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STABILITY CERTIFICATE

1. The detailed engineering and structure design of Plan Showing The Proposed Construction Of Group Housing Development Consisting Of 2 Blocks -Block 1: Stilt Floor + 3 Floors Residentialbuilding With 6 Dwelling Units (Height-12.00m) And Block 2: Stilt Floor +3 Floors Residential Building With 3 Dwelling Units (Height 12.00m) Totally 9 Dwelling Units At. Old Door No 10, New Door- No-17, Veerabadran Street, Nungambakkam, Chennai Comprised In Old R.S.No - 198/16,New R.S.No. 198/35 &198/40 Block No -24. Of Nungambakkam Village Within The Limits Of Greater Chennai Corporation has been done by me/us based on the report of geotechnical investigation (soil test) done by T.J.ENGINEERS PROJECT NO. TJE/002861/2023 Dated 19.07.2023 and considering the functional requirement of the building.

2. It is certified that among other factors, the proposed building has been designed to resist earthquake. We have checked parameters and found that the proposed building would be safe.

3. I/we further certify that:

(i) The Minimum grade of concrete is M30

(ii) The Design and analysis has been done using the code of practice for plain and reinforced concrete as per IS 456, Design loads as per IS codes No IS 875 (PART-2) and design of earthquake structure as per IS Code No 1893

4. The Building will be safe and sound when used for the purpose for which it is designed.

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Stamp and Signature

Encl: Structural Design Calculation

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STRUCTURAL STABILITY CERTIFICATE

Name of work : PLAN SHOWING THE PROPOSED CONSTRUCTION OF STILT + 3 FLOORS RESIDENTIAL BUILDING WITH 9 DWELLING UNITS AT NO - 10, NEW NO-17, VEERABADRAN STREET, NUNGAMBAKKAM, CHENNAI - 600 034 COMPRISED IN R.SNO - 198 / 35, 198/40, BLOCK NO -24 OF NUNGAMBAKKAM VILLAGE. GREATER CHENNAI CORPORATION DIVISION - 113, ZONE - 09.

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 + 3 upper Floors.

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

4. All concrete for RCC members in Stilt + 3 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 =0.483sec.
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	: 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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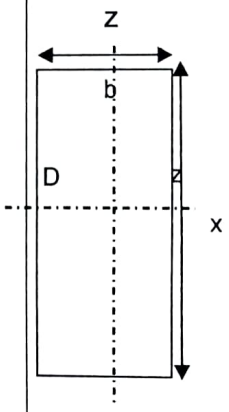
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3 DESIGN:

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	530	
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	810.000	1
Factored Moment	M_{ux}	kN.m	90.000	1
Factored Moment	M_{uz}	kN.m	28.000	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	%	1.8	
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		1.000	
	k_y		1.000	
Minimum Eccentricity	e_x	mm	23.666667	
	e_y	mm	16	
Moments due to min. eccentricity	M_{ex}	kN.m	19.17 < 90.000	kN.m
Moments due to min. eccentricity	M_{ez}	kN.m	12.96 < 28.000	kN.m
Total Moments for which the column is to be designed are				
	M_{ux}	kN.m	90.000	
	M_{uz}	kN.m	28.000	
The section is to be checked for biaxial bending				
	$P_u/f_{ck}bD$		0.170	
	p/f_{ck}		0.06	
Referring (d'/D is0.1)	$M_u/f_{ck}bD^2$		0.1	
	M_{ux1}	kN.m	252.810	
Referring to (d'/D = 0.2)	$M_u/f_{ck}bD^2$		0.120	
	M_{uy1}	kN.m	171.720	
	M_{ux}/M_{ux1}		0.356	
	M_{uy}/M_{uy1}		0.163	
	P_u/P_{uz}		0.255	
		a	1 1.0917 < 1	
Mux/Mux1 + Muy/Muy1			0.462	OK
Area of Reinforcement	As	mm^2	2862	
Minimum no of to be provided			6	
No of Bars to be provided	Nos.		10	
Provide 10 Nos of 20 Diameter				

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3.2 FOUNDATION DESIGN

3.2.1 PILE CAP DESIGN

Concrete Grade:	M30
Steel :	Fe 500

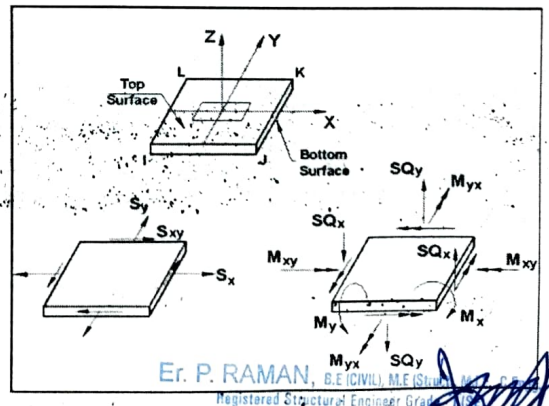
BASE SLAB

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	16	50	690
My (+) =	695.32	680.84	750	20	50	670
My (-) =	140.19	305.71	750	16	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	150	0.364	20Y @ 150
1000	0.140	0.170	1173.00	268	150	0.364	16Y @ 150
1000	1.549	0.381	2552.70	127	150	0.375	20Y @ 150
1000	0.312	0.170	1139.00	276	150	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	150 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
Mu/bd²	3.64	3.22
xumax	252	252
Mulim	243	243
Mulim/bd²	3.99	3.99

Span Moment 222 KN-m

Support Moment 196 KN-m | 239 KN-m | 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	3	1257 sqmm
Layer 2	16 mm	2	402 sqmm
Layer 3			
		Total Steel Provided	1659 sqmm

1884 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	1.707 %
	Provided Steel OK			

1674 sqmm
1315 sqmm

Compression Reinforcement

2356 sqmm

Type	Bar dia	Nos	Area of Steel
Layer 1	**16 mm**	**0**	
Layer 2	-	**0**	
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	150 mm
Concrete	fck	30 MPa
Steel	fy	500 MPa

Sunken Depth: 0 mm

Loading

Slab Load

Dead Load	DL	3.750 KN/m
Live Load	LL	2.000 KN/m
Finishes Load	WL	1.000 KN/m
Total Load	Ws	6.750 KN/m
Factored Load	Wsu	10 KN/m

Sunken Slab Load

Dead Load	DL	3.750 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	7.75 KN/m
Factored Load	Wsku	12 KN/m

Slab Data

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Slab Type	Regular
Load	10 KN/m
Longer Span (ly)	4.350 m
Shorter Span (lx)	3.850 m

ly/lx ratio	1.12
Slab type	+

Loading on edges		*one way*	*two way*
W_{longer}	**21 KN/m**	*.=w*lx/2*	*.=(w*lx/2) + (1-(1/3)*(lx/ly)^2)*
$W_{shorter}$	**17 KN/m**		*.=w*lx/3*

Moments		*one way*	*two way*
Mx	21 KN-m	*.=w*lx^2/ 8*	*.=αx * w*lx^2*
My	15 KN-m		*.=αy * w*lx^2*

Thickness Check	OK	*.=Mulim > Mux or Muy*
Deflection	21 mm	*.= 5*W*l^4/(384EI)*

Area of Steel	Astx	Asty
	396 sqmm	**276 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
127 c/c	**182 c/c**	**199 c/c**	**285 c/c**	**286 c/c**	**410 c/c**	**508 c/c**	**729 c/c**

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

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

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