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R.KOTTEESWARAN B.E(Hons),M.E(Structures),

Structural Engineer

122, PERAMBUR HIGH ROAD ,

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STABILITY CERTIFICATE

The detailed engineering and structure design of the proposed building comprising of..Stilt+ 4 Floors + 5th Floor (part) at. Ramappa Nagar 2nd Cross Street and Ramappa Nagar 4th Main Road, Perungudi Chennai ..comprised in. S.No...44/1A,56/1A (Document), Survey Numbers 44/1B, 56/16A1 (PATTA), of Perungudi Village .Within the Limit of Greater Chennai Corporation has been done by me based on the report of geotechnical investigation (soil test) done by..TJ ENGINEERS Report No. TJE/003352/2024 Dated 26-06-2024 and considering the functional requirement of the building.

1. It is certified that among other factors, the proposed building has been designed to resist earthquake. I have checked various parameters and found that the proposed building would be safe.
2. I further certify that:

a. The minimum grade of concrete is M25

b. 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 I to part III and design of earthquake resistant structure as per IS Code No… IS 1893

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

Encl.: Structural Design Calculation

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DESIGN CALCULATIONS

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STRUCTURAL STABILITY CALCULATION

I Following parameters are considered

1. The least dimension of the column is 300mm.
2. The minimum grade of concrete is M20 & M25.
3. The design analysis using the code of practice for loading standards as per IS 875,IS 432,IS 456 and SP16 and seismic force as per code IS 1893/1984.

   DESIGN CONSIDERING THE SEISMIC CONDITION AS PER 1893/1984 AND AS PER IS 873/PII

   Live load on roof = 1.50 KN/m^2

   Live load on floors = 2.00 KN/m^2

   Weathering course on roof = 2.00 KN/m^2

   Floor finish = 1.00 KN/m^2

   Weight of concrete = 25.00 KN/m^2

   Weight of Brick Work = 20.00 KN/m^2

   Least dimension of the column= 300x457mm

DESIGN DETAILS :

Design method : limit State design method.

Codes and Special publication used : SP 16+ IS 875/PII + IS 1893(Part 1)/2002 for

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Concrete Grade	: M25
Steel Grade	: Fe 500
IS code dimension of column adapted to seismic condition	: 1893(Part 1)/2002& IS 875/PII
Least dimension of column Adopted in this building	: 300 mm Dia.

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STRUCTURAL DESIGN

LOAD CALCULATION SHEET

Name of project : Proposed stilt + four Floors+ fifth floor (part) of Residential Building at Perungudi Chennai

CONSTRUCTION AND TYPE OF FOUNDATION	: RCC framed type with footing foundation Connected with plinth beam.
FLOOR HEIGHT	: 10'0" (3M)
SIZE OF COLUMN	: 0.300X0.609 m

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Load Calculation

The Live load on the floor 2 KN/ M2	--	2
Dead Load on the floor		
The weight of slab is .15X25 KN/M3	--	3.75
Floor Finish is 1KN /M2	--	1.0
Partition load is 2 KN/M2	--	2.0
Total Load on the Floor	--	8.75 KN/ SqM

Say 8.75 KN/ SQM

Considering column in grid I 3

The influence area is 3.848M X7.29 (I A) --28.05 Sq.M

Load on the Floor 8.75KN/ SQM

Weight on one Floor is I A X Total load / Sq. M (P) --245.45 KN

Length of (9" Thick height is 7.80M)

Weight of Wall is 7.80KN /M run X13.8M (Q) --107.64 KN

five floor slabs and one roof slab (P) and wall weight in five floors (Q)

Total weight on the column is 6 P + 5Q --2010.9 KN

(6 x 245.45 + 5 x 107.64 = 2010.9 KN)

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Foundation design

Total Load on one column is 2010.9 KN

Total Load on the Footing is 2010.9X 1.1 --2211.99 KN

Design of Pile cap (CAP1)

4 PILE GROUP

The pile cap is resting on 4 Pile group with pile diameter of 600mm.

The spacing of pile is 1.3716M

The size of Pile cap is taken as 2.438 Mx 2.438M in Plan.

The depth of the pile cap is 1.016M as effective depth.

The Factored load on the cap is P= 2211.99 X 1.5 = 3317.98 KN

2L= 1.3716 M, d= 1.016 M

P= 3317.98 KN

d=1.016M

Cap2

2L=1.3716M

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ANALYSIS BY TRUSS ANALOGY

The tensile force at the bottom of the cap is

$T_{As} = PL/4d = 3317.98 \times 0.6855 / 4 \times 1.016 = 559.66KN$

A_{st} required $=559.66 \times 10^3/0.87 \times 500 = 1286\ mm^2$

Minimum steel required $=0.12 \times 2438 \times 1016/100 = 2972 mm^2$

Provide 16 No of 20mm dia. at bottom as main reinforcement.

Provided Reinforcement 5024 mm^2

Provided Reinforcement is greater than the minimum Requirement (Hence OK)

Y20 @150mm C/C

Provide Y16 @ 150 mm C/C at top reinforcement.

All main and top reinforcement to be bent up by 450mm.

8Nos of 10mm dia. at side face reinforcement.

Shear Plane length is 2480 mm and depth is 1016 mm

Load from two pile is considered

Load taken by two piles = Total Load 2 /4 = 3317.99 x2/4 = 1658.99 KN

C heck for Normal Shear Stress $=1658.99 \times 10^3/2480 \times 1016$

$= 0.658\ N/mm^2$

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The enhanced shear stresses is = 2 d x τ_c / a_v = 2x 1016 x .33 / 343 = 1.954 N/mm^2

The Actual Shear stress is less than the enhanced shear stress. (Hence OK)

Percentage of reinforcement is 100 x5024 /(2480 x 1016)= .199 %

Permissible Shear Stress For M25 grade concrete τ_c=0.33N/mm^2(0.199% of steel)

Hence it is ok.

Check for Punching Shear

τ_v=3016.34x10^3/1003x4 x1016 = 0.739 N/mm^{2s}

The permissible Shear Stress is $0.25\sqrt{f_{ck}}$

=1.25N/mm^2

$\tau_v < \tau_c$ (Permissible)

The shear stress is less than Permissible value. Hence it is safe.

Check for Load on the pile and load carrying capacity as per soil report.

Load on each pile = 2211.98 KN / 4 = 552.99 KN

Safe load carrying capacity of the 600 mm dia. pile is 810 KN

Load on the pile is less than the Safe load carrying capacity of the pile.

Hence OK .

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COLUMN DESIGN (Critical column design) (size 304 X 609 mm) (M40 grade Concrete)

Total load on the critical column =2211.98 KN

Factored load on the column = 2211.98 x1.5 =3317.97 KN

M40 grade concrete and Fe 500 Steel grade considered.

Asc = 5176 sqmm , Ac = 179 960 sqmm.

Column capacity Pu= .4 fck Ac +.67 fy Asc

Pu= .4 X 40 X 179960 + .67 X500 X 5176

=2879360 + 1733960 =4613320 N

=4613 KN (461.3 T) which is greater than 3317.97 KN (Pu)

The Actual Factored Load is less than the column capacity Hence OK

Provide 8-Y25 +4-20 as main reinforcement

Provide 10 @ 100mm C/C as Ties (3 ties).

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Checking the column for Axial Load and moment

Axial Load on the column is = 3317.97 KN (Pu)

Moment on the column is = 53.11KNM

Column size is 300 X 609 mm clear cover is = 50 mm ; d' / D = .082 say .1

P / Fck B D = 3317.97 KN x 1000 / (40 X 300 X 609) = 0.454

M / Fck B D^2 = 53.11 KNM X 1000000 / (40 X 300 X 600^2) = 0.012

Chart 36 sp 16 (1980)

p/Fck = .02 hence Percentage Steel required = .02 x 40 = .8 %

MINIMUM PERCENTAGE IS 0.8 %

Provided is 8- Y25 +4-Y20 = 5176 SQMM 2.83 % (provided)

Hence OK

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DESIGN OF ROOF BEAM (FB5)

Design of beam of size 230mm X 762mm

The factored BM is 350KNM X 1.5= 525 KNM

BM at Centre is 215 KNM

The Factored BM is 215 X1.5 =322.5 KNM

Doubly reinforced beam at support section

Total Ast required on top is 1999 mm^2

Ast provided is 3174 mm^2

Ast required at bottom is = 451mm^2

Provided is 1884 mm^2 Hence OK

Design of middle section

T beam action is considered

width of T beam = 2200 mm
Ast required = 1068 mm^2

Provided is 1884 mm^2 > 1068 mm^2 (required)

Required steel is less than the provided steel

Hence OK

Factored Shear force on the beam is = 239.38 KN X1.5=359.08 KN

Shear stress , V_u /b d = 359.08 X1000/ (230 X 712) =2.19 N/mm^2

Referring table 20 page 73 IS 456- 2000

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τ_c max = 3.1 N/mm^2

percentage of reinforcement is 100X 3174 /230X712 = 1.93 N/mm^2

Referring table 19 of Is456 :2000 for M25

τ_v = 0.81 N/mm^2

Shear capacity of concrete is 0.81X230X712= 132645 N

Shear steel provision required for Vus= 359.08 KN – 132.645 KN=226.435 KN

Taking Y8- 2legged stirrups

Spacing of vertical 2 legged stirrups is Sv = .87 Fy X Asv X d /Vus

Sv = .87 X500 X2 X79X712 /226435= 216 mm

Provide Y10- 2 legged stirrups @ 100 mm C/C

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DESIGN OF TWO WAY SLAB: (S1)

Design parameters:

Grade of concrete	= M25
Grade of steel	= Fe415
Characteristic compressive strength of concrete ,f_{ck} (N/mm^2)	= 25
Characteristic yield strength of steel ,f_y (N/mm^2)	= 500
Unit weight of concrete ,y_c (KN/m^3)	= 25
Partial safety factor for concrete	= 1.5
Exposure condition	= Mild
Nominal cover to exposure condition (mm)	= 15

Dimension of the slab

The slab taken for design is restrained in four direction.

Clear span in long direction, L_Y(m)	= 3.96
Clear span in short direction, L_X (m)	= 3.35
Thickness of slab, D(mm)	= 150

Calculation of Effective depth

Thickness of the slab ,D(mm)	= 150
Assumed diameter of reinforcement bars (mm)	= 10
Effective depth, d (mm) (150-15-10/2) =	= 130.

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Effective depth from deflection criteria

For two way slab on rigid beams the minimum overall thickness

Is taken as $L_e/48$ whe²e $L_e$is the clear span in longer direction.

Minimum overall depth required, D_{min} (mm) = (3.96x1000/48)

D_{min}= 82.5mm

Thickness adequate

Effective length of spans

Effective depth in x direction ,d_x (mm) (150-15-10/2) =130

Effective depth in y direction, (130-10) =120

d_x = 130mm

d_y = 120mm

Effective spans

i)L_X = 3.58 m

ii)L_Y = 4.19 m

Loads taken for Analysis & Design

Live Load	=2 KN/m²
Dead load of slab	=3.75 KN/m²
Finishes	=1.0 KN/m²
partition Load	=2.0 KN/m²
Total load	=8.75 KN/m²

Say 8.75 KN/SQM

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Factored load = 13.125 KN/m^2

Design Moments

The design moments are found out using code moment

Coefficient for restrained slabs (Table 26 of IS 456:2000)

$\alpha_x^- = 0.043$

$\alpha_x^+ = 0.032$

$\alpha_y^- = 0.032$

$\alpha_y^+ = 0.024$

The corresponding moments are given by :

$M_x^- = 0.043 \times 13.125 \times 3.58^2 = 7.233$ KNm

$M_x^+ = 0.032 \times 13.125 \times 3.58^2 = 5.38$ KNm

$M_y^- = 0.032 \times 13.125 \times 3.58^2 = 5.38$KNm

$M_y^+ = 0.024 \times 13.125 \times 3.58^2 = 4.037$ KNm

Reinforcements

For the moment M_y^+

Reinforcement required is = 130 mm^2

Provided is 10mm dia. Steel at 150mm C/C in x shorter direction

10mm dia. Steel at 150mm C/C in longer direction

Hence OK

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Area of steel provided =1000x79/150=526mm^2

% of steel =100x130/1000x130=0.1%

Deflection check

service stress = .58 x 500 x stel required / steel provided =71.67 N/ sqmm

(Refer chart 4 from IS 456 2000)

MODIFICATION FACTOR = 2.0

DEPTH REQUIRED = span / (26 x modification factor) = 3.58 x1000 / (26 x 2.0)= 68.84mm

depth provided is 130mm hence OK

Hence it is safe.



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CHENNAI METROPOLITAN DEVELOPMENT AUTHORITY
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PROFESSIONAL REGISTRATION CERTIFICATE

This is to certify that the **Thiru. R. KOTTEESWARAN** 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 **16 years**.

He has been given the Registration No **SE/GR-I/19/10/213 Renewed** on **30.10.2024**. 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 **29.10.2029.**



30/10/24

(A. MEGANATHAN)
Superintendent



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