

STRUCTURAL ANALYSIS AND DESIGN AS PER **INDIAN STANDARDS**

FOR THE PROPOSED RESIDENTIAL FLATS AT BLOCK M54/1 To 12, M55/1 To 12 & M56/1 To 12, STATION ROAD,(STATION TO NORTH TOWNSHIP SCHOOL), TNHB, KORATTUR, CHEENAI – 600080. COMPRISED IN SURVEY NO.1020/1A PART,T.S.NO:201 PART,IN BLOCK NO.43, OF KORATTUR VILLAGE, GREATER CHENNAI CORPORATION DIVISION – ZONE- 7.

The construction will be carried out by M/S RAJUS FLAT PROMOTERS PRIVATE LTD.


Er. P. ANAND RAJU
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Class-1A Panel of Private Practicing Engineer, Chennai Dist. (Structural Engineer)

Registered Valuer : Under Companies Act | Approved Valuer | Income Tax Valuer | Chartered Engineer | Licensed Surveyor**STABILITY CERTIFICATE**

(To be furnished while filing application for registration of building)

The detailed engineering and structure design of the proposed building comprising of Stilt + 5 floors at M54/1 To 12, M55/1 To 12 & M56/1 To 12, Station Road, (Station To North Township School), TNHB, Korattur, Cheenai - 600080 S.No No.1020/1A Part, T.S.No:201 Part, has been done by me/us based on the report of geotechnical investigation (soil test) done by T.J.Engineers Report No. TJE/003621/2025 Dated 01.02.2025 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/We further certify that:

(i) The minimum grade of concrete is M25.

(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 456 : 2000 and design of earthquake resistant structure as per IS Code No IS 875 Series (part 1-5) and IS 1893 :2016

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


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DESIGN OF SLAB

Consider a critical bay of slab with safe end conditions for typical slab design.

Slab thickness	=	130 cm
Longer span	=	6.86 m
Shorter span	=	3.43 m
Grade of concrete	=	20 N/mm ²
Grade of steel	=	415 N/mm ²
Clear cover	=	15 mm
Load factor	=	1.5
Boundary condition	=	Two long edges continuously

EFFECTIVE SPAN

Longer span	ly	=	6.86 m
Shorter span	lx	=	3.43 m
Span ratio	ly/ lx	=	2

Hence, the slab may be designed as a Two-way slab.

EFFECTIVE DEPTH

Longer span	=	110 mm
Shorter span	=	105 mm

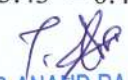
LOAD CALCULATION

Self-weight of slab	=	$[130 \times 25] / 1000$	= 3.25 kN/m ²
Live load			= 2.00 kN/m ²
Floor finish and partition			= 1.75 kN/m ²
Total load (W)			= 7.00 kN/m ²

MOMENT CALCULATION

Factored bending moment-

Shorter span:	-ve moment coefficient	= 0.069
	Negative Bending Moment	= $1.5 \times 7.0 \times 0.069 \times 3.43^2 = 8.52$ kN-m
	+ve moment coefficient	= 0.052
	Positive Bending Moment	= $1.5 \times 7.0 \times 0.052 \times 3.43^2 = 6.42$ kN-m


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Longer span: -ve moment coefficient = 0.000
 Negative Bending Moment = $1.5 \times 7.0 \times 0.000 \times 3.43^2 = 0.000 \text{ kN-m}$
 -ve moment coefficient = 0.035

DEPTH CHECK

1) W.r.t to moment:

$$\begin{aligned} \mu & \quad \mu = f_{ck} b d^2 \\ & \quad 8.5220 \times 100 \times d^2 \\ d & \quad = \sqrt{8.52 \times 10^9 / (20 \times 110)} = 62.23 \text{ mm} \quad \text{Proposed } d = 110 \text{ mm} \\ D & \quad = 130 \text{ mm} \end{aligned}$$

2) W.r.t to deflection:

$$\begin{aligned} \text{Pt\%} & = 2.51/130 = 19.31\% \\ \text{Span /effective depth} & = 34 \text{ (Chart-22, Design Aids for Reinforced Concrete)} \\ \text{Effective depth} & = 3280/34 = 96.5 \text{ mm} \\ \text{Proposed Effective depth} & = 110 \text{ mm} \end{aligned}$$

REINFORCEMENT DETAILS:

	μ/bd^2	Pt Reqd	Ast Reqd (%)	Ast Provided (mm^2)
Shorter span-				
-ve Moment at support	0.70	0.203	223	8 Tor @ 20cm c/c (251 mm^2)
+ve Moment at midspan	0.53	0.152	167	8 Tor @ 20cm c/c (251 mm^2)
Long span-				
-ve Moment at support	0.00	0.000	000	8 Tor @ 20cm c/c (251 mm^2)
+ve Moment at midspan	0.36	0.102	1.12	8 Tor @ 20cm c/c (251 mm^2)


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DESIGN OF BEAM

A model calculation of beam is given below.

GENERAL DATA

Breath of beam	b	= 230 mm
Depth of beam	D	= 750 mm
Clear cover of Reinforcement		= 25 mm
Diameter of main bars	Y	= 25 mm
Diameter of stirrups	Y1	= 8 mm
Effective depth of beam	d	= 710 mm
Dist from beam edge to center of main steel	d'	= 40 mm
d'/d Ratio		40/710 = 0.07
Characteristic compressive strength of concrete	fck	= 20 N/mm ²
Characteristic yield strength of steel	fy	= 415 N/mm ²

RESULTS FROM STAAD ANALYSIS

The following are the results taken from the STAAD Analysis. Critical values due to the combination of loads by Earthquake and Wind are considered for calculation.

Maximum positive moment at mid span	= 340 kN-m
Maximum Negative moment at support	= 286 kN-m
Maximum shear force	= 297 kN

DESIGN FOR POSITIVE MOMENT

Mu/bd ²	340000x1.5/230 x 710 x 710 = 4.40 N/mm ²
Percentage of reinforcement	Pt = 1.434 (Table no. 50 of Design aids for RCC)
	Pc = 0.498 (Table no. 50 of Design aids for RCC)
Area of tensile steel required	Ast = 1.434 x 230 x 710 = 234172mm ²
Provide 5 nos. 25mm dia Tor steel (245400mm ²)	
Area of compression reinforcement Asc	= 0.498 x 230 x 710 = 81323mm ²
Provide 3 nos. 25 mm dia Tor steel (147200mm ²)	


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DESIGN FOR NEGATIVE MOMENT

$$M_u/bd^2 \quad 286000/230 \times 710 \times 710 = 2.47 \text{ N/mm}^2$$

$$\text{Percentage of reinforcement} \quad P_t = 0.827 \text{ (Table no 2 of Design aids for RCC)}$$

$$\text{Area of tensile steel required} \quad A_{st} = 0.827 \times 230 \times 710 = 135049 \text{ mm}^2$$

$$\text{Provide 3 nos 25 mm Dia tor steel } (147200 \text{ mm}^2)$$

DESIGN FOR SHEAR

$$\text{Ultimate shear} \quad V_u = 297 \times 1.5 \text{ kN}$$

$$\text{Shear stress} \quad \tau_v = V_u/d = 445500/230 \times 710 = 2.73 \text{ N/mm}^2$$

$$\text{From table J for M20,} \quad \tau_c = 2.8 \text{ N/mm}^2$$

τ_v is less than τ_c .

$$P_t = 100 A_{st}/bd \quad 245400/230 \times 710 = 1.50$$

$$\text{From Table 61, for } P_t = 1.50, \quad \tau_c = 0.72 \text{ N/mm}^2$$

$$\text{Shear capacity of concrete section } \tau_c bd = 0.72 \times 230 \times 710/1000 = 118 \text{ kN}$$

$$\text{Shear to be carried by stirrups} \quad = 273 - 118 = 155 \text{ kN}$$

$$V_{us}/d \quad = 155/71 = 2.18 \text{ kN/cm}$$

$$\text{Referring to table 62 for steel } f_y = 415 \text{ N/mm}^2$$

8mm diameter two legged vertical stirrups at 16 cm spacing is required.

Proposed 8mm diameter two legged vertical stirrups at 10cm spacing.


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DESIGN OF COLUMNS

Grade of concrete M25	f_{ck}	$= 25 \text{ N/mm}^2$
Grade of steel 415	f_y	$= 415 \text{ N/mm}^2$
Column size	B	$= 300 \text{ mm}$
	D	$= 600 \text{ mm}$
Unsupported length	L	$= 2.2$
5 m		
Clear cover		$= 40 \text{ mm}$
Dia of the bar		$= 25 \text{ mm}$
Axial load on column	P	$= 2550 \text{ KN}$
Bending moment	M_x	$= 60 \text{ kN-m}$

$$P_u / f_{ck} \times b \times d = 2550 \times 1.5 \times 1000 / 25 \times 300 \times 600 = 0.85$$

$$M_{ux} / f_{ck} \times b \times d^2 = 60 \times 1.5 \times 1000000 / 25 \times 300 \times 600 \times 600 = 0.035$$

Refer Chart 46, $f_y = 415 \text{ N/mm}^2$ $d'/D = 0.10$

$$P / f_{ck} = 0.15$$

$$A_{st} \text{ required} = 0.15 \times 25 \times 300 \times 600 / 100 = 6750 \text{ mm}^2$$

Proposed 10 nos. of 32 mm dia Tor steel (8942 mm^2)

Spacing of lateral ties is the minimum of the following,

1. Least lateral dimension $= 300 \text{ mm}$
2. 16 times smallest dia of longitudinal reinforcement $16 \times 12 = 192 \text{ mm}$
3. 48 times the dia of transverse reinforcement $48 \times 8 = 384 \text{ mm}$

Proposed Y-8 lateral ties at 150mm C/C.


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DESIGN OF PILE FOUNDATION

Column size	a = 300 mm b = 450 mm
SBC of soil	w = 79.44 kN/m ²
Axial load	p = 2550 kN
Weight of footing 10 %	= 255 kN
Total load	Pu = 2800 kN
Area required 2800/90	a = 31.11 m ²
Size of footing required	= 5.58 m x 5.58 m (Since footing size is very big, design for pile foundation)

Load carrying capacity of 600 mm dia pile = 142 x 9.807 kN (As per soil report)

Number of piles required = 2550 / 142 x 9.807 = 1.83 say 2 piles

Ast required for 600mm Dia pile = $0.4 \times 22 \times 600 \times 600 / 4 \times 7 \times 100 = 1131 \text{ mm}^2$

Provide 10 numbers 12 Tor and 8mm dia rings at 150 mm center to center.

Depth of pile = 30 meters (As per soil report)

PILE CAP DESIGN -MOMENT CALCULATION

Center to center of piles = 2.5 to 3 times dia of the pile

Breath of pile cap = 600+150+150=900 mm

Length of pile cap = 2.5x 600+150+150 = 1800 mm

Depth of pile cap = 1400 mm

Moment at critical section for pile cap

Mu = $WL/4 = 2550 \times 1.5 \times 1.80 / 4 = 1721 \text{ kN-m}$

Mu/bd² = $1721 / 0.9 \times 1.34 \times 1.34 \times 1000 = 1.06$

Pt for singly reinforced sections = 0.314 (Table no 3)

Ast = $0.314 \times 90 \times 134 / 100 = 37.87 \text{ cm}^2 = 12 \text{ nos } 25 \text{ dia Tor steel}$


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Shear force = $2550 / 2 = 1275$ KN

$V_{us}/d = 1275 \times 1.5/134 = 13.27$

$P_t = 5890/900 \times 1340 = 0.49\%$

Shear strength of concrete = 0.48 N/mm^2

Vertical stirrups = $13.27 - 0.49 \times 134/10 = 6.61 \text{ N/mm}^2$

Assuming diameter of bar = 12 mm,

Spacing of bars using 12 mm = 120 mm

Hence, proposed 12mm rods @ 100mm C/C



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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 P. ANAND RAJU has enrolled as
Registered Structural Engineer Grade-I (SE) with Chennai Metropolitan
Development Authority (CMDA) who has the qualification of M.E.,(Civil
Engg.) and experience in the relevant field for 19years.

He has been given the Registration No.SE/GR-I/2024/02/004 on
13.02.2024. 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 12.02.2029.



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