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STRUCTURAL STABILITY CERTIFICATE

Name of work : The Planning Permission Application for the proposed construction of Group Development Residential building consisting 2 Blocks, Block A - Stilt Floor + 5 Floors(Height – 18.30m) with 25 dwelling units, Block B - Stilt Floor + 5 Floors (Height - 18.30m) with 30 dwelling units totally 55 dwelling units with availing premium FSI at T Ponnambalam Salai, Kulapakkam, Chennai comprised inS.No. 116/2 of Kulapakkam village within the limits of Kundrathur Panchayat Union

Preamble :
1. I hereby certify that the structural design sheet isdone 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 230mm walls and inner 115mm 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.

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.

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 =0.483sec.
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	: Combined Footing

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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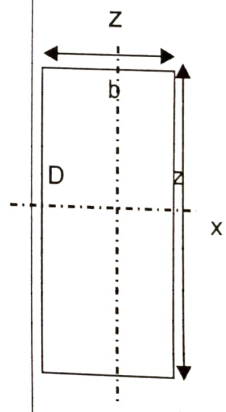
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3 DESIGN:

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	690.000	1
Factored Moment	M_{ux}	kN.m	89.950	1
Factored Moment	M_{uz}	kN.m	32.510	1
Effective Length of Column	l_{ex}	mm	3600	1.2
	l_{ez}	mm	3600	1.2
	l_{ex}/D		6 <12- Short Column	0
	l_{ey}/b		12 <12- Short Column	0
Additional Moment due to Slender	M_{ax}	kN.m	0	
Additional Moment due to Slender	M_{az}	kN.m	0	
Percentage of Reinf.	p	%	1.8	
Gross Area of Cross Section	A_g	mm^2	180000	
Ultimate Axial Load	P_{uz}	kN	3601.26	
d'/D (about x-x axis)			0.084	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	1224.072		
	k1		0.184		
	k2		0.028		
	P_{bz}	kN	1002.672		
	k_x		1.000		
	k_y		1.000		
Minimum Eccentricity	e_x	mm	26		
	e_y	mm	16		
Moments due to min. eccentricity	M_{ex}	kN.m	17.94	<	89.950 kN.m
Moments due to min. eccentricity	M_{ez}	kN.m	11.04	<	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	32.510		
The section is to be checked for biaxial bending					
	$P_u/f_{ck}bD$		0.128		
	p/f_{ck}		0.06		
Referring (d'/D is0.1)	$M_u/f_{ck}bD^2$		0.09		
	M_{ux1}	kN.m	291.600		
Referring to (d'/D = 0.2)	$M_u/f_{ck}bD^2$		0.100		
	M_{uy1}	kN.m	162.000		
	M_{ux}/M_{ux1}		0.308		
	M_{uy}/M_{uy1}		0.201		
	P_u/P_{uz}		0.192		
		a	0		1
Mux/Mux1 + Muy/Muy1			0.509	< 1	OK
Area of Reinforcement	As	mm^2	3240		
Minimum no of to be provided			6		
No of Bars to be provided	Nos.		11		
Provide 11 Nos of 20 Diameter					

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3.2 FOUNDATION DESIGN

3.2.1 COMBAINED FOOTING

1 Footing Size Design

Load 1	Pu1	660 KN
Load 2	Pu2	690 KN
Combine load	Pcu	1350 KN
Design Load	Pc	990 KN
Moment in x dir	Mux	35 KN-m
Moment in y dir	Muy	40 KN-m
c/c dist b/w col in x dir		3.430 meters
c/c dist b/w col in y dir		0.000 meters
Col Dim	x dir	0.60 meters
	y dir	0.30 meters
SBC	q	120 KNm2
Footing Size required	A req	8.25 sqmm
Footing Size Provided	L	**6.00 meters**
	B	**2.30 meters**
Area Provided	A prvd	**13.80 meters**
	x bar	1.753
	y bar	0.000
	Zx	5.29
	Zx	13.80
	Nup	78 KNm2

Footing Size OK

2 Beam Design

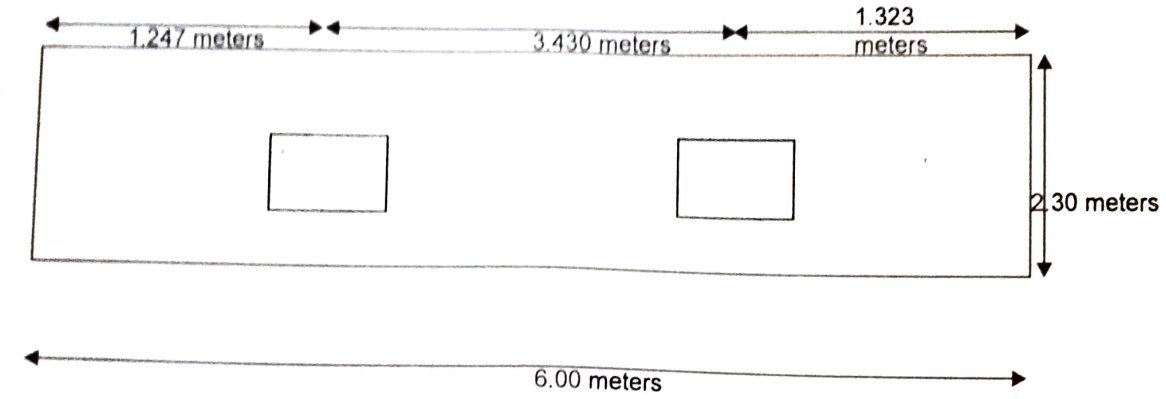
Total Load	W	78 KNm2
Factored Load	Wu	271 KNm2

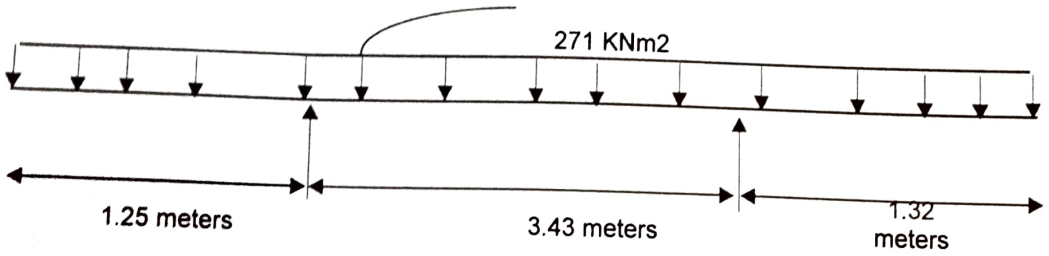
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Beam Size	width	600 mm
	depth	685 mm
Moment	Mb	898 KN-m

Design the beam from the BEAM DESIGN SHEET

Bottom Reinforcement

Type	Bar dia	Nos	Area of Steel
Layer 1	20 mm	6	1885 sqmm
Layer 2	-		
Layer 3	-		
		Total Steel Provided	1885 sqmm
		Percentage of Steel	0.487 %

Top Reinforcement

Type	Bar dia	Nos	Area of Steel
Layer 1	20 mm	6	1885 sqmm
Layer 2	-		

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Layer 3	-		
		Total Steel Provided	1885 sqmm

3 Slab Design

Net upward pressure	Nup	78 KNm2	
	l	0.85 meters	/=width of footing from col face
Bending Moment	Ms	28 KN-m	$M=Nup*l^2/2$
Factored Moment	Mus	43 KN-m	1.5*Ms
Concrete	fck	30 MPa	
Steel	fy	500 MPa	
Minimum Depth Required	dmin	103	d=sqrt(Ms/Rumax*1000*b)
Depth Provided	D	**600 mm**	
Clear Cover	c	50 mm	
Effective Cover	d'	56 mm	
Effective Depth	d'	544 mm	

Area of Steel across x dir	Spacing c/c in mm		
	12#	16#	20#
653 sqmm	173 c/c	308 c/c	481 c/c

Minimum Ast required across x direcion

Ast across x direction	**12 mm dia**	**@ 150 mm c/c**	**754 sqmm**
Dist Ast across y direction	**10 mm dia**	**@ 150 mm c/c**	**524 sqmm**

4 Shear Check for Slab

Vu1	36 KN
ζv	0.066 MPa
ζc	0.265 MPa

Shear Check OK

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3.3 BEAM DESIGN

Beam Design

Beam Data

width	230 mm
depth	530 mm
clear cover to main reinf.	30 mm
Slab Thickness	125 mm

d' 48 mm .= cc+ sdia + mdia/2
eff depth 482 mm = d - d'

Material Grades

Concrete	30 MPa
Steel	500 MPa

	Span Moment	Support Moment
Span Moment 210 KN-m		
Mu/bd²	3.93	3.56
xumax	220	220
Mulim	213	213
Mulim/bd²	3.99	3.99

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	1.110 %	----
Area of Steel	1230 sqmm	

Refer Table 2 SP 16 pg 48

400 KN-m

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

2014 sqmm

1.700 %

Provided Steel OK

Compression Reinforcement

Type	Bar dia	Nos	Area of Steel
Layer 1	-		

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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	0.977 %	-----	Refer Table 2 SP 16 pg 48
Area of Steel	1084 sqmm		

Tension Reinforcement

Type	Bar dia	Nos	Area of Steel
Layer 1	25 mm	3	1473 sqmm
Layer 2	25 mm	3	1473 sqmm
Layer 3	-		
Total Steel Provided			2945 sqmm

Provided Steel OK

2.657 %

4.35702571251516
-1.546985529821000
0.132294005725571

1804 sqmm
1445 sqmm

Compression Reinforcement

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

2486 sqmm

#VALUE!

Shear Force (Vu)	**112 KN**		
ζv	1.010	*=Vu / (b * d)*	
ζc	0.797	*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*	

Type	Bar Dia	Nos	Area of Steel
Layer 1	12 mm	0	0 sqmm
Layer 2	25 mm	0	0 sqmm
Layer 3	20 mm	0	0 sqmm

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		0 sqmm	0.000 %	
Sectional Dimensions OK Shear Reinforcements required				
Steel	415 MPa			
Type of stirrup	2 legged	Vus/d	0.490 kN/cm	1.458
Stirrup diameter	8 mm			
Spacing	300 c/c	Safe		

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

Slab Type	Regular
Load	9 KN/m
Longer Span (ly)	4.40 m
Shorter Span (lx)	3.23 m

ly/lx ratio	1.36
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	8 KN-m	.=w*lx^2/ 8	.=ax * w*lx^2
My	5 KN-m		.=ay * w*lx^2

Thickness Check	OK	.=Mulim > Mux or Muy
Deflection	10 mm	.= 5*W*l^4/(384EI)

Area of Steel	Astx	Asty
	178 sqmm	**150 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
282 c/c	**335 c/c**	**440 c/c**	**524 c/c**	**634 c/c**	**754 c/c**	**#######**	**1340 c/c**

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

Final Ast provided	x	y
	8# @ 150c/c	**10# @ 150c/c**

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