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STRUCTURAL STABILITY CERTIFICATE

Name of work: PLAN SHOWING THE PROPOSED RESIDENTIAL APARTMENTS STILT+5 FLOOR BUILDING AT SITE LOCATED AT 12B , C COLONY ROAD , PERUMALPURAM, TIRUNELVELI.T.S.NO:62, NEW SURVEY WARD : BM, BLOCK:6, SURVEY NO:507/9, KULAVANIGARPURAM VILLAGE, MELAPALAYAM WARD, THIRUNELVELI CITY MUNICIPAL CORPORATION, TIRUNELVELI DISTRICT.

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 Ground + 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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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	: Isolated 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

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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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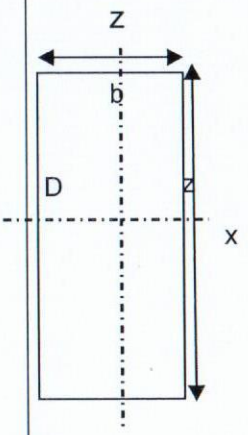
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3 DESIGN:

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	1537.000	1
Factored Moment	M_{ux}	kN.m	11.000	1
Factored Moment	M_{uz}	kN.m	56.000	1
Effective Length of Column	l_{ex}	mm	3600	1.2
	l_{ez}	mm	3600	1.2
	l_{ex}/D		6.7924528	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		2	
Gross Area of Cross Section	A_g	mm^2	159000	
Ultimate Axial Load	P_{uz}	kN	3181.113	
d'/D (about x-x axis)			0.095	0.1
d'/D (about y-y axis)			0.167	0.2
(Table 60)	k1		0.207	



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	k2		0.328	
	P_{bx}	kN	1081.264	
	k1		0.184	
	k2		0.028	
	P_{bz}	kN	885.694	
	k_x		0.735	
	k_y		0.673	
Minimum Eccentricity	e_x	mm	23.666667	
	e_y	mm	16	
Moments due to min. eccentricity	M_{ex}	kN.m	38.74 > 11.000 kN.m	
Moments due to min. eccentricity	M_{ez}	kN.m	26.19 < 56.000 kN.m	
Total Moments for which the column is to be designed are				
	M_{ux}	kN.m	38.742	
	M_{uz}	kN.m	56.000	
The section is to be checked for biaxial bending				
	$P_u/f_{ck}bD$		0.343	
	p/f_{ck}		0.06	
Referring (d'/D is0.1)	$M_u/f_{ck}bD^2$		0.11	
	M_{ux1}	kN.m	278.091	
Referring to (d'/D = 0.2)	$M_u/f_{ck}bD^2$		0.100	
	M_{uy1}	kN.m	143.100	
	M_{ux}/M_{ux1}		0.139	
	M_{uy}/M_{uy1}		0.391	
	P_u/P_{uz}		0.515	
		a	1 1.525 < 1	
Mux/Mux1 + Muy/Muy1			0.289 OK	
Area of Reinforcement	As	mm^2	2862	
Minimum no of to be provided			6	
No of Bars to be provided	Nos.		10	
Provide 12 Nos of 20 Diameter				

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3.2 FOUNDATION DESIGN

3.2.1 ISOLATED FOOTING DESIGN

1 **Footing Size Design**

Load	Pu	1574 KN
Design Load	P	1081 KN
Moment in x dir	Mux	2 KN-m
Moment in y dir	Muy	4 KN-m
Column size	cx	300 mm
	cy	600 mm
SBC	q	340 KN/sqm
Footing Size required	A req	3.60 sqmm
Footing Size Provided	L	**2.40 meters**
	B	**2.40 meters**
Area Provided	A prvd	5.76 meters
	Zx	2.03
	Zx	2.03
Net upward pressure	Nup	273 KNm2

Footing Size OK

2 **Slab Design**

	lx	0.850
	ly	0.735
Bending Moment in x dir	Mx	148 KN-m
Bending Moment in y dir	My	111 KN-m
Concrete	fck	30 MPa
Steel	fy	500 MPa
Minimum Depth Required	dmin	193
Depth Provided	D	**600 mm**

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Clear Cover	c	50 mm
Effective Cover	d'	56 mm
Effective Depth	d'	544 mm

Area of Steel	Spacing c/c in mm			
	10#	12#	16#	20#
653 sqmm	120 c/c	173 c/c	308 c/c	481 c/c
653 sqmm	120 c/c	173 c/c	308 c/c	481 c/c

Minimum Ast required across x direcion

Minimum Ast required across y direcion

Ast across x direction	**10 mm dia**	**@ 200 mm c/c**	**785 sqmm**
Ast across y direction	**12 mm dia**	**@ 125 mm c/c**	**905 sqmm**

3 **One Way Shear along x direction**

Vu1	251 KN
ζv	0.231 MPa
ζc	0.265 MPa
Vc1	288 KN

One Way Shear Check OK

4 **One Way Shear along y direction**

Vu1	157 KN
ζv	0.144 MPa
ζc	0.265 MPa
Vc1	288 KN

One Way Shear Check OK

5 **Two Way Shear**

Vu2	1268 KN
ζv	0.608 MPa
ks*ζc	1.369 MPa
Vc1	2857 KN

Two Way Shear Check OK

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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	150 mm

d'	51 mm	.= cc+ sdia + mdia/2
eff depth	550 mm	.= d - d'

Material Grades

Concrete	30 MPa
Steel	500 MPa

	Span Moment	Support Moment
Mu/bd²	3.81	3.15
xumax	251	251
Mulim	241	241
Mulim/bd²	3.99	3.99

Span Moment	230 KN-m	
Support Moment	190 KN-m	190 KN-m
		0 KN-m

Span Reinforcement

Beam is designed as Singly Reinforced Beam

Area of Steel	Tension (Ast)	Compr (Asc)	
Percentage	1.066 %	------	*Refer Table 2 SP 16 pg 48*
Area of Steel	1171 sqmm		

420 KN-m

Tension Reinforcement

Type	Bar dia	Nos	Area of Steel	
Layer 1	25 mm	3	1473 sqmm	
Layer 2	20 mm	2	628 sqmm	1855 sqmm
Layer 3	20 mm	0	0 sqmm	
	Total Steel Provided		2101 sqmm	1.912 %
	Provided Steel OK			

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	0.842 %	-------	*Refer Table 2 SP 16 pg 48*
Area of Steel	925 sqmm		

3.25164844718689
-0.274161029363862
0.223777556784572

Tension Reinforcement

Type	Bar dia	Nos	Area of Steel	
Layer 1	25 mm	3	1473 sqmm	
Layer 2	-			
Layer 3	-			
Total Steel Provided			1473 sqmm	1.340 %
Provided Steel OK				1645 sqmm
				1286 sqmm

Compression Reinforcement 2327 sqmm

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

Shear Force (Vu)	90 KN		
ζv	0.819	*=Vu / (b * d)*	*or =(0.85*√(0.8*fck)*√(1+5β) -1)) / (6β)*
ζc	0.830	*Refer Table 61 SP 16 pg 179*	
ζcmax	3.5	*Refer Table J SP 16 pg 175*	

Type	Bar Dia	Nos	Area of Steel
Layer 1	8 mm	0	0 sqmm

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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**	Vus/d	-0.023 kN/cm	1.458
Type of stirrup	**2 legged**			
Stirrup diameter	**8 mm**			
Spacing	300 c/c	Safe		

3.4 TWO WAY 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

Slab Type	Regular
Load	9 KN/m
Longer Span (ly)	4.3 m
Shorter Span (lx)	3.5 m

ly/lx ratio	1.22
Slab type	+

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Loading on edges		one way	two way
W_{longer}	**12 KN/m**	.=w*lx/2	.=(w*lx/2) + (1-(1/3)*(lx/ly)^2)
$W_{shorter}$	**10 KN/m**		.=w*lx/3

Moments		one way	two way
Mx	7 KN-m	.=w*lx^2/ 8	.=ax * w*lx^2
My	6 KN-m		.=ay * w*lx^2

Thickness Check	OK	.=Mulim > Mux or Muy
Deflection	6 mm	.= 5*W*l^4/(384EI)

Area of Steel	Astx	Asty
	162 sqmm	**133 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
311 c/c	**378 c/c**	**486 c/c**	**590 c/c**	**699 c/c**	**850 c/c**	**#######**	**1511 c/c**

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

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

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