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METIN ENGINEERS

(Civil & Structural Consultant, Quality Audit consultation and PMC)

03-04-2025

STABILITY CERTIFICATE

1. The detailed engineering and structure design of the proposed building comprising of Stilt + five floors at Padikuppam Main Road, Padikuppam, Chennai. S.No 240 & 241,T.S.No.4/3,Ward-1, Block-69 of Padi Village within the Limits of Greater Chennai Corporation has been done by us based on the report of geotechnical investigation (soil test) done by Geo Mines Engineers Pvt. Ltd. Report No. **GMEPL/Mr. VEDAMURTHY/214/2023-24** Dated 17-07-2023 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. I/We have checked various parameters and found that the proposed building would be safe.

3. I further certify that:

(i) The minimum grade of concrete is considered as 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 875 and Design of earthquake structure as per IS 1893.

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

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No.700, LIG Plot 8th Main Road, MugappairEri scheme,Chennai – 600 037.
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PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING (STILT+5 FLOORS) AT PADIKUPPAM MAIN ROAD,PADIKUPPAM,CHENNAI,COMPRISED IN OLD S.NO.240 & 241,T.S.NO.4/3,WARD-1,BLOCK-69 OF PADI VILLAGE WITHIN THE LIMITS OF GREATER CHENNAI CORPORATION.

TYPICAL STRUCTURAL DESIGN CALCULATION

1 **General:**

Proposed building is Stlit+5 storey for Residential purpose. The Ground floor roof will be conventional slab with beams and in upper floors Slab with RCC Beam

2 **Design Basis:**

Latest Design codes of BIS-456, 875 and 1893 are followed with SP-16 Design Aid book. A typical 3-D Frame was taken for analysis to arrive at the reactions under maximum loading case at foundation. Analysis and and design software " STAAD" is used to analyise the model.

Pile foundation is proposed as per soil report .

Fe-550 steel is used as main steel and distributors

For All members, concrete grade is Minimu of M-30 .

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Following loading combination is used for analysis:

1.5(DL + LL with reduction factor)	CB-1	LL= Live load
1.5(DL+WL)	CB-2	DL=Dead load
1.2(DL+WI +LL with reduction factor)	CB-3	EQ=Earhquake load
1.5(DL +EQ)	CB-4	WL=Wind load
1.2(DL+EQ +LL with reduction factor)	CB-5	CB-1,2.. IS LOAD COMBINATION

Seismic Zone -3 is used for analysis.

3 **WIND LOAD**

Vz	=	Vb x K1 x K2 x k3						
Vb	=	50 m/sec	in Chennai					
K1	=	Probability Factor	=	1				
K2	=	Terrain, Height Factor =		1				
K3	=	Topography Factor	=	1				
p	=	0.6 x Vz x Vz *(k1*k2*k3)						
	=	0.6	x	50	x	50	x	1.00
	=	1500	N/Sq.m					
		1.50	Kn/sqm					

This value is applied on the building face as uniformly distributed load

4 Design Loads

Live load	=	2.0	KN/sqm
Floor Finish	=	1.5	KN/sqm
slab 125 thk	=	3.1	KN/sqm
Brick Wall as a partion wall for the Maximum thickness of 230mm	=	12.7	KN/m

5 **Earthquake consideration:**

Seismic Zone= 3 for Chennai

EARTHQUAKE LOAD

Design horizontal Seismic coeff. Ag = $\frac{Z}{2} \times \frac{I}{R} \times \frac{Sa}{g}$

Z	=	Zone Factor = 0.16	for Chennai
I	=	Importance Factor = 1.0	
R	=	Response reduction Factor = 5	
$\frac{Sa}{g}$	=	Avg. response acc.coeff. Depends on Ta	
Ta	=	Fundamental natural period	
=	$\frac{0.09\ h}{\sqrt{d}}$	for infill walls h = height of the building d = Width of the building	
=	$0.075\ h^{0.75}$	for residential building	
=	0.864 sec		
Sa/g	= 1.36/T=	1.574 for medium soil	
W	=	seismic weight of building	

Design of Pilecap

1.Given data:

STAAD Node number	=	21	
No. of Pile	=	2	
Breath of Pedestal (a)	=	300	mm
Width of Pedestal (b)	=	450	mm
Diameter of pile (Dp)	=	500	mm
Grade of concrete (fck)	=	30	N/mm^2
Grade of steel (fy)	=	550	N/mm^2
Clear cover	=	75	mm
Axial load from column	=	1223	KN
Moment Mx	=	24.46	KN.m
Moment My	=	24.46	KN.m
Factor of safety for load	=	1.5	
Xumax/d	=	0.443	
Mu limit/bd^2	=	3.897	

Solution:

2.Size of pile cap:

C/C distance between piles (3.0d)	=	1.500	m	
Edge distance from outer face of exterior pile	=	0.150	m (min 150mm)	
Width of pile cap (B)	=	**0.800**	**m**	
Length of pile cap (L)	=	**2.300**	**m**	
Effective depth	=	0.750	m	
Depth of pilecap	=	0.829	~	**0.75 m**
Provide effective depth	=	671.00	mm	

3.Load calculation:

Total axial Load on pilecap	=	1257.50	KN
Vertical load due to Mx	=	16.31	KN
Vertical load due to My	=	16.31	KN
Design Factored load	=	1910.71	KN
Total design Load on one pile	=	955.36	KN

4.Check for truss action:

Shear span (av)	=	0.38	m
d/av	=	1.79	

Truss action

5.Design Bending Moment:

Cantilever length in Shorter direction	=	0.600	m
Cantilever length in Longer direction	=	0.525	m
Bending moment about Shorter direction	=	501.56	KN.m
Bending moment about Longer direction	=	573.21	KN.m
Required depth for Moment	=	401.08	mm

The Pilecap depth is OK

6.Reinforcement:

BOTTOM REINFORCEMENT

$$\text{Area of Steel (Ast)} = \frac{0.5 \times fck}{fy}\left(1 - \sqrt{1 - \frac{4.6 \times Mu}{fck \times b \times d^2}}\right) b \times d$$

Longer direction (Ast)	=	1656.65	mm^2
Required Spacing	=	121.37	mm
Provide	16 mmØ @	115	mm c/c
% of reinforcement	=	0.261	% (Min 0.12%)

Area of Steel is enough, Hence safe

Shorter direction (Ast)	=	720.00	mm^2
Required Spacing	=	279.25	mm
Provide	16 mmØ @	115	mm c/c
% of reinforcement	=	0.261	% (Min 0.12%)

Area of Steel is enough, Hence safe

Top Reinforcement

Since the Pile Cap is assumed as simply supported,Provide minimum percentage of steel

Provide	16 mmØ @	115	mm c/c
% of reinforcement	=	0.261	% (Min 0.12%)

Area of Steel is enough, Hence safe

7.Check for One-way shear:

Longer direction

The critical section for one-way shear is located at a distance of d/2 from the face of the column = 335.5 mm

d" value = 514.5 mm

Provide shear reinforcement

Shear force (Vu)	=	732.53	KN
Nominal shear stress (τv)	=	0.475	N/mm^2
% of reinforcement	=	0.261	%
Permissible shear stress (τc)	=	0.376	N/mm^2
Max.Per.shear stress ($\tau cmax$)	=	1.369	N/mm^2

Check Enhanced shear

Enhanced shear stress ($\tau c' = (2\ \tau c\ d\ /av)$ = 1.345 N/mm^2

Shear stress is within permissible limit

Shorter direction

The critical section for one-way shear is located at a distance of d/2 from the face of the column = 335.5 mm

d" value = 439.5 mm

Provide shear reinforcement

Shear force (Vu)	=	625.75	KN
Nominal shear stress (τv)	=	1.166	N/mm^2
% of reinforcement	=	0.261	%
Permissible shear stress (τc)	=	0.376	N/mm^2

Max.Per.shear stress (τ_{cmax}) = 1.369 N/mm^2

Check Enhanced shear

Enhanced shear stress (τ_c') = ($2\ \tau_c\ d\ /av$) = 1.345 N/mm^2

Shear stress is within permissible limit

8.Check for Two-way shear:

The critical section for punching shear is located at a distance of d/2 from the face of the column

Perimeter at the critical section (bo) = 4184.0 mm

Net Shear force (Vu) = 1883.4 KN

Punching shear stress (τ_v) = (Vu/ bo x d)

= 0.671 N/mm^2

The permissible shear stress

Ks = (0.5 +Bc) <1

= 1

(τ_c) = 0.25 x $\sqrt{(fck)}$

= 1.369 N/mm^2

Ks *τ_c = 1.369 N/mm^2

Shear stress is within permissible limit

COLUMN DESIGN-C1

Node No :21

Grid No :E14

Floor		**Ground**		
Size of Column	b		300	
	D		450	
Column Load	**1502.00**	kN		**(STAAD OUTPUT)**
Column Moment	**125.00**	kNm		**(STAAD OUTPUT)**
fck	30.00	N/Sqmm		
fy	550.00	N/Sqmm		
Pu/fck bd	**0.37**			
Mu/fckbd^2	**0.07**			
d'/D	0.11			
Pt/fck	**0.06**			
Pt	1.80	%		
Pt min	0.80			
Req.Ast	2430.00	Sqmm		
Reinforcement Provide				
	Dia		**20**	**12**
	Nos		**8**	**2**
Provided Ast	**2738.08**	**Sqmm**		

Hence Safe

BEAM DESIGN

Span	5.60	m	
Max.Bending moment	134.00	kNm	**(STAAD OUTPUT)**
Max Shear	92.00		
Size of Beam			
b	230	mm	
D	450	mm	
d	415.00	mm	
d'/d	0.08		
Materials Used			
Grade of concrete	M30	30	
Grade of steel	Fe500		
K=Mu/bd^2	3.38	**Singly reinforced beam**	
	Pt	Pc	
Percentage of steel	0.93	0.23125	
Ast Required	957.38	239.3438	
Minimum Ast	211.99		

	Top at edge		Bottom at edge	
	Dia(mm)	Nos	Dia(mm)	Nos
Reinforcement provided	**16**	**5**	**16**	**3**
Reinforcement required		**4.8**		**1.19**

Ast(Top at Edge)	1004.80	Sqmm
Ast(Bottom at edge)	251.20	Sqmm
Ast (provide)	1004.80	
Pt (provide)	0.97	

SHEAR DESIGN

S F	92.00		**(STAAD OUTPUT)**
SHEARING STRESS	0.96		
PT	0.97		
Tc	0.63		
Tv	0.96	KN	
Tc b d	60.13		
Vus	31.87		
legged	1.00	(2 LEGGED STIRRUPS)	
Vus/D	0.77		
PROVIDE STIRRUPS	8	150MM C/C	

Check-Deflection

LOAD	60.00	kN/M	
SPAN	5.60	M	
E	27386.13	N/Sq.mm	
I	1746562500.00	mm^4	
DEFLECTION	16.11		
allowable deflection	22.40		
	16.11	<	22.4028
	6.29	MM	**Hence safe**

SLAB DESIGN

Sl. No.	TWO WAY SLAB				
	Unit Weight of concrete	25	KN/m^3		
	Concrete Grade	30	N/mm^2		
	Grade of Steel	500	N/mm^2		
	Clear Cover	25	mm		
	(This is to be determined based on the fire rating and exposure conditions mentioned in IS456)				
	Diameter of Rod used	8	mm		
	l/d is to be taken as 30 for edge panel & 35 for interior panel		mm		
	Assume total depth	125	mm		
	d_{eff} = Depth - clear cover - 1/2 dia	96	mm		
	l_x	3.16	m		
	l_y	5.56	m		
	l_y / l_x	1.76			
	(Effective lengths are to be provided as per clause 22.2 of IS456)				
	Width (b)	1000	mm		
	Loading details				
	Dead load	3.125	KN/m^2		
	Live load	2	KN/m^2		
	Finishes	1.5	KN/m^2		
	Partitions	0	KN/m^2		
	Extra (const.load)	0	KN/m^2		
	Filling load	0	KN/m^2		
	Total load w	6.625	KN/m^2		
	Edge condition	Two edge discontinuous			
	Bending moment = w l_x^2	66.1546	KN-m		

Details	Short span		Long span	
	Support	Mid span	Support	Mid span
B.M coefficients (Refer table 26 of IS456)	0.065	0.05	0.032	0.024

SLAB DESIGN

Sl. No.	TWO WAY SLAB				
	Diameter of Rod used	8	8	8	8
	B.M = w l_x^2 x coefficients	4.30	3.31	2.12	1.59
	Factore moment(M_u) = 1.5 x M	6.45	4.96	3.18	2.38
	k = M_U / bd^2	0.70	0.54	0.34	0.26
	p_t (From SP16)	0.17	0.13	0.09	0.06
	A_{st} = p_t bd /100	167.97	129.21	82.69	62.02
	Area of one Reinforcement	50.24	50.24	50.24	50.24
	spacing required	299.10	388.83	607.55	810.06
	Spacing provided	200	200	200	200
	Area Provided	251	251	251.20	251.2
	pt provided	0.26	0.26	0.26	0.26
	Check for Deflection				
	Actual l_x /d	32.92	mm		
	p_t	0.26	%		
	Steel stress of service load f_s	193.92	N/mm^2		
	Modification factor (from IS456)	1.5			
	l_{eff} /d	26			
	Allowable deflection	39	mm		
		>actual Hence safe			

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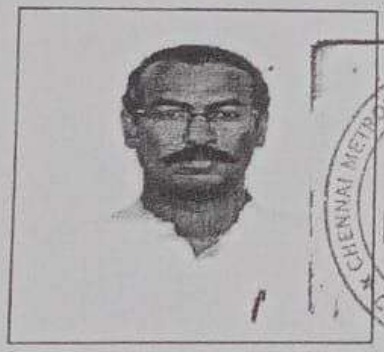
CHENNAI METROPOLITAN DEVELOPMENT AUTHORITY
'ThalamuthuNatarajan Building', No.1, Gandhi Irwin Road,
Egmore, Chennai-600 008.

PROFESSIONAL REGISTRATION CERTIFICATE

This is to certify that the **Thiru. S. SENTHIL** has enrolled as **Registered Structural Engineer Grade-I (SE)** with Chennai Metropolitan Development Authority (CMDA) who has the qualification of **M.E.,(Structural Engg.)**and experience in the relevant field for **9 years**.

He has been given the Registration No.**SE/GR-I/2019/03/054** Renewed on **27.03.2024.** He shall be required to comply with the duties and responsibilities prescribed by the Government of Tamil Nadu in Part-V, "Registration of Professionals", Tamil Nadu Combined Development and Building Rules, 2019 approved vide G.O.(Ms) No.18 MAWS (MA1) Dept. dated 04.02.2019.

This Registration is valid upto **26.03.2029**.



CHENNAI METROPOLITAN DEVELOPMENT AUTHORITY
CHENNAI-600 008

22/3/24

(A. MEGANATHAN)
Superintendent

Er. S. SENTHIL, M.E. (STR)., M.B.A., M.I.E.,
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