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Structural Stability Certificate

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

This is to certify that the STRUCTURAL DESIGN for the proposed Residential Development in the property bearing Survey Nos.88/2 Part, 89/2 part, 90/2 Part, 91/2 part, 92/2 part, 95 Part, 96/1Part, 96/2 Part, 97/1 part, 97/2 part, 98 part, 129/2 part, 130/1, 130/2, 131, 132/1, 132/2, 132/3, 133/1, 133/2, 133/3, 133/4, 134/2, 134/1A, 134/1B, 143 part situated at Paranur Village, Chengalpattu Talu,, Chengalpattu District Chennai – 603002, Tamil Nadu State, Residential buildings consisting of Block A – Stilt floor + 13 Floors. Combined Block B, C, D, E - One basement + Stilt Floor + 19 Floors, Block F (Club House) consists of One basement + Ground floor + 4 floors + Terrace floor, Block G – Ground floor + 2 Floors has been done by FS ENGINEER Report No : 7728 dated : 14.06.2023 belonging to M/s. Alliance Budget Housing India Pvt Ltd is designed based on the architectural plans submitted to Concerned Development Authority.

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

3. I/We further certify that:

1. The minimum grade of concrete is M30
2. The design and analysis has been done using the code of practice for plain and reinforced concrete as per IS 456, IS 875 and design of earthquake resistant structure as per IS code No 1893 (part 1) – 2016.

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

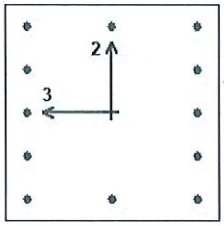
For Innotech Engineering Consult (P) Ltd.

Innotech Engineering Consult Pvt. Ltd. INNOTECH Bangalore

H P YOGESH
Registered Structural Engineer Grade – I,
Registration No SE/GR –I/19/03/022

ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Column Section Design



Column Element Details Type: Ductile Frame (Summary) (Part 1 of 2)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc
STILT FLOOR	C51	11542	C 600X600 M30	0.9TDL+0.45SpecX+1.5SpecY+0.45SpecZ	0

Column Element Details Type: Ductile Frame (Summary) (Part 2 of 2)

Length (mm)	LLRF
3850	1

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
600	600	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
27386.13	30	1	500	415

Design Code Parameters

γ_c	γ_s
1.5	1.15

Axial Force and Biaxial Moment Design For P_u , M_{u2} , M_{u3}

Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Minimum M_2 kN-m	Minimum M_3 kN-m	Rebar Area mm²	Rebar % %
495.2642	180.2638	-72.946	13.7188	13.7188	2880	0.8

Axial Force and Biaxial Moment Factors

	K Factor Unitless	Length mm	Initial Moment kN-m	Additional Moment kN-m	Minimum Moment kN-m
Major Bend(M3)	0.695225	3850	45.0596	0	13.7188
Minor Bend(M2)	0.695225	3850	72.1055	0	13.7188

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Shear Design for V_{u2} , V_{u3}

	Shear V_u kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv}/s mm²/m
Major, V_{u2}	47.8213	173.6395	129.6005	0	665.06
Minor, V_{u3}	71.3451	173.6395	129.6005	0	665.06

Joint Shear Check/Design

	Joint Shear Force kN	Shear V_{Top} kN	Shear $V_{u,Tot}$ kN	Shear V_c kN	Joint Area cm²	Shear Ratio Unitless
Major Shear, V_{u2}	N/A	N/A	N/A	N/A	N/A	N/A
Minor Shear, V_{u3}	N/A	N/A	N/A	N/A	N/A	N/A

(1.4) Beam/Column Capacity Ratio

Major Ratio	Minor Ratio
N/A	N/A

Additional Moment Reduction Factor k (IS 39.7.1.1)

A_g cm²	A_{sc} cm²	P_{uz} kN	P_b kN	P_u kN	k Unitless
3600	28.8	5940	2215.2601	495.2642	1

Additional Moment (IS 39.7.1)

	Consider M_a	Length Factor	Section Depth (mm)	KL/Depth Ratio	KL/Depth Limit	KL/Depth Exceeded	M_a Moment (kN-m)
Major Bending (M_3)	Yes	1	600	4.461	12	No	0
Minor Bending (M_2)	Yes	1	600	4.461	12	No	0

Notes:

N/A: Not Applicable

N/C: Not Calculated

N/N: Not Needed

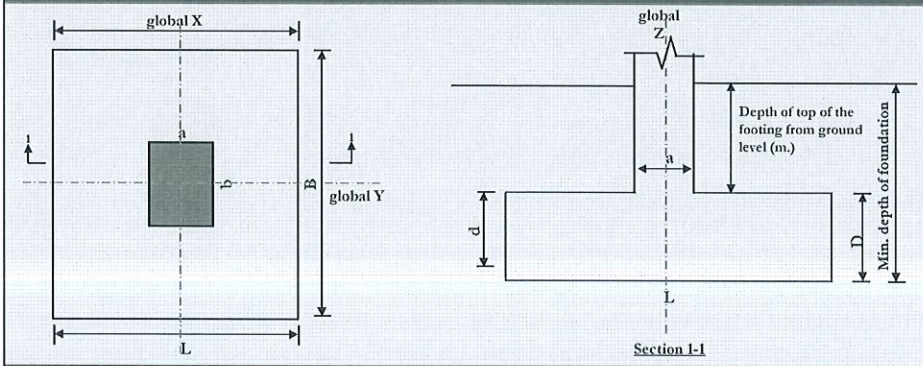
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18-10-2023

Innotech Engineering Consult Pvt. Ltd.

Project : MAHINDRA WORLD CITY - CHENNAI - BLOCK C		Job Number :	385
		Dwg. Ref. No. :	
Part of the structure : Design of isolated footing		Date :	18-10-2023
		Footing No.	Grid
Prepared by : Kiran R P	Checked by : Pooja L	P-F1	**

Basic Data

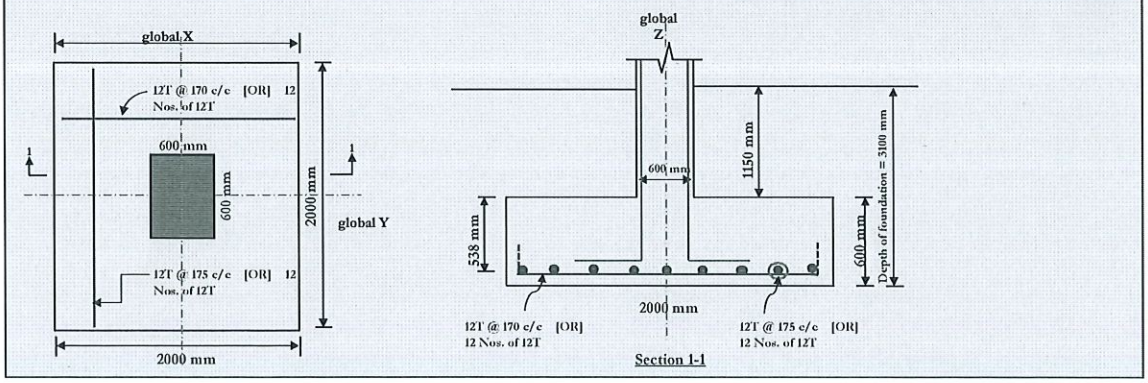


Footing type / No.			P-F1			
Grade of concrete :		fck (N/sqmm)	30 N/sqmm			
Grade of reinforcement steel :		fy (N/sqmm)	500 N/sqmm			
SBC of soil		(kN/sqm)	500 kN/sqm			
Density of the Soil		(kN/cum)	18 kN/cum			
Type of soil [Hard(I), Medium (II) or Soft (III)]			Type I			
Clear cover for reinforcement			50 mm			
Joint label/Pier label in ETABS			C51			
Column details	Dimension along X-direction (m.) a		0.600 m			
	Dimension along Y-direction (m.) b		0.600 m			
	Maximum Dia of bar in column		16 mm			
	Design bond stress for bars in compression		3.00 N/sqmm			
	Ldc of column bars		580 mm			
Footing dimensions	Dimension along X-direction (m.)	L	2.000 m			
	Dimension along Y-direction (m.)	B	2.000 m			
	Depth along Z-axis (mm.)	D	600 mm			
Depth of top of the footing from ground level (m.)			1.15 m			
Self weight of the footing 'P1' (kN)			60.00			
Weight of soil retained above footing 'P2' (kN)			75.348			
Unfactored Design Load Combinations (Critical load combinations)			TDL+TLL	TDL+TLL+WX	TDL+TLL+0.3SPECX+SPECY+0.3SPECZ	TDL+TLL-WX
Joint reactions from ETABS	Axial force in global Z axis 'P'(kN)		767.45	778.58	738.62	756.31
	Moment about global X axis 'Mx' (kN-m)		6.83	19.46	124.07	-5.79
	Moment about global Y axis 'My' (kN-m)		-48.85	-2.33	-20.84	-95.37
If (DL + LL) or (DL+EQ/WL) = 1 ; (L+LL+EQ/WL) = 2			1	2	2	2
Partial Safety factor			1.5	1.2	1.2	1.2
SBC Enhancement factor (Type I = 1.5, Type II = 1.25, Type III = 1)			1	1.50	1.50	1.50
Check for bearing pressure						
Required footing area (sqm)			1.81	1.22	1.17	1.19
Provided footing area (sqm)			4.00	4.00	4.00	4.00
Min. Gross Bearing Pressure (kN/m^2)			183.94	212.15	109.81	147.04
Max. Net Bearing Pressure (kN/sqm)			233.62	210.98	293.34	264.95
Min. Net Bearing Pressure (kN/sqm)			150.10	178.31	75.97	113.21
Design soil pressure (due to applied loads only) (kN/sqm)			350.43	253.18	352.01	317.94
			SAFE	SAFE	SAFE	SAFE
Reinforcement along Global X axis (II el to Y-axis)						
Effective depth of footing			538 mm	538	538	538

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Innotech Engineering Consult Pvt. Ltd.	Project : MAHINDRA WORLD CITY - CHENNAI - BLOCK C		Job Number :	385
			Dwg. Ref. No. :	
	Part of the structure : Design of isolated footing		Date :	18-10-2023
			Footing No.	Grid
	Prepared by : Kiran R P	Checked by : Pooja L	P-F1	**

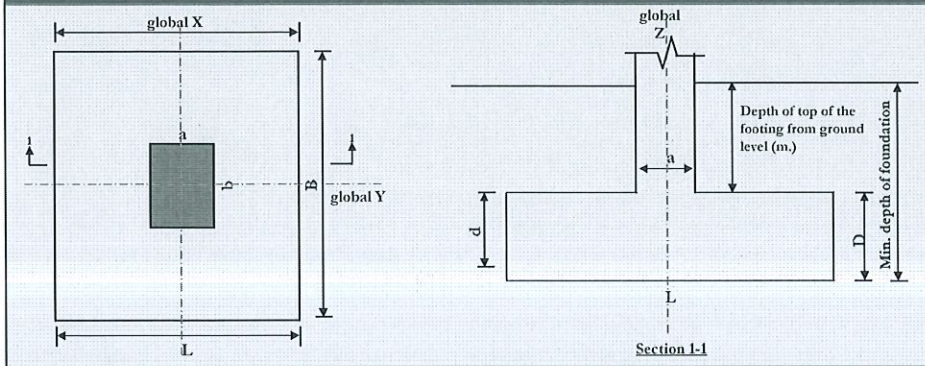
Cantilever projection from column face along X axis (m)		0.700	0.700	0.700	0.700
Cantelever BM in X direction (kN-m)		85.86	62.03	86.24	77.90
Mu/Bd^2 (N/sqmm)		0.30	0.21	0.30	0.27
Percentage of steel : p_t		0.07	0.05	0.07	0.06
p_t actual or pt min		0.12	0.12	0.12	0.12
Ast along X-axis (sqmm)		**645.6**	**645.6**	**645.6**	**645.6**
Choosing bar dia as :	12 mm	Provide : 12T @ 175 c/c [OR] 12 Nos. of 12T			
1 Way Shear Check along X axis					
One way shear force (kN)		56.77	41.01	57.03	51.51
Depth for one way shear (mm)		538	538	538	538
pt provided at the critical section		0.12	0.12	0.12	0.12
Shear stress to be resisted	ζv (N/mm2)	**0.106**	**0.076**	**0.106**	**0.096**
Shear stress resisted by concrete + provided steel	ζc (N/mm2)	**0.290**	**0.290**	**0.290**	**0.290**
		SAFE	SAFE	SAFE	SAFE
Reinforcement along Global Y axis (II el to X-axis)					
Effective depth of footing		550 mm	550	550	550
Cantilever projection from column face along Y axis (m)		0.700	0.700	0.700	0.700
Cantelever BM in Y direction (kN-m)		85.86	62.03	86.24	77.90
Mu/Bd^2 (N/sqmm)		0.28	0.21	0.29	0.26
Percentage of steel : p_t		0.07	0.05	0.07	0.06
p_t actual or pt min		0.12	0.12	0.12	0.12
Ast along Y-axis (sqmm)		**660.0**	**660.0**	**660.0**	**660.0**
Choosing bar dia as	12 mm	Provide : 12T @ 170 c/c [OR] 12 Nos. of 12T			
1 Way Shear Check along Y axis					
One way shear force (kN)		52.56	37.98	52.80	47.69
Depth for one way shear (mm)		550	550	550	550
pt provided at the critical section		0.12	0.12	0.12	0.12
Shear stress to be resisted	ζv (N/mm2)	**0.096**	**0.069**	**0.096**	**0.087**
Shear stress resisted by concrete + provided steel	ζc (N/mm2)	**0.290**	**0.290**	**0.290**	**0.290**
		SAFE	SAFE	SAFE	SAFE
Two Way/Punching Shear Check					
Effective depth of footing considered for two way shear check		538	538	538	538
Punching area	L1 (m)	1.138	1.138	1.138	1.138
	B1 (m)	1.138	1.138	1.138	1.138
Two way/Punching shear force (kN)		948	685	952	860
Shear stress to be resisted	ζv (N/mm2)	**0.39**	**0.28**	**0.39**	**0.35**
Shear stress resisted by concrete + provided steel	ζc (N/mm2)	**1.37**	**1.37**	**1.37**	**1.37**
		SAFE	SAFE	SAFE	SAFE



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Innotech Engineering Consult Pvt. Ltd.	Project : MAHINDRA WORLD CITY - CHENNAI		Job Number : 385	
			Dwg. Ref. No. :	
	Part of the structure : Design of isolated footing		Date : 18-10-2023	
			Footing No.	Grid
	Prepared by : Kiran R P	Checked by : Pooja L	F1	**

Basic Data



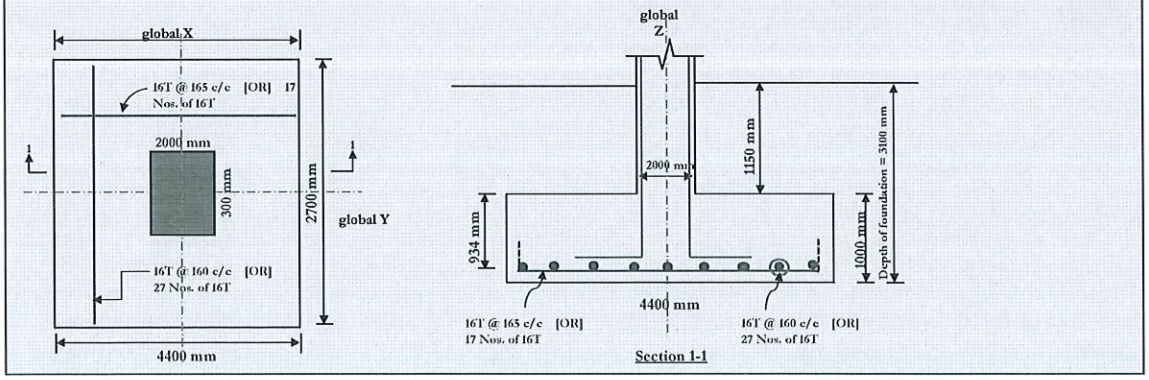
Footing type / No.			F1
Grade of concrete :		fck (N/sqmm)	30 N/sqmm
Grade of reinforcement steel :		fy (N/sqmm)	500 N/sqmm
SBC of soil		(kN/sqm)	500 kN/sqm
Density of the Soil		(kN/cum)	18 kN/cum
Type of soil [Hard(I), Medium (II) or Soft (III)]			Type I
Clear cover for reinforcement			50 mm
Joint label/Pier label in ETABS			T8
Column details	Dimension along X-direction (m.) a		2.000 m
	Dimension along Y-direction (m.) b		0.300 m
	Maximum Dia of bar in column		16 mm
	Design bond stress for bars in compression		3.00 N/sqmm
	Ldc of column bars		580 mm
Footing dimensions	Dimension along X-direction (m.) L		4.400 m
	Dimension along Y-direction (m.) B		2.700 m
	Depth along Z-axis (mm.) D		1000 mm
Depth of top of the footing from ground level (m.)			1.15 m
Self weight of the footing 'P1' (kN)			297.00
Weight of soil retained above footing 'P2' (kN)			233.496

Unfactored Design Load Combinations (Critical load combinations)		TDL+TLL	TDL+TLL+0.3SPECX+0.3SPECY+SPECZ-1 MIN	TDL+TLL+0.3SPECX+SPECY+0.3SPECZ MAX	TDL+TLL+SPECX+0.3SPECY+0.3SPECZ MAX
Joint reactions from ETABS	Axial force in global Z axis 'P'(kN)	5269.64	5757.10	4928.89	4809.16
	Moment about global X axis 'Mx' (kN-m)	12.60	-0.69	46.29	26.95
	Moment about global Y axis 'My' (kN-m)	40.97	-164.66	298.16	461.35
If (DL + LL) or (DL+EQ/WL) = 1 ; (L+LL+EQ/WL) = 2		1	2	2	2
Partial Safety factor		1.5	1.2	1.2	1.2
SBC Enhancement factor (Type I = 1.5, Type II = 1.25, Type III = 1)		1	1.50	1.50	1.50
Check for bearing pressure					
Required footing area (sqm)		11.60	8.38	7.28	7.12
Provided footing area (sqm)		11.88	11.88	11.88	11.88
Min. Gross Bearing Pressure (kN/m^2)		481.17	510.23	416.66	391.47
Max. Net Bearing Pressure (kN/sqm)		450.63	503.63	457.77	462.81
Min. Net Bearing Pressure (kN/sqm)		436.51	465.57	372.01	346.81
Design soil pressure (due to applied loads only) (kN/sqm)		675.95	604.36	549.33	555.37
		SAFE	SAFE	SAFE	SAFE
Reinforcement along Global X axis (II el to Y-axis)					
Effective depth of footing		934 mm	934	934	934

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			Dwg. Ref. No. :	
	Part of the structure : Design of isolated footing		Date : 18-10-2023	
			Footing No.	Grid
	Prepared by : Kiran R P	Checked by : Pooja L	F1	**

Cantilever projection from column face along X axis (m)		1.200	1.200	1.200	1.200
Cantelever BM in X direction (kN-m)		486.68	435.14	395.52	399.87
Mu/Bd^2 (N/sqmm)		0.56	0.50	0.45	0.46
Percentage of steel : p_t		0.13	0.12	0.11	0.11
p_t actual or pt min		0.13	0.12	0.12	0.12
Ast along X-axis (sqmm)		**1225.3**	**1120.8**	**1120.8**	**1120.8**
Choosing bar dia as :	16 mm	Provide : 16T @ 160 c/c [OR] 27 Nos. of 16T			
1 Way Shear Check along X axis					
One way shear force (kN)		179.80	160.76	146.12	147.73
Depth for one way shear (mm)		934	934	934	934
pt provided at the critical section		0.13	0.12	0.12	0.12
Shear stress to be resisted	ζv (N/mm2)	**0.193**	**0.172**	**0.156**	**0.158**
Shear stress resisted by concrete + provided steel	ζc (N/mm2)	**0.290**	**0.290**	**0.290**	**0.290**
		SAFE	SAFE	SAFE	SAFE
Reinforcement along Global Y axis (II el to X-axis)					
Effective depth of footing		950 mm	950	950	950
Cantilever projection from column face along Y axis (m)		1.200	1.200	1.200	1.200
Cantelever BM in Y direction (kN-m)		486.68	435.14	395.52	399.87
Mu/Bd^2 (N/sqmm)		0.54	0.48	0.44	0.44
Percentage of steel : p_t		0.13	0.11	0.10	0.10
p_t actual or pt min		0.13	0.12	0.12	0.12
Ast along Y-axis (sqmm)		**1203.7**	**1140.0**	**1140.0**	**1140.0**
Choosing bar dia as	16 mm	Provide : 16T @ 165 c/c [OR] 17 Nos. of 16T			
1 Way Shear Check along Y axis					
One way shear force (kN)		168.99	151.09	137.33	138.84
Depth for one way shear (mm)		950	950	950	950
pt provided at the critical section		0.13	0.12	0.12	0.12
Shear stress to be resisted	ζv (N/mm2)	**0.178**	**0.159**	**0.145**	**0.146**
Shear stress resisted by concrete + provided steel	ζc (N/mm2)	**0.290**	**0.290**	**0.290**	**0.290**
		SAFE	SAFE	SAFE	SAFE
Two Way/Punching Shear Check					
Effective depth of footing considered for two way shear check		934	934	934	934
Punching area	L1 (m)	1.234	1.234	1.234	1.234
	B1 (m)	2.934	2.934	2.934	2.934
Two way/Punching shear force (kN)		5583	4992	4537	4587
Shear stress to be resisted	ζv (N/mm2)	**0.72**	**0.64**	**0.58**	**0.59**
Shear stress resisted by concrete + provided steel	ζc (N/mm2)	**0.89**	**0.89**	**0.89**	**0.89**
		SAFE	SAFE	SAFE	SAFE



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ETABS Shear Wall Design

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
1F/TRANSFER	T1	-12654.2	45569.9	1501.5	300	1

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
27386.13	30	1	500	415

Design Code Parameters

Γ_s	Γ_c	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	-13405	45569.9	-11903.5	45569.9	1501.5	300
Bottom	Leg 1	-13405	45569.9	-11903.5	45569.9	1501.5	300

Flexural Design for P_u, M_{u2} and M_{u3} (Part 1 of 2)

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m
Top	11396	0.0253	0.0035	1.5TDL+0.45SpecX+1.5SpecY+0.45SpecZ	880.3107	-588.2145
Bottom	5116	0.0114	0.0035	0.9TDL+0.45SpecX+1.5SpecY+0.45SpecZ	241.9247	258.3134

Flexural Design for P_u, M_{u2} and M_{u3} (Part 2 of 2)

M_{u3} kN-m	Pier A_g mm²
533.4773	450456
-320.8247	450456

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	1.5TDL+1.5SpecX+0.45SpecY+0.45SpecZ	1017.8394	592.6541	-274.9246	215.9288	541.0407
Bottom	Leg 1	750	1.5TDL+1.5SpecX+0.45SpecY+0.45SpecZ	1078.2543	383.7776	-275.3175	215.9288	541.0407

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Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	0	0.9TDL+0.45SpecX+1.5SpecY+0.45SpecZ	1817.6042	-12.9222	4.15	6
Top–Right	Leg 1	300	0.9TDL+0.45SpecX+1.5SpecY+0.45SpecZ	2492.0829	533.4773	10.26	6
Bottom–Left	Leg 1	300	1.5TDL+0.45SpecX+1.5SpecY+0.45SpecZ	2553.2887	-326.3382	8.56	6
Botttom–Right	Leg 1	300	1.5TDL+0.45SpecX+1.5SpecY+0.45SpecZ	2553.2887	298.7706	8.32	6

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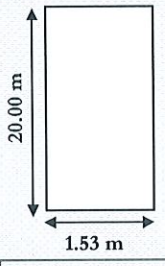
Innotech Engineering Consult Pvt. Ltd.	Project	IECP 385 - Mahindra World City
	Prepared by	Sanath Kumar K V
	Checked by	Pooja L
	Part of the structure	One way continuous slab

ONE WAY (Continuous) SLAB

ALL CALCULATIONS ARE PER SQM AREA OF SLAB

Preliminary Data

Long span	20.00 m
Short span	1.53 m
Aspect Ratio	13.15
One way slab	



Long span		l_{ey}	20.10 m
Short span		l_{ex}	1.62 m
Grade of concrete		f_{ck}	30 N/sqmm
Grade of steel		f_y	500 N/sqmm
Unit weight of RCC		Yc	25.00 kN/cum
Overall depth (assumed)		D	125 mm
Effective cover		d'	25 mm
Effective depth provided		d	96 mm
Load calculations			
Self weight		W_d	3.13 kN/sqm
Floor finish		FF	1.20 kN/sqm
Miscellaneous		W	0.00 kN/sqm
Total dead load		DL	4.33 kN/sqm
Live load		LL	3.00 kN/sqm
Check for depth from BM criteria			
Factored moment (Bottom - Mid span)	$[(W_d*l_x^2)/12] + [(W_l*l_x^2)/10]$	M^+	2.60 kN-m
Factored moment (Top - At Supports)	$[(W_d*l_x^2)/10] + [(W_l*l_x^2)/9]$	M^-	3.02 kN-m
Effective depth required		d req	27 mm
		Depth provided is Sufficient	
Reinforcement details			
Minimum Area of steel	[(pt = 0.12%)=>(0.12*b*D)/100]	$A_{st\ min}$	150.00 sqmm
Shorter span (Bottom Bars)			
Area of steel		$A_{st\ bot}$	150.00 sqmm
Dia of reinforcing bar		φ	8 mm
Spacing between bars		s	250 mm
Area of steel provided		$A_{st\ pro}$	201.06 sqmm
Percentage of steel	pt = 100*Ast / b*d	pt	0.209 %
Provide, parallel to shorter span (bottom)		8T @ 250 mm c/c	
Longer span (Bottom Bars)			
Area of steel		$A_{st\ min}$	150.00 sqmm
Dia of reinforcing bar		ϕ	8 mm
Spacing between bars		s	250 mm
Area of steel provided		$A_{st\ pro}$	201.06 sqmm
Percentage of steel	pt = 100*Ast / b*d	pt	0.161 %
Provide, parallel to longer span (bottom)		8T @ 250 mm c/c	
Shorter span (Top Bars)			
Area of steel		$A_{st\ top}$	150.00 sqmm
Dia of reinforcing bar		φ	8 mm
Spacing between bars		s	250 mm
Area of steel provided		$A_{st\ pro}$	201.06 sqmm

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Percentage of steel	pt = 100*Ast / b*d	pt	0.209 %
Provide, parallel to shorter span (top)		8T @ 250 mm c/c	

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Check for shear			
Design shear force	[(1.5*0.6)*(W_d+ W_l)*l_x]	V_u	8.936 kN
Design shear stress	(Vu /bd)	τ_v	0.09 N/sqmm
β = [(0.8*fck)/(6.89*pt)	(from SP:24)	β	16.632
Shear resisted by concrete	(from SP:24)	τ_c	0.34 N/sqmm
		Safe under shear	
Check for Deflection			
Basic span to effective depth ratio		$(l/d)_{basic}$	26
Modification factor for compression reinforcement		K_c	1
Reduction factor		K_f	1
Stress in reinforcement	[(0.58 x f_y x A_{st})/ $A_{st\ pro}$]	f_s	216.35 N/sqmm
Modification factor for tensile reinforcement		K_t	2.00
Maximum span to effective depth ratio	[(l/d)basic*K_c*K_f*K_t]	$(l/d)_{max}$	52.000
Actual span to effective depth ratio		$(l/d)_{actual}$	16.885
		Safe under Deflection	
Summary			
Shorter span (bottom) reinforcement		8T @ 250 mm c/c	
Longer span (bottom) reinforcement		8T @ 250 mm c/c	
At supports, top reinforcement		8T @ 250 mm c/c	

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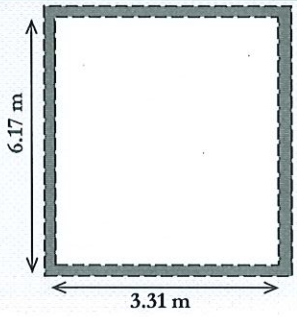
Innotech Engineering Consult Pvt. Ltd.	Project	IECP 385 - Mahindra World City
	Prepared by	Sanath Kumar K V
	Checked by	Pooja L
	Part of the structure	Two way slab

TWO WAY SLAB

ALL CALCULATIONS ARE PER SQM AREA OF SLAB

Preliminary Data

Long span	6.07 m
Short span	3.21 m
Aspect Ratio	1.90
Hence Two way slab	



Effective Long span	l_{ey}	6.17 m
Effective Short span	l_{ex}	3.31 m
Grade of concrete	f_{ck}	30 N/sqmm
Grade of steel	f_y	500 N/sqmm
Unit weight of RCC	Yc	25.00 kN/cum
Overall depth (assumed)	D	125 mm
Effective cover	d'	25 mm
Effective depth provided	d	96 mm

Load calculations

Self weight of slab	DL	3.13 kN/sqm
Floor finish	FF	1.20 kN/sqm
Miscellaneous	W	
Live load	LL	2.00 kN/sqm
Total Factored load	W_u	9.49 kN/sqm

Edge condition : Interior panel/all 4 edges continuous

Bending Moment calculations

Shorter span

+ve moment coefficient at mid span		α_x	0.048
Factored moment (Bottom - Mid span)	$[\alpha_x * W * l_x^2]$	M_{ux}	4.98 kN-m
-ve moment at coefficient continuous edge		α_x	0.063
Factored moment (Top - At Supports)	$[\alpha_x * W * l_x^2]$	M_{ux}	6.53 kN-m

Longer span

+ve moment coefficient at mid span		α_y	0.024
Factored moment (Bottom - Mid span)	$[\alpha_x * W * l_x^2]$	M_{uy}	2.49 kN-m
-ve moment at coefficient continuous edge		α_y	0.032
Factored moment (Top - At Supports)	$[\alpha_x * W * l_x^2]$	M_{uy}	3.32 kN-m

Check for depth from BM criteria

Effective depth required	d req	40 mm
	Depth provided is Sufficient	

Reinforcement details

Minimum Area of steel	$A_{st\ min}$	150.00 sqmm

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Shorter span (Bottom Bars)			
Area of steel		Ast	150.00 sqmm
Dia of reinforcing bar		φ	8 mm
Spacing between bars		s	250 mm
Area of steel provided		$A_{st\ pro}$	201.06 sqmm
Percentage of steel	pt = 100*Ast / b*d	pt	0.209 %
Provide, parallel to shorter span (bottom)		8T @ 250 mm c/c	
Longer span (Bottom Bars)			
Area of steel		Ast	150.00 sqmm
Dia of reinforcing bar		φ	8 mm
Spacing between bars		s	250 mm
Area of steel provided		$A_{st\ pro}$	201.06 sqmm
Percentage of steel	pt = 100*Ast / b*d	pt	0.209 %
Provide, parallel to longer span (bottom)		8T @ 250 mm c/c	
Shorter span (Top Bars)			
Area of steel		Ast	170.00 sqmm
Dia of reinforcing bar		φ	8 mm
Spacing between bars		s	250 mm
Area of steel provided		$A_{st\ pro}$	201.06 sqmm
Percentage of steel	pt = 100*Ast / b*d	pt	0.209 %
Provide, parallel to shorter span (top)		8T @ 250 mm c/c	
Longer span (Top Bars)			
Area of steel		Ast	150.00 sqmm
Dia of reinforcing bar		φ	8 mm
Spacing between bars		s	250 mm
Area of steel provided		$A_{st\ pro}$	201.06 sqmm
Percentage of steel	pt = 100*Ast / b*d	pt	0.209 %
Provide, parallel to longer span (top)		8T @ 250 mm c/c	
Check for shear			
Design shear force	(Wu*l/2)	V_u	7.841 kN
Design shear stress	(Vu /bd)	τ_v	0.08 N/sqmm
β = [(0.8*fck)/(6.89*pt)	(from SP:24)	β	16.632
Shear resisted by concrete	(from SP:24)	τ_c	0.34 N/sqmm
		Safe under shear	
Check for Deflection			
Basic span to effective depth ratio		$(l/d)_{basic}$	26
Modification factor for compression reinforcement		K_c	1.00
Reduction factor		K_f	1.00
Stress in reinforcement	$[(0.58 \times f_y \times A_{st})/ A_{st\ pro}]$	f_s	216.35 N/sqmm
Modification factor for tensile reinforcement		K_t	2.00
Maximum span to effective depth ratio	$[(l/d)basic*K_c*K_f*K_t]$	$(l/d)_{max}$	52.000
Actual span to effective depth ratio		$(l/d)_{actual}$	34.438
		Safe under Deflection	

Summary		
Shorter span (bottom) reinforcement	A	8T @ 250 mm c/c
Longer span (bottom) reinforcement	B	8T @ 250 mm c/c
Shorter span (top) reinforcement	C	8T @ 250 mm c/c
Longer span (top) reinforcement	D	8T @ 250 mm c/c

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Innotech Engineering Consult Pvt. Ltd.	Project : MAHINDRA WORLD CITY CHENNAI		Job Number IECP - 385
	Part of the structure : Dog Legged Staircase		Date 18-10-2023
	Prepared by : KIRAN R P	Checked by : MANOHARVD	Staircase No.

Preliminary data		
Grade of Concrete	fck	30 N/sqmm
Grade of steel	fy	500 N/sqmm
Unit weight of RCC	Yc	25.00 kN/cum
Width of going	B	1.25 m
First landing width	l1	1.22 m
Span of going	l2	2.98 m
Intermediate landing width	l3	1.38 m
Effective Span of going	L	3.58 m
Riser	R	0.17 m
Tread	T	0.27 m
clear Span of supporting landing slab	L1	2.70 m
Overall Depth of waist slab	D	175 mm
Overall Depth of landing slab	D	175 mm
Effective Cover	d'	25 mm
Effective depth of waist slab	d	150 mm
Effective depth of landing slab	d	150 mm

Design of Waist slab Load calculations (per unit width of waist slab)		
SW of waist slab	W1	5.13 kN/sqm
SW of steps	W2	2.06 kN/sqm
Floor finish	W3	3.60 kN/sqm
Live load	W4	3.00 kN/sqm
Total load	W	13.79 kN/sqm
Total Factored load per unit width of the flight	Wu	20.68 kN/m

Check for depth from BM criteria		
Factored Moment	Mu	26.51 kN-m
Effective depth required	d req	82 mm
	Depth provided is Sufficient	

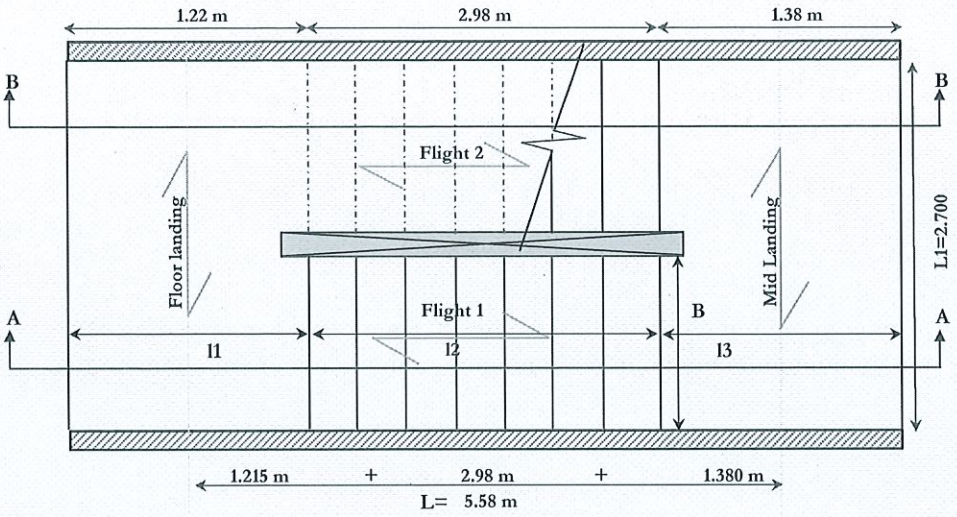
Reinforcement details		
Minimum Area of steel	$A_{st\ min}$	210 sqmm
Required Area of steel	A_{st}	430 sqmm
Dia of reinforcing bar	φ	10 mm
Spacing between the bars	s	100 mm
Area of steel provided	$A_{st\ pro}$	785.40 sqmm
Percentage of steel	pt	0.524 %
Along the span, provide	T10 @ 100 mm c/c	
Distribution steel	A_{st}	210.00 sqmm
Dia of reinforcing bar	φ	8 mm
Perpendicular to the span, provide	T8 @ 220 mm c/c	

Check for depth from Deflection criteria				
Basic span to effective depth ratio			$(l/d)_{basic}$	20
Modification factor for compression reinforcement			K_c	1
Reduction factor			K_f	1
Stress in reinforcement	$[(0.58 \times f_y \times A_{st}) / A_{st\ pro}]$		f_s	159 N/sqmm
Modification factor for tensile reinforcement			K_t	1.78
Maximum span to effective depth ratio	$[(l/d)basic*K_c*K_f*K_t]$		$(l/d)_{max}$	35.675
Actual span to effective depth ratio			$(l/d)_{actual}$	23.867

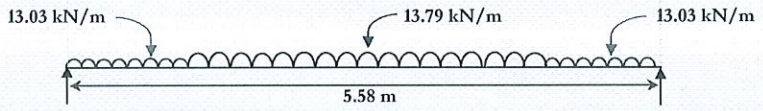
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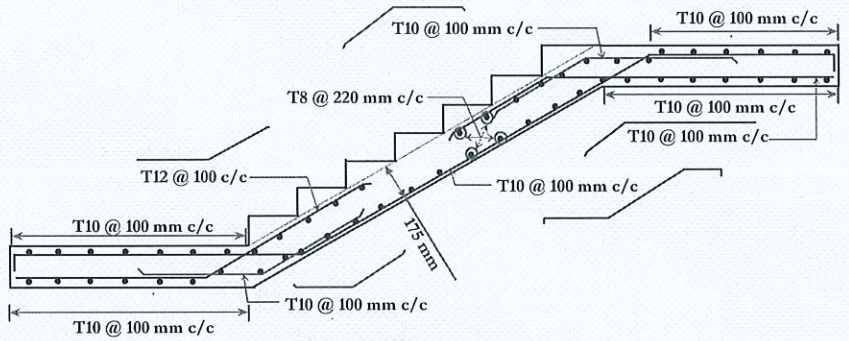
Design of Landing slab			
Load calculations (per unit width of landing slab)			
SW of landing slab		W1	5.13 kN/sqm
SW of steps		W2	2.06 kN/sqm
Floor finish		W2	3.90 kN/sqm
Live load		W3	4.00 kN/sqm
Sub-Total load per unit width of landing		W	15.09 kN/m
Load on landing slab from waist slab (per meter width)		W4	20.55 kN/m
Total load per unit width of landing		W	35.64 kN/m
Total Factored load per unit width of the landing		Wu	53.45 kN/m
Check for depth from BM criteria			
Factored Moment		Mu	43.42 kN-m
Effective depth required		d req	105 mm
		Depth provided is Sufficient	
Reinforcement details			
Minimum Area of steel		$A_{st\ min}$	210 sqmm
Required Area of steel		A_{st}	730 sqmm
Dia of reinforcing bar		φ	10 mm
Dia of reinforcing bar		φ	100 mm
Area of steel provided		$A_{st\ pro}$	785.40 sqmm
Percentage of steel		pt	0.524 %
Along the span, provide		T10 @ 100 mm c/c	
Distribution steel		A_{st}	210.00 sqmm
Dia of reinforcing bar		φ	8 mm
Perpendicular to the span, provide		T8 @ 220 mm c/c	
Check for shear			
Design shear force	(Wu*l/2)	V_u	64.146 kN
Design shear stress	(Vu /bd)	τ_v	0.43 N/sqmm
β = [(0.8*fck)/(6.89*pt)	(from SP:24)	β	6.653
Shear resisted by concrete	(from SP:24)	τ_c	0.51 N/sqmm
		Safe under Shear	
Check for depth from Deflection criteria			
Basic span to effective depth ratio		$(l/d)_{basic}$	20
Modification factor for compression reinforcement		K_c	1
Reduction factor		K_f	1
Stress in reinforcement	$[(0.58 \times f_y \times A_{st})/ A_{st\ pro}]$	f_s	270 N/sqmm
Modification factor for tensile reinforcement		K_t	1.09
Maximum span to effective depth ratio	$[(l/d)basic*K_c*K_f*K_t]$	$(l/d)_{max}$	21.803
Actual span to effective depth ratio		$(l/d)_{actual}$	8.333
		Safe under Deflection	

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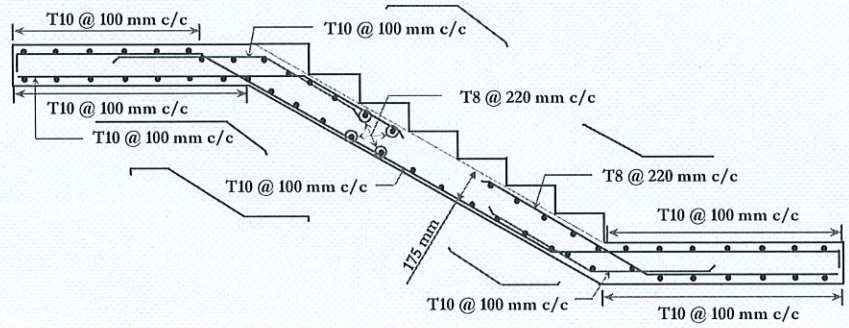


PLAN





SECTION A-A

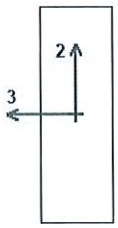


SECTION B-B

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ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Beam Section Design



Beam Element Details Type: Ductile Frame (Summary)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF
2F	B133	91	B 200X600 M30	1.5TDL+0.45SpecX+1.5SpecY+0.45SpecZ	3210	3210	1

Section Properties

b (mm)	h (mm)	b_f (mm)	d_s (mm)	d_{ct} (mm)	d_{cb} (mm)
200	600	200	0	60	60

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
27386.13	30	1	500	415

Design Code Parameters

γ_c	γ_s
1.5	1.15

Factored Forces and Moments

Factored M_{u3} kN-m	Factored T_u kN-m	Factored V_{u2} kN	Factored P_u kN
-98.135	0.3268	75.5882	-36.6308

Design Moments, M_{u3} & M_t

Factored Moment kN-m	Factored M_t kN-m	Positive Moment kN-m	Negative Moment kN-m
-98.135	0.7689	0	-98.9039

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Design Moment and Flexural Reinforcement for Moment, M_{u3} & T_u

	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm²	+Moment Rebar mm²	Minimum Rebar mm²	Required Rebar mm²
Top (+2 Axis)	-98.9039		485	42	485	284
Bottom (-2 Axis)		0	284	42	0	284

Shear Force and Reinforcement for Shear, V_{u2} & T_u

Shear V_e kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv}/s mm²/m
75.5882	0	78.2023	75.3443	401.31

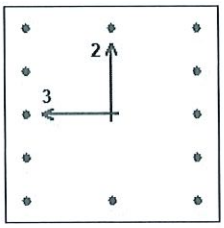
Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{U2}

T_u kN-m	V_u kN	Core b_1 mm	Core d_1 mm	Rebar A_{svt}/s mm²/m
0.2931	75.5882	100	500	192.77

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ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Column Section Design



Column Element Details Type: Ductile Frame (Summary) (Part 1 of 2)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc
STILT FLOOR	C51	11542	C 600X600 M30	0.9TDL+0.45SpecX+1.5SpecY+0.45SpecZ	0

Column Element Details Type: Ductile Frame (Summary) (Part 2 of 2)

Length (mm)	LLRF
3850	1

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
600	600	60	30

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
27386.13	30	1	500	415

Design Code Parameters

γ_c	γ_s
1.5	1.15

Axial Force and Biaxial Moment Design For P_u , M_{u2} , M_{u3}

Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Minimum M_2 kN-m	Minimum M_3 kN-m	Rebar Area mm²	Rebar % %
495.2642	180.2638	-72.946	13.7188	13.7188	2880	0.8

Axial Force and Biaxial Moment Factors

	K Factor Unitless	Length mm	Initial Moment kN-m	Additional Moment kN-m	Minimum Moment kN-m
Major Bend(M3)	0.695225	3850	45.0596	0	13.7188
Minor Bend(M2)	0.695225	3850	72.1055	0	13.7188

18-10-2023

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Shear Design for V_{u2} , V_{u3}

	Shear V_u kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv} /s mm²/m
Major, V_{u2}	47.8213	173.6395	129.6005	0	665.06
Minor, V_{u3}	71.3451	173.6395	129.6005	0	665.06

Joint Shear Check/Design

	Joint Shear Force kN	Shear V_{Top} kN	Shear $V_{u,Tot}$ kN	Shear V_c kN	Joint Area cm²	Shear Ratio Unitless
Major Shear, V_{u2}	N/A	N/A	N/A	N/A	N/A	N/A
Minor Shear, V_{u3}	N/A	N/A	N/A	N/A	N/A	N/A

(1.4) Beam/Column Capacity Ratio

Major Ratio	Minor Ratio
N/A	N/A

Additional Moment Reduction Factor k (IS 39.7.1.1)

A_g cm²	A_{sc} cm²	P_{uz} kN	P_b kN	P_u kN	k Unitless
3600	28.8	5940	2215.2601	495.2642	1

Additional Moment (IS 39.7.1)

	Consider M_a	Length Factor	Section Depth (mm)	KL/Depth Ratio	KL/Depth Limit	KL/Depth Exceeded	M_a Moment (kN-m)
Major Bending (M_3)	Yes	1	600	4.461	12	No	0
Minor Bending (M_2)	Yes	1	600	4.461	12	No	0

Notes:

N/A: Not Applicable

N/C: Not Calculated

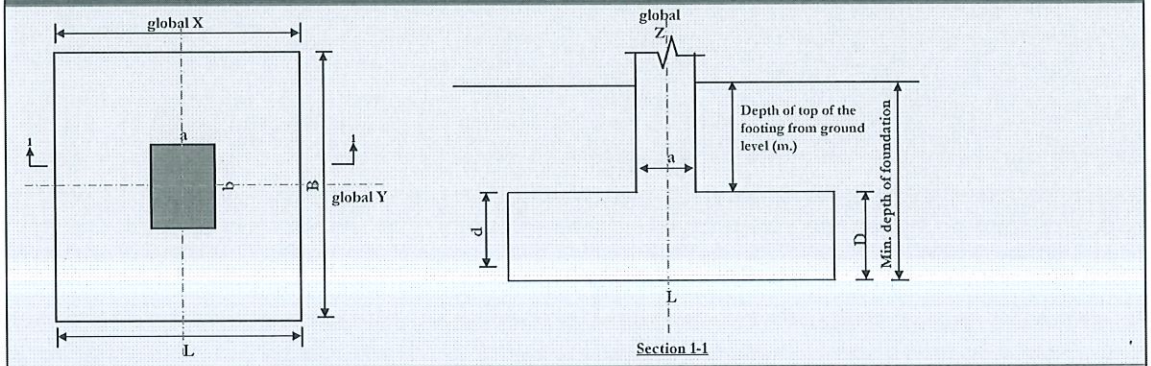
N/N: Not Needed

18-10-2023

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Innotech Engineering Consult Pvt. Ltd.	Project : MAHINDRA WORLD CITY - CHENNAI - BLOCK C		Job Number :	385
			Dwg. Ref. No. :	
	Part of the structure : Design of isolated footing		Date :	18-10-2023
			Footing No.	Grid
	Prepared by : Kiran R P	Checked by : Pooja L	P-F1	**

Basic Data



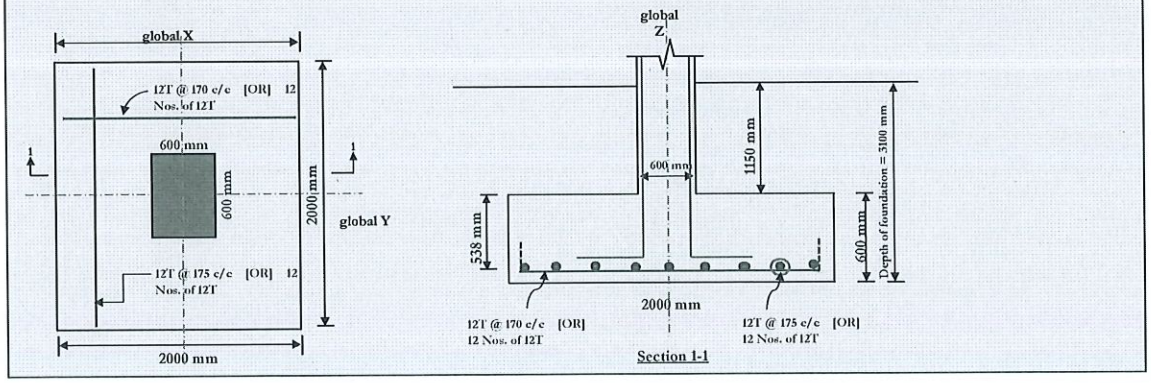
Footing type / No.		P-F1
Grade of concrete :	fck (N/sqmm)	30 N/sqmm
Grade of reinforcement steel :	fy (N/sqmm)	500 N/sqmm
SBC of soil	(kN/sqm)	500 kN/sqm
Density of the Soil	(kN/cum)	18 kN/cum
Type of soil [Hard(I), Medium (II) or Soft (III)]		Type I
Clear cover for reinforcement		50 mm
Joint label/Pier label in ETABS		C51
Column details	Dimension along X-direction (m.) a	0.600 m
	Dimension along Y-direction (m.) b	0.600 m
	Maximum Dia of bar in column	16 mm
	Design bond stress for bars in compression	3.00 N/sqmm
	Ldc of column bars	580 mm
Footing dimensions	Dimension along X-direction (m.) L	2.000 m
	Dimension along Y-direction (m.) B	2.000 m
	Depth along Z-axis (mm.) D	600 mm
Depth of top of the footing from ground level (m.)		1.15 m
Self weight of the footing 'P1' (kN)		60.00
Weight of soil retained above footing 'P2' (kN)		75.348

Unfactored Design Load Combinations (Critical load combinations)		TDL+TLL	TDL+TLL+WX	TDL+TLL+0.3SPECX+SPECY+0.3SPECZ	TDL+TLL-WX
Joint reactions from ETABS	Axial force in global Z axis 'P'(kN)	767.45	778.58	738.62	756.31
	Moment about global X axis 'Mx' (kN-m)	6.83	19.46	124.07	-5.79
	Moment about global Y axis 'My' (kN-m)	-48.85	-2.33	-20.84	-95.37
If (DL + LL) or (DL+EQ/WL) = 1 ; (L+LL+EQ/WL) = 2		1	2	2	2
Partial Safety factor		1.5	1.2	1.2	1.2
SBC Enhancement factor (Type I = 1.5, Type II = 1.25, Type III = 1)		1	1.50	1.50	1.50
Check for bearing pressure					
Required footing area (sqm)		1.81	1.22	1.17	1.19
Provided footing area (sqm)		4.00	4.00	4.00	4.00
Min. Gross Bearing Pressure (kN/m^2)		183.94	212.15	109.81	147.04
Max. Net Bearing Pressure (kN/sqm)		233.62	210.98	293.34	264.95
Min. Net Bearing Pressure (kN/sqm)		150.10	178.31	75.97	113.21
Design soil pressure (due to applied loads only) (kN/sqm)		350.43	253.18	352.01	317.94
		SAFE	SAFE	SAFE	SAFE
Reinforcement along Global X axis (II el to Y-axis)					
Effective depth of footing		538 mm	538	538	538

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Innotech Engineering Consult Pvt. Ltd.	Project : MAHINDRA WORLD CITY - CHENNAI - BLOCK C		Job Number : 385	
			Dwg. Ref. No. :	
	Part of the structure : Design of isolated footing		Date : 18-10-2023	
			Footing No.	Grid
	Prepared by : Kiran R P	Checked by : Pooja L	P-F1	**

Cantilever projection from column face along X axis (m)		0.700	0.700	0.700	0.700
Cantelever BM in X direction (kN-m)		85.86	62.03	86.24	77.90
Mu/Bd^2 (N/sqmm)		0.30	0.21	0.30	0.27
Percentage of steel : p_t		0.07	0.05	0.07	0.06
p_t actual or pt min		0.12	0.12	0.12	0.12
Ast along X-axis (sqmm)		**645.6**	**645.6**	**645.6**	**645.6**
Choosing bar dia as :	12 mm	Provide : 12T @ 175 c/c [OR] 12 Nos. of 12T			
1 Way Shear Check along X axis					
One way shear force (kN)		56.77	41.01	57.03	51.51
Depth for one way shear (mm)		538	538	538	538
pt provided at the critical section		0.12	0.12	0.12	0.12
Shear stress to be resisted	ζv (N/mm2)	**0.106**	**0.076**	**0.106**	**0.096**
Shear stress resisted by concrete + provided steel	ζc (N/mm2)	**0.290**	**0.290**	**0.290**	**0.290**
		SAFE	SAFE	SAFE	SAFE
Reinforcement along Global Y axis (II el to X-axis)					
Effective depth of footing		550 mm	550	550	550
Cantilever projection from column face along Y axis (m)		0.700	0.700	0.700	0.700
Cantelever BM in Y direction (kN-m)		85.86	62.03	86.24	77.90
Mu/Bd^2 (N/sqmm)		0.28	0.21	0.29	0.26
Percentage of steel : p_t		0.07	0.05	0.07	0.06
p_t actual or pt min		0.12	0.12	0.12	0.12
Ast along Y-axis (sqmm)		**660.0**	**660.0**	**660.0**	**660.0**
Choosing bar dia as	12 mm	Provide : 12T @ 170 c/c [OR] 12 Nos. of 12T			
1 Way Shear Check along Y axis					
One way shear force (kN)		52.56	37.98	52.80	47.69
Depth for one way shear (mm)		550	550	550	550
pt provided at the critical section		0.12	0.12	0.12	0.12
Shear stress to be resisted	ζv (N/mm2)	**0.096**	**0.069**	**0.096**	**0.087**
Shear stress resisted by concrete + provided steel	ζc (N/mm2)	**0.290**	**0.290**	**0.290**	**0.290**
		SAFE	SAFE	SAFE	SAFE
Two Way/Punching Shear Check					
Effective depth of footing considered for two way shear check		538	538	538	538
Punching area	L1 (m)	1.138	1.138	1.138	1.138
	B1 (m)	1.138	1.138	1.138	1.138
Two way/Punching shear force (kN)		948	685	952	860
Shear stress to be resisted	ζv (N/mm2)	**0.39**	**0.28**	**0.39**	**0.35**
Shear stress resisted by concrete + provided steel	ζc (N/mm2)	**1.37**	**1.37**	**1.37**	**1.37**
		SAFE	SAFE	SAFE	SAFE

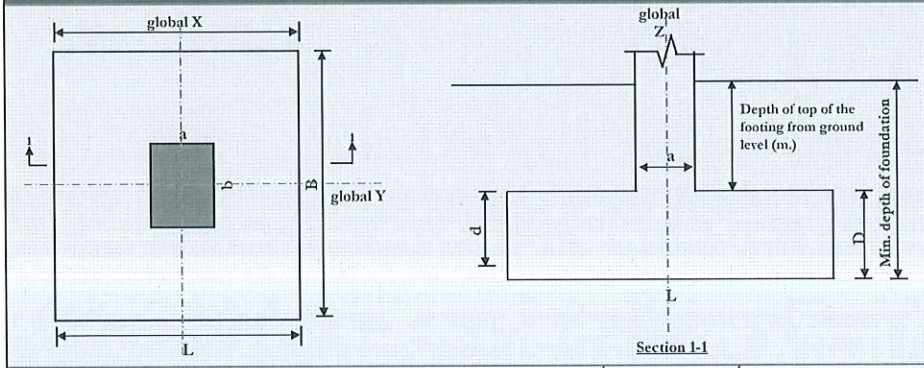


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Innotech Engineering Consult Pvt. Ltd.

Project : MAHINDRA WORLD CITY - CHENNAI		Job Number :	385
		Dwg. Ref. No. :	
Part of the structure : Design of isolated footing		Date :	18-10-2023
		Footing No.	Grid
Prepared by : Kiran R P	Checked by : Pooja L	F1	**

Basic Data



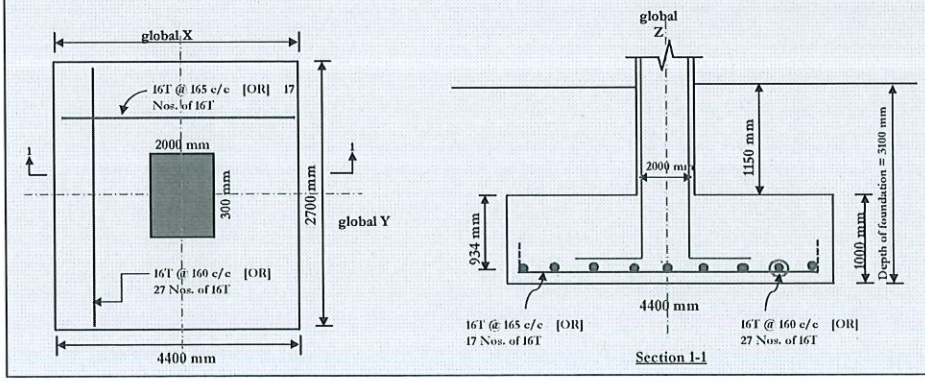
Footing type / No.			F1
Grade of concrete :		fck (N/sqmm)	30 N/sqmm
Grade of reinforcement steel :		fy (N/sqmm)	500 N/sqmm
SBC of soil		(kN/sqm)	500 kN/sqm
Density of the Soil		(kN/cum)	18 kN/cum
Type of soil [Hard(I), Medium (II) or Soft (III)]			Type I
Clear cover for reinforcement			50 mm
Joint label/Pier label in ETABS			T8
Column details	Dimension along X-direction (m.) a		2.000 m
	Dimension along Y-direction (m.) b		0.300 m
	Maximum Dia of bar in column		16 mm
	Design bond stress for bars in compression		3.00 N/sqmm
	Ldc of column bars		580 mm
Footing dimensions	Dimension along X-direction (m.) L		4.400 m
	Dimension along Y-direction (m.) B		2.700 m
	Depth along Z-axis (mm.) D		1000 mm
Depth of top of the footing from ground level (m.)			1.15 m
Self weight of the footing 'P1' (kN)			297.00
Weight of soil retained above footing 'P2' (kN)			233.496

Unfactored Design Load Combinations (Critical load combinations)		TDL+TLL	TDL+TLL+0.3SPEC X+0.3SPECY+SPEC Z-1 MIN	TDL+TLL+0.3SPEC X+SPECY+0.3SPEC Z MAX	TDL+TLL+SPECX +0.3SPECY+0.3SPE CZ MAX
Joint reactions from ETABS	Axial force in global Z axis 'P'(kN)	5269.64	5757.10	4928.89	4809.16
	Moment about global X axis 'Mx' (kN-m)	12.60	-0.69	46.29	26.95
	Moment about global Y axis 'My' (kN-m)	40.97	-164.66	298.16	461.35
If (DL + LL) or (DL+EQ/WL) = 1 ; (L+LL+EQ/WL) = 2		1	2	2	2
Partial Safety factor		1.5	1.2	1.2	1.2
SBC Enhancement factor (Type I = 1.5, Type II = 1.25, Type III = 1)		1	1.50	1.50	1.50
Check for bearing pressure					
Required footing area (sqm)		11.60	8.38	7.28	7.12
Provided footing area (sqm)		11.88	11.88	11.88	11.88
Min. Gross Bearing Pressure (kN/m^2)		481.17	510.23	416.66	391.47
Max. Net Bearing Pressure (kN/sqm)		450.63	503.63	457.77	462.81
Min. Net Bearing Pressure (kN/sqm)		436.51	465.57	372.01	346.81
Design soil pressure (due to applied loads only) (kN/sqm)		675.95	604.36	549.33	555.37
		SAFE	SAFE	SAFE	SAFE
Reinforcement along Global X axis (II el to Y-axis)					
Effective depth of footing		934 mm	934	934	934

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Innotech Engineering Consult Pvt. Ltd.	Project : MAHINDRA WORLD CITY - CHENNAI		Job Number : 385	
			Dwg. Ref. No. :	
	Part of the structure : Design of isolated footing		Date : 18-10-2023	
			Footing No.	Grid
	Prepared by : Kiran R P	Checked by : Pooja L	F1	**

Cantilever projection from column face along X axis (m)		1.200	1.200	1.200	1.200
Cantelever BM in X direction (kN-m)		486.68	435.14	395.52	399.87
Mu/Bd^2 (N/sqmm)		0.56	0.50	0.45	0.46
Percentage of steel : p_t		0.13	0.12	0.11	0.11
p_t actual or pt min		0.13	0.12	0.12	0.12
Ast along X-axis (sqmm)		**1225.3**	**1120.8**	**1120.8**	**1120.8**
Choosing bar dia as :	16 mm	Provide : 16T @ 160 c/c [OR] 27 Nos. of 16T			
1 Way Shear Check along X axis					
One way shear force (kN)		179.80	160.76	146.12	147.73
Depth for one way shear (mm)		934	934	934	934
pt provided at the critical section		0.13	0.12	0.12	0.12
Shear stress to be resisted	ζv (N/mm2)	**0.193**	**0.172**	**0.156**	**0.158**
Shear stress resisted by concrete + provided steel	ζc (N/mm2)	**0.290**	**0.290**	**0.290**	**0.290**
		SAFE	SAFE	SAFE	SAFE
Reinforcement along Global Y axis (II el to X-axis)					
Effective depth of footing		950 mm	950	950	950
Cantilever projection from column face along Y axis (m)		1.200	1.200	1.200	1.200
Cantelever BM in Y direction (kN-m)		486.68	435.14	395.52	399.87
Mu/Bd^2 (N/sqmm)		0.54	0.48	0.44	0.44
Percentage of steel : p_t		0.13	0.11	0.10	0.10
p_t actual or pt min		0.13	0.12	0.12	0.12
Ast along Y-axis (sqmm)		**1203.7**	**1140.0**	**1140.0**	**1140.0**
Choosing bar dia as	16 mm	Provide : 16T @ 165 c/c [OR] 17 Nos. of 16T			
1 Way Shear Check along Y axis					
One way shear force (kN)		168.99	151.09	137.33	138.84
Depth for one way shear (mm)		950	950	950	950
pt provided at the critical section		0.13	0.12	0.12	0.12
Shear stress to be resisted	ζv (N/mm2)	**0.178**	**0.159**	**0.145**	**0.146**
Shear stress resisted by concrete + provided steel	ζc (N/mm2)	**0.290**	**0.290**	**0.290**	**0.290**
		SAFE	SAFE	SAFE	SAFE
Two Way/Punching Shear Check					
Effective depth of footing considered for two way shear check		934	934	934	934
Punching area	L1 (m)	1.234	1.234	1.234	1.234
	B1 (m)	2.934	2.934	2.934	2.934
Two way/Punching shear force (kN)		5583	4992	4537	4587
Shear stress to be resisted	ζv (N/mm2)	**0.72**	**0.64**	**0.58**	**0.59**
Shear stress resisted by concrete + provided steel	ζc (N/mm2)	**0.89**	**0.89**	**0.89**	**0.89**
		SAFE	SAFE	SAFE	SAFE



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ETABS Shear Wall Design

IS 456:2000 Pier Design

Pier Details

Story ID	Pier ID	Centroid X (mm)	Centroid Y (mm)	Length (mm)	Thickness (mm)	LLRF
1F/TRANSFER	T1	-12654.2	45569.9	1501.5	300	1

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
27386.13	30	1	500	415

Design Code Parameters

Γ_s	Γ_c	IP_{MAX}	IP_{MIN}	P_{MAX}	MinEcc Major	MinEcc Minor
1.15	1.5	0.04	0.0025	0.8	Yes	Yes

Pier Leg Location, Length and Thickness

Station Location	ID	Left X_1 mm	Left Y_1 mm	Right X_2 mm	Right Y_2 mm	Length mm	Thickness mm
Top	Leg 1	-13405	45569.9	-11903.5	45569.9	1501.5	300
Bottom	Leg 1	-13405	45569.9	-11903.5	45569.9	1501.5	300

Flexural Design for P_u, M_{u2} and M_{u3} (Part 1 of 2)

Station Location	Required Rebar Area (mm²)	Required Reinf Ratio	Current Reinf Ratio	Flexural Combo	P_u kN	M_{u2} kN-m
Top	11396	0.0253	0.0035	1.5TDL+0.45SpecX+1.5SpecY+0.45SpecZ	880.3107	-588.2145
Bottom	5116	0.0114	0.0035	0.9TDL+0.45SpecX+1.5SpecY+0.45SpecZ	241.9247	258.3134

Flexural Design for P_u, M_{u2} and M_{u3} (Part 2 of 2)

M_{u3} kN-m	Pier A_g mm²
533.4773	450456
-320.8247	450456

Shear Design

Station Location	ID	Rebar mm²/m	Shear Combo	P_u kN	M_u kN-m	V_u kN	V_c kN	$V_c + V_s$ kN
Top	Leg 1	750	1.5TDL+1.5SpecX+0.45SpecY+0.45SpecZ	1017.8394	592.6541	-274.9246	215.9288	541.0407
Bottom	Leg 1	750	1.5TDL+1.5SpecX+0.45SpecY+0.45SpecZ	1078.2543	383.7776	-275.3175	215.9288	541.0407

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Boundary Element Check

Station Location	ID	Edge Length (mm)	Governing Combo	P_u kN	M_u kN-m	Stress Comp MPa	Stress Limit MPa
Top–Left	Leg 1	0	0.9TDL+0.45SpecX+1.5SpecY+0.45SpecZ	1817.6042	-12.9222	4.15	6
Top–Right	Leg 1	300	0.9TDL+0.45SpecX+1.5SpecY+0.45SpecZ	2492.0829	533.4773	10.26	6
Bottom–Left	Leg 1	300	1.5TDL+0.45SpecX+1.5SpecY+0.45SpecZ	2553.2887	-326.3382	8.56	6
Botttom–Right	Leg 1	300	1.5TDL+0.45SpecX+1.5SpecY+0.45SpecZ	2553.2887	298.7706	8.32	6

18-10-2023

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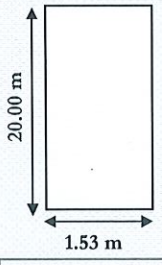
Innotech Engineering Consult Pvt. Ltd.	Project	IECP 385 - Mahindra World City
	Prepared by	Sanath Kumar K V
	Checked by	Pooja L
	Part of the structure	One way continuous slab

ONE WAY (Continuous) SLAB

ALL CALCULATIONS ARE PER SQM AREA OF SLAB

Preliminary Data

Long span	20.00 m
Short span	1.53 m
Aspect Ratio	13.15
One way slab	



Long span		l_{ey}	20.10 m
Short span		l_{ex}	1.62 m
Grade of concrete		f_{ck}	30 N/sqmm
Grade of steel		f_y	500 N/sqmm
Unit weight of RCC		Yc	25.00 kN/cum
Overall depth (assumed)		D	125 mm
Effective cover		d'	25 mm
Effective depth provided		d	96 mm
Load calculations			
Self weight		W_d	3.13 kN/sqm
Floor finish		FF	1.20 kN/sqm
Miscellaneous		W	0.00 kN/sqm
Total dead load		DL	4.33 kN/sqm
Live load		LL	3.00 kN/sqm
Check for depth from BM criteria			
Factored moment (Bottom - Mid span)	$[(W_d*l_x^2)/12] + [(W_l*l_x^2)/10]$	M^+	2.60 kN-m
Factored moment (Top - At Supports)	$[(W_d*l_x^2)/10] + [(W_l*l_x^2)/9]$	M^-	3.02 kN-m
Effective depth required		d req	27 mm
		Depth provided is Sufficient	
Reinforcement details			
Minimum Area of steel	[(pt = 0.12%)=>(0.12*b*D)/100]	$A_{st\ min}$	150.00 sqmm
Shorter span (Bottom Bars)			
Area of steel		$A_{st\ bot}$	150.00 sqmm
Dia of reinforcing bar		φ	8 mm
Spacing between bars		s	250 mm
Area of steel provided		$A_{st\ pro}$	201.06 sqmm
Percentage of steel	pt = 100*Ast / b*d	pt	0.209 %
Provide, parallel to shorter span (bottom)		8T @ 250 mm c/c	
Longer span (Bottom Bars)			
Area of steel		$A_{st\ min}$	150.00 sqmm
Dia of reinforcing bar		ϕ	8 mm
Spacing between bars		s	250 mm
Area of steel provided		$A_{st\ pro}$	201.06 sqmm
Percentage of steel	pt = 100*Ast / b*d	pt	0.161 %
Provide, parallel to longer span (bottom)		8T @ 250 mm c/c	
Shorter span (Top Bars)			
Area of steel		$A_{st\ top}$	150.00 sqmm
Dia of reinforcing bar		φ	8 mm
Spacing between bars		s	250 mm
Area of steel provided		$A_{st\ pro}$	201.06 sqmm

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Percentage of steel	pt = 100*Ast / b*d	pt	0.209 %
Provide, parallel to shorter span (top)		8T @ 250 mm c/c	

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Check for shear			
Design shear force	[(1.5*0.6)*(W_d+ W_l)*l_x]	V_u	8.936 kN
Design shear stress	(Vu /bd)	τ_v	0.09 N/sqmm
β = [(0.8*fck)/(6.89*pt)	(from SP:24)	β	16.632
Shear resisted by concrete	(from SP:24)	τ_c	0.34 N/sqmm
		Safe under shear	
Check for Deflection			
Basic span to effective depth ratio		$(l/d)_{basic}$	26
Modification factor for compression reinforcement		K_c	1
Reduction factor		K_f	1
Stress in reinforcement	[(0.58 x f_y x A_{st})/ $A_{st\ pro}$]	f_s	216.35 N/sqmm
Modification factor for tensile reinforcement		K_t	2.00
Maximum span to effective depth ratio	[(l/d)basic*K_c*K_f*K_t]	$(l/d)_{max}$	52.000
Actual span to effective depth ratio		$(l/d)_{actual}$	16.885
		Safe under Deflection	
Summary			
Shorter span (bottom) reinforcement		8T @ 250 mm c/c	
Longer span (bottom) reinforcement		8T @ 250 mm c/c	
At supports, top reinforcement		8T @ 250 mm c/c	

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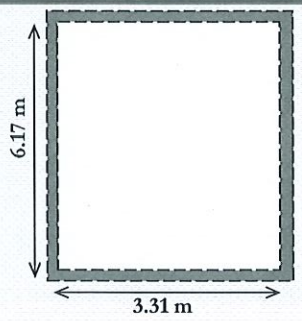
Innotech Engineering Consult Pvt. Ltd.	Project	IECP 385 - Mahindra World City
	Prepared by	Sanath Kumar K V
	Checked by	Pooja L
	Part of the structure	Two way slab

TWO WAY SLAB

ALL CALCULATIONS ARE PER SQM AREA OF SLAB

Preliminary Data

Long span	6.07 m
Short span	3.21 m
Aspect Ratio	1.90
Hence Two way slab	



Effective Long span	l_{ey}	6.17 m
Effective Short span	l_{ex}	3.31 m
Grade of concrete	f_{ck}	30 N/sqmm
Grade of steel	f_y	500 N/sqmm
Unit weight of RCC	Yc	25.00 kN/cum
Overall depth (assumed)	D	125 mm
Effective cover	d'	25 mm
Effective depth provided	d	96 mm

Load calculations

Self weight of slab	DL	3.13 kN/sqm
Floor finish	FF	1.20 kN/sqm
Miscellaneous	W	
Live load	LL	2.00 kN/sqm
Total Factored load	W_u	9.49 kN/sqm

Edge condition : Interior panel/all 4 edges continuous

Bending Moment calculations

Shorter span

+ve moment coefficient at mid span		α_x	0.048
Factored moment (Bottom - Mid span)	$[\alpha_x * W * l_x^2]$	M_{ux}	4.98 kN-m
-ve moment at coefficient continuous edge		α_x	0.063
Factored moment (Top - At Supports)	$[\alpha_x * W * l_x^2]$	M_{ux}	6.53 kN-m

Longer span

+ve moment coefficient at mid span		α_y	0.024
Factored moment (Bottom - Mid span)	$[\alpha_x * W * l_x^2]$	M_{uy}	2.49 kN-m
-ve moment at coefficient continuous edge		α_y	0.032
Factored moment (Top - At Supports)	$[\alpha_x * W * l_x^2]$	M_{uy}	3.32 kN-m

Check for depth from BM criteria

Effective depth required	d req	40 mm
	Depth provided is Sufficient	

Reinforcement details

Minimum Area of steel	$A_{st\ min}$	150.00 sqmm

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Shorter span (Bottom Bars)			
Area of steel		Ast	150.00 sqmm
Dia of reinforcing bar		φ	8 mm
Spacing between bars		s	250 mm
Area of steel provided		$A_{st\ pro}$	201.06 sqmm
Percentage of steel	pt = 100*Ast / b*d	pt	0.209 %
Provide, parallel to shorter span (bottom)		8T @ 250 mm c/c	
Longer span (Bottom Bars)			
Area of steel		Ast	150.00 sqmm
Dia of reinforcing bar		φ	8 mm
Spacing between bars		s	250 mm
Area of steel provided		$A_{st\ pro}$	201.06 sqmm
Percentage of steel	pt = 100*Ast / b*d	pt	0.209 %
Provide, parallel to longer span (bottom)		8T @ 250 mm c/c	
Shorter span (Top Bars)			
Area of steel		Ast	170.00 sqmm
Dia of reinforcing bar		φ	8 mm
Spacing between bars		s	250 mm
Area of steel provided		$A_{st\ pro}$	201.06 sqmm
Percentage of steel	pt = 100*Ast / b*d	pt	0.209 %
Provide, parallel to shorter span (top)		8T @ 250 mm c/c	
Longer span (Top Bars)			
Area of steel		Ast	150.00 sqmm
Dia of reinforcing bar		φ	8 mm
Spacing between bars		s	250 mm
Area of steel provided		$A_{st\ pro}$	201.06 sqmm
Percentage of steel	pt = 100*Ast / b*d	pt	0.209 %
Provide, parallel to longer span (top)		8T @ 250 mm c/c	
Check for shear			
Design shear force	(Wu*l/2)	V_u	7.841 kN
Design shear stress	(Vu /bd)	τ_v	0.08 N/sqmm
β = [(0.8*fck)/(6.89*pt)	(from SP:24)	β	16.632
Shear resisted by concrete	(from SP:24)	τ_c	0.34 N/sqmm
		Safe under shear	
Check for Deflection			
Basic span to effective depth ratio		$(l/d)_{basic}$	26
Modification factor for compression reinforcement		K_c	1.00
Reduction factor		K_f	1.00
Stress in reinforcement	$[(0.58 \times f_y \times A_{st})/ A_{st\ pro}]$	f_s	216.35 N/sqmm
Modification factor for tensile reinforcement		K_t	2.00
Maximum span to effective depth ratio	[(l/d)basic*K_c*K_f*K_t]	$(l/d)_{max}$	52.000
Actual span to effective depth ratio		$(l/d)_{actual}$	34.438
		Safe under Deflection	

Summary		
Shorter span (bottom) reinforcement	A	8T @ 250 mm c/c
Longer span (bottom) reinforcement	B	8T @ 250 mm c/c
Shorter span (top) reinforcement	C	8T @ 250 mm c/c
Longer span (top) reinforcement	D	8T @ 250 mm c/c

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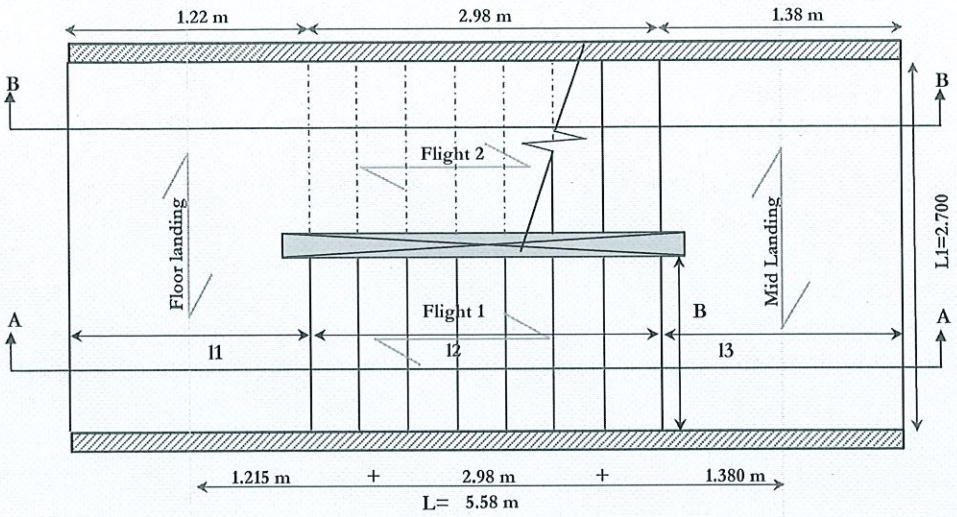
Innotech Engineering Consult Pvt. Ltd.	Project : MAHINDRA WORLD CITY CHENNAI		Job Number IECP - 385
	Part of the structure : Dog Legged Staircase		Date 18-10-2023
	Prepared by : KIRAN R P	Checked by : MANOHARVD	Staircase No.

Preliminary data			
Grade of Concrete		fck	30 N/sqmm
Grade of steel		fy	500 N/sqmm
Unit weight of RCC		Yc	25.00 kN/cum
Width of going		B	1.25 m
First landing width		l1	1.22 m
Span of going		l2	2.98 m
Intermediate landing width		l3	1.38 m
Effective Span of going		L	3.58 m
Riser		R	0.17 m
Tread		T	0.27 m
clear Span of supporting landing slab		L1	2.70 m
Overall Depth of waist slab		D	175 mm
Overall Depth of landing slab		D	175 mm
Effective Cover		d'	25 mm
Effective depth of waist slab		d	150 mm
Effective depth of landing slab		d	150 mm
Design of Waist slab			
Load calculations (per unit width of waist slab)			
SW of waist slab		W1	5.13 kN/sqm
SW of steps		W2	2.06 kN/sqm
Floor finish		W3	3.60 kN/sqm
Live load		W4	3.00 kN/sqm
Total load		W	13.79 kN/sqm
Total Factored load per unit width of the flight		Wu	20.68 kN/m
Check for depth from BM criteria			
Factored Moment		Mu	26.51 kN-m
Effective depth required		d req	82 mm
		Depth provided is Sufficient	
Reinforcement details			
Minimum Area of steel		$A_{st\ min}$	210 sqmm
Required Area of steel		A_{st}	430 sqmm
Dia of reinforcing bar		φ	10 mm
Spacing between the bars		s	100 mm
Area of steel provided		$A_{st\ pro}$	785.40 sqmm
Percentage of steel		pt	0.524 %
Along the span, provide		T10 @ 100 mm c/c	
Distribution steel		A_{st}	210.00 sqmm
Dia of reinforcing bar		φ	8 mm
Perpendicular to the span, provide		T8 @ 220 mm c/c	
Check for depth from Deflection criteria			
Basic span to effective depth ratio		$(l/d)_{basic}$	20
Modification factor for compression reinforcement		K_c	1
Reduction factor		K_f	1
Stress in reinforcement	$[(0.58 \times f_y \times A_{st})/ A_{st\ pro}]$	f_s	159 N/sqmm
Modification factor for tensile reinforcement		K_t	1.78
Maximum span to effective depth ratio	$[(l/d)basic*K_c*K_f*K_t]$	$(l/d)_{max}$	35.675
Actual span to effective depth ratio		$(l/d)_{actual}$	23.867

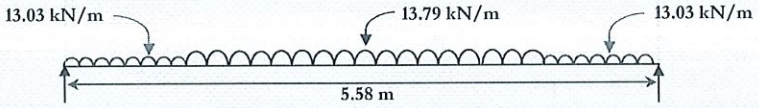
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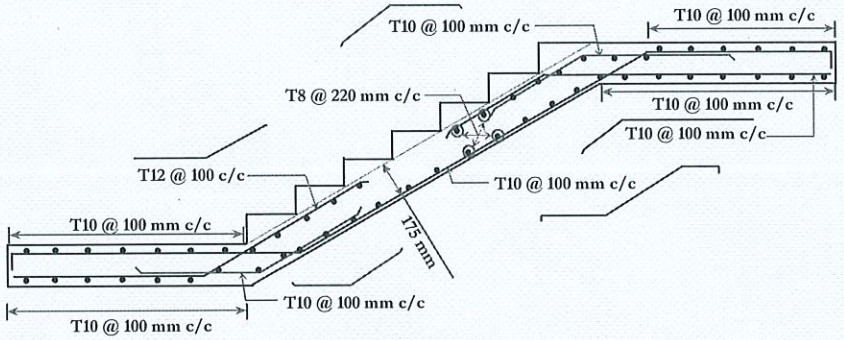
Design of Landing slab			
Load calculations (per unit width of landing slab)			
SW of landing slab		W1	5.13 kN/sqm
SW of steps		W2	2.06 kN/sqm
Floor finish		W2	3.90 kN/sqm
Live load		W3	4.00 kN/sqm
Sub-Total load per unit width of landing		W	15.09 kN/m
Load on landing slab from waist slab (per meter width)		W4	20.55 kN/m
Total load per unit width of landing		W	35.64 kN/m
Total Factored load per unit width of the landing		Wu	53.45 kN/m
Check for depth from BM criteria			
Factored Moment		Mu	43.42 kN-m
Effective depth required		d req	105 mm
		Depth provided is Sufficient	
Reinforcement details			
Minimum Area of steel		$A_{st\ min}$	210 sqmm
Required Area of steel		A_{st}	730 sqmm
Dia of reinforcing bar		φ	10 mm
Dia of reinforcing bar		φ	100 mm
Area of steel provided		$A_{st\ pro}$	785.40 sqmm
Percentage of steel		pt	0.524 %
Along the span, provide		T10 @ 100 mm c/c	
Distribution steel		A_{st}	210.00 sqmm
Dia of reinforcing bar		φ	8 mm
Perpendicular to the span, provide		T8 @ 220 mm c/c	
Check for shear			
Design shear force	(Wu*l/2)	V_u	64.146 kN
Design shear stress	(Vu /bd)	τ_v	0.43 N/sqmm
β = [(0.8*fck)/(6.89*pt)	(from SP:24)	β	6.653
Shear resisted by concrete	(from SP:24)	τ_c	0.51 N/sqmm
		Safe under Shear	
Check for depth from Deflection criteria			
Basic span to effective depth ratio		$(l/d)_{basic}$	20
Modification factor for compression reinforcement		K_c	1
Reduction factor		K_f	1
Stress in reinforcement	[(0.58 x f_y x A_{st})/ $A_{st\ pro}$]	f_s	270 N/sqmm
Modification factor for tensile reinforcement		K_t	1.09
Maximum span to effective depth ratio	[(l/d)basic*K_c*K_f*K_t]	$(l/d)_{max}$	21.803
Actual span to effective depth ratio		$(l/d)_{actual}$	8.333
		Safe under Deflection	

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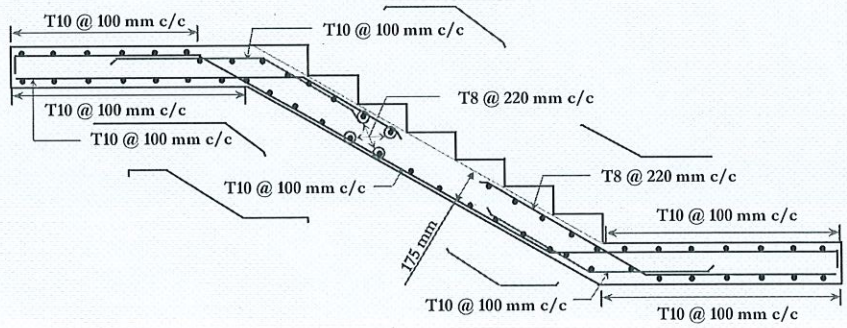


PLAN





SECTION A-A

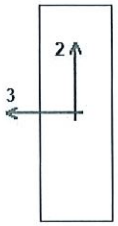


SECTION B-B

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ETABS Concrete Frame Design

IS 456:2000 + IS 13920:2016 Beam Section Design



Beam Element Details Type: Ductile Frame (Summary)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF
2F	B133	91	B 200X600 M30	1.5TDL+0.45SpecX+1.5SpecY+0.45SpecZ	3210	3210	1

Section Properties

b (mm)	h (mm)	b_f (mm)	d_s (mm)	d_{ct} (mm)	d_{cb} (mm)
200	600	200	0	60	60

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
27386.13	30	1	500	415

Design Code Parameters

γ_c	γ_s
1.5	1.15

Factored Forces and Moments

Factored M_{u3} kN-m	Factored T_u kN-m	Factored V_{u2} kN	Factored P_u kN
-98.135	0.3268	75.5882	-36.6308

Design Moments, M_{u3} & M_t

Factored Moment kN-m	Factored M_t kN-m	Positive Moment kN-m	Negative Moment kN-m
-98.135	0.7689	0	-98.9039

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18-10-2023

Design Moment and Flexural Reinforcement for Moment, M_{u3} & T_u

	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm²	+Moment Rebar mm²	Minimum Rebar mm²	Required Rebar mm²
Top (+2 Axis)	-98.9039		485	42	485	284
Bottom (-2 Axis)		0	284	42	0	284

Shear Force and Reinforcement for Shear, V_{u2} & T_u

Shear V_e kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv}/s mm²/m
75.5882	0	78.2023	75.3443	401.31

Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{U2}

T_u kN-m	V_u kN	Core b_1 mm	Core d_1 mm	Rebar A_{svt}/s mm²/m
0.2931	75.5882	100	500	192.77

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