
161 167 173 UNI GZ -1.45
162 TO 166 168 TO 172 251 TO 274 UNI GZ -1.82
************************************************************
*Normal load
LOAD COMB 21 1.5DL
1 1.5 2 1.5 3 1.5
*Total dead load + EQ load - tank full condition
LOAD COMB 22 1.5DL+1.5EQX+0.45EQZ
1 1.5 2 1.5 3 1.5 4 1.5 5 0.45
LOAD COMB 23 1.5DL+1.5EQX-0.45EQZ
1 1.5 2 1.5 3 1.5 4 1.5 7 0.45
LOAD COMB 24 1.5DL-1.5EQX+0.45EQZ
1 1.5 2 1.5 3 1.5 6 1.5 5 0.45
LOAD COMB 25 1.5DL-1.5EQX-0.45EQZ
1 1.5 2 1.5 3 1.5 6 1.5 7 0.45
LOAD COMB 26 1.5DL+0.45EQX+1.50EQZ
1 1.5 2 1.5 3 1.5 4 0.45 5 1.5
LOAD COMB 27 1.5DL-0.45EQX+1.50EQZ
1 1.5 2 1.5 3 1.5 6 0.45 5 1.5
LOAD COMB 28 1.5DL+0.45EQX-1.50EQZ
1 1.5 2 1.5 3 1.5 4 0.45 7 1.5
LOAD COMB 29 1.5DL-0.45EQX-1.50EQZ
1 1.5 2 1.5 3 1.5 6 0.45 7 1.5
*Total load + EQ load - tank full condition
LOAD COMB 30 1.2DL+1.2EQX+0.36EQZ
1 1.2 2 1.2 3 1.2 4 1.2 5 0.36
LOAD COMB 31 1.2DL+1.2EQX-0.36EQZ
1 1.2 2 1.2 3 1.2 4 1.2 7 0.36
LOAD COMB 32 1.2DL-1.2EQX+0.36EQZ
```

```
1 1.2 2 1.2 3 1.2 6 1.2 5 0.36
LOAD COMB 33 1.2DL-1.2EQX-0.36EQZ
1 1.2 2 1.2 3 1.2 6 1.2 7 0.36
LOAD COMB 34 1.2DL+0.36EQX+1.20EQZ
1 1.2 2 1.2 3 1.2 4 0.36 5 1.2
LOAD COMB 35 1.2DL-0.36EQX+1.20EQZ
1 1.2 2 1.2 3 1.2 6 0.36 5 1.2
LOAD COMB 36 1.2DL+0.36EQX-1.20EQZ
1 1.2 2 1.2 3 1.2 4 0.36 7 1.2
LOAD COMB 37 1.2DL-0.36EQX-1.20EQZ
1 1.2 2 1.2 3 1.2 6 0.36 7 1.2
* 0.9 time dead load + EQ load - tank full condition
LOAD COMB 38 0.9DL+1.5EQX+0.45EQZ
1 0.9 2 0.9 3 0.9 4 1.5 5 0.45
LOAD COMB 39 0.9DL+1.5EQX-0.45EQZ
1 0.9 2 0.9 3 0.9 4 1.5 7 0.45
LOAD COMB 40 0.9DL-1.5EQX+0.45EQZ
1 0.9 2 0.9 3 0.9 6 1.5 5 0.45
LOAD COMB 41 0.9DL-1.5EQX-0.45EQZ
1 0.9 2 0.9 3 0.9 6 1.5 7 0.45
LOAD COMB 42 0.9DL+0.45EQX+1.50EQZ
1 0.9 2 0.9 3 0.9 4 0.45 5 1.5
LOAD COMB 43 0.9DL-0.45EQX+1.50EQZ
1 0.9 2 0.9 3 0.9 6 0.45 5 1.5
LOAD COMB 44 0.9DL+0.45EQX-1.50EQZ
1 0.9 2 0.9 3 0.9 4 0.45 7 1.5
LOAD COMB 45 0.9DL-0.45EQX-1.50EQZ
1 0.9 2 0.9 3 0.9 6 0.45 7 1.5
*Total dead LOAD + EQ load - tank empty condition
LOAD COMB 46 1.5DL+1.5EQX+0.45EQZ
1 1.5 2 1.5 8 1.5 9 0.45
LOAD COMB 47 1.5DL+1.5EQX-0.45EQZ
1 1.5 2 1.5 8 1.5 11 0.45
LOAD COMB 48 1.5DL-1.5EQX+0.45EQZ
1 1.5 2 1.5 10 1.5 9 0.45
LOAD COMB 49 1.5DL-1.5EQX-0.45EQZ
1 1.5 2 1.5 10 1.5 11 0.45
LOAD COMB 50 1.5DL+0.45EQX+1.50EQZ
1 1.5 2 1.5 8 0.45 9 1.5
LOAD COMB 51 1.5DL-0.45EQX+1.50EQZ
1 1.5 2 1.5 10 0.45 9 1.5
LOAD COMB 52 1.5DL+0.45EQX-1.50EQZ
1 1.5 2 1.5 8 0.45 11 1.5
LOAD COMB 53 1.5DL-0.45EQX-1.50EQZ
1 1.5 2 1.5 10 0.45 11 1.5
* 0.9 time dead LOAD + EQ LOAD - tank empty condition
LOAD COMB 54 0.9DL +1.5EQX+0.45EQZ
1 0.9 2 0.9 8 1.5 9 0.45
LOAD COMB 55 0.9DL+1.5EQX-0.45EQZ
1 0.9 2 0.9 8 1.5 11 0.45
LOAD COMB 56 0.9DL-1.5EQX+0.45EQZ
1 0.9 2 0.9 10 1.5 9 0.45
LOAD COMB 57 0.9DL-1.5EQX-0.45EQZ
```

```
1 0.9 2 0.9 10 1.5 11 0.45
LOAD COMB 58 0.9DL+0.45EQX+1.50EQZ
1 0.9 2 0.9 8 0.45 9 1.5
LOAD COMB 59 0.9DL-0.45EQX+1.50EQZ
1 0.9 2 0.9 10 0.45 9 1.5
LOAD COMB 60 0.9DL+0.45EQX-1.50EQZ
1 0.9 2 0.9 8 0.45 11 1.5
LOAD COMB 61 0.9DL-0.45EQX-1.50EQZ
1 0.9 2 0.9 10 0.45 11 1.5
*Total load + Wind load (TANK FULL)
LOAD COMB 62 1.5TL+1.5WLX
1 1.5 2 1.5 3 1.5 12 1.5
LOAD COMB 63 1.5TL+1.5WLZ
1 1.5 2 1.5 3 1.5 13 1.5
LOAD COMB 64 1.5TL-1.5WLX
1 1.5 2 1.5 3 1.5 14 1.5
LOAD COMB 65 1.5TL-1.5WLZ
1 1.5 2 1.5 3 1.5 15 1.5
*Total dead load + Wind load (tank empty)
LOAD COMB 66 1.5DL+1.5WLX
1 1.5 2 1.5 12 1.5
LOAD COMB 67 1.5DL+1.5WLZ
1 1.5 2 1.5 13 1.5
LOAD COMB 68 1.5DL-1.5WLX
1 1.5 2 1.5 14 1.5
LOAD COMB 69 1.5DL-1.5WLZ
1 1.5 2 1.5 15 1.5
**********service LOAD COMB**********
LOAD COMB 71 DL
1 1.0 2 1.0 3 1.0
*Total dead load + EQ load - tank full condition
LOAD COMB 72 1.0DL+1.0EQX+0.30EQZ
1 1.0 2 1.0 3 1.0 4 1.0 5 0.3
LOAD COMB 73 1.0DL+1.0EQX-0.3EQZ
1 1.0 2 1.0 3 1.0 4 1.0 7 0.3
LOAD COMB 74 1.0DL-1.0EQX+0.3EQZ
1 1.0 2 1.0 3 1.0 6 1.0 5 0.3
LOAD COMB 75 1.0DL-1.0EQX-0.3EQZ
1 1.0 2 1.0 3 1.0 6 1.0 7 0.3
LOAD COMB 76 1.0DL+0.3EQX+1.0EQZ
1 1.0 2 1.0 3 1.0 4 0.3 5 1.0
LOAD COMB 77 1.0DL-0.3EQX+1.0EQZ
1 1.0 2 1.0 3 1.0 6 0.3 5 1.0
LOAD COMB 78 1.0DL+0.3EQX-1.0EQZ
1 1.0 2 1.0 3 1.0 4 0.3 7 1.0
LOAD COMB 79 1.0DL-0.3EQX-1.0EQZ
1 1.0 2 1.0 3 1.0 6 0.3 7 1.0
*0.9 dead load + EQ load - tank full condition
LOAD COMB 80 0.9DL+1.0EQX+0.30EQZ
1 0.9 2 0.9 3 0.9 4 1.0 5 0.3
LOAD COMB 81 0.9DL+1.0EQX-0.3EQZ
1 0.9 2 0.9 3 0.9 4 1.0 7 0.3
LOAD COMB 82 0.9DL-1.0EQX+0.3EQZ
```

```
1 0.9 2 0.9 3 0.9 6 1.0 5 0.3
LOAD COMB 83 0.9DL-1.0EQX-0.3EQZ
1 0.9 2 0.9 3 0.9 6 1.0 7 0.3
LOAD COMB 84 0.9DL+0.3EQX+1.0EQZ
1 0.9 2 0.9 3 0.9 4 0.3 5 1.0
LOAD COMB 85 0.9DL-0.3EQX+1.0EQZ
1 0.9 2 0.9 3 0.9 6 0.3 5 1.0
LOAD COMB 86 0.9DL+0.3EQX-1.0EQZ
1 0.9 2 0.9 3 0.9 4 0.3 7 1.0
LOAD COMB 87 0.9DL-0.3EQX-1.0EQZ
1 0.9 2 0.9 3 0.9 6 0.3 7 1.0
************************************************************
LOAD COMB 88 1.0TL+1.0WLX
1 1.0 2 1.0 3 1.0 12 1.0
LOAD COMB 89 1.0TL+1.0WLZ
1 1.0 2 1.0 3 1.0 13 1.0
LOAD COMB 90 1.0TL-1.0WLX
1 1.0 2 1.0 3 1.0 14 1.0
LOAD COMB 91 1.0TL-1.0WLZ
1 1.0 2 1.0 3 1.0 15 1.0
LOAD COMB 92 1.0DL+1.0WLX
1 1.0 2 1.0 12 1.0
LOAD COMB 93 1.0DL+1.0WLZ
1 1.0 2 1.0 13 1.0
LOAD COMB 94 1.0DL-1.0WLX
1 1.0 2 1.0 14 1.0
LOAD COMB 95 1.0DL-1.0WLZ
1 1.0 2 1.0 15 1.0
PERFORM ANALYSIS
************************************************************
LOAD LIST 21 TO 69
START CONCRETE DESIGN
CODE INDIAN
UNIT MMS NEWTON
CLEAR 50 MEMB 5 10 15 20 25 30 35 40 45 50 55 60 161 TO 187 251 TO 274
301 302 TO 312 1191 TO 1214
CLEAR 40 MEMB 1 TO 4 6 TO 9 11 TO 14 16 TO 19 21 TO 24 26 TO 29 31 TO 34
36 37 TO 39 41 TO 44 46 TO 49 51 TO 54 56 TO 59
CLEAR 25 MEMB 101 TO 160
FC 30 ALL
FYMAIN 415 ALL
FYSEC 415 ALL
MAXSEC 10 ALL
DESIGN BEAM 101 TO 187 251 TO 274 301 TO 312
DESIGN COLUMN 1 TO 60
END CONCRETE DESIGN
UNIT METER KN
LOAD LIST 21 TO 69
FINISH
```

4.0 FOOTING DESIGN

TYPICAL CALCULATION OF FOOTING

Safe bearing capacity of soil = 200 kN/ m^2

Increase in S.B.C for the combination of Earthquake forces and Wind force = 25 %

S.B.C for Eq forces and wind forces = 250 kN/m^2

Footing area & loads are also design for following combination

```
LOAD COMB 21 1.5DL+1.5LL
1 1.5 2 1.5 3 1.5 4 1.5
*Total dead load + EQ load - tank full condition
LOAD COMB 22 1.5DL+1.5EQX+0.45EQZ
1 1.5 3 1.5 4 1.5 5 1.5 6 0.45
LOAD COMB 23 1.5DL+1.5EQX-0.45EQZ
1 1.5 3 1.5 4 1.5 5 1.5 8 0.45
LOAD COMB 24 1.5DL-1.5EQX+0.45EQZ
1 1.5 3 1.5 4 1.5 7 1.5 6 0.45
LOAD COMB 25 1.5DL-1.5EQX-0.45EQZ
1 1.5 3 1.5 4 1.5 7 1.5 8 0.45
LOAD COMB 26 1.5DL+0.45EQX+1.50EQZ
1 1.5 3 1.5 4 1.5 5 0.45 6 1.5
LOAD COMB 27 1.5DL-0.45EQX+1.50EQZ
1 1.5 3 1.5 4 1.5 7 0.45 6 1.5
LOAD COMB 28 1.5DL+0.45EQX-1.50EQZ
1 1.5 3 1.5 4 1.5 5 0.45 8 1.5
LOAD COMB 29 1.5DL-0.45EQX-1.50EQZ
1 1.5 3 1.5 4 1.5 7 0.45 8 1.5
*Total load + EQ load - tank full condition
LOAD COMB 30 1.2DL+1.2LL+1.2EQX+0.36EQZ
1 1.2 2 1.2 3 1.2 4 1.2 5 1.2 6 0.36
LOAD COMB 31 1.2DL+1.2LL+1.2EQX-0.36EQZ
1 1.2 2 1.2 3 1.2 4 1.2 5 1.2 8 0.36
LOAD COMB 32 1.2DL+1.2LL-1.2EQX+0.36EQZ
1 1.2 2 1.2 3 1.2 4 1.2 7 1.2 6 0.36
LOAD COMB 33 1.2DL+1.2LL-1.2EQX-0.36EQZ
1 1.2 2 1.2 3 1.2 4 1.2 7 1.2 8 0.36
LOAD COMB 34 1.2DL+1.2LL+0.36EQX+1.20EQZ
1 1.2 2 1.2 3 1.2 4 1.2 5 0.36 6 1.2
LOAD COMB 35 1.2DL+1.2LL-0.36EQX+1.20EQZ
1 1.2 2 1.2 3 1.2 4 1.2 7 0.36 6 1.2
LOAD COMB 36 1.2DL+1.2LL+0.36EQX-1.20EQZ
1 1.2 2 1.2 3 1.2 4 1.2 5 0.36 8 1.2
LOAD COMB 37 1.2DL+1.2LL-0.36EQX-1.20EQZ
1 1.2 2 1.2 3 1.2 4 1.2 7 0.36 8 1.2
LOAD COMB 62 1.5TL+1.5WLX
1 1.5 2 1.5 3 1.5 4 1.5 13 1.5
LOAD COMB 63 1.5TL+1.5WLZ
1 1.5 2 1.5 3 1.5 4 1.5 14 1.5
LOAD COMB 64 1.5TL-1.5WLX
1 1.5 2 1.5 3 1.5 4 1.5 15 1.5
LOAD COMB 65 1.5TL+1.5WLZ
1 1.5 2 1.5 3 1.5 4 1.5 16 1.5
```

REFER ANNEXTURE - A FOR FOOTING DESIGN

5.0 COLUMN DESIGN

COLUMN C1

```
C O L U M N   N O.      1  D E S I G N   R E S U L T S

M30                    Fe415 (Main)              Fe415 (Sec.)

LENGTH:  2000.0 mm   CROSS SECTION:  400.0 mm X  400.0 mm  COVER: 40.0 mm

** GUIDING LOAD CASE:   65 END JOINT:    13  SHORT COLUMN


REQD. STEEL AREA    :      745.15 Sq.mm.
REQD. CONCRETE AREA:    93144.27 Sq.mm.
MAIN REINFORCEMENT : Provide   8 - 12 dia. (0.57%,    904.78 Sq.mm.)
(Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 190 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
---------------------------------------------------------
Puz :   2381.87   Muz1 :    123.74   Muy1 :    123.74

INTERACTION RATIO: 0.46 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
---------------------------------------------------------
WORST LOAD CASE:    67
END JOINT:    13 Puz :   2429.40   Muz :    113.09   Muy :    113.09
IR: 0.60
=========================================================================


=========================================================================

C O L U M N   N O.      2  D E S I G N   R E S U L T S

M30                    Fe415 (Main)              Fe415 (Sec.)

LENGTH:  3300.0 mm   CROSS SECTION:  400.0 mm X  400.0 mm  COVER: 40.0 mm

** GUIDING LOAD CASE:   65 END JOINT:     1  SHORT COLUMN

STAAD SPACE                                              -- PAGE NO.  120


REQD. STEEL AREA    :      679.48 Sq.mm.
REQD. CONCRETE AREA:    84934.77 Sq.mm.
MAIN REINFORCEMENT : Provide   8 - 12 dia. (0.57%,    904.78 Sq.mm.)
(Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 190 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
---------------------------------------------------------
Puz :   2362.31   Muz1 :    125.55   Muy1 :    125.55

INTERACTION RATIO: 0.74 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
---------------------------------------------------------
```

```
WORST LOAD CASE:     67
END JOINT:      1 Puz :    2429.40    Muz :     113.93    Muy :     113.93
IR: 0.81
================================================================================


================================================================================

C O L U M N   N O.      3  D E S I G N   R E S U L T S

M30                     Fe415 (Main)               Fe415 (Sec.)

LENGTH:  3300.0 mm   CROSS SECTION:  400.0 mm X  400.0 mm  COVER: 40.0 mm

** GUIDING LOAD CASE:    65 END JOINT:     25  SHORT COLUMN


REQD. STEEL AREA    :       613.12 Sq.mm.
REQD. CONCRETE AREA:     76640.16 Sq.mm.
MAIN REINFORCEMENT : Provide   8 - 12 dia. (0.57%,     904.78 Sq.mm.)
(Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 190 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
----------------------------------------------------------
Puz :    2342.56    Muz1 :     125.71    Muy1 :     125.71

INTERACTION RATIO: 0.46 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
----------------------------------------------------------
WORST LOAD CASE:     69
END JOINT:     37 Puz :    2429.40    Muz :     122.56    Muy :     122.56
IR: 0.60
STAAD SPACE                                              -- PAGE NO.   121

================================================================================


================================================================================

C O L U M N   N O.      4  D E S I G N   R E S U L T S

M30                     Fe415 (Main)               Fe415 (Sec.)

LENGTH:  3400.0 mm   CROSS SECTION:  400.0 mm X  400.0 mm  COVER: 40.0 mm

** GUIDING LOAD CASE:    65 END JOINT:     37  SHORT COLUMN


REQD. STEEL AREA    :       550.11 Sq.mm.
REQD. CONCRETE AREA:     68763.82 Sq.mm.
MAIN REINFORCEMENT : Provide   8 - 12 dia. (0.57%,     904.78 Sq.mm.)
(Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 190 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
----------------------------------------------------------
Puz :    2323.80    Muz1 :     123.13    Muy1 :     123.13

INTERACTION RATIO: 0.42 (as per Cl. 39.6, IS456:2000)
```

```
SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
----------------------------------------------------------
WORST LOAD CASE:    65
END JOINT:    49 Puz :   2429.40   Muz :    137.72   Muy :    137.72
IR: 0.79
================================================================================


================================================================================

C O L U M N   N O.      5  D E S I G N   R E S U L T S

M30                     Fe415 (Main)              Fe415 (Sec.)

LENGTH:  3450.0 mm   CROSS SECTION:  400.0 mm X  400.0 mm  COVER: 50.0 mm

** GUIDING LOAD CASE:   63 END JOINT:    49  SHORT COLUMN

STAAD SPACE                                                -- PAGE NO.  122


REQD. STEEL AREA    :      909.40 Sq.mm.
REQD. CONCRETE AREA:   113675.05 Sq.mm.
MAIN REINFORCEMENT : Provide   4 - 20 dia. (0.79%,   1256.64 Sq.mm.)
(Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 300 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
----------------------------------------------------------
Puz :   2430.77   Muz1 :     71.13   Muy1 :     71.13

INTERACTION RATIO: 0.99 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
----------------------------------------------------------
WORST LOAD CASE:    63
END JOINT:    49 Puz :   2534.16   Muz :     87.96   Muy :     87.96
IR: 0.80
================================================================================
```

COLUMN C2

```
C O L U M N   N O.      16  D E S I G N   R E S U L T S

M30                     Fe415 (Main)              Fe415 (Sec.)

LENGTH:  2000.0 mm   CROSS SECTION:  400.0 mm X  400.0 mm  COVER: 40.0 mm

** GUIDING LOAD CASE:   63 END JOINT:    16  SHORT COLUMN


REQD. STEEL AREA    :     1117.67 Sq.mm.
REQD. CONCRETE AREA:   139708.45 Sq.mm.
MAIN REINFORCEMENT : Provide   4 - 20 dia. (0.79%,   1256.64 Sq.mm.)
(Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 300 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
----------------------------------------------------------
```

```
Puz :   2492.79    Muz1 :     88.56    Muy1 :     88.56

INTERACTION RATIO: 0.74 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
----------------------------------------------------------
WORST LOAD CASE:    63
END JOINT:    16 Puz :   2534.16    Muz :     98.70    Muy :     98.70
IR: 0.61
================================================================================


================================================================================

C O L U M N   N O.     17  D E S I G N   R E S U L T S

M30                    Fe415 (Main)              Fe415 (Sec.)

LENGTH:  3300.0 mm   CROSS SECTION:  400.0 mm X  400.0 mm  COVER: 40.0 mm

** GUIDING LOAD CASE:   64 END JOINT:     4  SHORT COLUMN

STAAD SPACE                                                -- PAGE NO.  130


REQD. STEEL AREA    :     1354.03 Sq.mm.
REQD. CONCRETE AREA:   158645.97 Sq.mm.
MAIN REINFORCEMENT : Provide  12 - 12 dia. (0.85%,   1357.17 Sq.mm.)
(Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 190 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
----------------------------------------------------------
Puz :   2563.16    Muz1 :    110.66    Muy1 :    110.66

INTERACTION RATIO: 0.96 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
----------------------------------------------------------
WORST LOAD CASE:    65
END JOINT:     4 Puz :   2564.10    Muz :    111.17    Muy :    111.17
IR: 0.99
================================================================================


================================================================================

C O L U M N   N O.     18  D E S I G N   R E S U L T S

M30                    Fe415 (Main)              Fe415 (Sec.)

LENGTH:  3300.0 mm   CROSS SECTION:  400.0 mm X  400.0 mm  COVER: 40.0 mm

** GUIDING LOAD CASE:   22 END JOINT:    28  SHORT COLUMN


REQD. STEEL AREA    :     1033.27 Sq.mm.
REQD. CONCRETE AREA:   129159.04 Sq.mm.
MAIN REINFORCEMENT : Provide   4 - 20 dia. (0.79%,   1256.64 Sq.mm.)
(Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 300 mm c/c
```

```
SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
----------------------------------------------------------
Puz :   2467.66   Muz1 :    100.27   Muy1 :    100.27

INTERACTION RATIO: 0.28 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
----------------------------------------------------------
WORST LOAD CASE:    65
END JOINT:    40 Puz :   2534.16   Muz :    117.30   Muy :    117.30
IR: 0.61
STAAD SPACE                                              -- PAGE NO.  131

==========================================================================


==========================================================================

C O L U M N   N O.     19  D E S I G N   R E S U L T S

M30                    Fe415 (Main)              Fe415 (Sec.)

LENGTH:  3400.0 mm   CROSS SECTION:  400.0 mm X  400.0 mm  COVER: 40.0 mm

** GUIDING LOAD CASE:   65 END JOINT:    52  SHORT COLUMN


REQD. STEEL AREA   :     1106.71 Sq.mm.
REQD. CONCRETE AREA:   138339.31 Sq.mm.
MAIN REINFORCEMENT : Provide   4 - 20 dia. (0.79%,   1256.64 Sq.mm.)
(Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 300 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
----------------------------------------------------------
Puz :   2489.52   Muz1 :    107.12   Muy1 :    107.12

INTERACTION RATIO: 0.99 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
----------------------------------------------------------
WORST LOAD CASE:    65
END JOINT:    52 Puz :   2534.16   Muz :    118.85   Muy :    118.85
IR: 0.82
==========================================================================


==========================================================================

C O L U M N   N O.     20  D E S I G N   R E S U L T S

M30                    Fe415 (Main)              Fe415 (Sec.)

LENGTH:  3450.0 mm   CROSS SECTION:  400.0 mm X  400.0 mm  COVER: 50.0 mm

** GUIDING LOAD CASE:   29 END JOINT:   112  SHORT COLUMN

STAAD SPACE                                              -- PAGE NO.  132
```

```
REQD. STEEL AREA    :       920.22 Sq.mm.
REQD. CONCRETE AREA:    115027.34 Sq.mm.
MAIN REINFORCEMENT : Provide   4 - 20 dia. (0.79%,    1256.64 Sq.mm.)
(Equally distributed)
TIE REINFORCEMENT  : Provide  8 mm dia. rectangular ties @ 300 mm c/c

SECTION CAPACITY BASED ON REINFORCEMENT REQUIRED (KNS-MET)
-----------------------------------------------------------
Puz :   2434.00   Muz1 :     81.84   Muy1 :     81.84

INTERACTION RATIO: 0.99 (as per Cl. 39.6, IS456:2000)

SECTION CAPACITY BASED ON REINFORCEMENT PROVIDED (KNS-MET)
-----------------------------------------------------------
WORST LOAD CASE:    65
END JOINT:    112 Puz :   2534.16   Muz :     98.70   Muy :     98.70
IR: 0.82
================================================================================
```

6.0 BEAM DESIGN

Beam No	Beam No	l * b * d in mm	Reinforcement in mm2 Top/Bottom					Stirrups Dia * spacing * leggs				
PB1	101	5300										
		230	430	269	0	269	430	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		600	309	269	269	269	309	2	2	2	2	2
PB2a	102	3829										
		230	482	269	0	269	432	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		600	406	268	268	268	386	2	2	2	2	2
PB2b	103	5300										
		230	346	269	0	269	346	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		600	269	269	269	269	269	2	2	2	2	2
PB2a	104	3829										
		230	432	269	0	269	482	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		600	386	268	268	268	406	2	2	2	2	2
PB2a	105	3829										
		230	482	269	0	269	432	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		600	406	268	268	268	386	2	2	2	2	2
PB2b	106	5300										
		230	346	269	0	269	346	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		600	269	269	269	269	269	2	2	2	2	2
PB2a	107	3829										
		230	432	269	0	269	482	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		600	386	268	268	268	406	2	2	2	2	2
PB1	108	5300										
		230	430	269	0	269	430	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		600	309	269	269	269	309	2	2	2	2	2
PB1	109	5415										
		230	269	269	0	269	269	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		600	269	269	269	269	269	2	2	2	2	2
PB1	110	5300										
		230	438	268	0	268	438	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		600	318	268	268	268	318	2	2	2	2	2
PB1	111	5415										
		230	269	269	0	269	269	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		600	269	269	269	269	269	2	2	2	2	2
PB2a	112	3829										
		230	493	269	0	269	440	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		600	415	268	268	268	397	2	2	2	2	2
PB2b	113	5300										
		230	353	269	0	269	353	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		600	269	269	269	269	269	2	2	2	2	2
PB2a	114	3829										
		230	440	269	0	269	493	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300

		600	397	268	268	268	415	2	2	2	2	2
PB2a	**115**	3829										
		230	493	269	0	269	440	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		600	415	268	268	268	397	2	2	2	2	2
PB2b	**116**	5300										
		230	353	269	0	269	353	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		600	269	269	269	269	269	2	2	2	2	2
PB2a	**117**	3829										
		230	440	269	0	269	493	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		600	397	268	268	268	415	2	2	2	2	2
PB1	**118**	5415										
		230	269	269	0	269	269	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		600	269	269	269	269	269	2	2	2	2	2
PB1	**119**	5300										
		230	438	268	0	268	438	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		600	318	268	268	268	318	2	2	2	2	2
PB1	**120**	5415										
		230	269	269	0	269	269	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		600	269	269	269	269	269	2	2	2	2	2
TB1	**121**	5300										
		230	549	221	0	221	549	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	414	242	197	242	414	2	2	2	2	2
TB2a	**122**	3829										
		230	724	312	0	247	594	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	546	291	196	307	610	2	2	2	2	2
TB2b	**123**	5300										
		230	481	198	0	198	481	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	348	213	198	213	348	2	2	2	2	2
TB2a	**124**	3829										
		230	594	247	0	312	724	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	610	307	196	291	546	2	2	2	2	2
TB2a	**125**	3829										
		230	724	312	0	247	594	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	546	291	196	307	610	2	2	2	2	2
TB2b	**126**	5300										
		230	481	198	0	198	481	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	348	213	198	213	348	2	2	2	2	2
TB2a	**127**	3829										
		230	594	247	0	312	724	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	610	307	196	291	546	2	2	2	2	2
TB1	**128**	5300										
		230	549	221	0	221	549	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	414	242	197	242	414	2	2	2	2	2
TB1	**129**	5415										
		230	344	198	0	198	350	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300

		450	218	198	198	198	228	2	2	2	2	2
TB1	**130**	5300										
		230	565	228	0	228	565	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	427	248	197	248	427	2	2	2	2	2
TB1	**131**	5415										
		230	350	198	0	198	344	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	228	198	198	198	218	2	2	2	2	2
TB2a	**132**	3829										
		230	745	321	0	254	610	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	561	298	196	315	627	2	2	2	2	2
TB2b	**133**	5300										
		230	492	198	0	198	492	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	359	219	198	219	359	2	2	2	2	2
TB2a	**134**	3829										
		230	610	254	0	321	745	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	627	315	196	298	561	2	2	2	2	2
TB2a	**135**	3829										
		230	745	321	0	254	610	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	561	298	196	315	627	2	2	2	2	2
TB2b	**136**	5300										
		230	492	198	0	198	492	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	359	219	198	219	359	2	2	2	2	2
TB2a	**137**	3829										
		230	610	254	0	321	745	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	627	315	196	298	561	2	2	2	2	2
TB1	**138**	5415										
		230	344	198	0	198	350	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	218	198	198	198	228	2	2	2	2	2
TB1	**139**	5300										
		230	565	228	0	228	565	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	427	248	197	248	427	2	2	2	2	2
TB1	**140**	5415										
		230	350	198	0	198	344	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	228	198	198	198	218	2	2	2	2	2
TB101	**141**	5300										
		230	443	198	0	198	443	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	304	198	198	198	304	2	2	2	2	2
TB102a	**142**	3829										
		230	671	300	197	197	425	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	377	209	197	279	554	2	2	2	2	2
TB102b	**143**	5300										
		230	383	198	0	198	383	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	267	198	198	198	267	2	2	2	2	2
TB102a	**144**	3829										
		230	425	197	197	300	671	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300

PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)

		450	554	279	197	209	377	2	2	2	2	2
TB102a	**145**	3829										
		230	671	300	197	197	425	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	377	209	197	279	554	2	2	2	2	2
TB102b	**146**	5300										
		230	383	198	0	198	383	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	267	198	198	198	267	2	2	2	2	2
TB102a	**147**	3829										
		230	425	197	197	300	671	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	554	279	197	209	377	2	2	2	2	2
TB101	**148**	5300										
		230	443	198	0	198	443	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	304	198	198	198	304	2	2	2	2	2
TB101	**149**	5415										
		230	281	198	0	198	286	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	197	197	197	197	197	2	2	2	2	2
TB101	**150**	5300										
		230	460	198	0	198	460	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	317	197	197	197	317	2	2	2	2	2
TB101	**151**	5415										
		230	286	198	0	198	281	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	197	197	197	197	197	2	2	2	2	2
TB102a	**152**	3829										
		230	705	307	0	198	440	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	392	217	196	295	585	2	2	2	2	2
TB102b	**153**	5300										
		230	398	198	0	198	398	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	274	198	198	198	274	2	2	2	2	2
TB102a	**154**	3829										
		230	440	198	0	307	705	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	585	295	196	217	392	2	2	2	2	2
TB102a	**155**	3829										
		230	705	307	0	198	440	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	392	217	196	295	585	2	2	2	2	2
TB102b	**156**	5300										
		230	398	198	0	198	398	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	274	198	198	198	274	2	2	2	2	2
TB102a	**157**	3829										
		230	440	198	0	307	705	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	585	295	196	217	392	2	2	2	2	2
TB101	**158**	5415										
		230	281	198	0	198	286	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	197	197	197	197	197	2	2	2	2	2
TB101	**159**	5300										
		230	460	198	0	198	460	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300

PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)

		450	317	197	197	197	317	2	2	2	2	2
TB101	**160**	5415										
		230	286	198	0	198	281	8 - 300	8 - 300	8 - 300	8 - 300	8 - 300
		450	197	197	197	197	197	2	2	2	2	2
B2	**161**	5300										
		300	0	0	0	0	0	10 - 300	10 - 300	10 - 300	10 - 300	10 - 300
		800	0	1173	1717	1173	0	2	2	2	2	2
B3a	**162**	1679										
		350	677	677	0	0	0	10 - 200	10 - 220	10 - 300	10 - 300	10 - 300
		1000	674	674	674	726	936	2	2	2	2	2
	163	2150										
		350	0	0	0	677	677	10 - 300	10 - 300	10 - 300	10 - 270	10 - 240
		1000	936	706	674	674	0	2	2	2	2	2
B3b	**164**	5300										
		350	933	0	0	0	933	10 - 300	10 - 300	10 - 300	10 - 300	10 - 300
		1000	0	677	892	677	0	2	2	2	2	2
B3a	**165**	2150										
		350	677	677	0	0	0	10 - 240	10 - 270	10 - 300	10 - 300	10 - 300
		1000	0	674	674	706	936	2	2	2	2	2
	166	1679										
		350	0	0	0	677	677	10 - 300	10 - 300	10 - 300	10 - 220	10 - 200
		1000	936	726	674	674	674	2	2	2	2	2
B4	**167**	5300										
		300	0	0	0	0	0	10 - 300	10 - 300	10 - 300	10 - 300	10 - 300
		800	0	1751	2607	1751	0	2	2	2	2	2
B3a	**168**	1679										
		350	677	677	0	0	0	10 - 200	10 - 220	10 - 300	10 - 300	10 - 300
		1000	674	674	674	726	936	2	2	2	2	2
	169	2150										
		350	0	0	0	677	677	10 - 300	10 - 300	10 - 300	10 - 270	10 - 240
		1000	936	706	674	674	0	2	2	2	2	2
B3b	**170**	5300										
		350	933	0	0	0	933	10 - 300	10 - 300	10 - 300	10 - 300	10 - 300
		1000	0	677	892	677	0	2	2	2	2	2
B3a	**171**	2150										
		350	677	677	0	0	0	10 - 240	10 - 270	10 - 300	10 - 300	10 - 300
		1000	0	674	674	706	936	2	2	2	2	2
	172	1679										
		350	0	0	0	677	677	10 - 300	10 - 300	10 - 300	10 - 220	10 - 200
		1000	936	726	674	674	674	2	2	2	2	2
B2	**173**	5300										
		300	0	0	0	0	0	10 - 300	10 - 300	10 - 300	10 - 300	10 - 300

PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)

		800	0	1173	1717	1173	0	2	2	2	2	2
B2	**174**	5300										
		300	0	0	0	0	0	10 - 300	10 - 300	10 - 300	10 - 300	10 - 300
		800	0	1173	1717	1173	0	2	2	2	2	2
B5a	**175**	1679										
		350	677	677	0	0	0	10 - 220	10 - 250	10 - 300	10 - 300	10 - 300
		1000	673	673	673	673	831	2	2	2	2	2
	176	2150										
		350	0	0	0	674	906	10 - 300	10 - 300	10 - 300	10 - 260	10 - 230
		1000	831	673	673	0	0	2	2	2	2	2
B5b	**177**	2650										
		350	1324	677	0	0	0	10 - 300	10 - 150	10 - 220	10 - 300	10 - 300
		1000	0	675	675	1237	1679	2	2	2	2	2
	178	2650										
		350	0	0	0	677	1324	10 - 300	10 - 300	10 - 220	10 - 150	10 - 300
		1000	1679	1237	675	675	0	2	2	2	2	2
B5a	**179**	2150										
		350	906	674	0	0	0	10 - 230	10 - 260	10 - 300	10 - 300	10 - 300
		1000	0	0	673	673	831	2	2	2	2	2
	180	1679										
		350	0	0	0	677	677	10 - 300	10 - 300	10 - 300	10 - 250	10 - 220
		1000	831	673	673	673	673	2	2	2	2	2
B5a	**181**	1679										
		350	677	677	0	0	0	10 - 220	10 - 250	10 - 300	10 - 300	10 - 300
		1000	673	673	673	673	831	2	2	2	2	2
	182	2150										
		350	0	0	0	674	906	10 - 300	10 - 300	10 - 300	10 - 260	10 - 230
		1000	831	673	673	0	0	2	2	2	2	2
B5b	**183**	2650										
		350	1324	677	0	0	0	10 - 300	10 - 150	10 - 220	10 - 300	10 - 300
		1000	0	675	675	1237	1679	2	2	2	2	2
	184	2650										
		350	0	0	0	677	1324	10 - 300	10 - 300	10 - 220	10 - 150	10 - 300
		1000	1679	1237	675	675	0	2	2	2	2	2
B5a	**185**	2150										
		350	906	674	0	0	0	10 - 230	10 - 260	10 - 300	10 - 300	10 - 300
		1000	0	0	673	673	831	2	2	2	2	2
	186	1679										
		350	0	0	0	677	677	10 - 300	10 - 300	10 - 300	10 - 250	10 - 220
		1000	831	673	673	673	673	2	2	2	2	2
B2	**187**	5300										
		300	0	0	0	0	0	10 -	10 -	10 -	10 -	10 -

PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)

								300	300	300	300	300
		800	0	1173	1717	1173	0	2	2	2	2	2
B1	**251**	1869										
		350	777	673	677	677	0	10 - 240	10 - 240	10 - 240	10 - 240	10 - 240
		1000	0	0	677	677	677	2	2	2	2	2
	252	1682										
		350	0	0	0	0	0	8 - 240	8 - 240	8 - 240	8 - 240	8 - 240
		1000	677	677	677	677	677	2	2	2	2	2
	253	1869										
		350	0	677	677	673	777	10 - 240	10 - 240	10 - 240	10 - 240	10 - 240
		1000	677	677	677	0	0	2	2	2	2	2
B1	**254**	1910										
		350	710	673	673	0	0	10 - 180	10 - 210	10 - 220	10 - 240	10 - 240
		1000	0	673	673	673	740	2	2	2	2	2
	255	1722										
		350	0	0	0	0	0	8 - 240	8 - 240	8 - 240	8 - 240	8 - 240
		1000	677	677	677	677	677	2	2	2	2	2
	256	1910										
		350	0	0	673	673	688	10 - 240	10 - 230	10 - 210	10 - 200	10 - 180
		1000	768	673	673	673	0	2	2	2	2	2
B1	**257**	1869										
		350	773	673	677	677	0	10 - 230	10 - 240	10 - 240	10 - 240	10 - 240
		1000	0	0	677	677	677	2	2	2	2	2
	258	1682										
		350	0	0	0	0	0	8 - 240	8 - 240	8 - 240	8 - 240	8 - 240
		1000	677	677	677	677	677	2	2	2	2	2
	259	1869										
		350	0	677	677	673	773	10 - 240	10 - 240	10 - 240	10 - 240	10 - 230
		1000	677	677	677	0	0	2	2	2	2	2
B1	**260**	1910										
		350	688	673	673	0	0	10 - 180	10 - 200	10 - 210	10 - 230	10 - 240
		1000	0	673	673	673	768	2	2	2	2	2
	261	1722										
		350	0	0	0	0	0	8 - 240	8 - 240	8 - 240	8 - 240	8 - 240
		1000	677	677	677	677	677	2	2	2	2	2
	262	1910										
		350	0	0	673	673	710	10 - 240	10 - 240	10 - 220	10 - 210	10 - 180
		1000	740	673	673	673	0	2	2	2	2	2
B1	**263**	1869										
		350	777	673	677	677	0	10 - 240	10 - 240	10 - 240	10 - 240	10 - 240
		1000	0	0	677	677	677	2	2	2	2	2
	264	1682										
		350	0	0	0	0	0	8 - 240	8 - 240	8 - 240	8 - 240	8 - 240

PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)

		1000	677	677	677	677	677	2	2	2	2	2
	265	1869										
		350	0	677	677	673	777	10 - 240	10 - 240	10 - 240	10 - 240	10 - 240
		1000	677	677	677	0	0	2	2	2	2	2
B1	**266**	1910										
		350	710	673	673	0	0	10 - 180	10 - 210	10 - 220	10 - 240	10 - 240
		1000	0	673	673	673	740	2	2	2	2	2
	267	1722										
		350	0	0	0	0	0	8 - 240	8 - 240	8 - 240	8 - 240	8 - 240
		1000	677	677	677	677	677	2	2	2	2	2
	268	1910										
		350	0	0	673	673	688	10 - 240	10 - 230	10 - 210	10 - 200	10 - 180
		1000	768	673	673	673	0	2	2	2	2	2
B1	**269**	1869										
		350	773	673	677	677	0	10 - 230	10 - 240	10 - 240	10 - 240	10 - 240
		1000	0	0	677	677	677	2	2	2	2	2
	270	1682										
		350	0	0	0	0	0	8 - 240	8 - 240	8 - 240	8 - 240	8 - 240
		1000	677	677	677	677	677	2	2	2	2	2
	271	1869										
		350	0	677	677	673	773	10 - 240	10 - 240	10 - 240	10 - 240	10 - 230
		1000	677	677	677	0	0	2	2	2	2	2
B1	**272**	1910										
		350	688	673	673	0	0	10 - 180	10 - 200	10 - 210	10 - 230	10 - 240
		1000	0	673	673	673	768	2	2	2	2	2
	273	1722										
		350	0	0	0	0	0	8 - 240	8 - 240	8 - 240	8 - 240	8 - 240
		1000	677	677	677	677	677	2	2	2	2	2
	274	1910										
		350	0	0	673	673	710	10 - 240	10 - 240	10 - 220	10 - 210	10 - 180
		1000	740	673	673	673	0	2	2	2	2	2
B101a	**301**	3829										
		300	355	243	0	243	290	8 - 290	8 - 290	8 - 290	8 - 290	8 - 290
		450	0	243	243	243	0	2	2	2	2	2
B101b	**302**	5300										
		300	456	0	0	0	456	8 - 290	8 - 290	8 - 290	8 - 290	8 - 290
		450	0	243	347	243	0	2	2	2	2	2
B101a	**303**	3829										
		300	290	243	0	243	355	8 - 290	8 - 290	8 - 290	8 - 290	8 - 290
		450	0	243	243	243	0	2	2	2	2	2
B101a	**304**	3829										
		300	355	243	0	243	290	8 - 290	8 - 290	8 - 290	8 - 290	8 - 290
		450	0	243	243	243	0	2	2	2	2	2

PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)

B101b	**305**	5300									
		300	456	0	0	0	456	8 - 290	8 - 290	8 - 290	8 - 290	8 - 290
		450	0	243	347	243	0	2	2	2	2	2
B101a	**306**	3829									
		300	290	243	0	243	355	8 - 290	8 - 290	8 - 290	8 - 290	8 - 290
		450	0	243	243	243	0	2	2	2	2	2
B101a	**307**	3829									
		300	360	243	0	243	285	8 - 290	8 - 290	8 - 290	8 - 290	8 - 290
		450	0	243	243	243	0	2	2	2	2	2
B101b	**308**	5300									
		300	458	0	0	0	458	8 - 290	8 - 290	8 - 290	8 - 290	8 - 290
		450	0	243	341	243	0	2	2	2	2	2
B101a	**309**	3829									
		300	285	243	0	243	360	8 - 290	8 - 290	8 - 290	8 - 290	8 - 290
		450	0	243	243	243	0	2	2	2	2	2
B101a	**310**	3829									
		300	360	243	0	243	285	8 - 290	8 - 290	8 - 290	8 - 290	8 - 290
		450	0	243	243	243	0	2	2	2	2	2
B101b	**311**	5300									
		300	458	0	0	0	458	8 - 290	8 - 290	8 - 290	8 - 290	8 - 290
		450	0	243	341	243	0	2	2	2	2	2
B101a	**312**	3829									
		300	285	243	0	243	360	8 - 290	8 - 290	8 - 290	8 - 290	8 - 290
		450	0	243	243	243	0	2	2	2	2	2

JOB : L16-02

Beam Design

Botttom slab of back wash tank

Concrete grade	Fck	**30**
Steel	Fy	**415**
Clear cover	Cv	**45**
Density of concrete	Wd	**25**
Width	B	**1000**
Max.Dia. of Bar	Db	**32**
Permissble stress in Steel	fyucb	**130**
per. stress in con. for direct comp	fckc	8
per. stress in con in com.due to bending	fckbc	10
per. stress in con. for direct tension	fckt	1.5
per. stress in con. In ten due to bending	fcktb	2
Modular ratio	m	9.3333333
	k	0.4179104
	j	0.8606965

		beam width	beam depth	effective depth		Moment	Per. Stress	Ast req
		mm	mm	mm		kN-m	N/mm2	mm2
1	B1	350	1000	939	Sup - top	138.00	130	1313.5
					mid	125.00	130	1189.7
					Sup - top	138.00	130	1313.5
2	B2	300	800	739	Sup - top	0.00	130	0.0
					mid	378.00	130	4571.4
					Sup - top	0.00	130	0.0
3	B3a	350	1000	939	Sup - top	124.00	130	1180.2
					mid	204.00	130	1941.7
					Sup - top	134.00	130	1275.4
	B3b	350	1000	939	Sup - top	203.00	130	1932.1
					mid	195.00	130	1856.0
					Sup - top	2.32	130	22.1
4	B4	300	800	739	Sup - top	0.00	130	0.0
					mid	378.00	130	4571.4
					Sup - top	0.00	130	0.0
5	B5a	350	1000	939	Sup - top	122.00	130	1161.2
					mid	181.00	130	1722.7
					Sup - top	197.00	130	1875.0
	B5b	350	1000	939	Sup - top	281.00	130	2674.5
					mid	350.00	130	3331.3
					Sup - top	281.00	130	2674.5

JOB : I16-02

Beam Design

Top slab of back wash tank

Concrete grade	Fck	**30**
Steel	Fy	**415**
Clear cover	Cv	**45**
Density of concrete	Wd	**25**
Width	B	**1000**
Max.Dia. of Bar	Db	**16**
Permissble stress in Steel	fyucb	**130**
per. stress in con. for direct comp	fckc	8
per. stress in con in com.due to bending	fckbc	10
per. stress in con. for direct tension	fckt	1.5
per. stress in con. In ten due to bending	fcktb	2
Modular ratio	m	9.3333333
	k	0.4179104
	j	0.8606965

		beam width	beam depth	effective depth		Moment	Per. Stress	Ast req
		mm	mm	mm		kN-m	N/mm2	mm2
1	B101a	300	450	397	Sup - top	32.50	130	731.6
					mid	11.50	130	258.9
					Sup - top	41.50	130	934.3
	b	300	450	397	Sup - top	41.50	130	934.3
					mid	32.00	130	720.4
					Sup - top	41.50	130	934.3
	c	300	450	397	Sup - top	41.50	130	934.3
					mid	11.50	130	258.9
					Sup - top	32.50	130	731.6

7.0 SLAB DESIGN

TWO WAY SLAB DESIGN										
PROJECT : 30MLD WTP AT ASIFABAD							JOB : L16-02			
UNIT: BACK WASH TANK										
LEVEL : BOTTTOM SLAB										
GENERAL DATA										
Concrete grade			Fck	30	N/mm2					
Steel			Fy	415	N/mm2					
Clear cover			Cv	45	mm					
Density of concrete			Wd	25	Kn/m3					
Width			B	1000	mm					
Max.Dia. of Bar			Db	12	mm					
Permissble stress in Steel			fyucb	130	N/mm2					
per. stress in con. for direct comp			fckc	8	N/mm2					
per. stress in con in com.due to bending			fckbc	10	N/mm2					
per. stress in con. for direct tension			fckt	1.5	N/mm2					
per. stress in con. In ten due to bending			fcktb	2	N/mm2					
Modular ratio			m	9.3333						
			k	0.4179						
			j	0.8607						
Slab Data										
Slab No			S1	S2	S3	S4	S5	S6	S7	S8
shorter span	Lx	m	2.65							
longer span	Ly	m	5.3							
Slab type	St		1							
Depth	D	mm	250							
Loading										
Live load	LI	kN/m2	0.75							
Finishing load	FI	kN/m2	0.5							
Sunk load	SI	kN/m2								
Other Load	OI	kN/m2	34.5							

CALCULATION			
Calculation of loading			
Self wt (Dead load)	Dl	Kn/m2	6.25
Total Load	Tl	Kn/m2	42
Effective depth	De	mm	199
Calcultation of Two slab coefficient			
Ratio Ly/lx		Rat	2.00
Short span			
Negative mom. At continuous ec		Axs	0.065
Positive momenet at mid span		Axm	0.049
Long span			
Negative mom. At continuous ec		Ays	0.032
Positive momenet at mid span		Aym	0.024
Moment - Factored			
Short span			
Neg. mom. At contin. edge		kN-m	19.17
Positive momenet at mid span		kN-m	14.45
Long span			
Neg. mom. At cont.edge		kN-m	9.44
Positive momenet at mid span		kN-m	7.08
Reinforcement Required			
Short span			
Neg. mom. At contin. edge		mm2	861
Positive momenet at mid span		mm2	649
Long span			
Neg. mom. At cont.edge		mm2	424
Positive momenet at mid span		mm2	318
Reinforcement provided			
Short span			
Neg. mom. At contin. edge		mm2	958
Positive momenet at mid span		mm2	707
Long span			
Neg. mom. At cont.edge		mm2	958
Positive momenet at mid span		mm2	707
Check for Shear			
Shear at support	Vus	Kn	55.65
Actual Shear stress	Vuact	N/mm2	0.28
Ast provide	Astsh	mm2	958
% Ast	pt	%	0.48
beta			7.23
permissible shear for pt			0.49
k value corrosponds to slab thk			1.10
permissible shear for pt			0.54
Check for Deflection			
basic span /deph ratio	bsd		26
fs	fs		221.02
% steel provided	pt		0.36
Moification factor	mf		1.530
permissible span/ depth	psd		39.784
actual span /depth ratic	sdr		13.317
Deflecttion Check			OK

TWO WAY SLAB DESIGN																	
PROJECT : 30MLD WTP AT ASIFABAD														JOB : L16-02			
UNIT: BACK WASH TANK																	
LEVEL : TOP SLAB																	
REINFORCEMENT DATA																	
		-ve At cont edge short span				+ve momenet At mid short span				-ve At cont edge long span				+ve momenet At mid long span			
S1	ASTR	861				649				424				318			
	bar	10	200	12	200	12	160			10	200	12	200	12	160		
	ASTP	958				707				958				707			

TWO WAY SLAB DESIGN										
PROJECT : 30MLD WTP AT ASIFABAD									JOB : L16-02	
UNIT: BACK WASH TANK										
LEVEL : TOP SLAB										
GENERAL DATA										
Concrete grade			Fck	30	N/mm2					
Steel			Fy	415	N/mm2					
Clear cover			Cv	45	mm					
Density of concrete			Wd	25	Kn/m3					
Width			B	1000	mm					
Max.Dia. of Bar			Db	10	mm					
Permissble stress in Steel			fyucb	130	N/mm2					
per. stress in con. for direct comp			fckc	8	N/mm2					
per. stress in con in com.due to bending			fckbc	10	N/mm2					
per. stress in con. for direct tension			fckt	1.5	N/mm2					
per. stress in con. In ten due to bending			fcktb	2	N/mm2					
Modular ratio			m	9.3333						
			k	0.4179						
			j	0.8607						
Slab Data										
Slab No			S1	S2	S3	S4	S5	S6	S7	S8
shorter span	Lx	m	5.05	4.025	4.025					
longer span	Ly	m	5.05	5.05	4.025					
Slab type	St		1	3	4					
Depth	D	mm	150	150	150					
Loading										
Live load	LI	kN/m2	0.75	0.75	0.75					
Finishing load	FI	kN/m2	0.5	0.5	0.5					
Sunk load	SI	kN/m2								
Other Load	OI	kN/m2								

CALCULATION					
Calculation of loading					
Self wt (Dead load)	Dl	Kn/m2	3.75	3.75	3.75
Total Load	Tl	Kn/m2	5	5	5
Effective depth	De	mm	100	100	100
Calcultation of Two slab coefficient					
Ratio Ly/lx		Rat	1.00	1.25	1.00
Short span					
Negative mom. At continuous ec		Axs	0.032	0.055	0.047
Positive momenet at mid span		Axm	0.024	0.042	0.035
Long span					
Negative mom. At continuous ec		Ays	0.032	0.037	0.047
Positive momenet at mid span		Aym	0.024	0.028	0.035
Moment - Factored					
Short span					
Neg. mom. At contin. edge		kN-m	4.08	4.43	3.81
Positive momenet at mid span		kN-m	3.06	3.38	2.84
Long span					
Neg. mom. At cont.edge		kN-m	4.08	3.00	3.81
Positive momenet at mid span		kN-m	3.06	2.27	2.84
Reinforcement Required					
Short span					
Neg. mom. At contin. edge		mm2	365	396	340
Positive momenet at mid span		mm2	274	302	253
Long span					
Neg. mom. At cont.edge		mm2	365	268	340
Positive momenet at mid span		mm2	274	203	253
Reinforcement provided					
Short span					
Neg. mom. At contin. edge		mm2	479	479	479
Positive momenet at mid span		mm2	393	393	393
Long span					
Neg. mom. At cont.edge		mm2	479	479	479
Positive momenet at mid span		mm2	393	393	393
Check for Shear					
Shear at support	Vus	Kn	12.63	10.06	10.06
Actual Shear stress	Vuact	N/mm2	0.13	0.10	0.10
Ast provide	Astsh	mm2	479	479	479
% Ast	pt	%	0.48	0.48	0.48
beta			7.27	7.27	7.27
permissible shear for pt			0.49	0.49	0.49
k value corrosponds to slab thk			1.30	1.30	1.30
permissible shear for pt			0.63	0.63	0.63
Check for Deflection					
basic span /deph ratio	bsd		26	26	26
fs	fs		167.64	185.18	155.31
% steel provided	pt		0.39	0.39	0.39
Moification factor	mf		1.963	1.768	2.000
permissible span/ depth	psd		51.038	45.958	52
actual span /depth ratic	sdr		50.5	40.25	40.25
Deflecttion Check			OK	OK	OK

TWO WAY SLAB DESIGN																	
PROJECT : 30MLD WTP AT ASIFABAD														JOB : L16-02			
UNIT: BACK WASH TANK																	
LEVEL : TOP SLAB																	
REINFORCEMENT DATA																	
		-ve At cont edge short span					+ve momenet At mid short span					-ve At cont edge long span				+ve momenet At mid long span			
S1	ASTR	365					274					365				274			
	bar	10	400	12	400		10	200				10	400	12	400	10	200		
	ASTP	479					393					479				393			
S2	ASTR	396					302					268				203			
	bar	10	400	12	400		10	200				10	400	12	400	10	200		
	ASTP	479					393					479				393			
S3	ASTR	340					253					340				253			
	bar	10	400	12	400		10	200				10	400	12	400	10	200		
	ASTP	479					393					479				393			

ANNEXTURE - A

Isolated Footing Design (IS 456-2000)

Design For Isolated Sloped Footing 13

Design For Isolated Sloped Footing 14

Design For Isolated Sloped Footing 15

Design For Isolated Sloped Footing 18

Design For Isolated Sloped Footing 19

Design For Isolated Sloped Footing 22

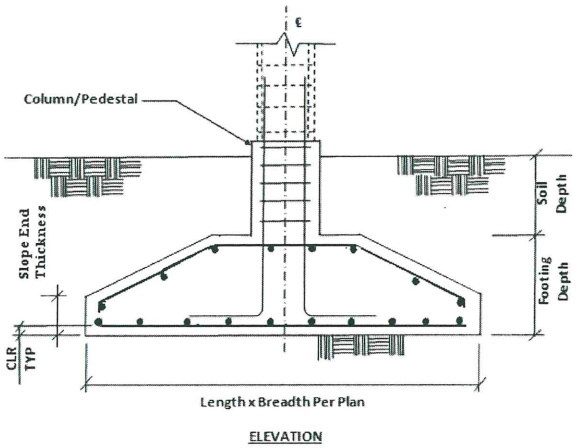
Design For Isolated Sloped Footing 23

Design For Isolated Sloped Footing 24

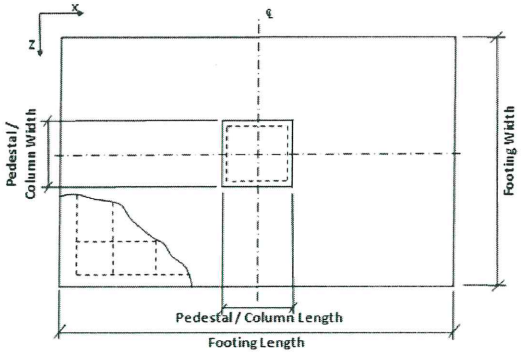
Footing No.	Group ID	Foundation Geometry			
-	-	Length	Width	Thickness	Slope End Thickness
13	1	2.300 m	2.300 m	0.450 m	0.200 m
14	2	2.300 m	2.300 m	0.450 m	0.200 m
15	3	2.300 m	2.300 m	0.450 m	0.200 m
18	4	2.300 m	2.300 m	0.450 m	0.200 m
19	5	2.300 m	2.300 m	0.450 m	0.200 m
22	6	2.300 m	2.300 m	0.450 m	0.200 m
23	7	2.300 m	2.300 m	0.450 m	0.200 m
24	8	2.300 m	2.300 m	0.450 m	0.200 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
13	Ø12 @ 125 mm c/c	Ø12 @ 115 mm c/c	Ø12 @ 215 mm c/c	Ø12 @ 215 mm c/c	N/A	N/A
14	Ø12 @ 125 mm c/c	Ø12 @ 115 mm c/c	Ø12 @ 215 mm c/c	Ø12 @ 215 mm c/c	N/A	N/A
15	Ø12 @ 145 mm c/c	Ø12 @ 125 mm c/c	Ø12 @ 215 mm c/c	Ø12 @ 215 mm c/c	N/A	N/A
18	Ø12 @ 145 mm c/c	Ø12 @ 125 mm c/c	Ø12 @ 215 mm c/c	Ø12 @ 215 mm c/c	N/A	N/A
19	Ø12 @ 115 mm c/c	Ø12 @ 125 mm c/c	Ø12 @ 215 mm c/c	Ø12 @ 215 mm c/c	N/A	N/A
22	Ø12 @ 145 mm c/c	Ø12 @ 125 mm c/c	Ø12 @ 215 mm c/c	Ø12 @ 215 mm c/c	N/A	N/A
23	Ø12 @ 125 mm c/c	Ø12 @ 145 mm c/c	Ø12 @ 215 mm c/c	Ø12 @ 215 mm c/c	N/A	N/A
24	Ø12 @ 125 mm c/c	Ø12 @ 115 mm c/c	Ø12 @ 215 mm c/c	Ø12 @ 215 mm c/c	N/A	N/A

Isolated Footing 13



ELEVATION



PLAN

Input Values

Footing Geomtery

Design Type :	Set Dimension
Footing Thickness (Ft) :	450.000 mm
Slope End Thickness (St) :	200.000 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) :	0.400 m
Column Width - Z (Pw) :	0.400 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 : 30.000 N/mm2
Yield Strength of Steel : 415.000 N/mm2
Minimum Bar Size : Ø12
Maximum Bar Size : Ø32
Minimum Bar Spacing : 100.000 mm
Maximum Bar Spacing : 300.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : UnDrained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 200.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 0.000 mm
Undrained Shear Strength : 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**
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ
80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ

92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ

Load Combination/s- Service Stress Level

Load Combination Number	Load Combination Title
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ
80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ
37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ
48	1.5DL-1.5EQX+0.45EQZ

49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ
Load Combination/s- Strength Level	
Load Combination Number	**Load Combination Title**
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ
37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ
48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ

60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	712.362	-0.893	-4.162	-2.617	0.559
72	675.392	10.065	-2.560	1.244	-15.860
73	713.816	11.517	-10.086	-9.221	-16.772
74	710.907	-13.303	1.761	3.988	17.890
75	749.332	-11.851	-5.765	-6.478	16.977
76	642.994	0.193	7.733	14.414	-2.984
77	653.649	-6.818	9.029	15.237	7.141
78	771.075	5.032	-17.354	-20.471	-6.024
79	781.729	-1.978	-16.058	-19.648	4.101
80	604.156	10.155	-2.144	1.506	-15.916
81	642.580	11.607	-9.670	-8.960	-16.828
82	639.671	-13.214	2.178	4.249	17.834
83	678.095	-11.762	-5.349	-6.216	16.922
84	571.758	0.282	8.149	14.676	-3.040
85	582.413	-6.729	9.446	15.499	7.085
86	699.838	5.122	-16.938	-20.209	-6.080
87	710.493	-1.889	-15.641	-19.386	4.045
88	681.294	26.467	-8.993	-5.657	-38.397
89	593.876	-6.530	25.797	38.466	4.095
90	743.430	-28.253	0.668	0.423	39.514
91	830.847	4.745	-34.122	-43.700	-2.978
92	370.147	26.535	-7.615	-4.781	-38.444
93	282.729	-6.463	27.175	39.343	4.048
94	432.282	-28.185	2.045	1.300	39.468
95	519.700	4.812	-32.744	-42.824	-3.024

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	712.362	-0.893	-4.162	-2.617	0.559
72	675.392	10.065	-2.560	1.244	-15.860
73	713.816	11.517	-10.086	-9.221	-16.772
74	710.907	-13.303	1.761	3.988	17.890
75	749.332	-11.851	-5.765	-6.478	16.977
76	642.994	0.193	7.733	14.414	-2.984
77	653.649	-6.818	9.029	15.237	7.141
78	771.075	5.032	-17.354	-20.471	-6.024
79	781.729	-1.978	-16.058	-19.648	4.101
80	604.156	10.155	-2.144	1.506	-15.916
81	642.580	11.607	-9.670	-8.960	-16.828
82	639.671	-13.214	2.178	4.249	17.834
83	678.095	-11.762	-5.349	-6.216	16.922
84	571.758	0.282	8.149	14.676	-3.040
85	582.413	-6.729	9.446	15.499	7.085
86	699.838	5.122	-16.938	-20.209	-6.080
87	710.493	-1.889	-15.641	-19.386	4.045
88	681.294	26.467	-8.993	-5.657	-38.397
89	593.876	-6.530	25.797	38.466	4.095
90	743.430	-28.253	0.668	0.423	39.514

91	830.847	4.745	-34.122	-43.700	-2.978
92	370.147	26.535	-7.615	-4.781	-38.444
93	282.729	-6.463	27.175	39.343	4.048
94	432.282	-28.185	2.045	1.300	39.468
95	519.700	4.812	-32.744	-42.824	-3.024

Applied Loads - Strength Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
21	1068.542	-1.339	-6.244	-3.925	0.838
22	1013.088	15.098	-3.840	1.866	-23.791
23	1070.724	17.276	-15.129	-13.832	-25.159
24	1066.361	-19.955	2.642	5.982	26.834
25	1123.997	-17.777	-8.647	-9.716	25.466
26	964.491	0.289	11.599	21.621	-4.476
27	980.473	-10.227	13.544	22.856	10.712
28	1156.612	7.548	-26.031	-30.706	-9.036
29	1172.594	-2.967	-24.087	-29.471	6.151
30	810.470	12.079	-3.072	1.493	-19.032
31	856.579	13.821	-12.103	-11.065	-20.127
32	853.089	-15.964	2.114	4.785	21.467
33	899.198	-14.222	-6.918	-7.773	20.373
34	771.593	0.231	9.280	17.297	-3.581
35	784.378	-8.182	10.835	18.285	8.569
36	925.290	6.039	-20.825	-24.565	-7.229
37	938.075	-2.374	-19.269	-23.577	4.921
38	585.671	15.634	-1.342	3.436	-24.126
39	643.307	17.812	-12.632	-12.262	-25.494
40	638.944	-19.419	5.139	7.552	26.499
41	696.580	-17.241	-6.150	-8.146	25.131
42	537.074	0.824	14.097	23.191	-4.811
43	553.056	-9.691	16.041	24.426	10.377
44	729.195	8.084	-23.534	-29.136	-9.371
45	745.177	-2.432	-21.589	-27.901	5.816
46	558.023	11.745	-2.279	1.963	-18.684
47	603.544	13.465	-11.195	-10.435	-19.764
48	600.099	-15.940	2.840	5.214	21.300
49	645.620	-14.220	-6.076	-7.185	20.220
50	519.641	0.048	9.915	17.566	-3.429
51	532.264	-8.257	11.451	18.541	8.567
52	671.380	5.782	-19.806	-23.762	-7.030
53	684.002	-2.523	-18.270	-22.787	4.965
54	317.294	12.240	-0.608	3.008	-18.991
55	362.816	13.960	-9.524	-9.391	-20.071
56	359.370	-15.445	4.511	6.258	20.993
57	404.892	-13.725	-4.405	-6.141	19.913
58	278.912	0.543	11.586	18.610	-3.736
59	291.535	-7.762	13.122	19.585	8.259
60	430.651	6.277	-18.135	-22.718	-7.338
61	443.274	-2.028	-16.599	-21.743	4.658
62	1021.941	39.701	-13.489	-8.485	-57.596
63	890.814	-9.796	38.696	57.700	6.142
64	1115.144	-42.380	1.002	0.635	59.271
65	1246.271	7.117	-51.183	-65.550	-4.467
66	555.220	39.803	-11.423	-7.171	-57.665
67	424.094	-9.694	40.762	59.014	6.072
68	648.423	-42.278	3.068	1.950	59.202
69	779.550	7.219	-49.117	-64.235	-4.536

Applied Loads - Strength Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
21	1068.542	-1.339	-6.244	-3.925	0.838
22	1013.088	15.098	-3.840	1.866	-23.791

23	1070.724	17.276	-15.129	-13.832	-25.159
24	1066.361	-19.955	2.642	5.982	26.834
25	1123.997	-17.777	-8.647	-9.716	25.466
26	964.491	0.289	11.599	21.621	-4.476
27	980.473	-10.227	13.544	22.856	10.712
28	1156.612	7.548	-26.031	-30.706	-9.036
29	1172.594	-2.967	-24.087	-29.471	6.151
30	810.470	12.079	-3.072	1.493	-19.032
31	856.579	13.821	-12.103	-11.065	-20.127
32	853.089	-15.964	2.114	4.785	21.467
33	899.198	-14.222	-6.918	-7.773	20.373
34	771.593	0.231	9.280	17.297	-3.581
35	784.378	-8.182	10.835	18.285	8.569
36	925.290	6.039	-20.825	-24.565	-7.229
37	938.075	-2.374	-19.269	-23.577	4.921
38	585.671	15.634	-1.342	3.436	-24.126
39	643.307	17.812	-12.632	-12.262	-25.494
40	638.944	-19.419	5.139	7.552	26.499
41	696.580	-17.241	-6.150	-8.146	25.131
42	537.074	0.824	14.097	23.191	-4.811
43	553.056	-9.691	16.041	24.426	10.377
44	729.195	8.084	-23.534	-29.136	-9.371
45	745.177	-2.432	-21.589	-27.901	5.816
46	558.023	11.745	-2.279	1.963	-18.684
47	603.544	13.465	-11.195	-10.435	-19.764
48	600.099	-15.940	2.840	5.214	21.300
49	645.620	-14.220	-6.076	-7.185	20.220
50	519.641	0.048	9.915	17.566	-3.429
51	532.264	-8.257	11.451	18.541	8.567
52	671.380	5.782	-19.806	-23.762	-7.030
53	684.002	-2.523	-18.270	-22.787	4.965
54	317.294	12.240	-0.608	3.008	-18.991
55	362.816	13.960	-9.524	-9.391	-20.071
56	359.370	-15.445	4.511	6.258	20.993
57	404.892	-13.725	-4.405	-6.141	19.913
58	278.912	0.543	11.586	18.610	-3.736
59	291.535	-7.762	13.122	19.585	8.259
60	430.651	6.277	-18.135	-22.718	-7.338
61	443.274	-2.028	-16.599	-21.743	4.658
62	1021.941	39.701	-13.489	-8.485	-57.596
63	890.814	-9.796	38.696	57.700	6.142
64	1115.144	-42.380	1.002	0.635	59.271
65	1246.271	7.117	-51.183	-65.550	-4.467
66	555.220	39.803	-11.423	-7.171	-57.665
67	424.094	-9.694	40.762	59.014	6.072
68	648.423	-42.278	3.068	1.950	59.202
69	779.550	7.219	-49.117	-64.235	-4.536

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, $A_{min} = P / q_{max} = 4.195\ m^2$

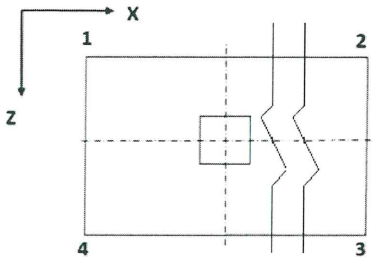
Note: A_{min} is an initial estimation.

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 :	# 91
Width (W_2) =	2.300	m	Governing Load Case :	# 91
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)
91	**191.1698**	196.2124	137.9675	132.9248	0.000
91	191.1698	**196.2124**	137.9675	132.9248	0.000
88	116.2741	165.8917	**156.3213**	106.7036	0.000
90	173.4425	121.9305	122.6446	**174.1566**	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)
91	**191.1698**	196.2124	137.9675	132.9248
91	191.1698	**196.2124**	137.9675	132.9248
88	116.2741	165.8917	**156.3213**	106.7036
90	173.4425	121.9305	122.6446	**174.1566**

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
71	432.232	92.721	197.704	924.290
72	36.506	143.540	9158.905	41.448
73	33.572	38.337	64.631	40.506
74	28.956	218.703	185.334	37.107
75	34.125	70.154	102.533	41.691
76	1824.645	45.423	45.148	263.111
77	52.299	39.491	42.492	80.331
78	82.525	23.931	33.775	115.238
79	212.618	26.194	35.999	193.826
80	32.678	154.796	1410.083	37.255
81	30.245	36.303	60.656	36.614
82	26.456	160.542	153.756	33.812
83	31.356	68.954	98.371	38.184
84	1120.090	38.732	39.576	229.260
85	47.700	33.980	37.378	72.994
86	74.132	22.416	31.377	104.148
87	203.813	24.614	33.510	180.893
88	13.995	41.189	87.794	16.934
89	50.027	12.664	15.005	106.830
90	14.210	601.006	1275.350	17.680
91	93.830	13.047	17.338	200.264
92	8.096	28.210	60.202	9.807
93	26.479	6.297	7.632	56.577
94	8.724	120.218	254.740	10.845
95	60.179	8.844	11.572	128.345

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

Critical Load Case for Sliding along X-Direction :	92
Governing Disturbing Force :	26.535 kN
Governing Restoring Force :	214.830 kN
Minimum Sliding Ratio for the Critical Load Case :	8.096
Critical Load Case for Overturning about X-Direction :	93
Governing Overturning Moment :	51.571 kNm
Governing Resisting Moment :	393.571 kNm
Minimum Overturning Ratio for the Critical Load Case :	7.632

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

Critical Load Case for Sliding along Z-Direction :	93
Governing Disturbing Force :	27.175 kN
Governing Restoring Force :	171.121 kN

Minimum Sliding Ratio for the Critical Load Case :	6.297	
Critical Load Case for Overturning about Z-Direction :	92	
Governing Overturning Moment :	-50.384	kNm
Governing Resisting Moment :	494.099	kNm
Minimum Overturning Ratio for the Critical Load Case :	9.807	

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

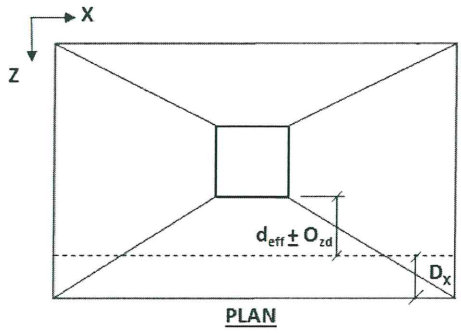
Critical Load Case	**= #65**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.394	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.144	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.637	m
Governing moment (M_u)		= 277.352	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 409.020726	kNm
$M_u <= M_{umax}$	hence, safe		

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

Critical Load Case	**= #65**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.394	m
Effective End Depth		= 0.144	m
Effective Width		= 0.637	m
Governing moment (M_u) =		= 247.355	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 409.020726	kNm
$M_u <= M_{umax}$	hence, safe		

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

(Shear Plane Parallel To X axis)



PLAN

Critical Load Case = #65

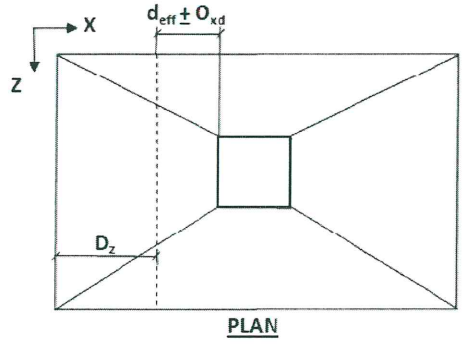
D_X = 0.394 m

Shear Force(S)	= 343.631	kN
Shear Stress(T_v)	= 527.212370	kN/m2
Percentage Of Steel(P_t)	= 0.7755	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 593.847	kN/m2

$T_v < T_c$ hence, safe

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

(Shear Plane Parallel To Z axis)



PLAN

Critical Load Case = #64

D_Z = 0.394 m

Shear Force(S)	= 307.036	kN
Shear Stress(T_v)	= 471.067093	kN/m2
Percentage Of Steel(P_t)	= 0.6768	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 562.382	kN/m2

$T_v < T_c$ hence, safe

Check Trial Depth for two way shear

Critical Load Case = #65

Shear Force(S)		= 1097.747	kN
Shear Stress(T_v)		= 1010.172	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)=	$0.25\times\sqrt{f_{ck}}$	= 1369.3064	kN/m2
K_s X T_c		= 1369.3064	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) = 20 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b\times 0.87\times f_y}{4\times \Gamma_{bd}}$	= 0.736 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) = 20 mm

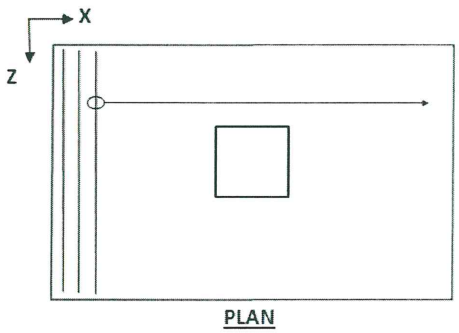
As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b\times 0.87\times f_y}{4\times \Gamma_{bd}}$	= 0.736 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 = #65

Minimum Area of Steel (A_{stmin}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 2221.540 mm2

Provided Area of Steel ($A_{st,Provided}$) = 2221.540 mm2

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

Selected bar Size (d_b) = Ø12

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

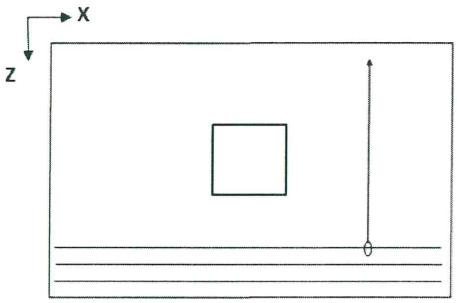
Selected spacing (S) = 115.158 mm

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 @ 115.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = #65

Minimum Area of Steel (A_{stmin}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1947.817 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1947.817 mm2

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

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 100.000 mm

Selected spacing (S) = 128.706 mm

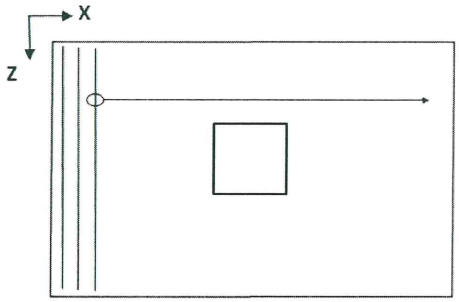
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 125.000 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}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1242.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1242.000 mm2

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

Selected bar Size (d_b) = Ø12

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

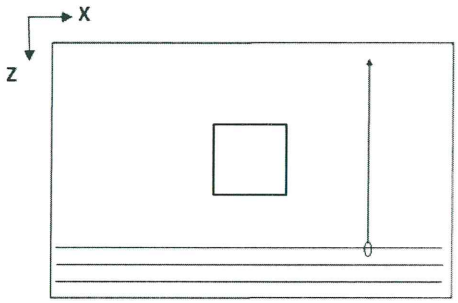
Selected spacing (S) = 218.800mm

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 @ 215 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}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1242.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1242.000 mm2

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

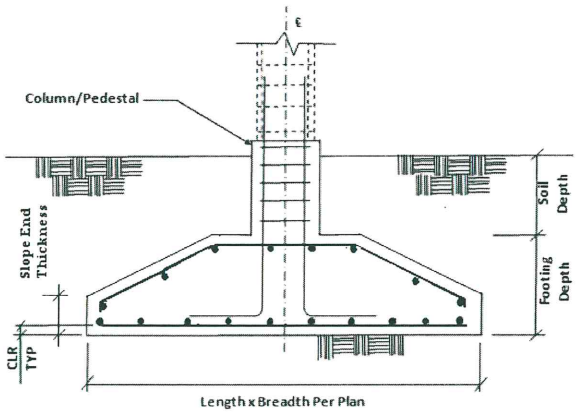
Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 100.000 mm
Selected spacing (S)	= 218.800 mm

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

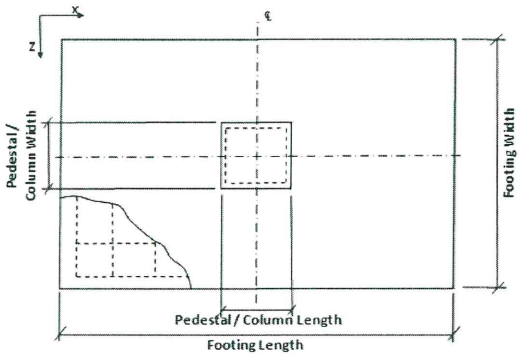
Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 215 mm o.c.

Isolated Footing 14



ELEVATION



PLAN

Input Values

Footing Geomtery

Design Type :	Set Dimension
Footing Thickness (Ft) :	450.000 mm
Slope End Thickness (St) :	200.000 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) :	0.400 m

Column Width - Z (Pw) : 0.400 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 : 30.000 N/mm2
Yield Strength of Steel : 415.000 N/mm2
Minimum Bar Size : Ø12
Maximum Bar Size : Ø32
Minimum Bar Spacing : 100.000 mm
Maximum Bar Spacing : 300.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : UnDrained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 200.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 0.000 mm
Undrained Shear Strength : 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**
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ

80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ

Load Combination/s- Service Stress Level

Load Combination Number	Load Combination Title
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ
80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ

37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ
48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ
37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ

48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	712.362	0.893	-4.162	-2.617	-0.559
72	710.907	13.303	1.761	3.988	-17.890
73	749.332	11.851	-5.765	-6.478	-16.977
74	675.392	-10.065	-2.560	1.244	15.860
75	713.816	-11.517	-10.086	-9.221	16.772
76	653.649	6.818	9.029	15.237	-7.141
77	642.994	-0.193	7.733	14.414	2.984
78	781.729	1.978	-16.058	-19.648	-4.101
79	771.075	-5.032	-17.354	-20.471	6.024
80	639.671	13.214	2.178	4.249	-17.834
81	678.095	11.762	-5.349	-6.216	-16.922
82	604.155	-10.155	-2.144	1.506	15.916
83	642.580	-11.607	-9.670	-8.960	16.828
84	582.412	6.729	9.446	15.499	-7.085
85	571.758	-0.282	8.149	14.676	3.040
86	710.493	1.889	-15.641	-19.386	-4.045
87	699.838	-5.122	-16.938	-20.209	6.080
88	743.430	28.253	0.668	0.423	-39.514
89	593.876	6.530	25.797	38.466	-4.095
90	681.294	-26.467	-8.993	-5.657	38.397
91	830.847	-4.745	-34.122	-43.700	2.978
92	432.282	28.185	2.045	1.300	-39.468
93	282.729	6.463	27.175	39.343	-4.048
94	370.147	-26.535	-7.615	-4.781	38.444
95	519.700	-4.812	-32.744	-42.824	3.024

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	712.362	0.893	-4.162	-2.617	-0.559
72	710.907	13.303	1.761	3.988	-17.890
73	749.332	11.851	-5.765	-6.478	-16.977
74	675.392	-10.065	-2.560	1.244	15.860
75	713.816	-11.517	-10.086	-9.221	16.772
76	653.649	6.818	9.029	15.237	-7.141
77	642.994	-0.193	7.733	14.414	2.984
78	781.729	1.978	-16.058	-19.648	-4.101

79	771.075	-5.032	-17.354	-20.471	6.024
80	639.671	13.214	2.178	4.249	-17.834
81	678.095	11.762	-5.349	-6.216	-16.922
82	604.155	-10.155	-2.144	1.506	15.916
83	642.580	-11.607	-9.670	-8.960	16.828
84	582.412	6.729	9.446	15.499	-7.085
85	571.758	-0.282	8.149	14.676	3.040
86	710.493	1.889	-15.641	-19.386	-4.045
87	699.838	-5.122	-16.938	-20.209	6.080
88	743.430	28.253	0.668	0.423	-39.514
89	593.876	6.530	25.797	38.466	-4.095
90	681.294	-26.467	-8.993	-5.657	38.397
91	830.847	-4.745	-34.122	-43.700	2.978
92	432.282	28.185	2.045	1.300	-39.468
93	282.729	6.463	27.175	39.343	-4.048
94	370.147	-26.535	-7.615	-4.781	38.444
95	519.700	-4.812	-32.744	-42.824	3.024

Applied Loads - Strength Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
21	1068.542	1.339	-6.244	-3.925	-0.838
22	1066.361	19.955	2.642	5.982	-26.834
23	1123.997	17.777	-8.647	-9.716	-25.466
24	1013.088	-15.098	-3.840	1.866	23.791
25	1070.724	-17.276	-15.129	-13.832	25.159
26	980.473	10.227	13.544	22.856	-10.712
27	964.491	-0.289	11.599	21.621	4.476
28	1172.594	2.967	-24.087	-29.471	-6.151
29	1156.612	-7.548	-26.031	-30.706	9.036
30	853.089	15.964	2.114	4.785	-21.467
31	899.198	14.222	-6.918	-7.773	-20.373
32	810.470	-12.079	-3.072	1.493	19.032
33	856.579	-13.821	-12.103	-11.065	20.127
34	784.378	8.182	10.835	18.285	-8.569
35	771.593	-0.231	9.280	17.297	3.581
36	938.075	2.374	-19.269	-23.577	-4.921
37	925.290	-6.039	-20.825	-24.565	7.229
38	638.944	19.419	5.139	7.552	-26.499
39	696.580	17.241	-6.150	-8.146	-25.131
40	585.671	-15.634	-1.342	3.436	24.126
41	643.307	-17.812	-12.632	-12.262	25.494
42	553.056	9.691	16.041	24.426	-10.377
43	537.074	-0.824	14.097	23.191	4.811
44	745.177	2.432	-21.589	-27.901	-5.816
45	729.195	-8.084	-23.534	-29.136	9.371
46	600.099	15.940	2.840	5.214	-21.300
47	645.620	14.220	-6.076	-7.185	-20.220
48	558.023	-11.745	-2.279	1.963	18.684
49	603.544	-13.465	-11.195	-10.435	19.764
50	532.264	8.257	11.451	18.541	-8.567
51	519.641	-0.048	9.915	17.566	3.429
52	684.002	2.523	-18.270	-22.787	-4.965
53	671.380	-5.782	-19.806	-23.762	7.030
54	359.370	15.445	4.511	6.258	-20.993
55	404.892	13.725	-4.405	-6.141	-19.913
56	317.294	-12.240	-0.608	3.008	18.991
57	362.816	-13.960	-9.524	-9.391	20.071
58	291.535	7.762	13.122	19.585	-8.259
59	278.912	-0.543	11.586	18.610	3.736
60	443.274	2.028	-16.599	-21.743	-4.658
61	430.651	-6.277	-18.135	-22.718	7.338

62	1115.144	42.380	1.002	0.635	-59.271
63	890.814	9.796	38.696	57.700	-6.142
64	1021.941	-39.701	-13.489	-8.485	57.596
65	1246.271	-7.117	-51.183	-65.550	4.467
66	648.423	42.278	3.068	1.950	-59.202
67	424.093	9.694	40.762	59.014	-6.072
68	555.220	-39.803	-11.423	-7.171	57.665
69	779.550	-7.219	-49.117	-64.235	4.536
Applied Loads - Strength Level					
LC	**Axial (kN)**	**Shear X (kN)**	**Shear Z (kN)**	**Moment X (kNm)**	**Moment Z (kNm)**
21	1068.542	1.339	-6.244	-3.925	-0.838
22	1066.361	19.955	2.642	5.982	-26.834
23	1123.997	17.777	-8.647	-9.716	-25.466
24	1013.088	-15.098	-3.840	1.866	23.791
25	1070.724	-17.276	-15.129	-13.832	25.159
26	980.473	10.227	13.544	22.856	-10.712
27	964.491	-0.289	11.599	21.621	4.476
28	1172.594	2.967	-24.087	-29.471	-6.151
29	1156.612	-7.548	-26.031	-30.706	9.036
30	853.089	15.964	2.114	4.785	-21.467
31	899.198	14.222	-6.918	-7.773	-20.373
32	810.470	-12.079	-3.072	1.493	19.032
33	856.579	-13.821	-12.103	-11.065	20.127
34	784.378	8.182	10.835	18.285	-8.569
35	771.593	-0.231	9.280	17.297	3.581
36	938.075	2.374	-19.269	-23.577	-4.921
37	925.290	-6.039	-20.825	-24.565	7.229
38	638.944	19.419	5.139	7.552	-26.499
39	696.580	17.241	-6.150	-8.146	-25.131
40	585.671	-15.634	-1.342	3.436	24.126
41	643.307	-17.812	-12.632	-12.262	25.494
42	553.056	9.691	16.041	24.426	-10.377
43	537.074	-0.824	14.097	23.191	4.811
44	745.177	2.432	-21.589	-27.901	-5.816
45	729.195	-8.084	-23.534	-29.136	9.371
46	600.099	15.940	2.840	5.214	-21.300
47	645.620	14.220	-6.076	-7.185	-20.220
48	558.023	-11.745	-2.279	1.963	18.684
49	603.544	-13.465	-11.195	-10.435	19.764
50	532.264	8.257	11.451	18.541	-8.567
51	519.641	-0.048	9.915	17.566	3.429
52	684.002	2.523	-18.270	-22.787	-4.965
53	671.380	-5.782	-19.806	-23.762	7.030
54	359.370	15.445	4.511	6.258	-20.993
55	404.892	13.725	-4.405	-6.141	-19.913
56	317.294	-12.240	-0.608	3.008	18.991
57	362.816	-13.960	-9.524	-9.391	20.071
58	291.535	7.762	13.122	19.585	-8.259
59	278.912	-0.543	11.586	18.610	3.736
60	443.274	2.028	-16.599	-21.743	-4.658
61	430.651	-6.277	-18.135	-22.718	7.338
62	1115.144	42.380	1.002	0.635	-59.271
63	890.814	9.796	38.696	57.700	-6.142
64	1021.941	-39.701	-13.489	-8.485	57.596
65	1246.271	-7.117	-51.183	-65.550	4.467
66	648.423	42.278	3.068	1.950	-59.202
67	424.093	9.694	40.762	59.014	-6.072
68	555.220	-39.803	-11.423	-7.171	57.665
69	779.550	-7.219	-49.117	-64.235	4.536

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, $A_{min} = P / q_{max} = 4.195\ m^2$

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

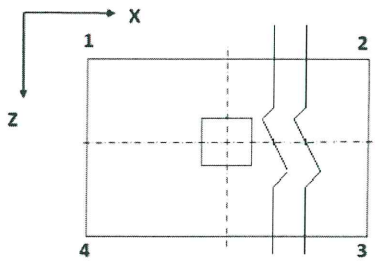
Final dimensions for design

Length (L_2) = 2.300 m Governing Load Case : # 91

Width (W_2) = 2.300 m Governing Load Case : # 91

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)
91	**196.2124**	191.1697	132.9248	137.9675	0.000
91	196.2124	**191.1697**	132.9248	137.9675	0.000
88	121.9305	173.4425	**174.1566**	122.6446	0.000
90	165.8917	116.2741	106.7036	**156.3212**	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)
91	**196.2124**	191.1697	132.9248	137.9675
91	196.2124	**191.1697**	132.9248	137.9675
88	121.9305	173.4425	**174.1566**	122.6446
90	165.8917	116.2741	106.7036	**156.3212**

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
71	432.232	92.721	197.704	924.290
72	28.956	218.703	185.334	37.107
73	34.125	70.154	102.533	41.691
74	36.506	143.540	9158.952	41.448
75	33.572	38.337	64.631	40.506
76	52.299	39.491	42.492	80.331
77	1824.645	45.423	45.148	263.111
78	212.618	26.194	35.999	193.826
79	82.525	23.931	33.775	115.238
80	26.456	160.542	153.756	33.812
81	31.356	68.954	98.371	38.184
82	32.678	154.796	1410.084	37.255
83	30.245	36.303	60.656	36.614
84	47.700	33.980	37.378	72.994
85	1120.090	38.732	39.576	229.260
86	203.813	24.614	33.510	180.893
87	74.132	22.416	31.377	104.148
88	14.210	601.006	1275.350	17.680
89	50.027	12.664	15.005	106.830
90	13.995	41.189	87.794	16.934
91	93.830	13.047	17.338	200.264
92	8.724	120.217	254.740	10.845
93	26.479	6.297	7.632	56.577
94	8.096	28.210	60.202	9.807
95	60.179	8.844	11.572	128.345

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

Critical Load Case for Sliding along X-Direction : 94
Governing Disturbing Force : -26.535 kN

Governing Restoring Force :	214.830	kN
Minimum Sliding Ratio for the Critical Load Case :	8.096	
Critical Load Case for Overturning about X-Direction :	93	
Governing Overturning Moment :	51.571	kNm
Governing Resisting Moment :	393.571	kNm
Minimum Overturning Ratio for the Critical Load Case :	7.632	

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

Critical Load Case for Sliding along Z-Direction :	93	
Governing Disturbing Force :	27.175	kN
Governing Restoring Force :	171.121	kN
Minimum Sliding Ratio for the Critical Load Case :	6.297	
Critical Load Case for Overturning about Z-Direction :	94	
Governing Overturning Moment :	50.384	kNm
Governing Resisting Moment :	494.099	kNm
Minimum Overturning Ratio for the Critical Load Case :	9.807	

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

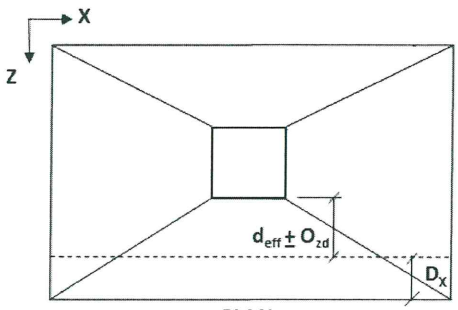
Critical Load Case	**= #65**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.394	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.144	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.637	m
Governing moment (M_u)		= 277.352	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 409.020726	kNm
$M_u <= M_{umax}$	hence, safe		

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

Critical Load Case	**= #65**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.394	m
Effective End Depth		= 0.144	m
Effective Width		= 0.637	m
Governing moment (M_u) =		= 247.352	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 409.020726	kNm
$M_u <= M_{umax}$	hence, safe		

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

(Shear Plane Parallel To X axis)



PLAN

Critical Load Case = #65

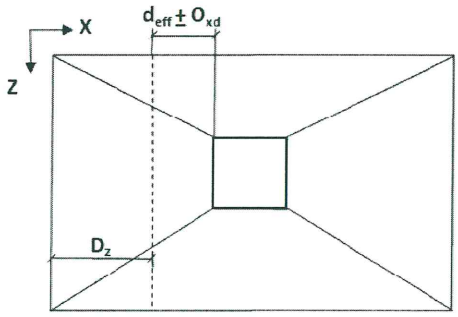
D_X = 0.394 m

Shear Force(S)	= 343.631	kN
Shear Stress(T_v)	= 527.212364	kN/m2
Percentage Of Steel(P_t)	= 0.7755	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 593.843	kN/m2

$T_v < T_c$ hence, safe

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

(Shear Plane Parallel To Z axis)



PLAN

Critical Load Case = #62

D_Z = 0.394 m

Shear Force(S)	= 307.036	kN
Shear Stress(T_v)	= 471.067093	kN/m2
Percentage Of Steel(P_t)	= 0.6768	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 562.382	kN/m2

$T_v < T_c$ hence, safe

Check Trial Depth for two way shear

Critical Load Case	**= #65**		
Shear Force(S)		= 1097.747	kN
Shear Stress(T_v)		= 1010.172	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)=	$0.25\times\sqrt{f_{ck}}$	= 1369.3064	kN/m2
K_s X T_c		= 1369.3064	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) = 20 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b\times 0.87\times f_y}{4\times\Gamma_{bd}}$	= 0.736 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) = 20 mm

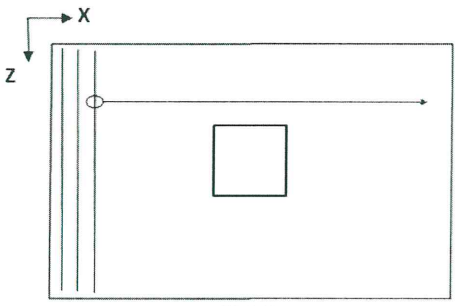
As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b\times 0.87\times f_y}{4\times\Gamma_{bd}}$	= 0.736 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 = #65

Minimum Area of Steel (A_{stmin}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 2221.540 mm2

Provided Area of Steel ($A_{st,Provided}$) = 2221.540 mm2

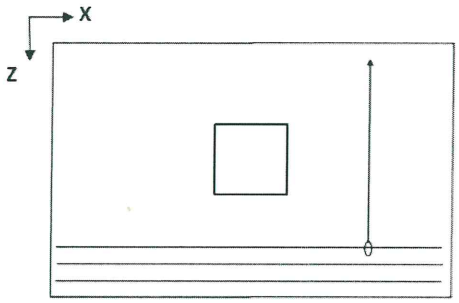
A_{stmin} <= $A_{st,Provided}$ Steel area is accepted

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 52.000 mm
Selected spacing (S)	= 115.158 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 @ 115.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = #65

Minimum Area of Steel (A_{stmin}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1947.787 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1947.787 mm2

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

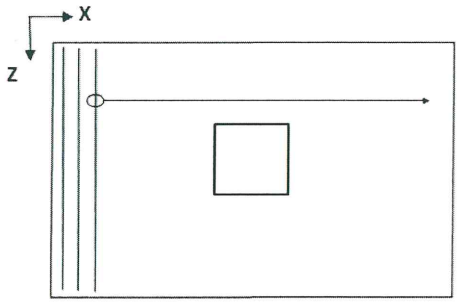
Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 100.000 mm
Selected spacing (S)	= 128.706 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 125.000 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}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1242.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1242.000 mm2

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

Selected bar Size (d_b) = Ø12

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

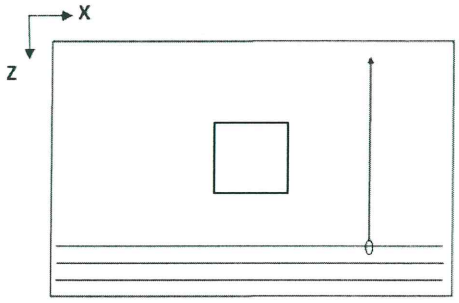
Selected spacing (S) = 218.800mm

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 @ 215 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}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1242.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1242.000 mm2

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

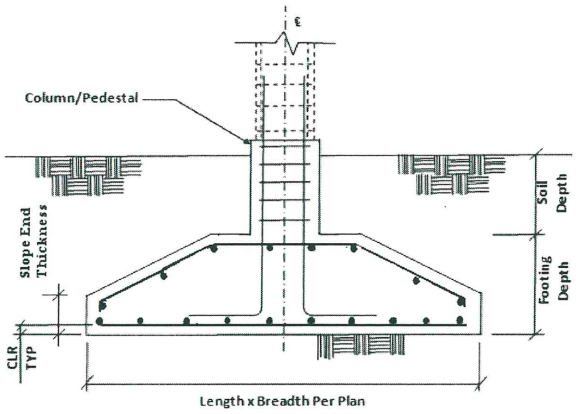
Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 100.000 mm
Selected spacing (S)	= 218.800 mm

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

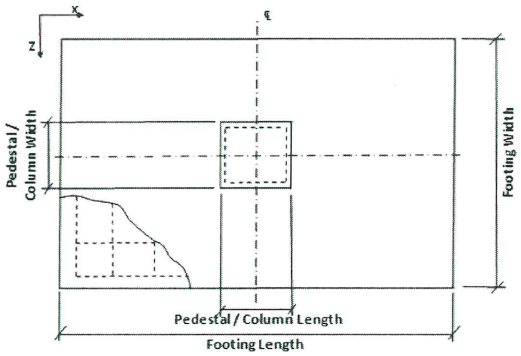
Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 215 mm o.c.

Isolated Footing 15



ELEVATION



PLAN

Input Values

Footing Geomtery

Design Type :	Set Dimension
Footing Thickness (Ft) :	450.000 mm
Slope End Thickness (St) :	200.000 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) :	0.400 m

Column Width - Z (Pw) : 0.400 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 : 30.000 N/mm2
Yield Strength of Steel : 415.000 N/mm2
Minimum Bar Size : Ø12
Maximum Bar Size : Ø32
Minimum Bar Spacing : 100.000 mm
Maximum Bar Spacing : 300.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : UnDrained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 200.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 0.000 mm
Undrained Shear Strength : 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**
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ

80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ

Load Combination/s- Service Stress Level

Load Combination Number	Load Combination Title
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ
80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ

37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ
48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ
Load Combination/s- Strength Level	
Load Combination Number	**Load Combination Title**
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ
37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ

48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	726.431	-4.063	-0.915	-0.573	2.555
72	657.063	7.833	0.171	2.969	-14.476
73	667.718	9.129	-6.840	-7.156	-15.299
74	785.144	-17.255	5.011	6.010	20.409
75	795.799	-15.958	-2.000	-4.115	19.586
76	689.461	-2.460	10.044	15.846	-1.306
77	727.885	-9.987	11.496	16.758	9.159
78	724.977	1.861	-13.325	-17.904	-4.050
79	763.401	-5.665	-11.873	-16.992	6.416
80	584.420	8.239	0.262	3.027	-14.732
81	595.075	9.535	-6.748	-7.098	-15.555
82	712.501	-16.848	5.102	6.067	20.153
83	723.156	-15.552	-1.909	-4.058	19.330
84	616.818	-2.054	10.135	15.903	-1.562
85	655.242	-9.580	11.587	16.815	8.904
86	652.334	2.267	-13.233	-17.847	-4.305
87	690.758	-5.259	-11.782	-16.935	6.160
88	611.080	25.283	-6.434	-4.035	-37.675
89	694.494	-8.999	27.018	39.209	5.662
90	841.782	-33.408	4.604	2.889	42.784
91	758.368	0.873	-28.847	-40.355	-0.553
92	289.423	26.586	-6.350	-3.978	-38.505
93	372.837	-7.696	27.102	39.266	4.832
94	520.125	-32.105	4.688	2.946	41.954
95	436.711	2.176	-28.763	-40.297	-1.383

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	726.431	-4.063	-0.915	-0.573	2.555
72	657.063	7.833	0.171	2.969	-14.476
73	667.718	9.129	-6.840	-7.156	-15.299
74	785.144	-17.255	5.011	6.010	20.409
75	795.799	-15.958	-2.000	-4.115	19.586
76	689.461	-2.460	10.044	15.846	-1.306
77	727.885	-9.987	11.496	16.758	9.159
78	724.977	1.861	-13.325	-17.904	-4.050

79	763.401	-5.665	-11.873	-16.992	6.416
80	584.420	8.239	0.262	3.027	-14.732
81	595.075	9.535	-6.748	-7.098	-15.555
82	712.501	-16.848	5.102	6.067	20.153
83	723.156	-15.552	-1.909	-4.058	19.330
84	616.818	-2.054	10.135	15.903	-1.562
85	655.242	-9.580	11.587	16.815	8.904
86	652.334	2.267	-13.233	-17.847	-4.305
87	690.758	-5.259	-11.782	-16.935	6.160
88	611.080	25.283	-6.434	-4.035	-37.675
89	694.494	-8.999	27.018	39.209	5.662
90	841.782	-33.408	4.604	2.889	42.784
91	758.368	0.873	-28.847	-40.355	-0.553
92	289.423	26.586	-6.350	-3.978	-38.505
93	372.837	-7.696	27.102	39.266	4.832
94	520.125	-32.105	4.688	2.946	41.954
95	436.711	2.176	-28.763	-40.297	-1.383

Applied Loads - Strength Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
21	1089.647	-6.094	-1.372	-0.859	3.832
22	985.595	11.749	0.256	4.454	-21.714
23	1001.577	13.693	-10.260	-10.733	-22.949
24	1177.716	-25.882	7.516	9.014	30.613
25	1193.698	-23.937	-3.000	-6.173	29.378
26	1034.192	-3.691	15.066	23.769	-1.959
27	1091.828	-14.980	17.244	25.137	13.739
28	1087.465	2.791	-19.987	-26.856	-6.075
29	1145.102	-8.498	-17.809	-25.488	9.623
30	788.476	9.399	0.205	3.563	-17.371
31	801.262	10.955	-8.208	-8.587	-18.359
32	942.173	-20.705	6.013	7.212	24.490
33	954.959	-19.150	-2.400	-4.938	23.503
34	827.353	-2.952	12.053	19.015	-1.568
35	873.462	-11.984	13.795	20.110	10.991
36	869.972	2.233	-15.990	-21.485	-4.860
37	916.081	-6.798	-14.248	-20.390	7.699
38	549.736	14.186	0.805	4.798	-23.247
39	565.719	16.131	-9.711	-10.390	-24.482
40	741.857	-23.444	8.065	9.358	29.080
41	757.839	-21.500	-2.451	-5.829	27.846
42	598.333	-1.253	15.614	24.113	-3.492
43	655.969	-12.542	17.792	25.481	12.206
44	651.607	5.229	-19.439	-26.512	-7.608
45	709.243	-6.060	-17.261	-25.144	8.091
46	524.980	9.953	0.040	3.423	-17.590
47	537.603	11.489	-8.266	-8.572	-18.565
48	676.719	-19.768	5.774	7.025	23.739
49	689.342	-18.232	-2.532	-4.970	22.764
50	563.362	-2.241	11.737	18.678	-1.987
51	608.884	-11.157	13.457	19.759	10.412
52	605.438	2.878	-15.949	-21.306	-5.237
53	650.960	-6.038	-14.228	-20.225	7.161
54	282.116	11.609	0.538	3.733	-18.624
55	294.739	13.145	-7.767	-8.263	-19.600
56	433.855	-18.112	6.272	7.334	22.704
57	446.477	-16.576	-2.033	-4.661	21.729
58	320.498	-0.585	12.235	18.988	-3.022
59	366.020	-9.502	13.955	20.068	9.377
60	362.574	4.534	-15.450	-20.996	-6.272
61	408.095	-4.382	-13.730	-19.916	6.126

62	916.620	37.924	-9.650	-6.052	-56.512
63	1041.741	-13.498	40.526	58.813	8.493
64	1262.673	-50.113	6.907	4.333	64.176
65	1137.552	1.310	-43.270	-60.532	-0.829
66	434.135	39.879	-9.524	-5.966	-57.757
67	559.255	-11.544	40.653	58.899	7.248
68	780.187	-48.158	7.033	4.419	62.931
69	655.067	3.265	-43.144	-60.446	-2.074
Applied Loads - Strength Level					
LC	**Axial (kN)**	**Shear X (kN)**	**Shear Z (kN)**	**Moment X (kNm)**	**Moment Z (kNm)**
21	1089.647	-6.094	-1.372	-0.859	3.832
22	985.595	11.749	0.256	4.454	-21.714
23	1001.577	13.693	-10.260	-10.733	-22.949
24	1177.716	-25.882	7.516	9.014	30.613
25	1193.698	-23.937	-3.000	-6.173	29.378
26	1034.192	-3.691	15.066	23.769	-1.959
27	1091.828	-14.980	17.244	25.137	13.739
28	1087.465	2.791	-19.987	-26.856	-6.075
29	1145.102	-8.498	-17.809	-25.488	9.623
30	788.476	9.399	0.205	3.563	-17.371
31	801.262	10.955	-8.208	-8.587	-18.359
32	942.173	-20.705	6.013	7.212	24.490
33	954.959	-19.150	-2.400	-4.938	23.503
34	827.353	-2.952	12.053	19.015	-1.568
35	873.462	-11.984	13.795	20.110	10.991
36	869.972	2.233	-15.990	-21.485	-4.860
37	916.081	-6.798	-14.248	-20.390	7.699
38	549.736	14.186	0.805	4.798	-23.247
39	565.719	16.131	-9.711	-10.390	-24.482
40	741.857	-23.444	8.065	9.358	29.080
41	757.839	-21.500	-2.451	-5.829	27.846
42	598.333	-1.253	15.614	24.113	-3.492
43	655.969	-12.542	17.792	25.481	12.206
44	651.607	5.229	-19.439	-26.512	-7.608
45	709.243	-6.060	-17.261	-25.144	8.091
46	524.980	9.953	0.040	3.423	-17.590
47	537.603	11.489	-8.266	-8.572	-18.565
48	676.719	-19.768	5.774	7.025	23.739
49	689.342	-18.232	-2.532	-4.970	22.764
50	563.362	-2.241	11.737	18.678	-1.987
51	608.884	-11.157	13.457	19.759	10.412
52	605.438	2.878	-15.949	-21.306	-5.237
53	650.960	-6.038	-14.228	-20.225	7.161
54	282.116	11.609	0.538	3.733	-18.624
55	294.739	13.145	-7.767	-8.263	-19.600
56	433.855	-18.112	6.272	7.334	22.704
57	446.477	-16.576	-2.033	-4.661	21.729
58	320.498	-0.585	12.235	18.988	-3.022
59	366.020	-9.502	13.955	20.068	9.377
60	362.574	4.534	-15.450	-20.996	-6.272
61	408.095	-4.382	-13.730	-19.916	6.126
62	916.620	37.924	-9.650	-6.052	-56.512
63	1041.741	-13.498	40.526	58.813	8.493
64	1262.673	-50.113	6.907	4.333	64.176
65	1137.552	1.310	-43.270	-60.532	-0.829
66	434.135	39.879	-9.524	-5.966	-57.757
67	559.255	-11.544	40.653	58.899	7.248
68	780.187	-48.158	7.033	4.419	62.931
69	655.067	3.265	-43.144	-60.446	-2.074

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, $A_{min} = P / q_{max} = 4.250\ m^2$

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

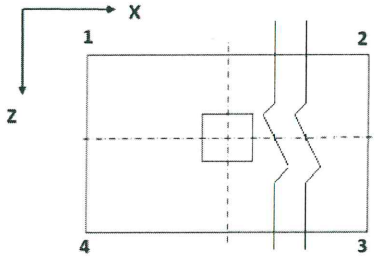
Final dimensions for design

Length (L_2) = 2.300 m Governing Load Case : # 90

Width (W_2) = 2.300 m Governing Load Case : # 90

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)
90	**192.7018**	135.6768	140.5696	197.5946	0.000
91	176.7034	**177.6360**	125.0316	124.0990	0.000
89	118.2510	108.6727	**159.3350**	168.9133	0.000
90	192.7018	135.6768	140.5696	**197.5946**	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)
90	**192.7018**	135.6768	140.5696	197.5946
91	176.7034	**177.6360**	125.0316	124.0990
89	118.2510	108.6727	**159.3350**	168.9133
90	192.7018	135.6768	140.5696	**197.5946**

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
71	96.724	429.657	917.989	206.215
72	45.744	2097.935	270.514	45.778
73	39.831	53.162	81.722	43.092
74	24.476	84.287	117.533	34.478
75	26.799	213.826	196.116	36.747
76	152.206	37.286	42.292	4325.365
77	39.423	34.248	41.288	66.322
78	210.785	29.437	37.747	184.592
79	72.628	34.655	42.371	105.560
80	39.079	1227.740	235.480	40.160
81	34.325	48.500	74.273	37.931
82	22.911	75.657	106.161	32.010
83	25.163	205.042	183.053	34.186
84	164.629	33.365	38.007	1220.183
85	37.304	30.843	37.312	62.200
86	156.991	26.896	34.393	153.714
87	71.332	31.841	38.801	101.188
88	13.262	52.116	111.281	15.722
89	41.894	13.954	16.881	89.286
90	13.489	97.874	208.932	17.927
91	468.273	14.176	17.634	994.652
92	6.562	27.477	58.710	7.951
93	28.090	7.976	9.661	59.938
94	9.027	61.816	131.839	11.818
95	114.002	8.626	10.718	241.606

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

Critical Load Case for Sliding along X-Direction : 92
Governing Disturbing Force : 26.586 kN

Governing Restoring Force :	174.468	kN
Minimum Sliding Ratio for the Critical Load Case :	6.562	
Critical Load Case for Overturning about X-Direction :	93	
Governing Overturning Moment :	51.462	kNm
Governing Resisting Moment :	497.193	kNm
Minimum Overturning Ratio for the Critical Load Case :	9.661	

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

Critical Load Case for Sliding along Z-Direction :	93	
Governing Disturbing Force :	27.102	kN
Governing Restoring Force :	216.175	kN
Minimum Sliding Ratio for the Critical Load Case :	7.976	
Critical Load Case for Overturning about Z-Direction :	92	
Governing Overturning Moment :	-50.468	kNm
Governing Resisting Moment :	401.269	kNm
Minimum Overturning Ratio for the Critical Load Case :	7.951	

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

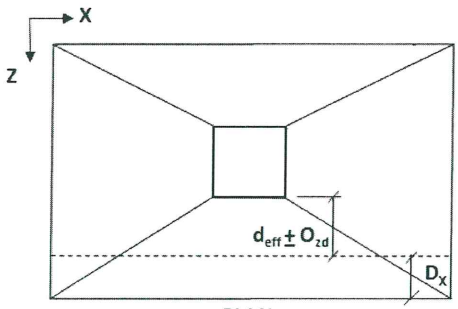
Critical Load Case	**= #65**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.394	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.144	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.637	m
Governing moment (M_u)		= 252.842	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 409.020726	kNm
$M_u <= M_{umax}$	hence, safe		

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

Critical Load Case	**= #65**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.394	m
Effective End Depth		= 0.144	m
Effective Width		= 0.637	m
Governing moment (M_u) =		= 223.705	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 409.020726	kNm
$M_u <= M_{umax}$	hence, safe		

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

(Shear Plane Parallel To X axis)



PLAN

Critical Load Case = #65

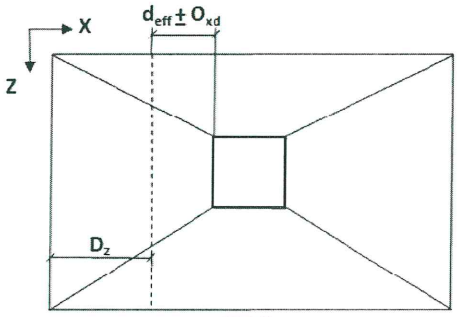
D_X = 0.394 m

Shear Force(S)	= 313.248	kN
Shear Stress(T_v)	= 480.596751	kN/m2
Percentage Of Steel(P_t)	= 0.6924	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 567.569	kN/m2

$T_v < T_c$ hence, safe

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

(Shear Plane Parallel To Z axis)



PLAN

Critical Load Case = #64

D_Z = 0.394 m

Shear Force(S)	= 346.709	kN
Shear Stress(T_v)	= 531.934459	kN/m2
Percentage Of Steel(P_t)	= 0.7867	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 597.228	kN/m2

$T_v < T_c$ hence, safe

Check Trial Depth for two way shear

Critical Load Case	**= #64**		
Shear Force(S)		= 1112.194	kN
Shear Stress(T_v)		= 1023.467	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)=	$0.25\times\sqrt{f_{ck}}$	= 1369.3064	kN/m2
K_s X T_c		= 1369.3064	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) = 20 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b\times 0.87\times f_y}{4\times\Gamma_{bd}}$	= 0.736 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) = 20 mm

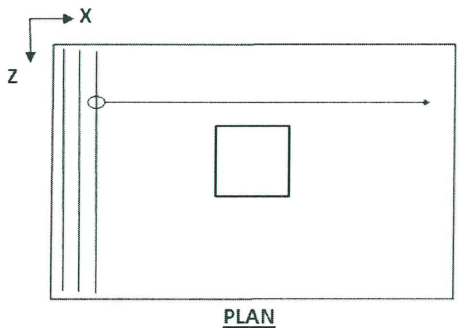
As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b\times 0.87\times f_y}{4\times\Gamma_{bd}}$	= 0.736 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 = #65

Minimum Area of Steel (A_{stmin}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1997.089 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1997.089 mm2

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

Selected bar Size (d_b) = Ø12

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

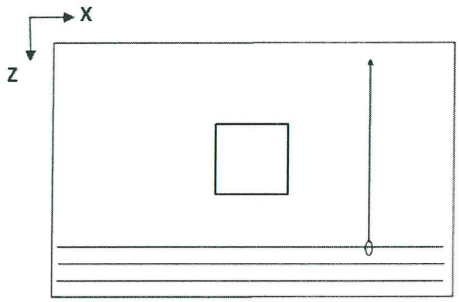
Selected spacing (S) = 128.706 mm

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 @ 125.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = #65

Minimum Area of Steel (A_{stmin}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1739.200 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1739.200 mm2

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

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 100.000 mm

Selected spacing (S) = 145.867 mm

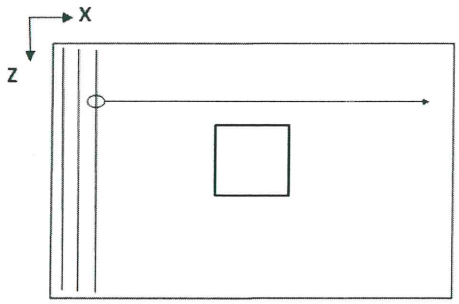
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 145.000 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}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1242.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1242.000 mm2

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

Selected bar Size (d_b) = Ø12

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

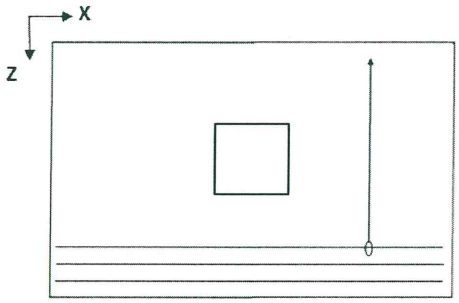
Selected spacing (S) = 218.800mm

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 @ 215 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}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1242.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1242.000 mm2

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

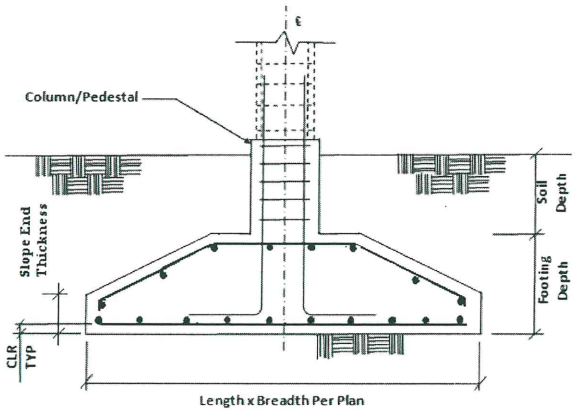
Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 100.000 mm
Selected spacing (S)	= 218.800 mm

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

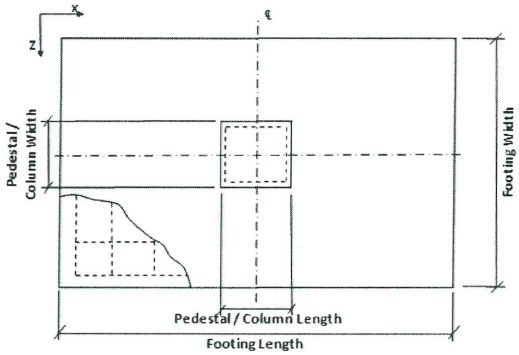
Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 215 mm o.c.

Isolated Footing 18



ELEVATION



PLAN

Input Values

Footing Geomtery

Design Type :	Set Dimension
Footing Thickness (Ft) :	450.000 mm
Slope End Thickness (St) :	200.000 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) :	0.400 m

Column Width - Z (Pw) : 0.400 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 : 30.000 N/mm2
Yield Strength of Steel : 415.000 N/mm2
Minimum Bar Size : Ø12
Maximum Bar Size : Ø32
Minimum Bar Spacing : 100.000 mm
Maximum Bar Spacing : 300.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : UnDrained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 200.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 0.000 mm
Undrained Shear Strength : 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**
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ

80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ

Load Combination/s- Service Stress Level

Load Combination Number	Load Combination Title
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ
80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ

37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ
48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ
37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ

48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	726.431	4.063	-0.915	-0.573	-2.555
72	785.144	17.255	5.011	6.010	-20.409
73	795.799	15.958	-2.000	-4.115	-19.586
74	657.064	-7.833	0.171	2.969	14.476
75	667.718	-9.129	-6.840	-7.156	15.299
76	727.885	9.987	11.496	16.758	-9.159
77	689.461	2.460	10.044	15.846	1.306
78	763.401	5.665	-11.873	-16.992	-6.416
79	724.977	-1.861	-13.325	-17.904	4.050
80	712.501	16.848	5.102	6.067	-20.153
81	723.156	15.552	-1.909	-4.058	-19.330
82	584.420	-8.239	0.262	3.027	14.732
83	595.075	-9.535	-6.748	-7.098	15.555
84	655.242	9.580	11.587	16.815	-8.904
85	616.818	2.054	10.135	15.903	1.562
86	690.758	5.259	-11.782	-16.935	-6.160
87	652.334	-2.267	-13.233	-17.847	4.305
88	841.782	33.408	4.604	2.889	-42.784
89	694.494	8.999	27.018	39.209	-5.662
90	611.080	-25.283	-6.434	-4.035	37.675
91	758.368	-0.873	-28.847	-40.355	0.553
92	520.125	32.105	4.688	2.946	-41.954
93	372.837	7.696	27.102	39.266	-4.832
94	289.423	-26.586	-6.350	-3.978	38.505
95	436.711	-2.176	-28.763	-40.297	1.383

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	726.431	4.063	-0.915	-0.573	-2.555
72	785.144	17.255	5.011	6.010	-20.409
73	795.799	15.958	-2.000	-4.115	-19.586
74	657.064	-7.833	0.171	2.969	14.476
75	667.718	-9.129	-6.840	-7.156	15.299
76	727.885	9.987	11.496	16.758	-9.159
77	689.461	2.460	10.044	15.846	1.306
78	763.401	5.665	-11.873	-16.992	-6.416

79	724.977	-1.861	-13.325	-17.904	4.050
80	712.501	16.848	5.102	6.067	-20.153
81	723.156	15.552	-1.909	-4.058	-19.330
82	584.420	-8.239	0.262	3.027	14.732
83	595.075	-9.535	-6.748	-7.098	15.555
84	655.242	9.580	11.587	16.815	-8.904
85	616.818	2.054	10.135	15.903	1.562
86	690.758	5.259	-11.782	-16.935	-6.160
87	652.334	-2.267	-13.233	-17.847	4.305
88	841.782	33.408	4.604	2.889	-42.784
89	694.494	8.999	27.018	39.209	-5.662
90	611.080	-25.283	-6.434	-4.035	37.675
91	758.368	-0.873	-28.847	-40.355	0.553
92	520.125	32.105	4.688	2.946	-41.954
93	372.837	7.696	27.102	39.266	-4.832
94	289.423	-26.586	-6.350	-3.978	38.505
95	436.711	-2.176	-28.763	-40.297	1.383

Applied Loads - Strength Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
21	1089.647	6.094	-1.372	-0.859	-3.832
22	1177.716	25.882	7.516	9.014	-30.613
23	1193.698	23.937	-3.000	-6.173	-29.378
24	985.595	-11.749	0.256	4.454	21.714
25	1001.577	-13.693	-10.260	-10.733	22.949
26	1091.828	14.980	17.244	25.137	-13.739
27	1034.192	3.691	15.066	23.769	1.959
28	1145.102	8.498	-17.809	-25.488	-9.623
29	1087.465	-2.791	-19.987	-26.856	6.075
30	942.173	20.705	6.013	7.212	-24.490
31	954.959	19.150	-2.400	-4.938	-23.503
32	788.476	-9.399	0.205	3.563	17.371
33	801.262	-10.955	-8.208	-8.587	18.359
34	873.463	11.984	13.795	20.110	-10.991
35	827.354	2.952	12.053	19.015	1.568
36	916.081	6.798	-14.248	-20.390	-7.699
37	869.972	-2.233	-15.990	-21.485	4.860
38	741.857	23.444	8.065	9.358	-29.080
39	757.840	21.500	-2.451	-5.829	-27.846
40	549.736	-14.186	0.805	4.798	23.247
41	565.719	-16.131	-9.711	-10.390	24.482
42	655.969	12.542	17.792	25.481	-12.206
43	598.333	1.253	15.614	24.113	3.492
44	709.243	6.060	-17.261	-25.144	-8.091
45	651.607	-5.229	-19.439	-26.512	7.608
46	676.719	19.768	5.774	7.025	-23.739
47	689.342	18.232	-2.532	-4.970	-22.764
48	524.980	-9.953	0.040	3.423	17.590
49	537.603	-11.489	-8.266	-8.572	18.565
50	608.884	11.157	13.457	19.759	-10.412
51	563.362	2.241	11.737	18.678	1.987
52	650.960	6.038	-14.228	-20.225	-7.161
53	605.438	-2.878	-15.949	-21.306	5.237
54	433.855	18.112	6.272	7.334	-22.704
55	446.478	16.576	-2.033	-4.661	-21.729
56	282.116	-11.609	0.538	3.733	18.624
57	294.739	-13.145	-7.767	-8.263	19.600
58	366.020	9.502	13.955	20.068	-9.377
59	320.498	0.585	12.235	18.988	3.022
60	408.095	4.382	-13.730	-19.916	-6.126
61	362.574	-4.534	-15.450	-20.996	6.272

62	1262.673	50.113	6.907	4.333	-64.176
63	1041.741	13.498	40.526	58.813	-8.493
64	916.621	-37.924	-9.650	-6.052	56.512
65	1137.552	-1.310	-43.270	-60.532	0.829
66	780.187	48.158	7.033	4.419	-62.931
67	559.256	11.544	40.653	58.899	-7.248
68	434.135	-39.879	-9.524	-5.966	57.757
69	655.067	-3.265	-43.144	-60.446	2.074
Applied Loads - Strength Level					
LC	**Axial (kN)**	**Shear X (kN)**	**Shear Z (kN)**	**Moment X (kNm)**	**Moment Z (kNm)**
21	1089.647	6.094	-1.372	-0.859	-3.832
22	1177.716	25.882	7.516	9.014	-30.613
23	1193.698	23.937	-3.000	-6.173	-29.378
24	985.595	-11.749	0.256	4.454	21.714
25	1001.577	-13.693	-10.260	-10.733	22.949
26	1091.828	14.980	17.244	25.137	-13.739
27	1034.192	3.691	15.066	23.769	1.959
28	1145.102	8.498	-17.809	-25.488	-9.623
29	1087.465	-2.791	-19.987	-26.856	6.075
30	942.173	20.705	6.013	7.212	-24.490
31	954.959	19.150	-2.400	-4.938	-23.503
32	788.476	-9.399	0.205	3.563	17.371
33	801.262	-10.955	-8.208	-8.587	18.359
34	873.463	11.984	13.795	20.110	-10.991
35	827.354	2.952	12.053	19.015	1.568
36	916.081	6.798	-14.248	-20.390	-7.699
37	869.972	-2.233	-15.990	-21.485	4.860
38	741.857	23.444	8.065	9.358	-29.080
39	757.840	21.500	-2.451	-5.829	-27.846
40	549.736	-14.186	0.805	4.798	23.247
41	565.719	-16.131	-9.711	-10.390	24.482
42	655.969	12.542	17.792	25.481	-12.206
43	598.333	1.253	15.614	24.113	3.492
44	709.243	6.060	-17.261	-25.144	-8.091
45	651.607	-5.229	-19.439	-26.512	7.608
46	676.719	19.768	5.774	7.025	-23.739
47	689.342	18.232	-2.532	-4.970	-22.764
48	524.980	-9.953	0.040	3.423	17.590
49	537.603	-11.489	-8.266	-8.572	18.565
50	608.884	11.157	13.457	19.759	-10.412
51	563.362	2.241	11.737	18.678	1.987
52	650.960	6.038	-14.228	-20.225	-7.161
53	605.438	-2.878	-15.949	-21.306	5.237
54	433.855	18.112	6.272	7.334	-22.704
55	446.478	16.576	-2.033	-4.661	-21.729
56	282.116	-11.609	0.538	3.733	18.624
57	294.739	-13.145	-7.767	-8.263	19.600
58	366.020	9.502	13.955	20.068	-9.377
59	320.498	0.585	12.235	18.988	3.022
60	408.095	4.382	-13.730	-19.916	-6.126
61	362.574	-4.534	-15.450	-20.996	6.272
62	1262.673	50.113	6.907	4.333	-64.176
63	1041.741	13.498	40.526	58.813	-8.493
64	916.621	-37.924	-9.650	-6.052	56.512
65	1137.552	-1.310	-43.270	-60.532	0.829
66	780.187	48.158	7.033	4.419	-62.931
67	559.256	11.544	40.653	58.899	-7.248
68	434.135	-39.879	-9.524	-5.966	57.757
69	655.067	-3.265	-43.144	-60.446	2.074

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, $A_{min} = P / q_{max}$ = 4.250 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.

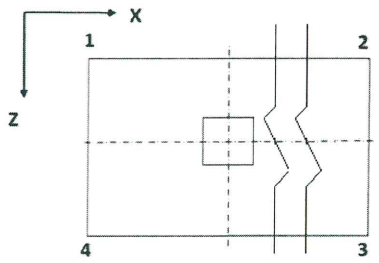
Final dimensions for design

Length (L_2) = 2.300 m Governing Load Case : # 88

Width (W_2) = 2.300 m Governing Load Case : # 88

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)
91	**177.6361**	176.7034	124.0990	125.0316	0.000
88	135.6768	**192.7018**	197.5946	140.5696	0.000
88	135.6768	192.7018	**197.5946**	140.5696	0.000
89	108.6727	118.2510	168.9133	**159.3350**	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)
91	**177.6361**	176.7034	124.0990	125.0316
88	135.6768	**192.7018**	197.5946	140.5696
88	135.6768	192.7018	**197.5946**	140.5696
89	108.6727	118.2510	168.9133	**159.3350**

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
71	96.724	429.657	917.988	206.215
72	24.476	84.287	117.534	34.478
73	26.799	213.826	196.116	36.747
74	45.744	2097.943	270.514	45.778
75	39.831	53.162	81.722	43.092
76	39.423	34.248	41.288	66.322
77	152.207	37.286	42.292	4325.342
78	72.628	34.655	42.371	105.560
79	210.785	29.437	37.747	184.592
80	22.911	75.657	106.161	32.010
81	25.163	205.042	183.053	34.186
82	39.079	1227.744	235.480	40.160
83	34.325	48.500	74.273	37.931
84	37.304	30.843	37.312	62.200
85	164.629	33.365	38.007	1220.181
86	71.332	31.841	38.801	101.188
87	156.991	26.896	34.393	153.714
88	13.489	97.874	208.932	17.927
89	41.894	13.954	16.881	89.286
90	13.262	52.116	111.281	15.722
91	468.272	14.176	17.634	994.652
92	9.027	61.816	131.839	11.818
93	28.090	7.976	9.661	59.938
94	6.562	27.477	58.710	7.951
95	114.002	8.626	10.718	241.606

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

Critical Load Case for Sliding along X-Direction : 94
Governing Disturbing Force : -26.586 kN

Governing Restoring Force :	174.468	kN
Minimum Sliding Ratio for the Critical Load Case :	6.562	
Critical Load Case for Overturning about X-Direction :	93	
Governing Overturning Moment :	51.462	kNm
Governing Resisting Moment :	497.193	kNm
Minimum Overturning Ratio for the Critical Load Case :	9.661	

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

Critical Load Case for Sliding along Z-Direction :	93	
Governing Disturbing Force :	27.102	kN
Governing Restoring Force :	216.175	kN
Minimum Sliding Ratio for the Critical Load Case :	7.976	
Critical Load Case for Overturning about Z-Direction :	94	
Governing Overturning Moment :	50.468	kNm
Governing Resisting Moment :	401.269	kNm
Minimum Overturning Ratio for the Critical Load Case :	7.951	

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

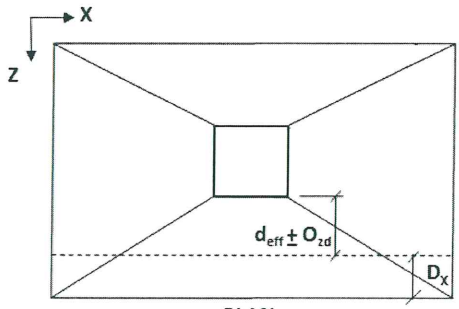
Critical Load Case	**= #65**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.394	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.144	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.637	m
Governing moment (M_u)		= 252.842	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 409.020726	kNm
$M_u <= M_{umax}$	hence, safe		

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

Critical Load Case	**= #65**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.394	m
Effective End Depth		= 0.144	m
Effective Width		= 0.637	m
Governing moment (M_u) =		= 223.705	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 409.020726	kNm
$M_u <= M_{umax}$	hence, safe		

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

(Shear Plane Parallel To X axis)



PLAN

Critical Load Case = #65

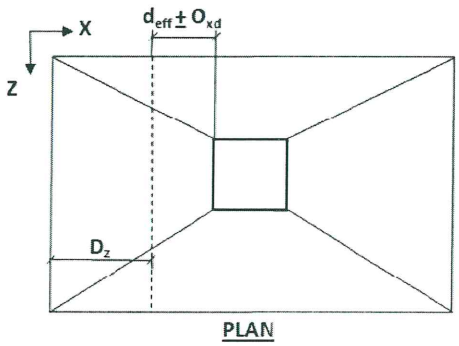
D_X = 0.394 m

Shear Force(S)	= 313.248	kN
Shear Stress(T_v)	= 480.596797	kN/m2
Percentage Of Steel(P_t)	= 0.6924	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 567.568	kN/m2

$T_v < T_c$ hence, safe

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

(Shear Plane Parallel To Z axis)



PLAN

Critical Load Case = #62

D_Z = 0.394 m

Shear Force(S)	= 346.709	kN
Shear Stress(T_v)	= 531.934552	kN/m2
Percentage Of Steel(P_t)	= 0.7867	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 597.228	kN/m2

$T_v < T_c$ hence, safe

Check Trial Depth for two way shear

Critical Load Case	**= #62**		
Shear Force(S)		= 1112.194	kN
Shear Stress(T_v)		= 1023.467	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)=	$0.25\times\sqrt{f_{ck}}$	= 1369.3064	kN/m2
K_s X T_c		= 1369.3064	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) = 20 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b\times 0.87\times f_y}{4\times\tau_{bd}}$	= 0.736 m
Allowable Length(l_{db}) =	$\left[\frac{(B-b)}{2}-cc\right]$	= 0.900 m
$l_{db} >= l_d$	hence, safe	

Along Z Axis

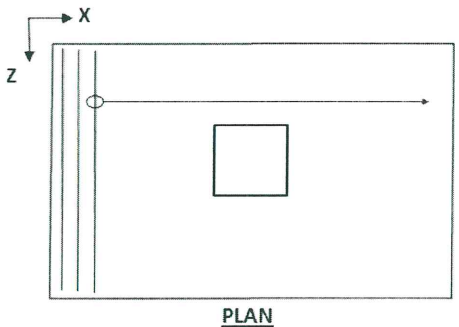
Bar diameter corresponding to max bar size(d_b) = 20 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b\times 0.87\times f_y}{4\times\tau_{bd}}$	= 0.736 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 = #65

Minimum Area of Steel (A_{stmin}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1997.089 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1997.089 mm2

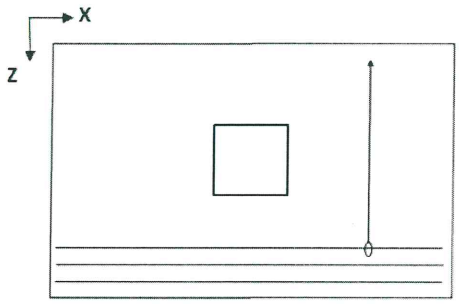
A_{stmin} <= $A_{st,Provided}$ Steel area is accepted

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 52.000 mm
Selected spacing (S)	= 128.706 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 @ 125.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = #65

Minimum Area of Steel (A_{stmin}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1739.195 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1739.195 mm2

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

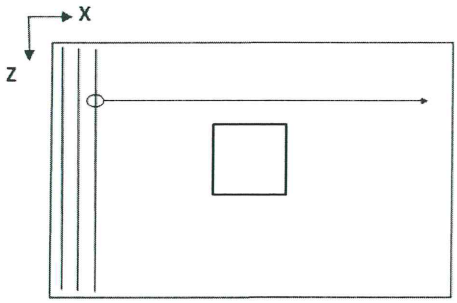
Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 100.000 mm
Selected spacing (S)	= 145.867 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 145.000 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}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1242.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1242.000 mm2

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

Selected bar Size (d_b) = Ø12

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

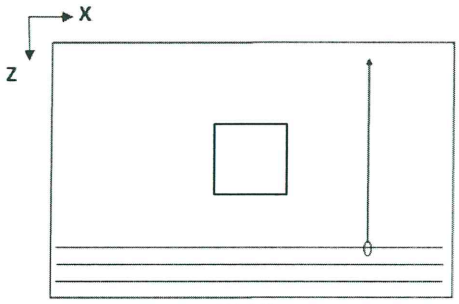
Selected spacing (S) = 218.800mm

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 @ 215 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}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1242.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1242.000 mm2

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

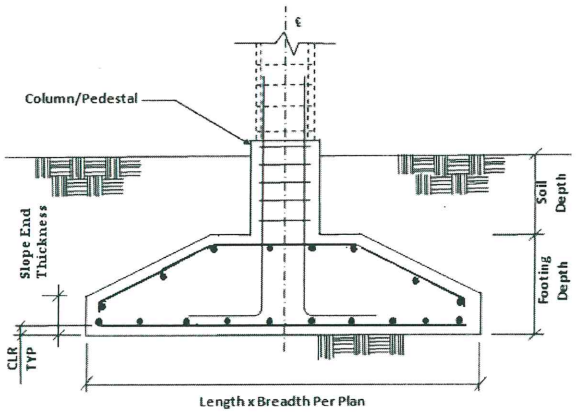
Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 100.000 mm
Selected spacing (S)	= 218.800 mm

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

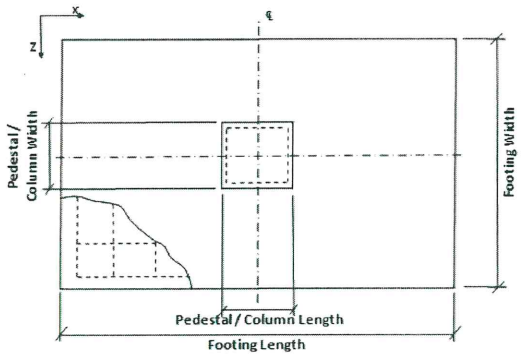
Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 215 mm o.c.

Isolated Footing 19



ELEVATION



PLAN

Input Values

Footing Geomtery

Design Type :	Set Dimension
Footing Thickness (Ft) :	450.000 mm
Slope End Thickness (St) :	200.000 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) :	0.400 m

Column Width - Z (Pw) : 0.400 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 : 30.000 N/mm2
Yield Strength of Steel : 415.000 N/mm2
Minimum Bar Size : Ø12
Maximum Bar Size : Ø32
Minimum Bar Spacing : 100.000 mm
Maximum Bar Spacing : 300.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : UnDrained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 200.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 0.000 mm
Undrained Shear Strength : 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**
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ

80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ
Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ
80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ
Load Combination/s- Strength Level	
Load Combination Number	**Load Combination Title**
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ

37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ
48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ
37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ

48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	726.431	-4.063	0.915	0.573	2.555
72	667.718	9.129	6.840	7.156	-15.299
73	657.063	7.833	-0.171	-2.969	-14.476
74	795.799	-15.958	2.000	4.115	19.586
75	785.144	-17.255	-5.011	-6.010	20.409
76	724.977	1.861	13.325	17.904	-4.050
77	763.401	-5.665	11.873	16.992	6.416
78	689.461	-2.460	-10.044	-15.846	-1.306
79	727.885	-9.987	-11.496	-16.758	9.159
80	595.075	9.535	6.748	7.098	-15.555
81	584.420	8.239	-0.262	-3.027	-14.732
82	723.156	-15.552	1.909	4.058	19.330
83	712.501	-16.848	-5.102	-6.067	20.153
84	652.334	2.267	13.233	17.847	-4.305
85	690.758	-5.259	11.782	16.935	6.160
86	616.818	-2.054	-10.135	-15.903	-1.562
87	655.242	-9.580	-11.587	-16.815	8.904
88	611.080	25.283	6.434	4.035	-37.675
89	758.368	0.873	28.847	40.355	-0.553
90	841.782	-33.408	-4.604	-2.889	42.784
91	694.494	-8.999	-27.018	-39.209	5.662
92	289.423	26.586	6.350	3.978	-38.505
93	436.711	2.176	28.763	40.297	-1.383
94	520.125	-32.105	-4.688	-2.946	41.954
95	372.837	-7.696	-27.102	-39.266	4.832

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	726.431	-4.063	0.915	0.573	2.555
72	667.718	9.129	6.840	7.156	-15.299
73	657.063	7.833	-0.171	-2.969	-14.476
74	795.799	-15.958	2.000	4.115	19.586
75	785.144	-17.255	-5.011	-6.010	20.409
76	724.977	1.861	13.325	17.904	-4.050
77	763.401	-5.665	11.873	16.992	6.416
78	689.461	-2.460	-10.044	-15.846	-1.306

79	727.885	-9.987	-11.496	-16.758	9.159
80	595.075	9.535	6.748	7.098	-15.555
81	584.420	8.239	-0.262	-3.027	-14.732
82	723.156	-15.552	1.909	4.058	19.330
83	712.501	-16.848	-5.102	-6.067	20.153
84	652.334	2.267	13.233	17.847	-4.305
85	690.758	-5.259	11.782	16.935	6.160
86	616.818	-2.054	-10.135	-15.903	-1.562
87	655.242	-9.580	-11.587	-16.815	8.904
88	611.080	25.283	6.434	4.035	-37.675
89	758.368	0.873	28.847	40.355	-0.553
90	841.782	-33.408	-4.604	-2.889	42.784
91	694.494	-8.999	-27.018	-39.209	5.662
92	289.423	26.586	6.350	3.978	-38.505
93	436.711	2.176	28.763	40.297	-1.383
94	520.125	-32.105	-4.688	-2.946	41.954
95	372.837	-7.696	-27.102	-39.266	4.832

Applied Loads - Strength Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
21	1089.647	-6.094	1.372	0.859	3.832
22	1001.577	13.693	10.260	10.733	-22.949
23	985.595	11.749	-0.256	-4.454	-21.714
24	1193.698	-23.937	3.000	6.173	29.378
25	1177.716	-25.882	-7.516	-9.014	30.613
26	1087.465	2.791	19.987	26.856	-6.075
27	1145.102	-8.498	17.809	25.488	9.623
28	1034.192	-3.691	-15.066	-23.769	-1.959
29	1091.828	-14.980	-17.244	-25.137	13.739
30	801.262	10.955	8.208	8.587	-18.359
31	788.476	9.399	-0.205	-3.563	-17.371
32	954.959	-19.150	2.400	4.938	23.503
33	942.173	-20.705	-6.013	-7.212	24.490
34	869.972	2.233	15.990	21.485	-4.860
35	916.081	-6.798	14.248	20.390	7.699
36	827.353	-2.952	-12.053	-19.015	-1.568
37	873.462	-11.984	-13.795	-20.110	10.991
38	565.718	16.131	9.711	10.390	-24.482
39	549.736	14.186	-0.805	-4.798	-23.247
40	757.839	-21.500	2.451	5.829	27.846
41	741.857	-23.444	-8.065	-9.358	29.080
42	651.607	5.229	19.439	26.512	-7.608
43	709.243	-6.060	17.261	25.144	8.091
44	598.333	-1.253	-15.614	-24.113	-3.492
45	655.969	-12.542	-17.792	-25.481	12.206
46	537.603	11.489	8.266	8.572	-18.565
47	524.980	9.953	-0.040	-3.423	-17.590
48	689.342	-18.232	2.532	4.970	22.764
49	676.719	-19.768	-5.774	-7.025	23.739
50	605.438	2.878	15.949	21.306	-5.237
51	650.960	-6.038	14.228	20.225	7.161
52	563.362	-2.241	-11.737	-18.678	-1.987
53	608.884	-11.157	-13.457	-19.759	10.412
54	294.739	13.145	7.767	8.263	-19.600
55	282.116	11.609	-0.538	-3.733	-18.624
56	446.477	-16.576	2.033	4.661	21.729
57	433.855	-18.112	-6.272	-7.334	22.704
58	362.574	4.534	15.450	20.996	-6.272
59	408.095	-4.382	13.730	19.916	6.126
60	320.498	-0.585	-12.235	-18.988	-3.022
61	366.020	-9.502	-13.955	-20.068	9.377

62	916.620	37.924	9.650	6.052	-56.512
63	1137.552	1.310	43.270	60.532	-0.829
64	1262.673	-50.113	-6.907	-4.333	64.176
65	1041.741	-13.498	-40.526	-58.813	8.493
66	434.135	39.879	9.524	5.966	-57.757
67	655.067	3.265	43.144	60.446	-2.074
68	780.187	-48.158	-7.033	-4.419	62.931
69	559.255	-11.544	-40.653	-58.899	7.248
Applied Loads - Strength Level					
LC	**Axial (kN)**	**Shear X (kN)**	**Shear Z (kN)**	**Moment X (kNm)**	**Moment Z (kNm)**
21	1089.647	-6.094	1.372	0.859	3.832
22	1001.577	13.693	10.260	10.733	-22.949
23	985.595	11.749	-0.256	-4.454	-21.714
24	1193.698	-23.937	3.000	6.173	29.378
25	1177.716	-25.882	-7.516	-9.014	30.613
26	1087.465	2.791	19.987	26.856	-6.075
27	1145.102	-8.498	17.809	25.488	9.623
28	1034.192	-3.691	-15.066	-23.769	-1.959
29	1091.828	-14.980	-17.244	-25.137	13.739
30	801.262	10.955	8.208	8.587	-18.359
31	788.476	9.399	-0.205	-3.563	-17.371
32	954.959	-19.150	2.400	4.938	23.503
33	942.173	-20.705	-6.013	-7.212	24.490
34	869.972	2.233	15.990	21.485	-4.860
35	916.081	-6.798	14.248	20.390	7.699
36	827.353	-2.952	-12.053	-19.015	-1.568
37	873.462	-11.984	-13.795	-20.110	10.991
38	565.718	16.131	9.711	10.390	-24.482
39	549.736	14.186	-0.805	-4.798	-23.247
40	757.839	-21.500	2.451	5.829	27.846
41	741.857	-23.444	-8.065	-9.358	29.080
42	651.607	5.229	19.439	26.512	-7.608
43	709.243	-6.060	17.261	25.144	8.091
44	598.333	-1.253	-15.614	-24.113	-3.492
45	655.969	-12.542	-17.792	-25.481	12.206
46	537.603	11.489	8.266	8.572	-18.565
47	524.980	9.953	-0.040	-3.423	-17.590
48	689.342	-18.232	2.532	4.970	22.764
49	676.719	-19.768	-5.774	-7.025	23.739
50	605.438	2.878	15.949	21.306	-5.237
51	650.960	-6.038	14.228	20.225	7.161
52	563.362	-2.241	-11.737	-18.678	-1.987
53	608.884	-11.157	-13.457	-19.759	10.412
54	294.739	13.145	7.767	8.263	-19.600
55	282.116	11.609	-0.538	-3.733	-18.624
56	446.477	-16.576	2.033	4.661	21.729
57	433.855	-18.112	-6.272	-7.334	22.704
58	362.574	4.534	15.450	20.996	-6.272
59	408.095	-4.382	13.730	19.916	6.126
60	320.498	-0.585	-12.235	-18.988	-3.022
61	366.020	-9.502	-13.955	-20.068	9.377
62	916.620	37.924	9.650	6.052	-56.512
63	1137.552	1.310	43.270	60.532	-0.829
64	1262.673	-50.113	-6.907	-4.333	64.176
65	1041.741	-13.498	-40.526	-58.813	8.493
66	434.135	39.879	9.524	5.966	-57.757
67	655.067	3.265	43.144	60.446	-2.074
68	780.187	-48.158	-7.033	-4.419	62.931
69	559.255	-11.544	-40.653	-58.899	7.248

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, $A_{min} = P / q_{max} = 4.250\ m^2$

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

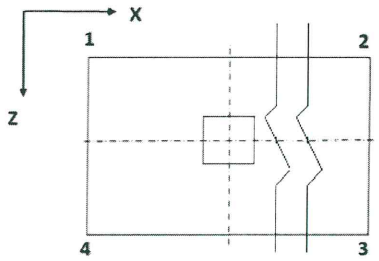
Final dimensions for design

Length (L_2) = 2.300 m Governing Load Case : # 90

Width (W_2) = 2.300 m Governing Load Case : # 90

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)
90	**197.5945**	140.5696	135.6768	192.7017	0.000
91	168.9133	**159.3350**	108.6727	118.2509	0.000
89	124.0989	125.0316	**177.6360**	176.7034	0.000
90	197.5945	140.5696	135.6768	**192.7017**	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)
90	**197.5945**	140.5696	135.6768	192.7017
91	168.9133	**159.3350**	108.6727	118.2509
89	124.0989	125.0316	**177.6360**	176.7034
90	197.5945	140.5696	135.6768	**192.7017**

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
71	96.724	429.657	917.988	206.215
72	39.831	53.161	81.722	43.092
73	45.744	2097.936	270.514	45.778
74	26.799	213.826	196.116	36.747
75	24.476	84.287	117.534	34.478
76	210.785	29.437	37.747	184.592
77	72.628	34.655	42.371	105.560
78	152.206	37.286	42.292	4325.373
79	39.423	34.248	41.288	66.322
80	34.325	48.500	74.273	37.931
81	39.079	1227.741	235.480	40.160
82	25.163	205.042	183.053	34.186
83	22.911	75.657	106.161	32.010
84	156.991	26.896	34.393	153.714
85	71.332	31.841	38.801	101.188
86	164.629	33.365	38.007	1220.184
87	37.304	30.843	37.312	62.200
88	13.262	52.116	111.281	15.722
89	468.273	14.176	17.634	994.652
90	13.489	97.874	208.932	17.927
91	41.894	13.954	16.881	89.286
92	6.562	27.477	58.710	7.951
93	114.002	8.626	10.718	241.606
94	9.027	61.816	131.840	11.818
95	28.090	7.976	9.661	59.938

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

Critical Load Case for Sliding along X-Direction : 92
Governing Disturbing Force : 26.586 kN

Governing Restoring Force :	174.468	kN
Minimum Sliding Ratio for the Critical Load Case :	6.562	
Critical Load Case for Overturning about X-Direction :	95	
Governing Overturning Moment :	-51.462	kNm
Governing Resisting Moment :	497.193	kNm
Minimum Overturning Ratio for the Critical Load Case :	9.661	

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

Critical Load Case for Sliding along Z-Direction :	95	
Governing Disturbing Force :	-27.102	kN
Governing Restoring Force :	216.175	kN
Minimum Sliding Ratio for the Critical Load Case :	7.976	
Critical Load Case for Overturning about Z-Direction :	92	
Governing Overturning Moment :	-50.468	kNm
Governing Resisting Moment :	401.269	kNm
Minimum Overturning Ratio for the Critical Load Case :	7.951	

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

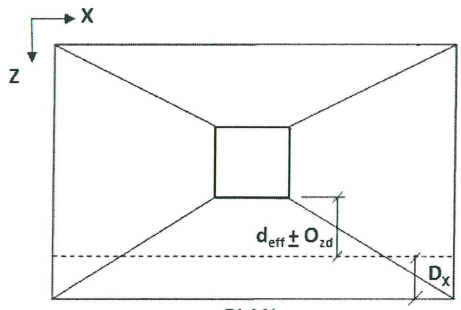
Critical Load Case	**= #64**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.394	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.144	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.637	m
Governing moment (M_u)		= 250.486	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 409.020726	kNm
$M_u <= M_{umax}$	hence, safe		

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

Critical Load Case	**= #64**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.394	m
Effective End Depth		= 0.144	m
Effective Width		= 0.637	m
Governing moment (M_u) =		= 279.882	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 409.020726	kNm
$M_u <= M_{umax}$	hence, safe		

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

(Shear Plane Parallel To X axis)



PLAN

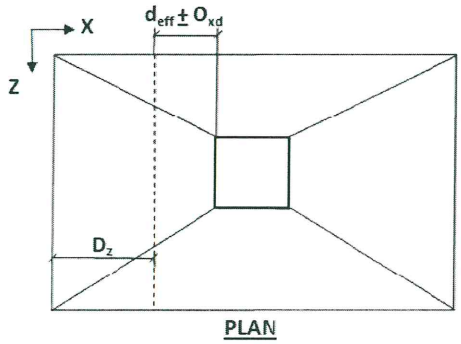
Critical Load Case = #63

D_X = 0.394 m

Shear Force(S)	= 313.248	kN
Shear Stress(T_v)	= 480.596752	kN/m2
Percentage Of Steel(P_t)	= 0.6924	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 567.569	kN/m2
$T_v < T_c$	hence, safe	

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

(Shear Plane Parallel To Z axis)



PLAN

Critical Load Case = #64

D_Z = 0.394 m

Shear Force(S)	= 346.709	kN
Shear Stress(T_v)	= 531.934459	kN/m2
Percentage Of Steel(P_t)	= 0.7867	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 597.224	kN/m2
$T_v < T_c$	hence, safe	

Check Trial Depth for two way shear

Critical Load Case	**= #64**		
Shear Force(S)		= 1112.194	kN
Shear Stress(T_v)		= 1023.467	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)=	$0.25\times\sqrt{f_{ck}}$	= 1369.3064	kN/m2
K_s X T_c		= 1369.3064	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) = 20 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b\times 0.87\times f_y}{4\times\Gamma_{bd}}$	= 0.736 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) = 20 mm

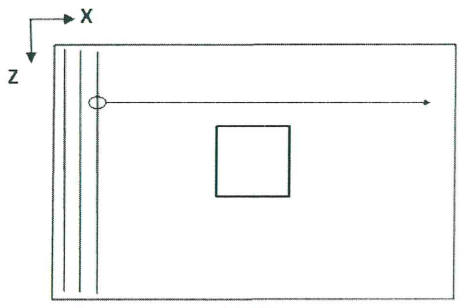
As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b\times 0.87\times f_y}{4\times\Gamma_{bd}}$	= 0.736 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 = #64

Minimum Area of Steel (A_{stmin}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1975.887 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1975.887 mm2

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

Selected bar Size (d_b) = Ø12

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

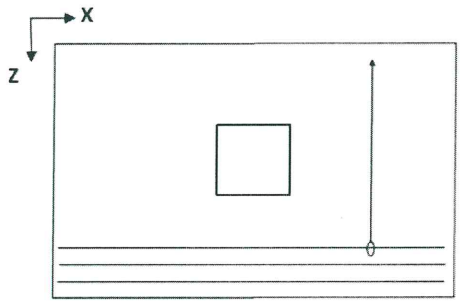
Selected spacing (S) = 128.706 mm

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 @ 125.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = #64

Minimum Area of Steel (A_{stmin}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 2245.129 mm2

Provided Area of Steel ($A_{st,Provided}$) = 2245.129 mm2

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

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 100.000 mm

Selected spacing (S) = 115.158 mm

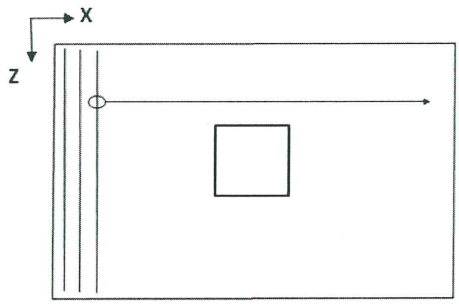
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 115.000 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}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1242.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1242.000 mm2

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

Selected bar Size (d_b) = Ø12

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

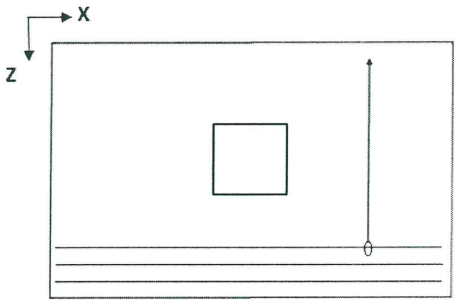
Selected spacing (S) = 218.800mm

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 @ 215 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}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1242.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1242.000 mm2

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

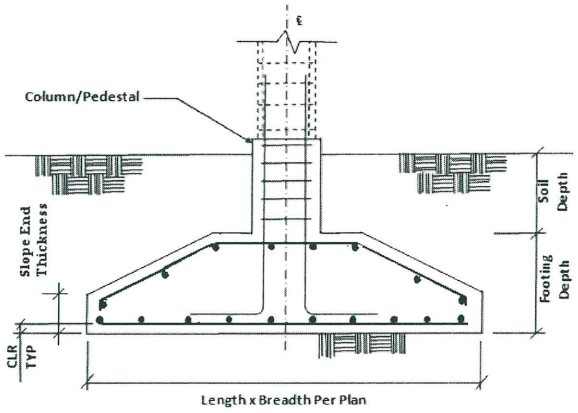
Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 100.000 mm
Selected spacing (S)	= 218.800 mm

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

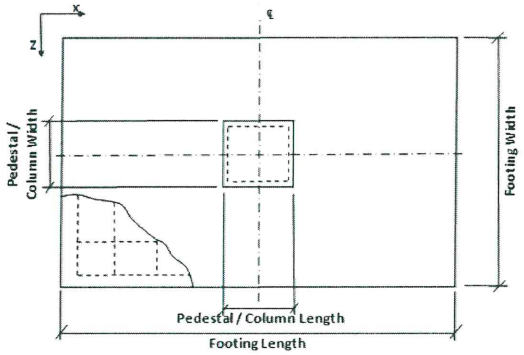
Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 215 mm o.c.

Isolated Footing 22



ELEVATION



PLAN

Input Values

Footing Geomtery

Design Type :	Set Dimension
Footing Thickness (Ft) :	450.000 mm
Slope End Thickness (St) :	200.000 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) :	0.400 m

Column Width - Z (Pw) : 0.400 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 : 30.000 N/mm2
Yield Strength of Steel : 415.000 N/mm2
Minimum Bar Size : Ø12
Maximum Bar Size : Ø32
Minimum Bar Spacing : 100.000 mm
Maximum Bar Spacing : 300.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : UnDrained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 200.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 0.000 mm
Undrained Shear Strength : 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**
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ

80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ
Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ
80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ
Load Combination/s- Strength Level	
Load Combination Number	**Load Combination Title**
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ

37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ
48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ
37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ

48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	726.431	4.063	0.915	0.573	-2.555
72	795.799	15.958	2.000	4.115	-19.586
73	785.144	17.255	-5.011	-6.010	-20.409
74	667.718	-9.129	6.840	7.156	15.299
75	657.064	-7.833	-0.171	-2.969	14.476
76	763.401	5.665	11.873	16.992	-6.416
77	724.977	-1.861	13.325	17.904	4.050
78	727.885	9.987	-11.496	-16.758	-9.159
79	689.461	2.460	-10.044	-15.846	1.306
80	723.156	15.552	1.909	4.058	-19.330
81	712.501	16.848	-5.102	-6.067	-20.153
82	595.075	-9.535	6.748	7.098	15.555
83	584.420	-8.239	-0.262	-3.027	14.732
84	690.758	5.259	11.782	16.935	-6.160
85	652.334	-2.267	13.233	17.847	4.305
86	655.242	9.580	-11.587	-16.815	-8.904
87	616.818	2.054	-10.135	-15.903	1.562
88	841.782	33.408	-4.604	-2.889	-42.784
89	758.368	-0.873	28.847	40.355	0.553
90	611.080	-25.283	6.434	4.035	37.675
91	694.494	8.999	-27.018	-39.209	-5.662
92	520.125	32.105	-4.688	-2.946	-41.954
93	436.711	-2.176	28.763	40.297	1.383
94	289.423	-26.586	6.350	3.978	38.505
95	372.837	7.696	-27.102	-39.266	-4.832

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	726.431	4.063	0.915	0.573	-2.555
72	795.799	15.958	2.000	4.115	-19.586
73	785.144	17.255	-5.011	-6.010	-20.409
74	667.718	-9.129	6.840	7.156	15.299
75	657.064	-7.833	-0.171	-2.969	14.476
76	763.401	5.665	11.873	16.992	-6.416
77	724.977	-1.861	13.325	17.904	4.050
78	727.885	9.987	-11.496	-16.758	-9.159

79	689.461	2.460	-10.044	-15.846	1.306
80	723.156	15.552	1.909	4.058	-19.330
81	712.501	16.848	-5.102	-6.067	-20.153
82	595.075	-9.535	6.748	7.098	15.555
83	584.420	-8.239	-0.262	-3.027	14.732
84	690.758	5.259	11.782	16.935	-6.160
85	652.334	-2.267	13.233	17.847	4.305
86	655.242	9.580	-11.587	-16.815	-8.904
87	616.818	2.054	-10.135	-15.903	1.562
88	841.782	33.408	-4.604	-2.889	-42.784
89	758.368	-0.873	28.847	40.355	0.553
90	611.080	-25.283	6.434	4.035	37.675
91	694.494	8.999	-27.018	-39.209	-5.662
92	520.125	32.105	-4.688	-2.946	-41.954
93	436.711	-2.176	28.763	40.297	1.383
94	289.423	-26.586	6.350	3.978	38.505
95	372.837	7.696	-27.102	-39.266	-4.832

Applied Loads - Strength Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
21	1089.647	6.094	1.372	0.859	-3.832
22	1193.698	23.937	3.000	6.173	-29.378
23	1177.716	25.882	-7.516	-9.014	-30.613
24	1001.577	-13.693	10.260	10.733	22.949
25	985.595	-11.749	-0.256	-4.454	21.714
26	1145.102	8.498	17.809	25.488	-9.623
27	1087.465	-2.791	19.987	26.856	6.075
28	1091.828	14.980	-17.244	-25.137	-13.739
29	1034.192	3.691	-15.066	-23.769	1.959
30	954.959	19.150	2.400	4.938	-23.503
31	942.173	20.705	-6.013	-7.212	-24.490
32	801.262	-10.955	8.208	8.587	18.359
33	788.476	-9.399	-0.205	-3.563	17.371
34	916.081	6.798	14.248	20.390	-7.699
35	869.972	-2.233	15.990	21.485	4.860
36	873.463	11.984	-13.795	-20.110	-10.991
37	827.353	2.952	-12.053	-19.015	1.568
38	757.840	21.500	2.451	5.829	-27.846
39	741.857	23.444	-8.065	-9.358	-29.080
40	565.719	-16.131	9.711	10.390	24.482
41	549.736	-14.186	-0.805	-4.798	23.247
42	709.243	6.060	17.261	25.144	-8.091
43	651.607	-5.229	19.439	26.512	7.608
44	655.969	12.542	-17.792	-25.481	-12.206
45	598.333	1.253	-15.614	-24.113	3.492
46	689.342	18.232	2.532	4.970	-22.764
47	676.719	19.768	-5.774	-7.025	-23.739
48	537.603	-11.489	8.266	8.572	18.565
49	524.980	-9.953	-0.040	-3.423	17.590
50	650.960	6.038	14.228	20.225	-7.161
51	605.438	-2.878	15.949	21.306	5.237
52	608.884	11.157	-13.457	-19.759	-10.412
53	563.362	2.241	-11.737	-18.678	1.987
54	446.478	16.576	2.033	4.661	-21.729
55	433.855	18.112	-6.272	-7.334	-22.704
56	294.739	-13.145	7.767	8.263	19.600
57	282.116	-11.609	-0.538	-3.733	18.624
58	408.095	4.382	13.730	19.916	-6.126
59	362.574	-4.534	15.450	20.996	6.272
60	366.020	9.502	-13.955	-20.068	-9.377
61	320.498	0.585	-12.235	-18.988	3.022

62	1262.673	50.113	-6.907	-4.333	-64.176
63	1137.552	-1.310	43.270	60.532	0.829
64	916.621	-37.924	9.650	6.052	56.512
65	1041.741	13.498	-40.526	-58.813	-8.493
66	780.187	48.158	-7.033	-4.419	-62.931
67	655.067	-3.265	43.144	60.446	2.074
68	434.135	-39.879	9.524	5.966	57.757
69	559.256	11.544	-40.653	-58.899	-7.248

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
21	1089.647	6.094	1.372	0.859	-3.832
22	1193.698	23.937	3.000	6.173	-29.378
23	1177.716	25.882	-7.516	-9.014	-30.613
24	1001.577	-13.693	10.260	10.733	22.949
25	985.595	-11.749	-0.256	-4.454	21.714
26	1145.102	8.498	17.809	25.488	-9.623
27	1087.465	-2.791	19.987	26.856	6.075
28	1091.828	14.980	-17.244	-25.137	-13.739
29	1034.192	3.691	-15.066	-23.769	1.959
30	954.959	19.150	2.400	4.938	-23.503
31	942.173	20.705	-6.013	-7.212	-24.490
32	801.262	-10.955	8.208	8.587	18.359
33	788.476	-9.399	-0.205	-3.563	17.371
34	916.081	6.798	14.248	20.390	-7.699
35	869.972	-2.233	15.990	21.485	4.860
36	873.463	11.984	-13.795	-20.110	-10.991
37	827.353	2.952	-12.053	-19.015	1.568
38	757.840	21.500	2.451	5.829	-27.846
39	741.857	23.444	-8.065	-9.358	-29.080
40	565.719	-16.131	9.711	10.390	24.482
41	549.736	-14.186	-0.805	-4.798	23.247
42	709.243	6.060	17.261	25.144	-8.091
43	651.607	-5.229	19.439	26.512	7.608
44	655.969	12.542	-17.792	-25.481	-12.206
45	598.333	1.253	-15.614	-24.113	3.492
46	689.342	18.232	2.532	4.970	-22.764
47	676.719	19.768	-5.774	-7.025	-23.739
48	537.603	-11.489	8.266	8.572	18.565
49	524.980	-9.953	-0.040	-3.423	17.590
50	650.960	6.038	14.228	20.225	-7.161
51	605.438	-2.878	15.949	21.306	5.237
52	608.884	11.157	-13.457	-19.759	-10.412
53	563.362	2.241	-11.737	-18.678	1.987
54	446.478	16.576	2.033	4.661	-21.729
55	433.855	18.112	-6.272	-7.334	-22.704
56	294.739	-13.145	7.767	8.263	19.600
57	282.116	-11.609	-0.538	-3.733	18.624
58	408.095	4.382	13.730	19.916	-6.126
59	362.574	-4.534	15.450	20.996	6.272
60	366.020	9.502	-13.955	-20.068	-9.377
61	320.498	0.585	-12.235	-18.988	3.022
62	1262.673	50.113	-6.907	-4.333	-64.176
63	1137.552	-1.310	43.270	60.532	0.829
64	916.621	-37.924	9.650	6.052	56.512
65	1041.741	13.498	-40.526	-58.813	-8.493
66	780.187	48.158	-7.033	-4.419	-62.931
67	655.067	-3.265	43.144	60.446	2.074
68	434.135	-39.879	9.524	5.966	57.757
69	559.256	11.544	-40.653	-58.899	-7.248

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, $A_{min} = P / q_{max}$ = 4.250 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.

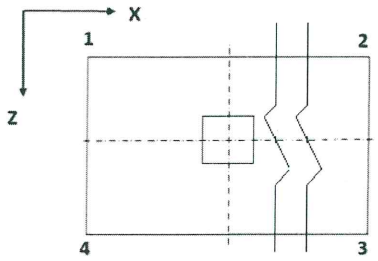
Final dimensions for design

Length (L_2) = 2.300 m Governing Load Case : # 88

Width (W_2) = 2.300 m Governing Load Case : # 88

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)
91	**159.3350**	168.9133	118.2510	108.6727	0.000
88	140.5696	**197.5946**	192.7018	135.6768	0.000
88	140.5696	197.5946	**192.7018**	135.6768	0.000
89	125.0316	124.0990	176.7034	**177.6361**	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)
91	**159.3350**	168.9133	118.2510	108.6727
88	140.5696	**197.5946**	192.7018	135.6768
88	140.5696	197.5946	**192.7018**	135.6768
89	125.0316	124.0990	176.7034	**177.6361**

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
71	96.724	429.657	917.988	206.215
72	26.799	213.826	196.116	36.747
73	24.476	84.287	117.534	34.478
74	39.831	53.162	81.722	43.092
75	45.744	2097.936	270.514	45.778
76	72.628	34.655	42.371	105.560
77	210.785	29.437	37.747	184.592
78	39.423	34.248	41.288	66.322
79	152.207	37.286	42.292	4325.347
80	25.163	205.042	183.053	34.186
81	22.911	75.657	106.161	32.010
82	34.325	48.500	74.273	37.931
83	39.079	1227.741	235.480	40.160
84	71.332	31.841	38.801	101.188
85	156.991	26.896	34.393	153.714
86	37.304	30.843	37.312	62.200
87	164.629	33.365	38.007	1220.181
88	13.489	97.874	208.932	17.927
89	468.272	14.176	17.634	994.652
90	13.262	52.116	111.281	15.722
91	41.894	13.954	16.881	89.286
92	9.027	61.816	131.840	11.818
93	114.002	8.626	10.718	241.606
94	6.562	27.477	58.710	7.951
95	28.090	7.976	9.661	59.938

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

Critical Load Case for Sliding along X-Direction : 94
Governing Disturbing Force : -26.586 kN

Governing Restoring Force :	174.468	kN
Minimum Sliding Ratio for the Critical Load Case :	6.562	
Critical Load Case for Overturning about X-Direction :	95	
Governing Overturning Moment :	-51.462	kNm
Governing Resisting Moment :	497.193	kNm
Minimum Overturning Ratio for the Critical Load Case :	9.661	

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

Critical Load Case for Sliding along Z-Direction :	95	
Governing Disturbing Force :	-27.102	kN
Governing Restoring Force :	216.175	kN
Minimum Sliding Ratio for the Critical Load Case :	7.976	
Critical Load Case for Overturning about Z-Direction :	94	
Governing Overturning Moment :	50.468	kNm
Governing Resisting Moment :	401.269	kNm
Minimum Overturning Ratio for the Critical Load Case :	7.951	

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

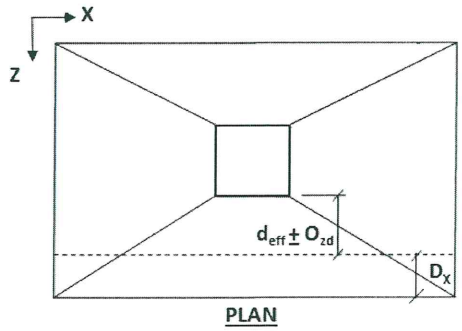
Critical Load Case	**= #63**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.394	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.144	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.637	m
Governing moment (M_u)		= 252.876	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 409.020726	kNm
$M_u <= M_{umax}$	hence, safe		

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

Critical Load Case	**= #63**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.394	m
Effective End Depth		= 0.144	m
Effective Width		= 0.637	m
Governing moment (M_u) =		= 223.705	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 409.020726	kNm
$M_u <= M_{umax}$	hence, safe		

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

(Shear Plane Parallel To X axis)



PLAN

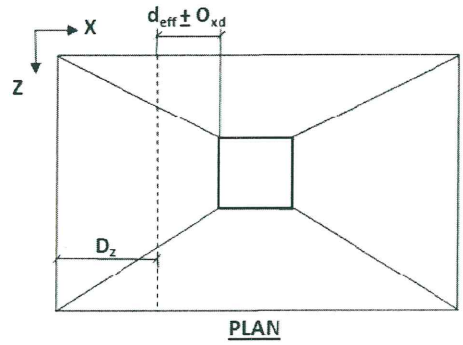
Critical Load Case = #63

D_X = 0.394 m

Shear Force(S)	= 313.248	kN
Shear Stress(T_v)	= 480.596797	kN/m2
Percentage Of Steel(P_t)	= 0.6924	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 567.568	kN/m2
$T_v < T_c$	hence, safe	

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

(Shear Plane Parallel To Z axis)



PLAN

Critical Load Case = #62

D_Z = 0.394 m

Shear Force(S)	= 346.709	kN
Shear Stress(T_v)	= 531.934552	kN/m2
Percentage Of Steel(P_t)	= 0.7867	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 597.224	kN/m2
$T_v < T_c$	hence, safe	

Check Trial Depth for two way shear

Critical Load Case	**= #62**		
Shear Force(S)		= 1112.194	kN
Shear Stress(T_v)		= 1023.467	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)=	$0.25\times\sqrt{f_{ck}}$	= 1369.3064	kN/m2
K_s X T_c		= 1369.3064	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) = 20 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b\times 0.87\times f_y}{4\times \Gamma_{bd}}$	= 0.736 m
Allowable Length(l_{db}) =	$\left[\frac{(B-b)}{2}-cc\right]$	= 0.900 m
$l_{db} >= l_d$	hence, safe	

Along Z Axis

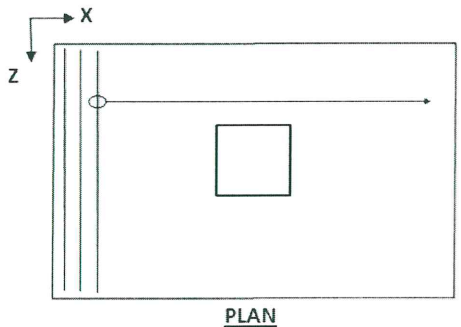
Bar diameter corresponding to max bar size(d_b) = 20 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b\times 0.87\times f_y}{4\times \Gamma_{bd}}$	= 0.736 m
Allowable Length(l_{db}) =	$\left[\frac{(H-b)}{2}-cc\right]$	= 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 = #63

Minimum Area of Steel (A_{stmin}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1997.403 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1997.403 mm2

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

Selected bar Size (d_b) = Ø12

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

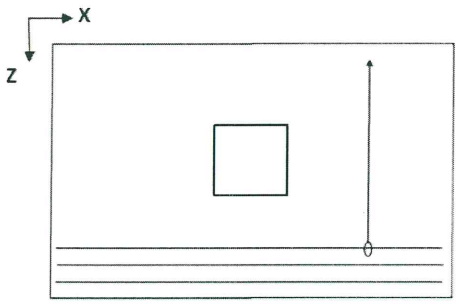
Selected spacing (S) = 128.706 mm

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 @ 125.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = #63

Minimum Area of Steel (A_{stmin}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1739.195 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1739.195 mm2

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

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 100.000 mm

Selected spacing (S) = 145.867 mm

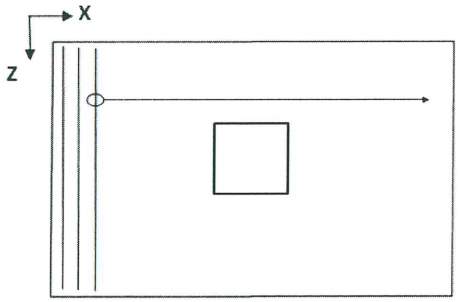
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 145.000 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}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1242.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1242.000 mm2

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

Selected bar Size (d_b) = Ø12

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

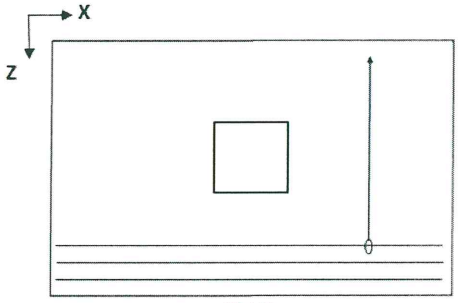
Selected spacing (S) = 218.800mm

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 @ 215 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}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1242.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1242.000 mm2

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

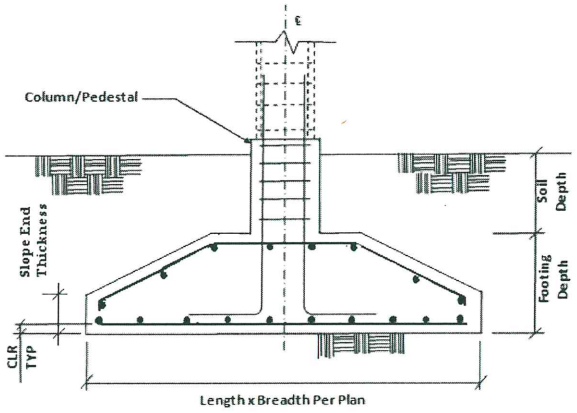
Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 100.000 mm
Selected spacing (S)	= 218.800 mm

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

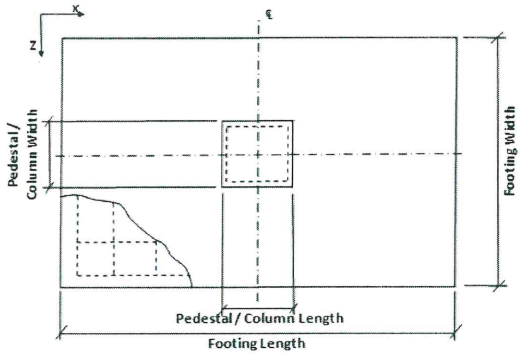
Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 215 mm o.c.

Isolated Footing 23



ELEVATION



PLAN

Input Values

Footing Geomtery

Design Type :	Set Dimension
Footing Thickness (Ft) :	450.000 mm
Slope End Thickness (St) :	200.000 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) :	0.400 m

Column Width - Z (Pw) : 0.400 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 : 30.000 N/mm2
Yield Strength of Steel : 415.000 N/mm2
Minimum Bar Size : Ø12
Maximum Bar Size : Ø32
Minimum Bar Spacing : 100.000 mm
Maximum Bar Spacing : 300.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : UnDrained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 200.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 0.000 mm
Undrained Shear Strength : 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**
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ

80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ

Load Combination/s- Service Stress Level

Load Combination Number	Load Combination Title
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ
80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ

37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ
48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ
37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ

48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	712.362	-0.893	4.162	2.617	0.559
72	713.816	11.517	10.086	9.221	-16.772
73	675.392	10.065	2.560	-1.244	-15.860
74	749.332	-11.851	5.765	6.478	16.977
75	710.908	-13.303	-1.761	-3.988	17.890
76	771.075	5.032	17.354	20.471	-6.024
77	781.729	-1.978	16.058	19.648	4.101
78	642.994	0.193	-7.733	-14.414	-2.984
79	653.649	-6.818	-9.029	-15.237	7.141
80	642.580	11.607	9.670	8.960	-16.828
81	604.156	10.155	2.144	-1.506	-15.916
82	678.095	-11.762	5.349	6.216	16.922
83	639.671	-13.214	-2.178	-4.249	17.834
84	699.839	5.122	16.938	20.209	-6.080
85	710.493	-1.889	15.641	19.386	4.045
86	571.758	0.282	-8.149	-14.676	-3.040
87	582.413	-6.729	-9.446	-15.499	7.085
88	681.294	26.467	8.993	5.657	-38.397
89	830.847	4.745	34.122	43.700	-2.978
90	743.430	-28.253	-0.668	-0.423	39.514
91	593.876	-6.530	-25.797	-38.466	4.095
92	370.147	26.535	7.615	4.781	-38.444
93	519.700	4.812	32.744	42.824	-3.024
94	432.282	-28.185	-2.045	-1.300	39.468
95	282.729	-6.463	-27.175	-39.343	4.048

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	712.362	-0.893	4.162	2.617	0.559
72	713.816	11.517	10.086	9.221	-16.772
73	675.392	10.065	2.560	-1.244	-15.860
74	749.332	-11.851	5.765	6.478	16.977
75	710.908	-13.303	-1.761	-3.988	17.890
76	771.075	5.032	17.354	20.471	-6.024
77	781.729	-1.978	16.058	19.648	4.101
78	642.994	0.193	-7.733	-14.414	-2.984

79	653.649	-6.818	-9.029	-15.237	7.141
80	642.580	11.607	9.670	8.960	-16.828
81	604.156	10.155	2.144	-1.506	-15.916
82	678.095	-11.762	5.349	6.216	16.922
83	639.671	-13.214	-2.178	-4.249	17.834
84	699.839	5.122	16.938	20.209	-6.080
85	710.493	-1.889	15.641	19.386	4.045
86	571.758	0.282	-8.149	-14.676	-3.040
87	582.413	-6.729	-9.446	-15.499	7.085
88	681.294	26.467	8.993	5.657	-38.397
89	830.847	4.745	34.122	43.700	-2.978
90	743.430	-28.253	-0.668	-0.423	39.514
91	593.876	-6.530	-25.797	-38.466	4.095
92	370.147	26.535	7.615	4.781	-38.444
93	519.700	4.812	32.744	42.824	-3.024
94	432.282	-28.185	-2.045	-1.300	39.468
95	282.729	-6.463	-27.175	-39.343	4.048

Applied Loads - Strength Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
21	1068.543	-1.339	6.244	3.925	0.838
22	1070.724	17.276	15.129	13.832	-25.159
23	1013.088	15.098	3.840	-1.866	-23.791
24	1123.998	-17.777	8.647	9.716	25.466
25	1066.361	-19.955	-2.642	-5.982	26.834
26	1156.612	7.548	26.031	30.706	-9.036
27	1172.594	-2.967	24.087	29.471	6.151
28	964.491	0.289	-11.599	-21.621	-4.476
29	980.473	-10.227	-13.544	-22.856	10.712
30	856.579	13.821	12.103	11.065	-20.127
31	810.470	12.079	3.072	-1.493	-19.032
32	899.198	-14.222	6.918	7.773	20.373
33	853.089	-15.964	-2.114	-4.785	21.467
34	925.290	6.039	20.825	24.565	-7.229
35	938.075	-2.374	19.269	23.577	4.921
36	771.593	0.231	-9.280	-17.297	-3.581
37	784.379	-8.182	-10.835	-18.285	8.569
38	643.307	17.812	12.632	12.262	-25.494
39	585.671	15.634	1.342	-3.436	-24.126
40	696.581	-17.241	6.150	8.146	25.131
41	638.944	-19.419	-5.139	-7.552	26.499
42	729.195	8.084	23.534	29.136	-9.371
43	745.177	-2.432	21.589	27.901	5.816
44	537.074	0.824	-14.097	-23.191	-4.811
45	553.056	-9.691	-16.041	-24.426	10.377
46	603.545	13.465	11.195	10.435	-19.764
47	558.023	11.745	2.279	-1.963	-18.684
48	645.620	-14.220	6.076	7.185	20.220
49	600.099	-15.940	-2.840	-5.214	21.300
50	671.380	5.782	19.806	23.762	-7.030
51	684.002	-2.523	18.270	22.787	4.965
52	519.641	0.048	-9.915	-17.566	-3.429
53	532.264	-8.257	-11.451	-18.541	8.567
54	362.816	13.960	9.524	9.391	-20.071
55	317.294	12.240	0.608	-3.008	-18.991
56	404.892	-13.725	4.405	6.141	19.913
57	359.370	-15.445	-4.511	-6.258	20.993
58	430.651	6.277	18.135	22.718	-7.338
59	443.274	-2.028	16.599	21.743	4.658
60	278.912	0.543	-11.586	-18.610	-3.736
61	291.535	-7.762	-13.122	-19.585	8.259

62	1021.941	39.701	13.489	8.485	-57.596
63	1246.271	7.117	51.183	65.550	-4.467
64	1115.144	-42.380	-1.002	-0.635	59.271
65	890.814	-9.796	-38.696	-57.700	6.142
66	555.220	39.803	11.423	7.171	-57.665
67	779.550	7.219	49.117	64.235	-4.536
68	648.423	-42.278	-3.068	-1.950	59.202
69	424.094	-9.694	-40.762	-59.014	6.072
Applied Loads - Strength Level					
LC	**Axial (kN)**	**Shear X (kN)**	**Shear Z (kN)**	**Moment X (kNm)**	**Moment Z (kNm)**
21	1068.543	-1.339	6.244	3.925	0.838
22	1070.724	17.276	15.129	13.832	-25.159
23	1013.088	15.098	3.840	-1.866	-23.791
24	1123.998	-17.777	8.647	9.716	25.466
25	1066.361	-19.955	-2.642	-5.982	26.834
26	1156.612	7.548	26.031	30.706	-9.036
27	1172.594	-2.967	24.087	29.471	6.151
28	964.491	0.289	-11.599	-21.621	-4.476
29	980.473	-10.227	-13.544	-22.856	10.712
30	856.579	13.821	12.103	11.065	-20.127
31	810.470	12.079	3.072	-1.493	-19.032
32	899.198	-14.222	6.918	7.773	20.373
33	853.089	-15.964	-2.114	-4.785	21.467
34	925.290	6.039	20.825	24.565	-7.229
35	938.075	-2.374	19.269	23.577	4.921
36	771.593	0.231	-9.280	-17.297	-3.581
37	784.379	-8.182	-10.835	-18.285	8.569
38	643.307	17.812	12.632	12.262	-25.494
39	585.671	15.634	1.342	-3.436	-24.126
40	696.581	-17.241	6.150	8.146	25.131
41	638.944	-19.419	-5.139	-7.552	26.499
42	729.195	8.084	23.534	29.136	-9.371
43	745.177	-2.432	21.589	27.901	5.816
44	537.074	0.824	-14.097	-23.191	-4.811
45	553.056	-9.691	-16.041	-24.426	10.377
46	603.545	13.465	11.195	10.435	-19.764
47	558.023	11.745	2.279	-1.963	-18.684
48	645.620	-14.220	6.076	7.185	20.220
49	600.099	-15.940	-2.840	-5.214	21.300
50	671.380	5.782	19.806	23.762	-7.030
51	684.002	-2.523	18.270	22.787	4.965
52	519.641	0.048	-9.915	-17.566	-3.429
53	532.264	-8.257	-11.451	-18.541	8.567
54	362.816	13.960	9.524	9.391	-20.071
55	317.294	12.240	0.608	-3.008	-18.991
56	404.892	-13.725	4.405	6.141	19.913
57	359.370	-15.445	-4.511	-6.258	20.993
58	430.651	6.277	18.135	22.718	-7.338
59	443.274	-2.028	16.599	21.743	4.658
60	278.912	0.543	-11.586	-18.610	-3.736
61	291.535	-7.762	-13.122	-19.585	8.259
62	1021.941	39.701	13.489	8.485	-57.596
63	1246.271	7.117	51.183	65.550	-4.467
64	1115.144	-42.380	-1.002	-0.635	59.271
65	890.814	-9.796	-38.696	-57.700	6.142
66	555.220	39.803	11.423	7.171	-57.665
67	779.550	7.219	49.117	64.235	-4.536
68	648.423	-42.278	-3.068	-1.950	59.202
69	424.094	-9.694	-40.762	-59.014	6.072

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, $A_{min} = P / q_{max}$ = 4.195 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.

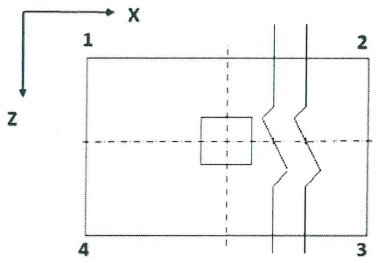
Final dimensions for design

Length (L_2) = 2.300 m Governing Load Case : # 89

Width (W_2) = 2.300 m Governing Load Case : # 89

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)
90	**174.1566**	122.6446	121.9305	173.4425	0.000
88	106.7036	**156.3213**	165.8918	116.2741	0.000
89	132.9248	137.9675	**196.2124**	191.1698	0.000
89	132.9248	137.9675	196.2124	**191.1698**	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)
90	**174.1566**	122.6446	121.9305	173.4425
88	106.7036	**156.3213**	165.8918	116.2741
89	132.9248	137.9675	**196.2124**	191.1698
89	132.9248	137.9675	196.2124	**191.1698**

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
71	432.232	92.721	197.704	924.290
72	33.572	38.337	64.631	40.506
73	36.506	143.540	9158.812	41.448
74	34.125	70.154	102.533	41.691
75	28.956	218.703	185.334	37.107
76	82.525	23.931	33.775	115.238
77	212.618	26.194	35.999	193.826
78	1824.651	45.423	45.148	263.111
79	52.299	39.491	42.492	80.331
80	30.245	36.303	60.656	36.614
81	32.678	154.796	1410.080	37.255
82	31.356	68.954	98.371	38.184
83	26.456	160.542	153.756	33.812
84	74.132	22.416	31.377	104.148
85	203.813	24.614	33.510	180.893
86	1120.093	38.732	39.576	229.261
87	47.700	33.980	37.378	72.994
88	13.995	41.189	87.794	16.934
89	93.830	13.047	17.338	200.264
90	14.210	601.006	1275.350	17.680
91	50.027	12.664	15.005	106.830
92	8.096	28.210	60.202	9.807
93	60.179	8.844	11.572	128.345
94	8.724	120.218	254.740	10.845
95	26.479	6.297	7.632	56.577

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

Critical Load Case for Sliding along X-Direction : 92
Governing Disturbing Force : 26.535 kN

Governing Restoring Force :	214.830	kN
Minimum Sliding Ratio for the Critical Load Case :	8.096	
Critical Load Case for Overturning about X-Direction :	95	
Governing Overturning Moment :	-51.571	kNm
Governing Resisting Moment :	393.571	kNm
Minimum Overturning Ratio for the Critical Load Case :	7.632	

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

Critical Load Case for Sliding along Z-Direction :	95	
Governing Disturbing Force :	-27.175	kN
Governing Restoring Force :	171.121	kN
Minimum Sliding Ratio for the Critical Load Case :	6.297	
Critical Load Case for Overturning about Z-Direction :	92	
Governing Overturning Moment :	-50.384	kNm
Governing Resisting Moment :	494.099	kNm
Minimum Overturning Ratio for the Critical Load Case :	9.807	

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

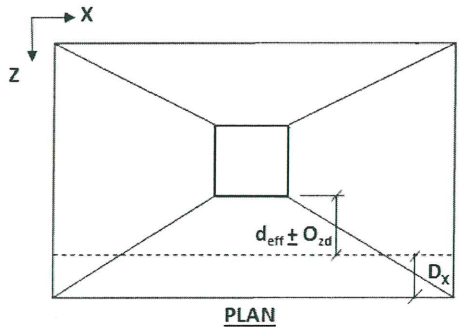
Critical Load Case	**= #64**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.394	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.144	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.637	m
Governing moment (M_u)		= 219.185	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 409.020726	kNm
$M_u <= M_{umax}$	hence, safe		

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

Critical Load Case	**= #64**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.394	m
Effective End Depth		= 0.144	m
Effective Width		= 0.637	m
Governing moment (M_u) =		= 247.829	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 409.020726	kNm
$M_u <= M_{umax}$	hence, safe		

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

(Shear Plane Parallel To X axis)



PLAN

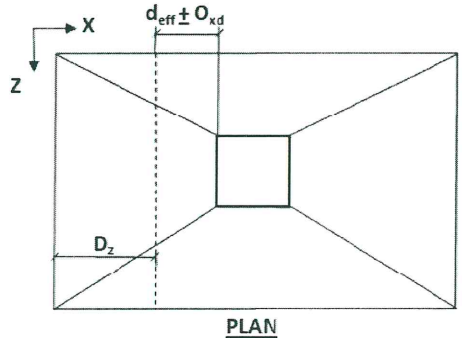
Critical Load Case = #63

D_X = 0.394 m

Shear Force(S)	= 343.631	kN
Shear Stress(T_v)	= 527.212416	kN/m2
Percentage Of Steel(P_t)	= 0.7755	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 593.847	kN/m2
$T_v < T_c$	hence, safe	

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

(Shear Plane Parallel To Z axis)



PLAN

Critical Load Case = #64

D_Z = 0.394 m

Shear Force(S)	= 307.036	kN
Shear Stress(T_v)	= 471.067140	kN/m2
Percentage Of Steel(P_t)	= 0.6768	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 562.381	kN/m2
$T_v < T_c$	hence, safe	

Check Trial Depth for two way shear

Critical Load Case	**= #63**		
Shear Force(S)		= 1097.747	kN
Shear Stress(T_v)		= 1010.172	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)=	$0.25\times\sqrt{f_{ck}}$	= 1369.3064	kN/m2
K_s X T_c		= 1369.3064	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) = 20 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b\times 0.87\times f_y}{4\times \Gamma_{bd}}$	= 0.736 m
Allowable Length(l_{db}) =	$\left[\frac{(B-b)}{2}-cc\right]$	= 0.900 m
l_{db} >=l_d	hence, safe	

Along Z Axis

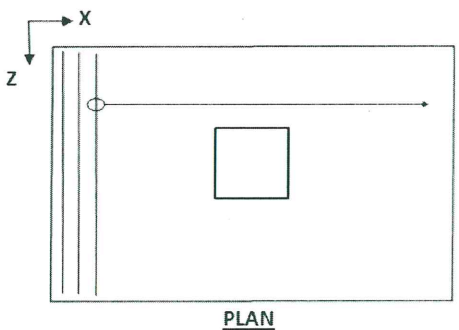
Bar diameter corresponding to max bar size(d_b) = 20 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b\times 0.87\times f_y}{4\times \Gamma_{bd}}$	= 0.736 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 = #64

Minimum Area of Steel (A_{stmin}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1699.999 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1699.999 mm2

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

Selected bar Size (d_b) = Ø12

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

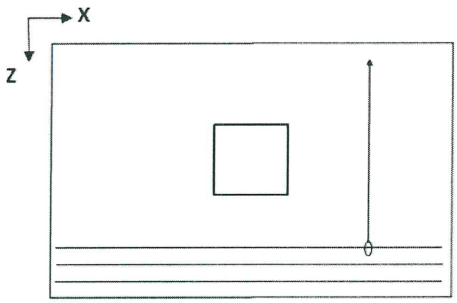
Selected spacing (S) = 145.867 mm

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 @ 145.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = #64

Minimum Area of Steel (A_{stmin}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1952.060 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1952.060 mm2

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

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 100.000 mm

Selected spacing (S) = 128.706 mm

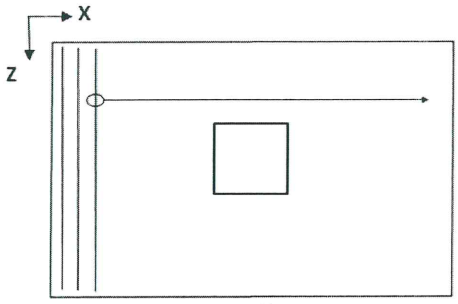
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 125.000 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}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1242.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1242.000 mm2

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

Selected bar Size (d_b) = Ø12

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

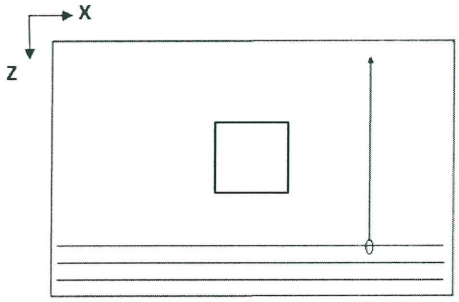
Selected spacing (S) = 218.800mm

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 @ 215 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}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1242.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1242.000 mm2

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

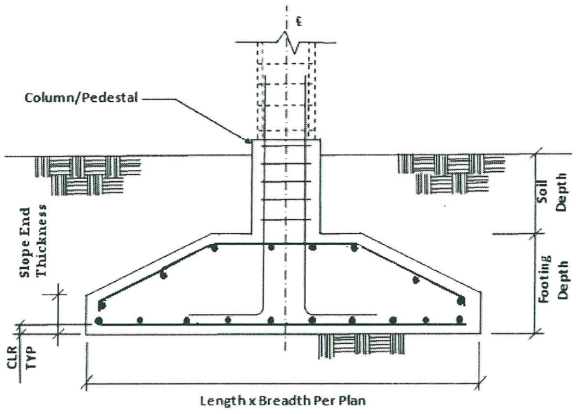
Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 100.000 mm
Selected spacing (S)	= 218.800 mm

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

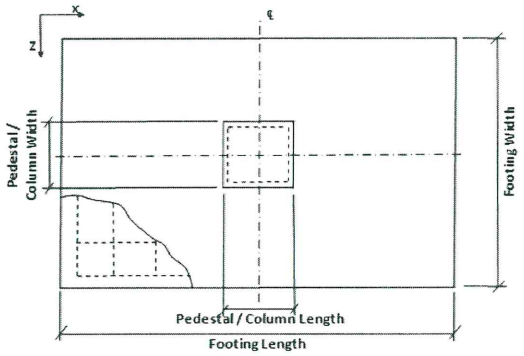
Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 215 mm o.c.

Isolated Footing 24



ELEVATION



PLAN

Input Values

Footing Geomtery

Design Type :	Set Dimension
Footing Thickness (Ft) :	450.000 mm
Slope End Thickness (St) :	200.000 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) :	0.400 m

Column Width - Z (Pw) : 0.400 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 : 30.000 N/mm2
Yield Strength of Steel : 415.000 N/mm2
Minimum Bar Size : Ø12
Maximum Bar Size : Ø32
Minimum Bar Spacing : 100.000 mm
Maximum Bar Spacing : 300.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : UnDrained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 200.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 0.000 mm
Undrained Shear Strength : 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**
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ

80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ
Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ
80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ
Load Combination/s- Strength Level	
Load Combination Number	**Load Combination Title**
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ

37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ
48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ
37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ

48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	712.362	0.893	4.162	2.617	-0.559
72	749.332	11.851	5.765	6.478	-16.977
73	710.908	13.303	-1.761	-3.988	-17.890
74	713.816	-11.517	10.086	9.221	16.772
75	675.392	-10.065	2.560	-1.244	15.860
76	781.729	1.978	16.058	19.648	-4.101
77	771.075	-5.032	17.354	20.471	6.024
78	653.649	6.818	-9.029	-15.237	-7.141
79	642.994	-0.193	-7.733	-14.414	2.984
80	678.095	11.762	5.349	6.216	-16.922
81	639.671	13.214	-2.178	-4.249	-17.834
82	642.580	-11.607	9.670	8.960	16.828
83	604.156	-10.155	2.144	-1.506	15.916
84	710.493	1.889	15.641	19.386	-4.045
85	699.839	-5.122	16.938	20.209	6.080
86	582.413	6.729	-9.446	-15.499	-7.085
87	571.758	-0.282	-8.149	-14.676	3.040
88	743.430	28.253	-0.668	-0.423	-39.514
89	830.847	-4.745	34.122	43.700	2.978
90	681.294	-26.467	8.993	5.657	38.397
91	593.876	6.530	-25.797	-38.466	-4.095
92	432.282	28.185	-2.045	-1.300	-39.468
93	519.700	-4.812	32.744	42.824	3.024
94	370.147	-26.535	7.615	4.781	38.444
95	282.729	6.463	-27.175	-39.343	-4.048

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	712.362	0.893	4.162	2.617	-0.559
72	749.332	11.851	5.765	6.478	-16.977
73	710.908	13.303	-1.761	-3.988	-17.890
74	713.816	-11.517	10.086	9.221	16.772
75	675.392	-10.065	2.560	-1.244	15.860
76	781.729	1.978	16.058	19.648	-4.101
77	771.075	-5.032	17.354	20.471	6.024
78	653.649	6.818	-9.029	-15.237	-7.141

79	642.994	-0.193	-7.733	-14.414	2.984
80	678.095	11.762	5.349	6.216	-16.922
81	639.671	13.214	-2.178	-4.249	-17.834
82	642.580	-11.607	9.670	8.960	16.828
83	604.156	-10.155	2.144	-1.506	15.916
84	710.493	1.889	15.641	19.386	-4.045
85	699.839	-5.122	16.938	20.209	6.080
86	582.413	6.729	-9.446	-15.499	-7.085
87	571.758	-0.282	-8.149	-14.676	3.040
88	743.430	28.253	-0.668	-0.423	-39.514
89	830.847	-4.745	34.122	43.700	2.978
90	681.294	-26.467	8.993	5.657	38.397
91	593.876	6.530	-25.797	-38.466	-4.095
92	432.282	28.185	-2.045	-1.300	-39.468
93	519.700	-4.812	32.744	42.824	3.024
94	370.147	-26.535	7.615	4.781	38.444
95	282.729	6.463	-27.175	-39.343	-4.048

Applied Loads - Strength Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
21	1068.543	1.339	6.244	3.925	-0.838
22	1123.998	17.777	8.647	9.716	-25.466
23	1066.361	19.955	-2.642	-5.982	-26.834
24	1070.724	-17.276	15.129	13.832	25.159
25	1013.088	-15.098	3.840	-1.866	23.791
26	1172.594	2.967	24.087	29.471	-6.151
27	1156.612	-7.548	26.031	30.706	9.036
28	980.473	10.227	-13.544	-22.856	-10.712
29	964.491	-0.289	-11.599	-21.621	4.476
30	899.198	14.222	6.918	7.773	-20.373
31	853.089	15.964	-2.114	-4.785	-21.467
32	856.579	-13.821	12.103	11.065	20.127
33	810.470	-12.079	3.072	-1.493	19.032
34	938.075	2.374	19.269	23.577	-4.921
35	925.290	-6.039	20.825	24.565	7.229
36	784.379	8.182	-10.835	-18.285	-8.569
37	771.593	-0.231	-9.280	-17.297	3.581
38	696.581	17.241	6.150	8.146	-25.131
39	638.944	19.419	-5.139	-7.552	-26.499
40	643.307	-17.812	12.632	12.262	25.494
41	585.671	-15.634	1.342	-3.436	24.126
42	745.177	2.432	21.589	27.901	-5.816
43	729.195	-8.084	23.534	29.136	9.371
44	553.056	9.691	-16.041	-24.426	-10.377
45	537.074	-0.824	-14.097	-23.191	4.811
46	645.620	14.220	6.076	7.185	-20.220
47	600.099	15.940	-2.840	-5.214	-21.300
48	603.545	-13.465	11.195	10.435	19.764
49	558.023	-11.745	2.279	-1.963	18.684
50	684.002	2.523	18.270	22.787	-4.965
51	671.380	-5.782	19.806	23.762	7.030
52	532.264	8.257	-11.451	-18.541	-8.567
53	519.641	-0.048	-9.915	-17.566	3.429
54	404.892	13.725	4.405	6.141	-19.913
55	359.370	15.445	-4.511	-6.258	-20.993
56	362.816	-13.960	9.524	9.391	20.071
57	317.294	-12.240	0.608	-3.008	18.991
58	443.274	2.028	16.599	21.743	-4.658
59	430.651	-6.277	18.135	22.718	7.338
60	291.535	7.762	-13.122	-19.585	-8.259
61	278.912	-0.543	-11.586	-18.610	3.736

62	1115.144	42.380	-1.002	-0.635	-59.271
63	1246.271	-7.117	51.183	65.550	4.467
64	1021.941	-39.701	13.489	8.485	57.596
65	890.815	9.796	-38.696	-57.700	-6.142
66	648.423	42.278	-3.068	-1.950	-59.202
67	779.550	-7.219	49.117	64.235	4.536
68	555.220	-39.803	11.423	7.171	57.665
69	424.094	9.694	-40.762	-59.014	-6.072
Applied Loads - Strength Level					
LC	**Axial (kN)**	**Shear X (kN)**	**Shear Z (kN)**	**Moment X (kNm)**	**Moment Z (kNm)**
21	1068.543	1.339	6.244	3.925	-0.838
22	1123.998	17.777	8.647	9.716	-25.466
23	1066.361	19.955	-2.642	-5.982	-26.834
24	1070.724	-17.276	15.129	13.832	25.159
25	1013.088	-15.098	3.840	-1.866	23.791
26	1172.594	2.967	24.087	29.471	-6.151
27	1156.612	-7.548	26.031	30.706	9.036
28	980.473	10.227	-13.544	-22.856	-10.712
29	964.491	-0.289	-11.599	-21.621	4.476
30	899.198	14.222	6.918	7.773	-20.373
31	853.089	15.964	-2.114	-4.785	-21.467
32	856.579	-13.821	12.103	11.065	20.127
33	810.470	-12.079	3.072	-1.493	19.032
34	938.075	2.374	19.269	23.577	-4.921
35	925.290	-6.039	20.825	24.565	7.229
36	784.379	8.182	-10.835	-18.285	-8.569
37	771.593	-0.231	-9.280	-17.297	3.581
38	696.581	17.241	6.150	8.146	-25.131
39	638.944	19.419	-5.139	-7.552	-26.499
40	643.307	-17.812	12.632	12.262	25.494
41	585.671	-15.634	1.342	-3.436	24.126
42	745.177	2.432	21.589	27.901	-5.816
43	729.195	-8.084	23.534	29.136	9.371
44	553.056	9.691	-16.041	-24.426	-10.377
45	537.074	-0.824	-14.097	-23.191	4.811
46	645.620	14.220	6.076	7.185	-20.220
47	600.099	15.940	-2.840	-5.214	-21.300
48	603.545	-13.465	11.195	10.435	19.764
49	558.023	-11.745	2.279	-1.963	18.684
50	684.002	2.523	18.270	22.787	-4.965
51	671.380	-5.782	19.806	23.762	7.030
52	532.264	8.257	-11.451	-18.541	-8.567
53	519.641	-0.048	-9.915	-17.566	3.429
54	404.892	13.725	4.405	6.141	-19.913
55	359.370	15.445	-4.511	-6.258	-20.993
56	362.816	-13.960	9.524	9.391	20.071
57	317.294	-12.240	0.608	-3.008	18.991
58	443.274	2.028	16.599	21.743	-4.658
59	430.651	-6.277	18.135	22.718	7.338
60	291.535	7.762	-13.122	-19.585	-8.259
61	278.912	-0.543	-11.586	-18.610	3.736
62	1115.144	42.380	-1.002	-0.635	-59.271
63	1246.271	-7.117	51.183	65.550	4.467
64	1021.941	-39.701	13.489	8.485	57.596
65	890.815	9.796	-38.696	-57.700	-6.142
66	648.423	42.278	-3.068	-1.950	-59.202
67	779.550	-7.219	49.117	64.235	4.536
68	555.220	-39.803	11.423	7.171	57.665
69	424.094	9.694	-40.762	-59.014	-6.072

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, $A_{min} = P / q_{max}$ = 4.195 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.

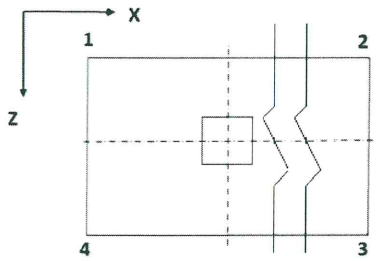
Final dimensions for design

Length (L_2) = 2.300 m Governing Load Case : # 89

Width (W_2) = 2.300 m Governing Load Case : # 89

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)
90	**156.3213**	106.7036	116.2741	165.8918	0.000
88	122.6446	**174.1566**	173.4425	121.9305	0.000
89	137.9675	132.9248	**191.1698**	196.2124	0.000
89	137.9675	132.9248	191.1698	**196.2124**	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)
90	**156.3213**	106.7036	116.2741	165.8918
88	122.6446	**174.1566**	173.4425	121.9305
89	137.9675	132.9248	**191.1698**	196.2124
89	137.9675	132.9248	191.1698	**196.2124**

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
71	432.232	92.721	197.704	924.290
72	34.125	70.154	102.533	41.691
73	28.956	218.703	185.334	37.107
74	33.572	38.337	64.631	40.506
75	36.506	143.540	9158.824	41.448
76	212.618	26.194	35.999	193.826
77	82.525	23.931	33.775	115.238
78	52.299	39.491	42.492	80.331
79	1824.644	45.423	45.148	263.111
80	31.356	68.954	98.371	38.184
81	26.456	160.542	153.756	33.812
82	30.245	36.303	60.656	36.614
83	32.678	154.796	1410.080	37.255
84	203.813	24.614	33.510	180.893
85	74.132	22.416	31.377	104.148
86	47.700	33.980	37.378	72.994
87	1120.090	38.732	39.576	229.260
88	14.210	601.006	1275.350	17.680
89	93.830	13.047	17.338	200.264
90	13.995	41.189	87.794	16.934
91	50.027	12.664	15.005	106.830
92	8.724	120.218	254.740	10.845
93	60.179	8.844	11.572	128.345
94	8.096	28.210	60.202	9.807
95	26.479	6.297	7.632	56.577

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

Critical Load Case for Sliding along X-Direction : 94
Governing Disturbing Force : -26.535 kN

Governing Restoring Force :	214.830	kN
Minimum Sliding Ratio for the Critical Load Case :	8.096	
Critical Load Case for Overturning about X-Direction :	95	
Governing Overturning Moment :	-51.571	kNm
Governing Resisting Moment :	393.571	kNm
Minimum Overturning Ratio for the Critical Load Case :	7.632	

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

Critical Load Case for Sliding along Z-Direction :	95	
Governing Disturbing Force :	-27.175	kN
Governing Restoring Force :	171.121	kN
Minimum Sliding Ratio for the Critical Load Case :	6.297	
Critical Load Case for Overturning about Z-Direction :	94	
Governing Overturning Moment :	50.384	kNm
Governing Resisting Moment :	494.099	kNm
Minimum Overturning Ratio for the Critical Load Case :	9.807	

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

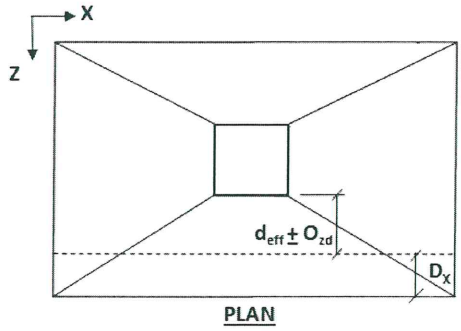
Critical Load Case	**= #63**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.394	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.144	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.637	m
Governing moment (M_u)		= 277.391	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 409.020726	kNm
$M_u <= M_{umax}$	hence, safe		

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

Critical Load Case	**= #63**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.394	m
Effective End Depth		= 0.144	m
Effective Width		= 0.637	m
Governing moment (M_u) =		= 247.352	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 409.020726	kNm
$M_u <= M_{umax}$	hence, safe		

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

(Shear Plane Parallel To X axis)



PLAN

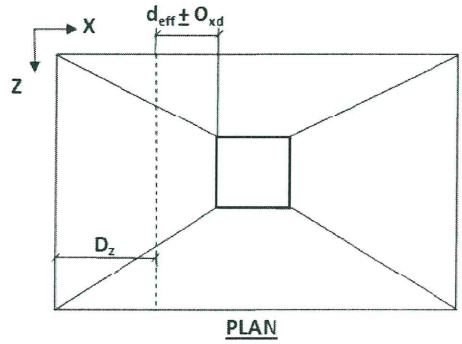
Critical Load Case = #63

D_X = 0.394 m

Shear Force(S)	= 343.631	kN
Shear Stress(T_v)	= 527.212457	kN/m2
Percentage Of Steel(P_t)	= 0.7755	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 593.843	kN/m2
$T_v < T_c$	hence, safe	

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

(Shear Plane Parallel To Z axis)



PLAN

Critical Load Case = #62

D_Z = 0.394 m

Shear Force(S)	= 307.036	kN
Shear Stress(T_v)	= 471.067140	kN/m2
Percentage Of Steel(P_t)	= 0.6768	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 562.381	kN/m2
$T_v < T_c$	hence, safe	

Check Trial Depth for two way shear

Critical Load Case	**= #63**		
Shear Force(S)		= 1097.747	kN
Shear Stress(T_v)		= 1010.172	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)=	$0.25\times\sqrt{f_{ck}}$	= 1369.3064	kN/m2
K_s X T_c		= 1369.3064	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) = 20 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b\times 0.87\times f_y}{4\times\Gamma_{bd}}$	= 0.736 m
Allowable Length(l_{db}) =	$\left[\frac{(B-b)}{2}-cc\right]$	= 0.900 m
$l_{db} >= l_d$	hence, safe	

Along Z Axis

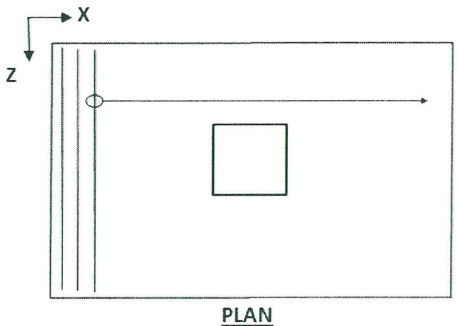
Bar diameter corresponding to max bar size(d_b) = 20 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b\times 0.87\times f_y}{4\times\Gamma_{bd}}$	= 0.736 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 = #63

Minimum Area of Steel (A_{stmin}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 2221.901 mm2

Provided Area of Steel ($A_{st,Provided}$) = 2221.901 mm2

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

Selected bar Size (d_b) = Ø12

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

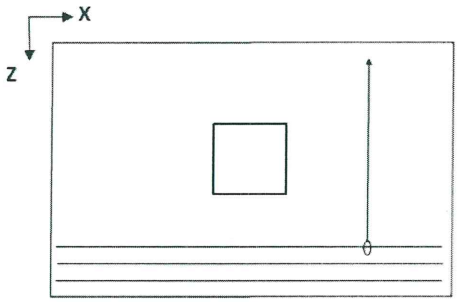
Selected spacing (S) = 115.158 mm

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 @ 115.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = #63

Minimum Area of Steel (A_{stmin}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1947.788 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1947.788 mm2

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

Selected bar Size (d_b) = Ø12

Minimum spacing allowed (S_{min}) = 100.000 mm

Selected spacing (S) = 128.706 mm

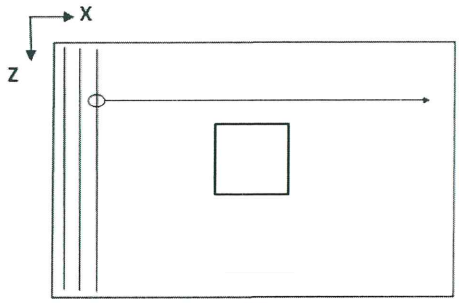
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø12 @ 125.000 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}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1242.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1242.000 mm2

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

Selected bar Size (d_b) = Ø12

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

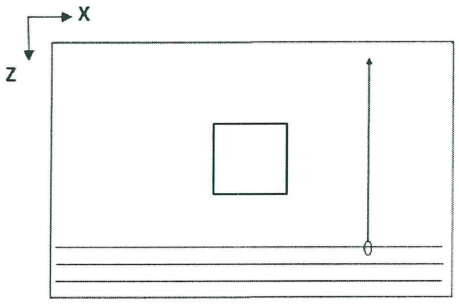
Selected spacing (S) = 218.800mm

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 @ 215 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}) = 1242.000 mm2

Calculated Area of Steel (A_{st}) = 1242.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1242.000 mm2

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

Selected bar Size (d_b)	= Ø12
Minimum spacing allowed (S_{min})	= 100.000 mm
Selected spacing (S)	= 218.800 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 @ 215 mm o.c.

Print Calculation Sheet

Isolated Footing Design (IS 456-2000)

Design For Isolated Sloped Footing 16

Design For Isolated Sloped Footing 17

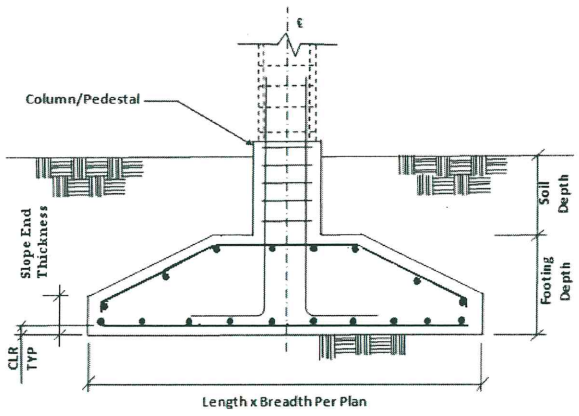
Design For Isolated Sloped Footing 20

Design For Isolated Sloped Footing 21

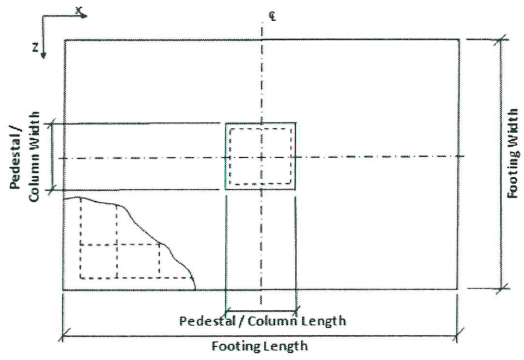
Footing No.	Group ID	Foundation Geometry			
-	-	Length	Width	Thickness	Slope End Thickness
16	1	2.700 m	2.700 m	0.500 m	0.200 m
17	2	2.700 m	2.700 m	0.500 m	0.200 m
20	3	2.700 m	2.700 m	0.500 m	0.200 m
21	4	2.700 m	2.700 m	0.500 m	0.200 m

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
16	Ø16 @ 170 mm c/c	Ø16 @ 150 mm c/c	Ø16 @ 300 mm c/c	Ø16 @ 300 mm c/c	N/A	N/A
17	Ø16 @ 170 mm c/c	Ø16 @ 150 mm c/c	Ø16 @ 300 mm c/c	Ø16 @ 300 mm c/c	N/A	N/A
20	Ø16 @ 160 mm c/c	Ø16 @ 140 mm c/c	Ø16 @ 300 mm c/c	Ø16 @ 300 mm c/c	N/A	N/A
21	Ø16 @ 160 mm c/c	Ø16 @ 140 mm c/c	Ø16 @ 300 mm c/c	Ø16 @ 300 mm c/c	N/A	N/A

Isolated Footing 16



ELEVATION



PLAN

Input Values

Footing Geomtery

Design Type : Set Dimension

Footing Thickness (Ft) : 450.000 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) : 0.400 m
Column Width - Z (Pw) : 0.400 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 : 30.000 N/mm2
Yield Strength of Steel : 415.000 N/mm2
Minimum Bar Size : Ø16
Maximum Bar Size : Ø16
Minimum Bar Spacing : 100.000 mm
Maximum Bar Spacing : 300.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : UnDrained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 200.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 0.000 mm
Undrained Shear Strength : 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
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ
80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ
Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ
80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ
Load Combination/s- Strength Level	
Load Combination Number	**Load Combination Title**
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ

26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ
37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ
48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ

37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ
48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	1213.887	-2.199	-2.221	-1.399	1.384
72	1235.620	12.873	2.451	4.402	-17.651
73	1225.589	12.773	-6.562	-7.001	-17.592
74	1202.185	-17.172	2.120	4.204	20.360
75	1192.155	-17.271	-6.894	-7.200	20.419
76	1235.620	2.473	12.851	17.636	-4.417
77	1225.589	-6.540	12.751	17.577	6.986
78	1202.185	2.142	-17.194	-20.374	-4.219
79	1192.155	-6.872	-17.293	-20.434	7.185
80	1114.231	13.092	2.673	4.542	-17.789
81	1104.200	12.993	-6.340	-6.861	-17.730
82	1080.797	-16.952	2.342	4.344	20.221
83	1070.767	-17.051	-6.671	-7.060	20.281
84	1114.231	2.693	13.073	17.776	-4.555
85	1104.200	-6.320	12.973	17.717	6.848
86	1080.797	2.362	-16.972	-20.235	-4.357
87	1070.767	-6.652	-17.071	-20.294	7.046
88	1245.382	32.685	-1.759	-1.109	-42.331
89	1246.200	-1.729	33.399	43.246	1.089
90	1182.393	-37.084	-2.683	-1.689	45.098
91	1181.575	-2.669	-37.841	-46.044	1.679
92	565.756	33.962	-0.467	-0.290	-43.139
93	566.575	-0.453	34.691	44.065	0.281
94	502.768	-35.808	-1.390	-0.869	44.290
95	501.950	-1.393	-36.548	-45.224	0.870

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	1213.887	-2.199	-2.221	-1.399	1.384
72	1235.620	12.873	2.451	4.402	-17.651
73	1225.589	12.773	-6.562	-7.001	-17.592
74	1202.185	-17.172	2.120	4.204	20.360
75	1192.155	-17.271	-6.894	-7.200	20.419
76	1235.620	2.473	12.851	17.636	-4.417
77	1225.589	-6.540	12.751	17.577	6.986
78	1202.185	2.142	-17.194	-20.374	-4.219
79	1192.155	-6.872	-17.293	-20.434	7.185
80	1114.231	13.092	2.673	4.542	-17.789
81	1104.200	12.993	-6.340	-6.861	-17.730
82	1080.797	-16.952	2.342	4.344	20.221
83	1070.767	-17.051	-6.671	-7.060	20.281
84	1114.231	2.693	13.073	17.776	-4.555
85	1104.200	-6.320	12.973	17.717	6.848
86	1080.797	2.362	-16.972	-20.235	-4.357
87	1070.767	-6.652	-17.071	-20.294	7.046
88	1245.382	32.685	-1.759	-1.109	-42.331
89	1246.200	-1.729	33.399	43.246	1.089
90	1182.393	-37.084	-2.683	-1.689	45.098
91	1181.575	-2.669	-37.841	-46.044	1.679
92	565.756	33.962	-0.467	-0.290	-43.139
93	566.575	-0.453	34.691	44.065	0.281
94	502.768	-35.808	-1.390	-0.869	44.290
95	501.950	-1.393	-36.548	-45.224	0.870

Applied Loads - Strength Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
21	1820.831	-3.299	-3.332	-2.098	2.076
22	1853.429	19.309	3.676	6.603	-26.477
23	1838.384	19.160	-9.843	-10.502	-26.387
24	1803.278	-25.758	3.180	6.305	30.539
25	1788.233	-25.907	-10.340	-10.799	30.629
26	1853.429	3.709	19.276	26.454	-6.625
27	1838.384	-9.810	19.127	26.365	10.480
28	1803.278	3.213	-25.791	-30.562	-6.328
29	1788.233	-10.307	-25.940	-30.651	10.777
30	1482.743	15.447	2.941	5.282	-21.181
31	1470.707	15.328	-7.875	-8.402	-21.110
32	1442.623	-20.606	2.544	5.044	24.431
33	1430.586	-20.725	-8.272	-8.639	24.503
34	1482.743	2.968	15.421	21.163	-5.300
35	1470.707	-7.848	15.301	21.092	8.384
36	1442.623	2.570	-20.632	-24.449	-5.062
37	1430.586	-8.246	-20.752	-24.521	8.622
38	1125.097	20.628	5.009	7.442	-27.307
39	1110.051	20.479	-8.511	-9.663	-27.218
40	1074.946	-24.438	4.512	7.145	29.709
41	1059.900	-24.587	-9.008	-9.960	29.798
42	1125.097	5.029	20.609	27.294	-7.455
43	1110.051	-8.491	20.459	27.204	9.649
44	1074.946	4.532	-24.458	-29.722	-7.158
45	1059.900	-8.988	-24.607	-29.812	9.947
46	827.140	16.471	4.142	6.003	-21.688
47	815.257	16.354	-6.536	-7.507	-21.617
48	787.530	-19.122	3.750	5.768	23.344
49	775.647	-19.240	-6.928	-7.741	23.415
50	827.140	4.151	16.463	21.682	-6.009
51	815.257	-6.527	16.345	21.611	7.501

52	787.530	3.758	-19.131	-23.350	-5.774
53	775.647	-6.920	-19.249	-23.420	7.736
54	506.582	17.025	4.700	6.351	-22.033
55	494.699	16.907	-5.979	-7.159	-21.963
56	466.973	-18.569	4.307	6.116	22.999
57	455.090	-18.686	-6.371	-7.394	23.069
58	506.582	4.705	17.020	22.030	-6.354
59	494.699	-5.974	16.902	21.959	7.155
60	466.973	4.312	-18.574	-23.002	-6.119
61	455.090	-6.366	-18.691	-23.073	7.390
62	1868.072	49.028	-2.639	-1.664	-63.496
63	1869.299	-2.594	50.098	64.869	1.634
64	1773.590	-55.626	-4.025	-2.533	67.648
65	1772.363	-4.004	-56.762	-69.065	2.518
66	848.635	50.942	-0.700	-0.435	-64.708
67	849.862	-0.679	52.037	66.098	0.422
68	754.152	-53.711	-2.086	-1.304	66.435
69	752.925	-2.090	-54.823	-67.836	1.305

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
21	1820.831	-3.299	-3.332	-2.098	2.076
22	1853.429	19.309	3.676	6.603	-26.477
23	1838.384	19.160	-9.843	-10.502	-26.387
24	1803.278	-25.758	3.180	6.305	30.539
25	1788.233	-25.907	-10.340	-10.799	30.629
26	1853.429	3.709	19.276	26.454	-6.625
27	1838.384	-9.810	19.127	26.365	10.480
28	1803.278	3.213	-25.791	-30.562	-6.328
29	1788.233	-10.307	-25.940	-30.651	10.777
30	1482.743	15.447	2.941	5.282	-21.181
31	1470.707	15.328	-7.875	-8.402	-21.110
32	1442.623	-20.606	2.544	5.044	24.431
33	1430.586	-20.725	-8.272	-8.639	24.503
34	1482.743	2.968	15.421	21.163	-5.300
35	1470.707	-7.848	15.301	21.092	8.384
36	1442.623	2.570	-20.632	-24.449	-5.062
37	1430.586	-8.246	-20.752	-24.521	8.622
38	1125.097	20.628	5.009	7.442	-27.307
39	1110.051	20.479	-8.511	-9.663	-27.218
40	1074.946	-24.438	4.512	7.145	29.709
41	1059.900	-24.587	-9.008	-9.960	29.798
42	1125.097	5.029	20.609	27.294	-7.455
43	1110.051	-8.491	20.459	27.204	9.649
44	1074.946	4.532	-24.458	-29.722	-7.158
45	1059.900	-8.988	-24.607	-29.812	9.947
46	827.140	16.471	4.142	6.003	-21.688
47	815.257	16.354	-6.536	-7.507	-21.617
48	787.530	-19.122	3.750	5.768	23.344
49	775.647	-19.240	-6.928	-7.741	23.415
50	827.140	4.151	16.463	21.682	-6.009
51	815.257	-6.527	16.345	21.611	7.501
52	787.530	3.758	-19.131	-23.350	-5.774
53	775.647	-6.920	-19.249	-23.420	7.736
54	506.582	17.025	4.700	6.351	-22.033
55	494.699	16.907	-5.979	-7.159	-21.963
56	466.973	-18.569	4.307	6.116	22.999
57	455.090	-18.686	-6.371	-7.394	23.069
58	506.582	4.705	17.020	22.030	-6.354
59	494.699	-5.974	16.902	21.959	7.155
60	466.973	4.312	-18.574	-23.002	-6.119
61	455.090	-6.366	-18.691	-23.073	7.390
62	1868.072	49.028	-2.639	-1.664	-63.496

63	1869.299	-2.594	50.098	64.869	1.634
64	1773.590	-55.626	-4.025	-2.533	67.648
65	1772.363	-4.004	-56.762	-69.065	2.518
66	848.635	50.942	-0.700	-0.435	-64.708
67	849.862	-0.679	52.037	66.098	0.422
68	754.152	-53.711	-2.086	-1.304	66.435
69	752.925	-2.090	-54.823	-67.836	1.305

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, $A_{min} = P / q_{max}$ = 6.269 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.

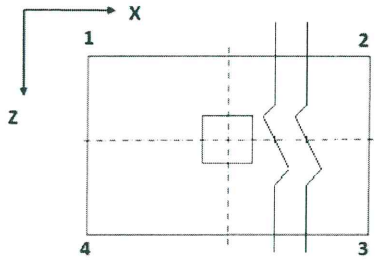
Final dimensions for design

Length (L_2) = 2.700 m Governing Load Case : # 88

Width (W_2) = 2.700 m Governing Load Case : # 88

Area (A_2) = 7.290 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)
91	**188.8614**	187.1057	148.6523	150.4081	0.000
88	160.7014	**195.4764**	194.3175	159.5425	0.000
89	160.4266	159.2880	**194.8168**	195.9554	0.000
89	160.4266	159.2880	194.8168	**195.9554**	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)
91	**188.8614**	187.1057	148.6523	150.4081
88	160.7014	**195.4764**	194.3175	159.5425
89	160.4266	159.2880	**194.8168**	195.9554
89	160.4266	159.2880	194.8168	**195.9554**

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

Governing load case = N/A
Plan area of footing = 7.290 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 = 7.290 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
71	294.620	291.698	729.406	737.025
72	51.180	268.801	323.136	75.875
73	51.186	99.629	177.332	75.633
74	37.393	302.916	336.139	61.724
75	36.887	92.417	166.974	61.016
76	266.407	51.268	75.955	321.687
77	99.965	51.274	75.713	177.775
78	299.801	37.345	61.670	334.531
79	92.714	36.840	60.962	167.377
80	45.684	223.758	281.118	68.194
81	45.648	93.547	164.842	67.921
82	34.298	248.266	290.840	56.366
83	33.804	86.397	154.667	55.672
84	222.111	45.754	68.258	280.030
85	93.840	45.718	67.985	165.221
86	246.183	34.257	56.321	289.643
87	86.654	33.764	55.627	155.011
88	20.306	377.240	942.730	31.416
89	384.050	19.884	30.769	960.128
90	17.048	235.611	589.392	27.626
91	236.686	16.696	27.046	592.344
92	9.537	694.171	1750.120	14.968

93	716.039	9.348	14.672	1805.710
94	8.166	210.280	528.082	13.069
95	209.604	7.989	12.783	526.560

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

Critical Load Case for Sliding along X-Direction :	94	
Governing Disturbing Force :	-35.808	kN
Governing Restoring Force :	292.390	kN
Minimum Sliding Ratio for the Critical Load Case :	8.166	
Critical Load Case for Overturning about X-Direction :	95	
Governing Overturning Moment :	-61.671	kNm
Governing Resisting Moment :	788.335	kNm
Minimum Overturning Ratio for the Critical Load Case :	12.783	

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

Critical Load Case for Sliding along Z-Direction :	95	
Governing Disturbing Force :	-36.548	kN
Governing Restoring Force :	291.981	kN
Minimum Sliding Ratio for the Critical Load Case :	7.989	
Critical Load Case for Overturning about Z-Direction :	94	
Governing Overturning Moment :	60.403	kNm
Governing Resisting Moment :	789.439	kNm
Minimum Overturning Ratio for the Critical Load Case :	13.069	

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

Critical Load Case	**= #65**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.442	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.142	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.687	m
Governing moment (M_u)		= 470.914	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 555.123952	kNm
$M_u <= M_{umax}$	hence, safe		

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

Critical Load Case	**= #65**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.442	m
Effective End Depth		= 0.142	m
Effective Width		= 0.687	m
Governing moment (M_u) =		= 435.740	kNm

As Per IS 456 2000 ANNEX G G-1.1C

Limiting Factor1 (K_{umax}) = $\frac{700}{(1100 + 0.87 \times f_y)}$ = 0.479107

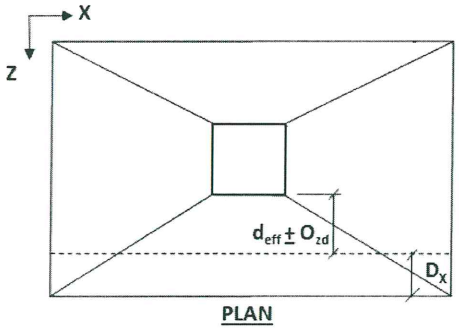
Limiting Factor2 (R_{umax}) = $0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$ = 4133.149375 kN/m2

Limit Moment Of Resistance (M_{umax}) = $R_{umax} \times B \times d_e^2$ = 555.123952 kNm

$M_u <= M_{umax}$ hence, safe

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

(Shear Plane Parallel To X axis)



PLAN

Critical Load Case = #63

D_X = 0.442 m

Shear Force(S) = 527.753 kN

Shear Stress(T_v) = 650.331460 kN/m2

Percentage Of Steel(P_t) = 1.1198

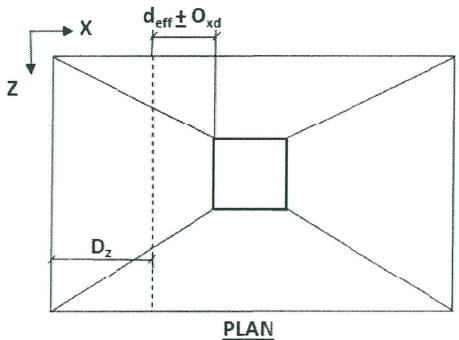
As Per IS 456 2000 Clause 40 Table 19

Shear Strength Of Concrete(T_c) = 684.622 kN/m2

$T_v < T_c$ hence, safe

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

(Shear Plane Parallel To Z axis)



PLAN

Critical Load Case = #62

D_Z = 0.442 m

Shear Force(S)		= 526.634	kN
Shear Stress(T_v)		= 648.952467	kN/m2
Percentage Of Steel(P_t)		= 1.1189	
As Per IS 456 2000 Clause 40 Table 19			
Shear Strength Of Concrete(T_c)		= 684.429	kN/m2
$T_v < T_c$	hence, safe		

Check Trial Depth for two way shear

Critical Load Case	**= #63**		
Shear Force(S)		= 1687.507	kN
Shear Stress(T_v)		= 1303.616	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)=	$0.25\times\sqrt{f_{ck}}$	= 1369.3064	kN/m2
K_s X T_c		= 1369.3064	kN/m2
$T_v <= K_s$ X T_c	hence, safe		

Calculation of Maximum Bar Size

Along X Axis

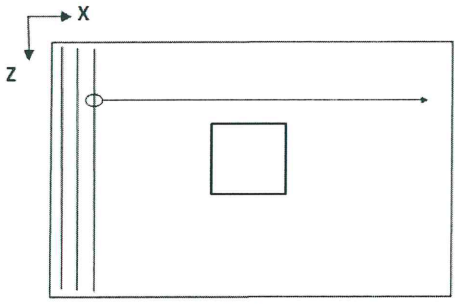
Bar diameter corresponding to max bar size (d_b)		= 16	mm
As Per IS 456 2000 Clause 26.2.1			
Development Length(l_d) =	$\frac{d_b\times 0.87\times f_y}{4\times\tau_{bd}}$	= 0.589	m
Allowable Length(l_{db}) =	$\left[\frac{(B-b)}{2}-cc\right]$	= 1.100	m
$l_{db} >= l_d$	hence, safe		

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) =	$\frac{d_b\times 0.87\times f_y}{4\times\tau_{bd}}$	= 0.589	m
Allowable Length(l_{db}) =	$\left[\frac{(H-h)}{2}-cc\right]$	= 1.100	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 = #65

Minimum Area of Steel (A_{stmin}) = 1620.000 mm2

Calculated Area of Steel (A_{st}) = 3512.628 mm2

Provided Area of Steel ($A_{st,Provided}$) = 3512.628 mm2

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

Selected bar Size (d_b) = Ø16

Minimum spacing allowed (S_{min}) = 56.000 mm

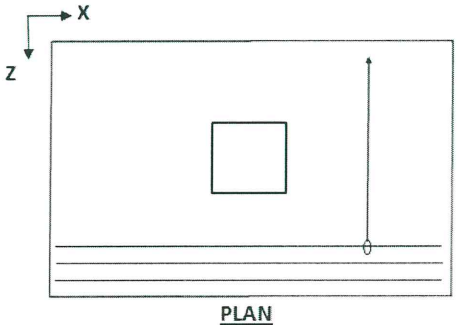
Selected spacing (S) = 152.000 mm

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

Ø16 @ 150.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = #65

Minimum Area of Steel (A_{stmin}) = 1620.000 mm2

Calculated Area of Steel (A_{st}) = 3195.315 mm2

Provided Area of Steel ($A_{st,Provided}$) = 3195.315 mm2

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

Selected bar Size (d_b) = Ø16

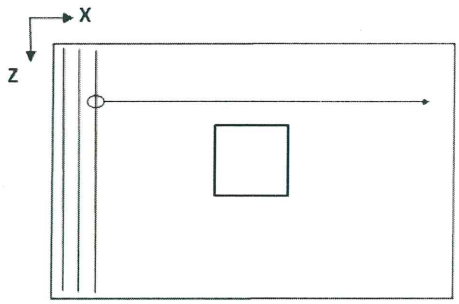
Minimum spacing allowed (S_{min})	= 100.000 mm
Selected spacing (S)	= 172.267 mm
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size...	The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø16 @ 170.000 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

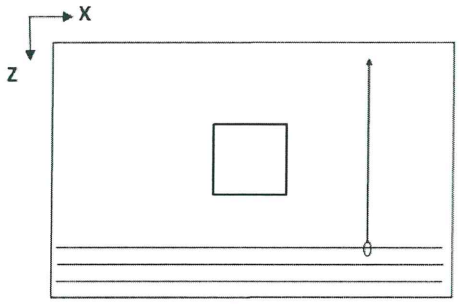
Minimum Area of Steel (A_{stmin})	= 1620.000	mm2
Calculated Area of Steel (A_{st})	= 1458.000	mm2
Provided Area of Steel ($A_{st,Provided}$)	= 1620.000	mm2
A_{stmin} <= $A_{st,Provided}$	Steel area is accepted	

Selected bar Size (d_b)	= Ø16
Minimum spacing allowed (S_{min})	= 56.000 mm
Selected spacing (S)	= 300.000mm
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

Ø16 @ 300 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}) = 1620.000 mm2

Calculated Area of Steel (A_{st}) = 1458.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1620.000 mm2

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

Selected bar Size (d_b) = Ø16

Minimum spacing allowed (S_{min}) = 100.000 mm

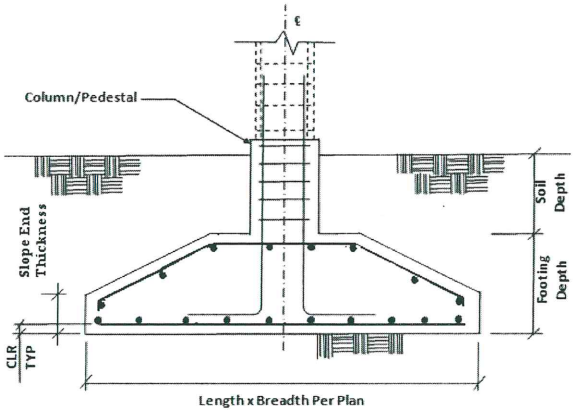
Selected spacing (S) = 300.000 mm

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

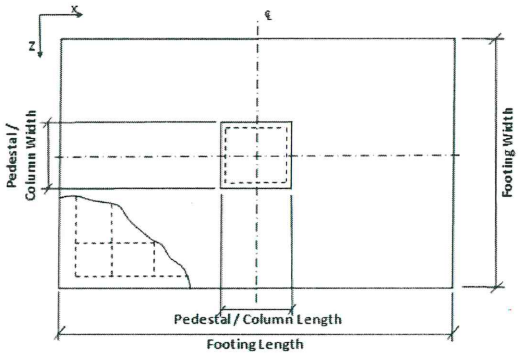
Based on spacing reinforcement increment; provided reinforcement is

Ø16 @ 300 mm o.c.

Isolated Footing 17



ELEVATION



PLAN

Input Values

Footing Geomtery

Design Type : Set Dimension
Footing Thickness (Ft) : 450.000 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) : 0.400 m
Column Width - Z (Pw) : 0.400 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 : 30.000 N/mm2
Yield Strength of Steel : 415.000 N/mm2
Minimum Bar Size : Ø16
Maximum Bar Size : Ø16
Minimum Bar Spacing : 100.000 mm
Maximum Bar Spacing : 300.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : UnDrained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 200.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 0.000 mm
Undrained Shear Strength : 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**
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ
80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ

92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ

Load Combination/s- Service Stress Level

Load Combination Number	Load Combination Title
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ
80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ
37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ
48	1.5DL-1.5EQX+0.45EQZ

49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ
37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ
48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ

60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	1213.887	2.199	-2.221	-1.399	-1.384
72	1202.185	17.172	2.120	4.204	-20.360
73	1192.155	17.271	-6.894	-7.200	-20.419
74	1235.620	-12.873	2.451	4.402	17.651
75	1225.589	-12.773	-6.562	-7.001	17.592
76	1225.589	6.540	12.751	17.577	-6.986
77	1235.620	-2.473	12.851	17.636	4.417
78	1192.155	6.872	-17.293	-20.434	-7.185
79	1202.185	-2.142	-17.194	-20.374	4.219
80	1080.797	16.952	2.342	4.344	-20.221
81	1070.766	17.051	-6.671	-7.060	-20.281
82	1114.231	-13.092	2.673	4.542	17.789
83	1104.200	-12.993	-6.340	-6.861	17.730
84	1104.200	6.320	12.973	17.717	-6.848
85	1114.231	-2.693	13.073	17.776	4.555
86	1070.766	6.652	-17.071	-20.294	-7.046
87	1080.797	-2.362	-16.972	-20.235	4.357
88	1182.393	37.084	-2.683	-1.689	-45.098
89	1246.200	1.729	33.399	43.246	-1.089
90	1245.382	-32.685	-1.759	-1.109	42.331
91	1181.575	2.669	-37.841	-46.044	-1.679
92	502.768	35.808	-1.390	-0.869	-44.290
93	566.575	0.453	34.691	44.065	-0.281
94	565.756	-33.962	-0.467	-0.290	43.139
95	501.950	1.393	-36.548	-45.224	-0.870

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	1213.887	2.199	-2.221	-1.399	-1.384
72	1202.185	17.172	2.120	4.204	-20.360
73	1192.155	17.271	-6.894	-7.200	-20.419
74	1235.620	-12.873	2.451	4.402	17.651
75	1225.589	-12.773	-6.562	-7.001	17.592
76	1225.589	6.540	12.751	17.577	-6.986
77	1235.620	-2.473	12.851	17.636	4.417
78	1192.155	6.872	-17.293	-20.434	-7.185
79	1202.185	-2.142	-17.194	-20.374	4.219
80	1080.797	16.952	2.342	4.344	-20.221
81	1070.766	17.051	-6.671	-7.060	-20.281
82	1114.231	-13.092	2.673	4.542	17.789
83	1104.200	-12.993	-6.340	-6.861	17.730
84	1104.200	6.320	12.973	17.717	-6.848
85	1114.231	-2.693	13.073	17.776	4.555
86	1070.766	6.652	-17.071	-20.294	-7.046
87	1080.797	-2.362	-16.972	-20.235	4.357
88	1182.393	37.084	-2.683	-1.689	-45.098
89	1246.200	1.729	33.399	43.246	-1.089
90	1245.382	-32.685	-1.759	-1.109	42.331

91	1181.575	2.669	-37.841	-46.044	-1.679
92	502.768	35.808	-1.390	-0.869	-44.290
93	566.575	0.453	34.691	44.065	-0.281
94	565.756	-33.962	-0.467	-0.290	43.139
95	501.950	1.393	-36.548	-45.224	-0.870

Applied Loads - Strength Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
21	1820.831	3.299	-3.332	-2.098	-2.076
22	1803.278	25.758	3.180	6.305	-30.539
23	1788.233	25.907	-10.340	-10.799	-30.629
24	1853.429	-19.309	3.676	6.603	26.477
25	1838.384	-19.160	-9.843	-10.502	26.387
26	1838.384	9.810	19.127	26.365	-10.480
27	1853.429	-3.709	19.276	26.454	6.625
28	1788.233	10.307	-25.940	-30.651	-10.777
29	1803.278	-3.213	-25.791	-30.562	6.328
30	1442.623	20.606	2.544	5.044	-24.431
31	1430.586	20.725	-8.272	-8.639	-24.503
32	1482.743	-15.447	2.941	5.282	21.181
33	1470.707	-15.328	-7.875	-8.402	21.110
34	1470.707	7.848	15.301	21.092	-8.384
35	1482.743	-2.968	15.421	21.163	5.300
36	1430.586	8.246	-20.752	-24.521	-8.622
37	1442.623	-2.570	-20.632	-24.449	5.062
38	1074.946	24.438	4.512	7.145	-29.709
39	1059.900	24.587	-9.008	-9.960	-29.798
40	1125.097	-20.628	5.009	7.442	27.307
41	1110.051	-20.479	-8.511	-9.663	27.218
42	1110.051	8.491	20.459	27.204	-9.649
43	1125.097	-5.029	20.609	27.294	7.455
44	1059.900	8.988	-24.607	-29.812	-9.947
45	1074.946	-4.532	-24.458	-29.722	7.158
46	787.530	19.122	3.750	5.768	-23.344
47	775.647	19.240	-6.928	-7.741	-23.415
48	827.140	-16.471	4.142	6.003	21.688
49	815.257	-16.354	-6.536	-7.507	21.617
50	815.257	6.527	16.345	21.611	-7.501
51	827.140	-4.151	16.463	21.682	6.009
52	775.647	6.920	-19.249	-23.420	-7.736
53	787.530	-3.758	-19.131	-23.350	5.774
54	466.973	18.569	4.307	6.116	-22.999
55	455.090	18.686	-6.371	-7.394	-23.069
56	506.582	-17.025	4.700	6.351	22.033
57	494.699	-16.907	-5.979	-7.159	21.963
58	494.699	5.974	16.902	21.959	-7.155
59	506.582	-4.705	17.020	22.030	6.354
60	455.090	6.366	-18.691	-23.073	-7.390
61	466.973	-4.312	-18.574	-23.002	6.119
62	1773.590	55.626	-4.025	-2.533	-67.648
63	1869.299	2.594	50.098	64.869	-1.634
64	1868.072	-49.028	-2.639	-1.664	63.496
65	1772.363	4.004	-56.762	-69.065	-2.518
66	754.152	53.711	-2.086	-1.304	-66.435
67	849.862	0.679	52.037	66.098	-0.422
68	848.635	-50.942	-0.700	-0.435	64.708
69	752.925	2.090	-54.823	-67.836	-1.305

Applied Loads - Strength Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
21	1820.831	3.299	-3.332	-2.098	-2.076
22	1803.278	25.758	3.180	6.305	-30.539

23	1788.233	25.907	-10.340	-10.799	-30.629
24	1853.429	-19.309	3.676	6.603	26.477
25	1838.384	-19.160	-9.843	-10.502	26.387
26	1838.384	9.810	19.127	26.365	-10.480
27	1853.429	-3.709	19.276	26.454	6.625
28	1788.233	10.307	-25.940	-30.651	-10.777
29	1803.278	-3.213	-25.791	-30.562	6.328
30	1442.623	20.606	2.544	5.044	-24.431
31	1430.586	20.725	-8.272	-8.639	-24.503
32	1482.743	-15.447	2.941	5.282	21.181
33	1470.707	-15.328	-7.875	-8.402	21.110
34	1470.707	7.848	15.301	21.092	-8.384
35	1482.743	-2.968	15.421	21.163	5.300
36	1430.586	8.246	-20.752	-24.521	-8.622
37	1442.623	-2.570	-20.632	-24.449	5.062
38	1074.946	24.438	4.512	7.145	-29.709
39	1059.900	24.587	-9.008	-9.960	-29.798
40	1125.097	-20.628	5.009	7.442	27.307
41	1110.051	-20.479	-8.511	-9.663	27.218
42	1110.051	8.491	20.459	27.204	-9.649
43	1125.097	-5.029	20.609	27.294	7.455
44	1059.900	8.988	-24.607	-29.812	-9.947
45	1074.946	-4.532	-24.458	-29.722	7.158
46	787.530	19.122	3.750	5.768	-23.344
47	775.647	19.240	-6.928	-7.741	-23.415
48	827.140	-16.471	4.142	6.003	21.688
49	815.257	-16.354	-6.536	-7.507	21.617
50	815.257	6.527	16.345	21.611	-7.501
51	827.140	-4.151	16.463	21.682	6.009
52	775.647	6.920	-19.249	-23.420	-7.736
53	787.530	-3.758	-19.131	-23.350	5.774
54	466.973	18.569	4.307	6.116	-22.999
55	455.090	18.686	-6.371	-7.394	-23.069
56	506.582	-17.025	4.700	6.351	22.033
57	494.699	-16.907	-5.979	-7.159	21.963
58	494.699	5.974	16.902	21.959	-7.155
59	506.582	-4.705	17.020	22.030	6.354
60	455.090	6.366	-18.691	-23.073	-7.390
61	466.973	-4.312	-18.574	-23.002	6.119
62	1773.590	55.626	-4.025	-2.533	-67.648
63	1869.299	2.594	50.098	64.869	-1.634
64	1868.072	-49.028	-2.639	-1.664	63.496
65	1772.363	4.004	-56.762	-69.065	-2.518
66	754.152	53.711	-2.086	-1.304	-66.435
67	849.862	0.679	52.037	66.098	-0.422
68	848.635	-50.942	-0.700	-0.435	64.708
69	752.925	2.090	-54.823	-67.836	-1.305

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, $A_{min} = P / q_{max} = 6.269\ m^2$

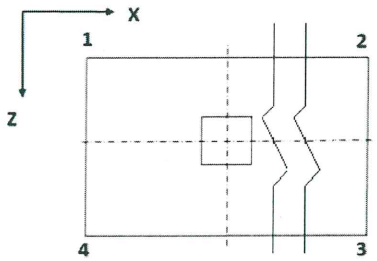
Note: A_{min} is an initial estimation.

P = Critical Factored Axial Load(without self weight/buoyancy/soil).
q_{max} = Respective Factored Bearing Capacity.

Final dimensions for design

Length (L_2) =	2.700	m	Governing Load Case :	# 89
Width (W_2) =	2.700	m	Governing Load Case :	# 89
Area (A_2) =	7.290	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)
90	**195.4764**	160.7014	159.5425	194.3175	0.000
91	187.1057	**188.8614**	150.4081	148.6523	0.000
89	159.2880	160.4266	**195.9554**	194.8168	0.000
89	159.2880	160.4266	195.9554	**194.8168**	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)
90	**195.4764**	160.7014	159.5425	194.3175
91	187.1057	**188.8614**	150.4081	148.6523
89	159.2880	160.4266	**195.9554**	194.8168
89	159.2880	160.4266	195.9554	**194.8168**

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

Governing load case = N/A
Plan area of footing = 7.290 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 = 7.290 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
71	294.619	291.698	729.406	737.025
72	37.393	302.916	336.139	61.724
73	36.887	92.417	166.974	61.016
74	51.180	268.801	323.136	75.875
75	51.186	99.629	177.332	75.633
76	99.965	51.274	75.713	177.775
77	266.407	51.268	75.955	321.687
78	92.714	36.840	60.962	167.377
79	299.801	37.345	61.670	334.531
80	34.298	248.266	290.840	56.366
81	33.804	86.397	154.667	55.672
82	45.684	223.758	281.118	68.194
83	45.648	93.547	164.842	67.921
84	93.840	45.718	67.985	165.221
85	222.111	45.754	68.258	280.030
86	86.654	33.764	55.627	155.011
87	246.183	34.257	56.321	289.643
88	17.048	235.611	589.392	27.626
89	384.050	19.884	30.769	960.127
90	20.306	377.240	942.730	31.416
91	236.686	16.696	27.046	592.344
92	8.166	210.280	528.082	13.069
93	716.039	9.348	14.672	1805.711
94	9.537	694.171	1750.121	14.968
95	209.604	7.989	12.783	526.559

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

Critical Load Case for Sliding along X-Direction :	92	
Governing Disturbing Force :	35.808	kN
Governing Restoring Force :	292.390	kN
Minimum Sliding Ratio for the Critical Load Case :	8.166	
Critical Load Case for Overturning about X-Direction :	95	
Governing Overturning Moment :	-61.671	kNm
Governing Resisting Moment :	788.335	kNm
Minimum Overturning Ratio for the Critical Load Case :	12.783	

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

Critical Load Case for Sliding along Z-Direction :	95	
Governing Disturbing Force :	-36.548	kN
Governing Restoring Force :	291.981	kN

Minimum Sliding Ratio for the Critical Load Case :	7.989	
Critical Load Case for Overturning about Z-Direction :	92	
Governing Overturning Moment :	-60.403	kNm
Governing Resisting Moment :	789.439	kNm
Minimum Overturning Ratio for the Critical Load Case :	13.069	

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

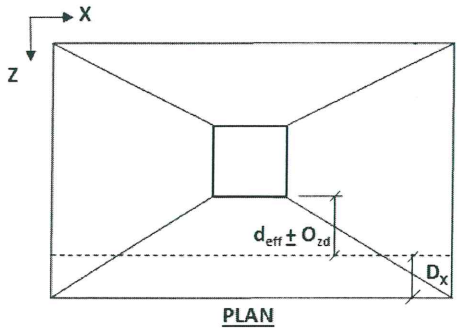
Critical Load Case	**= #65**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.442	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.142	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.687	m
Governing moment (M_u)		= 470.914	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 555.123952	kNm
$M_u <= M_{umax}$	hence, safe		

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

Critical Load Case	**= #65**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.442	m
Effective End Depth		= 0.142	m
Effective Width		= 0.687	m
Governing moment (M_u) =		= 435.742	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 555.123952	kNm
$M_u <= M_{umax}$	hence, safe		

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

(Shear Plane Parallel To X axis)



PLAN

Critical Load Case = #63

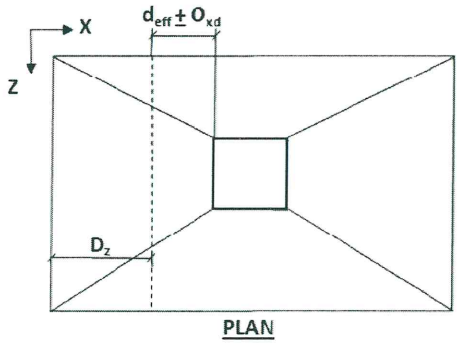
D_X = 0.442 m

Shear Force(S)	= 527.753	kN
Shear Stress(T_v)	= 650.331499	kN/m2
Percentage Of Steel(P_t)	= 1.1198	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 684.623	kN/m2

$T_v < T_c$ hence, safe

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

(Shear Plane Parallel To Z axis)



PLAN

Critical Load Case = #64

D_Z = 0.442 m

Shear Force(S)	= 526.634	kN
Shear Stress(T_v)	= 648.952467	kN/m2
Percentage Of Steel(P_t)	= 1.1189	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 684.429	kN/m2

$T_v < T_c$ hence, safe

Check Trial Depth for two way shear

Critical Load Case = #63

Shear Force(S)		= 1687.508	kN
Shear Stress(T_v)		= 1303.616	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)=	$0.25\times\sqrt{f_{ck}}$	= 1369.3064	kN/m2
K_s X T_c		= 1369.3064	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) =	$\frac{d_b\times 0.87\times f_y}{4\times\Gamma_{bd}}$	= 0.589 m
Allowable Length(l_{db}) =	$\left[\frac{(B-b)}{2}-cc\right]$	= 1.100 m

$l_{db} >= l_d$ hence, safe

Along Z Axis

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

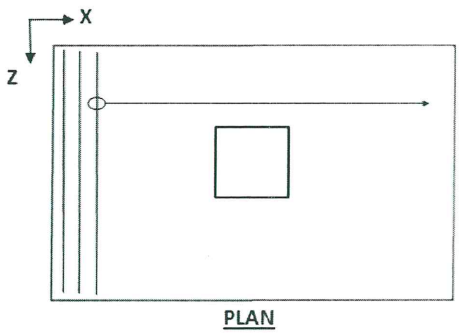
As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b\times 0.87\times f_y}{4\times\Gamma_{bd}}$	= 0.589 m
Allowable Length(l_{db}) =	$\left[\frac{(H-h)}{2}-cc\right]$	= 1.100 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 = #65

Minimum Area of Steel (A_{stmin}) = 1620.000 mm2

Calculated Area of Steel (A_{st}) = 3512.628 mm2

Provided Area of Steel ($A_{st,Provided}$) = 3512.628 mm2

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

Selected bar Size (d_b) = Ø16

Minimum spacing allowed (S_{min}) = 56.000 mm

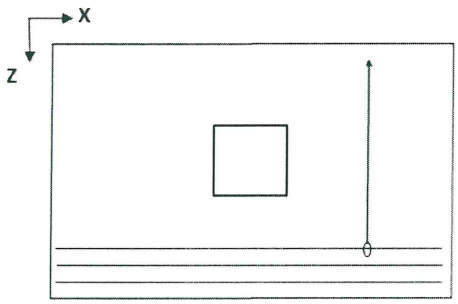
Selected spacing (S) = 152.000 mm

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

Ø16 @ 150.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = #65

Minimum Area of Steel (A_{stmin}) = 1620.000 mm2

Calculated Area of Steel (A_{st}) = 3195.331 mm2

Provided Area of Steel ($A_{st,Provided}$) = 3195.331 mm2

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

Selected bar Size (d_b) = Ø16

Minimum spacing allowed (S_{min}) = 100.000 mm

Selected spacing (S) = 172.267 mm

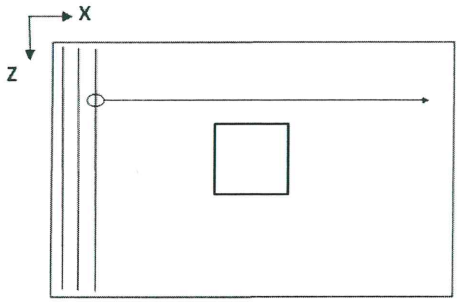
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø16 @ 170.000 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}) = 1620.000 mm2

Calculated Area of Steel (A_{st}) = 1458.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1620.000 mm2

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

Selected bar Size (d_b) = Ø16

Minimum spacing allowed (S_{min}) = 56.000 mm

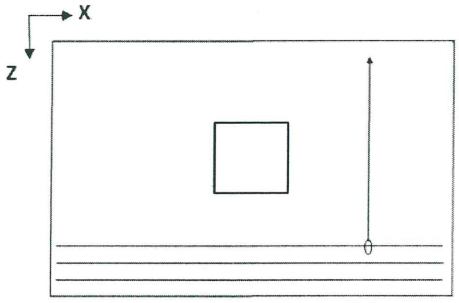
Selected spacing (S) = 300.000mm

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

Ø16 @ 300 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}) = 1620.000 mm2

Calculated Area of Steel (A_{st}) = 1458.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1620.000 mm2

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

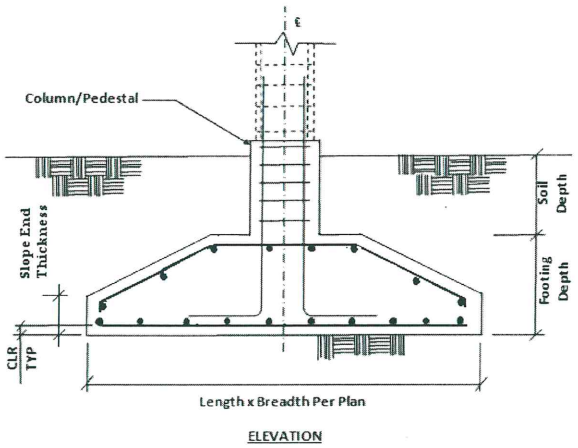
Selected bar Size (d_b)	= Ø16
Minimum spacing allowed (S_{min})	= 100.000 mm
Selected spacing (S)	= 300.000 mm

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

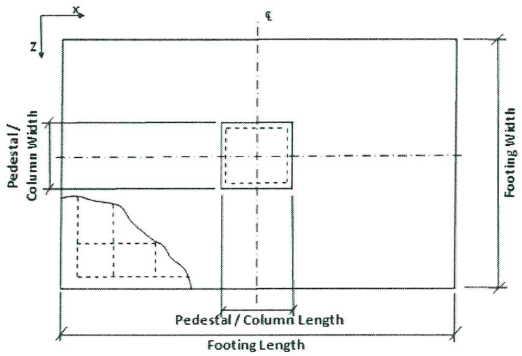
Based on spacing reinforcement increment; provided reinforcement is

Ø16 @ 300 mm o.c.

Isolated Footing 20



ELEVATION



PLAN

Input Values

Footing Geomtery

Design Type :	Set Dimension
Footing Thickness (Ft) :	450.000 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) :	0.400 m

Column Width - Z (Pw) : 0.400 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 : 30.000 N/mm2
Yield Strength of Steel : 415.000 N/mm2
Minimum Bar Size : Ø16
Maximum Bar Size : Ø16
Minimum Bar Spacing : 100.000 mm
Maximum Bar Spacing : 300.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : UnDrained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 200.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 0.000 mm
Undrained Shear Strength : 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**
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ

80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ

Load Combination/s- Service Stress Level

Load Combination Number	Load Combination Title
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ
80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ

37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ
48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ
37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ

48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	1213.887	-2.199	2.221	1.399	1.384
72	1225.589	12.773	6.562	7.001	-17.592
73	1235.620	12.873	-2.451	-4.402	-17.651
74	1192.155	-17.271	6.894	7.200	20.419
75	1202.185	-17.172	-2.120	-4.204	20.360
76	1202.185	2.142	17.194	20.374	-4.219
77	1192.155	-6.872	17.293	20.434	7.185
78	1235.620	2.473	-12.851	-17.636	-4.417
79	1225.589	-6.540	-12.751	-17.577	6.986
80	1104.200	12.993	6.340	6.861	-17.730
81	1114.231	13.092	-2.673	-4.542	-17.789
82	1070.767	-17.051	6.671	7.060	20.281
83	1080.797	-16.952	-2.342	-4.344	20.221
84	1080.797	2.362	16.972	20.235	-4.357
85	1070.766	-6.652	17.071	20.294	7.046
86	1114.231	2.693	-13.073	-17.776	-4.555
87	1104.200	-6.320	-12.973	-17.717	6.848
88	1245.382	32.685	1.759	1.109	-42.331
89	1181.575	-2.669	37.841	46.044	1.679
90	1182.393	-37.084	2.683	1.689	45.098
91	1246.200	-1.729	-33.399	-43.246	1.089
92	565.756	33.962	0.467	0.290	-43.139
93	501.950	-1.393	36.548	45.224	0.870
94	502.768	-35.808	1.390	0.869	44.290
95	566.575	-0.453	-34.691	-44.065	0.281

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	1213.887	-2.199	2.221	1.399	1.384
72	1225.589	12.773	6.562	7.001	-17.592
73	1235.620	12.873	-2.451	-4.402	-17.651
74	1192.155	-17.271	6.894	7.200	20.419
75	1202.185	-17.172	-2.120	-4.204	20.360
76	1202.185	2.142	17.194	20.374	-4.219
77	1192.155	-6.872	17.293	20.434	7.185
78	1235.620	2.473	-12.851	-17.636	-4.417

79	1225.589	-6.540	-12.751	-17.577	6.986
80	1104.200	12.993	6.340	6.861	-17.730
81	1114.231	13.092	-2.673	-4.542	-17.789
82	1070.767	-17.051	6.671	7.060	20.281
83	1080.797	-16.952	-2.342	-4.344	20.221
84	1080.797	2.362	16.972	20.235	-4.357
85	1070.766	-6.652	17.071	20.294	7.046
86	1114.231	2.693	-13.073	-17.776	-4.555
87	1104.200	-6.320	-12.973	-17.717	6.848
88	1245.382	32.685	1.759	1.109	-42.331
89	1181.575	-2.669	37.841	46.044	1.679
90	1182.393	-37.084	2.683	1.689	45.098
91	1246.200	-1.729	-33.399	-43.246	1.089
92	565.756	33.962	0.467	0.290	-43.139
93	501.950	-1.393	36.548	45.224	0.870
94	502.768	-35.808	1.390	0.869	44.290
95	566.575	-0.453	-34.691	-44.065	0.281

Applied Loads - Strength Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
21	1820.831	-3.299	3.332	2.098	2.076
22	1838.384	19.160	9.843	10.502	-26.387
23	1853.429	19.309	-3.676	-6.603	-26.477
24	1788.233	-25.907	10.340	10.799	30.629
25	1803.278	-25.758	-3.180	-6.305	30.539
26	1803.278	3.213	25.791	30.562	-6.328
27	1788.233	-10.307	25.940	30.651	10.777
28	1853.429	3.709	-19.276	-26.454	-6.625
29	1838.384	-9.810	-19.127	-26.365	10.480
30	1470.707	15.328	7.875	8.402	-21.110
31	1482.743	15.447	-2.941	-5.282	-21.181
32	1430.586	-20.725	8.272	8.639	24.503
33	1442.623	-20.606	-2.544	-5.044	24.431
34	1442.623	2.570	20.632	24.449	-5.062
35	1430.586	-8.246	20.752	24.521	8.622
36	1482.743	2.968	-15.421	-21.163	-5.300
37	1470.707	-7.848	-15.301	-21.092	8.384
38	1110.051	20.479	8.511	9.663	-27.218
39	1125.097	20.628	-5.009	-7.442	-27.307
40	1059.900	-24.587	9.008	9.960	29.798
41	1074.946	-24.438	-4.512	-7.145	29.709
42	1074.946	4.532	24.458	29.722	-7.158
43	1059.900	-8.988	24.607	29.812	9.947
44	1125.097	5.029	-20.609	-27.294	-7.455
45	1110.051	-8.491	-20.459	-27.204	9.649
46	815.257	16.354	6.536	7.507	-21.617
47	827.140	16.471	-4.142	-6.003	-21.688
48	775.647	-19.240	6.928	7.741	23.415
49	787.530	-19.122	-3.750	-5.768	23.344
50	787.530	3.758	19.131	23.350	-5.774
51	775.647	-6.920	19.249	23.420	7.736
52	827.140	4.151	-16.463	-21.682	-6.009
53	815.257	-6.527	-16.345	-21.611	7.501
54	494.699	16.907	5.979	7.159	-21.963
55	506.582	17.025	-4.700	-6.351	-22.033
56	455.090	-18.686	6.371	7.394	23.069
57	466.973	-18.569	-4.307	-6.116	22.999
58	466.973	4.312	18.574	23.002	-6.119
59	455.090	-6.366	18.691	23.073	7.390
60	506.582	4.705	-17.020	-22.030	-6.354
61	494.699	-5.974	-16.902	-21.959	7.155

62	1868.072	49.028	2.639	1.664	-63.496
63	1772.363	-4.004	56.762	69.065	2.518
64	1773.590	-55.626	4.025	2.533	67.648
65	1869.299	-2.594	-50.098	-64.869	1.634
66	848.635	50.942	0.700	0.435	-64.708
67	752.925	-2.090	54.823	67.836	1.305
68	754.152	-53.711	2.086	1.304	66.435
69	849.862	-0.679	-52.037	-66.098	0.422
Applied Loads - Strength Level					
LC	**Axial (kN)**	**Shear X (kN)**	**Shear Z (kN)**	**Moment X (kNm)**	**Moment Z (kNm)**
21	1820.831	-3.299	3.332	2.098	2.076
22	1838.384	19.160	9.843	10.502	-26.387
23	1853.429	19.309	-3.676	-6.603	-26.477
24	1788.233	-25.907	10.340	10.799	30.629
25	1803.278	-25.758	-3.180	-6.305	30.539
26	1803.278	3.213	25.791	30.562	-6.328
27	1788.233	-10.307	25.940	30.651	10.777
28	1853.429	3.709	-19.276	-26.454	-6.625
29	1838.384	-9.810	-19.127	-26.365	10.480
30	1470.707	15.328	7.875	8.402	-21.110
31	1482.743	15.447	-2.941	-5.282	-21.181
32	1430.586	-20.725	8.272	8.639	24.503
33	1442.623	-20.606	-2.544	-5.044	24.431
34	1442.623	2.570	20.632	24.449	-5.062
35	1430.586	-8.246	20.752	24.521	8.622
36	1482.743	2.968	-15.421	-21.163	-5.300
37	1470.707	-7.848	-15.301	-21.092	8.384
38	1110.051	20.479	8.511	9.663	-27.218
39	1125.097	20.628	-5.009	-7.442	-27.307
40	1059.900	-24.587	9.008	9.960	29.798
41	1074.946	-24.438	-4.512	-7.145	29.709
42	1074.946	4.532	24.458	29.722	-7.158
43	1059.900	-8.988	24.607	29.812	9.947
44	1125.097	5.029	-20.609	-27.294	-7.455
45	1110.051	-8.491	-20.459	-27.204	9.649
46	815.257	16.354	6.536	7.507	-21.617
47	827.140	16.471	-4.142	-6.003	-21.688
48	775.647	-19.240	6.928	7.741	23.415
49	787.530	-19.122	-3.750	-5.768	23.344
50	787.530	3.758	19.131	23.350	-5.774
51	775.647	-6.920	19.249	23.420	7.736
52	827.140	4.151	-16.463	-21.682	-6.009
53	815.257	-6.527	-16.345	-21.611	7.501
54	494.699	16.907	5.979	7.159	-21.963
55	506.582	17.025	-4.700	-6.351	-22.033
56	455.090	-18.686	6.371	7.394	23.069
57	466.973	-18.569	-4.307	-6.116	22.999
58	466.973	4.312	18.574	23.002	-6.119
59	455.090	-6.366	18.691	23.073	7.390
60	506.582	4.705	-17.020	-22.030	-6.354
61	494.699	-5.974	-16.902	-21.959	7.155
62	1868.072	49.028	2.639	1.664	-63.496
63	1772.363	-4.004	56.762	69.065	2.518
64	1773.590	-55.626	4.025	2.533	67.648
65	1869.299	-2.594	-50.098	-64.869	1.634
66	848.635	50.942	0.700	0.435	-64.708
67	752.925	-2.090	54.823	67.836	1.305
68	754.152	-53.711	2.086	1.304	66.435
69	849.862	-0.679	-52.037	-66.098	0.422

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, $A_{min} = P / q_{max}$ = 6.269 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.

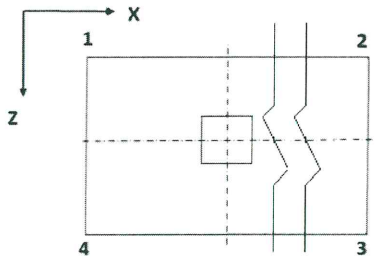
Final dimensions for design

Length (L_2) = 2.700 m Governing Load Case : # 88

Width (W_2) = 2.700 m Governing Load Case : # 88

Area (A_2) = 7.290 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)
91	**195.9554**	194.8168	159.2880	160.4266	0.000
91	195.9554	**194.8168**	159.2880	160.4266	0.000
88	159.5425	194.3175	**195.4764**	160.7014	0.000
89	150.4081	148.6523	187.1057	**188.8614**	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)
91	**195.9554**	194.8168	159.2880	160.4266
91	195.9554	**194.8168**	159.2880	160.4266
88	159.5425	194.3175	**195.4764**	160.7014
89	150.4081	148.6523	187.1057	**188.8614**

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

Governing load case = N/A
Plan area of footing = 7.290 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 = 7.290 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
71	294.619	291.698	729.406	737.025
72	51.186	99.629	177.332	75.633
73	51.180	268.801	323.136	75.875
74	36.887	92.417	166.974	61.016
75	37.393	302.916	336.139	61.724
76	299.801	37.345	61.670	334.531
77	92.714	36.840	60.962	167.377
78	266.407	51.268	75.955	321.687
79	99.965	51.274	75.713	177.775
80	45.648	93.547	164.842	67.921
81	45.684	223.758	281.118	68.194
82	33.804	86.397	154.667	55.672
83	34.298	248.267	290.840	56.366
84	246.183	34.257	56.321	289.643
85	86.654	33.764	55.627	155.011
86	222.111	45.754	68.258	280.030
87	93.840	45.718	67.985	165.221
88	20.306	377.240	942.730	31.416
89	236.686	16.696	27.046	592.344
90	17.048	235.611	589.392	27.626
91	384.050	19.884	30.769	960.127
92	9.537	694.171	1750.121	14.968
93	209.604	7.989	12.783	526.560
94	8.166	210.280	528.082	13.069
95	716.039	9.348	14.672	1805.711

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

Critical Load Case for Sliding along X-Direction : 94
Governing Disturbing Force : -35.808 kN

Governing Restoring Force :	292.390	kN
Minimum Sliding Ratio for the Critical Load Case :	8.166	
Critical Load Case for Overturning about X-Direction :	93	
Governing Overturning Moment :	61.671	kNm
Governing Resisting Moment :	788.335	kNm
Minimum Overturning Ratio for the Critical Load Case :	12.783	

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

Critical Load Case for Sliding along Z-Direction :	93	
Governing Disturbing Force :	36.548	kN
Governing Restoring Force :	291.981	kN
Minimum Sliding Ratio for the Critical Load Case :	7.989	
Critical Load Case for Overturning about Z-Direction :	94	
Governing Overturning Moment :	60.403	kNm
Governing Resisting Moment :	789.439	kNm
Minimum Overturning Ratio for the Critical Load Case :	13.069	

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

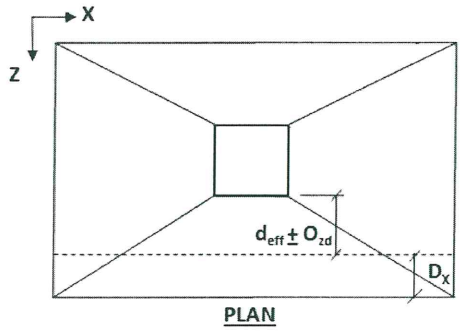
Critical Load Case	**= #65**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.442	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.142	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.687	m
Governing moment (M_u)		= 491.851	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 555.123952	kNm
$M_u <= M_{umax}$	hence, safe		

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

Critical Load Case	**= #65**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.442	m
Effective End Depth		= 0.142	m
Effective Width		= 0.687	m
Governing moment (M_u) =		= 458.889	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 555.123952	kNm
$M_u <= M_{umax}$	hence, safe		

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

(Shear Plane Parallel To X axis)



PLAN

Critical Load Case = #65

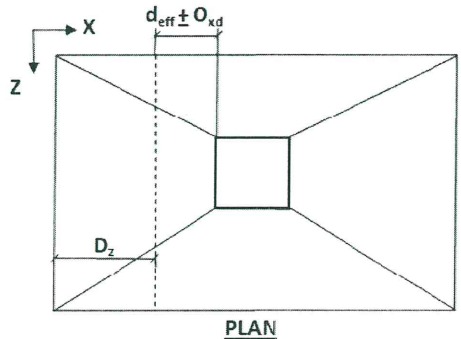
D_X = 0.442 m

Shear Force(S)	= 527.753	kN
Shear Stress(T_v)	= 650.331500	kN/m2
Percentage Of Steel(P_t)	= 1.1198	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 684.622	kN/m2

$T_v < T_c$ hence, safe

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

(Shear Plane Parallel To Z axis)



PLAN

Critical Load Case = #62

D_Z = 0.442 m

Shear Force(S)	= 526.634	kN
Shear Stress(T_v)	= 648.952466	kN/m2
Percentage Of Steel(P_t)	= 1.1189	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 684.430	kN/m2

$T_v < T_c$ hence, safe

Check Trial Depth for two way shear

Critical Load Case	**= #65**		
Shear Force(S)		= 1687.508	kN
Shear Stress(T_v)		= 1303.616	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)=	$0.25\times\sqrt{f_{ck}}$	= 1369.3064	kN/m2
K_s X T_c		= 1369.3064	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) =	$\frac{d_b\times 0.87\times f_y}{4\times\tau_{bd}}$	= 0.589 m
Allowable Length(l_{db}) =	$\left[\frac{(B-b)}{2}-cc\right]$	= 1.100 m

$l_{db} >= l_d$ hence, safe

Along Z Axis

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

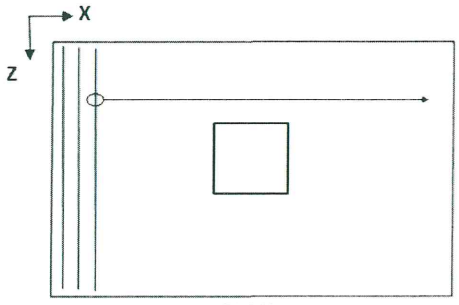
As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b\times 0.87\times f_y}{4\times\tau_{bd}}$	= 0.589 m
Allowable Length(l_{db}) =	$\left[\frac{(H-h)}{2}-cc\right]$	= 1.100 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 = #65

Minimum Area of Steel (A_{stmin}) = 1620.000 mm2

Calculated Area of Steel (A_{st}) = 3708.073 mm2

Provided Area of Steel ($A_{st,Provided}$) = 3708.073 mm2

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

Selected bar Size (d_b) = Ø16

Minimum spacing allowed (S_{min}) = 56.000 mm

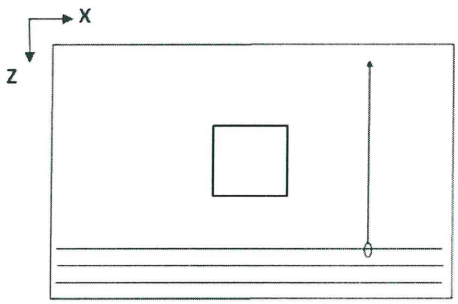
Selected spacing (S) = 143.556 mm

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

Ø16 @ 140.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = #65

Minimum Area of Steel (A_{stmin}) = 1620.000 mm2

Calculated Area of Steel (A_{st}) = 3402.648 mm2

Provided Area of Steel ($A_{st,Provided}$) = 3402.648 mm2

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

Selected bar Size (d_b) = Ø16

Minimum spacing allowed (S_{min}) = 100.000 mm

Selected spacing (S) = 161.500 mm

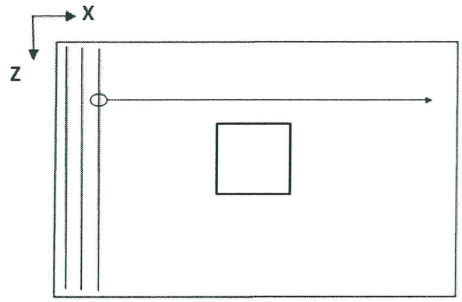
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø16 @ 160.000 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}) = 1620.000 mm2

Calculated Area of Steel (A_{st}) = 1458.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1620.000 mm2

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

Selected bar Size (d_b) = Ø16

Minimum spacing allowed (S_{min}) = 56.000 mm

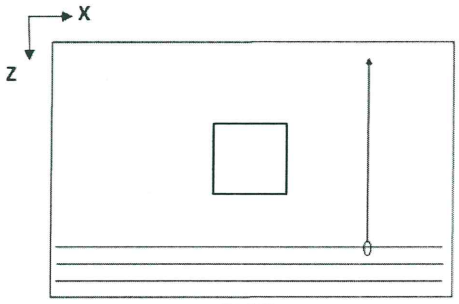
Selected spacing (S) = 300.000mm

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

Ø16 @ 300 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}) = 1620.000 mm2

Calculated Area of Steel (A_{st}) = 1604.805 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1620.000 mm2

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

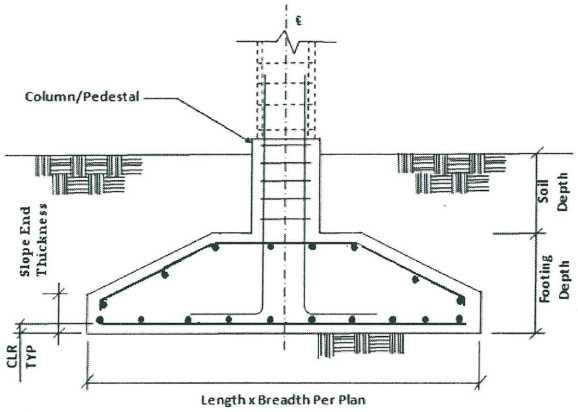
Selected bar Size (d_b)	= Ø16
Minimum spacing allowed (S_{min})	= 100.000 mm
Selected spacing (S)	= 300.000 mm

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

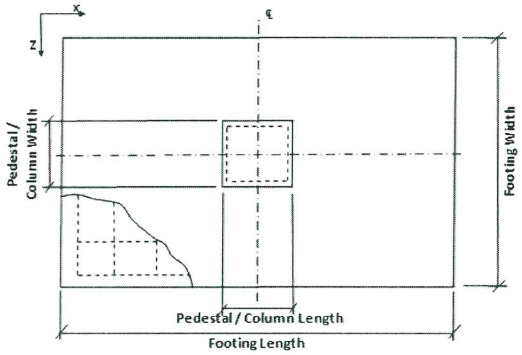
Based on spacing reinforcement increment; provided reinforcement is

Ø16 @ 300 mm o.c.

Isolated Footing 21



ELEVATION



PLAN

Input Values

Footing Geomtery

Design Type :	Set Dimension
Footing Thickness (Ft) :	450.000 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) :	0.400 m

Column Width - Z (Pw) : 0.400 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 : 30.000 N/mm2
Yield Strength of Steel : 415.000 N/mm2
Minimum Bar Size : Ø16
Maximum Bar Size : Ø16
Minimum Bar Spacing : 100.000 mm
Maximum Bar Spacing : 300.000 mm
Pedestal Clear Cover (P, CL) : 50.000 mm
Footing Clear Cover (F, CL) : 50.000 mm

Soil Properties

Soil Type : UnDrained
Unit Weight : 18.000 kN/m3
Soil Bearing Capacity : 200.000 kN/m2
Soil Surcharge : 0.000 kN/m2
Depth of Soil above Footing : 0.000 mm
Undrained Shear Strength : 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**
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ

80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ
Load Combination/s- Service Stress Level	
Load Combination Number	**Load Combination Title**
71	DL
72	1.0DL+1.0EQX+0.30EQZ
73	1.0DL+1.0EQX-0.3EQZ
74	1.0DL-1.0EQX+0.3EQZ
75	1.0DL-1.0EQX-0.3EQZ
76	1.0DL+0.3EQX+1.0EQZ
77	1.0DL-0.3EQX+1.0EQZ
78	1.0DL+0.3EQX-1.0EQZ
79	1.0DL-0.3EQX-1.0EQZ
80	0.9DL+1.0EQX+0.30EQZ
81	0.9DL+1.0EQX-0.3EQZ
82	0.9DL-1.0EQX+0.3EQZ
83	0.9DL-1.0EQX-0.3EQZ
84	0.9DL+0.3EQX+1.0EQZ
85	0.9DL-0.3EQX+1.0EQZ
86	0.9DL+0.3EQX-1.0EQZ
87	0.9DL-0.3EQX-1.0EQZ
88	1.0TL+1.0WLX
89	1.0TL+1.0WLZ
90	1.0TL-1.0WLX
91	1.0TL-1.0WLZ
92	1.0DL+1.0WLX
93	1.0DL+1.0WLZ
94	1.0DL-1.0WLX
95	1.0DL-1.0WLZ
Load Combination/s- Strength Level	
Load Combination Number	**Load Combination Title**
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ

37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ
48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Load Combination/s- Strength Level

Load Combination Number	Load Combination Title
21	1.5DL
22	1.5DL+1.5EQX+0.45EQZ
23	1.5DL+1.5EQX-0.45EQZ
24	1.5DL-1.5EQX+0.45EQZ
25	1.5DL-1.5EQX-0.45EQZ
26	1.5DL+0.45EQX+1.50EQZ
27	1.5DL-0.45EQX+1.50EQZ
28	1.5DL+0.45EQX-1.50EQZ
29	1.5DL-0.45EQX-1.50EQZ
30	1.2DL+1.2EQX+0.36EQZ
31	1.2DL+1.2EQX-0.36EQZ
32	1.2DL-1.2EQX+0.36EQZ
33	1.2DL-1.2EQX-0.36EQZ
34	1.2DL+0.36EQX+1.20EQZ
35	1.2DL-0.36EQX+1.20EQZ
36	1.2DL+0.36EQX-1.20EQZ
37	1.2DL-0.36EQX-1.20EQZ
38	0.9DL+1.5EQX+0.45EQZ
39	0.9DL+1.5EQX-0.45EQZ
40	0.9DL-1.5EQX+0.45EQZ
41	0.9DL-1.5EQX-0.45EQZ
42	0.9DL+0.45EQX+1.50EQZ
43	0.9DL-0.45EQX+1.50EQZ
44	0.9DL+0.45EQX-1.50EQZ
45	0.9DL-0.45EQX-1.50EQZ
46	1.5DL+1.5EQX+0.45EQZ
47	1.5DL+1.5EQX-0.45EQZ

48	1.5DL-1.5EQX+0.45EQZ
49	1.5DL-1.5EQX-0.45EQZ
50	1.5DL+0.45EQX+1.50EQZ
51	1.5DL-0.45EQX+1.50EQZ
52	1.5DL+0.45EQX-1.50EQZ
53	1.5DL-0.45EQX-1.50EQZ
54	0.9DL +1.5EQX+0.45EQZ
55	0.9DL+1.5EQX-0.45EQZ
56	0.9DL-1.5EQX+0.45EQZ
57	0.9DL-1.5EQX-0.45EQZ
58	0.9DL+0.45EQX+1.50EQZ
59	0.9DL-0.45EQX+1.50EQZ
60	0.9DL+0.45EQX-1.50EQZ
61	0.9DL-0.45EQX-1.50EQZ
62	1.5TL+1.5WLX
63	1.5TL+1.5WLZ
64	1.5TL-1.5WLX
65	1.5TL-1.5WLZ
66	1.5DL+1.5WLX
67	1.5DL+1.5WLZ
68	1.5DL-1.5WLX
69	1.5DL-1.5WLZ

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	1213.887	2.199	2.221	1.399	-1.384
72	1192.155	17.271	6.894	7.200	-20.419
73	1202.185	17.172	-2.120	-4.204	-20.360
74	1225.589	-12.773	6.562	7.001	17.592
75	1235.620	-12.873	-2.451	-4.402	17.651
76	1192.155	6.872	17.293	20.434	-7.185
77	1202.185	-2.142	17.194	20.374	4.219
78	1225.589	6.540	-12.751	-17.577	-6.986
79	1235.620	-2.473	-12.851	-17.636	4.417
80	1070.766	17.051	6.671	7.060	-20.281
81	1080.797	16.952	-2.342	-4.344	-20.221
82	1104.200	-12.993	6.340	6.861	17.730
83	1114.231	-13.092	-2.673	-4.542	17.789
84	1070.766	6.652	17.071	20.294	-7.046
85	1080.797	-2.362	16.972	20.235	4.357
86	1104.200	6.320	-12.973	-17.717	-6.848
87	1114.231	-2.693	-13.073	-17.776	4.555
88	1182.393	37.084	2.683	1.689	-45.098
89	1181.575	2.669	37.841	46.044	-1.679
90	1245.382	-32.685	1.759	1.109	42.331
91	1246.200	1.729	-33.399	-43.246	-1.089
92	502.768	35.808	1.390	0.869	-44.290
93	501.950	1.393	36.548	45.224	-0.870
94	565.756	-33.962	0.467	0.290	43.139
95	566.575	0.453	-34.691	-44.065	-0.281

Applied Loads - Service Stress Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
71	1213.887	2.199	2.221	1.399	-1.384
72	1192.155	17.271	6.894	7.200	-20.419
73	1202.185	17.172	-2.120	-4.204	-20.360
74	1225.589	-12.773	6.562	7.001	17.592
75	1235.620	-12.873	-2.451	-4.402	17.651
76	1192.155	6.872	17.293	20.434	-7.185
77	1202.185	-2.142	17.194	20.374	4.219
78	1225.589	6.540	-12.751	-17.577	-6.986

79	1235.620	-2.473	-12.851	-17.636	4.417
80	1070.766	17.051	6.671	7.060	-20.281
81	1080.797	16.952	-2.342	-4.344	-20.221
82	1104.200	-12.993	6.340	6.861	17.730
83	1114.231	-13.092	-2.673	-4.542	17.789
84	1070.766	6.652	17.071	20.294	-7.046
85	1080.797	-2.362	16.972	20.235	4.357
86	1104.200	6.320	-12.973	-17.717	-6.848
87	1114.231	-2.693	-13.073	-17.776	4.555
88	1182.393	37.084	2.683	1.689	-45.098
89	1181.575	2.669	37.841	46.044	-1.679
90	1245.382	-32.685	1.759	1.109	42.331
91	1246.200	1.729	-33.399	-43.246	-1.089
92	502.768	35.808	1.390	0.869	-44.290
93	501.950	1.393	36.548	45.224	-0.870
94	565.756	-33.962	0.467	0.290	43.139
95	566.575	0.453	-34.691	-44.065	-0.281

Applied Loads - Strength Level					
LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
21	1820.831	3.299	3.332	2.098	-2.076
22	1788.233	25.907	10.340	10.799	-30.629
23	1803.278	25.758	-3.180	-6.305	-30.539
24	1838.384	-19.160	9.843	10.502	26.387
25	1853.429	-19.309	-3.676	-6.603	26.477
26	1788.233	10.307	25.940	30.651	-10.777
27	1803.278	-3.213	25.791	30.562	6.328
28	1838.384	9.810	-19.127	-26.365	-10.480
29	1853.429	-3.709	-19.276	-26.454	6.625
30	1430.586	20.725	8.272	8.639	-24.503
31	1442.623	20.606	-2.544	-5.044	-24.431
32	1470.707	-15.328	7.875	8.402	21.110
33	1482.743	-15.447	-2.941	-5.282	21.181
34	1430.586	8.246	20.752	24.521	-8.622
35	1442.623	-2.570	20.632	24.449	5.062
36	1470.707	7.848	-15.301	-21.092	-8.384
37	1482.743	-2.968	-15.421	-21.163	5.300
38	1059.900	24.587	9.008	9.960	-29.798
39	1074.946	24.438	-4.512	-7.145	-29.709
40	1110.051	-20.479	8.511	9.663	27.218
41	1125.097	-20.628	-5.009	-7.442	27.307
42	1059.900	8.988	24.607	29.812	-9.947
43	1074.946	-4.532	24.458	29.722	7.158
44	1110.051	8.491	-20.459	-27.204	-9.649
45	1125.097	-5.029	-20.609	-27.294	7.455
46	775.647	19.240	6.928	7.741	-23.415
47	787.530	19.122	-3.750	-5.768	-23.344
48	815.257	-16.354	6.536	7.507	21.617
49	827.140	-16.471	-4.142	-6.003	21.688
50	775.647	6.920	19.249	23.420	-7.736
51	787.530	-3.758	19.131	23.350	5.774
52	815.257	6.527	-16.345	-21.611	-7.501
53	827.140	-4.151	-16.463	-21.682	6.009
54	455.090	18.686	6.371	7.394	-23.069
55	466.973	18.569	-4.307	-6.116	-22.999
56	494.699	-16.907	5.979	7.159	21.963
57	506.582	-17.025	-4.700	-6.351	22.033
58	455.090	6.366	18.691	23.073	-7.390
59	466.973	-4.312	18.574	23.002	6.119
60	494.699	5.974	-16.902	-21.959	-7.155
61	506.582	-4.705	-17.020	-22.030	6.354

62	1773.590	55.626	4.025	2.533	-67.648
63	1772.363	4.004	56.762	69.065	-2.518
64	1868.072	-49.028	2.639	1.664	63.496
65	1869.299	2.594	-50.098	-64.869	-1.634
66	754.152	53.711	2.086	1.304	-66.435
67	752.925	2.090	54.823	67.836	-1.305
68	848.635	-50.942	0.700	0.435	64.708
69	849.862	0.679	-52.037	-66.098	-0.422

Applied Loads - Strength Level

LC	Axial (kN)	Shear X (kN)	Shear Z (kN)	Moment X (kNm)	Moment Z (kNm)
21	1820.831	3.299	3.332	2.098	-2.076
22	1788.233	25.907	10.340	10.799	-30.629
23	1803.278	25.758	-3.180	-6.305	-30.539
24	1838.384	-19.160	9.843	10.502	26.387
25	1853.429	-19.309	-3.676	-6.603	26.477
26	1788.233	10.307	25.940	30.651	-10.777
27	1803.278	-3.213	25.791	30.562	6.328
28	1838.384	9.810	-19.127	-26.365	-10.480
29	1853.429	-3.709	-19.276	-26.454	6.625
30	1430.586	20.725	8.272	8.639	-24.503
31	1442.623	20.606	-2.544	-5.044	-24.431
32	1470.707	-15.328	7.875	8.402	21.110
33	1482.743	-15.447	-2.941	-5.282	21.181
34	1430.586	8.246	20.752	24.521	-8.622
35	1442.623	-2.570	20.632	24.449	5.062
36	1470.707	7.848	-15.301	-21.092	-8.384
37	1482.743	-2.968	-15.421	-21.163	5.300
38	1059.900	24.587	9.008	9.960	-29.798
39	1074.946	24.438	-4.512	-7.145	-29.709
40	1110.051	-20.479	8.511	9.663	27.218
41	1125.097	-20.628	-5.009	-7.442	27.307
42	1059.900	8.988	24.607	29.812	-9.947
43	1074.946	-4.532	24.458	29.722	7.158
44	1110.051	8.491	-20.459	-27.204	-9.649
45	1125.097	-5.029	-20.609	-27.294	7.455
46	775.647	19.240	6.928	7.741	-23.415
47	787.530	19.122	-3.750	-5.768	-23.344
48	815.257	-16.354	6.536	7.507	21.617
49	827.140	-16.471	-4.142	-6.003	21.688
50	775.647	6.920	19.249	23.420	-7.736
51	787.530	-3.758	19.131	23.350	5.774
52	815.257	6.527	-16.345	-21.611	-7.501
53	827.140	-4.151	-16.463	-21.682	6.009
54	455.090	18.686	6.371	7.394	-23.069
55	466.973	18.569	-4.307	-6.116	-22.999
56	494.699	-16.907	5.979	7.159	21.963
57	506.582	-17.025	-4.700	-6.351	22.033
58	455.090	6.366	18.691	23.073	-7.390
59	466.973	-4.312	18.574	23.002	6.119
60	494.699	5.974	-16.902	-21.959	-7.155
61	506.582	-4.705	-17.020	-22.030	6.354
62	1773.590	55.626	4.025	2.533	-67.648
63	1772.363	4.004	56.762	69.065	-2.518
64	1868.072	-49.028	2.639	1.664	63.496
65	1869.299	2.594	-50.098	-64.869	-1.634
66	754.152	53.711	2.086	1.304	-66.435
67	752.925	2.090	54.823	67.836	-1.305
68	848.635	-50.942	0.700	0.435	64.708
69	849.862	0.679	-52.037	-66.098	-0.422

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, $A_{min} = P / q_{max}$ = 6.269 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.

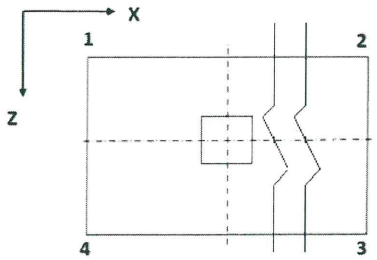
Final dimensions for design

Length (L_2) = 2.700 m Governing Load Case : # 90

Width (W_2) = 2.700 m Governing Load Case : # 90

Area (A_2) = 7.290 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)
91	**194.8168**	195.9554	160.4266	159.2880	0.000
91	194.8168	**195.9554**	160.4266	159.2880	0.000
89	148.6523	150.4081	**188.8614**	187.1057	0.000
90	194.3175	159.5425	160.7014	**195.4764**	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)
91	**194.8168**	195.9554	160.4266	159.2880
91	194.8168	**195.9554**	160.4266	159.2880
89	148.6523	150.4081	**188.8614**	187.1057
90	194.3175	159.5425	160.7014	**195.4764**

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

Governing load case = N/A
Plan area of footing = 7.290 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 = 7.290 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
71	294.619	291.698	729.406	737.025
72	36.887	92.417	166.974	61.016
73	37.393	302.916	336.139	61.724
74	51.186	99.629	177.332	75.633
75	51.180	268.801	323.136	75.875
76	92.714	36.840	60.962	167.377
77	299.801	37.345	61.670	334.531
78	99.965	51.274	75.713	177.775
79	266.407	51.268	75.955	321.687
80	33.804	86.397	154.667	55.672
81	34.298	248.266	290.840	56.366
82	45.648	93.547	164.842	67.921
83	45.684	223.758	281.118	68.194
84	86.654	33.764	55.627	155.011
85	246.183	34.257	56.321	289.643
86	93.840	45.718	67.985	165.221
87	222.111	45.754	68.258	280.030
88	17.048	235.611	589.392	27.626
89	236.686	16.696	27.046	592.344
90	20.306	377.240	942.730	31.416
91	384.050	19.884	30.769	960.128
92	8.166	210.280	528.082	13.069
93	209.604	7.989	12.783	526.559
94	9.537	694.171	1750.120	14.968
95	716.039	9.348	14.672	1805.710

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

Critical Load Case for Sliding along X-Direction : 92
Governing Disturbing Force : 35.808 kN

Governing Restoring Force :	292.390	kN
Minimum Sliding Ratio for the Critical Load Case :	8.166	
Critical Load Case for Overturning about X-Direction :	93	
Governing Overturning Moment :	61.671	kNm
Governing Resisting Moment :	788.335	kNm
Minimum Overturning Ratio for the Critical Load Case :	12.783	

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

Critical Load Case for Sliding along Z-Direction :	93	
Governing Disturbing Force :	36.548	kN
Governing Restoring Force :	291.981	kN
Minimum Sliding Ratio for the Critical Load Case :	7.989	
Critical Load Case for Overturning about Z-Direction :	92	
Governing Overturning Moment :	-60.403	kNm
Governing Resisting Moment :	789.439	kNm
Minimum Overturning Ratio for the Critical Load Case :	13.069	

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

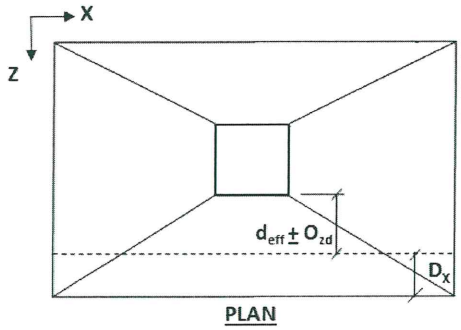
Critical Load Case	**= #65**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.442	m
Effective End Depth =	Initial End Depth - $D - (cc + 0.5 \times d_b)$	= 0.142	m
Effective Width of Equivalent Rectangle =	Col. Width + (Footing Width - Col. Width)/8.0	= 0.687	m
Governing moment (M_u)		= 491.851	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 555.123952	kNm
$M_u <= M_{umax}$	hence, safe		

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

Critical Load Case	**= #65**		
Effective Depth =	$D - (cc + 0.5 \times d_b)$	= 0.442	m
Effective End Depth		= 0.142	m
Effective Width		= 0.687	m
Governing moment (M_u) =		= 458.890	kNm
As Per IS 456 2000 ANNEX G G-1.1C			
Limiting Factor1 (K_{umax}) =	$\frac{700}{(1100 + 0.87 \times f_y)}$	= 0.479107	
Limiting Factor2 (R_{umax}) =	$0.36 \times f_{ck} \times k_{umax} \times (1 - 0.42 \times kumax)$	= 4133.149375	kN/m2
Limit Moment Of Resistance (M_{umax}) =	$R_{umax} \times B \times d_e^2$	= 555.123952	kNm
$M_u <= M_{umax}$	hence, safe		

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

(Shear Plane Parallel To X axis)



PLAN

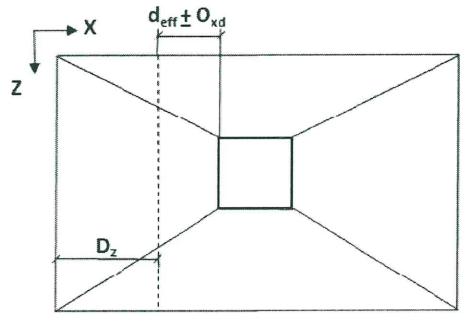
Critical Load Case = #65

D_X = 0.442 m

Shear Force(S)	= 527.753	kN
Shear Stress(T_v)	= 650.331500	kN/m2
Percentage Of Steel(P_t)	= 1.1198	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 684.623	kN/m2
$T_v < T_c$	hence, safe	

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

(Shear Plane Parallel To Z axis)



PLAN

Critical Load Case = #64

D_Z = 0.442 m

Shear Force(S)	= 526.634	kN
Shear Stress(T_v)	= 648.952466	kN/m2
Percentage Of Steel(P_t)	= 1.1189	
As Per IS 456 2000 Clause 40 Table 19		
Shear Strength Of Concrete(T_c)	= 684.430	kN/m2
$T_v < T_c$	hence, safe	

Check Trial Depth for two way shear

Critical Load Case	**= #65**		
Shear Force(S)		= 1687.508	kN
Shear Stress(T_v)		= 1303.616	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)=	$0.25 \times \sqrt{f_{ck}}$	= 1369.3064	kN/m2
K_s X T_c		= 1369.3064	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) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \tau_{bd}}$	= 0.589 m
Allowable Length(l_{db}) =	$\left[\frac{(B - b)}{2} - cc\right]$	= 1.100 m
$l_{db} >= l_d$	hence, safe	

Along Z Axis

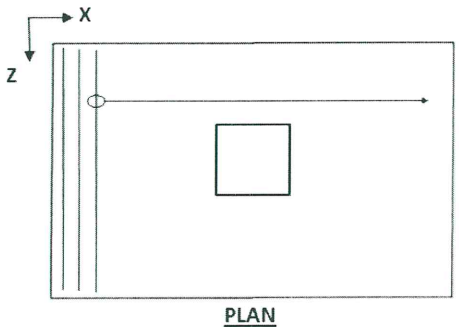
Bar diameter corresponding to max bar size(d_b) = 16 mm

As Per IS 456 2000 Clause 26.2.1

Development Length(l_d) =	$\frac{d_b \times 0.87 \times f_y}{4 \times \tau_{bd}}$	= 0.589 m
Allowable Length(l_{db}) =	$\left[\frac{(H - b)}{2} - cc\right]$	= 1.100 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 = #65

Minimum Area of Steel (A_{stmin}) = 1620.000 mm2

Calculated Area of Steel (A_{st}) = 3708.073 mm2

Provided Area of Steel ($A_{st,Provided}$) = 3708.073 mm2

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

Selected bar Size (d_b) = Ø16

Minimum spacing allowed (S_{min}) = 56.000 mm

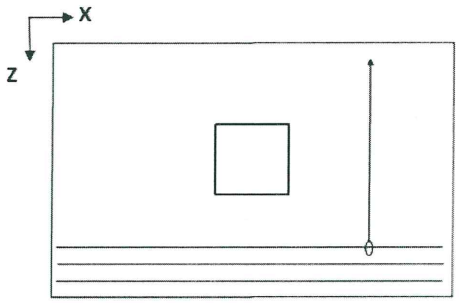
Selected spacing (S) = 143.556 mm

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

Ø16 @ 140.000 mm o.c.

Along X Axis



PLAN

As Per IS 456 2000 Clause 26.5.2.1

Critical Load Case = #65

Minimum Area of Steel (A_{stmin}) = 1620.000 mm2

Calculated Area of Steel (A_{st}) = 3402.659 mm2

Provided Area of Steel ($A_{st,Provided}$) = 3402.659 mm2

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

Selected bar Size (d_b) = Ø16

Minimum spacing allowed (S_{min}) = 100.000 mm

Selected spacing (S) = 161.500 mm

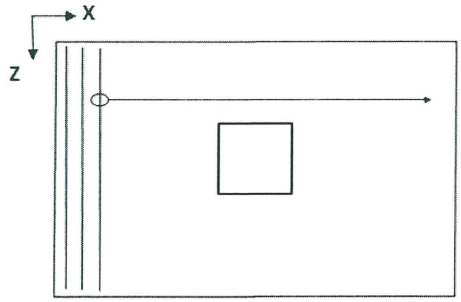
S_{min} <= S <= S_{max} and selected bar size < selected maximum bar size... The reinforcement is accepted.

Based on spacing reinforcement increment; provided reinforcement is

Ø16 @ 160.000 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}) = 1620.000 mm2

Calculated Area of Steel (A_{st}) = 1458.000 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1620.000 mm2

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

Selected bar Size (d_b) = Ø16

Minimum spacing allowed (S_{min}) = 56.000 mm

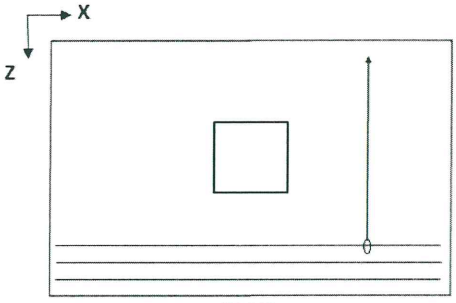
Selected spacing (S) = 300.000mm

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

Ø16 @ 300 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}) = 1620.000 mm2

Calculated Area of Steel (A_{st}) = 1604.808 mm2

Provided Area of Steel ($A_{st,Provided}$) = 1620.000 mm2

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

Selected bar Size (d_b)	= Ø16
Minimum spacing allowed (S_{min})	= 100.000 mm
Selected spacing (S)	= 300.000 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

Ø16 @ 300 mm o.c.

Print Calculation Sheet

LARSEN & TOUBRO LIMITED Construction - Chennai

Asst. Executive Engineer
TDWSP Asifabad

"Designs Vetted" By. Executive Engineer
TDWSP Asifabad

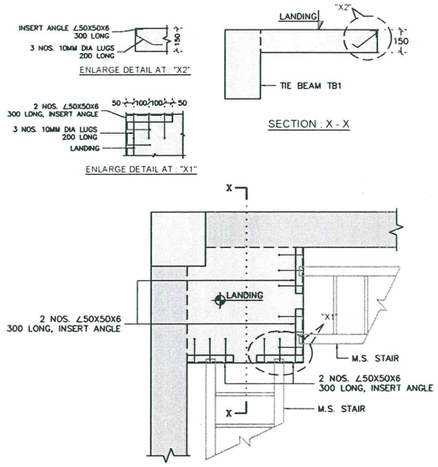
M/s. S.K. Associates HYD-8

WAPCOS LIMITED Hyderabad

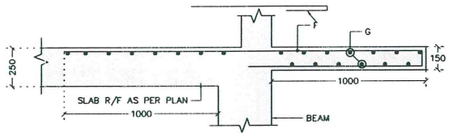
Executive Engineer
TDWSP Asifabad

APPROVED
30/4/16
SE, NIRMAL

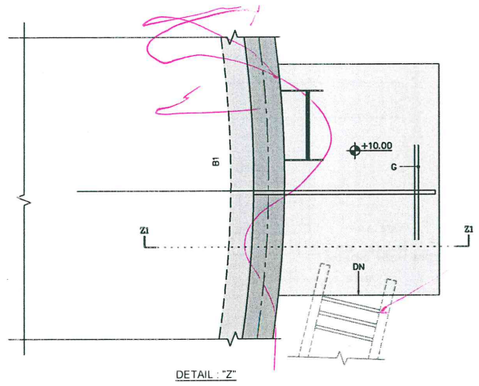
LARSEN & TOUBRO LTD. Komaram Bheem - Asifabad Segment Construction-TDWSP -ADILABAD



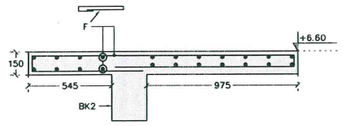
TYPICAL DETAILS FOR STAIR CONNECTION



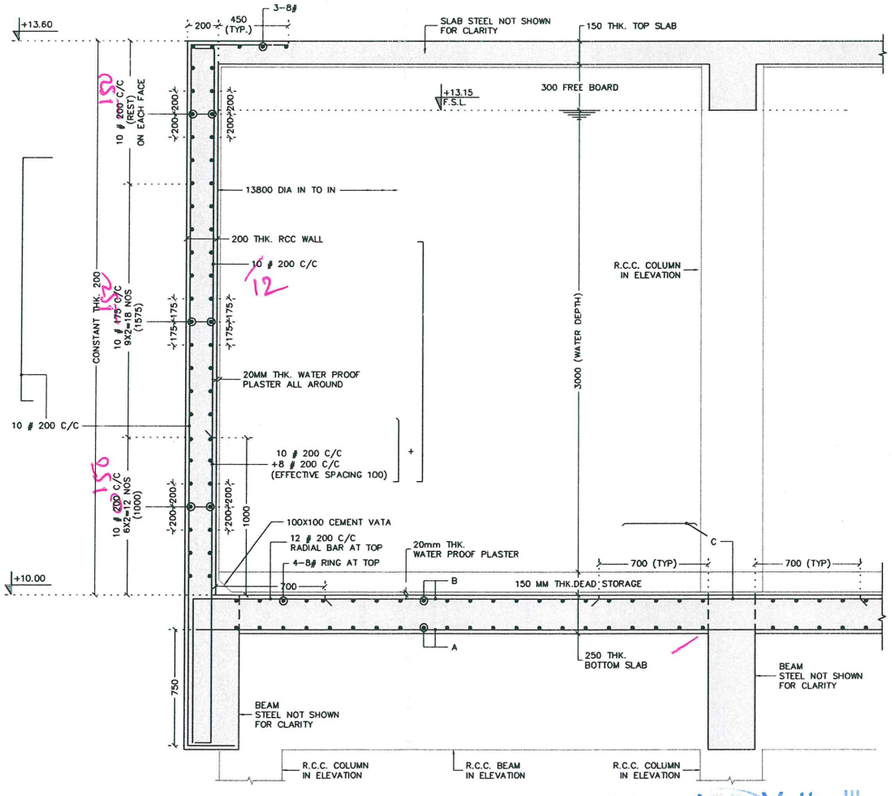
SECTION : Z1 - Z1



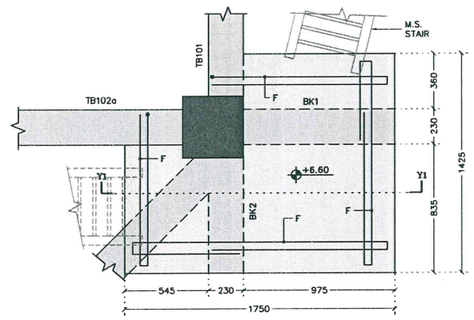
DETAIL : "Z"



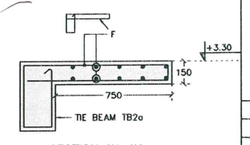
SECTION : Y1 - Y1



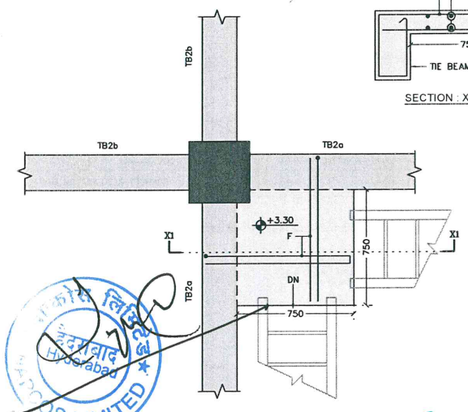
SECTION : 1 - 1



DETAIL : "Y"

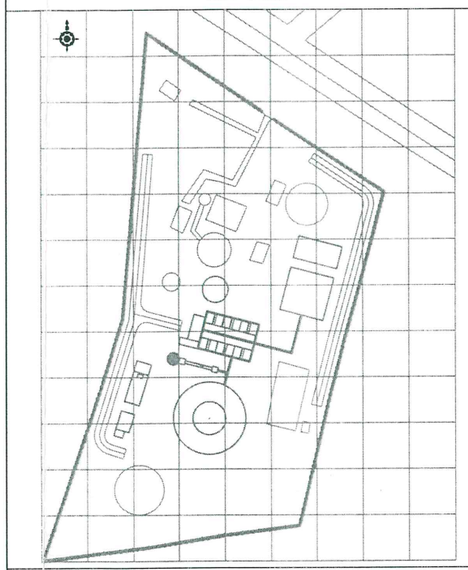


SECTION : X1 - X1



DETAIL : "X"

KEY PLAN



NOTES :
<1> ALL DIMENSION ARE IN MM AND LEVELS ARE IN METER.
<2> FOR ALL OTHER NOTES REFER SHEET NO 1 OF 3.
<3> READ THIS DRAWING ALONG WITH SHEET NO. 1 OF 3 & 2 OF 3.

SLAB SCHEDULE

TYPE	DESCRIPTION
A	12 ϕ 160 C/C THROUGH AT BOTTOM
B	10 ϕ 200 C/C THROUGH AT TOP
C	12 ϕ 200 C/C EXTRA AT TOP
D	10 ϕ 200 C/C ALT BENT UP BAR
E	12 ϕ 400 C/C EXTRA AT TOP
F	10 ϕ 200 C/C CHIPIYA
G	8 ϕ 200 C/C DISTRIBUTION BAR

APPROVED
30/4/16
SE, NIRMAL

LARSEN & TOUBRO LIMITED Construction - Chennai

REV. No	DESCRIPTION	DATE	DESIGNED	DRAWN	CHECKED	APPROVED
A	FOR APPROVAL	23/02/16	HMP	NSP	RMM	–

REVISIONS

L&T Construction
Water, Smart World & Communication.

CLIENT : GOVERNMENT OF TELANGANA
RURAL WATER SUPPLY AND SANITATION DEPARTMENT

CONSULTANT :

PROJECT : PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)

SUPPLIER / CONTRACTOR : L&T Construction
Water & Effluent Treatment SBG

JOB No : LE150883

TITLE : STRUCTURAL DRG FOR BACK WASH TANK (ENLARGE SECTION DETAIL)

SCALE 1:25

PROJECTION

	NAME	SIGN	DATE
DSGN	HMP		23-02-16
DRWN	NSP		23-02-16
CHKD	RMM		23-02-16
APPD	–		23-02-16

DRAWING No. LE150883-C-WS-WT-RC-1097 | SIZE A2 | REV. A

COMP. DATA : L16-02_08-02-03 | SHEET 3 OF 3

RELEASED FOR ☐ PRELIMINARY ☐ TENDER ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

"Drawings Vetted"

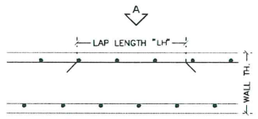
Asst. Executive Engineer
TDWSP Asifabad

Dy. Executive Engineer
TDWSP Asifabad

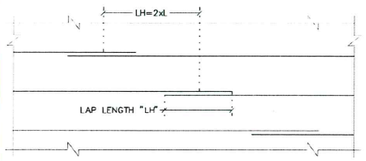
Executive Engineer
TDWSP Asifabad

LAP LENGTH SCHEDULE

DIA OF BAR	LAP LENGTH "L" IN mm
	LAP LENGTH FOR BEAM & COLUMN
8	320
10	400
12	480
16	640
20	800
25	1000

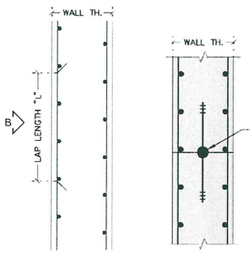


WALL PLAN
(LAP DETAILS FOR HORIZONTAL STEEL)
(LAP SHALL BE STAGGERED AS PER ELEVATION - A)
(FOR CYLINDRICAL WALL & RING BEAM)

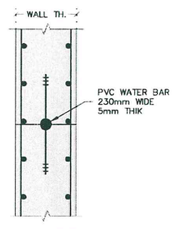


ELEVATION : A

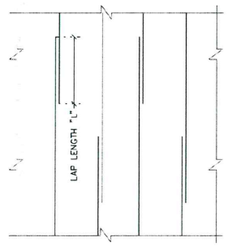
(CIRCULAR REINFORCEMENT FOR CONTAINER STEEL LAP LENGTH LH = 2 X L FOR HORIZONTAL STEEL)



WALL SECTION
LAP DETAILS FOR VERTICAL STEEL
(LAP SHALL BE STAGGERED AS PER ELEVATION - B)

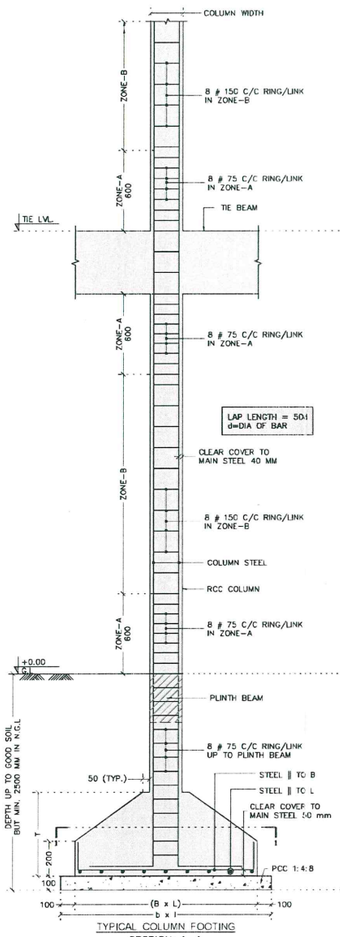


TYPICAL DETAIL OF WATER BAR

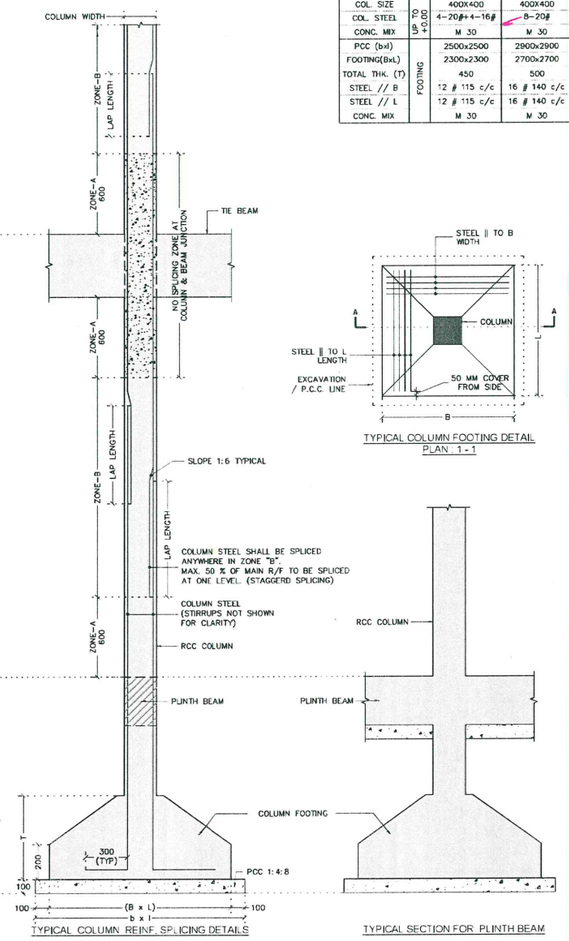


ELEVATION : B

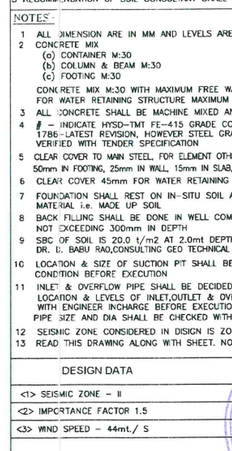
FOUNDATION PLAN



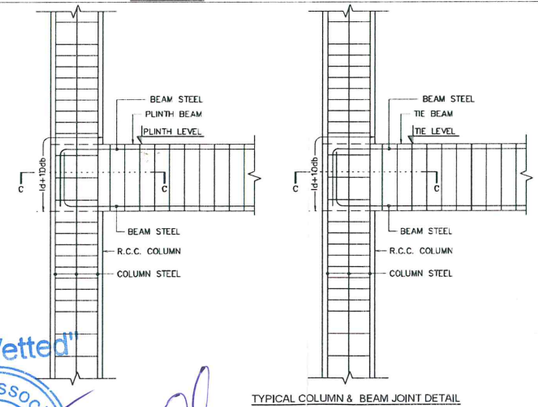
TYPICAL COLUMN FOOTING SECTION A-A



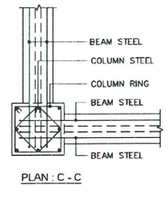
TYPICAL COLUMN REINF. SPLICING DETAILS



TYPICAL SECTION FOR PLINTH BEAM



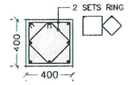
TYPICAL COLUMN & BEAM JOINT DETAIL



PLAN : C - C

TYPICAL COLUMN FOOTING DETAIL PLAN : 1 - 1

COLUMN C1 FOR 8 BAR



COLUMN C2 FOR 8 BAR

COLUMN SCHEDULE

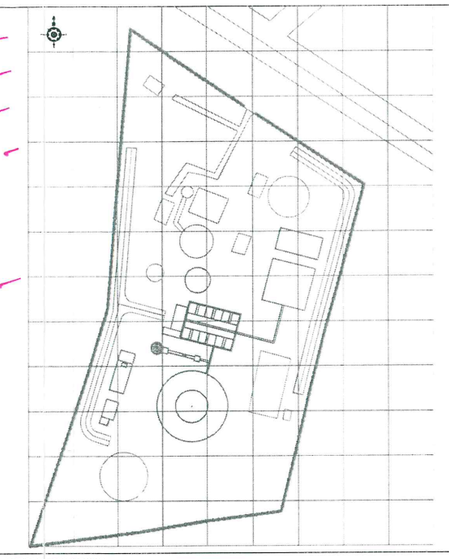
COLUMN NO		C1	C2
COL. SIZE	UP TO +13.60	400X400	400X400
COL. STEEL		4-20ϕ+4-16ϕ	8-20ϕ
CONC. MIX		M 30	M 30
COL. SIZE	UP TO +10.00	400X400	400X400
COL. STEEL		4-20ϕ+4-16ϕ	8-20ϕ
CONC. MIX		M 30	M 30
COL. SIZE	UP TO +6.60	400X400	400X400
COL. STEEL		4-20ϕ+4-16ϕ	8-20ϕ
CONC. MIX		M 30	M 30
COL. SIZE	UP TO +3.30	400X400	400X400
COL. STEEL		4-20ϕ+4-16ϕ	8-20ϕ
CONC. MIX		M 30	M 30
COL. SIZE	UP TO +0.00	400X400	400X400
COL. STEEL		4-20ϕ+4-16ϕ	8-20ϕ
CONC. MIX		M 30	M 30
PCC (bxl)	FOOTING	2500x2500	2900x2900
FOOTING(BxL)		2300x2300	2700x2700
TOTAL THK. (T)		450	500
STEEL // B		12 ϕ 115 c/c	16 ϕ 140 c/c
STEEL // L		12 ϕ 115 c/c	16 ϕ 140 c/c
CONC. MIX		M 30	M 30

IMPORTANT NOTE :
L BEND AT (BEAM, COLUMN JUNCTION / BEAM JUNCTION) SHALL BE PROVIDED PROPERLY. IT IS IMPORTANT TO RESIST SEISMIC FORCE

VALUE OF " ld +10db " WITH 90° BENT

DIA OF BAR	ld+10db
12	520
16	690
20	860
25	1075

KEY PLAN



IMPORTANT NOTES

1 AS PER SOIL INVESTIGATION REPORT OF M.A. PATEL TECHNICAL CONSULTANCY, NO GROUND WATER TABLE WAS FOUND UP TO DEPTH OF INVESTIGATION. IF WATER TABLE IS FOUND DURING THE EXECUTION, WORK SHALL BE STOP AND SAME SHALL BE INFORMED TO CONCERNED AUTHORITY AND DESIGNER. PROPER STORM WATER DRAINAGE SYSTEM FOR SURROUNDING AREA SHALL ALSO BE PROVIDED TO AVOID LOCALIZED TEMPORARY WATER TABLE EFFECTS.

2 FOUNDATION SHALL REST ON GOOD SOIL. IT SHOULD NOT REST ON BLACK COTTON SOIL OR SOIL HAVING EXPANSIVE PROPERTY.

3 RECOMMENDATION OF SOIL CONSULTANT SHALL BE STRICTLY FOLLOWED

NOTES :

1 ALL DIMENSION ARE IN MM AND LEVELS ARE IN METER.
2 CONCRETE MIX
  (a) CONTAINER M:30
  (b) COLUMN & BEAM M:30
  (c) FOOTING M:30
  CONCRETE MIX M:30 WITH MAXIMUM FREE WATER CEMENT RATIO OF 0.45 FOR WATER RETAINING STRUCTURE MAXIMUM CEMENT CONTENT 400kg/m3
3 ALL CONCRETE SHALL BE MACHINE MIXED AND MACHINE VIBRATED
4 ϕ - INDICATE HYSD-TMT FE-415 GRADE CONFORMING TO I.S 1786--LATEST REVISION, HOWEVER STEEL GRADE AND TYPE SHALL BE VERIFIED WITH TENDER SPECIFICATION
5 CLEAR COVER TO MAIN STEEL, FOR ELEMENT OTHER THAN WATER RETAINING SHALL BE 50mm IN FOOTING, 25mm IN WALL, 15mm IN SLAB, 40mm IN COLUMN, 25mm IN BEAM.
6 CLEAR COVER 45mm FOR WATER RETAINING STRUCTURE
7 FOUNDATION SHALL REST ON IN-SITU SOIL AND IT SHALL NOT BE ON FILLING MATERIAL i.e. MADE UP SOIL
8 BACK FILLING SHALL BE DONE IN WELL COMPACTED AND WELL WATER LAYER NOT EXCEEDING 300mm IN DEPTH
9 SBC OF SOIL IS 20.0 t/m2 AT 2.0mt DEPTH AS PER SOIL REPORT PREPARED BY DR. D. BABU RAO,CONSULTING GEO TECHNICAL ENGINEER
10 LOCATION & SIZE OF SUCTION PIT SHALL BE DECIDED AS PER SITE CONDITION BEFORE EXECUTION
11 INLET & OVERFLOW PIPE SHALL BE DECIDED AS PER SITE CONDITION
  LOCATION & LEVELS OF INLET,OUTLET & OVERFLOW PIPE SHALL BE VERIFY WITH ENGINEER INCHARGE BEFORE EXECUTION.
  PIPE SIZE AND DIA SHALL BE CHECKED WITH TENDER DOCUMENT
12 SEISMIC ZONE CONSIDERED IN DISIGN IS ZONE II
13 READ THIS DRAWING ALONG WITH SHEET. NO. 2 OF 3 & 3 OF 3

APPROVED
30/11/16
SE, NIRMAL

DESIGN DATA

<1> SEISMIC ZONE - II
<2> IMPORTANCE FACTOR 1.5
<3> WIND SPEED - 44mt./ S

REV. No	DESCRIPTION	DATE	DESIGNED	DRAWN	CHECKED	APPROVED
A	FOR APPROVAL	23/02/16	HMP	NSP	RMM	-

REVISIONS

L&T Construction
Water, Smart World & Communication.

CLIENT	GOVERNMENT OF TELANGANA RURAL WATER SUPPLY AND SANITATION DEPARTMENT	CONSULTANT -
PROJECT	PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)	
SUPPLIER / CONTRACTOR	L&T Construction Water & Effluent Treatment SBG	

JOB No. LE150883

	NAME	SIGN	DATE
DSGN	HMP		23-02-16
DRWN	NSP		23-02-16
CHKD	RMM		23-02-16
APPD	-		23-02-16

TITLE : STRUCTURAL DRG. FOR BACK WASH TANK (FOUNDATION PLAN & DETAIL)

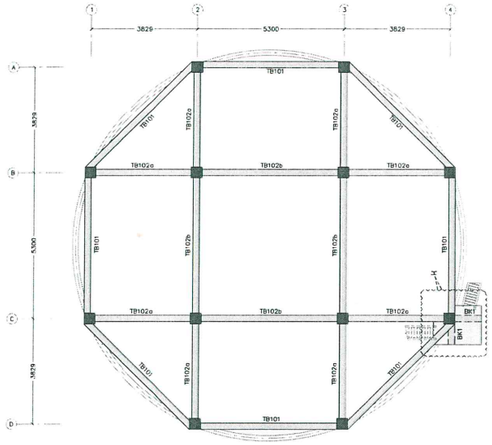
SCALE 1:100,60
PROJECTION

DRAWING No. LE1508 83-C-WS-WT-RC-1097
COMP. DATA : L16-02_08-02-01
SHEET 1 OF 3
SIZE A1 | REV. A

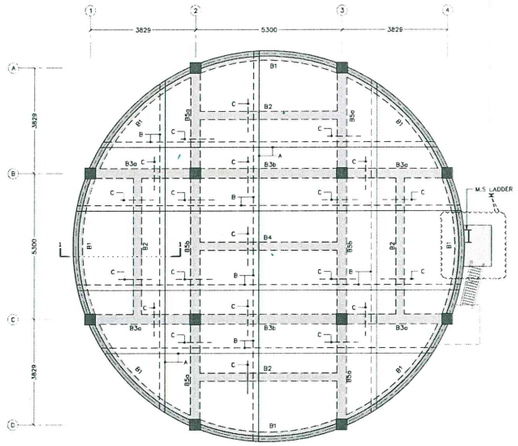
RELEASED FOR ☐ PRELIMINARY ☐ TENDER ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

"Drawings Vetted"
M/s. S.K. Associates HYD-8

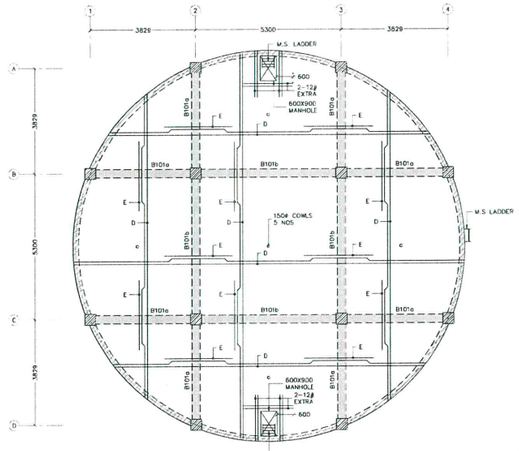
Asst. Executive Engineer
Dy. Executive Engineer
TDWSP Asifabad
Executive Engineer
TDWSP Asifabad



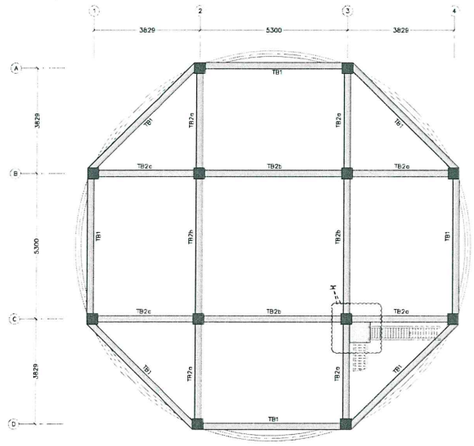
STRUCTURAL LAYOUT AT TIE LEVEL (+6.60 mt LVL)



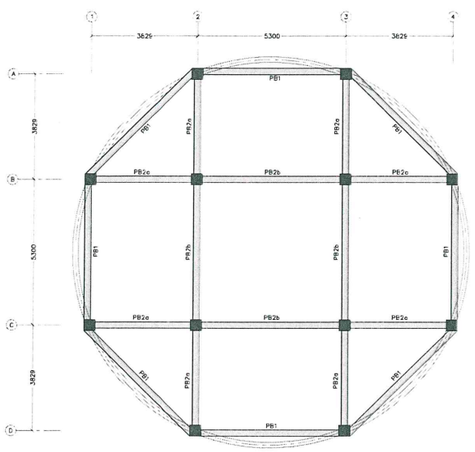
STRUCTURAL LAYOUT AT WATER TANK BOTTOM LEVEL (+10.00 MT LVL)



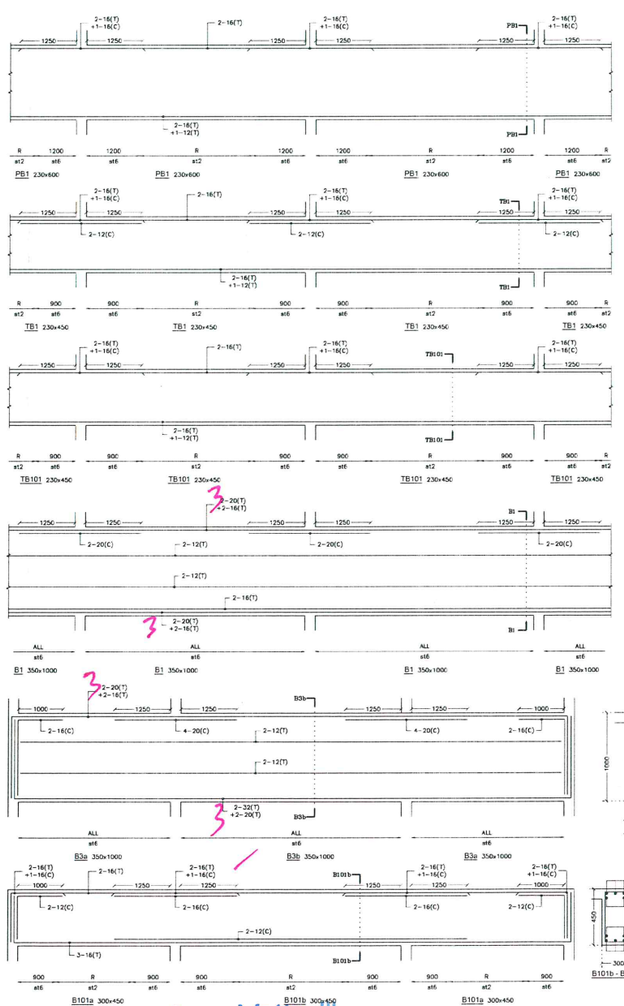
STRUCTURAL LAYOUT AT WATER TANK TOP LEVEL (+13.60 MT LVL)

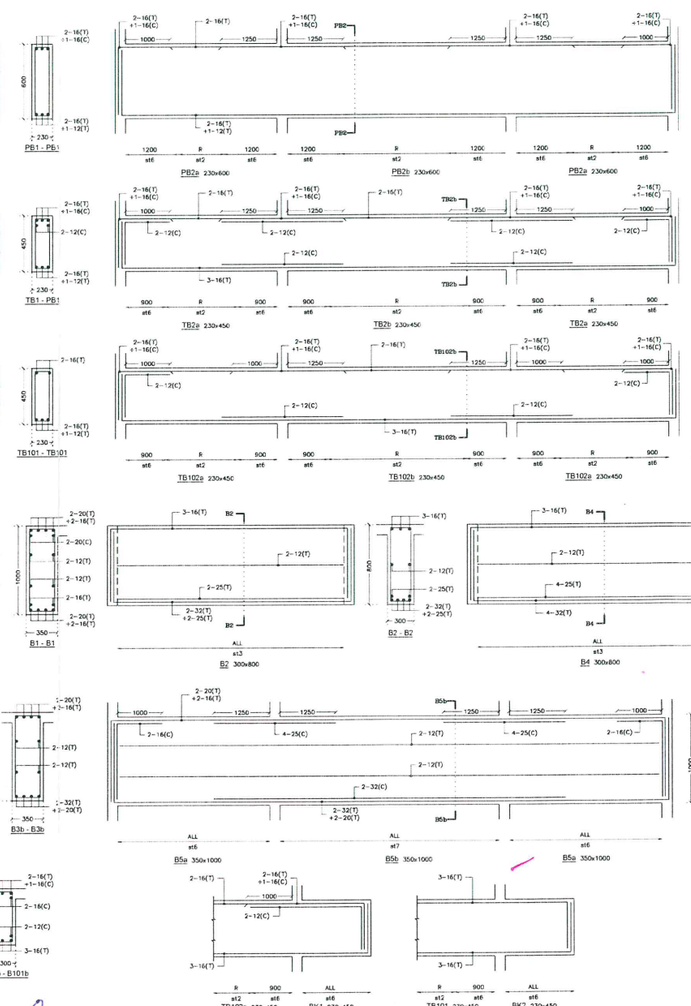


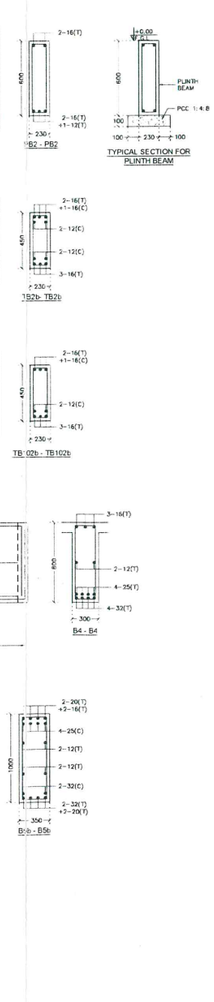
STRUCTURAL LAYOUT AT TIE LEVEL (+3.30 mt LVL)

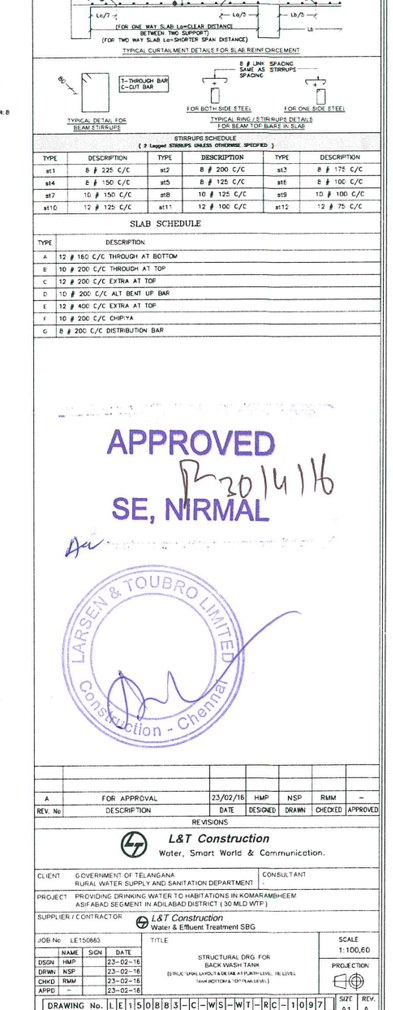


STRUCTURAL LAYOUT AT PLINTH (+0.00 mt LVL)



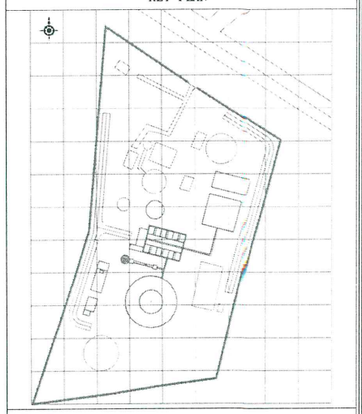




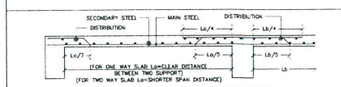


TYPICAL SECTION FOR PLINTH BEAM

KEY PLAN



NOTES :
<1> ALL DIMENSION ARE IN MM AND LEVELS ARE IN METER.
<2> FOR ALL OTHER NOTES REFER SHEET NO 1 OF 3.
<3> READ THIS DRAWING ALONG WITH SHEET NO. 1 OF 3 & 3 OF 3.



TYPICAL CURTAILMENT DETAILS FOR SLAB REINFORCEMENT

STIRRUPS SCHEDULE
(ϕ Legged STIRRUPS UNLESS OTHERWISE SPECIFIED)

TYPE	DESCRIPTION	TYPE	DESCRIPTION	TYPE	DESCRIPTION
st1	8 ϕ 225 C/C	st2	8 ϕ 200 C/C	st3	8 ϕ 175 C/C
st4	8 ϕ 150 C/C	st5	8 ϕ 125 C/C	st6	8 ϕ 100 C/C
st7	10 ϕ 150 C/C	st8	10 ϕ 125 C/C	st9	10 ϕ 100 C/C
st10	12 ϕ 125 C/C	st11	12 ϕ 100 C/C	st12	12 ϕ 75 C/C

SLAB SCHEDULE

TYPE	DESCRIPTION
A	12 ϕ 150 C/C THROUGH AT BOTTOM
B	10 ϕ 200 C/C THROUGH AT TOP
C	12 ϕ 200 C/C EXTRA AT TOP
D	10 ϕ 200 C/C ALT BENT UP BAR
E	12 ϕ 400 C/C EXTRA AT TOP
F	10 ϕ 200 C/C CHIPIYA
G	8 ϕ 200 C/C DISTRIBUTION BAR

APPROVED
30/4/16
SE, NIRMAL

L&T Construction - Chennai

REV. No	DESCRIPTION	DATE	DESIGNED	DRAWN	CHECKED	APPROVED
A	FOR APPROVAL	23/02/16	HMP	NSP	RMM	–

REVISIONS

L&T Construction
Water, Smart World & Communication.

CLIENT : GOVERNMENT OF TELANGANA, RURAL WATER SUPPLY AND SANITATION DEPARTMENT
CONSULTANT : –
PROJECT : PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)
SUPPLIER / CONTRACTOR : L&T Construction, Water & Effluent Treatment SBG

	NAME	SIGN	DATE
DSGN	HMP		23-02-16
DRWN	NSP		23-02-16
CHKD	RMM		23-02-16
APPD	–		23-02-16

JOB No. LE150863
TITLE : STRUCTURAL DRG. FOR BACK WASH TANK (STRUCTURAL LAYOUTS AT TIE, PLINTH LEVEL, TB, LEVEL, TANK BOTTOM & TOP TANK LEVEL)
SCALE : 1:100,60
PROJECTION :
DRAWING No. LE1150863-C-WS-WT-RC-10917
COMP. DATA : L16-02, 08-02-02
SIZE : A1
REV. : A
SHEET 2 OF 3

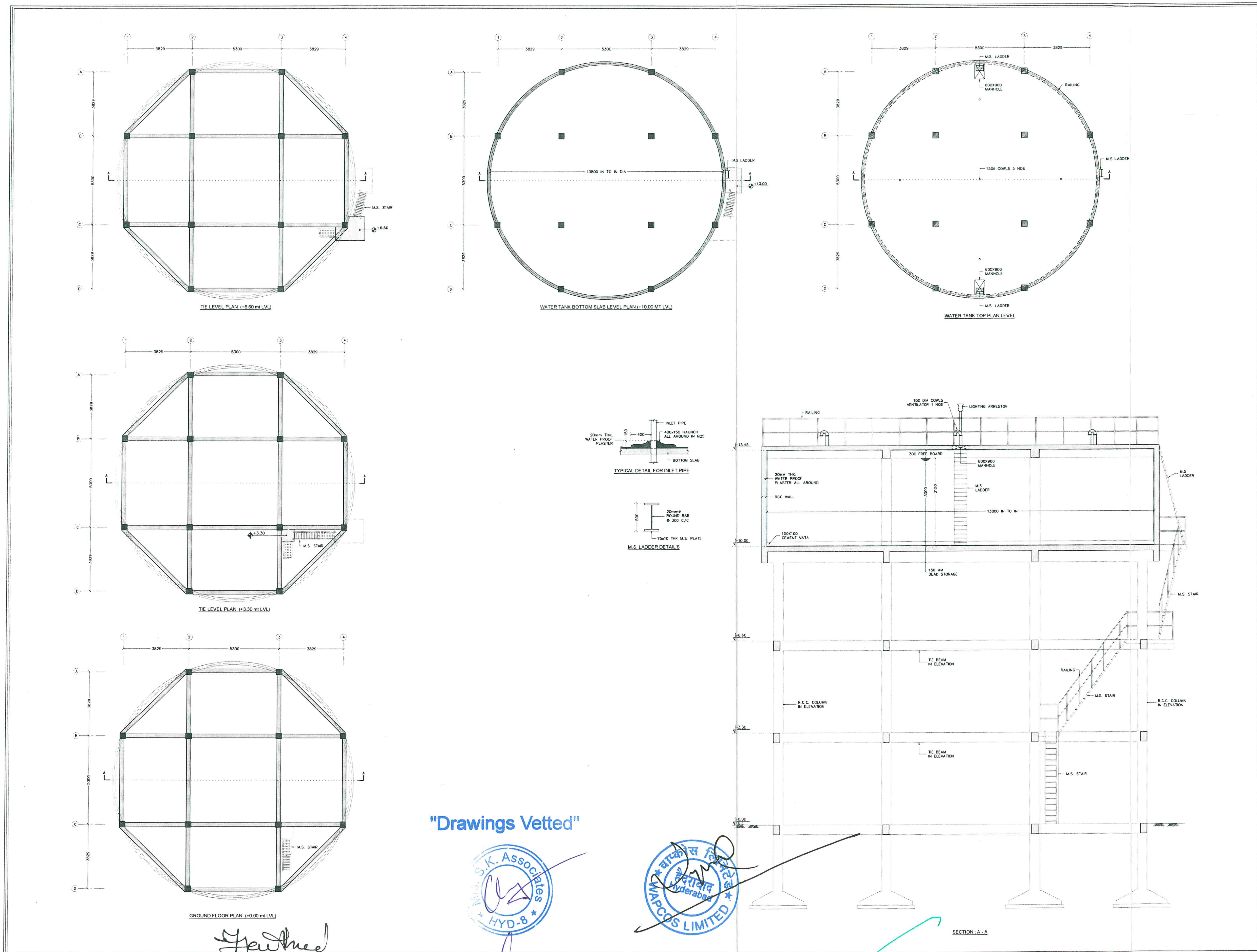
RELEASED FOR : ☐ PRELIMINARY ☐ TENDER ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

"Drawings Vetted"
M/s. S.K. Associates

Asst. Executive Engineer
TDWSP Asifabad

Dy. Executive Engineer

Executive Engineer
TDWSP Asifabad



KEY PLAN

NOTES :
<1> ALL DIMENSION ARE IN MM AND LEVELS ARE IN METER.
<2> LOCATION & LEVELS OF INLET ,OUTLET CUM WASHOUT & OVERFLOW PIPE SHALL BE VARIFIED WITH ENGINEER INCHARGE BEFORE EXECUTION.

APPROVED
SE, NIRMAL

REV. No	DESCRIPTION	DATE	DESIGNED	DRAWN	CHECKED	APPROVED
A	FOR APPROVAL	11/02/16	HMP	NSP	RMM	–

REVISIONS

L&T Construction
Water, Smart World & Communication.

CLIENT : GOVERNMENT OF TELANGANA
RURAL WATER SUPPLY AND SANITATION DEPARTMENT

CONSULTANT : -

PROJECT : PROVIDING DRINKING WATER TO HABITATIONS IN KOMARAMBHEEM ASIFABAD SEGMENT IN ADILABAD DISTRICT (30 MLD WTP)

SUPPLIER / CONTRACTOR : L&T Construction
Water & Effluent Treatment SBG

JOB No : LE150883

	NAME	SIGN	DATE
DSGN	HMP		11-02-16
DRWN	NSP		11-02-16
CHKD	RMM		11-02-16
APPD	–		11-02-16

TITLE
CIVIL G.A DRG. FOR
BACK WASH TANK
(PLAN & SECTION DETAIL)

SCALE 1:100

PROJECTION

DRAWING No. LE150883-C-WS-WT-GA-1094

COMP. DATA : L16-02_08-01-01

SHEET 1 OF 1

SIZE A1

REV. A

RELEASED FOR ☐ PRELIMINARY ☐ TENDER ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

LARSEN & TOUBRO LIMITED Construction - Chennai

"Drawings Vetted"

M/s. S.K. Associates HYD-8

WAPCOS LIMITED Hyderabad

Asst. Executive Engineer
TDWSP Asifabad

Dy. Executive Engineer
TDWSP Asifabad

Executive Engineer
TDWSP Asifabad