



CHENNAI METROPOLITAN DEVELOPMENT AUTHORITY

Thalamuthu Natarajan Building, No.1, Gandhi Irwin Road, Egmore,

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E-mail: mscmda@tn.gov.in

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PROFESSIONAL REGISTRATION CERTIFICATE

This is to certify that the Thiru / Tmt. / M/s. **M.SHANKAR** has enrolled as **Registered Structural Engineer Grade-I(SE)** with Chennai Metropolitan Development Authority (CMDA) who has the qualification of **M.E Structures** and experience in the relevant field for 7 years.

He/She has been given the Registration No. **SE/I/2024/4/0037** on **12-Apr-2024** He/She 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 **11-Apr-2029**.



Signature valid

Name : A. Meganathan
Designation : Superintendent
Date : 04/12/2024 3:58:02 PM

A. Meganathan

Superintendent

Er.M. SHANKAR, M.Tech(Struct), MIE, MISSE, FMACCE

CMDA Regd. Structural Engineer GR-I (SE-I)

Reg No. SE/I/2024/4/0037

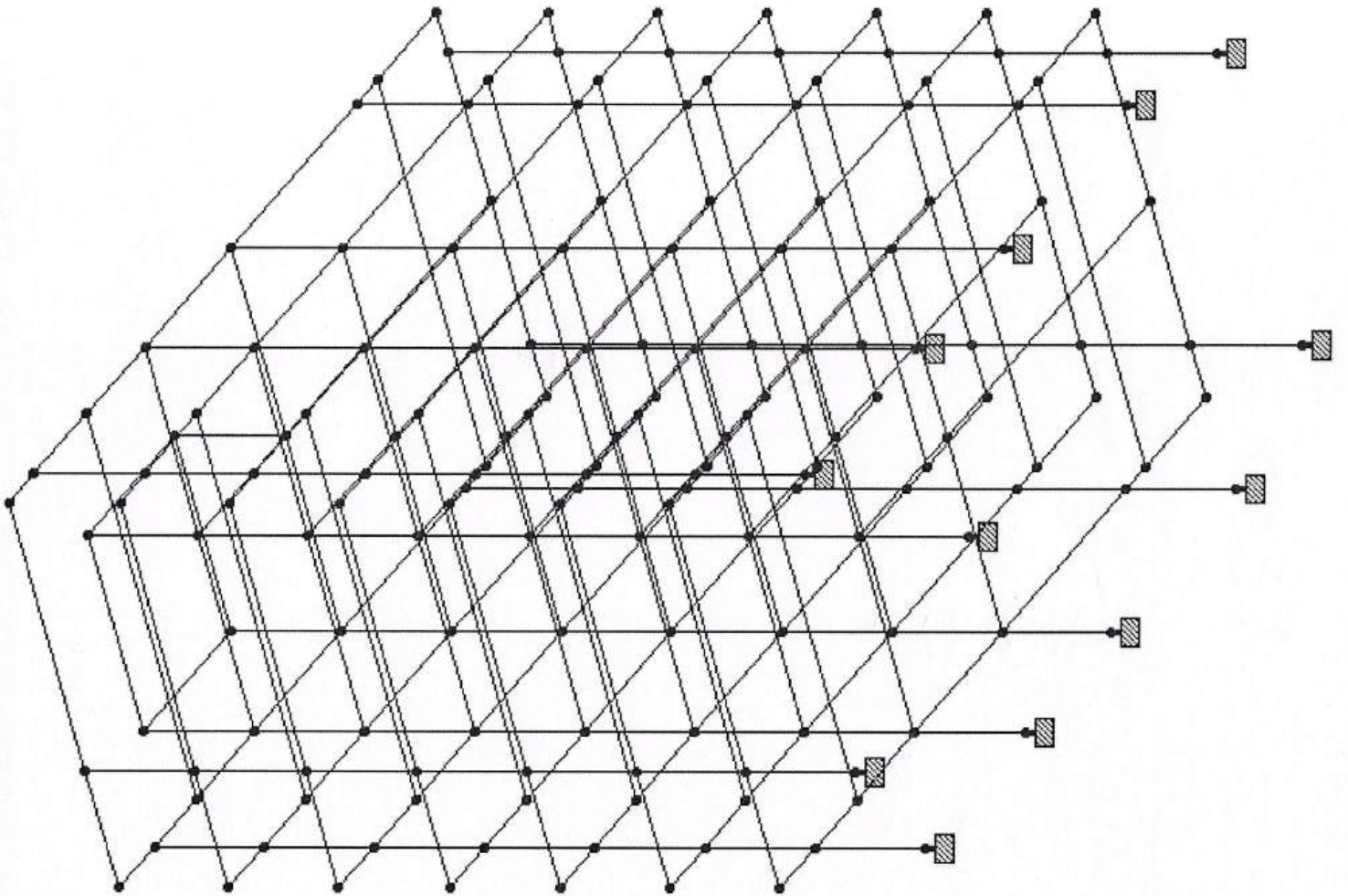
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Recta




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**STABILITY CALCULATIONS FOR THE PROPOSED CONSTRUCTION OF A STILT
+5 FLOORS RESIDENTIAL BUILDING AT PLOT NO.C-17, DOOR NO.15/12,5 TH
MAIN ROAD, NANGANALLUR CO-OPERATIVE BUILDING SOCIETY
NANGANALLUR , CHENNAI-600061 COMPRISED T.S NO.3 BLOCK NO.19 OF
NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT OF GREATER
CHENNAI CORPORATION**

Design Data Report :

Footing Data:

Soil Parameters :

SBC of soil	=260.00 kN/m ²
SBC Increment Factor for Seismic Load	= 1.500
SBC Increment Factor for Wind Load	= 1.500
Angle of friction,(phi)	= 30.00 degrees
Cohesion	= 60.00
Permissible factor of safty	= 1.400
Depth From Ground	= 2000 mm

Material Properties :

fck	= 30.00 N/mm ²
fy	= 500.00 N/mm ²

Footing Parameters :

Minimum steel Percentage	= 0.12
Minimum spacing between bars	= 100 mm
Maximum spacing between bars	= 200 mm
Diameters of selected bars	= 10 mm , 12 mm .
Bottom Cover	= 50 mm
End Cover	= 50 mm
Minimum Footing Depth	= 150 mm
Top Offset	= 50 mm
Bottom PCCOffset	= 150 mm
Bottom PCCDepth	= 150 mm
Pedestal Offset	= 150 mm
Pedestal Depth	= 150 mm
Size RoundingFactor	= 25 mm
Depth RoundingFactor	= 25 mm
Number of Steps	= 1
Minimum Step Depth	= 150 mm


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Column Data:

Material Properties :

fck	= 25.00 N/mm ²
fy	= 500.00 N/mm ²
fy - Stirrups	= 500.00 N/mm ²

Column Parameters :

Effective Length Factor (X - Axis)	= 1.00
Effective Length Factor (Y - Axis)	= 1.00
Minimum Eccentricity @ X-Axis	= 20 mm
Minimum Eccentricity @ Y-Axis	= 20 mm
Clear Cover	= 40 mm

Design Considerations :

Design is done as per IS 456.
Detailing is done as per IS 13920.
Confinement reinforcement is provided.
Live Load reduction is considered.
Minimum steel percentage is based on provided section.

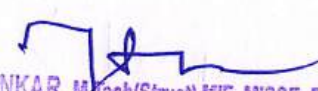
Reinforcement Details :

Steel Ratio(AstX/AstY)	= 1.00
Reinforcement Placing (on two sides or on four sides)	= 2
Minimum steel Percentage	= 0.80
Maximum steel Percentage	= 4.00
Minimum spacing between main bars	= 25 mm
Maximum spacing between main bars	= 300 mm
Minimum spacing between Stirrups	= 150 mm
Diameters of selected bars	= 12 mm , 16 mm , 20 mm , 25 mm , 32 mm .

Slab Data: Use Bent-up bars for steel detailing.

Material Properties :

RCC Grade = M20


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Main Steel Grade = Fe550

Distribution Steel Grade = Fe550

Slab Parameters :

Effective Cover = 25 mm

Minimum spacing between Main bars = 75 mm

Maximum spacing between Main bars = 200 mm

Minimum spacing between Dist.bars = 75 mm

Maximum spacing between Dist.bars = 300 mm

Maximum Main/Dist. bar Diameter = 32 mm

Minimum Main bar Diameter = 8 mm

Minimum Dist.bar Diameter = 8 mm

Maximum Dimension to be used for Trapizoidal Slab = Average of two parellel sides

Maximum Dimension to be used for General Slab = Maximum of two parellel sides

Beam Data:

Shear Design Data :

Minimum Stirrup Dia = 8 mm

Stirrup Legs = 2

Minimum Stirrups Spacing = 100 mm

Stirrups Steel Grade Name = Fe500

Effect of Concrete in shear considered

Beam Covers :

Tension Cover = 33 mm

Compression Cover = 33 mm

Side Cover = 25 mm

Beam sections are designed as Doubly Reinforced Section

Main Bars Detailing Straight + Curtailed

Detailing provision As per IS 13920 is followed

End Moments are calculatdaed at c/c distance of the beam span for design

Torsion Moments are considered in beam design

Anchor bar Dia

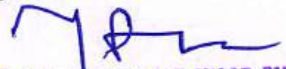
= 8 mm

Main Steel Grade

= Fe500

No. of division of the beam

= 10


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Max. Aggregate size

= 20


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Annexure – XIV

[See rule 51 (3)]

Form 1

Structural Design Basis Report

(1) This report to accompany the application for Building Developments

Part1	General Data		
S.No.	Description	Information	Notes
1.	Site Address		
2	Name of Owner		
3	Name of Registered Developer along with the Registration Number		
4	Name of Registered Architect/Engineer along with the Registration Number		
5	Name of Registered Structural engineer along with the Registration Number	SE/- I2024/4/003 7	
6	Use of the building	RESIDENTIAL	
7	Number of stories above ground level (including storeys to be added later, if any)	STILT+5FLO OS	
8	Number of basements below ground level	NIL	
9	Type of structure Load bearing walls R.C.C. frame R.C.C. frame and Shear Walls Steel frame	RC FRAME	
10	Soil data Type of soil Design safe bearing capacity	INDIVIDUAL ISOLATED FOOTING WITH SBC 260KN/SQ.M	IS:1893 C1.6.3.5.2 IS: 1904 IS: 1892 IS: 2131 IS: 2720

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11	Dead loads (unit weight adopted) • Earth: 18KN/CUM • Water: 10KN/CUM • Brick masonry:19.2KN/CUM • Plain cement concrete 24KN/CUM • Reinforced cement concrete:25 KN/CUM • Floor finish 50KG/SQM • Other fill materials		IS: 875 Part 1
12	Imposed (live) loads	4KN/SQM 1.5KN/SQM	IS: 875 Part 2
	Floor loads		
	Roof loads		

13	Cyclone/Wind • Speed • Design pressure intensity	N/A	IS: 875 Part 3
14	Seismic zone	III	IS: 1893 (2002)
15	Importance factor	1	IS:1893(2002) Table 6
16	Seismic zone factor (Z)	0.16	IS:1893 Table 2
17	Response reduction factor		IS:1893 Table 7
18	Fundamental natural period – approx.	0.29SEC	IS:1893 C1.7.6
19	Design horizontal acceleration spectrum value (A _h)		IS: 1893 C1.6.4.2
20	♥ Expansion/Separation Joints	N/A	
21	Building is regular/irregular	REGULAR	IS 1893

♥ Enclose detailed drawings drawn to scale for each floor

♦ In case terrace garden is provided, indicate additional fill load and live load along with the detailed drawings drawn to scale

Part 2 Load bearing masonry buildings			
Sl.No.	Description	Information	Notes
1	Building category	N/A	IS: 4326 C1.7 Read with IS:1893
			Zone II III IV V
			Bldg.
			Ordinary B C D E

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			Important	C	D	E	E
2	Basement Provided	N/A					
3	Number of floors including Ground Floor (all floors including stepped floors in hill slopes)	N/A					
4	Type of wall masonry	N/A					
5	Type and mix of Mortar	N/A	IS: 4326 C1.8.1.2				
6	Re: size and position of openings (See note No.[i]) - Minimum distance (b5) - Ratio $(b_1+b_2+b_3)/1_1$ or $(b_6+b_7)/1_2$ - Minimum pier width between consequent opening (b4) - Vertical distance (h3) - Ratio of wall height to thickness 4 - Ratio of wall length between cross wall to thickness	N/A	IS: 4326 Table 4, Fig.7				
7	Horizontal seismic band - at plinth level N/A - at window sill level N/A - at lintel level N/A - at ceiling level N/A	P IP NA	(see note No.2) IS:4326 C1 8.4.6 IS: 4326 C1 8.3 IS: 4326 C1 8.4.2 IS: 4326 C1 8.4.3 IS: 4326 C1 8.4.3				
	- at eave level of sloping roof N/A - at top of gable walls N/A - at top of ridge walls N/A		IS: 4326 C1 8.4.3 IS: 4326 C1 8.4.4				
8	Vertical reinforcing bar N/A at corners and T junction of walls at jambs of doors and window openings N/A		IS: 4326 C1 8.4.8. IS: 4326 C1 8.4.9				


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9	Integration of prefab roofing/flooring elements through reinforced concrete screed. N/A	☐ ☐ ☐	IS:4326 C1 9.1.4
10	Horizontal bracings in pitched truss in horizontal plane at the level of ties in the slopes of pitched roofs N/A	☐ ☐ ☐ ☐ ☐ ☐	

Notes: (i) Information in Item 6 should be given on separate A4 sheets for all walls with large number of openings

(ii) IP indicated "Information Provided"

IP indicates "Information to be provided" NA indicates "Not Applicable"

Tick mark one box

Part 3 Reinforced concrete framed buildings			
Sl. No.	Description	Information	Notes
1	Type of building - Regular frames - Regular frames with Shear Walls - Irregular frames - Irregular frames with Shear Walls - Soft storey	REGULAR FRAMES	IS: 1893 C1 7.1
2	Number of basements	NIL	
3	Number of floors including ground floor	S+5 TH FLOOR	
4	Horizontal floor system - Beams and slabs - Waffles - Ribbed floor - Flat slab with drops - Flat plate without drops	BEAM AND SLAB	


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5	Soil data - Type of soil - Recommended type of foundation -Independent footings -Raft -Piles - Recommended bearing capacity of soil	MEDIUM SOIL WITH ISOLATED FOOTING	IS: 1498

	- Recommended type, length, diameter and load capacity of piles - Depth of water table - Chemical analysis of ground water - Chemical analysis of soil		
6	Foundations Depth below ground level Type - Independent - Interconnected - Raft - Piles	INDIVIDUAL ISOLATED FOOTING	
7	System of interconnecting foundations Plinth beams Foundation beams	PLINTH BEAM	IS: 1893 C1 7.12.1
8	Grades if concrete used in different parts of building	M25 FOR COLUMNS & M30 FOR REST	
9	Method of analysis used	FEM	
10	Computer software used	STAAD PRO - V8SSI 6	
11	Torsion included	INCLUDED	IS: 1893 C1 7.9

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12	Base shear a. Based on approximate fundamental period b. Based on dynamic analysis c. Ratio of a/b	BASED ON APPROXIMATE FUNDAMENTAL PERIOD	IS: 1893 Cl. 7.5.3
13	Distribution of seismic forces along the height of the building.	REFER SESIMIC JUSTIFICATION	IS:1893 Cl.7.7 (Provide sketch)
14	The Column of soft ground storey specially designed.	YES	IS: 1893 Cl.7.10
15	Clear minimum cover provided in • Footing 50MM • Column 40MM • Beams 25MM • Slabs 20MM • Walls		IS: 456 Cl. 26.4
16	Ductile detailing of RC frame • Type of reinforcement used Fe 500D • Minimum dimension of beams 230MM • Minimum dimension of columns 230MM • Minimum percentage of reinforcement of beams at any cross section 0.20% • Maximum percentage of reinforcement at any section of beam 4% • Spacing of transverse reinforcement in 2-d length of beams near the ends 100MM • Ratio of capacity of beams in shear to capacity of beams in flexure <1 • Maximum percentage of reinforcement in column 4%		IS: 456 Cl. 5.6 IS: 13920 Cl.6.1 IS: 13920 Cl.7.1.2 IS: 456 Cl.26.5.1(a) IS: 13920 Cl.6.2.1 IS: 456 Cl.26.5.1.1(b) IS: 13920 Cl.6.2.2 IS: 13920 Cl.6.3.5 IS: 456 Cl.26.5.3.1 IS: 13920 Cl. 7.4


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	- Confining stirrups near ends of columns and in beam-column joints Diameter 8mm Spacing 100MM - Ratio of shear capacity of columns to maximum seismic shear in the storey. <1		
17	Does the features require clearance by SDRP Example: High rise building Prefab building Building in hazard prone areas	N/A	

Foundation

- In case raft foundation has been adopted, indicate K value used for analysis of the raft.
- In case pile foundations have been used, give full particulars of the piles, type, dia, length, capacity
- In case of high water table, indicate system of countering water pressure, and indicate the existing water table, and that assumed to design foundations.

Idealization for Earthquake analysis

- In case of composite system of shear walls and rigid frames, give distribution of base shear in the two systems on the basis of analysis, and that used for design of each system
- Indicate the idealization of frames and shear walls adopted in the analysis with the help of sketches.
- Submit framing plans of each floor
- In case of basements, indicate the system used to contain earth pressures.

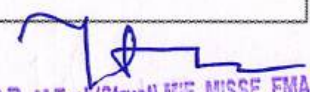
Part 4	Buildings in structural steel		
1	Adopted method of design	- Simple - Semi-rigid - Rigid	IS:800 Cl 3.4.4 IS:800 Cl.3.4.5 IS:800 Cl.3.5.6

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2	Design based on	- o Elastic analysis - o Plastic analysis	IS: 800 Section-9 SP;6 (6)
3	Floor construction	- o Composite - o Non composite - o Boarded	
4	Roof construction	- o Composite - o Non composite - o Metal - o Any other	
5	Horizontal force resisting system adopted	Frames Braced frames Frames & shear walls	Note: Seismic force As per IS:1893 Would depend on system
6	Slenderness ratios maintained	Members defined in Table 3.1, IS:800	IS 800; Cl.3.7
7	Member deflection	Beams, Rafters	IS:800 Cl.3.13

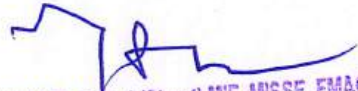
	limited to	Crane Girders, Purlins Top of columns	
8	Structural members	- o Encased in concrete - o Not encased	IS: 800 Section-10
9	Proposed material	- o General weld-able - o High strength - o Cold formed - o Tubular	IS: 2062 IS: 8500 IS: 801, 811 IS: 806
10.	Minimum metal thickness Specified for corrosion protection	- o Hot rolled sections - o Cold formed sections - o Tubes	IS: 800, Cl.3.8 Cl.3.8.1 to Cl.3.8.4 Cl.3.8.5
11	Structural connections	- o Rivets - o CT Bolts - o S H F G Bolts - o Black Bolts - o Welding field Shop (Specify welding type proposed) Composite	IS: 800, Section-8 IS: 1929, 2155, 1149 IS 6639, 1367 IS 3757, 4000 IS: 1363, 1367 IS: 816, 814,1395, 7280, 3613, 6419, 6560, 813, 9595


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12	Minimum Fire rating proposed, method	○ Rating..... hour ○ s ○ Method proposed. -In tumescent painting -Spraying -Quilting -Fire retardant boarding	IS: 1641, 1642, 1643
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STRUCTURAL ENGINEER

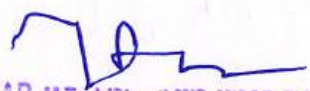

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**STABILITY CALCULATIONS FOR THE PROPOSED CONSTRUCTION OF A
STILT +5 FLOORS RESIDENTIAL BUILDING AT PLOT NO.C-17, DOOR
NO.15/12,5 TH MAIN ROAD, NANGANALLUR CO-OPERATIVE BUILDING
SOCIETY NANGANALLUR , CHENNAI-600061 COMPRISED T.S NO.3 BLOCK
NO.19 OF NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT
OF GREATER CHENNAI CORPORATION**

FOOTING DESIGN CALCULATIONS:

Definitions:

1. α = Coefficient of Thermal Expansion
2. ϵ_1 = Strain at level considered, Calculated ignoring the stiffening of the concrete in tension zone
3. ϵ_m = Average steel strain at level considered
4. p_{act} = Percentage steel provided
5. p_{crit} = Percentage steel critical as per code
6. A = Plan area of footing base
7. A_{cr} = Distance from the point considered to the surface of the nearest longitudinal bar
8. A_{stPrv} = Area of tensile reinforcement provided
9. A_{strqd} = Area of tensile reinforcement required
10. A_{sv} = Area of shear reinforcement required
11. A_{svPrv} = Area of shear reinforcement provided
12. A_1 = Bearing area of footing at slope of 1:2
13. A_2 = C/s Area of column
14. B = Width of footing base
15. B_{eff} = Effective width of footing
16. B_{offB} = Footing offset along B below column in plan
17. B_{offT} = Footing offset along B above column in plan
18. B_1 = Width of sloped footing at top
19. $ColOff$ = Column offset in sloped footing
20. D = Depth of footing
21. D_{eff} = Effective Depth of footing
22. D_f = Depth of founding layer
23. D_w = Ground water level
24. E_c = Modulus of elasticity of concrete


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25.	Es	=	Modulus of elasticity of steel
26.	Foss	=	Safety factor against sliding
27.	Fosu	=	Safety factor against uplift
28.	Fst	=	Stress in steel
29.	L	=	Length of footing base
30.	L _{eff}	=	Effective length of footing
31.	L _{offL}	=	Footing offset along L on left side of column
32.	L _{offR}	=	Footing offset along L on right side of column
33.	L ₁	=	Length of sloped footing at top
34.	M _x	=	Bending Moment along column D
35.	M _{x'}	=	Bending Moment along column D due to odd shaped column
36.	M _{ex}	=	Eccentricity moment along column D
37.	M _{xx}	=	Total Bending Moment along column D (M _x + M _{x'} + M _{ex})
38.	M _y	=	Bending Moment along column B
39.	M _{y'}	=	Bending Moment along column B due to odd shaped column
40.	M _{ey}	=	Eccentricity moment along column B
41.	M _{yy}	=	Total Bending Moment along column B (M _y + M _{y'} + M _{ey})
42.	M _{uy}	=	Factored moment along column B
43.	M _{uy'}	=	Factored Moment along column B due to odd shaped column
44.	M _{ux}	=	Factored moment along column D
45.	M _{ux'}	=	Factored Moment along column D due to odd shaped column
46.	Netdown	=	Net downward load
47.	OB	=	Maximum permissible offset on bottom side of column in plan
48.	OL	=	Maximum permissible offset on left side of column in plan
49.	OR	=	Maximum permissible offset on right side of column in plan
50.	OT	=	Maximum permissible offset on top side of column in plan
51.	P	=	Axial load for footing sizing
52.	P ₁	=	Soil pressure at corner 1
53.	P ₂	=	Soil pressure at corner 2


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54.	P3	=	Soil pressure at corner 3
55.	P4	=	Soil pressure at corner 4
56.	Pdelta	=	Column Load to be transferred by reinforcement
57.	Pt	=	Calculated percentage tensile reinforcement
58.	Pu	=	Factored axial load
59.	q	=	Surcharge Load
60.	sp	=	Spacing Between bars at outer most layer
61.	SPu	=	Upward Soil Pressure
62.	SPuL	=	Upward Soil Pressure from left
63.	SPuR	=	Upward Soil Pressure from right
64.	SPuB	=	Upward Soil Pressure from bottom
65.	SPuT	=	Upward Soil Pressure from top
66.	Tc	=	Design shear strength of concrete
67.	Temp1	=	Peak Hydration temperature
68.	Temp2	=	Seasonal Temperature Variations
69.	Tv	=	Nominal shear stress
70.	Vu	=	Design shear force
71.	Vus	=	Strength of shear reinforcement
72.	Vx	=	Shear along major axis
73.	Vy	=	Shear along minor axis
74.	Waterpr	=	Upward water pressure
75.	Waterup	=	Upward force due to water
76.	Wcr	=	Surface Crack Width
77.	WFoot	=	Add. Wt. due to difference in concrete and soil density
78.	WFootc	=	Weight of footing and column with concrete density
79.	WSoil	=	Weight of soil covering footing area
80.	Zx	=	Section modulus of footing base along L
81.	Zy	=	Section modulus of footing base along B


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Code References:

IS 456

	Parameter	Reference
1.	Ptmax :	Cl. 26.5.2.1
2.	Ptmin :	Cl. 26.5.2.1
3.	Pt :	Cl. 38
4.	Tc :	Cl. 40.2.1
5.	Tcmax :	Cl. 40.2.3
6.	Asv :	Cl. 40.4
7.	Min Shear Reinf:	Cl. 26.5.1.6
8.	Max Stirrup Spacing :	Cl. 26.5.1.5
9.	Punching Shear design :	Cl. 31.6.3
10.	Load transfer :	Cl. 34.4
11.	Ptnominal :	Cl. 34.5.2
12.	Crack width calculation :	Annex-F
13.	Cracking :	Cl. 35.3.2

BS 8007 (For Early / Initial Thermal Cracking)

1. Surface Zone for suspended slab : Figure A.1
2. Surface Zone for ground slab : Figure A.2
3. Factors for the calculation of minimum reinforcement : Table A.1

Design Code : IS 456 : 2000 + IS 13920 : 2016

Footing No : FC1

Column No : C1 (230 mm X 600 mm)

Analysis No : 33

Concrete Grade : M25 N/sqmm

Steel Grade : Fe550 N/sqmm


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Clear Cover : 40 mm

Df : 4 M

Dw : 1 M

Density of Soil = 18 kN/cum

Soil Bearing Capacity = 260 kN/sqm

Permissible SBC Increase for EQ = 25 %

Permissible SBC Increase for Wind = 25 %

Live Load Reduction = 50 %

Design cross section by : Average pressure

Footing Type : Sloped

Footing Size (Lx B x D) : 2150mm X 1800mm X 625mm, d =300mm

Column Offset : 50 mm

Without considering Effect of Water Table

Footing Self Wt., F1 = 42.69 kN

Soil Weight, S1 = 0.00 kN

Total Weight, W1 = F1 + S1

= 42.69 kN

Offset Along L (Loff) = 775 mm

Offset Along B (Boff) = 785 mm

Check For Maximum Soil Pressure:

Critical Load Combination = [3] : (LOAD 5: DL) +(LOAD 6: LL) +(LOAD 2: EQ-X)

Pcomb = 875.21 kN

P = Pcomb + W1


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$$P = 917.90 \text{ kN}$$

$$M_x = -17.87 \text{ kNm}$$

$$M_y = 2.69 \text{ kNm}$$

$$P/A = 237.18 \text{ kN/sqm}$$

$$M_x/Z_x = -12.88 \text{ kN/sqm}$$

$$M_y/Z_y = 2.31 \text{ kN/sqm}$$

$$\text{Maximum Soil Pressure} = 252.38 \text{ kN/sqm}$$

$$\text{Allowable Soil Pressure} = 1.25 \times 260 \text{ kN/sqm}$$

$$= 325 \text{ kN/sqm}$$

Check For Minimum Soil Pressure:

$$\text{Critical Load Combination} = [3] : (\text{LOAD 5: DL}) + (\text{LOAD 6: LL}) + (\text{LOAD 2: EQ-X})$$

$$P_{\text{comb}} = 875.21 \text{ kN}$$

$$P = P_{\text{comb}} + W_1$$

$$P = 917.9 \text{ kN}$$

$$M_x = -17.87 \text{ kNm}$$

$$M_y = 2.69 \text{ kNm}$$

$$P/A = 237.18 \text{ kN/sqm}$$

$$M_x/Z_x = -12.88 \text{ kN/sqm}$$

$$M_y/Z_y = 2.31 \text{ kN/sqm}$$

$$\text{Minimum Soil Pressure} = 221.99 \text{ kN/sqm}$$

$$> 0$$

Design For Bending:

Bottom Reinforcement Along L:

$$\text{Critical Load Combination} = [10] : 1.5 (\text{LOAD 5: DL}) + 1.5 (\text{LOAD 6: LL})$$

$$P_u = 1322.46 \text{ kN}$$

$$M_{ux} = -14.03 \text{ kNm}$$

$$M_{uy} = 3.9 \text{ kNm}$$


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$$P/A = 341.72 \text{ kN/sqm}$$

$$M_x/Z_x = -10.12 \text{ kN/sqm}$$

$$M_y/Z_y = 3.36 \text{ kN/sqm}$$

$$D_{eff} = 577 \text{ mm}$$

$$B_{eff} = 513.75 \text{ mm}$$

$$S_{Pu} = 351.84 \text{ kN/sqm}$$

$$M_u = S_{Pu} \times B \times L_{off} \times L_{off} / 2$$

$$= 190.19 \text{ kNm}$$

$$P_t = 0.246 \%$$

$$A_{st \text{ Rqd (BM)}} = 728 \text{ sqmm}$$

$$A_{st \text{ Prv (Distributed Across Total Width)}} = 10 - T10 @ 200$$

$$= 785 \text{ sqmm}$$

Top Reinforcement Along L:

$$(D+d_{min})/2 = 462.50 \text{ mm}$$

$$\leq 1000 \text{ mm, Hence}$$

$$A_{st} = \text{Min } P_t \text{ for Top Reinforcement} \times [(D+d_{min})/2] \times B$$

$$= 0.06\% \times 463 \times 1800$$

$$= 500 \text{ sqmm}$$

$$A_{st \text{ Prv (Distributed Across Total Width)}} = 9 - T10 @ 300 \text{ c/c}$$

$$= 550 \text{ sqmm}$$

Bottom Reinforcement Along B:

$$\text{Critical Load Combination} = [10] : 1.5 (\text{LOAD 5: DL}) + 1.5 (\text{LOAD 6: LL})$$

$$P_u = 1322.46 \text{ kN}$$

$$M_{ux} = -14.03 \text{ kNm}$$

$$M_{uy} = 3.9 \text{ kNm}$$

$$P/A = 341.72 \text{ kN/sqm}$$


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$$M_x/Z_x = -10.12 \text{ kN/sqm}$$

$$M_y/Z_y = 3.36 \text{ kN/sqm}$$

$$D_{eff} = 561 \text{ mm}$$

$$L_{eff} = 881.25 \text{ mm}$$

$$S_{Pu} = 345.08 \text{ kN/sqm}$$

$$M_u = S_{Pu} \times L \times B_{off} \times B_{off} / 2$$

$$= 228.6 \text{ kNm}$$

$$P_t = 0.179 \%$$

$$A_{st \text{ Rqd (BM)}} = 887 \text{ sqmm}$$

$$A_{st \text{ Prv (Distributed Across Total Length)}} = 12 - T10 @ 200$$

$$= 942 \text{ sqmm}$$

Top Reinforcement Along B:

$$(D+d_{min}) / 2 = 463 \text{ mm}$$

$$\leq 1000 \text{ mm, Hence}$$

$$A_{st} = \text{Min } P_t \text{ for Top Reinforcement} \times [(D+d_{min})/2] \times L$$

$$= 0.06\% \times 463 \times 2150$$

$$= 597 \text{ sqmm}$$

$$A_{st \text{ Prv (Distributed Across Total Length)}} = 10 - T10 @ 300 \text{ c/c}$$

$$= 707 \text{ sqmm}$$

Design For Shear:

One Way Shear Along L:

Critical Section @ d from Column Face

$$= 577 \text{ mm}$$

$$\text{Critical Load Combination} = [10] : 1.5 (\text{LOAD 5: DL}) + 1.5 (\text{LOAD 6: LL})$$

$$P_u = 1322.46 \text{ kN}$$


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Bottom 20.278 No Beam No Beam - - 1

Top 20.278 No Beam No Beam - - 1

Sway Condition (as per Stability Index) = Non Sway

Effective Length Factor along Minor axis = 1

Minimum Eccentricity Check

Since Axial Force is compressive, Min. Eccentricity check to be performed

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity = Unsupported Length / 500 + B / 30

= 13.67 mm

Mminy = Pu x Minimum Eccentricity

= 9.08 kNm

Slenderness Check

Max Slenderness Ratio(L/B) = 13.04

< 60 (Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

Effective Length Factor = 0.74

Slenderness Ratio = Effective Length / D

= 2.96, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor = 1

Slenderness Ratio = Effective Length / B

= 13.04, Column Slender Along B

Slenderness moment along B = (Pu B / 2000) (Ley/B)^2

= 8.88 kNm

Design slenderness moment along B


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Puz = 1756.08 kN

Pb = 591.36 kN

Reduction factor 'k' for slenderness moment = $(Puz - Pu) / (Puz - Pb) \leq 1$

= 1.12 > 1, Hence k=1

Mslndy = k x 8.88

= 8.88 kNm

Calculation of Design Moment

Direction	Manalysis		Mmin (Abs)		Mdesign	Mslndx (Abs)	Mdesign-final
A	B	C	E	F			
Major Axis - Mux		36.19	---	36.19	0	36.19	
Minor Axis - Muy		-1.83	9.08	-9.08	8.88	-17.96	

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu = 453.93 kN

Mux = 36.19 kNm

Muy = -17.96 kNm

Resultant Moment (Combined Action)


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Moment Capacity Check

Pt Calculated = 0.49

Reinforcement Provided= 6-T12

Load Angle = $\tan^{-1}(M_{uy}/M_{ux})$

= 26.39 deg

MRes = 40.41 kNm

MCap = 122.83 kNm

Capacity Ratio = MRes/ MCap

= 0.33 <= 1

Shear Calculation Along D Along B

Critical Load Combination [12] : 1.5 (LOAD 5: DL) -1.5 (LOAD 1: EQ+X) [22] : 0.9 (LOAD 5:
DL) +1.5 (LOAD 3: EQ +Z)

Design shear force, V_u (kN) -22.0512 -0.5545

P_u (kN) 369.46 221.29

Deff , Beff (mm) 544 174

Aeff (sqmm) 125120 104400

Design shear stress, T_v $V_u / (B \times Deff)$ $V_u / (D \times Beff)$

T_v (N/sqmm) 0.1762 0.0053

Pt (%) 0.246 0.246

Design shear strength, T_c (N/sqmm) 0.3621 0.3621

Shear Strength Enhancement Factor (Compressive Force) $1 + 3 \times P_u / (B \times D \times F_{ck})$

1.3543 1.2544

Shear Strength Enhancement Factor (Tensile Force) - -

Shear Strength Enhancement Factor (max) 1.5 1.5

Shear Strength Enhancement Factor 1.3543 1.2544

Enhanced shear strength, T_{c-e} (N/sqmm) 0.4904 0.4542

Design shear check $T_v < T_c \times \text{Enhancement factor}$ $T_v < T_c \times \text{Enhancement factor}$

Shear Links Design Shear Links Not Required Shear Links Not Required


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Design Of Links

Links in the zone where special confining links are not required

Normal Links

$$\begin{aligned} \text{Diameter of link} &= 8 \text{ mm} \\ &> \text{Max. longitudinal bar dia} / 4 \\ &= 3 \text{ mm} \end{aligned}$$

Criterion for spacing of normal links

$$\begin{aligned} \text{Min. Longitudinal Bar dia} \times 16 &= 192 \text{ mm} \\ \text{Min. dimension of column} &= 230 \text{ mm} \\ \text{Max. 300 mm} &= 300 \text{ mm} \\ \text{Provided spacing} &= 175 \text{ mm} \end{aligned}$$

Table For Links

Required	Provided					
Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone		
Link Dia.	8	---	---	8	---	
Spacing 175	---	---	175	---		

General Data

Column No. : C1
Level : 18 m To 21 m
Frame Type = Non-Ductile
Response Reduction Factor = 3
Design Code = IS 456 : 2000 + IS 13920 : 2016
Grade Of Concrete = M25 N/sqmm
Grade Of Steel (Main) = Fe415 N/sqmm
Grade Of Steel (Shear) = Fe415 N/sqmm


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**STABILITY CALCULATIONS FOR THE PROPOSED CONSTRUCTION OF A
STILT +5 FLOORS RESIDENTIAL BUILDING AT PLOT NO.C-17, DOOR
NO.15/12,5 TH MAIN ROAD, NANGANALLUR CO-OPERATIVE BUILDING
SOCIETY NANGANALLUR , CHENNAI-600061 COMPRISED T.S NO.3 BLOCK
NO.19 OF NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT
OF GREATER CHENNAI CORPORATION**

Grade Of Steel - Flexural Design = Fe415 N/sqmm

Grade Of Steel - Shear Design = Fe415 N/sqmm

Column B = 230 mm

Column D = 600 mm

Clear Cover = 50 mm

Clear Floor Height @ B = 3000 mm

Clear Floor Height @ D = 2400 mm

No Of Floors = 1

No Of Columns In Group = 1

Column Type : UnBraced

Minimum eccentricity check : One Axis at a Time

Code defined D/B ratio : 4

D/B Ratio : $2.61 \leq 4$ Hence, Design as Column

Flexural Design (Analysis Forces)

Analysis Reference No. = 273

Load Combination = [1] : 1.5 (LOAD 5: DL) +1.5 (LOAD 6: LL)

Critical Location= Top Joint

Pu = 197.54 kN

Mux = 35.39 kNm

Muy = 3.4 kNm

Vux = 1.65 kN

Vuy = -20.68 kN

Effective Length Calculation

Calculation Along Major Axis Of Column

Joint Column Stiffness Beam Sizes Beam Stiffness Beta


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Beam 1

(Length x Width x Depth)			Beam 2			
(Length x Width x Depth)			Beam 1 Beam 2			
N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6		
Bottom 138	7310 x 230 x 600		3170 x 230 x 600	56.635	130.599	0.596
Top 138	7310 x 230 x 600		3170 x 230 x 600	56.635	130.599	0.424
Sway Condition (as per Stability Index) =				Non Sway		
Effective Length Factor along Major Axis =				0.69		

Calculation Along Minor Axis Of Column

Joint Column Stiffness

Beam Sizes

Beam Stiffness

Beta

Beam 1

(Length x Width x Depth)			Beam 2			
(Length x Width x Depth)			Beam 1 Beam 2			
N-m x 10^6	mm	mm	N-m x 10^6	N-m x 10^6		
Bottom	20.278	No Beam	No Beam	-	-	1
Top	20.278	No Beam	No Beam	-	-	1
Sway Condition (as per Stability Index) =				Non Sway		
Effective Length Factor along Minor axis =				1		

Minimum Eccentricity Check

Since Axial Force is compressive, Min. Eccentricity check to be performed

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

$$\begin{aligned} \text{Minimum Eccentricity} &= \text{Unsupported Length} / 500 + B / 30 \\ &= 13.67 \text{ mm} \end{aligned}$$


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$$M_{miny} = P_u \times \text{Minimum Eccentricity}$$

$$= 3.95 \text{ kNm}$$

Slenderness Check

$$\text{Max Slenderness Ratio}(L/B) = 13.04$$

$$< 60 \text{ (Hence Ok)}$$

Column Is Unbraced Along D

Slenderness Check Along D:

$$\text{Effective Length Factor} = 0.69$$

$$\text{Slenderness Ratio} = \text{Effective Length} / D$$

$$= 2.76, \text{ Column not Slender Along D}$$

Column Is Unbraced Along B

Slenderness Check Along B:

$$\text{Effective Length Factor} = 1$$

$$\text{Slenderness Ratio} = \text{Effective Length} / B$$

$$= 13.04, \text{ Column Slender Along B}$$

$$\text{Slenderness moment along B} = (P_u B / 2000) (L_e / B)^2$$

$$= 3.86 \text{ kNm}$$

Design slenderness moment along B

$$P_{uz} = 1756.08 \text{ kN}$$

$$P_b = 591.36 \text{ kN}$$

$$\text{Reduction factor 'k' for slenderness moment} = (P_{uz} - P_u) / (P_{uz} - P_b) \leq 1$$

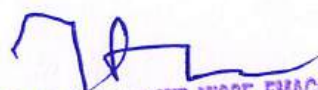
$$= 1.34 \geq 1, \text{ Hence } k=1$$

$$M_{sIndy} = k \times 3.86$$

$$= 3.86 \text{ kNm}$$

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
A	B	C	E	F	


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Major Axis - Mux 35.39 --- 35.39 0 35.39

Minor Axis - Muy 3.4 3.95 3.95 3.86 7.82

Where

- A = Moments directly from analysis
B = Moments due to minimum eccentricity
C = Maximum of analysis moment and min. eccentricity = Max (A,B)
E = Moment due to slenderness effect
F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu = 197.54 kN
Mux = 35.39 kNm
Muy = 7.82 kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated = 0.49

Reinforcement Provided= 6-T12

Load Angle = $\tan^{-1}(Muy/Mux)$

= 12.45 deg

MRes = 36.24 kNm

MCap = 104.29 kNm

Capacity Ratio = MRes/ MCap

= 0.35 <= 1

Shear Calculation Along D Along B


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Critical Load Combination [1] : 1.5 (LOAD 5: DL) +1.5 (LOAD 6: LL) [24] : 0.9 (LOAD 5: DL) -1.5 (LOAD 3: EQ +Z)

Design shear force, V_u (kN) -20.6806 0.6408

P_u (kN) 197.54 93.32

D_{eff} , B_{eff} (mm) 544 174

A_{eff} (sqmm) 125120 104400

Design shear stress, T_v $V_u / (B \times D_{eff})$ $V_u / (D \times B_{eff})$

T_v (N/sqmm) 0.1653 0.0061

P_t (%) 0.246 0.246

Design shear strength, T_c (N/sqmm) 0.3621 0.3621

Shear Strength Enhancement Factor (Compressive Force) $1 + 3 \times P_u / (B \times D \times F_{ck})$

1.1895 1.1073

Shear Strength Enhancement Factor (Tensile Force) - -

Shear Strength Enhancement Factor (max) 1.5 1.5

Shear Strength Enhancement Factor 1.1895 1.1073

Enhanced shear strength, T_{c-e} (N/sqmm) 0.4307 0.401

Design shear check $T_v < T_c \times \text{Enhancement factor}$ $T_v < T_c \times \text{Enhancement factor}$

Shear Links Design Shear Links Not Required Shear Links Not Required

Design Of Links

Links in the zone where special confining links are not required

Normal Links

Diameter of link= 8 mm

> Max. longitudinal bar dia / 4

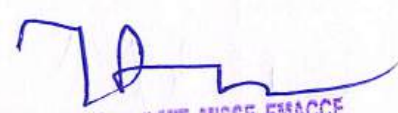
= 3 mm

Criterion for spacing of normal links

Min. Longitudinal Bar dia X 16 = 192 mm

Min. dimension of column = 230 mm

Max. 300 mm = 300 mm


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Beam Width = 230 mm

Beam Depth = 600 mm

Torsion = 1.82 > 0kNm

Beam Depth > 750 Or Torsion > 0,

Hence SFR Provided

Asr = 138 sqmm

SFR Provided = 2-T8EF

ASFR Provided = 201.08 sqmm

Spacing Criteria

Provided Spacing = 142.1 mm

1.<= beam Width = 230 mm

2. Not Greater Than = 300 mm


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SLAB DESIGN CALCULATIONS:

NOTES:

1. Slab is designed as per 1 M width of panel.
2. Density of concrete assumed as 25 kN/Cum.
3. Maximum spacing of Main steel is smaller of (3 x Deff and 300 mm)
4. Maximum spacing of Distribution steel is smaller of (5 x Deff and 450 mm)
5. All 6 mm diameter bars assumed of Fe250 grade with $F_y=250$ N/sq.mm

Definitions Of Terms:

1. α = Coefficient of Thermal Expansion
2. a_{cr} = Distance from the point considered to the surface of the nearest longitudinal bar
3. ϵ_m = Average steel strain at level considered
4. ϵ_1 = Strain at level considered, Calculated ignoring the stiffening of the concrete in tension zone
5. p_{act} = Percentage steel provided
6. p_{crit} = Percentage steel critical as per code
7. BM = Bending moment in kNm
8. D = Overall depth of slab in mm
9. Deff = Effective depth of slab in mm
10. E_c = Modulus of elasticity of concrete
11. E_s = Modulus of elasticity of steel
12. F_{ck} = Characteristic compressive strength of concrete cube in N/sqmm
13. F_{st} = Stress in steel
14. F_y = Yield Stress Of Steel in N/sqmm
15. M_u = Factored Bending moment in kNm
16. S_p = Spacing Between bars at outer most layer
17. T_c = Permissible Shear stress in concrete in N/sqmm


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1. Surface Zone for suspended slab : Figure A.1
2. Surface Zone for ground slab : Figure A.2
3. Factors for the calculation of minimum reinforcement : Table A.1

Slab No. : S2
 Level = 6 m
 Design Code = IS 456 : 2000 + IS 13920 : 2016
 Grade Of Concrete = M25
 Grade Of Steel = Fe500
 Clear Cover = 20.000 mm
 Long Span, Ly = 10.480 m
 Short Span, Lx = 3.140 m
 Imposed Load = 5.120 kN/sqm
 Live Load = 2.000 kN/sqm
 Dead Load, DL = 8.245 kN/sqm
 Slab Thickness = 125.000 mm
 Effective Depth Along LX, Deffx = 100.000 mm
 Self Weight = 3.125 kN/sqm
 Total Load, TL = 10.245 kN/sqm
 Span = 1-Way
 End Conditions = Span Next to End Span
 Load Combination = 1.5 DL + 1.5 LL

Design Moments:

Short Span Positive Moment at Mid Span -

Moment Coefficient(DL), M1 = 0.063

Moment Coefficient(LL), M2 = 0.083

BM = M1 x DL x Lx x Lx + M2 x LL x Lx x Lx = 6.724 kNm

Mu = 1.5 X BM = 10.086 kNm


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Area Of Reinforcement Required (Mu) = 243.812 sqmm/m

Reinforcement Provided= T8 @ 205 C/C

= 245.000 sqmm/m

Long Span Positive Reinforcement -

Area Of Reinforcement Required = 150.000 sqmm/m

Reinforcement Provided= T8 @ 300 C/C

= 168.000 sqmm/m

Short Span Negative Moment at Continuous Support -

Moment Coefficient(DL), M3 = 0.100

Moment Coefficient(LL), M4 = 0.111

BM = M3 x DL x Lx x Lx + M4 x LL x Lx x Lx = 10.320 kNm

Mu = 1.5 X BM = 15.480 kNm

Area Of Reinforcement Required (Mu) = 385.786 sqmm/m

Additional Area Of Reinforcement Required = 263.880 sqmm/m

Reinforcement Provided= T8 @ 190 C/C

= 265.000 sqmm/m

All Other Sections provide Minimum Steel @ 0.12% -

Area Of Reinforcement Required = 120.000 sqmm/m

Reinforcement Provided= T8 @ 300 C/C

= 168.000 sqmm/m

Shear Check :

Shear Coefficient(DL), SF1 = 0.600

Shear Coefficient(LL), SF2 = 0.600

V = SF1 x DL x Lx + SF2 x LL x Lx = 19.302 kN

Vu = 1.5 X V = 28.952 kN

Shear Stress, Tv = 0.290 N/sqmm

Nominal Shear Stress, Tc = 0.439 N/sqmm

Modification Factor 'K' = 1.300

K x Tc = 0.571


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> 0.290 Slab Is Safe In Shear

Deflection Check:

Basic Span To Depth Ratio = 26.000

Span Correction Factor = 1.000

Tensile Steel Factor = 1.295

Compression Steel Factor = 1.000

Flange Correction Factor = 1.000

Max Span To Depth Ratio = $26.00 \times 1.00 \times 1.30 \times 1.00 \times 1.00$

= 33.680

Lx/d = 31.400

< 33.680 Slab Is Safe In Deflection


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Provided spacing = 175 mm

Table For Links

Required	Provided					
Normal Design	Shear Design		Ductile Design	Normal Zone	Ductile Zone	
Link Dia.	8	---	---	8	---	
Spacing 175	---	---	175	---		


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BEAM DESIGN CALCULATION

Sr.No.	Symbol	Definitions
1	α	= Angle formed with horizontal by diagonal reinforcement
2	ϵ_1	= Strain at level considered, Calculated ignoring the stiffening of the concrete in tension zone
3	ϵ_m	= Average steel strain at level considered
4	A_{cr}	= Distance from the point considered to the surface of the nearest longitudinal bar
5	A_{dr}	= Area of diagonal reinforcement in coupler beam
6	A_{stCalc}	= Area of Tension reinforcement required in sqmm
7	$A_{st comp}$	= A_{st} at compression side
8	$A_{stCrack}$	= Area of Tension reinforcement for Crack Width required in sqmm
9	A_{stPrv}	= Area of reinforcement provided at given section in sqmm
10	A_{sv}	= Area of shear reinforcement required per meter length in sqmm
11	$A_{sv Reqd}$	= Min area shear reinforcement as per clause 41.4.3
12	$A_{sv Total Prv}$	= Total area of shear reinforcement provided, including that for torsion
13	$A_{sv Torsion}$	= Area of Stirrups over the corner bars to resist shear and torsion as per clause 41.4.3
14	$A_{sv Torsion Prv}$	= Area of shear reinforcement resisting torsion (outer legs only)
15	b	= Width of the Beam in mm
16	b_w	= Width of Web in mm
17	C_{eff}	= Effective Cover of Beam in mm
18	C_{min}	= Clear cover to top and bottom reinforcement in mm
19	C_{side}	= Clear cover to side reinforcement in mm
20	d	= Effective depth of Beam in mm
21	d'	= Clear cover to reinforcement at compression side.
22	D	= Depth of Beam in mm
23	D'	= Distance (c/c) between top-most and bottom-most layer
24	D_f	= Thickness of Flange in mm


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25	E_c	=	Modulus of elasticity of concrete
26	E_s	=	Modulus of elasticity of steel
27	F_cPerm	=	Permissible Stress in Concrete required in N/sqmm
28	F_{st}	=	Stress in steel
29	F_{stPerm}	=	Permissible Stress in Steel required in N/sqmm
30	Legs	=	Number of legs of the shear reinforcement
31	l_o	=	Effective Length of Beam in mm
32	M_h	=	Hogging Moment of Resistance in kNm
33	M_s	=	Sagging Moment of Resistance in kNm
34	M_{Tu}	=	Converted Bending Moment due to Torsion at a section in kNm
35	M_u	=	Factored Bending Moment in Limit State at a section in kNm
36	M_{ud}	=	Total Design Moment = $M_u + M_{Tu}$ in kNm
37	M_{uLim}	=	Limiting Moment of Resistance of Singly Reinforced Section
38	NA angle (ϕ)	=	It is a neutral axis angle corresponding to load angle to find out M _{Cap}
39	P_{cclc}	=	Calculated percentage compression steel
40	P_{tclc}	=	Calculated percentage tension steel
41	P_{tmin}	=	Minimum percentage steel as per code
42	P_{tPrv}	=	provided percentage steel
43	R	=	Moment Ratio M_{ud}/Bd^2
44	Reinf	=	Rebar arrangement provided
45	sp	=	Spacing Between bars at outer most layer
46	S_{pc1} to S_{pc6}	=	Max Stirrup Criteria in mm
47	Stirrup Dia	=	Diameter of shear stirrups in mm
48	S_vCalc	=	Stirrup spacing calculated as per A_{sv} in mm
49	S_vPrv	=	Stirrup spacing provided in m
50	T_c	=	Permissible Shear stress in concrete at a given section in N/sqmm as per Tensile reinforcement
51	T_{ce}	=	Earthquake induced shear stress in N/sqmm
52	T_{cep}	=	Permissible value of shear stress for checking of coupling action in N/sqmm


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STABILITY CALCULATIONS FOR THE PROPOSED CONSTRUCTION OF A STILT +5 FLOORS RESIDENTIAL BUILDING AT PLOT NO.C-17, DOOR NO.15/12,5 TH MAIN ROAD, NANGANALLUR CO-OPERATIVE BUILDING SOCIETY NANGANALLUR , CHENNAI-600061 COMPRISED T.S NO.3 BLOCK NO.19 OF NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT OF GREATER CHENNAI CORPORATION.

53	Tu	=	Factored Torsional Moment in Limit State at a section in kNm
54	Tv	=	Shear stress due to Vud in N/sqmm
55	VD+L	=	Shear force 1.2x(Dead Load + Live Load) in kN
56	Vc	=	Shear capacity of concrete section due to Tc in kN
57	Vu	=	Factored Shear Force in Limit State at a section in kN
58	Vu-A1	=	VD+LLeft - 1.4 x (MsLeft + MhRight)/L in kN
59	Vu-A2	=	VD+LLeft + 1.4 x (MhLeft + MsRight)/L in kN
60	Vu-B1	=	VD+LRight + 1.4 x (MsLeft + MhRight)/L in kN
61	Vu-B2	=	VD+LRight - 1.4 x (MhLeft + MsRight)/L in kN
62	Vud	=	Design Shear Force (Max of Vus and Vu-sway) in kN
63	Vue	=	Earthquake inducted shear in kN
64	Vu-sway	=	Max of (Vu-A1 and Vu-A2) & (Vu-B1 and Vu-B2) in kN
65	Vus	=	Vud - Vc Design Shear Force for reinforcement, in kN
66	Vut	=	Total Shear Force = Vu + VTu in kN
67	VTu	=	Converted Shear Force due to Torsion at a section in kN
68	Wcr	=	Surface Crack Width
69	WcrPerm	=	Permissible Crack Width required in mm
70	X1	=	Smaller c/c dimension of outermost Stirrups
71	Y1	=	Larger c/c dimension of outermost Stirrups

All 6mm diameter bars are assumed 250 grade with $f_y = 250$ N/sqmm

All Forces are in 'kN', 'kNm', Stress in 'N/sqmm' & Dimension are in 'mm'.

Code References

IS 456

Sr.No.	Item	Clause / Table
1.	Ptmax :	26.5.1.1
2.	Ptmin :	26.5.1.1
3.	MTu :	41.4.2


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STABILITY CALCULATIONS FOR THE PROPOSED CONSTRUCTION OF A STILT +5 FLOORS RESIDENTIAL BUILDING AT PLOT NO.C-17, DOOR NO.15/12, 5 TH MAIN ROAD, NANGANALLUR CO-OPERATIVE BUILDING SOCIETY NANGANALLUR , CHENNAI-600061 COMPRISED T.S NO.3 BLOCK NO.19 OF NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT OF GREATER CHENNAI CORPORATION.

4. VTu : 41.3.1
5. Ptc/c : 38
6. Tc : 40.2.1
7. Tcmax : 40.2.3
8. Asv : 40.4
9. Min Shear Reinf: 26.5.1.6
10. Max Stirrup Spacing : 26.5.1.5
11. Shear Reinf - Torsion : 26.5.1.7
12. Side Face Reinforcement : 26.5.1.3
13. crack width calculation : Annex-F
14. cracking : Clause 35.3.2

IS 13920 - 2016

Sr.No.	Item	Clause / Table
1.	Ptmax :	6.2.2
2.	Ptmin :	6.2.1
3.	Astmin :	6.2.3 & 6.2.4
4.	Sv/c/c :	6.3.5
5.	Shear Capacity :	6.3.4
6.	Coupling Beams:	10.5
Group	:	G1
Beam No	:	B1
Analysis Reference (Member)	:	89 (6 m)
Beam Length	:	3170 mm
Breadth (B)	:	230 mm
Depth (D)	:	600 mm
Effective Depth (d)	:	545 mm
Design Code	:	IS 456
Beam Type	:	Regular Beam


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**STABILITY CALCULATIONS FOR THE PROPOSED CONSTRUCTION OF A
STILT +5 FLOORS RESIDENTIAL BUILDING AT PLOT NO.C-17, DOOR
NO.15/12,5 TH MAIN ROAD, NANGANALLUR CO-OPERATIVE BUILDING
SOCIETY NANGANALLUR , CHENNAI-600061 COMPRISED T.S NO.3 BLOCK
NO.19 OF NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT
OF GREATER CHENNAI CORPORATION.**

Grade Of Concrete (Fck)	:	M25	N/sqmm
Grade Of Steel (Main)	:	Fe415	N/sqmm
Grade Of Steel (Shear)	:	Fe415	N/sqmm
Top/Bottom Clear Cover (Cmin)	:	25	mm
Side Clear Cover	:	25	mm
Es	:	2x10 ⁵ N/sqmm	
Ptnominal (%) (Bn)	:	0.2	%

Flexure Design

Beam Bottom Beam Top

Left	Mid	Right	Left	Mid	Right		
Critical L/C - RCDC		1	1	2	2	10	1
Mu (kNm)	17.48	15.09	-	-	41.71	100.42	
Tu (kNm)	0.65	0.65	0.84	0.84	0.48	0.65	
MTu (kNm)	1.39	1.39	1.77	1.77	1.01	1.39	
Mud (kNm)	18.87	16.48	1.77	1.77	42.72	101.81	
MuLim (kNm)	236	236	236	236	236	236	
R	0.276	0.241	0.026	0.026	0.625	1.49	
Ptmin (%) (A)	0.205	0.205	0.2	0.2	0.205	0.205	
Ptclc (%) (B')	0.205	0.205	0.2	0.2	0.205	0.446	
Pcclc (%) (C)	0	0	0.007	0.007	0	0	
PtPrv (%)	0.271	0.271	0.271	0.321	0.321	1.104	
AstCalc (sqmm)	256.74	256.74	250.7	250.7	256.74	558.99	
AstPrv (sqmm)	339.3	339.3	339.3	402.12	402.12	1383.86	
Reinforcement Provided	3-T12	3-T12	3-T12	2-T16	2-T16	2-T25	
	2-T16						

Note: Calculation of Ast


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STABILITY CALCULATIONS FOR THE PROPOSED CONSTRUCTION OF A STILT +5 FLOORS RESIDENTIAL BUILDING AT PLOT NO.C-17, DOOR NO.15/12,5 TH MAIN ROAD, NANGANALLUR CO-OPERATIVE BUILDING SOCIETY NANGANALLUR , CHENNAI-600061 COMPRISED T.S NO.3 BLOCK NO.19 OF NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT OF GREATER CHENNAI CORPORATION.

AstCalc = $\text{Max } \{B', C\} \times B \times d$ (for $\mu > 0$)

AstCalc = $B_n \times B \times d$ (for $\mu = 0$)

Where,

A = P_{tmin} = Min % area of flexural reinforcement

B' = P_{tcl} = Maximum of % reinforcement required for Bending Moment and Min % area of flexural reinforcement (A)

B_n = $P_{tnominal}$ = Nominal % area of reinforcement

C = P_{ccl} = % area of compression reinforcement required

D = AstCrack = Area of reinforcement required for Crackwidth

Shear Design

Left Mid Right

Critical L/C - RCDC 10 1 1

PtPrv (%) 0.271 0.321 1.104

Vu (kN) 12.22 52 92.48

Tu (kNm) 0.48 0.65 0.65

VTu (kN) 3.31 4.54 4.54

Vut (kN) 15.53 56.55 97.02

Tv (N/sqmm) 0.12 0.45 0.77

Tc (N/sqmm) 0.38 0.41 0.67

Vc (kN) 47.32 50.91 83.4

Vus=Vut-Vc (kN) 0 5.64 13.62

Legs 2 2 2

Stirrup Rebar 8 8 8

Asv Torsion (sqmm) 40.398 128.544 217.382

Asv Torsion Prv (sqmm) 335.13 543.46 543.46

Asv Reqd (sqmm/m) 254.81 254.81 254.81

SvCalc (mm) 300 185 185

SvPrv (mm) 300 185 185


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**STABILITY CALCULATIONS FOR THE PROPOSED CONSTRUCTION OF A
STILT +5 FLOORS RESIDENTIAL BUILDING AT PLOT NO.C-17, DOOR
NO.15/12,5 TH MAIN ROAD, NANGANALLUR CO-OPERATIVE BUILDING
SOCIETY NANGANALLUR , CHENNAI-600061 COMPRISED T.S NO.3 BLOCK
NO.19 OF NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT
OF GREATER CHENNAI CORPORATION.**

Asv Total Prv (sqmm) 335.13 543.46 543.46

Maximum Spacing Criteria

Basic

$$\text{Spc1} = 0.75d = 409 \text{ mm}$$

$$\text{Spc2} = 300 \text{ mm}$$

For Torsion

$$(X1 = 190, Y1 = 560)$$

$$\text{Spc3} = X1 = 190 \text{ mm}$$

$$\text{Spc4} = (X1 + Y1) / 4 = 185 \text{ mm}$$

SFR Design

$$\text{Beam Width} = 230 \text{ mm}$$

$$\text{Beam Depth} = 600 \text{ mm}$$

$$\text{Torsion} = 0.65 > 0 \text{ kNm}$$

$$\text{Beam Depth} > 750 \text{ Or Torsion} > 0,$$

Hence SFR Provided

$$\text{Asr} = 138 \text{ sqmm}$$

$$\text{SFR Provided} = 2\text{-T8EF}$$

$$\text{ASFR Provided} = 201.08 \text{ sqmm}$$

Spacing Criteria

$$\text{Provided Spacing} = 154.3 \text{ mm}$$

$$1. \leq \text{beam Width} = 230 \text{ mm}$$

$$2. \text{ Not Greater Than} = 300 \text{ mm}$$


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Group : G1

Beam No : B2

Analysis Reference (Member) : 90 (6 m)

Beam Length : 7310 mm

Breadth (B) : 230 mm

Depth (D) : 600 mm

Effective Depth (d) : 545 mm

Design Code : IS 456

Beam Type : Regular Beam

Grade Of Concrete (Fck) : M25 N/sqmm

Grade Of Steel (Main) : Fe415 N/sqmm

Grade Of Steel (Shear) : Fe415 N/sqmm

Top/Bottom Clear Cover (Cmin) : 25 mm

Side Clear Cover : 25 mm

Es : 2×10^5 N/sqmm

Ptnominal (%) (Bn) : 0.2 %

Flexure Design

Beam Bottom Beam Top

	Left	Mid	Right	Left	Mid	Right	
Critical L/C - RCDC	1	1	1	1	1	10	
Mu (kNm)	-	145.06	82.05	202.36	-	18.13	
Tu (kNm)	1.82	1.82	1.82	1.82	1.82	1.75	
MTu (kNm)	3.87	3.87	3.87	3.87	3.87	3.72	
Mud (kNm)	3.87	148.93	85.92	206.23	3.87	21.84	


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MuLim (kNm)	236	236	236	236	236	236
R	0.057	2.18	1.258	3.019	0.057	0.32
Ptmin (%) (A)	0.2	0.205	0.205	0.205	0.2	0.205
Ptcllc (%) (B')	0.2	0.681	0.371	1.004	0.2	0.205
Pccllc (%) (C)	0.016	0	0	0	0.016	0
PtPrv (%)	0.321	0.752	0.481	1.104	0.321	0.321
AstCalc (sqmm)	250.7	853.91	465.49	1259.01	250.7	256.74
AstPrv (sqmm)	402.12	942.48	603.18	1383.86	402.12	402.12
Reinforcement Provided	2-T16	3-T16				
	3-T12	3-T16	2-T25			
	2-T16	2-T16	2-T16			

Note: Calculation of Ast

AstCalc = $\text{Max } \{B', C\} \times B \times d$ (for $\text{Mu} > 0$)

AstCalc = $B_n \times B \times d$ (for $\text{Mu} = 0$)

Where,

A = Ptmin = Min % area of flexural reinforcement

B' = Ptcllc = Maximum of % reinforcement required for Bending Moment and
Min % area of flexural reinforcement (A)

Bn = Ptnominal = Nominal % area of reinforcement

C = Pccllc = % area of compression reinforcement required

D = AstCrack = Area of reinforcement required for Crackwidth

Shear Design

Left	Mid	Right			
Critical L/C - RCDC	1	1	1		
PtPrv (%)	1.104	0.752	0.321		
Vu (kN)	163.17	69.83	93.38		


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Tu (kNm)	1.82	1.82	1.82
VTu (kN)	12.67	12.67	12.67
Vut (kN)	175.84	82.5	106.05
Tv (N/sqmm)	1.4	0.66	0.85
Tc (N/sqmm)	0.67	0.58	0.41
Vc (kN)	83.4	72.12	50.91
Vus=Vut-Vc (kN)	92.44	10.38	55.14
Legs	2	2	2
Stirrup Rebar	8	8	8
Asv Torsion (sqmm)	406.321	202.481	251.348
Asv Torsion Prv (sqmm)	543.46	543.46	543.46
Asv Reqd (sqmm/m)	469.78	254.81	280.27
SvCalc (mm)	185	185	185
SvPrv (mm)	185	185	185
Asv Total Prv (sqmm)	543.46	543.46	543.46

Maximum Spacing Criteria

Basic

$$\text{Spc1} = 0.75d = 409 \text{ mm}$$

$$\text{Spc2} = 300 \text{ mm}$$

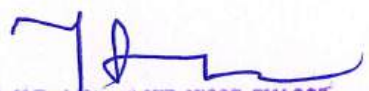
For Torsion

$$(X1 = 190, Y1 = 560)$$

$$\text{Spc3} = X1 = 190 \text{ mm}$$

$$\text{Spc4} = (X1 + Y1) / 4 = 185 \text{ mm}$$

SFR Design


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$$Mux = -14.03 \text{ kNm}$$

$$Muy = 3.9 \text{ kNm}$$

$$P/A = 341.72 \text{ kN/sqm}$$

$$Mx/Zx = -10.12 \text{ kN/sqm}$$

$$My/Zy = 3.36 \text{ kN/sqm}$$

$$Deff = 341 \text{ mm}$$

$$Beff = 1398.54 \text{ mm}$$

$$SPu = 351.84 \text{ kN/sqm}$$

$$Vu = SPu \times (L_{off} - d) \times B$$

$$= 125.39 \text{ kN}$$

$$Tv = Vu / (Beff \times Deff)$$

$$= 0.26 \text{ N/sqmm}$$

$$Tc = 0.36 \text{ N/sqmm}$$

$$Tv < Tc$$

One Way Shear Along B:

Critical Section @ d from Column Face

$$= 561 \text{ mm}$$

$$\text{Critical Load Combination} = [10] : 1.5 (\text{LOAD 5: DL}) + 1.5 (\text{LOAD 6: LL})$$

$$Pu = 1322.46 \text{ kN}$$

$$Mux = -14.03 \text{ kNm}$$

$$Muy = 3.9 \text{ kNm}$$

$$P/A = 341.72 \text{ kN/sqm}$$

$$Mx/Zx = -10.12 \text{ kN/sqm}$$

$$My/Zy = 3.36 \text{ kN/sqm}$$

$$Deff = 335 \text{ mm}$$


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$$\begin{aligned} \text{Leff} &= 1708.1 \text{ mm} \\ \text{SPu} &= 345.08 \text{ kN/sqm} \\ \text{Vu} &= \text{SPu} \times (\text{Boff} - d) \times L \\ &= 166.19 \text{ kN} \\ \text{Tv} &= \text{Vu} / (\text{Leff} \times \text{Deff}) \\ &= 0.29 \text{ N/sqmm} \\ \text{Tc} &= 0.32 \text{ N/sqmm} \\ \text{Tv} &< \text{Tc} \end{aligned}$$

Design For Punching Shear:

Critical Section @ $d/2$ from Column Face

$$= 284 \text{ mm}$$

Critical Load Combination = [10] : 1.5 (LOAD 5: DL) +1.5 (LOAD 6: LL)

$$\begin{aligned} \text{Pu} &= 1322.46 \text{ kN} \\ \text{Mux} &= -14.03 \text{ kNm} \\ \text{Muy} &= 3.9 \text{ kNm} \\ \text{P/A} &= 341.72 \text{ kN/sqm} \\ \text{Mx/Zx} &= -10.12 \text{ kN/sqm} \\ \text{My/Zy} &= 3.36 \text{ kN/sqm} \end{aligned}$$

$$\begin{aligned} \text{Deff} &= 465 \text{ mm} \\ \text{Leff} &= 1169 \text{ mm} \\ \text{Beff} &= 799 \text{ mm} \\ \text{Punching Perimeter} &= 3936 \text{ mm} \\ \text{Punching Area} &= 1831460.16 \text{ sqmm} \\ \text{SPu} &= \text{Average Pressure} \\ &= 341.72 \text{ kN/sqm} \\ \text{Vu} &= \text{SPu} \times ((L \times B) - (\text{Leff} \times \text{Beff})) \end{aligned}$$


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$$= 1003.28 \text{ kN}$$

$$T_v = V_u / \text{Punching Area}$$

$$= 0.548 \text{ N/sqmm}$$

$$T_c = 1.104 \text{ N/sqmm}$$

$$T_v < T_c$$

Load Transfer Check For Load Transfer From Column To Footing

$$\text{Critical Load Combination} = [10] : 1.5 (\text{LOAD 5: DL}) + 1.5 (\text{LOAD 6: LL})$$

$$P_u = 1322.46 \text{ kN}$$

$$A_2 = 0.14 \text{ sqm}$$

$$A_1 = 8.46 \text{ sqm}$$

$$\text{Base Area} = 3.87 \text{ sqm}$$

$$A_1 > \text{Base Area}$$

$$\text{Thus, } A_1 = 3.87$$

$$\text{Modification Factor} = \text{SquareRoot}(A_1/A_2) \leq 2$$

$$\text{SquareRoot}(A_1/A_2) = 5.2576$$

$$\text{Thus, Modification Factor} = 2$$

$$\text{Concrete Bearing Capacity} = 0.45 \times F_{ck} \times \text{Modification Factor} \times \text{Column Area}$$

$$= 3105 \text{ kN}$$

$$\text{Concrete Bearing Capacity} > P_u, \text{ Hence Safe.}$$


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COLUMN DESIGN CALCULATIONS

Definitions Of Terms:

All forces in units kN and m

All reinforcement details like area, spacing are mm

Grade Of steel for 6 mm dia. bars is Fe250. It is irrespective of the grade of steel defined by user in column design.

Neutral axis angle for resultant design moment is with respect to local major axis.

- 1 β = Stiffness proportion factor at joint (column stiffness/sum of stiffness of all members connected at joint)
- 2 Δu = Elastically computed first order lateral deflection.(Relative deflections)
- 3 ϵ_1 = Strain at level considered, Calculated ignoring the stiffening of the concrete in tension zone
- 4 ϵ_m = Average steel strain at level considered
- 5 a_{cr} = Distance from the point considered to the surface of the nearest longitudinal bar
- 6 A_g = Gross area of the column cross section
- 7 A_{eff} = Effective area of column / wall considered for shear check in sqmm
- 8 A_k = Area of confined concrete core
- 9 A_{sh} = Area of link cross section
- 10 b = Effective Width of Column in mm
- 11 b_{eff} = Effective Width of Column in mm
- 12 B = Width / Smaller Dimension of Column in mm
- 13 d = Effective Depth of Column in mm
- 14 d_{eff} = Effective Depth of Column in mm
- 15 D = Depth / Larger Dimension of Column OR Diameter of Circular Column in mm
- 16 D_k = Diameter Of core measured to the outside of circular link
- 17 E_c = Modulus of elasticity of concrete
- 18 E_s = Modulus of elasticity of steel
- 19 F_{cPerm} = Permissible Stress in Concrete required in N/ (sqmm)


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20	Fst	=	Stress in steel
21	FstPerm	=	Permissible Stress in Steel required in N/ (sqmm)
22	Fck	=	Characteristic compressive strength of concrete cube in N/sqmm
23	Fy	=	Yield Stress Of Steel in N/sqmm
24	h	=	Longer dimension of rectangular link measured to its outer face
25	Hu	=	Total lateral force acting within the story(Story shear)
26	Hs	=	Height of the story (Floor height)
27	k	=	Reduction factor for slenderness moments
28	Max	=	Additional moment due to slenderness about major axis (Along D)
29	May	=	Additional moment due to slenderness about minor axis (Along B)
30	Mminx	=	Moment due to minimum eccentricity along D
31	Mminy	=	Moment due to minimum eccentricity along B
32	Muv	=	Moment capacity of web portion of wall as per clause 9.4.2 and Annex A of IS 13920 - 2016
33	Mux	=	Factored moment Along D (Moment About Major Axis)
34	Muy	=	Factored moment Along B (Moment About Minor Axis)
35	MCap	=	Moment capacity of section for NA angle at design Pu
36	MRes	=	Resultant design moment at angle to local major axis
37	Pb	=	Axial capacity of column along B as defined in 39.7.1.1
38	Pd	=	Axial capacity of column along D as defined in 39.7.1.1
39	Pu	=	Factored axial force
40	Puz	=	Axial load on column as defined in 39.6
41	Pu_Total	=	Sum of Axial loads on all column in the story (Gravity Load)
42	Q	=	Stability Index (factor for checking sway/ non sway condition for a given story)
43	S	=	Link Spacing
44	Shear Strength Enhancement Factor	=	Multiplying factor for shear strength of concrete as per 40.2.2
45	Vur	=	Factored resultant shear force acting on the column
46	Vux	=	Factored shear force Along B


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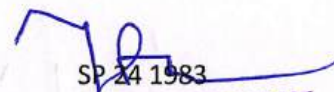
47	Vuy	=	Factored shear force Along D
48	Wcr	=	Surface Crack Width
49	WcrPerm	=	Permissible Crack Width required in mm
50	β	=	It is a Neutral Axis angle corresponding to load angle to find out MCap

Code References:

IS 456

ELEMENT	CLAUSE / table
1	Max area of reinforcement : 26.5.3.1-a & b
2	Min area of reinforcement : 26.5.3.1-a & b
3	Min number of bars : 26.5.3.1-c
4	Minimum Eccentricity Calc : 25.4 & 39.2
5	Effective Length : 25.2
6	Slenderness Moments : 25.3 & 39.7
7	Design for axial loads : 39.3
8	Design for axial loads And uniaxial bending : 39.5
9	Design for axial loads And Biaxial bending : 39.6
10	Design of horizontal links : 26.5.3.2
11	Design shear strength : 40.2
12	Stiffness Proportion Factor, β : E-1
13	Stability(Index, Q) : E -2
14	Crack width calculation : 3.8
15	Multiplying factor to Beam Stiffness for effective length calculation : SP 24 1983

APPENDIX D


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IS 13920 - 2016

ELEMENT	CLAUSE / table
1 Spacing of special confining reinforcement :	10.4 and 7.6
2 C/s area of special confining reinforcement :	7.6.1
3 Applicability of boundary element :	10.4.1
4 Muv-Moment Capacity of Web :	Annex
5 Additional Compressive Force in BE :	10.4.2
6 Check for BE in tension and compression :	10.4.2.1 and 10.4.3
7 Shear include due to Beam :	7.5
8 Minimum Flexural Strength of Column :	7.2
9 Shear Check at Column Joint :	9.1
10 Length of wall to thickness ratio :	10.1.3
11 Type of wall & Minimum reinforcement :	10.1.4
12 Largest diameter of longitudinal steel bar :	10.1.8
13 Shear reinforcement in RC wall :	10.2.3
14 Special confinement reinforcement in Boundary Element :	10.4.4
15 Minimum vertical reinforcement across horizontal construction joint :	10.7

Sway Calculation (Stability Index)

For Global-X Direction

Level (mm)	Load Name Storey Shear (kN)	Storey Height (m) Stability Index	Gravity Load P (kN) Sway Condition	Relative Displacements
A	B	C	D	B x C / (A x D)
0 m to 3 m	LOAD 1: EQ+X	3	14048.485	0.29 21.099 0.064 Sway
3 m to 6 m	LOAD 1: EQ+X	3	14048.485	0.441 21.099 0.098 Sway
6 m to 9 m	LOAD 1: EQ+X	3	11621.294	0.456 20.515 0.086 Sway
9 m to 12 m	LOAD 1: EQ+X	3	9507.095	0.438 19.467 0.071 Sway
12 m to 15 m	LOAD 1: EQ+X	3	7079.903	0.39 17.133 0.054 Sway
15 m to 18 m	LOAD 1: EQ+X	3	4652.712	0.312 13.485 0.036 Non Sway
18 m to 21 m	LOAD 1: EQ+X	3	2225.52	0.203 8.233 0.018 Non Sway

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SOCIETY NANGANALLUR , CHENNAI-600061 COMPRISED T.S NO.3 BLOCK
NO.19 OF NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT
OF GREATER CHENNAI CORPORATION**

21 m to 24 m LOAD 1: EQ+X 3 180.037 0.438 1.084 0.024 Non Sway

For Global-Y Direction

Level (mm)	Load Name Storey Shear (kN)	Storey Height (m)	Gravity Load P (kN)	Relative Displacements
		Stability Index	Sway Condition	
A	B	C	D	B x C / (A x D)
0 m to 3 m	LOAD 3: EQ +Z	3	14048.485	0.125 21.099 0.028 Non Sway
3 m to 6 m	LOAD 3: EQ +Z	3	14048.485	0.2 21.099 0.044 Sway
6 m to 9 m	LOAD 3: EQ +Z	3	11621.294	0.209 20.515 0.039 Non Sway
9 m to 12 m	LOAD 3: EQ +Z	3	9507.095	0.201 19.467 0.033 Non Sway
12 m to 15 m	LOAD 3: EQ +Z	3	7079.903	0.18 17.133 0.025 Non Sway
15 m to 18 m	LOAD 3: EQ +Z	3	4652.712	0.144 13.485 0.017 Non Sway
18 m to 21 m	LOAD 3: EQ +Z	3	2225.52	0.095 8.233 0.009 Non Sway
21 m to 24 m	LOAD 3: EQ +Z	3	180.037	0.132 0.635 0.012 Non Sway

General Data

Column No. : C1

Level : 0 m To 3 m

Frame Type = Non-Ductile

Response Reduction Factor = 3

Design Code = IS 456 : 2000 + IS 13920 : 2016

Grade Of Concrete = M25 N/sqmm

Grade Of Steel (Main) = Fe415 N/sqmm

Grade Of Steel (Shear) = Fe415 N/sqmm

Grade Of Steel - Flexural Design = Fe415 N/sqmm

Grade Of Steel - Shear Design = Fe415 N/sqmm

Column B = 230 mm


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STABILITY CALCULATIONS FOR THE PROPOSED CONSTRUCTION OF A STILT +5 FLOORS RESIDENTIAL BUILDING AT PLOT NO.C-17, DOOR NO.15/12, 5 TH MAIN ROAD, NANGANALLUR CO-OPERATIVE BUILDING SOCIETY NANGANALLUR , CHENNAI-600061 COMPRISED T.S NO.3 BLOCK NO.19 OF NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT OF GREATER CHENNAI CORPORATION

Column D = 600 mm
 Clear Cover = 50 mm
 Clear Floor Height @ B = 3000 mm
 Clear Floor Height @ D = 2400 mm
 No Of Floors = 1
 No Of Columns In Group = 1
 Column Type : UnBraced
 Minimum eccentricity check : One Axis at a Time
 Code defined D/B ratio : 4
 D/B Ratio : 2.61 $\leq$ 4 Hence, Design as Column

Flexural Design (Analysis Forces)

Analysis Reference No. = 33
 Load Combination = [1] : 1.5 (LOAD 5: DL) +1.5 (LOAD 6: LL)
 Critical Location= Top Joint
 Pu = 1322.46 kN
 Mux = 13.15 kNm
 Muy = -1.13 kNm
 Vux = -1.68 kN
 Vuy = -9.06 kN

Effective Length Calculation

Calculation Along Major Axis Of Column

Joint	Column Stiffness	Beam Sizes	Beam Stiffness	Beta
Beam 1				
(Length x Width x Depth)		Beam 2		
(Length x Width x Depth)		Beam 1 Beam 2		


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	N-m x 10 ⁶	mm	mm	N-m x 10 ⁶	N-m x 10 ⁶	
Bottom 138	No Beam		No Beam	-	-	1
Top 138	7310 x 230 x 600		3170 x 230 x 600	56.635	130.599	0.596
Sway Condition (as per Stability Index)	= Sway					
Effective Length Factor along Major Axis	= 2.75					

Calculation Along Minor Axis Of Column

Joint Column Stiffness

Beam Sizes

Beam Stiffness

Beta

Beam 1

(Length x Width x Depth) Beam 2

(Length x Width x Depth) Beam 1 Beam 2

	N-m x 10 ⁶	mm	mm	N-m x 10 ⁶	N-m x 10 ⁶	
Bottom 20.278	No Beam		No Beam	-	-	1
Top 20.278	No Beam		No Beam	-	-	1
Sway Condition (as per Stability Index)	= Non Sway					
Effective Length Factor along Minor axis	= 1					

Minimum Eccentricity Check

Since Axial Force is compressive, Min. Eccentricity check to be performed

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

$$\text{Minimum Eccentricity} = \frac{\text{Unsupported Length}}{500} + \frac{B}{30}$$

$$= 13.67 \text{ mm}$$

$$M_{\min} = P_u \times \text{Minimum Eccentricity}$$

$$= 26.45 \text{ kNm}$$

Slenderness Check


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$$\text{Max Slenderness Ratio}(L/B) = 13.04$$

< 60 (Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

$$\text{Effective Length Factor} = 2.75$$

$$\text{Slenderness Ratio} = \text{Effective Length} / D$$

$$= 11, \text{Column not Slender Along D}$$

Column Is Unbraced Along B

Slenderness Check Along B:

$$\text{Effective Length Factor} = 1$$

$$\text{Slenderness Ratio} = \text{Effective Length} / B$$

$$= 13.04, \text{Column Slender Along B}$$

$$\text{Slenderness moment along B} = (P_u B / 2000) (L_e / B)^2$$

$$= 25.87 \text{ kNm}$$

Design slenderness moment along B

$$P_{uz} = 1756.08 \text{ kN}$$

$$P_b = 591.36 \text{ kN}$$

$$\text{Reduction factor 'k' for slenderness moment} = (P_{uz} - P_u) / (P_{uz} - P_b) \leq 1$$

$$= 0.37 \leq 1, \text{Hence } k=0.37$$

$$M_{sIndy} = k \times 25.87$$

$$= 9.63 \text{ kNm}$$

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	MsIndx (Abs)	Mdesign-final
A	B	C	E	F	
Major Axis - Mux	13.15	---	13.15	0	13.15
Minor Axis - Muy	-1.13	26.45	-26.45	9.63	-36.08

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Where

- A = Moments directly from analysis
B = Moments due to minimum eccentricity
C = Maximum of analysis moment and min. eccentricity = Max (A,B)
E = Moment due to slenderness effect
F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

- Pu = 1322.46 kN
Mux = 13.15 kNm
Muy = -36.08 kNm

Resultant Moment (Combined Action)

Moment Capacity Check

- Pt Calculated = 0.49
Reinforcement Provided= 6-T12
Load Angle = $\tan^{-1}(M_{uy}/M_{ux})$
= 69.97 deg
MRes = 38.4 kNm
MCap = 42.61 kNm
Capacity Ratio = MRes/ MCap
= 0.9 <= 1

Shear Calculation Along D Along B

- Critical Load Combination [12] : 1.5 (LOAD 5: DL) -1.5 (LOAD 1: EQ+X) [1] : 1.5 (LOAD 5:
DL) +1.5 (LOAD 6: LL)
Design shear force, Vu (kN) -13.4196 -1.6783
Pu (kN) 1109.06 1322.46


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Deff , Beff (mm) 544 174

Aeff (sqmm) 125120 104400

Design shear stress, T_v $V_u / (B \times Deff)$ $V_u / (D \times Beff)$

T_v (N/sqmm) 0.1073 0.0161

Pt (%) 0.246 0.246

Design shear strength, T_c (N/sqmm) 0.3621 0.3621

Shear Strength Enhancement Factor (Compressive Force) $1 + 3 \times P_u / (B \times D \times F_{ck})$
2.0637 2.5201

Shear Strength Enhancement Factor (Tensile Force) - -

Shear Strength Enhancement Factor (max) 1.5 1.5

Shear Strength Enhancement Factor 1.5 1.5

Enhanced shear strength, T_{c-e} (N/sqmm) 0.5432 0.5432

Design shear check $T_v < T_c \times \text{Enhancement factor}$ $T_v < T_c \times \text{Enhancement factor}$

Shear Links Design Shear Links Not Required Shear Links Not Required

Design Of Links

Links in the zone where special confining links are not required

Normal Links

Diameter of link= 8 mm

> Max. longitudinal bar dia / 4

= 3 mm

Criterion for spacing of normal links

Min. Longitudinal Bar dia X 16 = 192 mm

Min. dimension of column = 230 mm

Max. 300 mm = 300 mm

Provided spacing = 175 mm

Table For Links


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Required Provided

Normal Design Shear Design Ductile Design Normal Zone Ductile Zone

Link Dia. 8 --- --- 8 ---

Spacing 175 --- --- 175 ---

General Data

Column No. : C1

Level : 6 m To 9 m

Frame Type = Non-Ductile

Response Reduction Factor = 3

Design Code = IS 456 : 2000 + IS 13920 : 2016

Grade Of Concrete = M25 N/sqmm

Grade Of Steel (Main) = Fe415 N/sqmm

Grade Of Steel (Shear) = Fe415 N/sqmm

Grade Of Steel - Flexural Design = Fe415 N/sqmm

Grade Of Steel - Shear Design = Fe415 N/sqmm

Column B = 230 mm

Column D = 600 mm

Clear Cover = 50 mm

Clear Floor Height @ B = 3000 mm

Clear Floor Height @ D = 2400 mm

No Of Floors = 1

No Of Columns In Group = 1

Column Type : UnBraced

Minimum eccentricity check : One Axis at a Time

Code defined D/B ratio : 4

D/B Ratio : $2.61 \leq 4$ Hence, Design as Column


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Flexural Design (Analysis Forces)

Analysis Reference No. = 113
Load Combination = [1] : 1.5 (LOAD 5: DL) +1.5 (LOAD 6: LL)
Critical Location= Top Joint
Pu = 1071.4 kN
Mux = 16.92 kNm
Muy = -0.35 kNm
Vux = -0.47 kN
Vuy = -20.34 kN

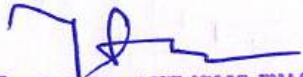
Effective Length Calculation

Calculation Along Major Axis Of Column

Joint	Column Stiffness	Beam Sizes	Beam Stiffness	Beta
Beam 1				
(Length x Width x Depth)		Beam 2		
(Length x Width x Depth)		Beam 1 Beam 2		
N-m x 10 ⁶	mm mm	N-m x 10 ⁶	N-m x 10 ⁶	
Bottom 138	7310 x 230 x 600	3170 x 230 x 600	56.635 130.599	0.596
Top 138	7310 x 230 x 600	3170 x 230 x 600	56.635 130.599	0.596
Sway Condition (as per Stability Index) = Sway				
Effective Length Factor along Major Axis = 1.66				

Calculation Along Minor Axis Of Column

Joint Column Stiffness
Beam Sizes
Beam Stiffness
Beta


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Beam 1

(Length x Width x Depth)			Beam 2		
(Length x Width x Depth)			Beam 1	Beam 2	
N-m x 10 ⁶	mm	mm	N-m x 10 ⁶	N-m x 10 ⁶	
Bottom	20.278	No Beam	No Beam	-	1
Top	20.278	No Beam	No Beam	-	1
Sway Condition (as per Stability Index) =			Non Sway		
Effective Length Factor along Minor axis =			1		

Minimum Eccentricity Check

Since Axial Force is compressive, Min. Eccentricity check to be performed

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

$$\begin{aligned} \text{Minimum Eccentricity} &= \text{Unsupported Length} / 500 + B / 30 \\ &= 13.67 \text{ mm} \end{aligned}$$

$$\begin{aligned} M_{\min y} &= P_u \times \text{Minimum Eccentricity} \\ &= 21.43 \text{ kNm} \end{aligned}$$

Slenderness Check

$$\begin{aligned} \text{Max Slenderness Ratio}(L/B) &= 13.04 \\ &< 60 \quad (\text{Hence Ok}) \end{aligned}$$

Column Is Unbraced Along D

Slenderness Check Along D:

$$\begin{aligned} \text{Effective Length Factor} &= 1.66 \\ \text{Slenderness Ratio} &= \text{Effective Length} / D \\ &= 6.64, \text{ Column not Slender Along D} \end{aligned}$$

Column Is Unbraced Along B

Slenderness Check Along B:

$$\begin{aligned} \text{Effective Length Factor} &= 1 \\ \text{Slenderness Ratio} &= \text{Effective Length} / B \end{aligned}$$


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= 13.04, Column Slender Along B

Slenderness moment along B = $(P_u B / 2000) (L_e / B)^2$

= 20.96 kNm

Design slenderness moment along B

$P_{uz} = 1756.08$ kN

$P_b = 591.36$ kN

Reduction factor 'k' for slenderness moment = $(P_{uz} - P_u) / (P_{uz} - P_b) \leq 1$

= $0.59 \leq 1$, Hence $k=0.59$

$M_{slndy} = k \times 20.96$

= 12.32 kNm

Calculation of Design Moment

Direction	Manalysis		Mmin (Abs)		Mdesign	Mslndx (Abs)	Mdesign-final
A B	C	E	F				
Major Axis - Mux	16.92	---	16.92	0	16.92		
Minor Axis - Muy	-0.35	21.43	-21.43	12.32	-33.75		

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)

E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

$P_u = 1071.4$ kN


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Mux = 16.92 kNm

Muy = -33.75 kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated = 0.49

Reinforcement Provided= 6-T12

Load Angle = $\tan^{-1}(M_{uy}/M_{ux})$

= 63.38 deg

MRes = 37.75 kNm

MCap = 64.37 kNm

Capacity Ratio = MRes/ MCap

= 0.59 <= 1

Shear Calculation Along D Along B

Critical Load Combination [12] : 1.5 (LOAD 5: DL) -1.5 (LOAD 1: EQ+X) [20] : 0.9 (LOAD 5:
DL) -1.5 (LOAD 1: EQ+X)

Design shear force, Vu (kN) -22.9706 -0.4639

Pu (kN) 901.75 538.79

Deff, Beff (mm) 544 174

Aeff (sqmm) 125120 104400

Design shear stress, Tv $V_u / (B \times Deff)$ $V_u / (D \times Beff)$

Tv (N/sqmm) 0.1836 0.0044

Pt (%) 0.246 0.246

Design shear strength, Tc (N/sqmm) 0.3621 0.3621

Shear Strength Enhancement Factor (Compressive Force)

1.8649 1.6193

Shear Strength Enhancement Factor (Tensile Force)

-

Shear Strength Enhancement Factor (max)

1.5

1.5

Shear Strength Enhancement Factor

1.5

1.5

$1 + 3 \times P_u / (B \times D \times F_{ck})$


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Enhanced shear strength, T_{c-e} (N/sqmm) 0.5432 0.5432

Design shear check $T_v < T_c \times \text{Enhancement factor}$ $T_v < T_c \times \text{Enhancement factor}$

Shear Links Design Shear Links Not Required Shear Links Not Required

Design Of Links

Links in the zone where special confining links are not required

Normal Links

Diameter of link= 8 mm

> Max. longitudinal bar dia / 4

= 3 mm

Criterion for spacing of normal links

Min. Longitudinal Bar dia X 16 = 192 mm

Min. dimension of column = 230 mm

Max. 300 mm = 300 mm

Provided spacing = 175 mm

Table For Links

Required	Provided					
Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone		
Link Dia.	8	---	---	8	---	
Spacing 175	---	---	175	---		

General Data

Column No. : C1

Level : 9 m To 12 m

Frame Type = Non-Ductile

Response Reduction Factor = 3


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NO.19 OF NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT
OF GREATER CHENNAI CORPORATION**

Design Code = IS 456 : 2000 + IS 13920 : 2016

Grade Of Concrete = M25 N/sqmm

Grade Of Steel (Main) = Fe415 N/sqmm

Grade Of Steel (Shear) = Fe415 N/sqmm

Grade Of Steel - Flexural Design = Fe415 N/sqmm

Grade Of Steel - Shear Design = Fe415 N/sqmm

Column B = 230 mm

Column D = 600 mm

Clear Cover = 50 mm

Clear Floor Height @ B = 3000 mm

Clear Floor Height @ D = 2400 mm

No Of Floors = 1

No Of Columns In Group = 1

Column Type : UnBraced

Minimum eccentricity check : One Axis at a Time

Code defined D/B ratio : 4

D/B Ratio : $2.61 \leq 4$ Hence, Design as Column

Flexural Design (Analysis Forces)

Analysis Reference No. = 153

Load Combination = [1] : 1.5 (LOAD 5: DL) +1.5 (LOAD 6: LL)

Critical Location= Bottom Joint

Pu = 963.2 kN

Mux = -9.4 kNm

Muy = 2.49 kNm

Vux = -1.26 kN

Vuy = -20.25 kN


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STABILITY CALCULATIONS FOR THE PROPOSED CONSTRUCTION OF A STILT +5 FLOORS RESIDENTIAL BUILDING AT PLOT NO.C-17, DOOR NO.15/12,5 TH MAIN ROAD, NANGANALLUR CO-OPERATIVE BUILDING SOCIETY NANGANALLUR , CHENNAI-600061 COMPRISED T.S NO.3 BLOCK NO.19 OF NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT OF GREATER CHENNAI CORPORATION

Effective Length Calculation

Calculation Along Major Axis Of Column

Joint	Column Stiffness	Beam Sizes	Beam Stiffness	Beta
Beam 1				
(Length x Width x Depth)		Beam 2		
(Length x Width x Depth)		Beam 1 Beam 2		
N-m x 10 ⁶	mm mm	N-m x 10 ⁶	N-m x 10 ⁶	
Bottom 138	7310 x 230 x 600	3170 x 230 x 600	56.635 130.599	0.596
Top 138	7310 x 230 x 600	3170 x 230 x 600	56.635 130.599	0.596
Sway Condition (as per Stability Index) =			Sway	
Effective Length Factor along Major Axis =			1.66	

Calculation Along Minor Axis Of Column

Joint	Column Stiffness	Beam Sizes	Beam Stiffness	Beta
Beam 1				
(Length x Width x Depth)		Beam 2		
(Length x Width x Depth)		Beam 1 Beam 2		
N-m x 10 ⁶	mm mm	N-m x 10 ⁶	N-m x 10 ⁶	
Bottom 20.278	No Beam	No Beam	- -	1
Top 20.278	No Beam	No Beam	- -	1
Sway Condition (as per Stability Index) =			Non Sway	
Effective Length Factor along Minor axis =			1	

Minimum Eccentricity Check

Since Axial Force is compressive, Min. Eccentricity check to be performed


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**STABILITY CALCULATIONS FOR THE PROPOSED CONSTRUCTION OF A
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NO.15/12, 5 TH MAIN ROAD, NANGANALLUR CO-OPERATIVE BUILDING
SOCIETY NANGANALLUR, CHENNAI-600061 COMPRISED T.S NO.3 BLOCK
NO.19 OF NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT
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Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

$$\begin{aligned}\text{Minimum Eccentricity} &= \text{Unsupported Length} / 500 + B / 30 \\ &= 13.67 \text{ mm}\end{aligned}$$

$$M_{\min y} = P_u \times \text{Minimum Eccentricity}$$

$$= 19.26 \text{ kNm}$$

Slenderness Check

$$\text{Max Slenderness Ratio}(L/B) = 13.04$$

$$< 60 \quad (\text{Hence Ok})$$

Column Is Unbraced Along D

Slenderness Check Along D:

$$\text{Effective Length Factor} = 1.66$$

$$\text{Slenderness Ratio} = \text{Effective Length} / D$$

$$= 6.64, \text{ Column not Slender Along D}$$

Column Is Unbraced Along B

Slenderness Check Along B:

$$\text{Effective Length Factor} = 1$$

$$\text{Slenderness Ratio} = \text{Effective Length} / B$$

$$= 13.04, \text{ Column Slender Along B}$$

$$\text{Slenderness moment along B} = (P_u B / 2000) (L_{\text{eff}} / B)^2$$

$$= 18.85 \text{ kNm}$$

Design slenderness moment along B

$$P_{uz} = 1756.08 \text{ kN}$$

$$P_b = 591.36 \text{ kN}$$

$$\text{Reduction factor 'k' for slenderness moment} = (P_{uz} - P_u) / (P_{uz} - P_b) \leq 1$$

$$= 0.68 \leq 1, \text{ Hence } k=0.68$$

$$M_{\text{slndy}} = k \times 18.85$$

$$= 12.83 \text{ kNm}$$


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NO.15/12,5 TH MAIN ROAD, NANGANALLUR CO-OPERATIVE BUILDING
SOCIETY NANGANALLUR , CHENNAI-600061 COMPRISED T.S NO.3 BLOCK
NO.19 OF NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT
OF GREATER CHENNAI CORPORATION**

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	MsIndx (Abs)	Mdesign-final
A	B	C	E	F	
Major Axis - Mux	-9.4	---	-9.4	0	-9.4
Minor Axis - Muy	2.49	19.26	19.26	12.83	32.09

Where

- A = Moments directly from analysis
 B = Moments due to minimum eccentricity
 C = Maximum of analysis moment and min. eccentricity = Max (A,B)
 E = Moment due to slenderness effect
 F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

- Pu = 963.2 kN
 Mux = -9.4 kNm
 Muy = 32.09 kNm

Resultant Moment (Combined Action)

Moment Capacity Check

- Pt Calculated = 0.49
 Reinforcement Provided= 6-T12
 Load Angle = $\tan^{-1}(Muy/Mux)$
 = 73.68 deg
 MRes = 33.44 kNm
 MCap = 55.2 kNm


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SOCIETY NANGANALLUR , CHENNAI-600061 COMPRISED T.S NO.3 BLOCK
NO.19 OF NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT
OF GREATER CHENNAI CORPORATION**

Capacity Ratio = M_{Res} / M_{Cap}

= 0.61 <= 1

Shear Calculation Along D Along B

Critical Load Combination [12] : 1.5 (LOAD 5: DL) -1.5 (LOAD 1: EQ+X) [20] : 0.9 (LOAD 5: DL) -1.5 (LOAD 1: EQ+X)

Design shear force, V_u (kN) -22.635 -0.8217

P_u (kN) 794.77 475.37

D_{eff} , B_{eff} (mm) 544 174

A_{eff} (sqmm) 125120 104400

Design shear stress, T_v $V_u / (B \times D_{eff})$ $V_u / (D \times B_{eff})$

T_v (N/sqmm) 0.1809 0.0079

P_t (%) 0.246 0.246

Design shear strength, T_c (N/sqmm) 0.3621 0.3621

Shear Strength Enhancement Factor (Compressive Force) $1 + 3 \times P_u / (B \times D \times F_{ck})$

1.7622 1.5464

Shear Strength Enhancement Factor (Tensile Force) - -

Shear Strength Enhancement Factor (max) 1.5 1.5

Shear Strength Enhancement Factor 1.5 1.5

Enhanced shear strength, T_{c-e} (N/sqmm) 0.5432 0.5432

Design shear check $T_v < T_c \times \text{Enhancement factor}$ $T_v < T_c \times \text{Enhancement factor}$

Shear Links Design Shear Links Not Required Shear Links Not Required

Design Of Links

Links in the zone where special confining links are not required

Normal Links

Diameter of link= 8 mm

> Max. longitudinal bar dia / 4

= 3 mm

Criterion for spacing of normal links


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SOCIETY NANGANALLUR , CHENNAI-600061 COMPRISED T.S NO.3 BLOCK
NO.19 OF NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT
OF GREATER CHENNAI CORPORATION**

Min. Longitudinal Bar dia X 16 = 192 mm

Min. dimension of column = 230 mm

Max. 300 mm = 300 mm

Provided spacing = 175 mm

Table For Links

Required	Provided				
Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone	
Link Dia.	8	---	---	8	---
Spacing 175	---	---	175	---	

General Data

Column No. : C1

Level : 12 m To 15 m

Frame Type = Non-Ductile

Response Reduction Factor = 3

Design Code = IS 456 : 2000 + IS 13920 : 2016

Grade Of Concrete = M25 N/sqmm

Grade Of Steel (Main) = Fe415 N/sqmm

Grade Of Steel (Shear) = Fe415 N/sqmm

Grade Of Steel - Flexural Design = Fe415 N/sqmm

Grade Of Steel - Shear Design = Fe415 N/sqmm

Column B = 230 mm

Column D = 600 mm

Clear Cover = 50 mm

Clear Floor Height @ B = 3000 mm

Clear Floor Height @ D = 2400 mm


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SOCIETY NANGANALLUR , CHENNAI-600061 COMPRISED T.S NO.3 BLOCK
NO.19 OF NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT
OF GREATER CHENNAI CORPORATION**

No Of Floors = 1

No Of Columns In Group = 1

Column Type : UnBraced

Minimum eccentricity check : One Axis at a Time

Code defined D/B ratio : 4

D/B Ratio : $2.61 \leq 4$ Hence, Design as Column

Flexural Design (Analysis Forces)

Analysis Reference No. = 193

Load Combination = [1] : 1.5 (LOAD 5: DL) +1.5 (LOAD 6: LL)

Critical Location= Top Joint

P_u = 708.87 kN

M_{ux} = 40.15 kNm

M_{uy} = -1.29 kNm

V_{ux} = -0.67 kN

V_{uy} = -24.16 kN

Effective Length Calculation

Calculation Along Major Axis Of Column

Joint Column Stiffness

Beam Sizes Beam Stiffness Beta

Beam 1

(Length x Width x Depth)

Beam 2

(Length x Width x Depth)

Beam 1 Beam 2

N-m x 10^6 mm mm N-m x 10^6 N-m x 10^6

Bottom 138 7310 x 230 x 600 3170 x 230 x 600 56.635 130.599 0.596

Top 138 7310 x 230 x 600 3170 x 230 x 600 56.635 130.599 0.596

Sway Condition (as per Stability Index) = Sway


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SOCIETY NANGANALLUR , CHENNAI-600061 COMPRISED T.S NO.3 BLOCK
NO.19 OF NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT
OF GREATER CHENNAI CORPORATION**

Effective Length Factor along Major Axis = 1.66

Calculation Along Minor Axis Of Column

Joint Column Stiffness

Beam Sizes

Beam Stiffness

Beta

Beam 1

(Length x Width x Depth)

Beam 2

(Length x Width x Depth)

Beam 1 Beam 2

N-m x 10⁶ mm mm

N-m x 10⁶

N-m x 10⁶

Bottom 20.278 No Beam

No Beam

- - 1

Top 20.278 No Beam

No Beam

- - 1

Sway Condition (as per Stability Index) = Non Sway

Effective Length Factor along Minor axis = 1

Minimum Eccentricity Check

Since Axial Force is compressive, Min. Eccentricity check to be performed

Most critical case is with Min. Eccentricity check in Y-direction

Minimum Eccentricity Along B :

Minimum Eccentricity = Unsupported Length / 500 + B / 30

= 13.67 mm

Mminy = Pu x Minimum Eccentricity

= 14.18 kNm

Slenderness Check

Max Slenderness Ratio(L/B) = 13.04

< 60 (Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:


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Effective Length Factor = 1.66

Slenderness Ratio = Effective Length / D

= 6.64, Column not Slender Along D

Column Is Unbraced Along B

Slenderness Check Along B:

Effective Length Factor = 1

Slenderness Ratio = Effective Length / B

= 13.04, Column Slender Along B

Slenderness moment along B = $(P_u B / 2000) (L_{ey}/B)^2$

= 13.87 kNm

Design slenderness moment along B

Puz = 1756.08 kN

Pb = 591.36 kN

Reduction factor 'k' for slenderness moment = $(P_{uz} - P_u) / (P_{uz} - P_b) \leq 1$

= 0.9 <= 1, Hence k=0.9

Mslndy = k x 13.87

= 12.47 kNm

Calculation of Design Moment

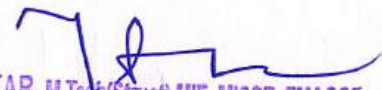
Direction	Manalysis		Mmin (Abs)		Mdesign	Mslndx (Abs)	Mdesign-final
A	B	C	E	F			
Major Axis - Mux		40.15	---	40.15	0	40.15	
Minor Axis - Muy		-1.29	14.18	-14.18	12.47	-26.65	

Where

A = Moments directly from analysis

B = Moments due to minimum eccentricity

C = Maximum of analysis moment and min. eccentricity = Max (A,B)


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E = Moment due to slenderness effect

F = Final design Moment = Max(C- Top Bottom , D- Top Bottom) + E

Final Critical Design Forces

Pu = 708.87 kN

Mux = 40.15 kNm

Muy = -26.65 kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated = 0.49

Reinforcement Provided= 6-T12

Load Angle = Tan-1(Muy/Mux)

= 33.58 deg

MRes = 48.18 kNm

MCap = 122.74 kNm

Capacity Ratio = MRes/ MCap

= 0.39 <= 1

Shear Calculation Along D Along B

Critical Load Combination [20] : 0.9 (LOAD 5: DL) -1.5 (LOAD 1: EQ+X) [20] : 0.9 (LOAD 5: DL) -1.5 (LOAD 1: EQ+X)

Design shear force, Vu (kN) -16.5198 -0.5606

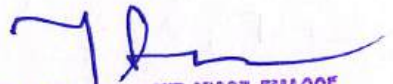
Pu (kN) 348.68 348.68

Deff , Beff (mm) 544 174

Aeff (sqmm) 125120 104400

Design shear stress, Tv Vu / (B x Deff) Vu / (D x Beff)

Tv (N/sqmm) 0.132 0.0054


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NO.15/12,5 TH MAIN ROAD, NANGANALLUR CO-OPERATIVE BUILDING
SOCIETY NANGANALLUR , CHENNAI-600061 COMPRISED T.S NO.3 BLOCK
NO.19 OF NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT
OF GREATER CHENNAI CORPORATION**

Pt (%) 0.246 0.246

Design shear strength, Tc (N/sqmm) 0.3621 0.3621

Shear Strength Enhancement Factor (Compressive Force) $1 + 3 \times Pu / (B \times D \times Fck)$
1.3344 1.4008

Shear Strength Enhancement Factor (Tensile Force) - -

Shear Strength Enhancement Factor (max) 1.5 1.5

Shear Strength Enhancement Factor 1.3344 1.4008

Enhanced shear strength, Tc-e (N/sqmm) 0.4832 0.5072

Design shear check $T_v < T_c \times \text{Enhancement factor}$ $T_v < T_c \times \text{Enhancement factor}$

Shear Links Design Shear Links Not Required Shear Links Not Required

Design Of Links

Links in the zone where special confining links are not required

Normal Links

Diameter of link= 8 mm
> Max. longitudinal bar dia / 4
= 3 mm

Criterion for spacing of normal links

Min. Longitudinal Bar dia X 16 = 192 mm
Min. dimension of column = 230 mm
Max. 300 mm = 300 mm
Provided spacing = 175 mm

Table For Links

Required	Provided			
Normal Design	Shear Design	Ductile Design	Normal Zone	Ductile Zone
Link Dia.	8	---	8	---
Spacing 175	---	---	175	---


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SOCIETY NANGANALLUR , CHENNAI-600061 COMPRISED T.S NO.3 BLOCK
NO.19 OF NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT
OF GREATER CHENNAI CORPORATION**

General Data

Column No. : C1
Level : 15 m To 18 m
Frame Type = Non-Ductile
Response Reduction Factor = 3
Design Code = IS 456 : 2000 + IS 13920 : 2016
Grade Of Concrete = M25 N/sqmm
Grade Of Steel (Main) = Fe415 N/sqmm
Grade Of Steel (Shear) = Fe415 N/sqmm
Grade Of Steel - Flexural Design = Fe415 N/sqmm
Grade Of Steel - Shear Design = Fe415 N/sqmm
Column B = 230 mm
Column D = 600 mm
Clear Cover = 50 mm
Clear Floor Height @ B = 3000 mm
Clear Floor Height @ D = 2400 mm
No Of Floors = 1
No Of Columns In Group = 1
Column Type : UnBraced
Minimum eccentricity check : One Axis at a Time
Code defined D/B ratio : 4
D/B Ratio : $2.61 \leq 4$ Hence, Design as Column

Flexural Design (Analysis Forces)

Analysis Reference No. = 233
Load Combination = [1] : 1.5 (LOAD 5: DL) + 1.5 (LOAD 6: LL)


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Critical Location= Top Joint

Pu = 453.93 kN
Mux = 36.19 kNm
Muy = -1.83 kNm
Vux = -0.68 kN
Vuy = -22.37 kN

Effective Length Calculation

Calculation Along Major Axis Of Column

Joint Column Stiffness Beam Sizes Beam Stiffness Beta

Beam 1

(Length x Width x Depth)

Beam 2

(Length x Width x Depth)

Beam 1 Beam 2

N-m x 10⁶ mm mm N-m x 10⁶ N-m x 10⁶

Bottom 138 7310 x 230 x 600 3170 x 230 x 600 56.635 130.599 0.596

Top 138 7310 x 230 x 600 3170 x 230 x 600 56.635 130.599 0.596

Sway Condition (as per Stability Index) = Non Sway

Effective Length Factor along Major Axis = 0.74

Calculation Along Minor Axis Of Column

Joint Column Stiffness

Beam Sizes

Beam Stiffness

Beta

Beam 1

(Length x Width x Depth)

Beam 2

(Length x Width x Depth)

Beam 1 Beam 2

N-m x 10⁶ mm mm N-m x 10⁶ N-m x 10⁶


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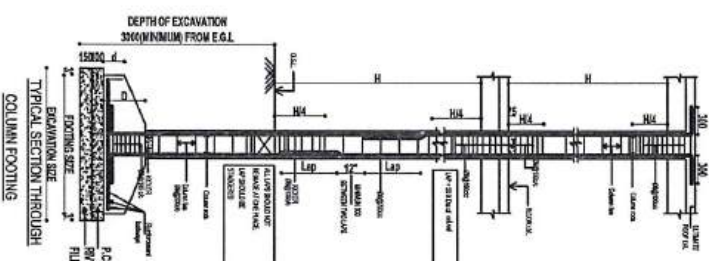
C O L U M N S C H E D U L E

SNO	COLUMN REFERENCE	SIZE	COLUMN SHAPE	MAINSTEEL	BINDERS	BINDERS	TE DETAILS
01.	C1	230X310	LINK BAR	4T25 + 6T20	-REFER- -SECTION-	M ₂₅	
02.	C2	230X310	LINK BAR	10T25	-REFER- -SECTION-	M ₂₅	
03.	C3	300X310	LINK BAR	12T25	-REFER- -SECTION-	M ₂₅	

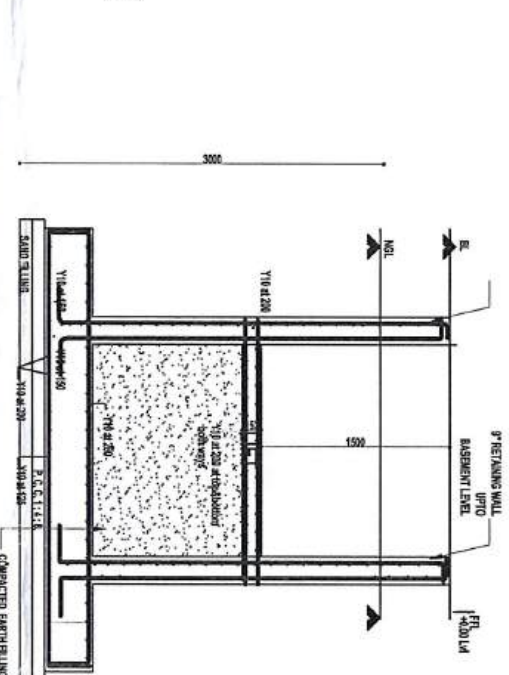
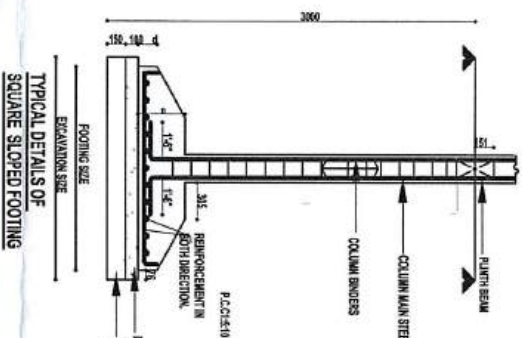
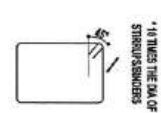
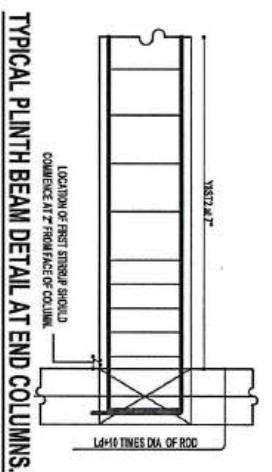
F O O T I N G S C H E D U L E

SNO	FOOTING REF	EX SIZE	FOOTING SIZE	DEPTH	STUB	REINFT	LOCUR	MIX
1	F1	230X230	230X230	300	600	Y12 at 150	Y12 at 150	M ₂₅
2	F2	340X340	330X330	-	-	-REFER SECTION-	-	M ₂₅
3	F3	270X270	250X250	-	600	Y12 at 100	Y12 at 100	M ₂₅

C.S. OF STUB COLUMN



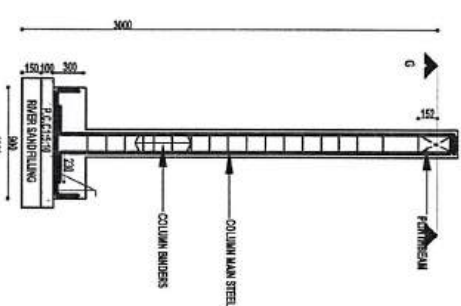
TYPICAL DETAILS OF BINDERS/STRIPS

TYPICAL LIFT PIT/SHEAR WALL DETAILS, F2
(WATER PROOFING TO BE DONE ON BOTH POSITIVE AND NEGATIVE SIDES)

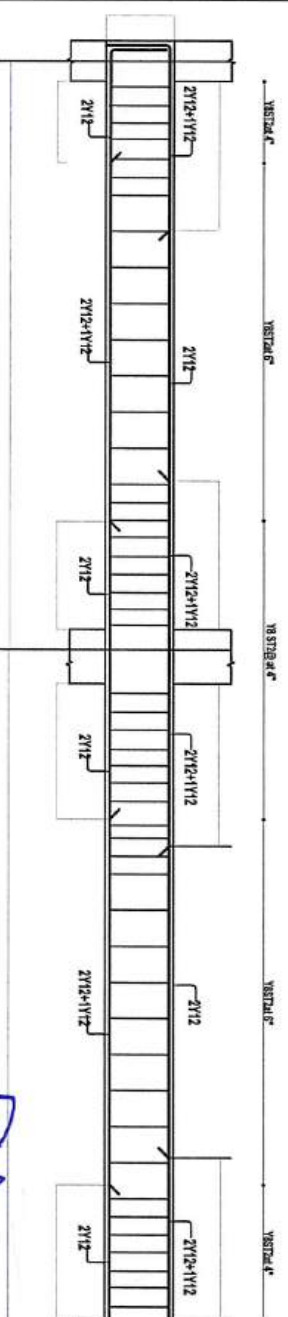
C.S. OF PB1



TYPICAL DETAILS OF STUB COLUMN FOOTING



TYP. DETAIL OF CONTINUOUS PLINTH BEAM PB



PROJECT:

PLAN SHOWING THE PROPOSED CONSTRUCTION OF A STILT FLOOR +5 FLOORS RESIDENTIAL BUILDING AT PLOT NO.C-17 DOOR NO.15/12.5 TH MAIN ROAD, NANGANALLUR CO-OPERATIVE BUILDING SOCIETY COLONY, NANGANALLUR, CHENNAI-600061 COMPRISED IN T.S. NO.3, BLOCK NO. 19 ON NANGANALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT OF GREATER CHENNAI CORPORATION.

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SPECIFIED
 2. M20 GRADE OF CONCRETE FOR COLUMNS AND FE 500 GRADE WITH MCC 320KG CLUM BY DESIGN MIX CONTRIBUTING TO IS 456-2000 AS 10062/1982 OTHER WISE SPECIFIED.
 3. CLEAR COVER TO MAIN STEEL SHALL BE 25MM FOR BEAMS, 25MM FOR COLUMNS, 50MM FOR FOOTINGS.
 4. FOUNDATION IS DESIGNED FOR STILT+6 FLOOR ONLY.
 5. SBC CONSIDERED AT 1M BELOW EXG. GL IS 240 KNSQ/M AS PER SOL REPORT.
 6. BUILDING IS DESIGNED FOR SEISMIC WIND LOAD ONLY.
 7. TYP DENOTES TOP 40 STEEL, CONTRIBUTING TO IS 1778-1985.
 8. TYP DENOTES MID STEEL CONTRIBUTING TO IS 426-1982.
 9. FORM WORK TO BE REMOVED FOR SPANS UP TO 3M - 28 DAYS
 10. 45M - 45M 20 DAYS
 11. AVOID CLAY SOIL FILLING IN BASEMENT.
 12. USE 1:1.2 MIX FOR STARTERS
 13. USE OPC FOR ALL CONCRETE WORKS.
 14. SLAB LENGTH SHALL BE 4 TIMES THE DIA OF BAR.
 15. NO DIMENSION SHOULD BE STAGGERED
 16. ALL COLUMN RODS TO BE STAGGERED
 17. ONLY HATCHED DIMENSION SHOULD BE FOLLOWED.
 18. USE CHAIR RODS FOR TOP REINFORCEMENT
 19. CANTILEVER PROPS SHOULD NOT BE RELEASED UNTIL ROOF IS CONCRETED.
 20. ALL FOOTING RODS BENT UP
 21. ALL BEAM TOP RODS SHALL BE PROPERLY IN COLUMNS
- THIS DRAWING IS THE PROPERTY OF SB CONSULTANTS AND IS NOT TO BE REPRODUCED, COPIED, HANDED OVER TO A THIRD PERSON / PARTY AND FOR ANY PURPOSE OF OTHER THAN FOR WHICH IT HAS BEEN LOANED. ARCHITECTURAL WORKING DRAWING SHOULD READ ALONG WITH STRUCTURAL DRAWING AND ANY DISCREPANCY SHOULD BE BROUGHT TO THE NOTICE OF THE ARCHITECT IMMEDIATELY. ELEVATION LEVELS ARE FINISHED FLOOR LEVEL.
- STRUCTURAL ENGINEER RESPONSIBILITY IS LIMITED TO DESIGN & ISSUAL OF STRUCTURAL DRAWING ONLY
- ONUS OF CONSTRUCTION LIES WITH CONTRACTOR/MAN

R.NO.	REVISION	DATE	SIGN
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1.			
2.			
3.			

PROJECT NO: **C O L U M N & F O O T I N G D E T A I L S**

STRUCTURAL DRAWING

DRG NO : SDPT ONLY.

SCALE : 1/4"=1'-0" & 1/8"=1'-0"

DATE : 17.12.2025

SHEET SIZE : A1

DRAWN BY : KUNA

GOOD FOR CONSTRUCTION

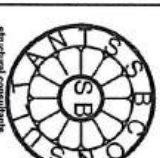
CAD FILE: ESHANKAR2025ANIRUDH FOUNDATION/LEADIN QUBURION

ANIRUDH
FOUNDATION PVT LTD

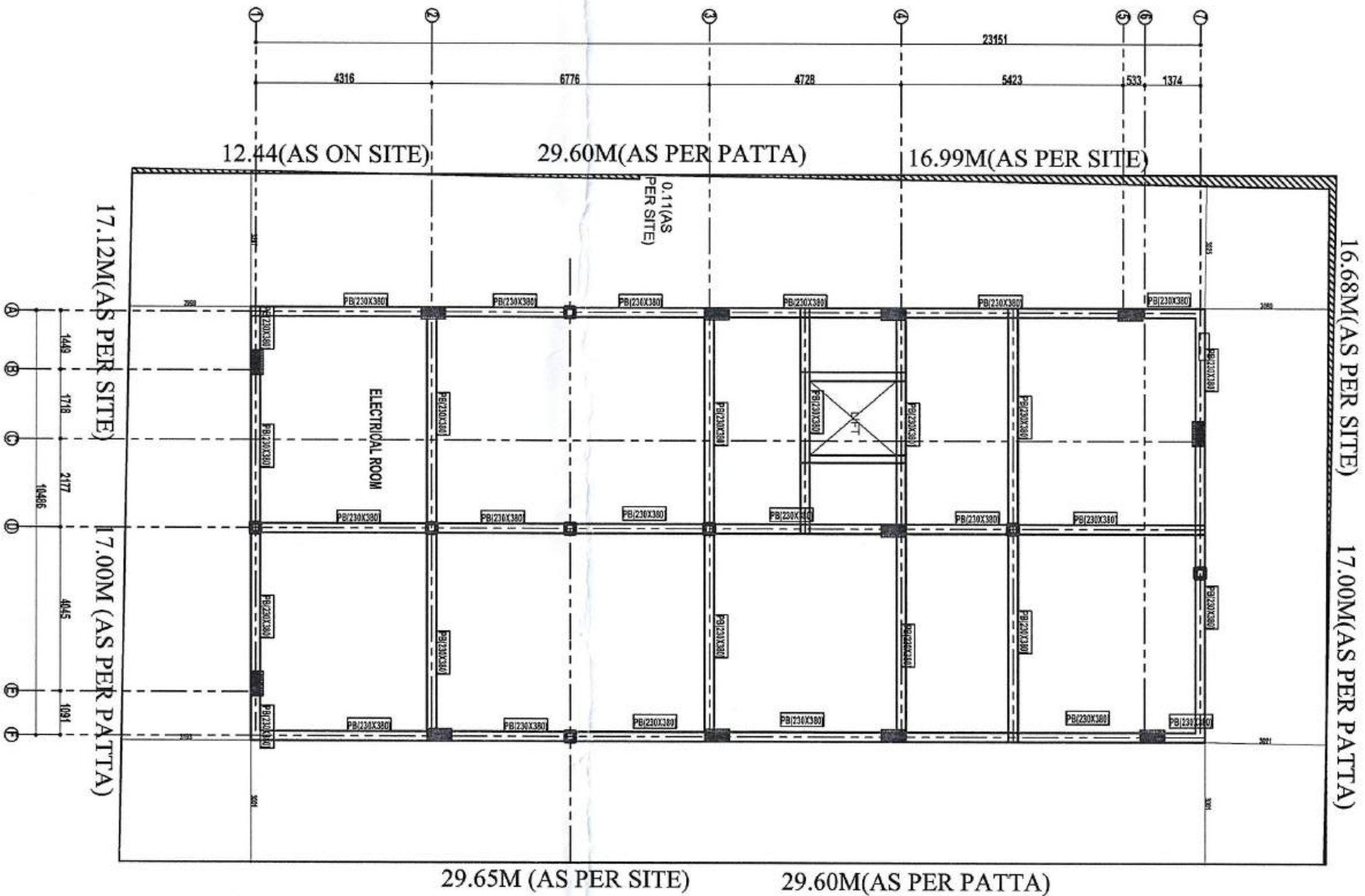
No.4, Lalethra Nagar, 10th Street,
Mangalapuram, Chennai - 600 061
Phone : 98400 51129, 97911 12935
E-mail : anirudh@anirudh.com
Web : www.anirudh.com



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Call: 9282102586 / 9952050643
Email: structshankar@yahoo.com



PLINTH BEAM LAYOUT

E.M. SHANKAR, M.Tech (Struct), M.E., M.S.E., P.M.A.C.E.
 CMDA Regd. Structural Engineer GR-1 (SE-1)
 Reg No. SE/2024/0037
SB CONSULTANTS
 No.11, Thiradi Street, Pallikarai, Chennai-600 100.
 Cell: 9282102586 / 9952050643
 Email: structshankar97@yahoo.com

PROJECT:
 PLAN SHOWING THE PROPOSED CONSTRUCTION OF A STILT FLOOR +5 FLOORS RESIDENTIAL BUILDING AT PLOT NO.C-17 DOOR NO.1512.5 TH MAIN ROAD, NANGAMALLUR CO-OPERATIVE BUILDING SOCIETY COLONY, NANGAMALLUR, CHENNAI-600061 COMPRISED IN T.S. NO.3, BLOCK NO. 19 ON NANGAMALLUR VILLAGE ALANDUR TALUK WITH IN THE LIMIT OF GREATER CHENNAI CORPORATION.

NOTES:

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE SPECIFIED.
2. THE GRADE OF CONCRETE FOR COLUMNS AND BEAMS SHALL BE M25 GRADE WITH M25 GRADE CEMENT CEMENT RATIO SHALL BE 1:1.5:3.0 AND FOR SLABS SHALL BE M20 GRADE WITH M20 GRADE CEMENT RATIO SHALL BE 1:1.5:3.0.
3. ALL DIMENSIONS SHALL BE TO FACE UNLESS OTHERWISE SPECIFIED.
4. ALL DIMENSIONS SHALL BE TO FACE UNLESS OTHERWISE SPECIFIED.
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19. ALL DIMENSIONS SHALL BE TO FACE UNLESS OTHERWISE SPECIFIED.
20. ALL DIMENSIONS SHALL BE TO FACE UNLESS OTHERWISE SPECIFIED.

SL. NO.	REVISION	DATE	BY
1.			
2.			
3.			

PROJECT NO. PLINTH BEAM LAYOUT

DESIGN NO. : SP-01 DWT.
SCALE : 1/4"=1' & 1/8"=2'
DATE : 11.12.2025
SHEET NO. : A1
DESIGNED BY : KJana

CAD FILE: EBMANKAR2025ANIRUDH FOUNDATION/CHENNAI BURUNDU
 GOOD FOR CONSTRUCTION

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