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Architect & Structural Consultants	**M/s. MP Developers construction Pvt. Ltd.**
Project	**Proposed Residential Building at Shri Krishna Nagar, Maduravoyal, Chennai**
Floors	**Stilt + 5 Floors**

A.N.MAGESH RAJA, M.E., (Structural Engineer)
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1 INTRODUCTION

1.1 General

This document details the input data, principles, methods and performance criteria to be used in the structural engineering design of the project.

1.2 Scope

The proposed Residential building with 27 dwelling units at Shri Krishna Nagar 27th Street, Maduravoyal, Chennai - 600095, Comprised In Old S.Nos. 302/1, 303/1b, New S.Nos. 302/16, 303/37 & 303/38 of Maduravoyal Village, Maduravoyal Taluk, Chennai District Within The Limit Of Greater Chennai Corporation. This report presents details of structural analysis and design of the residential building. The sizes and details of the sections of RC elements are based on detailed analysis, which is elaborated in this report. This report specifies the details of structural analysis, material properties, loads and load combinations, design summary for beams, columns, footings and slabs.

2 DESCRIPTION OF BUILDING

The proposed residential building consists of a stilt floor with three upper floors (Stilt + 5 storeys). The height of the stilt storey is 3 m, while the typical floor height for the upper storeys is 3 m each. The total building height is 18 m, measured from the Finished Floor Level (F.F.L).

The foundation system comprises Pile foundation, selected based on soil conditions and structural requirements. The Load carrying Capacity of bored cast in-situ piles has been adopted in accordance with the Geotechnical Investigation Report.

LOADS & LOAD COMBINATIONS

3.1 General

This chapter discusses applicable loading for structural analysis & design of the proposed building. The loading is classified and described in the following paragraphs.

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3.2 Description of types of loading & Load calculation

Dead load, Live Loads and Seismic Loads are considered for analysis and design as per relevant Indian Standards and Specifications applicable to Chennai region.

The sizes of members have been fixed based on stiffness criterion and based on compatibility with architectural drawings.

3.2.1 Dead load comprises of self-weight of various structural elements indicated below:

- Self-weight of Columns, beams, and red brick walls.
- Floor & roof finishes.

Self-weight of the modeled elements is calculated by Staad.Pro through SELF WEIGHT command. The self-weight of slab and floor finishes is applied explicitly as floor loads and distributed on the beams as trapezoidal or triangular loads in two way slabs and as rectangular loads in one way slab by using FLOOR LOAD command in STAAD.

Loads from components like walls are applied explicitly as member loads and UDL (Uniformly Distributed Load) as applicable.

Dead Load considered on slab: Self Weight + 1.5 kN/m^2 for Floor Finish.

= 0.125X25 = 3.125Kn/m^2.

Brick Wall load	= 4.6 kN/m (from NGL to FFL=0.23X20X1)
Red brick Wall load (9" Thk)	= 12kN/m (0.23 X 20 X (3-0.38))
Red brick Wall load (4.5" Thk)	= 6kN/m (0.115X 20 X (3-0.38))
Brick Wall load (Parapet)	= 5kN/m (0.23x1.1x20)
Staircase load	= 9.4 kN/m (RCC staircase)
Water Tank	= 15kN/m^2 (1200 mm height)
Lift	= 15kN/m^2
Floor finish	= 2kN/m^2 (Terrace)

3.2.2 Live Loads are considered for the analysis in addition to dead loads as follows,

Live Load considered on slab	=2 kN/m^2 (Typical floor)
Live Load considered on slab	=1.5 kN/m^2 (Terrace floor)
Staircase load	= 6 kN/m (RCC staircase)

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3.3 WIND LOAD

Wind loads are considered in the structural design in accordance with the applicable design code. The basic wind speed is 50m/sec, as per the code requirements for the project location. Wind pressure is calculated based on terrain category, building height, importance factor, and topography factor. The calculated wind loads are applied to the structural model in both principal directions and combined with other relevant load cases and load combinations as specified by the design code.

3.4 EARTHQUAKE LOAD

The loading due to earthquake is assessed based on the provisions of IS: 1893 (Part-1):2016

Seismic Zone	= III
Table-3 Zone factor (Z)	= 0.16
Table-8 Importance Factor (I)	= 1
Table-9 Response Reduction Factor (R)	= 5

Building frame system (OMRF) as per table 9 clause 7.3.1 of IS 1893 2016

Height of building (H) =13.7m

Base dimension of part of the building along the considered direction of Lateral force (D)

Fundamental Natural time period

T_s **= 0.09H/√d** from CL - 7.6.2 - IS 1893 (Part-I) 2016

S_a/g = from FIG-2 IS 1893 (part-I) 2016

The respective natural time period can be referred from the respective model.

Horizontal Seismic Co-efficient

Ah = (Z/2) x (I/R) x (S_a/g)

Seismic Base Shear

Vb = Ah x W

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As per IS: 1893 – 2016, (Table 10), percentage of imposed loads to be considered

for seismic weight calculation is mentioned below:

Imposed Uniformity Distributed Floor Load Loads (kN/ m2)	Percentage of Imposed
Up to & including 3.0	25
Above 3.0	50

3.4 LOAD COMBINATIONS

Strength combinations:

- 1.5DL + 1.5 LL
- 1.5DL (+/-)1.5 WL/EQ Load
- 1.2DL +1.2LL (+/-) 1.5 WL/EQ Load
- 0.9DL (+/-) 1.5 WL/EQ Load

Serviceability combinations:

- DL + LL
- DL +0.8 LL(+/-) 0.8 WL/EQ Load
- DL (+/-) WL/EQ Load.

4 MATERIAL PROPERTIES

4.1 General

This chapter describes the physical and elastic properties for various materials used. These are used for defining the stiffness calculation of the modeled structural members.

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4.2 Elastic & Physical Properties

The elastic properties of materials used are tabulated below in Table 1

Table.1 – **Elastic properties of materials**

S.No.	Material	Elastic Modulus (kPa)	Poisson's Ratio
1	Normal density reinforced concrete (M25 Grade)	25×10^3 calculated using $5000\sqrt{fck}$	0.2

4.3 Grade of Reinforcement

Reinforcement of Grade Fe-550 is used for RCC design.

4.4 Unit Weight of Materials

Unit weight of various materials used are given below

Reinforced cement concrete = 25 kN/m^3

Brick masonry = 20 kN/m^3

5. DESIGN METHODOLOGY

All structures have been designed according to the Limit State Method as specified in IS: 456-2000 & IS 1893 - 2016. Appropriate loads and its combinations, as per relevant clauses in IS 456:2000 code, for the most unfavorable effects are chosen for design.

6. COVER TO REINFORCEMENT

The clear cover to main reinforcement shall be as follows.

Foundation (pile cap) = Top/Bottom: 50mm, Sides: 50mm

Pile =: 50mm

Slab = 20mm

Columns = 40mm

Beams = 25m

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7. FOUNDATION SYSTEM

Foundation systems are based on recommendations given as per soil investigation report by Mars Synergy Geo tech private limited.

8. CODES & STANDARDS

All the design are conforming to the relevant Indian Standards. Some of the relevant Indian Standard Codes, which have been followed for the structural design are given below.

	Description
IS:875 (Part-1)-1987	Code of Practice for Design Loads (Other than Earthquake) for Building and Structures-Unit Weights of Buildings Materials and Stored Material.
IS:875 (Part-2)-1987	Code of Practice for Design Loads (Other than Earthquake) for Building and Structures-Imposed loads
IS:875 (Part-3)-2015	Code of Practice for Design Loads (Other than Earthquake) for Buildings and Structures –Wind Load.
IS:456 (Part-1)-2000	Code of Practice for Plain and Reinforced Concrete
IS:1893 (Part-1)-2016	Indian Standard Criteria for Earthquake Resistant Design of Structures.
IS:432 (Part-2)-1982	Specification of Mild Steel and Medium Tensile Steel bars and Hard drawn Steel Wire for concrete reinforcement – Hard drawn Steel Wire.
IS:1904	Indian Standard Code of practice for Design & Construction foundations in Soil: General Requirements.

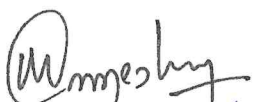
9. STRUCTURAL ANALYSIS

The Building structures are analyzed using STAAD PRO for various load combination as per Indian Codes.

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PILE CAP DESIGN(Grid-D/19)

Design Code	:	IS 456 : 2000 + IS 13920 : 2016	[
Pilecap No	:	PC28	[
Column No	:	C28	(300mm x 750mm)
Member Ref. No	:	28	[
[	[	[	[
Concrete Grade	:	M25	[
Steel Grade	:	Fe550	[
Clear Cover	:	50	mm
Top of pile-cap below ground	:	0.1	m
[	[	[	[
Density of Soil	=	18	kN/cum
Founding Depth	=	1	m
Pile Capacity in Compression	=	1250	kN
Pile Capacity in Tension	=	700	kN
Pile Capacity in Shear	=	56	kN
Pile Capacity Reduction	=	0	%
Pile Overloading	=	10	%
Pile Group Overloading	=	10	%
Pile Capacity Increase for EQ	=	25	%
Pile Capacity Increase for Wind	=	25	%
Live Load Reduction	=	0	%
[	[	[	[
Consider Capacity Design	:	No	[
Consider Overburden Pressure	:	No	[
[	[	[	[
No. of Piles	=	3	[
Pile Diameter	=	600	mm
Pilecap Offset	=	150	mm
Pile Spacing	=	2.75	x □
Pilecap Size	=	2170	mm (edge)
Pilecap Depth	=	900	mm
Pile-cap Wt.	=	92.427	kN
[	[	[	[
[	[	[	[
□			



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Check for Maximum Compressive Load on One Pile:

Critical Analysis Load Combination	:	212	
Critical Load Combination	:	[19] : (LOAD 3: DL) +0.8 (LOAD 4: LL) +0.8 (LOAD 1: EQ X)	
Pcomb	=	2809.66	kN
Ptotal	=	Pcomb + Pilecap Wt.	
[	=	2902.09	kN
Mx	=	96.42	kNm
My	=	16.8	kNm
P	=	Ptotal/ No. of Piles	
[	=	967.36	kN
Pmx	=	33.738	kN
Pmy	=	10.181	kN
[	[	[	[
Maximum Compressive load on pile	=	1011.28	kN
Allowable Compressive load on pile	=	1250 x 1.25 x 1.1	
[	=	1718.75	kN
[			

Check for Maximum Compressive Load on Pile Group:

Critical Analysis Load Combination	:	201	
Critical Load Combination	:	[14] : (LOAD 3: DL) +(LOAD 4: LL)	
Pcomb	=	2780.97	kN
Ptotal	=	Pcomb + Pilecap Wt.	
[	=	2873.4	kN
Mx	=	1.66	kNm
My	=	1.84	kNm
[	[	[	[
Maximum Compressive load on pile group	=	2873.39	kN
Allowable Compressive load on pile group	=	3 x 1250 x 1.1	
[	=	4125	kN
[			

Check for Maximum shear on Pile Group:

Critical Analysis Load Combination	:	204	
Critical Load Combination	:	[15] : (LOAD 3: DL) +(LOAD 1: EQX)	
Pcomb	=	2543.42	kN
Ptotal	=	Pcomb + Pilecap Wt.	
[	=	2635.85	kN
Mx	=	119.21	kNm
My	=	20.37	kNm
Vx	=	9.7	kNm
Vy	=	43.81	kNm
Maximum shear on pile group	=	sqrt(9.7^2 + 43.81^2)	

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	= 44.87	kN	
Shear capacity of pile group	= 3 x 56 x 1 x 1.25		
[	= 210	kN	
[			

Check for Tensile Load on One Pile:

No Tensile load in pile group.

[

Check for Maximum Tensile Load on Pile Group:

No Tensile load in pile group.

[

Design for Bending:

Bottom Reinforcement Along Parallel Edge

Critical Analysis Load Combination	: 101		
Critical Load Combination	: [23] : 1.5 (LOAD 3: DL) +1.5 (LOAD 4: LL)		
Pcomb	= 4171.45	kN	
Ptotal	= Pcomb + Pilecap Wt.		
[	= 4310.09	kN	
Mx	= 2.49	kNm	
My	= 2.75	kNm	
Ppile	= Max Load on pile		
[	= 1439.24	kN	
[	[[	[	
Deff	= 820	mm	
Beff	= 900	mm	
DfCol	= 0.67	m	
BMux	= Ppile x DfCol		
[	= 971.48	kNm	
PtReq	= 0.36	%	
AstReq (BM)	= 2993	sqmm/m	
AstPrv	= T20 @ 100 C/C		
[	= 3141.6	sqmm/m	
[			

Top Reinforcement Along Parallel Edge

There is no Tensile Force, hence Minimum Percentage of steel will be provided.

[

D	= 900	mm	
AstReq (BM)	= Min Pt for Top Reinforcement x D x 1000/100		
[]	= 0.06 x 900 x 1000/100		
[	= 540	sqmm/m	
AstPrv	= T10 @ 145 C/C		

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[= 541.66 sqmm/m

[

Bottom Reinforcement Along Perpendicular Edge

Critical Analysis Load Combination : 101

Critical Load Combination : [23] : 1.5 (LOAD 3: DL) +1.5 (LOAD 4: LL)

Pcomb = 4171.45 kN

Ptotal = Pcomb + Pilecap Wt.

[= 4310.09 kN

Mx = 2.49 kNm

My = 2.75 kNm

Ppile = Max Load on pile

[= 1434.95 kN

[[[[

Deff = 840 mm

Beff = 900 mm

DfCol = 0.58 m

BMuy = Ppile x DfCol

[= 828.87 kNm

PtReq = 0.29 %

AstReq (BM) = 2449 sqmm/m

AstPrv = T20 @ 125 C/C

[= 2513.28 sqmm/m

[

Top Reinforcement Along Perpendicular Edge

There is no Tensile Force, hence Minimum Percentage of steel will be provided.

[

D = 900 mm

AstReq (BM) = Min Pt for Top Reinforcement x D x 1000/100

= 0.06 x 900 x 1000/100

[] = 540 sqmm/m

AstPrv = T10 @ 145 C/C

[= 541.66 sqmm/m

[[[[

[

Design for One Way Shear:

Along Parallel Edge (Compression Case)

Critical Analysis Load Combination : 101

Critical Load Combination : [23] : 1.5 (LOAD 3: DL) +1.5 (LOAD 4: LL)

Pcomb = 4171.45 kN

Ptotal = Pcomb + Pilecap Wt.

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[	=	4310.09	kN
Mx	=	2.49	kNm
My	=	2.75	kNm
Ppile	=	Max Load on pile	
[	=	1439.237	kN
[	[	[	[

Location of critical section is at d/2 from face of column

Section Location from column center	=	560	mm
[	[	[	[
Data for Piles	[	[	[

Pile No	Load (kN)	% covered	Shear (kN)
P1	1434.95	0	0
P2	1435.9	5.83	1352.14
P3	1439.24	5.83	1355.28

[

Design Shear Force (Vu)	=	Max. of (Shear due to P2, P3)	
[	=	1355.28	kN
Deff	=	820	mm
Beff	=	1808.99	mm
Tv	=	Vu/(Beff x Deff)	
[	=	0.91	N/sqmm
Tc	=	0.429	N/sqmm
Av	=	265	mm
Shear enhancement factor	=	2 x Deff / A v	[]
[	=	6.19	
Enhanced shear strength (Tce)	=	2.655	N/sqmm
Tv	<	Tce, Hence Shear Reinforcement is not required	

[

Along Parallel Edge (Tension Case)

All Load Combination having Compressive Force. Thus, One way Shear is not applicable for Tensile For ce.

[

Along Perpendicular Edge (Compression Case)

Critical Analysis Load Combination	:	101
Critical Load Combination	:	[23] : 1.5 (LOAD 3: DL) +1.5 (LOAD 4: LL)
Pcomb	=	4171.45 kN
Ptotal	=	Pcomb + Pilecap Wt.
[	=	4310.09 kN
Mx	=	2.49 kNm
My	=	2.75 kNm
Ppile	=	Max Load on pile
[	=	1439.237 kN
[	[	[[

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Location of critical section is at d/2 from face of column

Section Location from column center = 795 mm

Data for Piles

Pile No	Load (kN)	% covered	Shear (kN)
P1	1434.95	23.73	1094.46
P2	1435.9	0	0
P3	1439.24	0	0

Design Shear Force (Vu) = Max. of (Shear due to P1, P2+P3)

= 1094.46 kN

Deff = 840 mm

Beff = 1221.24 mm

Tv = Vu/(Beff x Deff)

= 1.07 N/sqmm

Tc = 0.39 N/sqmm

Av = 157.63 mm

Shear enhancement factor = 2 x Deff / Av

= 10.66

Enhanced shear strength (Tce) = 3.1 N/sqmm

Tv < Tce, Hence Shear Reinforcement is not required

Along Perpendicular Edge (Tension Case)

All Load Combination having Compressive Force. Thus, One way Shear is not applicable for Tensile For ce.

Design of Face Reinforcement:

Asfr Req = SFR % x D x Beffsfr

= 0.05 x 900 x 500 / 100

= 225 sqmm

Asfr Prv = 3-T10

= 236 sqmm

Check for Load Transfer from Column to PileCap

Critical Analysis Load Combination = 101

Critical Load Combination : [23] : 1.5 (LOAD 3: DL) +1.5 (LOAD 4: LL)

P = 4171.45 kN

A2 = 0.22 sqm

A1 = 4.11 sqm

Base Area = 4.11 sqm

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A1	< Base Area	[
Modification Factor	= SquareRoot(A1/A2) < = 2	
SquareRoot(A1/A2)	= 4.27	[
Thus, Modification Factor	= 2	[
Concrete Bearing Capacity	= 0.45 x Fck x Modication Factor x Column Area	
[	= 5062.5	kN
Concrete Bearing Capacity	> P, Hence Safe.	

[

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Column design

General Data

Column No.	:	C28	
Level	:	3.6 m To 5.1 m	
Frame Type	=	Ductile	
Response Reduction Factor	=	5	
Design Code	=	IS 456 : 2000 + IS 13920 : 2016	
Grade Of Concrete	=	M25	N/sqmm
Grade Of Steel (Main)	=	Fe550	N/sqmm
Grade Of Steel (Shear)	=	Fe550	N/sqmm
Grade Of Steel - Flexural Design	=	Fe550	N/sqmm
Grade Of Steel - Shear Design	=	Fe415	N/sqmm
Column B	=	300	mm
Column D	=	750	mm
Clear Cover	=	40	mm
Clear Floor Height @ B	=	3370	mm
Clear Floor Height @ D	=	3370	mm
No Of Floors	=	1	
No Of Columns In Group	=	1	
Column Type	:	UnBraced	
Minimum eccentricity check	:	Simultaneously (Both Axis)	
Code defined D/B ratio	:	4	
D/B Ratio	:	2.5 <= 4 Hence, Design as Column	

Flexural Design (Analysis Forces)

Analysis Reference No.	= 71	
Critical Analysis Load Combination	: 101	
Load Combination	= [1] : 1.5 (LOAD 3: DL) +1.5 (LOAD 4: LL)	
Critical Location	= Bottom Joint	
Pu	= 4038.67	kN
Mux	= -47.76	kNm
Muy	= 16.12	kNm
Vux	= -11.97	kN
Vuy	= -40.6	kN

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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	703.125	No Beam	No Beam	-	-	0.968
Top	703.125	8450 x 230 x 600	5550 x 230 x 530	48.994	51.414	0.933

Sway Condition (as per Stability Index) = Sway

Effective Length Factor along Major Axis = 1

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	112.5	No Beam	No Beam	-	-	0.872
Top	112.5	No Beam	4700 x 230 x 530	-	60.712	0.788

Sway Condition (as per Stability Index) = Sway

Effective Length Factor along Minor axis = 1

Minimum Eccentricity Check

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

Minimum Eccentricity Along D:

Minimum Eccentricity	=	Unsupported Length / 500 + D / 30	
[[[[[[[[	=	31.74	mm
Minimum Eccentricity	>	20	mm
Mminx	=	Pu x Minimum Eccentricity	
	=	128.19	kNm

Minimum Eccentricity Along B :

Minimum Eccentricity	=	Unsupported Length / 500 + B / 30	
[[[[[[[[	=	16.74	mm
Mminy	=	Pu x Minimum Eccentricity	
	=	80.77	kNm

Slenderness Check

Max Slenderness Ratio(L/B) = 11.23

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	<	60	(Hence Ok)

Column Is Unbraced Along D

Slenderness Check Along D:

[[[[[[[[Effective Length Factor	=	1	
[[[[[[[[Slenderness Ratio	=	Effective Length / D	
	=	4.49, Column not Slender Along D	

Column Is Unbraced Along B

Slenderness Check Along B:

[[[[[[[[Effective Length Factor	=	1	
[[[[[[[[Slenderness Ratio	=	Effective Length / B	
	=	11.23, Column Not Slender Along B	

Calculation of Design Moment

Direction	Manalysis	Mmin (Abs)	Mdesign	Mslndx (Abs)	Mdesign-final
	A	B	C	E	F
Major Axis - Mux [	-47.76	128.19	-128.19	0	-128.19
Minor Axis - Muy	16.12	80.77	80.77	0	80.77

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	=	4038.67	kN
Mux	=	-128.19	kNm
Muy	=	80.77	kNm

Resultant Moment (Combined Action)

Moment Capacity Check

Pt Calculated	=	2.55	
Reinforcement Provided	=	12-T25	
Load Angle	=	Tan^{-1}(Muy/Mux)	
	=	32.22	deg
MRes	=	151.51	kNm
MCap	=	200.2	kNm
Capacity Ratio	=	MRes/ MCap	

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= 0.76 <= 1

Shear Calculation	Along D	Along B
Critical Analysis Load Combination	113	113
Critical Load Combination	[7] : 1.5 (LOAD 3: DL) -1.5 (LOAD 1: EQX)	[7] : 1.5 (LOAD 3: DL) -1.5 (LOAD 1: EQX)
Design shear force, Vu (kN)	-93.6173	-25.6554
Pu (kN)	3277.29	3277.29
Deff , Beff (mm)	697.5	247.5
Aeff (sqmm)	209250	185625
Design shear stress, Tv	Vu / (B x Deff)	Vu / (D x Beff)
Tv (N/sqmm)	0.4474	0.1382
Pt (%)	1.274	1.274
Design shear strength, Tc (N/sqmm)	0.7008	0.7008
Shear Strength Enhancement Factor (Compressive Force)	1 + 3 x Pu / (B x D x Fck)	
[	2.8795	3.1187
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, Tc-e (N/sqmm)	1.0512	1.0512
Design shear check	Tv < Tc x Enhancement factor	Tv < Tc x 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

Diameter of link	=	8	mm
[	>	Max. longitudinal bar dia / 4	
[	=	6.25	mm

Criterion for spacing of normal links

Min. Longitudinal Bar dia X 16	=	320	mm
Min. dimension of column	=	300	mm
Max. 300 mm	=	300	mm
Provided spacing	=	300	mm

[

[

Table For Links

	Required			Provided	
	Normal Design	**Shear Design**	**Ductile Design**	**Normal Zone**	**Ductile Zone**
Link Dia.	8	---	---	8	---
Spacing	300	---	---	300	---

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SLAB DESIGN

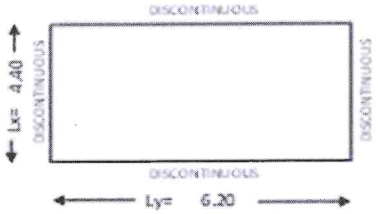
					Level	FF LVL								
Along Grid	:(A-D/2-4)							slab Refl.	S4					
INPUT DATA														
Slab								**Loads**						
Shorter Span	Lx =	4.400	m					Dead Load	DL =	3.75	kN/m²			
Longer Span	Ly =	6.200	m					Live load	LL =	2.00	kN/m²			
Thickness of Slab	D =	150	mm					Floor Finishes	FF =	1.50	kN/m²			
Clear Cover	d' =	25	mm					False Ceilling Load	=	0.25	kN/m²			
Ly/Lx ratio	k =	1.41	Two-Way Slab					Total Load	w =	7.50	kN/m²			
Panel Type								**Materials**						
Basic L/d ratio	=	26						Grade of Concrete	=	25	N/mm²			
Edge Condition:	=	9						Grade of Reinf. Steel	=	550	N/mm²			
Four Edges Discontinuous								Young's Modulus E		2.50E+04	N/mm²			

DESIGN

Direction	BM Coefficients (IS:456-2000)		Flexural Design Mu	Ast_{req}	Ast_{pro}	dia & Required Spacing 8	10	12	16	Provided Reinforcement			
			kNm	mm²	mm²	mm	mm	mm	mm				
Shorter Span	αX (-) =	0.0000	0.000	144	707	300	300	300	300	10 @	125	Safe	
	αX (+) =	0.0854	18.592	346	707	145	227	300	300	10 @	125	Safe	
Longer Span	αY (-) =	0.0000	0.000	144	550	300	300	300	300	10 @	150	Safe	
	αY (+) =	0.0560	12.197	222	550	227	300	300	300	10 @	150	Safe	

CHECK FOR DEFLECTION

Area of Steel required = 346 mm²
Area of Steel Provided = 707 mm²
Steel stress of service load = 156.08 N/mm²
Provided reinforcement (%) = 0.59%
Modification ratio MF = 1.712
Effective depth required for deflection point of view
d_{req} = 98.82183 mm
Eff. depth provided d = 120 mm Safe



SLAB SUMMARY

Shorter Span: Provide T 10 @ 125 mm c/c + 1 T 10 Extra between the two cranked bars
Longer Span: Provide T 10 @ 150 mm c/c + 1 T 10 Extra between the two cranked bars

CHECK FOR SHEAR

Max Shear Force	=	25	KN
Actual Shear stress	τv =	0.206	N/mm2
P_t of A_{st}	=	0.59%	
Design Shear Stress	τc =	0.52	N/mm²

Shear is less than Design Shear Stress, Hence Safe against shear

NOTES

1. Crank alternate bars at 0.3 times the respective span.
2. Provide 12mm dia chairs at 1000mm c/c in both directions.
3. Provide 6 mm thick cover blocks at 600mm c/c in both directions.

Reinforcement Summary:
Along Shorter Span
Provided T10@ 125mm c/c
Along Longer Span
Provided T10@ 150mm c/c

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BEAM DESIGN

IS-456 LIMIT STATE DESIGN
BEAM NO. B216 DESIGN RESULTS

M25 Fe550 (Main) Fe550 (Sec.)

Length: 3300.0 mm Size: 230.0 mm X 530.0 mm Cover: 25.0 mm

Sunnary of Reinforcement Area (Sq.mm)

Section	0.0 mm	825.0 mm	1650.0 mm	2475.0 mm	3300.0 mm
Top Reinforcement.	1712.30 (Sq. mm)	826.69 (Sq. mm)	174.88 (Sq. mm)	0.00 (Sq. mm)	489.56 (Sq. mm)
Bottom Reinforcement.	843.51 (Sq. mm)	0.00 (Sq. mm)	175.16 (Sq. mm)	857.81 (Sq. mm)	1378.73 (Sq. mm)

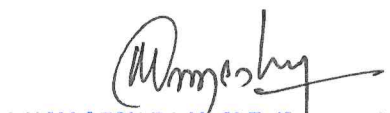
Summary of provided Reinforcement Area

Section	0.0 mm	825.0 mm	1650.0 mm	2475.0 mm	3300.0 mm
Top Reinforcement.	6-20d 2 layer(s)	3-20d 1 layer(s)	3-20d 1 layer(s)	3-20d 1 layer(s)	3-20d 1 layer(s)
Bottom Reinforcement.	5-20d 2 layer(s)	3-20d 1 layer(s)	3-20d 1 layer(s)	5-20d 2 layer(s)	5-20d 2 layer(s)
Shear Reinforcement.	2 legged 8d @ 160 mm c/c	2 legged 8d @ 110 mm c/c	2 legged 8d @ 110 mm c/c	2 legged 8d @ 155 mm c/c	2 legged 8d @ 160 mm c/c

Shear Design Results at distance d (EffectiveE Depth) From Face of the Support

Shear Design Results at 776.7 mm AWay From StartT Support
VY = 200.77 MX = -12.82 LD= 4
Provide 2 Legged 8d @ 105 mm c/c

==========



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THE LANDLENS SUITE

Eight ways to know a piece of land before you pay for it.

This report covers one part of the picture. These cover the rest, drawn from the same government records, for any property in Tamil Nadu.

LandLens One
Ask anything about a property and get an answer grounded in live government records, with the sources shown.
/landlens/one

Verify My Land
Every record check run on one property and returned as a single report.
/landlens/verify-my-land

Legal Opinion
An advocate's written opinion on the title, built on the records we pull for it.
/landlens

One Map
Every layer on one map: the parcel, its boundary, zoning, water bodies and what sits around it.
/landlens/one/map

PriceMap
What land actually changed hands for around this plot, taken from the registered deeds.
/landlens/pricemap

Build Scope
What you are allowed to build here: floor space, height, coverage and setbacks.
/landlens/build-scope

Property Tracker
Watch a property and hear about it when something new is registered against it.
/landlens/property-tracker

Deal Room
Run the transaction in one place: documents, stamping, signatures and the parties.
/landlens/deal-room

FREE TOOLS · NO ACCOUNT NEEDED

Twenty-four checks you can run yourself, at no cost.

Records and verification

The registers themselves, read for you.

- Encumbrance Certificate
- Patta and Chitta
- Field Measurement Sketch
- EC Analyzer
- Bank charge check
- Court case search
- Seller background check
- Approval check by survey

Value and duty

What it is worth and what it costs to register.

- Guideline value by street
- Guideline value by survey
- Stamp duty and registration fees
- Capital gains
- Floor space index
- Area unit converter

Zoning and land use

What the plan says can happen on this land.

- Land use zone finder
- CMDA land use check
- Coastal regulation zone
- Master plan check
- Water bodies finder
- Airport height clearance

Registers and directories

Who holds it, and which office keeps the record.

- Find your registering office
- Temple property check
- Waqf property check
- RERA register

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The LandLens suite
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