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STRUCTURAL STABILITY CERTIFICATE

Name of work : Plan Showing The Proposed Construction Of Stilt + 5 Floors Residential Building With 10 Dwelling Units At Plot Nos: 85 And 86, New Door No: 17, Old Door Nos: 85 And 86, A.V.M. Avenue 4th Street, Virugambakkam, Chennai - 600092. Comprised On T.S.No: 69, Block No: 16, Virugambakkam Village, Mambalam Guindy Taluk, Chennai District, Greater Chennai Corporation, Division No: 128, Zone No: 10.

Preamble : 1. I hereby certify that the structural design sheet is done for column, Foundation, Slab and beam.

2. The usage of the building is Stilt floor + 5 upper Floors.

3. The Super Structure is built on outer 200mm walls and inner 100mm walls.

4. All concrete for RCC members in Stilt + 5 Floors are M30 concrete.

5. The structural design includes the Earth quake Criteria as per IS: 1893(part 1)-latest revision.

ADDITIONAL CRITERIA

1. The structure is idealized as Special RC-Moment Resisting Frame (SMRF) and analyzed using software package (STAAD PRO) for both vertical and lateral loads.
2. The lateral load includes wind load and earthquake load, Seismic load of medium and moderate intensity of ZONE-III considered is for design and analysis purpose.
3. The Foundation is designed for critical un-Factored load combinations.
4. The Superstructure members are designed for actual flexure, shear and forces.
5. The structure is analyzed for specific loads (Dead and Live Loads) and for the load combinations given in relevant loads.
6. The design of the structure is **structurally sound and safe**.

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This is to certify that the Structural Design of the proposed construction of residential building at above said site has been DESIGNED on the basis of EARTHQUAKE RESISTANT DESIGN OF STRUCTURES IS 1893 (Part1): 2002 General Provisions & Buildings, with latest declaration of Seismic Zone III, Zone factor 0.16 and according to I.S. Loading standards I.S. – 875. All precautions have been taken as per the CONTENTS OF REPORT FOUNDATION ANALYSIS. This Report has recommendations for effect of Seismic Condition for this Soil.

CALCULATION OF SEISMIC CO-EFFICIENT

Name of city	: Chennai
Type of Building	: Residential Building
Building Frame System	: Special RC-Moment resisting frame (SMRF)
Fundamental Natural Period (Ts)	: (0.075)h ^3/4 =0.655sec.
Soil conditions	: medium
Zone Factor (Refer Table:2) (Z)	: 0.16 (moderate)
Importance Factor (Refer Table:6) (I)	: 1
Response Reduction (Refer Table:7)	: 5.0
Average response acceleration Co-efficient (Sa/g)	: 2.35

EARTH QUAKE ANALYSIS:

Horizontal Seismic Co-efficient (Ah)	= (Z/2)(I / R)(Sa/g) = (0.16/2) (1/5.0) (2.35) = 0.038
Design value of Ah	= 0.038
Type of Foundation	: Pile Foundation

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1. GENERAL LOADING CONDITIONS:

(a) Imposed loads on Roof - 1.50kN/m^2

(b) Imposed loads on Hall, Kitchen. & Bed, Residential - 2.00kN/m^2

(d) Dead weight of R.C.C - 25kN/m^3

(e) Dead weight of Brick Work - 20kN/m^3

2. LOADING ON SLABS:

2.1 Loading on Roof slab:

Roof finished with lime concrete terracing =(0.10)(20) =2.000kN/m^2

S/W of slab 125mm thick =(.125)(25) =3.125kN/m^2

Dead load =5.125kN/m^2

Live load =1.50kN/m^2

Total load on Roof = 6.625kN/m^2

2.2 Loading on Floor slabs:

Floor finish = 1.00kN/m^2

S/w of slab 125mm thick = 3.125kN/m^2

Dead load =4.125kN/m^2

Live load =2.00kN/m^2

Total load on Roof = 6.125kN/m^2

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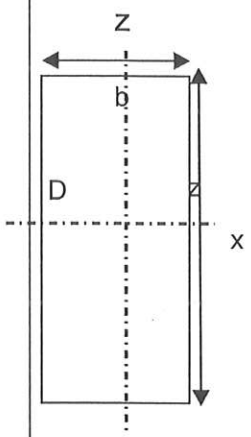
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3 DESIGN:

3.1 COLUMN DESIGN

Grade of Concrete			M 30	
Characteristic Strength of Reinf.		N/mm^2	500	
Width of Column	b	mm	300	
Depth of Column	D	mm	600	
Unsupported Length of Column	l_x	mm	3000	
Unsupported Length of Column	l_y	mm	3000	
Clear Cover to Reinf.		mm	40	
Diameter of Bar		mm	20	
Load		T		
Moment	M_{xx}	T.m		
Moment	M_{zz}	T.m		
Factored Load	P_u	kN	968.760	1
Factored Moment	M_{ux}	kN.m	88.550	1
Factored Moment	M_{uz}	kN.m	56.360	1
Effective Length of Column	l_{ex}	mm	3600	1.2
	l_{ez}	mm	3600	1.2
	l_{ex}/D		6	0
			<12- Short Column	
	l_{ey}/b		18	1
			>12- Slender Column	
Additional Moment due to Slender	M_{ax}	kN.m	0	
Additional Moment due to Slender	M_{az}	kN.m	30.214944	
Percentage of Reinf.	p	%	2.8	
Gross Area of Cross Section	A_g	mm^2	120000	
Ultimate Axial Load	P_{uz}	kN	2921.4	
d'/D (about x-x axis)			0.084	0.1
d'/D (about y-y axis)			0.250	0.2



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(Table 60)	k1		0.207		
	k2		0.328		
	P_{bx}	kN	863.280		
	k1		0		
	k2		0		
	P_{bz}	kN	0.000		
	k_x		0.966		
	k_y		0.681		
Minimum Eccentricity	e_x	mm	26		
	e_y	mm	12.666667		
Moments due to min. eccentricity	M_{ex}	kN.m	24.25	< 89.950	kN.m
Moments due to min. eccentricity	M_{ez}	kN.m	11.81	< 32.510	kN.m
Total Moments for which the column is to be designed are					
	M_{ux}	kN.m	89.950		
	M_{uz}	kN.m	53.080		
The section is to be checked for biaxial bending					
	$P_u/f_{ck}bD$		0.259		
	p/f_{ck}		0.1		
Referring (d'/D is0.1)	$M_u/f_{ck}bD^2$		0.161		
	M_{ux1}	kN.m	347.760		
Referring to (d'/D = 0.2)	$M_u/f_{ck}bD^2$		0.142		
	M_{uy1}	kN.m	102.240		
	M_{ux}/M_{ux1}		0.259		
	M_{uy}/M_{uy1}		0.519		
	P_u/P_{uz}		0.320		
		a	1	1.2	
				< 1	
Mux/Mux1 + Muy/Muy1			0.653	OK	
Area of Reinforcement	As	mm^2	3600		
Minimum no of to be provided			6		
No of Bars to be provided	Nos.		12		
Provide 12 Nos of 20 Diameter					

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3.2 FOUNDATION DESIGN

3.2.1 PILE CAP DESIGN

Concrete Grade:	M30
Steel :	Fe 500

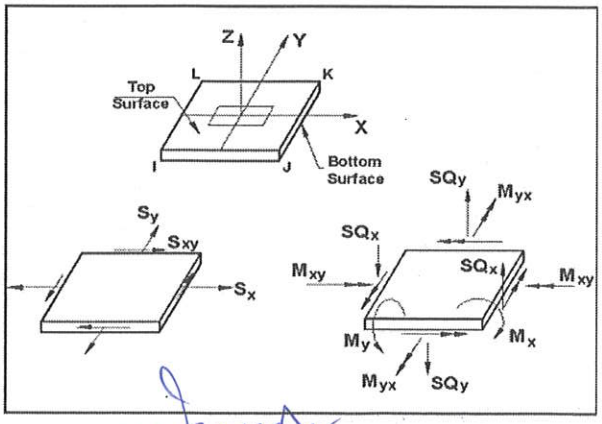
BASE SLAB

Bending moment (Mu) (kN-m/m)		Req.depth (D) (mm)	Total depth (D) (mm)	Bar dia. (mm)	Clear cover (mm)	Effect. depth (d) (mm)
Mx (+) =	750.81	707.49	750	20	50	690
Mx (-) =	66.74	210.93	750	20	50	690
My (+) =	695.32	680.84	750	20	50	670
My (-) =	140.19	305.71	750	20	50	670

Width (b) (mm)	Mu/bd^2	p_t required (%)	Ast required (mm^2/m)	S required mm c/c	S provided mm c/c	p_t provided (%)	Remarks
1000	1.577	0.388	2677.20	135	125	0.364	16Y @ 150
1000	0.140	0.170	1173.00	268	125	0.364	16Y @ 150
1000	1.549	0.381	2552.70	127	125	0.375	20Y @ 150
1000	0.312	0.170	1139.00	276	125	0.375	20Y @ 150

Check for Shear stresses :

Shear stress (τ_v) (N/mm^2)		p_t provided (%)	τ_c table 19, IS:456 (N/mm^2)	Remarks
SQx =	0.16	0.364	0.435	safe
SQy =	0.37	0.375	0.440	safe



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3.3 BEAM DESIGN

Beam Design

Beam Data

width	200 mm
depth	600 mm
clear cover to main reinf.	30 mm
Slab Thickness	125 mm

d' 48 mm .= cc+ sdia + mdia/2
eff depth 552 mm .= d - d'

Material Grades

Concrete	30 MPa
Steel	500 MPa

				Span Moment	Support Moment
Span Moment	256 KN-m		Mu/bd²	3.64	3.22
			xumax	252	252
			Mulim	243	243
Support Moment	233 KN-m	233 KN-m	Mulim/bd²	3.99	3.99
		0 KN-m			

Span Reinforcement
Beam is designed as Singly Reinforced Beam

Area of Steel	Tension (Ast)	Compr (Asc)
Percentage	1.007 %	-------
Area of Steel	1112 sqmm	

Refer Table 2 SP 16 pg 48

461 KN-m

Tension Reinforcement

Type	Bar dia	Nos	Area of Steel	
Layer 1	20 mm	4	1257 sqmm	
Layer 2	16 mm	2	402 sqmm	1884 sqmm
Layer 3	-			
		Total Steel Provided	1659 sqmm	1.503 %

Provided Steel OK

Compression Reinforcement

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Type	Bar dia	Nos	Area of Steel
Layer 1			
Layer 2			
Layer 3			
	Total Steel Provided		#VALUE!

Support Reinforcement
Beam is designed as Singly Reinforced Beam

Area of Steel	Tension (Ast)	Compr (Asc)	
Percentage	0.865 %	-------	*Refer Table 2 SP 16 pg 48*
Area of Steel	954 sqmm		

3.20988814605914
-
0.69993935894835
8
0.14288114488549
9

Tension Reinforcement

Type	Bar dia	Nos	Area of Steel
Layer 1	20 mm	3	942 sqmm
Layer 2	20 mm	3	942 sqmm
Layer 3	-		
	Total Steel Provided		1885 sqmm
	Provided Steel OK		1.707 %

1674 sqmm
1315 sqmm

Compression Reinforcement

2356 sqmm

Type	Bar dia	Nos	Area of Steel
Layer 1			
Layer 2			
Layer 3			
	Total Steel Provided		#VALUE!

Shear Force (Vu)	140 KN		
ζv	1.268	*.=Vu / (b * d)*	
ζc	0.763	*Refer Table 61 SP 16 pg 179*	*or =(0.85*√(0.8*fck)*√(1+5β)-1)) / (6β)*
ζcmax	3.5	*Refer Table J SP 16 pg 175*	

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Type	Bar Dia	Nos	Area of Steel
Layer 1	8 mm	0	0 sqmm
Layer 2	25 mm	0	0 sqmm
Layer 3	20 mm	0	0 sqmm
			0 sqmm

0.000 %

Sectional Dimensions OK
Shear Reinforcements required

Steel	**415 MPa**			
Type of stirrup	**2 legged**			
Stirrup diameter	**8 mm**			
Spacing	300 c/c	Safe	Vus/d	1.010 kN/cm	1.458

3.4 TWO WAY SLAB DESIGN

Slab Design

Slab thickness	t	125 mm
Concrete	fck	30 MPa
Steel	fy	500 MPa

Sunken Depth: 0 mm

Loading

Slab Load

Dead Load	DL	3.125 KN/m
Live Load	LL	2.000 KN/m
Finishes Load	WL	1.000 KN/m
Total Load	Ws	6.125 KN/m
Factored Load	Wsu	9 KN/m

Sunken Slab Load

Dead Load	DL	3.125 KN/m
Filler Load	FL	0 KN/m
Live Load	LL	3.0 KN/m
Finishes Load	WL	1.0 KN/m
Total Load	Wsk	7.13 KN/m
Factored Load	Wsku	11 KN/m

Slab Data

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Slab Type	Regular
Load	9 KN/m
Longer Span (ly)	3.600 m
Shorter Span (lx)	3.350 m

ly/lx ratio	1.23
Slab type	+

Loading on edges		*one way*	*two way*
W_{longer}	**16 KN/m**	*.=w*lx/2*	*.=(w*lx/2) + (1-(1/3)*(lx/ly)^2)*
$W_{shorter}$	**13 KN/m**		*.=w*lx/3*

Moments		*one way*	*two way*
Mx	13 KN-m	*.=w*lx^2/ 8*	*.=ax * w*lx^2*
My	10 KN-m		*.=ay * w*lx^2*

Thickness Check	OK
Deflection	15 mm

.=Mulim > Mux or Muy
*.= 5*W*l^4/(384EI)*

Area of Steel	Astx	Asty
	302 sqmm	**226 sqmm**

Refer Chart 4 SP 16 pg 21
Refer Table 5-44 SP 16 pg 51-80

or

Spacing required in mm

8#		10#		12#		16#	
x	y	x	y	x	y	x	x
166 c/c	**222 c/c**	**260 c/c**	**347 c/c**	**374 c/c**	**500 c/c**	**665 c/c**	**889 c/c**

*.=ast of bar*1000/ast req*

Final Ast provided	x	y
	10# @ 150c/c	**10# @ 150c/c**

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