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S.G CONSULTANTS.,

PLANNING | STRUCTURAL | ESTIMATION | CONSTRUCTION

STRUCTURAL ENGINEER GRADE-I REG NO: 3-1299/PPA/LIC/RE/2022, Pondy

STRUCTURAL ENGINEER GRADE-II REG NO: SE/GR-II/19/08/141, CMDA, Chennai

STRUCTURAL ENGINEER GRADE-II REG NO: CGLDIST/SE/GR-II/2023/12/009, DTCP, TAMIL NADU

MOBILE NO: +91-9789455270 Email id: ganeshramu1987@gmail.com

Er.R.GANESH, M.Tech **DATE: 26.02.2025**

STRUCTURAL STABILITY CERTIFICATE

CLIENT NAME: MRS.RADIKAA SARATHKUMAR

The detailed engineering and structure design of the proposed building comprising of Stilt+3 floors at Door.No.3&4, Paul Appaswamy Street, T.Nagar, Chennai -600017 Comprised in T.S.No.8319/3, 8327/1 & 8328, Block No.109 of T.Nagar Village has been done by me/us based on the report of Geotechnical investigation (Soil Test) done by NAGADI CONSULTANTS PVT.LTD Chennai, Report No: G (C) 9019A Dated 5.05.2017 and considering the functional requirement of the building.

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

3. We further certify that:

(i) Foundation & its vertical elements is designed for Stilt +3 Floors Commercial building considering relevant Commercial Building Loadings.

(ii). The minimum grade of concrete used in the structural design is M25

(iii).The Analysis and design carried out for the intended Commercial Building loading as per the code of practice IS 875 Part 1 to 2,wind forces as per IS875 and seismic forces as per the seismic code of practice IS 1893

(iv). Design of Structural elements carried out as per the stipulations made in the code of practice IS 456 & IS 13920.

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

R. Ganesh

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DESIGN METHODOLOGY REPORT FOR FOUR STORIED COMMERCIAL BUILDING AT CHENNAI

CLIENT : MRS.RADIKAA SARATHKUMAR

LOCATION : PAUL APPASWAMY STREET,
T.NAGAR, CHENNAI

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INTRODUCTION

1.0 INTRODUCTION

1.1 GENERAL:-

The objective of this document is to present a complete project design intent covering design criteria including assumptions, references, load cases, load combinations, etc. for the proposed construction of 'Commercial building at Chennai'.

The structural design of the project is governed by the architectural concept and the requirements for services. The design of the structure shall be comply with relevant Indian Standards & codes and best prevailing practices taking the following into consideration.

- Cost effective constructional System
- Efficient functioning of the building
- Speed of construction

2.0 STRUCTURE:-

2.1 LOCATION:-

The Proposed Project is located at Paul Appaswamy Street, T.nagar, Chennai. The Commercial building is designed for Silt+3 floors.

Structural system consists of Ordinary Moment Resisting R.C.C Framed Structure with columns and beams. The columns are formed from foundation level. The R.C.C framed structure is designed and detailed as per both IS: 456 – 2000 and IS: 13920 – 1993.

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SECTION - II

STRUCTURE

2.2 STRUCTURAL SYSTEM :-

2.2.1. FOUNDATION

Based on the recommendations given in the soil report submitted by NAGADI CONSULTANTS PVT.LTD CHENNAI, Isolated foundation is considered for the Commercial building. The depth of foundation will be 1.75 from the lowest ground level. The foundations will be supported on 150mm thick bed concrete. Plinth beams will be provided to safe guard the structure against differential settlements if any and also to improve lateral stability of the structure.

2.2.2. SUPER STRUCTURE:-

The Commercial building is analyzed and designed for the appropriate loads. The super structure is of regular R.C.C. frame with Silt + 3 Floors. No further provisions in the no. of floors are accounted. The structure shape is a regular one, rectangular in size. Column grids are generally taken at the wall centres. The block is provided with staircase as per the required standards.

The details of load calculations, the various standards followed and typical design calculations of main structural elements are given in the following sections.

2.3. STRUCTURAL STANDARDS AND CODES:-

The building structure for S+3 Commercial Building at Paul Appaswamy Street, T.nagar, Chennai, designed as reinforced concrete framed structure (space frame) subjected to vertical loads, self-weight, dead load and live load. The various Indian standards followed for evaluating loads, structural analysis and design are given below.

Sl.No.	Code	Description
1	IS:875(Part1)–1987	Code of Practice for Design Loads(Other Than Earthquake)for Building and Structures–Unit Weight of Building Materials and Stored Materials
2	IS:875(Part2)–1987	Code of Practice for Design Loads (Other than Earthquake) for Building and Structures–Imposed Loads
3	IS:875(Part5)–1987	Code Of Practice for Design Loads (Other than Earthquake) for Building and Structures–Special Loads and Load Combinations.
4	IS:456–2000	Code of Practice for Plain and Reinforced Concrete.
5	IS:1786–1985	Specification for High Strength Deformed Steel Bars and Wires for concrete reinforcement.
6	IS:432(Part1)–1982	Specification for Mild Steel and Medium Tensile steel Bars and Hard Drawn Steel Wire for Concrete Reinforcement–Mild Steel and Medium Tensile Steel Bars
7	IS:432(Part2)–1982	Specification for Mild Steel and Medium Tensile steel Bars and Hard Drawn Steel Wire for Concrete Reinforcement–Hard Drawn Steel Wire.
8	IS:2062-1999	Steel for General Structural purpose–Specification.
9	IS:1904–1986	Code of practice for Design and Construction of foundation in soils General Requirements.

2.4 CONSTRUCTION MATERIAL:-

Concrete shall comply with IS 456 2000. Unless noted otherwise concrete is to be normal-weight, with a typical dry density of 25kN/m^3.

The grade of concrete to be used in construction is M25 and the grade of steel is Fe 500 for seismic design.

SECTION - III

LOADING

3.0 LOADING:-

The structure will be designed for the number of floors as indicated in the approved architectural drawing. The building will be analyzed for the following basic load cases:-

1. Dead Load
2. Live Load
3. Seismic Load

The brief description of each basic load is as follows.

3.1 DEAD LOAD (DL):-

The dead load comprises of self weight of the structure and loading due to finishes and floorings etc, which are permanent in nature. The dead load of self weight, partitions, ceiling, flooring and façade etc, are applied as either area loads to slabs or line loads to beams.

The following parameters will be considered as per IS 875 part- I 1987

Finishes including services load	=	$1.0 kN/m^2$
Partition wall load	=	$2.25 kN/m^2$
Density of concrete	=	$25 kN/m^3$
Density of brick	=	$20 kN/m^3$
Density of Water	=	$10 kN/m^3$

3.2 LIVE (IMPOSED) LOAD (LL):-

Live Loads considered on floor slabs are as per IS 875 (Part 2) – 1987. In general, the following live loads will be considered.

Water load	=	$10.0 kN/m^2$

Staircase	=	4.0kN/m^2
Lobby, Balconies & corridors	=	4.0 kN/m^2
Office Hall	=	4.0kN/m^2
Toilets	=	2.0 kN/m^2

3.3 EARTHQUAKE LOAD (EL):-

Seismic Loads considered on the structure are as per IS 1893 (Part 1) – 2002. As per the code, Chennai lies in zone III. In general, the following parameters will be considered.

Zone factor (Z) for zone III	=	0.16	
Importance factor (I)	=	1.2	
Response reduction factor (R)	=	3.00	[For OMRF]
Percentage of Imposed Load considered in Seismic weight calculation	=	25%	

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SECTION - IV

DESIGN

4.0 DESIGN:-

4.1 DESIGN CONCEPTS:-

The Reinforced cement concrete (RCC) is adopted for the design of all members. All RCC members will be designed following guide- lines of the codes mentioned above.

4.2 ANALYSIS:-

The structure is analyzed using ETABS 2015 version 15.2.2 software. The forces from ETABS are used for the design of columns, footings and beams.

4.3 LOAD COMBINATIONS:-

The various load combinations for which the structure will be designed are as follows:

1. 1.5 (DL + LL)
2. 1.2 (DL + LL +/- EL)
3. 1.5 (DL +/- EL)
4. 0.9 DL +/- 1.5 EL

Individual members of the frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion, etc.

4.4 COLUMN DESIGN

The columns are designed directly using ETABS 2015 version 15.2.2 for the worst load combination and detailed as per SP: 34 or IS 13920 as the case may be.

4.5 BEAMS

Beam sizes vary according to the span and are designed using ETABS 2015 version 15.2.2 for the worst load combination and detailed as per SP: 34 or IS 13920 as the case may be.

4.6 SLAB

All slabs are manually designed for the various loads according to the utility of the rooms and edge conditions.

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FOUNDATION DESIGN

SOIL DETAILS

Footing depth	=	1.8	meters from LNGL	Dia =	12	mm
SBC	=	120	kN/m^2	Area =	113	mm^2

DESIGN PARAMETERS

f_{ck}	=	25	N/mm^2
f_y	=	500	N/mm^2
Clear cover	=	50	mm (Footing)
a	=	0.283	m (Column depth)
b	=	0.283	m (Column width)
X	=	**550**	m (Ledge along **'L'**)
Y	=	**550**	m (Ledge along **'B'**)
t	=	290	mm (Depth at end of slope)

Axial Load from Column

P	=	1000	kN
P_u	=	1500	kN

Area of footing	=	9.166667	m2	
Footing Size is	**3**	**m (L) X**	**3**	**m (B)**

Net upward pressure

P_r	=	111.1	kN/m^2	< SBC

Taking moment at the face of the column

$M_{xx} = [P*(B-b)^2] / (8 * L)$

$= 308$ kNm

We assume breadth resisting moment is the ledge width (i.e. 550 mm)

$M_u = 0.138*f_{ck}*b*d^2$

$d = 688$ mm

Provide effective depth of

(d) = 650 mm

Depth check from one-way shear

Taking section at effective depth from the face of column (d=700 mm),

the distance of section from the edge of the footing is equal to = [(L-a)/2]-d

$r_1 = 0.71$ m

The breadth of column face at this section with 45 degree diagonal is

$b_1 = L - (2 * r_1)$

= 1580 mm

V_1 = $[(L + b_1) / 2]*r_1*P_r$

= 180.6 kN

Stress	Pt
0.29	0.15
0.37	0.25
0.34	**0.21**

the effective depth of section d1 at the end of 45 degree line is

d_1 = $t + \{[(d - t)*r_1] / [(L - X)*0.5]\}$

= 498.7 mm

ζc (req.) = $1.5*V_1 / (b_1*d_1)$

= 0.34 N/mm^2

ζc (req.) is equal to ζc for M20 grade concrete with 0.2% steel as per IS:456(2000)

0.21 % steel as per IS:456(2000)

Depth check from two-way shear

Section at d/2 from the face of the column

d/2 = 325 mm

Distance of section from the edge of the footing is equal to

= $[(L-a) / 2]-(d / 2)$

r_2 = 1034 mm

b_2 = $L - (2*r_2)$

= 932 mm

d_2 = $t + \{[(d-t)*r_2] / [(L-X)*0.5]\}$

= 594 mm

V_2 = $P_r*(L_2^2 - b_2^2)$

= 903.4 kN

ζ_p = $(1.5*V_2) / (4*b_2*d_2)$

= 0.612 N/mm^2

Allowable punching shear

= $0.25*sqrt(f_{ck})$

ζc (Allow.) = 1.25 N/mm^2 **Safe in Two-way shear**

Area of steel required

M = 308 kNm

b = 550 mm

d = 650 mm **D = 706 mm**

A_{st} = 1820 mm2 **T = 346 mm**

No. of bars = 17

P_t = 0.54 % **Safe in One-way shear** A_{st} = 750.75

Actual A_{st} = 1820 mm^2

Provide 17 x 12 Y Bothways as Main Reinforcement

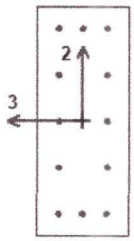
SIZE	LEDGE	D	d
3	550	706	346

COLUMN DESIGN

FROM ETABS Version 15.2.2

ETABS 2015 Concrete Frame Design

IS 456:2000 Column Section Design



Column Element Details Type: Ductile Frame (Summary)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF
UPPER BASEMENT	C13	457	300X600C3	09DL15EQXP	0	3600	1

Section Properties

b (mm)	h (mm)	dc (mm)	Cover (Torsion) (mm)
300	750	70.9	45

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
27386	30	1	500	415

Design Code Parameters

ɣc	ɣs
1.5	1.15

Axial Force and Biaxial Moment Design For P_u , M_{u2} , M_{u3}

Design P_u kN	Design M_{u2} kN-m	Design M_{u3} kN-m	Minimum M_2 kN-m	Minimum M_3 kN-m	Rebar Area mm²	Rebar % %
-626.0236	-188.6107	40.0505	0	0	6848	3.04

Axial Force and Biaxial Moment Factors

	K Factor Unitless	Length mm	Initial Moment kN-m	Additional Moment kN-m	Minimum Moment kN-m
Major Bend(M3)	2.184843	3000	16.0202	0	0
Minor Bend(M2)	1.360957	3000	-75.4443	0	0

Shear Design for V_{u2} , V_{u3}

	Shear V_u kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv} /s mm²/m
Major, V_{u2}	169.5336	160.7231	81.4903	169.5336	332.53
Minor, V_{u3}	142.3163	144.1291	68.7257	142.3163	831.33

Joint Shear Check/Design

Joint Shear Force kN	Shear V_{Top} kN	Shear $V_{u,Tot}$ kN	Shear V_c kN	Joint Area cm²	Shear Ratio Unitless

Major Shear, V_{u2}	N/A	N/A	N/A	N/A	N/A	N/A
Minor Shear, V_{u3}	N/A	N/A	N/A	N/A	N/A	N/A

(1.1) Beam/Column Capacity Ratio

Major Ratio	Minor Ratio
N/A	N/A

Additional Moment Reduction Factor k (IS 39.7.1.1)

A_g cm²	A_{sc} cm²	P_{uz} kN	P_b kN	P_u kN	k Unitless
2250	68.5	5605.5841	1371.5329	-626.0236	0.63038

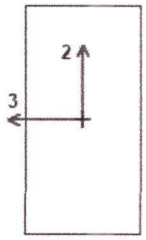
Additional Moment (IS 39.7.1)

	Consider M_a	Length Factor	Section Depth (mm)	KL/Depth Ratio	KL/Depth Limit	KL/Depth Exceeded	M_a Moment (kN-m)
Major Bending (M_3)	No	0.833	750	8.739	12	No	0
Minor Bending (M_2)	No	0.833	300	13.61	12	Yes	0

FLOOR BEAM DESIGN
FROM ETABS Version 15.2.2

ETABS 2015 Concrete Frame Design

IS 456:2000 Beam Section Design



Beam Element Details Type: Ductile Frame (Summary)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF
LEVEL-0	B33	159	300X600B2	ENVELOPE	3520	3820	1

Section Properties

b (mm)	h (mm)	b_f (mm)	d_s (mm)	d_{ct} (mm)	d_{cb} (mm)
300	600	300	0	40	40

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
27386	30	1	500	415

Design Code Parameters

ɣc	ɣs
1.5	1.15

Factored Forces and Moments

Factored M_{u3} kN-m	Factored T_u kN-m	Factored V_{u2} kN	Factored P_u kN
290.6182	0	200.4841	0

Design Moments, M_{u3} & M_t

Factored Moment kN-m	Factored M_t kN-m	Positive Moment kN-m	Negative Moment kN-m
290.6182	0	290.6182	-448.5874

Design Moment and Flexural Reinforcement for Moment, M_{u3} & T_u

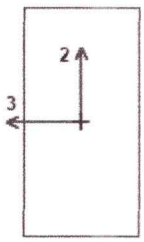
	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm²	+Moment Rebar mm²	Minimum Rebar mm²	Required Rebar mm²
Top (+2 Axis)	-448.5874		2230	0	2230	558
Bottom (-2 Axis)		290.6182	1387	1387	335	1115

Shear Force and Reinforcement for Shear, V_{u2} & T_u

Shear V_e kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv} /s mm²/m
323.2169	102.6848	220.5321	197.4022	1091.27

Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{U2}

T_u kN-m	V_u kN	Core b_1 mm	Core d_1 mm	Rebar A_{svt} /s mm²/m
0	200.4841	240	540	0



Beam Element Details Type: Ductile Frame (Summary)

Level	Element	Unique Name	Section ID	Combo ID	Station Loc	Length (mm)	LLRF
LEVEL+2	B38	1230	300X600B2	ENVELOPE	5075	5300	1

Section Properties

b (mm)	h (mm)	b_f (mm)	d_s (mm)	d_{ct} (mm)	d_{cb} (mm)
300	600	300	0	40	40

Material Properties

E_c (MPa)	f_{ck} (MPa)	Lt.Wt Factor (Unitless)	f_y (MPa)	f_{ys} (MPa)
27386	30	1	500	415

Design Code Parameters

ɣc	ɣs
1.5	1.15

Factored Forces and Moments

Factored M_{u3} kN-m	Factored T_u kN-m	Factored V_{u2} kN	Factored P_u kN
283.3578	0	223.548	0

Design Moments, M_{u3} & M_t

Factored Moment kN-m	Factored M_t kN-m	Positive Moment kN-m	Negative Moment kN-m
283.3578	0	283.3578	-409.104

Design Moment and Flexural Reinforcement for Moment, M_{u3} & T_u

	Design -Moment kN-m	Design +Moment kN-m	-Moment Rebar mm²	+Moment Rebar mm²	Minimum Rebar mm²	Required Rebar mm²
Top (+2 Axis)	-409.104		2056	0	2056	514
Bottom (-2 Axis)		283.3578	1346	1346	156	1028

Shear Force and Reinforcement for Shear, V_{u2} & T_u

Shear V_e kN	Shear V_c kN	Shear V_s kN	Shear V_p kN	Rebar A_{sv} /s mm²/m
336.2236	101.533	234.6906	232.1025	1161.33

Torsion Force and Torsion Reinforcement for Torsion, T_u & V_{U2}

T_u kN-m	V_u kN	Core b_1 mm	Core d_1 mm	Rebar A_{svt} /s mm²/m
0	223.548	240	540	0

FLOOR SLAB DESIGN

TWO WAY SLAB DESIGN

GIVEN :

Grade of concrete = 25 N/mm^2
Grade of steel = 500 N/mm^2
Clear cover = 25 mm
Shorter span = 2550 mm
Longer span = 3025 mm

EFFECTIVE DEPTH :

Bearing of 300 at each end
Span between centres of bearing = 2550 + 300 = 2850mm

Basic value of span – effective depth ratio for continuous two way slab = 40

Effective depth required = span / Modification factor

= 2850/40 x 0.8 = 90mm

Overall depth required = 90 + 25 + 8/2 = 119mm
Provide a thickness of 150mm

Effective depth =150-25-8/2 = 121mm

LOAD CALCULATION :

Self weight of slab = 0.15 x 25 = 3.75kN/m^2

Floor finish = 1.0kN/m^2

Live load = 4.0kN/m^2

Total load (W) = 8.75kN/m^2

Factored load W_u = 1.5 x 8.75 = 13.125kN/m^2

EFFECITVE SPAN :

This is taken as the lesser of the following

Effective span is X direction

(i) Distance between centers of bearing = 2.85m

(ii) Clear span + effective depth = 2.55 + 0.121 = 2.67m

L_x= 2.67m

Effective span in Y direction

(i) Distance between centres of bearings = 3.025 + 0.3 = 3.25m

(iii) Clear span + effective depth = 3.025 + 0.121 = 3.146m

L_y= 3.15m

MOMENT CALCULATION :

Factored moment (M_u) = $W_u l^2/8$

[Consider a 1m wide strip)

M_u = 13.15 x 2.67^2 /8 = 11.718kNm

MOMENT COEFFICIENTS AND MOMENTS :

Condition : Two adjacent edges discontinuous

L_y/l_x = 3.15/2.67 = 1.18

$-\alpha_x$ = 0.060

$+\alpha_x$ = 0.045

$-\alpha_y$ = 0.047

$+\alpha_y$ = 0.035

$-M_x$ = $-\alpha_x W_u l_x^2$

= 0.060 x 13.15 x 2.67^2 = 5.61kNm

$+M_x$ = $+\alpha_x W_u l_x^2$

= 0.045 x 13.15 x 2.67^2 = 4.21kNm

$-M_y$ = $-\alpha_y W_u l_x^2$

= 0.047 x 13.15 x 2.67^2 = 4.40kNm

$+M_y = +\alpha_y W_u l_x^2$

$= 0.035 \times 13.15 \times 2.67^2 = 3.27kNm$

Maximum moment = 5.61kNm

CHECK FOR DEPTH :

$$M_{u,limit} = 0.36 \frac{X_{umax}}{d}\left(1-0.42 \frac{X_{umax}}{d}\right) bd^2 f_{ck}$$

$5.61 \times 10^6 = 0.36 \times 0.46 (1-0.42 \times 0.46) \times 1000 \times d^2 \times 30$

$d^2 = \frac{5.61 \times 10^6}{4008}$

$d = 37.5mm$

$d_{req} < d_{assumed}$

Hence safe

REINFORCEMENT DETAILS :

$$M_u = 0.87 f_y A_{st} d \left(1 - \frac{A_{st} f_y}{bdf_{ck}}\right)$$

a) $-A_{st,x}$

$$5.61 \times 10^6 = 0.87 \times 500 \times A_{st} \times 121 \left(1 - \frac{A_{st} \times 500}{1000 \times 121 \times 30}\right)$$

$5.61 \times 10^6 = 52635 A_{st} - 7.23 A_{st}^2$

$7.23 A_{st}^2 - 52635 A_{st} + 5.61 \times 10^6 = 0$

$-A_{st,x} = 107mm^2$

Spacing = $50 \times 1000/107 = 467mm$

Provide 8mm diameter @ 200mm c/c spacing

b) $+A_{st,x}$

$$4.21 \times 10^6 = 0.87 \times 500 \times A_{st} \times 121 \left(1 - \frac{A_{st} \times 500}{1000 \times 121 \times 30}\right)$$

$4.21 \times 10^6 = 52635 A_{st} - 7.23 A_{st}^2$

$7.23\ A_{st}^2 - 52635\ A_{st} + 4.21 \times 10^6 = 0$

$A_{st,x} = 80mm^2$

Spacing = 50 x 1000 / 80 = 625mm

Provide 8mm dia @ 200mm c/c spacing.

c) $-A_{st,y}$

$$4.40 \times 10^6 = 0.87 \times 500 \times A_{st} \times 121 \left(1 - \frac{A_{st} \times 500}{1000 \times 121 \times 30}\right)$$

$4.40 \times 10^6 = 52635 A_{st} - 7.25\ A_{st}^2$

$7.25 A_{st}^2 - 52635\ A_{st} + 4.40 \times 10^6 = 0$

$-A_{st,y} = 83mm^2$

Spacing = 50 x 1000/83 = 602mm

Provide 8mm diameter @ 200mm c/c spacing.

d) $+A_{st,y}$

$$3.27 \times 10^6 = 0.87 \times 500 \times A_{st} \times 121 \left(1 - \frac{A_{st} \times 500}{1000 \times 121 \times 30}\right)$$

$3.27 \times 10^6 = 52635\ A_{st} - 7.25\ A_{st}^2$

$7.25\ A_{st}^2 - 52635\ A_{st} + 3.27 \times 10^6 = 0$

$+A_{st,y} = 62mm^2$

Spacing = 50 x 1000 /62 = 806mm

Provide 8mm dia @ 200mm c/c spacing.

SHEAR CALCULATION :

$$V_u = \frac{W_u L}{2} = \frac{13.125 \times 2.67}{2} = 17.52kN$$

$$\zeta_v = \frac{V_u}{bd} = \frac{17.52 \times 10^3}{1000 \times 121} = 0.14N/mm^2$$

Provide $A_{st} = \frac{50 \times 1000}{200} = 250mm^2$

$P_t = \frac{A_{st}}{bd} \times 100 = \frac{250}{1000 \times 121} \times 100 = 0.17\%$

ζ_c for $P_t = 0.17\%$, M30

$\zeta_c = 0.29\ N/mm^2$

$\zeta_v < \zeta_c$, Hence Safe.

ONE WAY SLAB DESIGN

GIVEN :

Grade of concrete	=	25 N/mm^2
Grade of steel	=	500 N/mm^2
Clear cover	=	25 mm
Shorter span	=	2550 mm
Longer span	=	5900 mm

EFFECTIVE DEPTH :

Bearing of 300 at each end
Span between centres of bearing = 2550 + 300 = 2850mm

Basic value of span – effective depth ratio for continuous one way slab = 26

Effective depth required = span / Modification factor
= 2850/26 = 110mm

Overall depth required = 110 + 25 + 8/2 = 139mm

Provide a thickness of 150mm
Effective depth = 150-25-8/2 = 121mm

LOAD CALCULATION :

Self weight of slab = 0.15 x 25
= 3.75kN/m^2

Floor finish = 1.0kN/m^2

Live load = $4.0kN/m^2$
Total load (W) = $8.75kN/m^2$
Factored load $W_u = 1.5 \times 8.75$ = $13.125kN/m^2$

EFFECITVE SPAN :

This is taken as the lesser of the following :

(i) Distance between centres of bearing = 2.850m
(ii) Clear span + effective depth = 2.550 + 0.121 = 2.67m
Effective span = 2.7m

MOMENT CALCULATION :

Factored moment $(M_u) = W_u l^2/8$
[Consider a 1m wide strip]
$M_u = 13.125 \times 2.7^2 /8 = 11.96kNm$

CHECK FOR DEPTH :

$$M_{u,limit} = 0.36 \frac{X_{u,max}}{d} \left(1-0.42 \frac{X_{u,max}}{d}\right) bd^2 f_{ck}$$

$$11.96 \times 10^6 = 0.36 \times 0.46 (1-0.42 \times 0.46) \times 1000 \times d^2 \times 30$$

$$d^2 = \frac{11.96 \times 10^6}{4008}$$

d_{req} = 55mm
$d_{req} < d_{assumed}$, hence safe

REINFORCEMENT :

a) **MAIN BAR**

$$M_u = 0.87 f_y A_{st} d \left(1 - \frac{A_{st} f_y}{bdf_{ck}}\right)$$

$$11.96 \times 10^6 = 0.87 \times 500 \times A_{st} \times 121 \left(1 - \frac{A_{st} \times 500}{1000 \times 121 \times 30}\right)$$

$$11.96 \times 10^6 = 52635 A_{st} - 7.25 A_{st}^2$$

$$7.25 A_{st}^2 - 52635 A_{st} + 11.96 \times 10^6$$

$A_{st,x} = 227mm^2$

Spacing = 50 x 1000/227 = 220mm

Provide 8mm diameter @ 200mm c/c spacing.

b) DISTRIBUTORS :

Distribution steel = 0.12% of the gross area

$= \frac{0.12 \times 1000 \times 150}{100}$

$= 180mm^2$

Spacing $= \frac{50 \times 1000}{180}$

$= 277mm$

Provide 8mm dia @ 250mm c/c spacing.

SHEAR CALCULATION :

$V_u = \frac{W_u L}{2} = \frac{13.125 \times 2.7}{2} = 17.72KN$

$\zeta_v = \frac{V}{bd} = \frac{17.72 \times 10^3}{1000 \times 121} = 0.15N/mm2$

Provide area of steel $= \frac{50 \times 1000}{200} = 250mm^2$

$P_t = \frac{250}{1000 \times 121} \times 100 = 0.21\%$, $\zeta_c = 0.33N/mm^2$

$\zeta_v < \zeta_c$ Hence Safe.

5.0 CONCLUSION:-

This design philosophy has been worked out based on the available data issued by the client and the Architect and it covers all the norms for the geometry and usage of the structure. All other guidelines and specific details will be given in the working drawing and general drawing.

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PROFESSIONAL REGISTRATION CERTIFICATE

This is to certify that the **Thiru. R. GANESH** has enrolled as **Registered Structural Engineer Grade-II (SE)** with Chennai Metropolitan Development Authority (CMDA) who has the qualification of **B.E., (Civil Engg.)** and experience in the relevant field for**10 years**.

He has been given the Registration No.**SE/GR-II/2019/08/141 Renewed** on **02.08.2024.** He shall be required to comply with the duties and responsibilities prescribed by the Government of Tamil Nadu in Part-V, "Registration of Professionals", Tamil Nadu Combined Development and Building Rules, 2019 approved vide G.O.(Ms) No.18 MAWS (MA1) Dept. dated 04.02.2019.

This Registration is valid upto **01.08.2029**.



2/8/2024

(A. MEGANATHAN)
Superintendent



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