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PROPOSED RESIDENTIAL BUILDING AT DOOR NO.B5, 10TH CROSS STREET,BESANT NAGAR, CHENNAI 600090.COMPRISED IN T.S.NO. 8/13 IN BLOCK NO.40 OF URUR VILLAGE, VELACHERY TALUK, CHENNAI DISTRICT, GREATER CHENNAI CORPORATION, ZONE - XIII, DIVISION - 176.

STRUCTURAL DESIGN CALCULATIONS

Structural Consultant

S.SANGEETA

CONSULTING ENGINEER

"MOUNT VIEW", Third Floor,
New No.64(Old No.111), Mount Road,
Guindy, Chennai – 600 032.

Architects

NATRAJ AND VENKAT ARCHITECTS

18, 3rd Seaward Rd,
Valmiki Nagar, Thiruvalluvar Nagar,
Thiruvanmiyur, Chennai 600041.

S.Sangeeta, M.E, M.I.E,
CONSULTING ENGINEER

'MOUNT VIEW', Third Floor, New No.64(Old No.111) Mount Road, Guindy, Chennai 600032.
Telephone: 22350711, E-mail: vsanga40@gmail.com, ssangrithi@gmail.com

STRUCTURAL STABILITY CERTIFICATE

Proposed Residential Building At Door No.B5, 10Th Cross Street,Besant Nagar, Chennai 600090.Comprised In T.S.No. 8/13 in Block No.40 Of Urur Village, Velachery Taluk, Chennai District, Greater Chennai Corporation, Zone - XIII, Division - 176.

The Residential Building referred to above is a framed structure with Stilt and Five Upper Floors. The Structural Design and Drawings for the building have been prepared by us conforming to the relevant Bureau of Indian Standards viz. IS 456:2000 for Plain and Reinforced Concrete, SP : 6(1)—1964, IS 456: 2000, IS 875(Part III):2015,IS 1893:2002(Part 1), SP 16, IS 1893 Part 1:2016 for Wind and Seismic Force.

We certify that the building when constructed according to our Structural Designs and Drawings will be structurally safe and sound against earthquake and fit for occupation

Chennai,
08.11.2023.

(S.Sangeeta.)

S. SANGEETA, M.E., M.I.E.,
STRUCTURAL ENGINEER,
CMDA REG. No. SE/GR-I/19/04/084
"MOUNT VIEW", THIRD FLOOR,
No. 64, MOUNT ROAD, GUINDY,
CHENNAI-600 032. PH: 044-22350711

CHENNAI METROPOLITAN DEVELOPMENT AUTHORITY
'Thalamuthu Natarajan Building', No.1, Gandhi Irwin Road,
Egmore, Chennai-600 008.

PROFESSIONAL REGISTRATION CERTIFICATE

This is to certify that the **Thirumathi. S.SANGEETHA** has enrolled as **Registered Structural Engineer Grade-I (SE)** with Chennai Metropolitan Development Authority (CMDA) who has the qualification of **M.E.,(Structural Engg.)** and experience in the relevant field for **15 years**.

She has been given the Registration No.**SE/GR-I/19/04/084** on **05.04.2019.** She 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 MAWS (MA1) Dept. dated 04.02.2019.

This Registration is valid upto **04.04.2024**.



S. Sgt 08.11.2023
S. SANGEETA, M.E., M.I.E.,
STRUCTURAL ENGINEER,
CMDA REG. No. SE/GR-I/19/04/084
"MOUNT VIEW", THIRD FLOOR,
No. 64, MOUNT ROAD, GUINDY,
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N. Muniprasad 5.4.19
N. MUNIPRASAD
ASSISTANT PLANNER
CHENNAI METROPOLITAN DEVELOPMENT AUTHORITY
CHENNAI - 600 008.

Proposed Residential Building Atnew No.14, Arcot Mudali Street, T.Nagar, Chennai 600017.

STRUCTURAL DESIGN BRIEF

Introduction

The Residential Building referred to above is a framed structure with Stilt and Five Upper Floors. The building is analysed and designed conforming to loading standards IS: 875 (Part II) and to seismic forces as per IS 1893: 2002, the revised Indian Code for Earthquake Resistant Design of Structures.

a. Loads considered in the design

Live Load on roof	**1.5 kN/m^2**
Live Load on floors	**2 kN/m^2**
Weathering course on roof	**3 kN/m^2**
Floor Finish	**1 kN/m^2**
Unit weight of brickwork	**20 kN/m^3**
Unit weight of concrete	**25 kN/m^3**

b. Design Details

Design Method	**LIMIT STATE DESIGN**
Codes & Special Publications used	**IS 800-2007 , SP : 6(1)—1964, IS 456: 2000, IS 875(Part III):2015,IS 1893:2002(Part 1), SP 16, IS 1893 Part 1:2016**
Concrete Grade	**M 25**
Steel Grade	**Fe 500**

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CMDA REG. No. SE/GR-I/19/04/084
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c. Foundation Details

Type of foundation	**Isolated footing**
Safe bearing capacity of the soil	**250kN/m^2 as per soil test report**
Depth of foundation	**2m below existing ground level**
Diameter of main bars	**10mm,12mm**

d. Slab Details

Type of slab	**Two Way Slab**
Thickness of the slab provided	**125mm,150mm**
Steel cover to slab	**25mm**
Diameter of main bars used	**8mm,10mm**

e. Beam Details

Size of the beam provided	**300x 600, 300x 450,200mmx 600mm, 200mm x 450mm, 300mm x 750mm, 200mm x 750mm**
Bottom steel cover to beam	**25mm**
Diameter of main bars used	**25mm, 20mm, 12mm**
Stirrups used	**2 legged stirrups 8mm dia,2 legged 10mm dia**

f. Column Details

Size of the columns provided	**300mm x 600mm, 300mm x 450mm,200mm x 450mm, 200mm x 600mm.**
Steel cover to column	**40mm**
Diameter of main bars used	**25mm,20mm**
Binder diameter	**8mm**

S. S/d 08.11.2023

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STRUCTURAL ENGINEER,
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1. *LOADINGS*

a. Dead and Live Loads

Gravity load on roof : 6.75,6.125kN/m^2

Gravity load on floors : 4.75,4.125kN/m^2

Live load on roof : 1.5kN/m^2

Live load on floors : 2 kN/m^2

b. Wind Loads

Wind loads for design of structures shall be based on the design wind speeds arrived on the basis of **IS: 875 (PART III).**

The parameters for calculation of design wind speed as per **IS: 875 (PART III)** are as follows:

Basic wind speed (V_b) : 50 m/sec.

Height : 18.3m

From Table 1, IS 875 (Part 3), for Mean probable design life of Structure as 50 yrs and wind speed of 50m/sec, Risk coefficient, K_1 : 1.0

From Table 2, Class A,terrain category 3 and for a height of 18.3m and plan dimensions 14.15 x 21.6, Terrain, Height, Structure size factor, **K2** :0.9964

Topography factor, K_3 : 1.0

Importance Factor for cyclonic region, K_4 : 1.0

Design wind speed (V_z) : Vb x K1 x K2 x K3 x K4

Design wind pressure (P_z) : $0.6Vz^2$

: 0.6×49.82^2 : 1489.22N/m^2.

: 1.48922kN/m^2

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c. Determination of Earthquake Parameters and Loadings

Zone Factor, **Z** for Chennai Seismic **Zone III** : 0.16, (Table 2, Clause 6.4.2)

I, Importance Factor : 1, (From Table 6)

R, Response Reduction Factor : 3 for OMRF(Ordinary Moment resisting Frame, Table 7)

Fundamental Natural Period along X direction, T_x : **0.09xh / $\sqrt{d_x}$** : 0.09 x 18.3/$\sqrt{14.15}$

: 0.437 (Clause 7.6.2)

The soil at the site is medium S_a/g : 2.5 as $0.1 \le T \le 0.67$:2.5(Clause 6.4.2)

Fundamental Natural Period along Z direction, T_z : **0.09xh / $\sqrt{d_z}$** : 0.09 x 18.3 /$\sqrt{21.6}$

: 0.354(Clause 7.6.2)

The soil at the site is medium S_a/g :2.5 as $0.1 \le T \le 0.67$:2.5(Clause 6.4.2)

Design Horizontal Seismic Coefficient

$$A_h : \frac{Z I S_a}{2Rg} \quad \text{(Clause 6.4.2)}$$

$$: \frac{0.16 \times 1 \times 2.5}{2 \times 3} : 0.0667$$

Seismic Weight of the Building : Total Gravity Load + 0.25 Superimposed Load

W : 22185kN

S. Sgt 08.11.2023
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Design Seismic Base Shear

V_B : **A_hW** (Clause 7.2.1)

: 0.0667 x 22185 :1479.7395kN

Shear per column : 1479.7395 / 25 : 59.18kN

Seismic Moment per column : 59.18 x 3.05/2 : 90.25kNm

2. LOAD CALCULATION FOR MAXIMUM LOADED COLUMN

Loading area for the column	: 5.35 x 3.1	: 16.59m^2
Gravity Load Reaction from the roof	: 6.125 x 16.59	: 101.58kN
Self Weight of the beams	: 0.30 x 0.475 x 25 x 8.45	: 30.01kN
Weight of the parapet wall	: 0.20 x 8.45 x 20 x 1.2	: 40.56kN
Total Gravity Load		: 172.25kN
Superimposed Load Reaction from roof	: 1.5 x 16.59	: 24.88kN
Superimposed Load Reaction from floor	: 2 x 16.59	: 33.17kN
Gravity Load Reaction from the floor	: 4.125 x 16.59	: 84.96kN
Self Weight of the beams	: 0.30 x 0.475 x 25 x 8.45	:30.01kN
Weight of the 200 mm thick wall	: 0.20 x 2.6 x 20 x 8.45	: 87.88kN
Self Weight of the column	: 0.3 x 0.6x 18.3 x 25	:82.35kN
Total Gravity Load		:216.64kN
Total Gravity Load at the foundation *level, kN*	**: 172.25 + 188.37 x 5 + 82.35**	**: 1337.78kN**
Total Superimposed Load at the foundation *level, kN*	**: (24.88 + (33.17 x 5)) x 0.5**	**: 95.36kN**
Total Load	**: 1337.78 + 95.369**	**:1433.14kN**

The loads for the other columns are calculated in a similar way.

S. Sgt 08.11.2023
S. SANGEETA, M.E., M.I.E.,
STRUCTURAL ENGINEER,
CMDA REG. No. SE/GR-I/19/04/084
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3. COLUMN DESIGN

Column Size

b	300 mm		fck	25	
D	600 mm		fy	500	
Cover	40 mm	Effect.Length ratio		0.65	IS 456:2000
Ground Floor Height,L		3050 mm	L_{eff1}	0.65 x L	1983 pg.9
First Floor Height,L		3050 mm	L_{eff2}	0.65 x L	1983

Check for slenderness

L_{eff1}/D	3.30	L_{eff1}/b	6.61
L_{eff2}/D	3.30	L_{eff2}/b	6.61

All columns are short about both axis

Size of column and check e_{min}

e_{min} : Leff/500 + D/30 :		23.97			
Find Mmin	0.02	x	1433.14	:	28.66 kNm
Design Axial Load, P_u :		1433.14 kN			
Design Moment,M_x :		M_{min}:	28.66	kNm	

Designing the column as an axially loaded column with uniaxial moment

Calculation of Area of Steel

Cover	40 mm			
Design Axial Load, Pu :	1433.14 kN			
Design Moment,Mx :	Pu x emin	28.66 kNm		
Design Moment from Staad,Mx :	185.74 kNm			
D	600 mm		fck	25
b	300 mm		fy	500
Cover	40 mm			

Diameter of rod assumed 25 mm

d' : 40 + 25/2: 52.5 mm

d'/D : 52.5/600 0.0875

$Mz/fckbD^2$: 185.74x1.5 x 10^6 / 25 x 300 X 600 600 : 0.07

Pu/fck bD : 1433.14 x 1.5 x 10^3/ 25 x 300 X 600 : 0.48

From SP16 Chart 48

p/fck : 0.08

A_{st} : 0.08 x 25 x 300 x 600/100 : 3600mm^2

However 10 Y25(4910mm^2) rods are provided.

Also binders Y8 @ 200mm are provided.

S. Sgt 08.11.2023

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STRUCTURAL ENGINEER,
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CHECK FOR COLUMN STEEL FOR EARTHQUAKE LOAD

As per Clause 7.10.3 the partial safety factor for limit state design of reinforced concrete is given by **1.2 (DL +IL +EL).**

The load coming on the column: P_u : 1.2(1433.14+ 2.5 x 0.25x 59.18):1764.153kN

Moment on column: M_u :1.2(185.74+2.5 x 0.6 x 90.25):385.34kNm

Refer page4,6 for P_u & M_u

40% makes up for the in filled walls, hence the factor 0.6 and 2.5 as per clause 7.10.3 .

P_u/ f_{ck} bd : 1764.153x 10^3 /25 x 300 x 600 : 0.4

M_u/ f_{ck} bd^2 : 385.34x 10^6/25x 300 x 600^2 : 0.14

From chart 48 of SP16 p/f_{ck} : 0.1

A_{st} : 0.1 x 25 x 300 x 600/ 100 : 4500mm²

However 10 Nos Y25 (4910mm²) rods are provided which is found to be safe for the requirement of steel. Other columns are also designed in a similar way.

Hence the design satisfies the requirements of extra steel for earthquake Loads.

S. Sgt 08.11.2023

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STRUCTURAL ENGINEER,
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4. DESIGN OF FOUNDATION

Load on column				1433.14 kN			
Add 10% for self weight				143.314 kN			
Total Load				1576.454 kN			
Area of the footing required				6.31 mm^2			
Provide a footing of size	**2.6 x2.6m**			6.76 mm^2			
Maximum bearing pressure on soil				233.20325 kN/mm^2			
				233.20325 < 250kN/m^2		O.K	
Design bearing pressure on soil	1433.14	/	2.6	x	2.6	212.00 kN/mm	
Factored bearing pressure	1.5	x	212.00	:	318.00 kN/mm^2		
M_{xx} at the face of the column	2.6 x	1.15	^{2}/ 2 x	318.00	:	546.729 kNm	

Effective depth required √ 546.729 x 10^6/ 0.138 x 25 x 1000

398.09 mm

An effective depth of **844** **mm** and an overall depth of 900mm is provided.

Mu/bd^2 : 546.7291 x 10^6 / 850 x 844 x 844: 0.9

From Table 3 of SP16 pt 0.216

Ast : 0.216 x 844 x 850 / 100 : **1549.58 mm^2**

6Nos. of Y12 is provided bothways. Area of steel provided : 1809mm^2

Check for One Way Shear

Maximum Shear force : 2.6 x 0.306 x 318.00 : 253.00 kN

Maximum Shear stress, t_c : 253.00 x 10^3 x 2600 x 334.60 : 0.29

Hence the section is safe in One Way Shear < 0.36N/mm^2

Check for Two Way Shear

Maximum Shear force: (2.6 - 1.144 x 1.444) x 318.00

: 301.48 kN

Maximum Shear stress, t_p : 301.48 X 10^3 / 2 (1144 + 1444) X 589.33

: 0.09 N/mm^2

Allowable Shear Stress : 0.25 √ 25 1.25 N/mm^2 0.09 N/mm^2 < 1.25 N/mm^2

Hence the section is safe in Two Way Shear

S. Sg 08.11.2023

S. SANGEETA, M.E., M.I.E.,
STRUCTURAL ENGINEER,
CMDA REG. No. SE/GR-I/19/04/084
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5. DESIGN OF PLINTH BEAM

Assuming a plinth beam of size 200mm x 375mm.

Self weight of the plinth beam : 0.2 x 0.375 x 25 : 1.875kN/m

Weight of the 200 mm wall : 0.2 x 3.2 x 20 : 12.8kN/m

Total Load on the plinth beam : 1.875 + 12.8 : 14.675kN/m

Maximum Moment for a span of 4.95m : $14.675 \times 1.5 \times 4.95^2 / 16$: 33.71kNm

Mu/bd^2 : $33.71 \times 10^6 / 200 \times 319^2$: 1.7

From Table 3 of SP16 p_t = 0.428, **A_{st} : 0.428 x 200 x 319/100 : 273.064mm²**

Top and bottom steel of 3 Nos. of Y12 is provided. Area of steel provided : 339mm²

4. DESIGN OF FLOOR BEAM

Self weight of the beam 200 x 750 : 0.2x0.625x25 :3.125kN/m

Weight of 200mm wall : 0.20x 20 x 2.6 : 10.4kN/m

STAAD.Pro Report

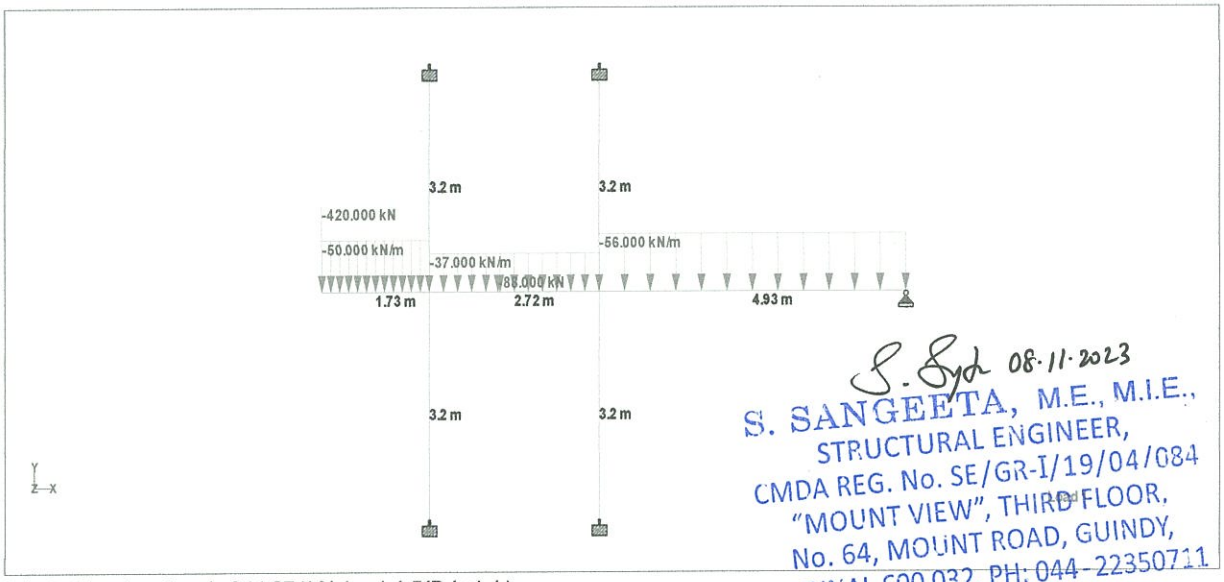
All The Whole Structure

Included in this printout are results for load cases:

Type	L/C	Name
Primary	1	1.5(D.L+L.L)

Beam Loads : 1 1.5(D.L+L.L)

Beam	Type	Direction	Fa	Da (m)	Fb	Db	Ecc. (m)
4	UNI kN/m	GY	-37.000	-	-	-	-
	CON kN	GY	-88.000	1.100	-	-	-
22	UNI kN/m	GY	-56.000	-	-	-	-
23	UNI kN/m	GY	-50.000	-	-	-	-
	CON kN	GY	-420.000	0.000	-	-	-



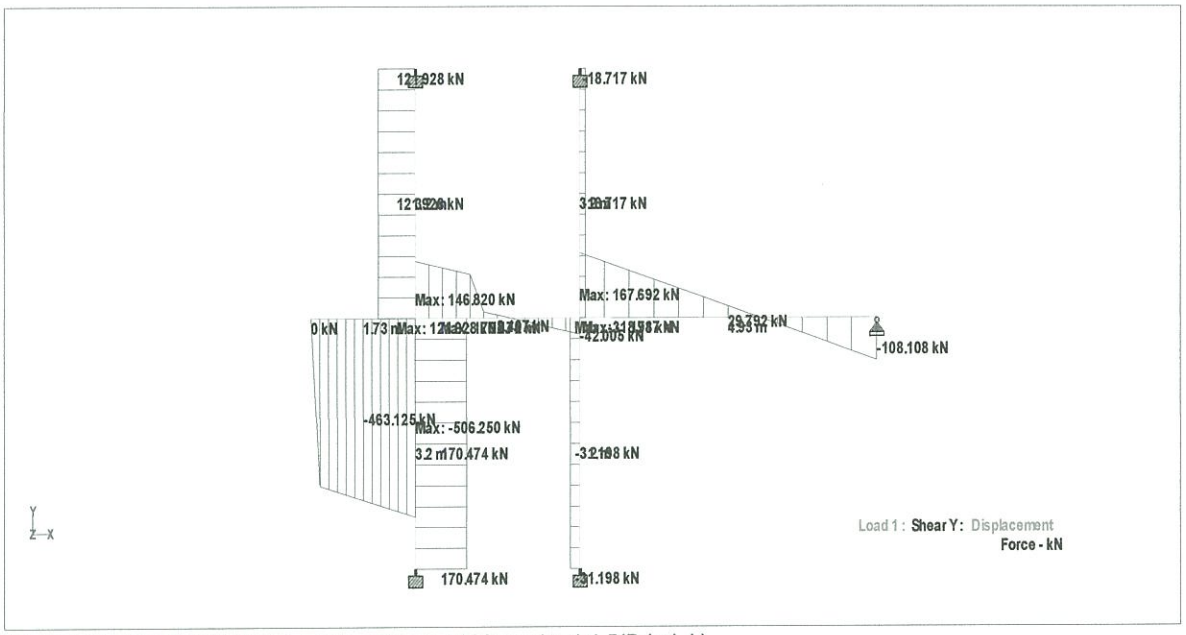
Whole Structure Loads 344.871kN:1m 1 1.5(D.L+L.L)

S. Sangeeta 08.11.2023
S. SANGEETA, M.E., M.I.E.,
STRUCTURAL ENGINEER,
CMDA REG. No. SE/GR-I/19/04/084
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Beam Maximum Shear Forces

Distances to maxima are given from beam end A.

Beam	Node A	Length (m)	L/C		d (m)	Max Fz (kN)	d (m)	Max Fy (kN)
4	9	2.725	1:1.5(D.L+L.L)	Max -ve	0.000	0.000	0.000	146.820
				Max +ve	0.000	0.000	2.725	-42.005
16	9	3.200	1:1.5(D.L+L.L)	Max -ve	0.000	0.000	0.000	121.928
				Max +ve	0.000	0.000		
17	9	3.200	1:1.5(D.L+L.L)	Max -ve	0.000	0.000	0.000	170.474
				Max +ve	0.000	0.000		
18	10	3.200	1:1.5(D.L+L.L)	Max -ve	0.000	0.000		
				Max +ve	0.000	0.000	0.000	-18.717
19	10	3.200	1:1.5(D.L+L.L)	Max -ve	0.000	0.000		
				Max +ve	0.000	0.000	0.000	-31.198
22	10	4.925	1:1.5(D.L+L.L)	Max -ve	0.000	0.000	0.000	167.692
				Max +ve	0.000	0.000	4.925	-108.108
23	27	1.725	1:1.5(D.L+L.L)	Max -ve	0.000	0.000		
				Max +ve	0.000	0.000	1.725	-506.250



Whole Structure Fy 200kN:1m Displacements 1000mm:1m 1 1.5(D.L+L.L)

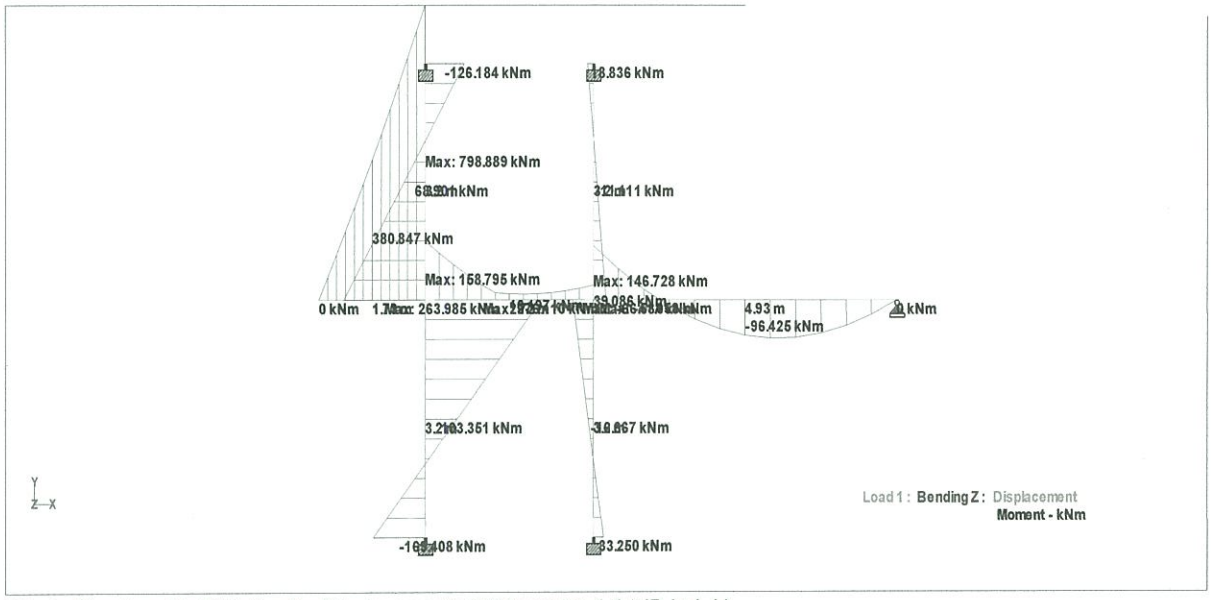
Beam Maximum Moments

Distances to maxima are given from beam end A.

Beam	Node A	Length (m)	L/C		d (m)	Max My (kNm)	d (m)	Max Mz (kNm)
4	9	2.725	1:1.5(D.L+L.L)	Max -	0.000	0.000	0.000	158.795
				Max	0.000	0.000		
16	9	3.200	1:1.5(D.L+L.L)	Max -	0.000	0.000	0.000	263.985
				Max	0.000	0.000	3.200	-126.184
17	9	3.200	1:1.5(D.L+L.L)	Max -	0.000	0.000	0.000	376.110
				Max	0.000	0.000	3.200	-169.408
18	10	3.200	1:1.5(D.L+L.L)	Max -	0.000	0.000	3.200	18.836
				Max	0.000	0.000	0.000	-41.058
19	10	3.200	1:1.5(D.L+L.L)	Max -	0.000	0.000	3.200	33.250
				Max	0.000	0.000	0.000	-66.584
22	10	4.925	1:1.5(D.L+L.L)	Max -	0.000	0.000	0.000	146.728
				Max	0.000	0.000	2.873	-103.936
23	27	1.249	1:1.5(D.L+L.L)	Max -	0.000	0.000	1.249	651.231
				Max	0.000	0.000	0.000	-0.000

08.11.2023

S. SANGEETA, ME., M.I.E.
STRUCTURAL ENGINEER,
CMDA REG. No. SE/GR-I/19/04/084
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Whole Structure Mz 200kNm:1m Displacements 1000mm:1m 1 1.5(D.L+L.L)

Maximum moment at the support : 651.231kNm

M_u/bd^2 : 651.231 x 10^6 / 200 x 712.5^2 : 6.5 *From Table 55 of SP16* p_t : 1.713,6 p_c : 0.81

A_{st} : 1.713 x 200 x 712.5/100 : 2441.025mm^2 , *A_{st} provided: 6Y25 (2238mm^2).*

A_{sc} : 0.81 x 200 x 712.5/100 : 1154.25mm^2 , *A_{st} provided : 2Y25(982mm^2).*

Maximum moment at mid span : 169.408kNm

M_u/bd^2 : 169.408 x 10^6 / 200 x 562.5^2 : 2.7 *From Table 55 of SP16* p_t :0.727

A_{st} : 0.727 x 200 x 562.5/100 : 817.875mm^2 , *A_{st} provided: 2Y25(982mm^2).*

Maximum Shear Force : 506.25kN. For p_t : 0.7

Shear capacity of the section : τ_c'bd : 0.56 x 200 x 562.5 : 79.8 kN

Shear to be carried by the stirrups, V_{us} : 506.5 – 79.8 : 426.7kN

V_{us} /d :426.7/71.25 :5.98.

Provide stirrups of Y10ST2@100mm for the cantilever,Y8ST2@100mm for the first and last 1m, Y8ST2@ 125mm for the next 1m and Y8ST2@ 150mm for the remaining span.

All the other beams are designed in a similar way.

S.Sgd 08.11.2023
S. SANGEETA, M.E., M.I.E.,
STRUCTURAL ENGINEER,
CMDA REG. No. SE/GR-I/19/04/084
"MOUNT VIEW", THIRD FLOOR,
No. 64, MOUNT ROAD, GUINDY,
CHENNAI-600 032. PH: 044-22350711

5. DESIGN OF FLOOR SLAB

Self Weight of the slab 150mm thick	: 4.75kN/m^2
Floor Finish	: 1 kN/m^2
Live Load	: 2kN/m^2
Total Load	: 6.75 kN/m^2

The slab is an interior panel slab.

l_y / l_x :4.8/5.35 : 1.2< 2. The slab is designed as a two-way slab.

From Table 26 of IS 456: 2000 for l_y / l_x : 1.2; α_{x+} : 0.043 , α_{y-} : 0.032

Negative moment at continuous edge for shorter side $M_x : \alpha_x w l^2_x$

: 0.043 x 6.75 x 4.8^2 x 1.5 : 10.03kNm

Effective depth required : $\sqrt{10.03x10^6/0.138x25x\ 1000}$

: 53.9

A slab depth of 150mm is provided.

M_u/bd^2 : 10.3x 10^6 /1000 x 125^2 : 0.7*From Table 3 of SP16* p_t : 0.167

A_{st} required : 0.167 x 1000 x125/100 : 208.75mm^2.

However Y8 @ 125mm c/c (403mm^2) is provided along the shorter span.

M_u/bd^2 : 7.46 x 10^6 /1000 x 125^2 : 0.5 p_t : 0.118

A_{st} required : 0.118x 1000 x125/100 : 147.5mm^2.

However Y8@ 150 mm c/c (335mm^2) is provided along the shorter span.

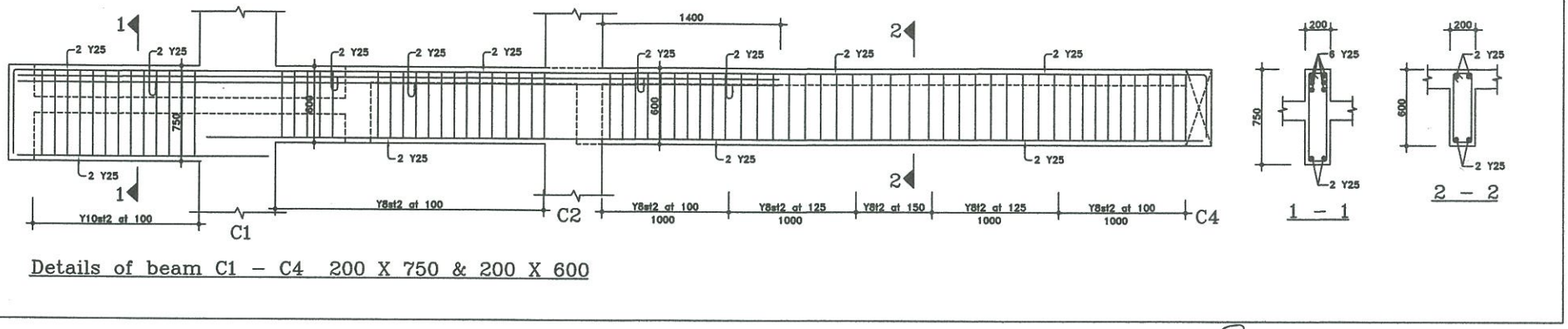
All other slabs are designed in a similar way.

08-11-2023

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APPENDIX

TYPICAL FLOOR BEAMS



Details of beam C1 – C4 200 X 750 & 200 X 600

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Vastu & Property Management Tools

Home Vastu Shastra, Plot Vastu Shastra, Property Management

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3/350/2 Mettukuppam,
OMR Thoraipakkam,
Chennai, India

hello@verified.realestate
+91 9996 12 9996
www.verified.realestate