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DIGITALLY VERIFIED RECORD

NSK ASSOCIATES
Consultant & Engineers

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STRUCTURAL ENGINEER,
DTCP/SALEM/29/RSE-1/2024,
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STABILITYCERTIFICATE

(To be furnished while filing application for registration of building)

The detailed engineering and structure design of the proposed building comprising of S+4 floors at Site Address : Salem south taluk ,Dadagapatti village, old sf no. 123/1, new ward y, block 16, ts no. 29/22, plot no. 22,23,24,25pt, 31pt,32,33 and 34 has been done by me/us based on the report of geotechnical investigation (soil test) done by SHRI BALAJI GEOTECH Report No. SBGT/CIV/2025-2026/54 Dated 13.03.2025Q and considering the functional requirement of the building.

2. It is certified that among other factors, the proposed building has been designed to resist earthquake. I/We have checked various parameters and found that the proposed building would be safe.

3. I/We further certify that:

(i) The minimum grade of concrete is M20

(ii) The design and analysis has been done using the code of practice for plain and reinforced concrete as per IS 456, design loads as per IS Codes No 875 part 1 and part 2

(iii) Design of earth quake resistant structure as per is Code No Nil

4. The building will be safe and sound when used for the purpose for which it is designed.

Stamp and Signature

N.CHANDRAMOULI, M.E.,
Registered Structural Engineer Grade-I
DTCP/SALEM/29/RSE-I/2024
Email: nskassociates2015@gmail.com
Mobile No: 98945 09342

ISOLATED FOOTING DESIGN

FOOTING ID: F1

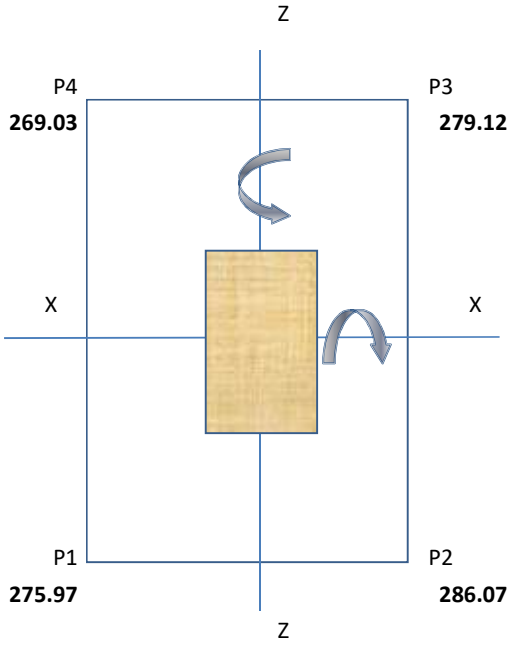
Data:

Grade of Concrete				f_{ck}	=	20	N/mm^2
Grade of steel				f_y	=	500	N/mm^2
Lateral load at X-axis				Hx	=	2	KN
Lateral load at Z-axis				Hz	=	1	KN
Axial load				P	=	497.00	KN
Moment at column base (about X axis)				M_x	=	1.572	KNm
Moment at column base (about Z axis)				M_z	=	2.08	KNm
$M_{x1} = M_x + H_z.D$				M_{x1}	=	1.95	KNm
$M_{z1} = M_z + H_x.D$				M_{z1}	=	2.84	KNm
S.B.C of soil				q_a	=	300.00	KN/m^2
Pedestal dimension along X-axis	(Col.dim	300	+ 0 mm)		=	300.00	mm
Pedestal dimension along Z-axis	(Col.dim	450	+ 0 mm)		=	450.00	mm
Density of concrete					=	25	KN/m^3
Unit weight of Soil					=	18.00	KN/m^3
Depth of Footing below NGL					=	3.00	m
Volume of footing					=	0.855	m^3
Volumn of filling					=	5.895	m^3
Weight of footing				P1	=	21.375	KN
Weight of filling				P2	=	106.110	KN
Clear cover					=	50.00	mm
Moment of resistance					=	$0.133f_{ck}bd^2$	

Area of footing

Weight of footing + backfill	(P1+P2)/P	=	25.65	% of P_u
Eccetricity along Z direction	e_z	=	2.52	mm
Eccentricity along X direction	e_x	=	3.33	mm
Width assumed (B, dim.ll X axis)	B	=	1.50	m
Length of the footing required (L, dim.ll Z axis)		=	1.39	m
Length of the footing provided (L, dim.ll Z axis)	L	=	1.50	m
Area of footing required		=	2.08	m^2
Area of footing provided		=	2.25	m^2
Cantilever projection in the shorter direction		=	0.600	m
Cantilever projection in the longer direction		=	0.525	m

Pressure Values at all four corners



$P1 = P/A + 6M_x/BL^2 - 6M_y/LB^2$	275.97
$P2 = P/A + 6M_x/BL^2 + 6M_y/LB^2$	286.07
$P3 = P/A - 6M_x/BL^2 + 6M_y/LB^2$	279.12
$P4 = P/A - 6M_x/BL^2 - 6M_y/LB^2$	269.03

Pressure Calculation about X axis

Maximum upward intensity of soil pressure	q_{max}	=	286.07	KN/m^2	
Minimum upward intensity of soil pressure	q_{min}	=	269.03	KN/m^2	**No Tension**
Length of footing in contact with soil	L_c	=	1.5	m	
Maximum loss of contact		=	0.0	%	< 30 % **OK**
Effective area of footing		=	2.25	m^2	**> Required**
Effective upward intensity of soil pressure	q_{max}	=	286.07	KN/m^2	**< SBC**
Overturning moment (M)		=	1.95	KNm	
Eccentricity of resultant vertical force		=	0.00	m	**< L/6**
Factor of safety against overturning	F.S	=	239.89		> 1.50 **OK**
Factored Maximum pressure (Pmax) for M_x	P_{max-x}	=	344.11	KN/m^2	
Factored Minimum pressure (Pmin) for M_x	P_{min-x}	=	318.56	KN/m^2	

Pressure calculation about Z axis

Maximum upward intensity of soil pressure	q_{max}	=	286.07	KN/m^2	
Minimum upward intensity of soil pressure	q_{min}	=	269.03	KN/m^2	**No Tension**
Length of footing in contact with soil	B_c	=	1.500	m	
Maximum loss of contact		=	0.0	%	< 30 % **OK**
Effective area of footing		=	2.25	m^2	**> Required**
Effective upward intensity of soil pressure	q_{max}	=	286.07	KN/m^2	**< SBC**
Overturning moment (M)		=	2.8389	KNm	
Eccentricity of resultant vertical force		=	0.00	m	**< L/6**
Factor of safety against overturning	F.S	=	164.981		> 1.50 **OK**
Factored Maximum pressure (Pmax) for M_z	P_{max-x}	=	344.11	KN/m^2	
Factored Minimum pressure (Pmin) for M_z	P_{min-x}	=	318.56	KN/m^2	

Pressure intensity at the face of the column		=	335.17	KN/m^2
Bending moment about X axis		=	70.52	KNm
Design Bending moment	M_{ux}	=	70.52	KNm

Bending moment about Z-axis

Pressure intensity at the face of the column		=	333.89	KN/m^2
Bending moment about Z-axis		=	91.99	KNm
Design Bending moment	M_{uy}	=	91.99	KNm
Effective depth required along longer span	d_{req}	=	130.51	mm
Effective depth required along shorter span	d_{req}	=	149.06	mm
Overall depth required		=	185.512	mm
Overall depth provided	D	=	380	mm
Overall depth at the end		=	380	mm
Effective depth provided along longer span		=	325.00	mm
Effective depth provided along shorter span		=	315.00	mm

Area of Reinforcement

Longer span

Percentage of reinforcement required		=	0.105	%
Area of reinforcement required		=	510.9963557	mm^2
Minimum area of reinforcement required		=	684	mm^2
Diameter of reinforcement		=	10	mm
Area of reinforcement required	A_{streq}	=	684	mm^2
Spacing of reinforcement required		=	172.20	mm
Spacing provided		=	150	mm
Area of reinforcement provided		=	785.25	mm^2
Percentage of reinforcement provided		=	0.161	%

Provide 10 mm diameter bars at 150 mm C/C spacing

Shorter span

Percentage of reinforcement required		=	0.148	%
Area of reinforcement		=	697.8559417	mm^2
Minimum area of reinforcement required		=	684	mm^2
Diameter of reinforcement		=	10	mm
Area of reinforcement required		=	697.8559417	mm^2
Spacing of reinforcement required		=	168.78	mm
Spacing provided		=	150	mm
Area of reinforcement provided		=	785.25	mm^2
Percentage of reinforcement provided		=	0.166	%

Provide 10 mm diameter bars at 150 mm C/C spacing

Check for One Way Shear

Longer Span:

Shear force V1		=	83264.67	N
Nominal shear stress		=	0.146	N/mm^2
Permissible Shear stress for p_t		=	0.30	N/mm^2

Safe in One Way Shear

Shorter span:

Shear force V1		=	118652.15	N
Nominal shear stress		=	0.208	N/mm^2
Permissible Shear stress for p_t		=	0.30	N/mm^2

Safe in One Way Shear

Check for Two Way Shear

Distance of section from the face of the column		=	160	mm
Width of punching square in shorter direction	b1	=	620	mm
Width of punching square in longer direction	b2	=	770	mm
Shear force at the critical section	V_{uz}	=	581.95	KN
Nominal shear stress	ζ_v	=	0.654	N/mm^2
Permissble Shear stress	$k_s.\zeta_{cz}$	=	1.118	N/mm^2

Safe in two way shear

Check for Development length and Anchorage Length

Design Bond stress	0	=	1.92	N/mm^2
Required development length		=	566	mm
Length available		=	550	mm
Minimum extension of column bars into footing beyond bend		=	300	mm

ISOLATED FOOTING DESIGN

FOOTING ID: F2

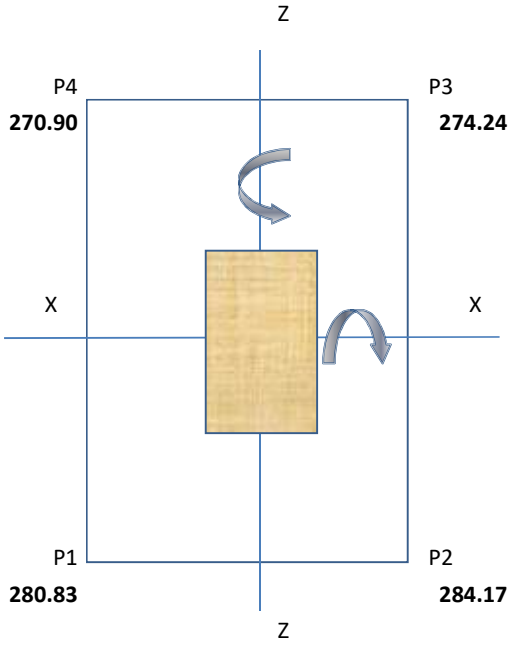
Data:

Grade of Concrete				f_{ck}	=	20	N/mm^2
Grade of steel				f_y	=	500	N/mm^2
Lateral load at X-axis				Hx	=	1	KN
Lateral load at Z-axis				Hz	=	2	KN
Axial load				P	=	656.00	KN
Moment at column base (about X axis)				M_x	=	3.664	KNm
Moment at column base (about Z axis)				M_z	=	0.98	KNm
$M_{x1} = M_x + H_z.D$				M_{x1}	=	4.42	KNm
$M_{z1} = M_z + H_x.D$				M_{z1}	=	1.36	KNm
S.B.C of soil				q_a	=	300.00	KN/m^2
Pedestal dimension along X-axis	(Col.dim	300	+ 0 mm)		=	300.00	mm
Pedestal dimension along Z-axis	(Col.dim	450	+ 0 mm)		=	450.00	mm
Density of concrete					=	25	KN/m^3
Unit weight of Soil					=	18.00	KN/m^3
Depth of Footing below NGL					=	3.00	m
Volume of footing					=	1.129	m^3
Volumn of filling					=	7.781	m^3
Weight of footing				P1	=	28.215	KN
Weight of filling				P2	=	140.065	KN
Clear cover					=	50.00	mm
Moment of resistance					=	$0.133f_{ck}bd^2$	

Area of footing

Weight of footing + backfill	(P1+P2)/P	=	25.65	% of P_u
Eccetricity along Z direction	e_z	=	4.45	mm
Eccentricity along X direction	e_x	=	1.19	mm
Width assumed (B, dim.ll X axis)	B	=	1.65	m
Length of the footing required (L, dim.ll Z axis)		=	1.67	m
Length of the footing provided (L, dim.ll Z axis)	L	=	1.80	m
Area of footing required		=	2.75	m^2
Area of footing provided		=	2.97	m^2
Cantilever projection in the shorter direction		=	0.675	m
Cantilever projection in the longer direction		=	0.675	m

Pressure Values at all four corners



$P1 = P/A + 6M_x/BL^2 - 6M_y/LB^2$		280.83
$P2 = P/A + 6M_x/BL^2 + 6M_y/LB^2$		284.17
$P3 = P/A - 6M_x/BL^2 + 6M_y/LB^2$		274.24
$P4 = P/A - 6M_x/BL^2 - 6M_y/LB^2$		270.90

Pressure Calculation about X axis

Maximum upward intensity of soil pressure	q_{max}	=	284.17 KN/m^2		
Minimum upward intensity of soil pressure	q_{min}	=	270.90 KN/m^2	**No Tension**	
Length of footing in contact with soil	L_c	=	1.8 m		
Maximum loss of contact		=	0.0 %	< 30 %	**OK**
Effective area of footing		=	2.97 m^2	**> Required**	
Effective upward intensity of soil pressure	q_{max}	=	284.17 KN/m^2	**< SBC**	
Overturning moment (M)		=	4.42 KNm		
Eccentricity of resultant vertical force		=	0.01 m	**< L/6**	
Factor of safety against overturning	F.S	=	153.71	> 1.50	**OK**
Factored Maximum pressure (Pmax) for M_x	P_{max-x}	=	341.26 KN/m^2		
Factored Minimum pressure (Pmin) for M_x	P_{min-x}	=	321.36 KN/m^2		

Pressure calculation about Z axis

Maximum upward intensity of soil pressure	q_{max}	=	284.17 KN/m^2		
Minimum upward intensity of soil pressure	q_{min}	=	270.90 KN/m^2	**No Tension**	
Length of footing in contact with soil	B_c	=	1.650 m		
Maximum loss of contact		=	0.0 %	< 30 %	**OK**
Effective area of footing		=	2.97 m^2	**> Required**	
Effective upward intensity of soil pressure	q_{max}	=	284.17 KN/m^2	**< SBC**	
Overturning moment (M)		=	1.3629 KNm		
Eccentricity of resultant vertical force		=	0.00 m	**< L/6**	
Factor of safety against overturning	F.S	=	544.319	> 1.50	**OK**
Factored Maximum pressure (Pmax) for M_z	P_{max-x}	=	341.26 KN/m^2		
Factored Minimum pressure (Pmin) for M_z	P_{min-x}	=	321.36 KN/m^2		

Pressure intensity at the face of the column		=	333.80	KN/m^2
Bending moment about X axis		=	127.34	KNm
Design Bending moment	M_{ux}	=	127.34	KNm

Bending moment about Z-axis

Pressure intensity at the face of the column		=	333.12	KN/m^2
Bending moment about Z-axis		=	138.83	KNm
Design Bending moment	M_{uy}	=	138.83	KNm
Effective depth required along longer span	d_{req}	=	167.22	mm
Effective depth required along shorter span	d_{req}	=	167.17	mm
Overall depth required		=	222.221	mm
Overall depth provided	D	=	380	mm
Overall depth at the end		=	380	mm
Effective depth provided along longer span		=	325.00	mm
Effective depth provided along shorter span		=	315.00	mm

Area of Reinforcement

Longer span

Percentage of reinforcement required		=	0.176	%
Area of reinforcement required		=	943.6675688	mm^2
Minimum area of reinforcement required		=	752.4	mm^2
Diameter of reinforcement		=	10	mm
Area of reinforcement required	A_{streq}	=	943.6675688	mm^2
Spacing of reinforcement required		=	137.30	mm
Spacing provided		=	100	mm
Area of reinforcement provided		=	1295.66	mm^2
Percentage of reinforcement provided		=	0.242	%

Provide 10 mm diameter bars at 100 mm C/C spacing

Shorter span

Percentage of reinforcement required		=	0.188	%
Area of reinforcement		=	1063.397263	mm^2
Minimum area of reinforcement required		=	820.8	mm^2
Diameter of reinforcement		=	10	mm
Area of reinforcement required		=	1063.397263	mm^2
Spacing of reinforcement required		=	132.92	mm
Spacing provided		=	100	mm
Area of reinforcement provided		=	1413.45	mm^2
Percentage of reinforcement provided		=	0.249	%

Provide 10 mm diameter bars at 100 mm C/C spacing

Check for One Way Shear

Longer Span:

Shear force V1		=	160276.71	N
Nominal shear stress		=	0.256	N/mm^2
Permissible Shear stress for p_t		=	0.35	N/mm^2

Safe in One Way Shear

Shorter span:

Shear force V1		=	179842.95	N
Nominal shear stress		=	0.263	N/mm^2
Permissible Shear stress for p_t		=	0.36	N/mm^2

Safe in One Way Shear

Check for Two Way Shear

Distance of section from the face of the column		=	160	mm
Width of punching square in shorter direction	b1	=	620	mm
Width of punching square in longer direction	b2	=	770	mm
Shear force at the critical section	V_{uz}	=	817.40	KN
Nominal shear stress	ζ_v	=	0.919	N/mm^2
Permissble Shear stress	$k_s.\zeta_{cz}$	=	1.118	N/mm^2

Safe in two way shear

Check for Development length and Anchorage Length

Design Bond stress	0	=	1.92	N/mm^2
Required development length		=	566	mm
Length available		=	625	mm
Minimum extension of column bars into footing beyond bend		=	300	mm

ISOLATED FOOTING DESIGN

FOOTING ID: F3

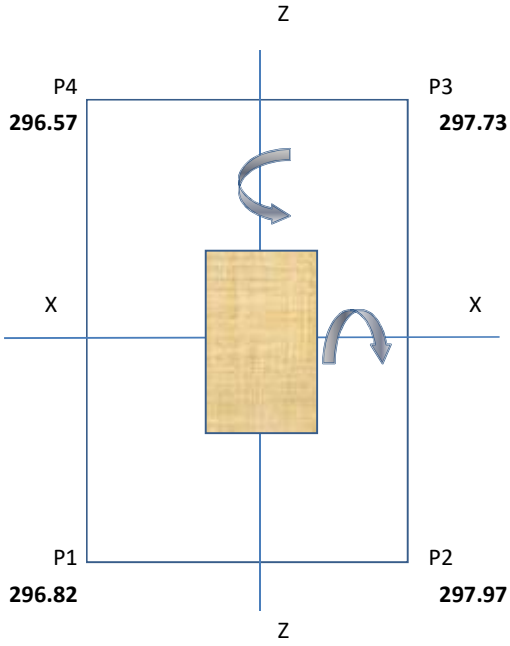
Data:

Grade of Concrete				f_{ck}	=	20	N/mm^2
Grade of steel				f_y	=	500	N/mm^2
Lateral load at X-axis				Hx	=	0.4141	KN
Lateral load at Z-axis				Hz	=	0.03877	KN
Axial load				P	=	778.00	KN
Moment at column base (about X axis)				M_x	=	0.101	KNm
Moment at column base (about Z axis)				M_z	=	0.38	KNm
$M_{x1} = M_x + H_z.D$				M_{x1}	=	0.12	KNm
$M_{z1} = M_z + H_x.D$				M_{z1}	=	0.56	KNm
S.B.C of soil				q_a	=	300.00	KN/m^2
Pedestal dimension along X-axis	(Col.dim	300	+ 0 mm)		=	300.00	mm
Pedestal dimension along Z-axis	(Col.dim	450	+ 0 mm)		=	450.00	mm
Density of concrete					=	25	KN/m^3
Unit weight of Soil					=	18.00	KN/m^3
Depth of Footing below NGL					=	3.00	m
Volume of footing					=	1.458	m^3
Volumn of filling					=	8.262	m^3
Weight of footing				P1	=	36.450	KN
Weight of filling				P2	=	148.716	KN
Clear cover					=	50.00	mm
Moment of resistance					=	$0.133f_{ck}bd^2$	

Area of footing

Weight of footing + backfill	(P1+P2)/P	=	23.80	% of P_u
Eccetricity along Z direction	e_z	=	0.11	mm
Eccentricity along X direction	e_x	=	0.39	mm
Width assumed (B, dim.ll X axis)	B	=	1.80	m
Length of the footing required (L, dim.ll Z axis)		=	1.78	m
Length of the footing provided (L, dim.ll Z axis)	L	=	1.80	m
Area of footing required		=	3.21	m^2
Area of footing provided		=	3.24	m^2
Cantilever projection in the shorter direction		=	0.750	m
Cantilever projection in the longer direction		=	0.675	m

Pressure Values at all four corners



$P1 = P/A + 6M_x/BL^2 - 6M_y/LB^2$	296.82
$P2 = P/A + 6M_x/BL^2 + 6M_y/LB^2$	297.97
$P3 = P/A - 6M_x/BL^2 + 6M_y/LB^2$	297.73
$P4 = P/A - 6M_x/BL^2 - 6M_y/LB^2$	296.57

Pressure Calculation about X axis

Maximum upward intensity of soil pressure	q_{max}	=	297.97	KN/m^2	
Minimum upward intensity of soil pressure	q_{min}	=	296.57	KN/m^2	**No Tension**
Length of footing in contact with soil	L_c	=	1.8	m	
Maximum loss of contact		=	0.0	%	< 30 % **OK**
Effective area of footing		=	3.24	m^2	**> Required**
Effective upward intensity of soil pressure	q_{max}	=	297.97	KN/m^2	**< SBC**
Overturning moment (M)		=	0.12	KNm	
Eccentricity of resultant vertical force		=	0.00	m	**< L/6**
Factor of safety against overturning	F.S	=	7293.86		> 1.50 **OK**
Factored Maximum pressure (Pmax) for M_x	P_{max-x}	=	361.23	KN/m^2	
Factored Minimum pressure (Pmin) for M_x	P_{min-x}	=	359.14	KN/m^2	

Pressure calculation about Z axis

Maximum upward intensity of soil pressure	q_{max}	=	297.97	KN/m^2	
Minimum upward intensity of soil pressure	q_{min}	=	296.57	KN/m^2	**No Tension**
Length of footing in contact with soil	B_c	=	1.800	m	
Maximum loss of contact		=	0.0	%	< 30 % **OK**
Effective area of footing		=	3.24	m^2	**> Required**
Effective upward intensity of soil pressure	q_{max}	=	297.97	KN/m^2	**< SBC**
Overturning moment (M)		=	0.561345	KNm	
Eccentricity of resultant vertical force		=	0.00	m	**< L/6**
Factor of safety against overturning	F.S	=	1544.236		> 1.50 **OK**
Factored Maximum pressure (Pmax) for M_z	P_{max-x}	=	361.23	KN/m^2	
Factored Minimum pressure (Pmin) for M_z	P_{min-x}	=	359.14	KN/m^2	

Pressure intensity at the face of the column		=	360.45	KN/m^2
Bending moment about X axis		=	148.02	KNm
Design Bending moment	M_{ux}	=	148.02	KNm

Bending moment about Z-axis

Pressure intensity at the face of the column		=	360.36	KN/m^2
Bending moment about Z-axis		=	182.73	KNm
Design Bending moment	M_{uy}	=	182.73	KNm
Effective depth required along longer span	d_{req}	=	172.61	mm
Effective depth required along shorter span	d_{req}	=	191.78	mm
Overall depth required		=	227.612	mm
Overall depth provided	D	=	450	mm
Overall depth at the end		=	450	mm
Effective depth provided along longer span		=	395.00	mm
Effective depth provided along shorter span		=	385.00	mm

Area of Reinforcement

Longer span

Percentage of reinforcement required		=	0.125	%
Area of reinforcement required		=	892.2596978	mm^2
Minimum area of reinforcement required		=	972	mm^2
Diameter of reinforcement		=	10	mm
Area of reinforcement required	A_{streq}	=	972	mm^2
Spacing of reinforcement required		=	145.42	mm
Spacing provided		=	100	mm
Area of reinforcement provided		=	1413.45	mm^2
Percentage of reinforcement provided		=	0.199	%

Provide 10 mm diameter bars at 100 mm C/C spacing

Shorter span

Percentage of reinforcement required		=	0.164	%
Area of reinforcement		=	1139.08076	mm^2
Minimum area of reinforcement required		=	972	mm^2
Diameter of reinforcement		=	10	mm
Area of reinforcement required		=	1139.08076	mm^2
Spacing of reinforcement required		=	124.09	mm
Spacing provided		=	100	mm
Area of reinforcement provided		=	1413.45	mm^2
Percentage of reinforcement provided		=	0.204	%

Provide 10 mm diameter bars at 100 mm C/C spacing

Check for One Way Shear

Longer Span:

Shear force V1		=	149825.82	N
Nominal shear stress		=	0.185	N/mm^2
Permissible Shear stress for p_t		=	0.33	N/mm^2

Safe in One Way Shear

Shorter span:

Shear force V1		=	195308.66	N
Nominal shear stress		=	0.241	N/mm^2
Permissible Shear stress for p_t		=	0.33	N/mm^2

Safe in One Way Shear

Check for Two Way Shear

Distance of section from the face of the column		=	195	mm
Width of punching square in shorter direction	b1	=	690	mm
Width of punching square in longer direction	b2	=	840	mm
Shear force at the critical section	V_{uz}	=	930.24	KN
Nominal shear stress	ζ_v	=	0.779	N/mm^2
Permissble Shear stress	$k_s.\zeta_{cz}$	=	1.118	N/mm^2

Safe in two way shear

Check for Development length and Anchorage Length

Design Bond stress	0	=	1.92	N/mm^2
Required development length		=	566	mm
Length available		=	700	mm
Minimum extension of column bars into footing beyond bend		=	300	mm

ISOLATED FOOTING DESIGN

FOOTING ID: F4

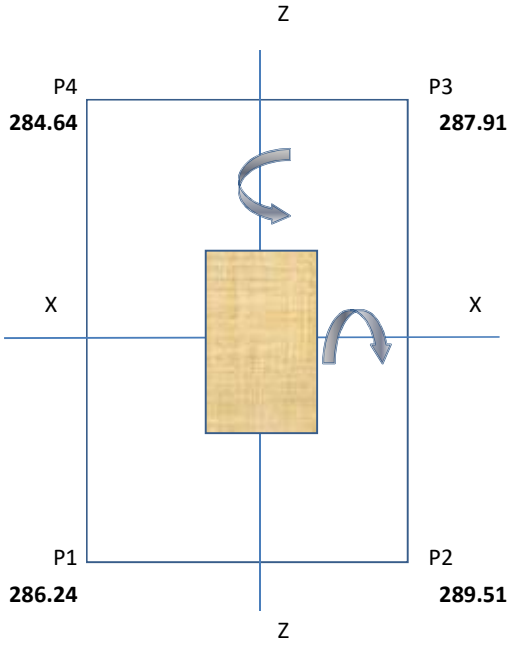
Data:

Grade of Concrete				f_{ck}	=	20	N/mm^2
Grade of steel				f_y	=	500	N/mm^2
Lateral load at X-axis				Hx	=	1	KN
Lateral load at Z-axis				Hz	=	0.3305	KN
Axial load				P	=	867.00	KN
Moment at column base (about X axis)				M_x	=	0.884	KNm
Moment at column base (about Z axis)				M_z	=	1.33	KNm
$M_{x1} = M_x + H_z.D$				M_{x1}	=	1.06	KNm
$M_{z1} = M_z + H_x.D$				M_{z1}	=	1.86	KNm
S.B.C of soil				q_a	=	300.00	KN/m^2
Pedestal dimension along X-axis	(Col.dim	300	+ 0 mm)		=	300.00	mm
Pedestal dimension along Z-axis	(Col.dim	450	+ 0 mm)		=	450.00	mm
Density of concrete					=	25	KN/m^3
Unit weight of Soil					=	18.00	KN/m^3
Depth of Footing below NGL					=	3.00	m
Volume of footing					=	2.003	m^3
Volumn of filling					=	9.337	m^3
Weight of footing				P1	=	50.085	KN
Weight of filling				P2	=	168.059	KN
Clear cover					=	50.00	mm
Moment of resistance					=	$0.133f_{ck}bd^2$	

Area of footing

Weight of footing + backfill	(P1+P2)/P	=	25.16	% of P_u
Eccetricity along Z direction	e_z	=	0.81	mm
Eccentricity along X direction	e_x	=	1.22	mm
Width assumed (B, dim.ll X axis)	B	=	1.80	m
Length of the footing required (L, dim.ll Z axis)		=	2.01	m
Length of the footing provided (L, dim.ll Z axis)	L	=	2.10	m
Area of footing required		=	3.62	m^2
Area of footing provided		=	3.78	m^2
Cantilever projection in the shorter direction		=	0.750	m
Cantilever projection in the longer direction		=	0.825	m

Pressure Values at all four corners



$P1 = P/A + 6M_x/BL^2 - 6M_y/LB^2$		286.24
$P2 = P/A + 6M_x/BL^2 + 6M_y/LB^2$		289.51
$P3 = P/A - 6M_x/BL^2 + 6M_y/LB^2$		287.91
$P4 = P/A - 6M_x/BL^2 - 6M_y/LB^2$		284.64

Pressure Calculation about X axis

Maximum upward intensity of soil pressure	q_{max}	=	289.51 KN/m^2		
Minimum upward intensity of soil pressure	q_{min}	=	284.64 KN/m^2	**No Tension**	
Length of footing in contact with soil	L_c	=	2.1 m		
Maximum loss of contact		=	0.0 %	< 30 %	**OK**
Effective area of footing		=	3.78 m^2	**> Required**	
Effective upward intensity of soil pressure	q_{max}	=	289.51 KN/m^2	**< SBC**	
Overturning moment (M)		=	1.06 KNm		
Eccentricity of resultant vertical force		=	0.00 m	**< L/6**	
Factor of safety against overturning	F.S	=	922.42	> 1.50	**OK**
Factored Maximum pressure (Pmax) for M_x	P_{max-x}	=	347.71 KN/m^2		
Factored Minimum pressure (Pmin) for M_x	P_{min-x}	=	340.39 KN/m^2		

Pressure calculation about Z axis

Maximum upward intensity of soil pressure	q_{max}	=	289.51 KN/m^2		
Minimum upward intensity of soil pressure	q_{min}	=	284.64 KN/m^2	**No Tension**	
Length of footing in contact with soil	B_c	=	1.800 m		
Maximum loss of contact		=	0.0 %	< 30 %	**OK**
Effective area of footing		=	3.78 m^2	**> Required**	
Effective upward intensity of soil pressure	q_{max}	=	289.51 KN/m^2	**< SBC**	
Overturning moment (M)		=	1.8581 KNm		
Eccentricity of resultant vertical force		=	0.00 m	**< L/6**	
Factor of safety against overturning	F.S	=	613.208	> 1.50	**OK**
Factored Maximum pressure (Pmax) for M_z	P_{max-x}	=	347.71 KN/m^2		
Factored Minimum pressure (Pmin) for M_z	P_{min-x}	=	340.39 KN/m^2		

Pressure intensity at the face of the column		=	344.83	KN/m^2
Bending moment about X axis		=	212.40	KNm
Design Bending moment	M_{ux}	=	212.40	KNm

Bending moment about Z-axis

Pressure intensity at the face of the column		=	344.66	KN/m^2
Bending moment about Z-axis		=	204.76	KNm
Design Bending moment	M_{uy}	=	204.76	KNm
Effective depth required along longer span	d_{req}	=	206.77	mm
Effective depth required along shorter span	d_{req}	=	187.96	mm
Overall depth required		=	261.772	mm
Overall depth provided	D	=	530	mm
Overall depth at the end		=	530	mm
Effective depth provided along longer span		=	475.00	mm
Effective depth provided along shorter span		=	465.00	mm

Area of Reinforcement

Longer span

Percentage of reinforcement required		=	0.125	%
Area of reinforcement required		=	1064.652482	mm^2
Minimum area of reinforcement required		=	1144.8	mm^2
Diameter of reinforcement		=	10	mm
Area of reinforcement required	A_{streq}	=	1144.8	mm^2
Spacing of reinforcement required		=	123.47	mm
Spacing provided		=	100	mm
Area of reinforcement provided		=	1413.45	mm^2
Percentage of reinforcement provided		=	0.165	%

Provide 10 mm diameter bars at 100 mm C/C spacing

Shorter span

Percentage of reinforcement required		=	0.106	%
Area of reinforcement		=	1037.499661	mm^2
Minimum area of reinforcement required		=	1335.6	mm^2
Diameter of reinforcement		=	10	mm
Area of reinforcement required		=	1335.6	mm^2
Spacing of reinforcement required		=	123.47	mm
Spacing provided		=	100	mm
Area of reinforcement provided		=	1649.03	mm^2
Percentage of reinforcement provided		=	0.169	%

Provide 10 mm diameter bars at 100 mm C/C spacing

Check for One Way Shear

Longer Span:

Shear force V1		=	180857.30	N
Nominal shear stress		=	0.190	N/mm^2
Permissible Shear stress for p_t		=	0.30	N/mm^2

Safe in One Way Shear

Shorter span:

Shear force V1		=	171814.44	N
Nominal shear stress		=	0.154	N/mm^2
Permissible Shear stress for p_t		=	0.30	N/mm^2

Safe in One Way Shear

Check for Two Way Shear

Distance of section from the face of the column		=	235	mm
Width of punching square in shorter direction	b1	=	770	mm
Width of punching square in longer direction	b2	=	920	mm
Shear force at the critical section	V_{uz}	=	1038.08	KN
Nominal shear stress	ζ_v	=	0.653	N/mm^2
Permissble Shear stress	$k_s.\zeta_{cz}$	=	1.118	N/mm^2

Safe in two way shear

Check for Development length and Anchorage Length

Design Bond stress	0	=	1.92	N/mm^2
Required development length		=	566	mm
Length available		=	700	mm
Minimum extension of column bars into footing beyond bend		=	300	mm

ISOLATED FOOTING DESIGN

FOOTING ID: F5

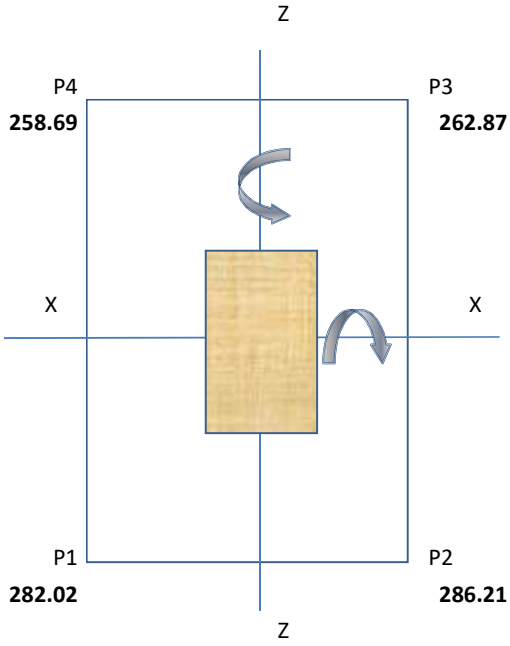
Data:

Grade of Concrete				f_{ck}	=	20	N/mm^2
Grade of steel				f_y	=	500	N/mm^2
Lateral load at X-axis				Hx	=	1	KN
Lateral load at Z-axis				Hz	=	6	KN
Axial load				P	=	947.00	KN
Moment at column base (about X axis)				M_x	=	14.827	KNm
Moment at column base (about Z axis)				M_z	=	2.70	KNm
$M_{x1} = M_x + H_z.D$				M_{x1}	=	18.01	KNm
$M_{z1} = M_z + H_x.D$				M_{z1}	=	3.23	KNm
S.B.C of soil				q_a	=	300.00	KN/m^2
Pedestal dimension along X-axis	(Col.dim	300	+ 0 mm)		=	300.00	mm
Pedestal dimension along Z-axis	(Col.dim	450	+ 0 mm)		=	450.00	mm
Density of concrete					=	25	KN/m^3
Unit weight of Soil					=	18.00	KN/m^3
Depth of Footing below NGL					=	3.00	m
Volume of footing					=	2.337	m^3
Volumn of filling					=	10.893	m^3
Weight of footing				P1	=	58.433	KN
Weight of filling				P2	=	196.069	KN
Clear cover					=	50.00	mm
Moment of resistance					=	$0.133f_{ck}bd^2$	

Area of footing

Weight of footing + backfill	(P1+P2)/P	=	26.87	% of P_u
Eccetricity along Z direction	e_z	=	12.34	mm
Eccentricity along X direction	e_x	=	2.25	mm
Width assumed (B, dim.ll X axis)	B	=	2.10	m
Length of the footing required (L, dim.ll Z axis)		=	1.91	m
Length of the footing provided (L, dim.ll Z axis)	L	=	2.10	m
Area of footing required		=	4.01	m^2
Area of footing provided		=	4.41	m^2
Cantilever projection in the shorter direction		=	0.900	m
Cantilever projection in the longer direction		=	0.825	m

Pressure Values at all four corners



$P1 = P/A + 6M_x/BL^2 - 6M_y/LB^2$	282.02
$P2 = P/A + 6M_x/BL^2 + 6M_y/LB^2$	286.21
$P3 = P/A - 6M_x/BL^2 + 6M_y/LB^2$	262.87
$P4 = P/A - 6M_x/BL^2 - 6M_y/LB^2$	258.69

Pressure Calculation about X axis

Maximum upward intensity of soil pressure	q_{max}	=	286.21	KN/m^2	
Minimum upward intensity of soil pressure	q_{min}	=	258.69	KN/m^2	**No Tension**
Length of footing in contact with soil	L_c	=	2.1	m	
Maximum loss of contact		=	0.0	%	< 30 % **OK**
Effective area of footing		=	4.41	m^2	**> Required**
Effective upward intensity of soil pressure	q_{max}	=	286.21	KN/m^2	**< SBC**
Overturning moment (M)		=	18.01	KNm	
Eccentricity of resultant vertical force		=	0.01	m	**< L/6**
Factor of safety against overturning	F.S	=	70.06		> 1.50 **OK**
Factored Maximum pressure (Pmax) for M_x	P_{max-x}	=	342.75	KN/m^2	
Factored Minimum pressure (Pmin) for M_x	P_{min-x}	=	301.47	KN/m^2	

Pressure calculation about Z axis

Maximum upward intensity of soil pressure	q_{max}	=	286.21	KN/m^2	
Minimum upward intensity of soil pressure	q_{min}	=	258.69	KN/m^2	**No Tension**
Length of footing in contact with soil	B_c	=	2.100	m	
Maximum loss of contact		=	0.0	%	< 30 % **OK**
Effective area of footing		=	4.41	m^2	**> Required**
Effective upward intensity of soil pressure	q_{max}	=	286.21	KN/m^2	**< SBC**
Overturning moment (M)		=	3.2282	KNm	
Eccentricity of resultant vertical force		=	0.00	m	**< L/6**
Factor of safety against overturning	F.S	=	390.799		> 1.50 **OK**
Factored Maximum pressure (Pmax) for M_z	P_{max-x}	=	342.75	KN/m^2	
Factored Minimum pressure (Pmin) for M_z	P_{min-x}	=	301.47	KN/m^2	

Pressure intensity at the face of the column		=	326.53	KN/m^2
Bending moment about X axis		=	241.08	KNm
Design Bending moment	M_{ux}	=	241.08	KNm

Bending moment about Z-axis

Pressure intensity at the face of the column		=	325.06	KN/m^2
Bending moment about Z-axis		=	286.49	KNm
Design Bending moment	M_{uy}	=	286.49	KNm
Effective depth required along longer span	d_{req}	=	203.95	mm
Effective depth required along shorter span	d_{req}	=	222.33	mm
Overall depth required		=	258.948	mm
Overall depth provided	D	=	530	mm
Overall depth at the end		=	530	mm
Effective depth provided along longer span		=	475.00	mm
Effective depth provided along shorter span		=	465.00	mm

Area of Reinforcement

Longer span

Percentage of reinforcement required		=	0.121	%
Area of reinforcement required		=	1208.127604	mm^2
Minimum area of reinforcement required		=	1335.6	mm^2
Diameter of reinforcement		=	10	mm
Area of reinforcement required	A_{streq}	=	1335.6	mm^2
Spacing of reinforcement required		=	123.47	mm
Spacing provided		=	100	mm
Area of reinforcement provided		=	1649.03	mm^2
Percentage of reinforcement provided		=	0.165	%

Provide 10 mm diameter bars at 100 mm C/C spacing

Shorter span

Percentage of reinforcement required		=	0.151	%
Area of reinforcement		=	1474.937728	mm^2
Minimum area of reinforcement required		=	1335.6	mm^2
Diameter of reinforcement		=	10	mm
Area of reinforcement required		=	1474.937728	mm^2
Spacing of reinforcement required		=	111.80	mm
Spacing provided		=	100	mm
Area of reinforcement provided		=	1649.03	mm^2
Percentage of reinforcement provided		=	0.169	%

Provide 10 mm diameter bars at 100 mm C/C spacing

Check for One Way Shear

Longer Span:

Shear force V1		=	200250.18	N
Nominal shear stress		=	0.180	N/mm^2
Permissible Shear stress for p_t		=	0.30	N/mm^2

Safe in One Way Shear

Shorter span:

Shear force V1		=	248882.37	N
Nominal shear stress		=	0.224	N/mm^2
Permissible Shear stress for p_t		=	0.30	N/mm^2

Safe in One Way Shear

Check for Two Way Shear

Distance of section from the face of the column		=	235	mm
Width of punching square in shorter direction	b1	=	770	mm
Width of punching square in longer direction	b2	=	920	mm
Shear force at the critical section	V_{uz}	=	1213.64	KN
Nominal shear stress	ζ_v	=	0.764	N/mm^2
Permissble Shear stress	$k_s.\zeta_{cz}$	=	1.118	N/mm^2

Safe in two way shear

Check for Development length and Anchorage Length

Design Bond stress	0	=	1.92	N/mm^2
Required development length		=	566	mm
Length available		=	850	mm
Minimum extension of column bars into footing beyond bend		=	300	mm

ISOLATED FOOTING DESIGN

FOOTING ID: F6

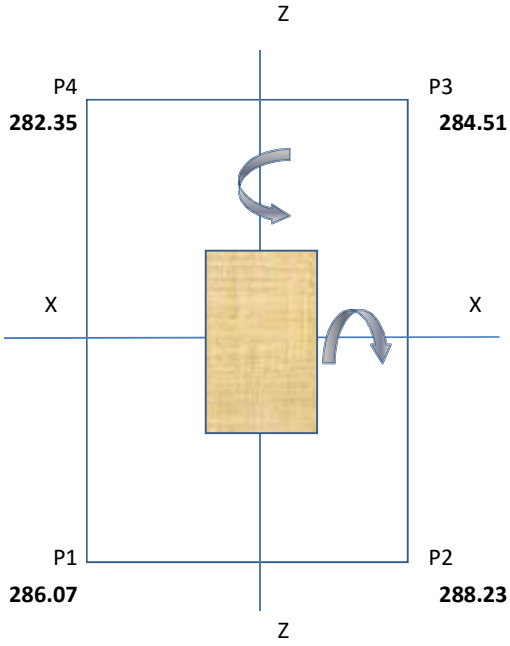
Data:

Grade of Concrete				f_{ck}	=	20	N/mm^2
Grade of steel				f_y	=	500	N/mm^2
Lateral load at X-axis				Hx	=	1	KN
Lateral load at Z-axis				Hz	=	2	KN
Axial load				P	=	1073.00	KN
Moment at column base (about X axis)				M_x	=	2.095	KNm
Moment at column base (about Z axis)				M_z	=	1.19	KNm
$M_{x1} = M_x + H_z.D$				M_{x1}	=	3.30	KNm
$M_{z1} = M_z + H_x.D$				M_{z1}	=	1.79	KNm
S.B.C of soil				q_a	=	300.00	KN/m^2
Pedestal dimension along X-axis	(Col.dim	300	+ 0 mm)		=	300.00	mm
Pedestal dimension along Z-axis	(Col.dim	450	+ 0 mm)		=	450.00	mm
Density of concrete					=	25	KN/m^3
Unit weight of Soil					=	18.00	KN/m^3
Depth of Footing below NGL					=	3.00	m
Volume of footing					=	2.835	m^3
Volumn of filling					=	11.340	m^3
Weight of footing				P1	=	70.875	KN
Weight of filling				P2	=	204.120	KN
Clear cover					=	50.00	mm
Moment of resistance					=	$0.133f_{ck}bd^2$	

Area of footing

Weight of footing + backfill	(P1+P2)/P	=	25.63	% of P_u
Eccetricity along Z direction	e_z	=	1.55	mm
Eccentricity along X direction	e_x	=	0.88	mm
Width assumed (B, dim.ll X axis)	B	=	2.10	m
Length of the footing required (L, dim.ll Z axis)		=	2.14	m
Length of the footing provided (L, dim.ll Z axis)	L	=	2.25	m
Area of footing required		=	4.49	m^2
Area of footing provided		=	4.73	m^2
Cantilever projection in the shorter direction		=	0.900	m
Cantilever projection in the longer direction		=	0.900	m

Pressure Values at all four corners



$P1 = P/A + 6M_x/BL^2 - 6M_y/LB^2$		286.07
$P2 = P/A + 6M_x/BL^2 + 6M_y/LB^2$		288.23
$P3 = P/A - 6M_x/BL^2 + 6M_y/LB^2$		284.51
$P4 = P/A - 6M_x/BL^2 - 6M_y/LB^2$		282.35

Pressure Calculation about X axis

Maximum upward intensity of soil pressure	q_{max}	=	288.23 KN/m^2		
Minimum upward intensity of soil pressure	q_{min}	=	282.35 KN/m^2	**No Tension**	
Length of footing in contact with soil	L_c	=	2.25 m		
Maximum loss of contact		=	0.0 %	< 30 %	**OK**
Effective area of footing		=	4.725 m^2	**> Required**	
Effective upward intensity of soil pressure	q_{max}	=	288.23 KN/m^2	**< SBC**	
Overturning moment (M)		=	3.30 KNm		
Eccentricity of resultant vertical force		=	0.00 m	**< L/6**	
Factor of safety against overturning	F.S	=	429.53	> 1.50	**OK**
Factored Maximum pressure (Pmax) for M_x	P_{max-x}	=	345.04 KN/m^2		
Factored Minimum pressure (Pmin) for M_x	P_{min-x}	=	336.23 KN/m^2		

Pressure calculation about Z axis

Maximum upward intensity of soil pressure	q_{max}	=	288.23 KN/m^2		
Minimum upward intensity of soil pressure	q_{min}	=	282.35 KN/m^2	**No Tension**	
Length of footing in contact with soil	B_c	=	2.100 m		
Maximum loss of contact		=	0.0 %	< 30 %	**OK**
Effective area of footing		=	4.725 m^2	**> Required**	
Effective upward intensity of soil pressure	q_{max}	=	288.23 KN/m^2	**< SBC**	
Overturning moment (M)		=	1.785 KNm		
Eccentricity of resultant vertical force		=	0.00 m	**< L/6**	
Factor of safety against overturning	F.S	=	849.577	> 1.50	**OK**
Factored Maximum pressure (Pmax) for M_z	P_{max-x}	=	345.04 KN/m^2		
Factored Minimum pressure (Pmin) for M_z	P_{min-x}	=	336.23 KN/m^2		

Pressure intensity at the face of the column		=	341.52	KN/m^2
Bending moment about X axis		=	292.46	KNm
Design Bending moment	M_{ux}	=	292.46	KNm

Bending moment about Z-axis

Pressure intensity at the face of the column		=	341.26	KN/m^2
Bending moment about Z-axis		=	313.27	KNm
Design Bending moment	M_{uy}	=	313.27	KNm
Effective depth required along longer span	d_{req}	=	224.63	mm
Effective depth required along shorter span	d_{req}	=	224.60	mm
Overall depth required		=	280.631	mm
Overall depth provided	D	=	600	mm
Overall depth at the end		=	600	mm
Effective depth provided along longer span		=	544.00	mm
Effective depth provided along shorter span		=	532.00	mm

Area of Reinforcement

Longer span

Percentage of reinforcement required		=	0.111	%
Area of reinforcement required		=	1272.121166	mm^2
Minimum area of reinforcement required		=	1512	mm^2
Diameter of reinforcement		=	12	mm
Area of reinforcement required	A_{streq}	=	1512	mm^2
Spacing of reinforcement required		=	157.05	mm
Spacing provided		=	150	mm
Area of reinforcement provided		=	1583.06	mm^2
Percentage of reinforcement provided		=	0.139	%

Provide 12 mm diameter bars at 150 mm C/C spacing

Shorter span

Percentage of reinforcement required		=	0.117	%
Area of reinforcement		=	1399.364047	mm^2
Minimum area of reinforcement required		=	1620	mm^2
Diameter of reinforcement		=	12	mm
Area of reinforcement required		=	1620	mm^2
Spacing of reinforcement required		=	157.05	mm
Spacing provided		=	150	mm
Area of reinforcement provided		=	1696.14	mm^2
Percentage of reinforcement provided		=	0.142	%

Provide 12 mm diameter bars at 150 mm C/C spacing

Check for One Way Shear

Longer Span:

Shear force V1		=	213282.76	N
Nominal shear stress		=	0.169	N/mm^2
Permissible Shear stress for p_t		=	0.28	N/mm^2

Safe in One Way Shear

Shorter span:

Shear force V1		=	236220.08	N
Nominal shear stress		=	0.175	N/mm^2
Permissible Shear stress for p_t		=	0.28	N/mm^2

Safe in One Way Shear

Check for Two Way Shear

Distance of section from the face of the column		=	269	mm
Width of punching square in shorter direction	b1	=	838	mm
Width of punching square in longer direction	b2	=	988	mm
Shear force at the critical section	V_{uz}	=	1307.29	KN
Nominal shear stress	ζ_v	=	0.665	N/mm^2
Permissble Shear stress	$k_s.\zeta_{cz}$	=	1.118	N/mm^2

Safe in two way shear

Check for Development length and Anchorage Length

Design Bond stress	0	=	1.92	N/mm^2
Required development length		=	680	mm
Length available		=	850	mm
Minimum extension of column bars into footing beyond bend		=	300	mm

ISOLATED FOOTING DESIGN

FOOTING ID: F7

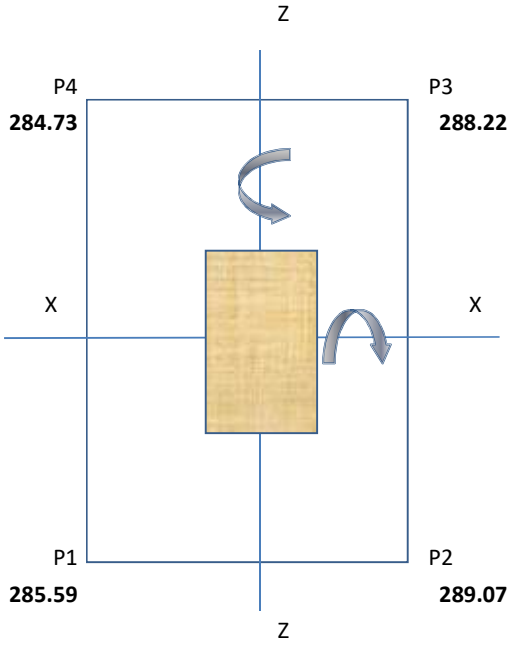
Data:

Grade of Concrete				f_{ck}	=	20	N/mm^2
Grade of steel				f_y	=	500	N/mm^2
Lateral load at X-axis				Hx	=	1	KN
Lateral load at Z-axis				Hz	=	0.207	KN
Axial load				P	=	1235.00	KN
Moment at column base (about X axis)				M_x	=	0.803	KNm
Moment at column base (about Z axis)				M_z	=	2.93	KNm
$M_{x1} = M_x + H_z.D$				M_{x1}	=	0.93	KNm
$M_{z1} = M_z + H_x.D$				M_{z1}	=	3.53	KNm
S.B.C of soil				q_a	=	300.00	KN/m^2
Pedestal dimension along X-axis	(Col.dim	300	+ 0 mm)		=	300.00	mm
Pedestal dimension along Z-axis	(Col.dim	530	+ 0 mm)		=	530.00	mm
Density of concrete					=	25	KN/m^3
Unit weight of Soil					=	18.00	KN/m^3
Depth of Footing below NGL					=	3.00	m
Volume of footing					=	3.240	m^3
Volumn of filling					=	12.960	m^3
Weight of footing				P1	=	81.000	KN
Weight of filling				P2	=	233.280	KN
Clear cover					=	50.00	mm
Moment of resistance					=	$0.133f_{ck}bd^2$	

Area of footing

Weight of footing + backfill	(P1+P2)/P	=	25.45	% of P_u
Eccetricity along Z direction	e_z	=	0.52	mm
Eccentricity along X direction	e_x	=	1.89	mm
Width assumed (B, dim.ll X axis)	B	=	2.25	m
Length of the footing required (L, dim.ll Z axis)		=	2.30	m
Length of the footing provided (L, dim.ll Z axis)	L	=	2.40	m
Area of footing required		=	5.16	m^2
Area of footing provided		=	5.40	m^2
Cantilever projection in the shorter direction		=	0.975	m
Cantilever projection in the longer direction		=	0.935	m

Pressure Values at all four corners



$P1 = P/A + 6M_x/BL^2 - 6M_y/LB^2$	285.59
$P2 = P/A + 6M_x/BL^2 + 6M_y/LB^2$	289.07
$P3 = P/A - 6M_x/BL^2 + 6M_y/LB^2$	288.22
$P4 = P/A - 6M_x/BL^2 - 6M_y/LB^2$	284.73

Pressure Calculation about X axis

Maximum upward intensity of soil pressure	q_{max}	=	289.07 KN/m^2		
Minimum upward intensity of soil pressure	q_{min}	=	284.73 KN/m^2	**No Tension**	
Length of footing in contact with soil	L_c	=	2.4 m		
Maximum loss of contact		=	0.0 %	< 30 %	**OK**
Effective area of footing		=	5.4 m^2	**> Required**	
Effective upward intensity of soil pressure	q_{max}	=	289.07 KN/m^2	**< SBC**	
Overturning moment (M)		=	0.93 KNm		
Eccentricity of resultant vertical force		=	0.00 m	**< L/6**	
Factor of safety against overturning	F.S	=	1879.38	> 1.50	**OK**
Factored Maximum pressure (Pmax) for M_x	P_{max-x}	=	346.31 KN/m^2		
Factored Minimum pressure (Pmin) for M_x	P_{min-x}	=	339.80 KN/m^2		

Pressure calculation about Z axis

Maximum upward intensity of soil pressure	q_{max}	=	289.07 KN/m^2		
Minimum upward intensity of soil pressure	q_{min}	=	284.73 KN/m^2	**No Tension**	
Length of footing in contact with soil	B_c	=	2.250 m		
Maximum loss of contact		=	0.0 %	< 30 %	**OK**
Effective area of footing		=	5.4 m^2	**> Required**	
Effective upward intensity of soil pressure	q_{max}	=	289.07 KN/m^2	**< SBC**	
Overturning moment (M)		=	3.5259 KNm		
Eccentricity of resultant vertical force		=	0.00 m	**< L/6**	
Factor of safety against overturning	F.S	=	527.280	> 1.50	**OK**
Factored Maximum pressure (Pmax) for M_z	P_{max-x}	=	346.31 KN/m^2		
Factored Minimum pressure (Pmin) for M_z	P_{min-x}	=	339.80 KN/m^2		

Pressure intensity at the face of the column		=	343.77	KN/m^2
Bending moment about X axis		=	339.77	KNm
Design Bending moment	M_{ux}	=	339.77	KNm

Bending moment about Z-axis

Pressure intensity at the face of the column		=	343.49	KN/m^2
Bending moment about Z-axis		=	393.98	KNm
Design Bending moment	M_{uy}	=	393.98	KNm
Effective depth required along longer span	d_{req}	=	233.91	mm
Effective depth required along shorter span	d_{req}	=	243.88	mm
Overall depth required		=	289.908	mm
Overall depth provided	D	=	600	mm
Overall depth at the end		=	600	mm
Effective depth provided along longer span		=	544.00	mm
Effective depth provided along shorter span		=	532.00	mm

Area of Reinforcement

Longer span

Percentage of reinforcement required		=	0.121	%
Area of reinforcement required		=	1486.730518	mm^2
Minimum area of reinforcement required		=	1620	mm^2
Diameter of reinforcement		=	12	mm
Area of reinforcement required	A_{streq}	=	1620	mm^2
Spacing of reinforcement required		=	157.05	mm
Spacing provided		=	125	mm
Area of reinforcement provided		=	2035.37	mm^2
Percentage of reinforcement provided		=	0.166	%

Provide 12 mm diameter bars at 125 mm C/C spacing

Shorter span

Percentage of reinforcement required		=	0.138	%
Area of reinforcement		=	1764.593208	mm^2
Minimum area of reinforcement required		=	1728	mm^2
Diameter of reinforcement		=	12	mm
Area of reinforcement required		=	1764.593208	mm^2
Spacing of reinforcement required		=	153.79	mm
Spacing provided		=	125	mm
Area of reinforcement provided		=	2171.06	mm^2
Percentage of reinforcement provided		=	0.170	%

Provide 12 mm diameter bars at 125 mm C/C spacing

Check for One Way Shear

Longer Span:

Shear force V1		=	252403.53	N
Nominal shear stress		=	0.187	N/mm^2
Permissible Shear stress for p_t		=	0.30	N/mm^2

Safe in One Way Shear

Shorter span:

Shear force V1		=	305036.02	N
Nominal shear stress		=	0.212	N/mm^2
Permissible Shear stress for p_t		=	0.30	N/mm^2

Safe in One Way Shear

Check for Two Way Shear

Distance of section from the face of the column		=	269	mm
Width of punching square in shorter direction	b1	=	838	mm
Width of punching square in longer direction	b2	=	1068	mm
Shear force at the critical section	V_{uz}	=	1499.98	KN
Nominal shear stress	ζ_v	=	0.731	N/mm^2
Permissble Shear stress	$k_s.\zeta_{cz}$	=	1.118	N/mm^2

Safe in two way shear

Check for Development length and Anchorage Length

Design Bond stress	0	=	1.92	N/mm^2
Required development length		=	680	mm
Length available		=	925	mm
Minimum extension of column bars into footing beyond bend		=	300	mm

ISOLATED FOOTING DESIGN

FOOTING ID: F8

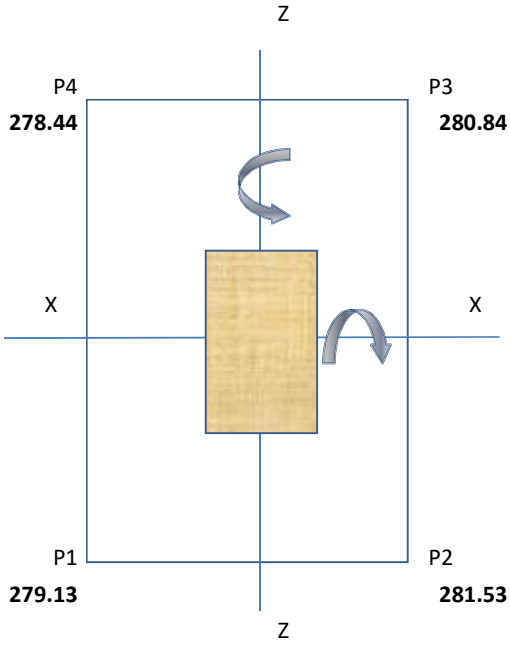
Data:

Grade of Concrete				f_{ck}	=	20	N/mm^2
Grade of steel				f_y	=	500	N/mm^2
Lateral load at X-axis				Hx	=	2	KN
Lateral load at Z-axis				Hz	=	0.2421	KN
Axial load				P	=	1407.00	KN
Moment at column base (about X axis)				M_x	=	0.802	KNm
Moment at column base (about Z axis)				M_z	=	1.70	KNm
$M_{x1} = M_x + H_z.D$				M_{x1}	=	0.97	KNm
$M_{z1} = M_z + H_x.D$				M_{z1}	=	3.06	KNm
S.B.C of soil				q_a	=	300.00	KN/m^2
Pedestal dimension along X-axis	(Col.dim	300	+ 0 mm)		=	300.00	mm
Pedestal dimension along Z-axis	(Col.dim	530	+ 0 mm)		=	530.00	mm
Density of concrete					=	25	KN/m^3
Unit weight of Soil					=	18.00	KN/m^3
Depth of Footing below NGL					=	3.00	m
Volume of footing					=	4.325	m^3
Volumn of filling					=	14.755	m^3
Weight of footing				P1	=	108.120	KN
Weight of filling				P2	=	265.594	KN
Clear cover					=	50.00	mm
Moment of resistance					=	$0.133f_{ck}bd^2$	

Area of footing

Weight of footing + backfill	(P1+P2)/P	=	26.56	% of P_u
Eccetricity along Z direction	e_z	=	0.45	mm
Eccentricity along X direction	e_x	=	0.95	mm
Width assumed (B, dim.ll X axis)	B	=	2.40	m
Length of the footing required (L, dim.ll Z axis)		=	2.47	m
Length of the footing provided (L, dim.ll Z axis)	L	=	2.65	m
Area of footing required		=	5.94	m^2
Area of footing provided		=	6.36	m^2
Cantilever projection in the shorter direction		=	1.050	m
Cantilever projection in the longer direction		=	1.060	m

Pressure Values at all four corners



$P1 = P/A + 6M_x/BL^2 - 6M_y/LB^2$		279.13
$P2 = P/A + 6M_x/BL^2 + 6M_y/LB^2$		281.53
$P3 = P/A - 6M_x/BL^2 + 6M_y/LB^2$		280.84
$P4 = P/A - 6M_x/BL^2 - 6M_y/LB^2$		278.44

Pressure Calculation about X axis

Maximum upward intensity of soil pressure	q_{max}	=	281.53 KN/m^2		
Minimum upward intensity of soil pressure	q_{min}	=	278.44 KN/m^2	**No Tension**	
Length of footing in contact with soil	L_c	=	2.65 m		
Maximum loss of contact		=	0.0 %	< 30 %	**OK**
Effective area of footing		=	6.36 m^2	**> Required**	
Effective upward intensity of soil pressure	q_{max}	=	281.53 KN/m^2	**< SBC**	
Overturning moment (M)		=	0.97 KNm		
Eccentricity of resultant vertical force		=	0.00 m	**< L/6**	
Factor of safety against overturning	F.S	=	2211.09	> 1.50	**OK**
Factored Maximum pressure (Pmax) for M_x	P_{max-x}	=	334.16 KN/m^2		
Factored Minimum pressure (Pmin) for M_x	P_{min-x}	=	329.52 KN/m^2		

Pressure calculation about Z axis

Maximum upward intensity of soil pressure	q_{max}	=	281.53 KN/m^2		
Minimum upward intensity of soil pressure	q_{min}	=	278.44 KN/m^2	**No Tension**	
Length of footing in contact with soil	B_c	=	2.400 m		
Maximum loss of contact		=	0.0 %	< 30 %	**OK**
Effective area of footing		=	6.36 m^2	**> Required**	
Effective upward intensity of soil pressure	q_{max}	=	281.53 KN/m^2	**< SBC**	
Overturning moment (M)		=	3.0569 KNm		
Eccentricity of resultant vertical force		=	0.00 m	**< L/6**	
Factor of safety against overturning	F.S	=	771.843	> 1.50	**OK**
Factored Maximum pressure (Pmax) for M_z	P_{max-x}	=	334.16 KN/m^2		
Factored Minimum pressure (Pmin) for M_z	P_{min-x}	=	329.52 KN/m^2		

Pressure intensity at the face of the column		=	332.30	KN/m^2
Bending moment about X axis		=	449.72	KNm
Design Bending moment	M_{ux}	=	449.72	KNm

Bending moment about Z-axis

Pressure intensity at the face of the column		=	332.13	KN/m^2
Bending moment about Z-axis		=	487.15	KNm
Design Bending moment	M_{uy}	=	487.15	KNm
Effective depth required along longer span	d_{req}	=	260.56	mm
Effective depth required along shorter span	d_{req}	=	258.08	mm
Overall depth required		=	316.561	mm
Overall depth provided	D	=	680	mm
Overall depth at the end		=	680	mm
Effective depth provided along longer span		=	624.00	mm
Effective depth provided along shorter span		=	612.00	mm

Area of Reinforcement

Longer span

Percentage of reinforcement required		=	0.114	%
Area of reinforcement required		=	1709.090861	mm^2
Minimum area of reinforcement required		=	1958.4	mm^2
Diameter of reinforcement		=	12	mm
Area of reinforcement required	A_{streq}	=	1958.4	mm^2
Spacing of reinforcement required		=	138.57	mm
Spacing provided		=	125	mm
Area of reinforcement provided		=	2171.06	mm^2
Percentage of reinforcement provided		=	0.145	%

Provide 12 mm diameter bars at 125 mm C/C spacing

Shorter span

Percentage of reinforcement required		=	0.117	%
Area of reinforcement		=	1891.212647	mm^2
Minimum area of reinforcement required		=	2162.4	mm^2
Diameter of reinforcement		=	12	mm
Area of reinforcement required		=	2162.4	mm^2
Spacing of reinforcement required		=	138.57	mm
Spacing provided		=	125	mm
Area of reinforcement provided		=	2397.21	mm^2
Percentage of reinforcement provided		=	0.148	%

Provide 12 mm diameter bars at 125 mm C/C spacing

Check for One Way Shear

Longer Span:

Shear force V1		=	292977.78	N
Nominal shear stress		=	0.180	N/mm^2
Permissible Shear stress for p_t		=	0.28	N/mm^2

Safe in One Way Shear

Shorter span:

Shear force V1		=	324980.23	N
Nominal shear stress		=	0.180	N/mm^2
Permissible Shear stress for p_t		=	0.29	N/mm^2

Safe in One Way Shear

Check for Two Way Shear

Distance of section from the face of the column		=	309	mm
Width of punching square in shorter direction	b1	=	918	mm
Width of punching square in longer direction	b2	=	1148	mm
Shear force at the critical section	V_{uz}	=	1712.76	KN
Nominal shear stress	ζ_v	=	0.671	N/mm^2
Permissble Shear stress	$k_s.\zeta_{cz}$	=	1.118	N/mm^2

Safe in two way shear

Check for Development length and Anchorage Length

Design Bond stress	0	=	1.92	N/mm^2
Required development length		=	680	mm
Length available		=	1000	mm
Minimum extension of column bars into footing beyond bend		=	300	mm

ISOLATED FOOTING DESIGN

FOOTING ID: F9

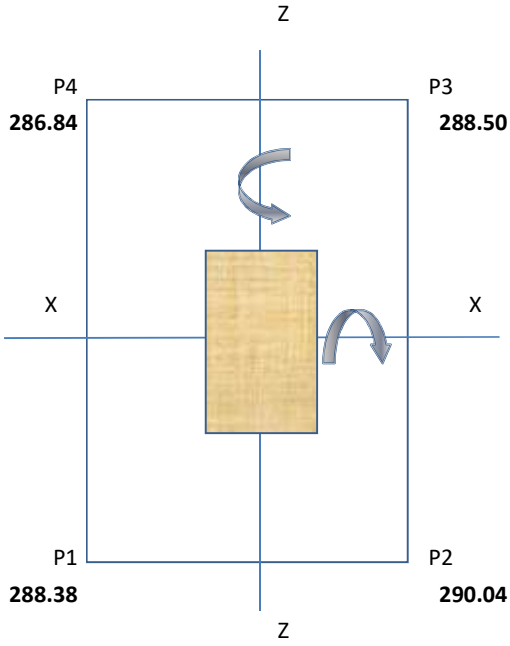
Data:

Grade of Concrete				f_{ck}	=	20	N/mm^2
Grade of steel				f_y	=	500	N/mm^2
Lateral load at X-axis				Hx	=	1	KN
Lateral load at Z-axis				Hz	=	2	KN
Axial load				P	=	1571.00	KN
Moment at column base (about X axis)				M_x	=	1.142	KNm
Moment at column base (about Z axis)				M_z	=	1.60	KNm
$M_{x1} = M_x + H_z.D$				M_{x1}	=	2.50	KNm
$M_{z1} = M_z + H_x.D$				M_{z1}	=	2.28	KNm
S.B.C of soil				q_a	=	300.00	KN/m^2
Pedestal dimension along X-axis	(Col.dim	300	+ 0 mm)		=	300.00	mm
Pedestal dimension along Z-axis	(Col.dim	600	+ 0 mm)		=	600.00	mm
Density of concrete					=	25	KN/m^3
Unit weight of Soil					=	18.00	KN/m^3
Depth of Footing below NGL					=	3.00	m
Volume of footing					=	4.651	m^3
Volumn of filling					=	15.869	m^3
Weight of footing				P1	=	116.280	KN
Weight of filling				P2	=	285.638	KN
Clear cover					=	50.00	mm
Moment of resistance					=	$0.133f_{ck}bd^2$	

Area of footing

Weight of footing + backfill	(P1+P2)/P	=	25.58	% of P_u
Eccetricity along Z direction	e_z	=	0.58	mm
Eccentricity along X direction	e_x	=	0.81	mm
Width assumed (B, dim.ll X axis)	B	=	2.40	m
Length of the footing required (L, dim.ll Z axis)		=	2.74	m
Length of the footing provided (L, dim.ll Z axis)	L	=	2.85	m
Area of footing required		=	6.58	m^2
Area of footing provided		=	6.84	m^2
Cantilever projection in the shorter direction		=	1.050	m
Cantilever projection in the longer direction		=	1.125	m

Pressure Values at all four corners



$P1 = P/A + 6M_x/BL^2 - 6M_y/LB^2$	288.38
$P2 = P/A + 6M_x/BL^2 + 6M_y/LB^2$	290.04
$P3 = P/A - 6M_x/BL^2 + 6M_y/LB^2$	288.50
$P4 = P/A - 6M_x/BL^2 - 6M_y/LB^2$	286.84

Pressure Calculation about X axis

Maximum upward intensity of soil pressure	q_{max}	=	290.04	KN/m^2	
Minimum upward intensity of soil pressure	q_{min}	=	286.84	KN/m^2	**No Tension**
Length of footing in contact with soil	L_c	=	2.85	m	
Maximum loss of contact		=	0.0	%	< 30 % **OK**
Effective area of footing		=	6.84	m^2	**> Required**
Effective upward intensity of soil pressure	q_{max}	=	290.04	KN/m^2	**< SBC**
Overturning moment (M)		=	2.50	KNm	
Eccentricity of resultant vertical force		=	0.00	m	**< L/6**
Factor of safety against overturning	F.S	=	946.28		> 1.50 **OK**
Factored Maximum pressure (Pmax) for M_x	P_{max-x}	=	346.92	KN/m^2	
Factored Minimum pressure (Pmin) for M_x	P_{min-x}	=	342.11	KN/m^2	

Pressure calculation about Z axis

Maximum upward intensity of soil pressure	q_{max}	=	290.04	KN/m^2	
Minimum upward intensity of soil pressure	q_{min}	=	286.84	KN/m^2	**No Tension**
Length of footing in contact with soil	B_c	=	2.400	m	
Maximum loss of contact		=	0.0	%	< 30 % **OK**
Effective area of footing		=	6.84	m^2	**> Required**
Effective upward intensity of soil pressure	q_{max}	=	290.04	KN/m^2	**< SBC**
Overturning moment (M)		=	2.2794	KNm	
Eccentricity of resultant vertical force		=	0.00	m	**< L/6**
Factor of safety against overturning	F.S	=	1233.399		> 1.50 **OK**
Factored Maximum pressure (Pmax) for M_z	P_{max-x}	=	346.92	KN/m^2	
Factored Minimum pressure (Pmin) for M_z	P_{min-x}	=	342.11	KN/m^2	

Pressure intensity at the face of the column		=	345.02	KN/m^2
Bending moment about X axis		=	525.93	KNm
Design Bending moment	M_{ux}	=	525.93	KNm

Bending moment about Z-axis

Pressure intensity at the face of the column		=	344.82	KN/m^2
Bending moment about Z-axis		=	543.93	KNm
Design Bending moment	M_{uy}	=	543.93	KNm
Effective depth required along longer span	d_{req}	=	281.78	mm
Effective depth required along shorter span	d_{req}	=	262.96	mm
Overall depth required		=	337.775	mm
Overall depth provided	D	=	680	mm
Overall depth at the end		=	680	mm
Effective depth provided along longer span		=	624.00	mm
Effective depth provided along shorter span		=	612.00	mm

Area of Reinforcement

Longer span

Percentage of reinforcement required		=	0.134	%
Area of reinforcement required		=	2007.820632	mm^2
Minimum area of reinforcement required		=	1958.4	mm^2
Diameter of reinforcement		=	12	mm
Area of reinforcement required	A_{streq}	=	2007.820632	mm^2
Spacing of reinforcement required		=	135.16	mm
Spacing provided		=	100	mm
Area of reinforcement provided		=	2713.82	mm^2
Percentage of reinforcement provided		=	0.181	%

Provide 12 mm diameter bars at 100 mm C/C spacing

Shorter span

Percentage of reinforcement required		=	0.121	%
Area of reinforcement		=	2115.635198	mm^2
Minimum area of reinforcement required		=	2325.6	mm^2
Diameter of reinforcement		=	12	mm
Area of reinforcement required		=	2325.6	mm^2
Spacing of reinforcement required		=	138.57	mm
Spacing provided		=	100	mm
Area of reinforcement provided		=	3222.67	mm^2
Percentage of reinforcement provided		=	0.185	%

Provide 12 mm diameter bars at 100 mm C/C spacing

Check for One Way Shear

Longer Span:

Shear force V1		=	346818.29	N
Nominal shear stress		=	0.213	N/mm^2
Permissible Shear stress for p_t		=	0.31	N/mm^2

Safe in One Way Shear

Shorter span:

Shear force V1		=	360057.61	N
Nominal shear stress		=	0.186	N/mm^2
Permissible Shear stress for p_t		=	0.32	N/mm^2

Safe in One Way Shear

Check for Two Way Shear

Distance of section from the face of the column		=	309	mm
Width of punching square in shorter direction	b1	=	918	mm
Width of punching square in longer direction	b2	=	1218	mm
Shear force at the critical section	V_{uz}	=	1904.14	KN
Nominal shear stress	ζ_v	=	0.721	N/mm^2
Permissble Shear stress	$k_s.\zeta_{cz}$	=	1.118	N/mm^2

Safe in two way shear

Check for Development length and Anchorage Length

Design Bond stress	0	=	1.92	N/mm^2
Required development length		=	680	mm
Length available		=	1000	mm
Minimum extension of column bars into footing beyond bend		=	300	mm

ISOLATED FOOTING DESIGN

FOOTING ID: F10

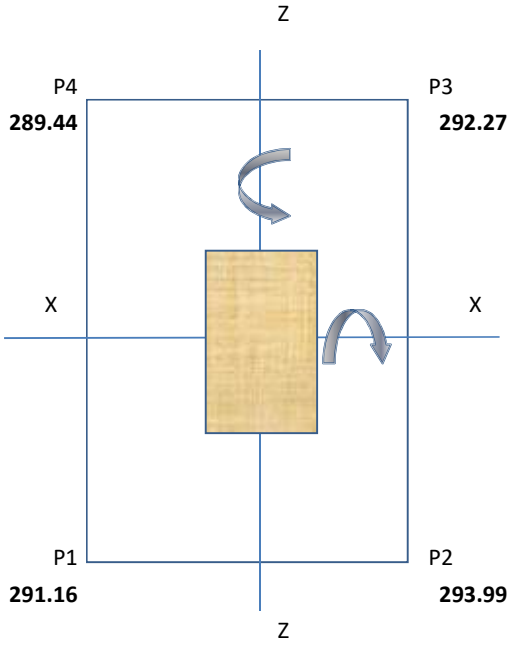
Data:

Grade of Concrete				f_{ck}	=	20	N/mm^2
Grade of steel				f_y	=	500	N/mm^2
Lateral load at X-axis				Hx	=	3	KN
Lateral load at Z-axis				Hz	=	1	KN
Axial load				P	=	1693.00	KN
Moment at column base (about X axis)				M_x	=	2.280	KNm
Moment at column base (about Z axis)				M_z	=	2.33	KNm
$M_{x1} = M_x + H_z.D$				M_{x1}	=	2.96	KNm
$M_{z1} = M_z + H_x.D$				M_{z1}	=	4.37	KNm
S.B.C of soil				q_a	=	300.00	KN/m^2
Pedestal dimension along X-axis	(Col.dim	300	+ 0 mm)		=	300.00	mm
Pedestal dimension along Z-axis	(Col.dim	600	+ 0 mm)		=	600.00	mm
Density of concrete					=	25	KN/m^3
Unit weight of Soil					=	18.00	KN/m^3
Depth of Footing below NGL					=	3.00	m
Volume of footing					=	4.942	m^3
Volumn of filling					=	16.861	m^3
Weight of footing				P1	=	123.548	KN
Weight of filling				P2	=	303.491	KN
Clear cover					=	50.00	mm
Moment of resistance					=	$0.133f_{ck}bd^2$	

Area of footing

Weight of footing + backfill	(P1+P2)/P	=	25.22	% of P_u
Eccetricity along Z direction	e_z	=	1.08	mm
Eccentricity along X direction	e_x	=	1.10	mm
Width assumed (B, dim.ll X axis)	B	=	2.55	m
Length of the footing required (L, dim.ll Z axis)		=	2.77	m
Length of the footing provided (L, dim.ll Z axis)	L	=	2.85	m
Area of footing required		=	7.07	m^2
Area of footing provided		=	7.27	m^2
Cantilever projection in the shorter direction		=	1.125	m
Cantilever projection in the longer direction		=	1.125	m

Pressure Values at all four corners



$P1 = P/A + 6M_x/BL^2 - 6M_y/LB^2$		291.16
$P2 = P/A + 6M_x/BL^2 + 6M_y/LB^2$		293.99
$P3 = P/A - 6M_x/BL^2 + 6M_y/LB^2$		292.27
$P4 = P/A - 6M_x/BL^2 - 6M_y/LB^2$		289.44

Pressure Calculation about X axis

Maximum upward intensity of soil pressure	q_{max}	=	293.99 KN/m^2		
Minimum upward intensity of soil pressure	q_{min}	=	289.44 KN/m^2	**No Tension**	
Length of footing in contact with soil	L_c	=	2.85 m		
Maximum loss of contact		=	0.0 %	< 30 %	**OK**
Effective area of footing		=	7.2675 m^2	**> Required**	
Effective upward intensity of soil pressure	q_{max}	=	293.99 KN/m^2	**< SBC**	
Overturning moment (M)		=	2.96 KNm		
Eccentricity of resultant vertical force		=	0.00 m	**< L/6**	
Factor of safety against overturning	F.S	=	913.25	> 1.50	**OK**
Factored Maximum pressure (Pmax) for M_x	P_{max-x}	=	352.84 KN/m^2		
Factored Minimum pressure (Pmin) for M_x	P_{min-x}	=	346.02 KN/m^2		

Pressure calculation about Z axis

Maximum upward intensity of soil pressure	q_{max}	=	293.99 KN/m^2		
Minimum upward intensity of soil pressure	q_{min}	=	289.44 KN/m^2	**No Tension**	
Length of footing in contact with soil	B_c	=	2.550 m		
Maximum loss of contact		=	0.0 %	< 30 %	**OK**
Effective area of footing		=	7.2675 m^2	**> Required**	
Effective upward intensity of soil pressure	q_{max}	=	293.99 KN/m^2	**< SBC**	
Overturning moment (M)		=	4.3704 KNm		
Eccentricity of resultant vertical force		=	0.00 m	**< L/6**	
Factor of safety against overturning	F.S	=	691.254	> 1.50	**OK**
Factored Maximum pressure (Pmax) for M_z	P_{max-x}	=	352.84 KN/m^2		
Factored Minimum pressure (Pmin) for M_z	P_{min-x}	=	346.02 KN/m^2		

Pressure intensity at the face of the column		=	350.15	KN/m^2
Bending moment about X axis		=	567.92	KNm
Design Bending moment	M_{ux}	=	567.92	KNm

Bending moment about Z-axis

Pressure intensity at the face of the column		=	349.83	KN/m^2
Bending moment about Z-axis		=	634.55	KNm
Design Bending moment	M_{uy}	=	634.55	KNm
Effective depth required along longer span	d_{req}	=	284.07	mm
Effective depth required along shorter span	d_{req}	=	284.02	mm
Overall depth required		=	340.066	mm
Overall depth provided	D	=	680	mm
Overall depth at the end		=	680	mm
Effective depth provided along longer span		=	624.00	mm
Effective depth provided along shorter span		=	612.00	mm

Area of Reinforcement

Longer span

Percentage of reinforcement required		=	0.136	%
Area of reinforcement required		=	2168.403727	mm^2
Minimum area of reinforcement required		=	2080.8	mm^2
Diameter of reinforcement		=	12	mm
Area of reinforcement required	A_{streq}	=	2168.403727	mm^2
Spacing of reinforcement required		=	132.98	mm
Spacing provided		=	100	mm
Area of reinforcement provided		=	2883.44	mm^2
Percentage of reinforcement provided		=	0.181	%

Provide 12 mm diameter bars at 100 mm C/C spacing

Shorter span

Percentage of reinforcement required		=	0.142	%
Area of reinforcement		=	2470.9742	mm^2
Minimum area of reinforcement required		=	2325.6	mm^2
Diameter of reinforcement		=	12	mm
Area of reinforcement required		=	2470.9742	mm^2
Spacing of reinforcement required		=	130.42	mm
Spacing provided		=	100	mm
Area of reinforcement provided		=	3222.67	mm^2
Percentage of reinforcement provided		=	0.185	%

Provide 12 mm diameter bars at 100 mm C/C spacing

Check for One Way Shear

Longer Span:

Shear force V1		=	372680.42	N
Nominal shear stress		=	0.215	N/mm^2
Permissible Shear stress for p_t		=	0.31	N/mm^2

Safe in One Way Shear

Shorter span:

Shear force V1		=	426501.82	N
Nominal shear stress		=	0.220	N/mm^2
Permissible Shear stress for p_t		=	0.32	N/mm^2

Safe in One Way Shear

Check for Two Way Shear

Distance of section from the face of the column		=	309	mm
Width of punching square in shorter direction	b1	=	918	mm
Width of punching square in longer direction	b2	=	1218	mm
Shear force at the critical section	V_{uz}	=	2077.61	KN
Nominal shear stress	ζ_v	=	0.787	N/mm^2
Permissble Shear stress	$k_s.\zeta_{cz}$	=	1.118	N/mm^2

Safe in two way shear

Check for Development length and Anchorage Length

Design Bond stress	0	=	1.92	N/mm^2
Required development length		=	680	mm
Length available		=	1075	mm
Minimum extension of column bars into footing beyond bend		=	300	mm

ISOLATED FOOTING DESIGN

FOOTING ID: F11

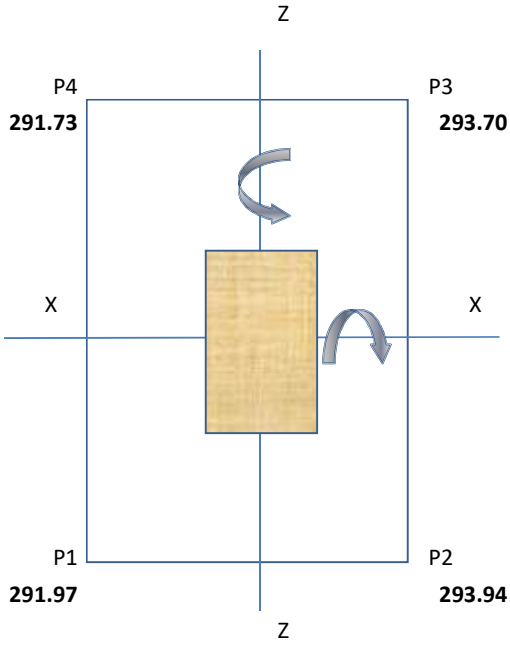
Data:

Grade of Concrete				f_{ck}	=	20	N/mm^2
Grade of steel				f_y	=	500	N/mm^2
Lateral load at X-axis				Hx	=	2	KN
Lateral load at Z-axis				Hz	=	0.2326	KN
Axial load				P	=	1896.00	KN
Moment at column base (about X axis)				M_x	=	0.323	KNm
Moment at column base (about Z axis)				M_z	=	2.24	KNm
$M_{x1} = M_x + H_z.D$				M_{x1}	=	0.48	KNm
$M_{z1} = M_z + H_x.D$				M_{z1}	=	3.60	KNm
S.B.C of soil				q_a	=	300.00	KN/m^2
Pedestal dimension along X-axis	(Col.dim	300	+ 0 mm)		=	300.00	mm
Pedestal dimension along Z-axis	(Col.dim	600	+ 0 mm)		=	600.00	mm
Density of concrete					=	25	KN/m^3
Unit weight of Soil					=	18.00	KN/m^3
Depth of Footing below NGL					=	3.00	m
Volume of footing					=	5.508	m^3
Volumn of filling					=	18.792	m^3
Weight of footing				P1	=	137.700	KN
Weight of filling				P2	=	338.256	KN
Clear cover					=	50.00	mm
Moment of resistance					=	$0.133f_{ck}bd^2$	

Area of footing

Weight of footing + backfill	(P1+P2)/P	=	25.10	% of P_u
Eccetricity along Z direction	e_z	=	0.14	mm
Eccentricity along X direction	e_x	=	0.94	mm
Width assumed (B, dim.ll X axis)	B	=	2.70	m
Length of the footing required (L, dim.ll Z axis)		=	2.93	m
Length of the footing provided (L, dim.ll Z axis)	L	=	3.00	m
Area of footing required		=	7.91	m^2
Area of footing provided		=	8.10	m^2
Cantilever projection in the shorter direction		=	1.200	m
Cantilever projection in the longer direction		=	1.200	m

Pressure Values at all four corners



$P1 = P/A + 6M_x/BL^2 - 6M_y/LB^2$	291.97
$P2 = P/A + 6M_x/BL^2 + 6M_y/LB^2$	293.94
$P3 = P/A - 6M_x/BL^2 + 6M_y/LB^2$	293.70
$P4 = P/A - 6M_x/BL^2 - 6M_y/LB^2$	291.73

Pressure Calculation about X axis

Maximum upward intensity of soil pressure	q_{max}	=	293.94 KN/m^2		
Minimum upward intensity of soil pressure	q_{min}	=	291.73 KN/m^2	**No Tension**	
Length of footing in contact with soil	L_c	=	3 m		
Maximum loss of contact		=	0.0 %	< 30 %	**OK**
Effective area of footing		=	8.1 m^2	**> Required**	
Effective upward intensity of soil pressure	q_{max}	=	293.94 KN/m^2	**< SBC**	
Overturning moment (M)		=	0.48 KNm		
Eccentricity of resultant vertical force		=	0.00 m	**< L/6**	
Factor of safety against overturning	F.S	=	6653.55	> 1.50	**OK**
Factored Maximum pressure (Pmax) for M_x	P_{max-x}	=	352.77 KN/m^2		
Factored Minimum pressure (Pmin) for M_x	P_{min-x}	=	349.45 KN/m^2		

Pressure calculation about Z axis

Maximum upward intensity of soil pressure	q_{max}	=	293.94 KN/m^2		
Minimum upward intensity of soil pressure	q_{min}	=	291.73 KN/m^2	**No Tension**	
Length of footing in contact with soil	B_c	=	2.700 m		
Maximum loss of contact		=	0.0 %	< 30 %	**OK**
Effective area of footing		=	8.1 m^2	**> Required**	
Effective upward intensity of soil pressure	q_{max}	=	293.94 KN/m^2	**< SBC**	
Overturning moment (M)		=	3.5958 KNm		
Eccentricity of resultant vertical force		=	0.00 m	**< L/6**	
Factor of safety against overturning	F.S	=	989.469	> 1.50	**OK**
Factored Maximum pressure (Pmax) for M_z	P_{max-x}	=	352.77 KN/m^2		
Factored Minimum pressure (Pmin) for M_z	P_{min-x}	=	349.45 KN/m^2		

Pressure intensity at the face of the column		=	351.44	KN/m^2
Bending moment about X axis		=	684.92	KNm
Design Bending moment	M_{ux}	=	684.92	KNm

Bending moment about Z-axis

Pressure intensity at the face of the column		=	351.30	KN/m^2
Bending moment about Z-axis		=	760.92	KNm
Design Bending moment	M_{uy}	=	760.92	KNm
Effective depth required along longer span	d_{req}	=	303.17	mm
Effective depth required along shorter span	d_{req}	=	303.15	mm
Overall depth required		=	359.169	mm
Overall depth provided	D	=	680	mm
Overall depth at the end		=	680	mm
Effective depth provided along longer span		=	624.00	mm
Effective depth provided along shorter span		=	612.00	mm

Area of Reinforcement

Longer span

Percentage of reinforcement required		=	0.156	%
Area of reinforcement required		=	2634.321713	mm^2
Minimum area of reinforcement required		=	2203.2	mm^2
Diameter of reinforcement		=	12	mm
Area of reinforcement required	A_{streq}	=	2634.321713	mm^2
Spacing of reinforcement required		=	115.90	mm
Spacing provided		=	100	mm
Area of reinforcement provided		=	3053.05	mm^2
Percentage of reinforcement provided		=	0.181	%

Provide 12 mm diameter bars at 100 mm C/C spacing

Shorter span

Percentage of reinforcement required		=	0.163	%
Area of reinforcement		=	2984.00063	mm^2
Minimum area of reinforcement required		=	2448	mm^2
Diameter of reinforcement		=	12	mm
Area of reinforcement required		=	2984.00063	mm^2
Spacing of reinforcement required		=	113.68	mm
Spacing provided		=	100	mm
Area of reinforcement provided		=	3392.28	mm^2
Percentage of reinforcement provided		=	0.185	%

Provide 12 mm diameter bars at 100 mm C/C spacing

Check for One Way Shear

Longer Span:

Shear force V1		=	455415.55	N
Nominal shear stress		=	0.248	N/mm^2
Permissible Shear stress for p_t		=	0.31	N/mm^2

Safe in One Way Shear

Shorter span:

Shear force V1		=	516559.31	N
Nominal shear stress		=	0.253	N/mm^2
Permissible Shear stress for p_t		=	0.32	N/mm^2

Safe in One Way Shear

Check for Two Way Shear

Distance of section from the face of the column		=	309	mm
Width of punching square in shorter direction	b1	=	918	mm
Width of punching square in longer direction	b2	=	1218	mm
Shear force at the critical section	V_{uz}	=	2365.39	KN
Nominal shear stress	ζ_v	=	0.896	N/mm^2
Permissble Shear stress	$k_s.\zeta_{cz}$	=	1.118	N/mm^2

Safe in two way shear

Check for Development length and Anchorage Length

Design Bond stress	0	=	1.92	N/mm^2
Required development length		=	680	mm
Length available		=	1150	mm
Minimum extension of column bars into footing beyond bend		=	300	mm

GOVERNMENT OF TAMIL NADU

TOWN AND COUNTRY PLANNING DEPARTMENT

SALEM DTCP

THE SALEM DISTRICT TOWN AND COUNTRY PLANNING

Phone: 0427-2448625

Email: ddslmregion@gmail.com

Website: www.tn.gov.in/tcp

PROFESSIONAL REGISTRATION CERTIFICATE

This is to certify that **THIRU. N. CHANDRAMOULI** has enrolled as **Registered Structural Engineer Grade-I (RSE-I)** with Salem District Town and Country Planning who has the qualification of **Master of Engineering in Structural Engineering** and experience in the relevant field for 14 years.

He has been given the **Registration No:29/RSE-I/2024** on 20.12.2024. He shall be required to comply with the duties and responsibilities prescribed by the Government of Tamil Nadu in Part V, "Registration of Professionals", Tamil Nadu Combined Development and Building Rules, 2019 approved vide G.O.(MS) No. 18, Municipal Administration and Water Supply (MA1) Department, Dated 04.02.2019.

This Registration is valid upto **19.12.2029.**



20/12/24

ASSISTANT DIRECTOR,
DISTRICT TOWN AND COUNTRY PLANNING,
SALEM DISTRICT.

THE LANDLENS SUITE

Eight ways to know a piece of land before you pay for it.

This report covers one part of the picture. These cover the rest, drawn from the same government records, for any property in Tamil Nadu.

LandLens One
Ask anything about a property and get an answer grounded in live government records, with the sources shown.
/landlens/one

Verify My Land
Every record check run on one property and returned as a single report.
/landlens/verify-my-land

Legal Opinion
An advocate's written opinion on the title, built on the records we pull for it.
/landlens

One Map
Every layer on one map: the parcel, its boundary, zoning, water bodies and what sits around it.
/landlens/one/map

PriceMap
What land actually changed hands for around this plot, taken from the registered deeds.
/landlens/pricemap

Build Scope
What you are allowed to build here: floor space, height, coverage and setbacks.
/landlens/build-scope

Property Tracker
Watch a property and hear about it when something new is registered against it.
/landlens/property-tracker

Deal Room
Run the transaction in one place: documents, stamping, signatures and the parties.
/landlens/deal-room

FREE TOOLS · NO ACCOUNT NEEDED

Twenty-four checks you can run yourself, at no cost.

Records and verification

The registers themselves, read for you.

- Encumbrance Certificate
- Patta and Chitta
- Field Measurement Sketch
- EC Analyzer
- Bank charge check
- Court case search
- Seller background check
- Approval check by survey

Value and duty

What it is worth and what it costs to register.

- Guideline value by street
- Guideline value by survey
- Stamp duty and registration fees
- Capital gains
- Floor space index
- Area unit converter

Zoning and land use

What the plan says can happen on this land.

- Land use zone finder
- CMDA land use check
- Coastal regulation zone
- Master plan check
- Water bodies finder
- Airport height clearance

Registers and directories

Who holds it, and which office keeps the record.

- Find your registering office
- Temple property check
- Waqf property check
- RERA register

Every free tool
/tools

Services we run for you
/services

The LandLens suite
/landlens/one

Verified RealEstate™

Every claim in this document traces back to a government record.

- Legal opinions, due diligence and title verification
- Building plan, layout and sub-division approvals
- Completion and occupancy certificates, regularisation
- Escrow, negotiation and NRI property management
- Land survey, soil testing, architecture and construction

Verified RealEstate
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OMR Thoraipakkam,
Chennai 600 097, India
hello@verified.realestate
+91 9996 12 9996

Prepared from the registers named on the page each finding sits on. Where a register could not be read, this document says so in its place rather than leaving the gap to be read as a clean result.