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STRUCTURAL STABILITY CERTIFICATE AND DESIGN
CALCULATIONS

Name of work : Proposed Construction Of Residential High Rise Group Development Consists Of 3 Blocks With Combined Basement, Block 1: Stilt + 11 Upper Floors With 143 Dwelling Units, Block 2: Stilt + 11 Upper Floors Block-3 (Incidental Block) With Total 286 Dwelling Units In S.Nos. 387/1a1a1,388,389/2,390/1b Of Padappai Village, Kundrathur Taluk, Kanchipuram District

Preamble:

- 1.the usage of the building-Stilt floor + 11 upper floors.
- 2 The Super Structure is built on outer 200mm walls and inner 100mm walls.
3. Concrete grade for RCC members is M40 grade concrete.
4. The SBC of the soil is 40Ton/sq.m.
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.

2. DESIGN CALCULATIONS.

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)	: $(0.09 \cdot h / (d^{0.5})) = 1.26 \text{sec.}$
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)	: 2.5

EARTH QUAKE ANALYSIS:

Horizontal Seismic Co-efficient (Ah)	$= (Z/2) (I/R) (Sa/g)$ $= (0.16/2) (1/5.0) (2.5)$ $= 0.04$
Design value of Ah	$= 0.04$
Type of Foundation	: RAFT FOUNDATION

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 SLAB:

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)	= 3.75kN/m ²
Dead load		= 5.75kN/m ²
Live load		= 1.50kN/m ²
Total load on Roof		= 7.25kN/m ²

2.2 Loading on Floor slabs:

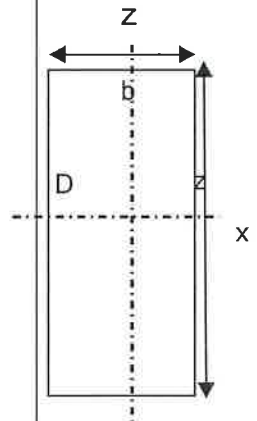
Floor finish	= 1.00kN/m ²
S/w of slab 125mm thick	= 3.75kN/m ²
Dead load	= 4.75kN/m ²
Live load	= 2.00kN/m ²
Total load on Roof	= 6.75kN/m ²

DESIGN CALCULATION

3 DESIGN:

3.1 COLUMN DESIGN

Grade of Concrete			M 40	
Characteristic Strength of Reinf.		N/mm ²	500	
Width of Column	b	mm	300	
Depth of Column	D	mm	900	
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	25	
Load	T			
Moment	M_{xx}	T.m		
Moment	M_{zz}	T.m		
Factored Load	P_u	kN	5760.000	1
Factored Moment	M_{ux}	kN.m	115.000	1
Factored Moment	M_{uz}	kN.m	89.000	1
Effective Length of Column	l_{ex}	mm	3600	1.2
	l_{ez}	mm	3600	1.2
	l_{ex}/D		4	0
			<12- Short Column	
	l_{ey}/b		12	0
			<12- Short Column	
Additional Moment due to Slender	M_{ax}	kN.m	0	
Additional Moment due to Slender	M_{az}	kN.m	0	
Percentage of Reinf.	p	%	3.1	
Gross Area of Cross Section	A_g	mm ²	270000	
Ultimate Axial Load	P_{uz}	kN	7848.09	
d'/D (about x-x axis)			0.059	0.1



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d'/D (about y-y axis) (Table 60)			0.175	0.2	
	k1		0.207		
	k2		0.328		
	P _{bx}	kN	2510.136		
	k1		0.184		
	k2		0.028		
	P _{bz}	kN	2010.636		
	k _x		0.391		
	k _y		0.358		
Minimum Eccentricity	e _x	mm	36		
	e _y	mm	16		
Moments due to min. eccentricity	M _{ex}	kN.m	207.36	>	
			115.000	kN.m	
Moments due to min. eccentricity	M _{ez}	kN.m	92.16	>	
			89.000	kN.m	
Total Moments for which the column is to be designed are					
	M _{ux}	kN.m	207.360		
	M _{uz}	kN.m	92.160		
The section is to be checked for biaxial bending					
	P _u /f _{ck} bD		0.533		
	p/f _{ck}		0.0775		
Referring (d'/D is 0.1)	M _u /f _{ck} bD ²		0.12		
	M _{ux1}	kN.m	1166.400		
Referring to (d'/D = 0.2)	M _u /f _{ck} bD ²		0.100		
	M _{uy1}	kN.m	324.000		
	M _{ux} /M _{ux1}		0.178		
	M _{uy} /M _{uy1}		0.284		
	P _u /P _{uz}		0.734		
	a		1.189		
			< 1		
Mux/Mux1 + Muy/Muy1			0.131	OK	
Area of Reinforcement	A _s	mm ²	8370		
Minimum no of to be provided			8		
No of Bars to be provided	Nos.		18		
Provide 18 Nos of 25 Diameter					

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3.2 FOUNDATION DESIGN

1 Footing Size Design

Load	Pu	5760 KN
Design Load	P	4224 KN
Moment in x dir	Mux	115 KN-m
Moment in y dir	Muy	86 KN-m
Column size	cx	300 mm
	cy	900 mm
SBC	q	400 KN/sqm
Footing Size required	A req	4.58 sqmm
Footing Size Provided	L	2.40 meters
	B	2.40 meters
Area Provided	A prvd	5.76 meters
	Zx	2.30
	Zy	2.30
Net upward pressure	Nup	376 KNm2

Footing Size OK

2 Slab Design

	lx	1.050
	ly	0.750
Bending Moment in x dir	Mx	311 KN-m
Bending Moment in y dir	My	159 KN-m
Concrete	fck	40 MPa
Steel	fy	500 MPa
Minimum Depth Required	dmin	280
Depth Provided	D	1100 mm
Clear Cover	c	50 mm
Effective Cover	d'	60 mm

Effective Depth d' 1040 mm

Area of Steel	Spacing c/c in mm		
	12#	16#	20#
1248 sqmm	91 c/c	161 c/c	252 c/c
1248 sqmm	91 c/c	161 c/c	252 c/c

Minimum Ast required across x direction

Minimum Ast required across y direction

Ast across x direction	20 mm dia @ 100 mm c/c	3142 sqmm
Ast across y direction	20 mm dia @ 100 mm c/c	3142 sqmm

3 One Way Shear along x direction

V_{u1}	14 KN
ζ_v	0.005 MPa
ζ_c	0.265 MPa
V_{c1}	662 KN

One Way Shear Check OK

4 One Way Shear along y direction

V_{u1}	-393 KN
ζ_v	-0.157 MPa
ζ_c	0.265 MPa
V_{c1}	662 KN

One Way Shear Check OK

5 Two Way Shear

V_{u2}	1785 KN
ζ_v	0.262 MPa
$k_s \cdot \zeta_c$	1.141 MPa
V_{c1}	7785 KN

Two Way Shear Check OK

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3.3 BEAM DESIGN

Beam Design

Beam Data

width	200 mm	d'	51 mm	$= cc + sdia + mdia/2$
depth	600 mm	eff depth	550 mm	$= d - d'$
clear cover to main reinf.	30 mm			
Slab Thickness	125 mm			

Material Grades

Concrete	40 MPa			
Steel	500 MPa			
Span Moment	310 KN-m	Mu/bd ²	5.13	3.96
		xumax	251	251
		Mulim	321	321
Support Moment	239 KN-m	Mulim/bd ²	5.32	5.32
	239 KN-m			
	0 KN-m			

Span Reinforcement

Beam is designed as Singly Reinforced Beam

Area of Steel	Tension (Ast)	Compr (Asc)
Percentage	1.441 %	-----
Area of Steel	1584 sqmm	

Refer Table 2 SP 16 pg 48

549 KN-m

Tension Reinforcement

Type	Bar dia	Nos	Area of Steel
Layer 1	25 mm	3	1473 sqmm
Layer 2	20 mm	3	942 sqmm
Layer 3			
Total Steel Provided			2415 sqmm
Provided Steel OK			2.198 %

2083 sqmm

Compression Reinforcement

Type	Bar dia	Nos	Area of Steel
------	---------	-----	---------------

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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	1.049 %	-----
Area of Steel	1153 sqmm	

Refer Table 2 SP 16 pg 48

Tension Reinforcement

Type	Bar dia	Nos	Area of Steel
Layer 1	25 mm	3	1473 sqmm
Layer 2	20 mm	3	942 sqmm
Layer 3	-		
Total Steel Provided			2415 sqmm
Provided Steel OK			

2.198 %

Compression Reinforcement

Type	Bar dia	Nos	Area of Steel
Layer 1	-		
Layer 2	-		
Layer 3			
Total Steel Provided			

#VALUE!

4.39508526378008

-0.756658683090652

0.392164202561418

1873 sqmm

1514 sqmm

2555 sqmm

Shear Force (Vu)

100 KN

ζ_v

0.910

$=V_u / (b \cdot d)$

ζ_c

0.910

Refer Table 61 SP 16 pg 179

ζ_{cmax}

4

Refer Table J SP 16 pg 175

or $= (0.85 \cdot \sqrt{0.8 \cdot f_{ck}}) \cdot \sqrt{(1 + 5\beta)} - 1$
 $/ (6\beta)$

Type	Bar Dia	Nos	Area of
------	---------	-----	---------

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			Steel
Layer 1	12 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 Check OK

Provide Nominal Shear
 Reinforcement

Steel	415 MPa
Type of stirrup	2 legged
Stirrup diameter	8 mm
Spacing	300 c/c

Safe

Vus/d

-0.001 kN/cm

1.458

3.4 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	W _s	6.125 KN/m
Factored Load	W _{su}	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	W _{sk}	7.13 KN/m
Factored Load	W _{sku}	11 KN/m

Slab Data

Slab Type	Regular
Load	9 KN/m

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Longer Span (ly)	4.15 m
Shorter Span (lx)	3.00 m

ly/lx ratio	1.38
Slab type	+

Loading on edges		one way	two way
W_{longer}	11 KN/m	$=w \cdot lx/2$	$=(w \cdot lx/2) + (1 - (1/3) \cdot (lx/ly)^2) \cdot w \cdot lx/3$
$W_{shorter}$	9 KN/m		$=w \cdot ly/3$

Moments		one way	two way
M_x	7 KN-m	$=w \cdot lx^2/8$	$=\alpha_x \cdot w \cdot lx^2$
M_y	5 KN-m		$=\alpha_y \cdot w \cdot ly^2$

Thickness Check	OK	$=M_{ulim} > M_{ux} \text{ or } M_{uy}$
Deflection	8 mm	$=5 \cdot W \cdot l^4 / (384EI)$

Area of Steel	Astx	Asty	Refer Chart 4 SP 16 pg 21 Refer Table 5-44 SP 16 pg 51-80
	156 sqmm	150 sqmm	

or

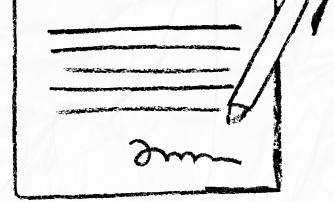
Spacing required in mm

8#		10#		12#		16#	
x	y	x	y	x	y	x	x
322 c/c	335 c/c	504 c/c	524 c/c	725 c/c	754 c/c	#####	1340 c/c

$=ast \text{ of bar} \cdot 1000 / ast_{req}$

Final Ast provided	x	y
	10# @ 100c/c	10# @ 100c/c

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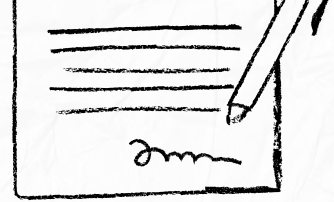
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