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Bharanidharan M.E, AMIE.
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gistered Civil & Structural Engineer
artered Engineer

KURAL ASSOCIATES
Perception to Execution

STRUCTURAL STABILITY CERTIFICATE

SITE ADDRESS:- Proposed Construction of Stilt Floor +5 Floor Residential Building With 15 Dwelling Units (Height-18.00 M) at Plot No.237&238, Erode Jagannathan Street, Golden George Nagar, Comprised in Survey No.420 , T.S.91/2 &92 Block 73 of Mogappair Village within the Limits of Greater Chennai Corporation. Zone-VII; Division-093.

The Residential Building referred to above is a framed structure with **S+5 upper floor**. The structural design and drawing for the building are being prepared by us conforming to the relevant bureau of Indian Standards viz. IS 456:2000 for plain and reinforced concrete, IS 875(part-II)- 1987 for imposed loads and IS 1893:2002(part-1) for seismic force.

We certify that the building when constructed according to our structural designs and drawings will be **structurally safe and sound** taking earthquake effects in account and fit for occupation. No more future vertical expansion will be allowed except staircase & lift headroom.

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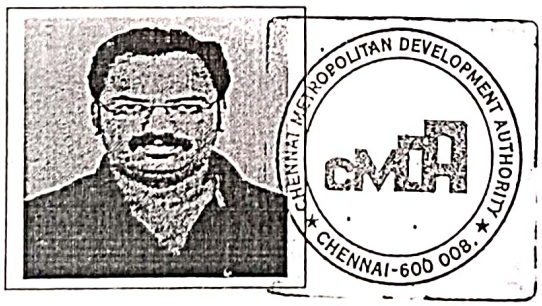
CHENNAI METROPOLITAN DEVELOPMENT AUTHORITY
'ThalamuthuNatarajan Building', No.1, Gandhi Irwin Road,
Egmore, Chennai-600 008.

PROFESSIONAL REGISTRATION CERTIFICATE

This is to certify that the **Thiru. T. BHARANITHARAN** has enrolled as **Registered Structural Engineer Grade-II (SE)** with Chennai Metropolitan Development Authority (CMDA) who has the qualification of **M.E.,(Structural Engg.)** and experience in the relevant field for **8 years**.

He has been given the Registration No.**SE/GR-II/2019/04/036 Renewed** on **01.04.2024.** 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 **31.03.2029.**



(A. MEGANATHAN)
Superintendent

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Proposed Construction of Stilt Floor +5 Floor Residential Building With 15 Dwelling Units (Height-18.00M) at Plot No.237&238, Erode Jagannathan Street, Golden George Nagar, Comprised in Survey No.420 T.S.91/2 &92 Block 73 of Mogappair Village within the Limits of Greater Chennai Corporation. Zone-VII; Division-093.

Structural design brief

Introduction

The proposed residential building is a framed structure with stilt and five upper floors. The building is analyzed and designed conforming to loading standards IS: 875 (part II) and to seismic force as per IS 1893: 2002, the revised India code for earth quake resistant design of structures.

A. Load considered in the design

Live load on roof	1.5 KN/M^2
Live load on floor	2 KN/M^2
Weathering course on roof	2KN/M^2
Floor finish	1 KN/M^2
Light partition	1 KN/M^2
Unit weight of brickwork	20 KN/M^3
Unit weight of concrete	25 KN/M^3

B. Design details

Design method	LIMIT STATE DESIGN
Codes & special publication used	IS 456: 2000, IS 1893:2002(PART I), SP 16, IS 875(PART II)
Concrete grade	M25
Steel grade	FE 415

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C. Foundation Details

Type of foundation	Pile foundation
Allowable capacity as per soil test report	160 tons for 750mm dia piles
Depth of foundation	27m below NGL
Diameter of main bars in footings	20mm, 20mm, 16mm, 12mm

D. Slab Details

Type of slab	Two way slab
Thickness of the slab provided	125mm
Steel cover to slab	25mm
Diameter of main bars used	10mm, 8mm

E. Beam Details

Size of the beam provided	230 x 450mm, 230 x 600mm, 230 x 380mm
Bottom steel cover to beam	25mm
Diameter of main bars used	25mm, 20mm, 16mm, 12mm
Stirrups used	2 legged stirrups 8mm dia

F. Column Details

Size of the columns provided	300mmx600mm
Steel cover to column	40mm
Diameter of main bars used	25mm, 20mm, 16mm
Binder diameter	8mm

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1. LOADINGS

A. Dead and live loads

Gravity load on roof :6.125 KN/m^2 (weathering course + slab)
Gravity load on floors :5.125 KN/m^2 (floor finish + light partition + slab)
Live load on roof :1.5 KN/m^2
Live load on floor :2 KN/m^2

B. Wind loads

Wind loads for design of structures shall be based on the design wind speeds arrived on the basis of IS: 875 (PART III)
The parameters for calculation of design wind speed as per IS: 875 (PART III) are as follows:
Basic wind speed (v_b) : 50m/sec
Height :15m
From table 1, IS 875 (part 3), for mean probable design life of structure as 50 yrs and wind speed of 50m/sec, risk coefficient, K_1 :10
From table 2, terrain category 2 and class A for a height of 15m and plan dimensions 13.34 x 33.34, terrain, height, structure size factor, K_2 : 1.02
Topography factor, K_3 :1.0
Design wind speed (V_z) :Vb x K1 X K2 X K3
Design wind pressure (P_z): 0.6 Vz^2
:0.6 x 51^2 :1560.6N/m^2
: 1.5606 KN/m^2

C. Determination of earthquake parameters and loadings

Zone factor, Z for Chennai seismic ZONE III: 0.16, (table 2, clause 6.4.2)
I, Importance factor : 1, (form table 6)
R, Response reduction factor : 3 for OMRF (ordinary moment resisting frame, table 7)
Fundamental natural period along X direction,

T_x : 0.09 x h / $\sqrt{d_x}$: 0.09 x 12 / $\sqrt{6.79}$

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: 0.041 (clause 7.62)

The soil at the site is soft S_a/g : 2.5 as $0.1 \leq T \leq 0.67$

Fundamental natural period along Z direction,

T_z : 0.09 x h / √ dz : 0.09 x 12 / √21.07

: 0.235 (clause 7.6.2)

The soil at the site is soft S_a/g : 2.5 as $0.1 \leq T \leq 0.67$

Design horizontal seismic coefficient

A_h : Z I S_a/ 2Rg (clause 6.4.2)

: 0.16 x 1 x 2.5/ 2 x 3:0.0667

Seismic weight of the building : Total gravity load + 0.25 superimposed load

W: 8194 + (0.25 x 1178)

W: 8489.0 kN

Design seismic base shear

V_B : A_hW (caluse 7.5.3)

0.0667 x 8489 : 566.2KN

Shear per column : 566.2 / 13 : 42.78KN

2. LOAD CALACULATION FOR MAXIMUM LOADED COLUMN

Loading area for the column	:3 x 4.6	:13.8m²
Gravity load reaction from the roof	:6.125 x 13.8	: 84.52Kn
Self weight of the beam	:0.30 x 0.9 x 7.6 x 25	

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	:51.3KN
Weight of the parapet wall	:1 x 0.23 x 20 x 7.6
	:34.96KN
Total gravity load	:170.72KN
Gravity load reaction from the floor	:5.125 x 13.8 : 70.725KN
Self weight of the beam	:0.30 x 0.9 x 25 x 7.6
	:51.3KN
Weight of 230mm wall	:0.23 x 2.1 x 20 x 7.6
	:73.4KN
Weight of toilet filling	:0.25 x 20 x 3.2 :16KN
Weight of 115mm wall	:0.115 x 20 x 2.4 x 3.9
	:21.53KN
Total gravity load	:232.83 KN
Self weight of the column	:0.3 x 0.6 x 25 x 20.74
	:93.38KN
Total gravity load at the foundation	:170.72 + (232.8 x 5)+ 93.38
Level, KN	:1428.1 KN
Total superimposed load at the foundation	:(30.6 + (40.79x 4)) x 0.7)
Level, KN	:164.18 KN
Total load	:1592.28 KN

The loads for the other column are calculated in a similar way.

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3.COLUMN DESIGN

Column size

B	300mm	fck	25
D	600mm	fy	415

Cover 40mm Effect. Length ratio 0.65 IS 456:200

Ground floor height,L 3000mm L_{eff1} 0.65 X L 950 pg 9

First floor height,L 3000mm L_{eff2} 0.65 X L 1950

Check for slenderness

L_{eff1}/D	3.25	L_{eff1}/b	6.50
L_{eff2}/D	3.25	L_{eff2}/b	6.50

All columns are short about both axis

Size of column and check e_{min}

e_{min} :$L_{eff}/500 + D/30$ 18.90

Hence adopt 20mm eccentricity. 0.02 x 1592.43 : 31.84KN

Design axial load, P_u : 1592.28 KN

Design moment, M_x : M_{min}: 31.84 KNm

Designing the column as axially loaded column with uniaxial moment

Calculation of area of steel

Cover	40mm		
Design axial load, pu:	1592.28 KN		
Design moment, Mx:	Pu x emin	31.84 KN	
D	600mm	fck	25
b	300mm	fy	415
cover	40mm		

diameter of rod assumed 25mm

d' : 40 + 25/2 :52.5mm

d'/D : 52.5/600 :0.0875mm

$Mz/fckbD^2$: 31.84 x 1.5 x 10^6/25 x 300x x 600 x 600

:0.0176

p_u/fck bD :1592.28 x 1.5 x 10^3/25 x 300 x 600

:0.53

From SP 16 chart 45

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p/fck : 0.03

Ast : 0.03 x 25 x 300 x 600/100 : 1350 mm^2

However 10 Nos of Y16 (2010.62mm^2) rods are provided.

Also binders Y8 @ 150mm are provided.

4. DESIGN OF FOUNDATION

BORED PILE 500 mm DIA

LOAD 160 t (Stilt + 5 = 5 floors)

Earthquake load =10%
wind load =10% =30%
self weight =10%

160 + 48 = 208 t

Load on each pile = 208/3 = 69.3 t

Depth = 16.5 m (Rock formation) pile – 50 cm dia

L/D=1650/50 = 33>12 (long column)

Reduction Co- efficient Cr= 1.75 – (1650/48 x 50)

=1.75 –(165 / 240)

=1.75 – 0.68

=0.67

Concrete safe stress = 0.67 x 400 =268 N / cm^2

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Steel safe stress = 0.67 x 23000 = 15410 N / cm^2

268 x [1963 – At] + [14375 x At] = 700000

490750 – 250 At + 14375 At = 700000

14125 At =14.81 cm^2

12 x π/4 d^2 = 1481

d^2 = (1481 x 4)/(3.14 x 12)

d = 12.5 mm say 12 mm

provide 3 NOS 16mm & 3 NOS 12mm

CHECK FOR EARTH QUAKE FORCES:

Check the critical column and its foundation to earth quack forces as per IS 1893

Use seismic co-efficient method as per clause 3.4.2-3(a)

$\alpha_h = \beta I (\alpha_b)$

(α_h) = Horizontal seismic co-efficient

α_b = basic horizontal seismic co-efficient as per seismic zone (Chennai) – zone III = 0.04

β = A co-efficient depent up on soil foundation as per table – 3 =1.

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I = A co-efficient depent up on soil as per table – 4. = 1.20

(α_h) = 0.048

Total load on column = 160 ton.

Size of pile = 500 mm dia.

Safe bearing capacity of soil = 84T/m²

HΣ = horizontal force component of earth quake.

$= (\alpha_h) \times w$

$= 0.048 \times 100$

= 4.8 Ton.

Column size = 300 mm x 450 mm

Effective depth = 40 cm

Shear stress = HΣ / bjd

$= 4800 / (30 \times 0.87 \times 50)$

$= 3.678 \text{ kg / cm}^2 < 8 \text{kg / cm}^2$

Hence the column is safe against earth quake.

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H_V = vertical component of earth quake force as per clause 3.4.5 of IS 1893

$H_V = (\alpha_h) / 2 = 0.024$

Vertical component force due to seismic (P1) = HV x P

= 0.024 X 160 = 3.84 Ton

Total load on footing = P + P1 = 160 + 3.84 = 163.84 Ton.

Size of pile = 500 mm dia

Stress on soil = P/A

=163.84 / (500 mm dia)

= 9.8 ton / m^2< 10.0 ton / m^2

Which is safe

However it is proposed to provide bored piles 500 mm dia @ 16.5 m depth (as per enclosed drawing)

5. DESIGN OF PILTH BEAM

Assuming a plinth beam of size 230mm x 380mm

Self weight of the plinth beam:0.23 x 0.380 x 25 : 2.185 KN/m

Weight of the 230mm wall :0.23 x 2.4 x 20 :11.04KN/M

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Total load on plinth beam :2.185 + 11.04 :13.225KN/M

Maximum moment for a span of 5m :13.225 x 1.5 x 5^2/16: 30.99KN/m

Mu/bd^2 : 30.99 x 10^6 / 230 x 330^2 :1.24

From table 3 of SP 1 6 P_t= 0.3658, Ast : 0.3658 x 230 x 350/100

: 294.469mm^2

Top and bottom steel of 3 NOS, of Y12 is provided. Area of steel provide

:339mm^2

6. DESIGN OF FLOOR BEAM

Self weight of the beam :0.23 x 0.45 x 25 : 2.6N/m

Weight of the 230mm wall :0.23 x 2.1 x 20 : 9.66KN/m

Span

Reaction from slab : 2.6 x 2 : 5.2 KN/m

Total factored load : 1.5(5.2 + 9.66 + 6.3): 31.75 KN/m

Maximum moment at support : 432.02 KN/m

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Mu/bd^2 : 432.02 x 10^6/230 x 450^2 : 1.72, from table 3 of SP 16 Pt : 0.566

Ast : 0.566 x 230 x 450/100 : 1551.97mm^2

Ast provided : 4 Y16 (804.2MM^2)

Maximum moment at mid-span : 432.02KN/m

Mu/bd^2 : 432.02 x 10^6 / 230 x 450^2 : 1.72, from table 3 of SP Pt: 0.566

Ast : 0.566 x 230 x 450/100 : 585.81mm^2,

Ast provided: 4-Y16(804.2MM^2)

Maximum shear force : 239KN.for Pt : 1.4

Shear capacity of the section :τc bd : 0.72 x 230 x 450 : 74.52KN

Shear to be carried by the stirrups, Vus: 320.88 – 12.2 : 196.68KN

Vus/d : 196.68/57.5 : 3.42. provide stirrups of Y8ST2@100MM for 1m near

The supports, Y8ST2@125MM for the next 1m, Y8ST2@125mm for the next

1m and Y8ST2@230mm for the remaining span.

All the other beam are designed in a similar way.

7. DESIGN OF FLOOR SLAB:

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Self weight of the slab 125mm thick	:3.125KN/m^2
Floor finish	:1 KN/m^2
Live load	:2 KN/m^2
Total load	:6.125 KN/m^2

The slab has one long edge continuous

ly/lx : 4.53/3.69:1.23<2. The slab is designed as a two-way slab.

From table 26 of IS 456:2000 for ly/lx : 1.15; αx: 0.0725, αy : 0.043

Negative moment at continuous edge for shorter side Mx : αx w l^2X

:0.0725 X 6.125 X 3.69^2 X 1.5:9.07KN/m

Effective depth required :$\sqrt{9.07 \times 10^6 / 0.138 \times 25 \times 1000}$

:51.27mm.

A slab depth of 125mm is provided.

Mu/bd^2 : 9.07 x 10^6/1000 x 100^2 : 0.907. from table 3 of SP 16 Pt: 0.2631

Ast required : 0.2631 x 1000 x 125/100: 263.1mm^2.

However Y8@ 150mm c/c (335mm^2) is provided along the shorter span.

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Positive moment at mid span for the longer side My : $\alpha y \, w \, l^2x$

: 0.043 x 6.125 x 3.69^2 x 1.5 : 5.37KNm

Mu/bd^2: 5.37 x 10^6 / 1000 x 100^2 : 0.537. from table 3 of SP 16 Pt :0.15236

Ast required : 0.15236 x 1000 x 100/100 :152.36mm^2.

However Y8@ 150mm c/c (335mm^2) is provided along the longer span.

All other slab are designed in a similar way.

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