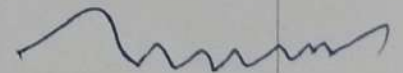


DESIGN BASIS REPORT

**FOR
Mr.LOGANATHAN**

THE PROPOSED CONSTRUCTION OF A SHOPPING COMPLEX BUILDING AT DOOR NO: 18/22, COMPRISED IN SURVEY NO: 123/10A2A1, 123/10B, 125/2 OF ARCOT ROAD, PORUR, GREATER CHENNAI CORPORATION, ZONE -XI .DIVISION-151



S. P. S. INBARAJAN,
M.E., (Struct) A.M.I.E.,

Structural Consultant
Registered Structural Engineer
Grade-I (SE) in CMDA

Reg. No. SE/GR-1/2024/02/009 Dt. 27.02.2024
Door No.50, Kirupasankari Street,
West Mambalam, Chennai-600 033.

TABLE OF CONTENTS

1.0 OBJECTIVE

2.0 DESIGN LOADS

2.1 Dead Loads

2.2 Imposed Loads

2.3 Earthquake Loads

2.4 Load Combinations

3.0 ANALYSIS METHOD

4.0 DESIGN ASSUMPTION

5.0 FOUNDATION DESIGN

6.0 MATERIALS

7.0 NOMINAL COVER TO REINFORCEMENT



S. P. S. INBARAJAN,
M.E., (Struct) A.M.I.E.,
Structural Consultant
Registered Structural Engineer
Grade-I (SE) in CMDA

Reg. No SE/GR-1/2024/02/009 Dt. 27.02.2024
Door No.50, Kirupasankari Street,
West Mambalam, Chennai-600 033.

1.0 OBJECTIVE

The Design basis covers the basic requirement that will be followed for the design of THE PROPOSED CONSTRUCTION OF A SHOPPING COMPLEX BUILDING FOR Mr.LOGANATHAN AT DOOR NO: 18/22, COMPRISED IN SURVEY NO: 123/10A2A1, 123/10B, 125/2 OF ARCOT ROAD, PORUR , GREATER CHENNAI CORPORATION, ZONE -XI .DIVISION-151

The building is designed for Basement + Ground + 2 Floors. The structure is supported on column in turn resting on Pile Foundation. The Structural system comprises columns, beams, slabs and wall structure.

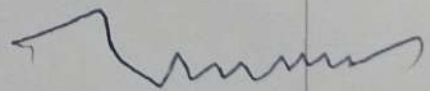
3-D Analysis of all the building structures will be carried out using STAAD PRO software package and analysis results shall be used for designing the various elements.

2.0 DESIGN LOADS

2.1 Dead Loads

The Dead loads that are envisaged to act permanently are considered as per IS: 875 (Part 1) – 1987 – Dead loads. Indian Standard “Code of Practice for Design Loads (other than earthquake) for Buildings and Structures”.

1. Slab is assumed to be 150mm thick – 3.75 KN/m²
2. Slab is assumed to be 125mm thick – 3.125 KN/m²
3. Floor finish – 1.5KN/m²
4. Brick work masonry walls 230thick are proposed to be used (location of walls per Architectural drawings) Unit weight is taken as 20 KN/m³
5. Weathering course in Terrace finish – 3 KN/m²



S. P. S. INBARAJAN,
M.E., (Struct) A.M.I.E.,
Structural Consultant
Registered Structural Engineer
Grade-I (SE) in CMDA

Reg. No. SE/GR-1/2024/02/009 Dt. 27.02.2024
Door No.50, Kirupasankari Street,
West Mambalam, Chennai-600 033.

2.2 Imposed Loads

The imposed loads that are envisaged to act permanently are considered as per IS : 875 (Part 2) – 1987 . Indian Standard “Code of Practice for Design Loads (other than earthquake) for Buildings and Structures”.

1. Living	=	2 KN/m ²
2. Staircase	=	4 KN/m ²
3. Toilets	=	2 KN/m ²
4. Terrace floors	=	1.5 KN/m ²

2.3 Earthquake Load

The loading due to earthquake is assessed based on the provisions of IS: 1893-2016. Structure with ductile detailing is considered as per IS: 13920-2016.

CHENNAI falls under Seismic Zone III

Zone factor	=	0.16
Response reduction factor	=	5
Importance factor	=	1.0

Structure with ductile detailing is considered as per IS: 13920-2016

2.4 Load Combinations

The various loads shall be combined in accordance with the stipulations in IS: 875 (Part 5) – 1987. Whichever combinations produced the most unfavorable effect in the building, foundations or structural member concerned shall be adopted. The various load combinations considered in the analysis are as follows:

1. 1(DL+LL)
2. 1 DL+0.8 LL+ 0.8 SQX +1
3. 1 DL+0.8 LL+ 0.8 SQX -1
4. 1 DL+0.8 LL+ 0.8 SQZ +1
5. 1 DL+0.8 LL+ 0.8 SQZ -1

6. $1.0 (DL+SQX +)$
7. $1.0 (DL+SQX -1)$
8. $1.0 (DL+SQZ +1)$
9. $1.0 (DL+SQZ -1)$
10. $1.5(DL+LL)$
11. $1.5(DL+SQX +1)$
12. $1.5(DL+SQX -1)$
13. $1.5(DL+SQZ +1)$
14. $1.5(DL+SQZ -1)$
15. $1.2(DL+LL+SQX +1)$
16. $1.2(DL+LL+SQX -1)$
17. $1.2(DL+LL+SQZ +1)$
18. $1.2(DL+LL+SQZ -1)$
19. $0.9DL+1.5SQX+1$
20. $0.9DL+1.5SQX -1$
21. $0.9DL+1.5SQZ +1$
22. $0.9DL+1.5SQZ -1$

The above load combinations will be considered and effect of worst combinations

Will be taken for design of various building elements.

3.0 ANALYSIS METHODS

The analysis of the structures is carried out using the STAAD PRO. The entire super-structure is modeled using frame elements as appropriate. Beams and columns are modeled as frame elements. Appropriate loads and its combinations, as per relevant IS code clauses, for most unfavorable effects are chosen for design. Various load cases considered in the analysis are briefed above.

4.0 DESIGN ASSUMPTION

- 4.1.1 The Base of the Foundation is assumed to be FIXED.
- 4.1.2 All Concrete elements shall be designed in accordance with IS456:2000 Limit State Design.
- 4.1.3 Appropriate loads and its combinations, as per relevant clauses, for the most unfavorable effects are chosen for design. (Refer Load Combination below).

5.0 FOUNDATION DESIGN

Type of Foundation : Pile foundation.

Depth of Foundation : 27.5 m

6.0 MATERIALS

The self-weight of the various elements are computed based on the unit weight of materials as given below:

S.no	Materials	Unit weight KN/m ³
1	Reinforced Cement Concrete	25
2	Solid Block/Brick	20
3	Steel	78.50

Structural concrete shall be of grade M25 for Pile

Structural concrete shall be of grade M20 for Pile cap & Column

Structural concrete shall be of grade M20 for Beam & Slab

Steel reinforcement shall be of Grade Fe500 conforming to IS:1786-2008.

7.0 NOMINAL COVER TO REINFORCEMENT

From Durability requirement, exposure condition is assumed as mild for structural elements above ground level and moderate for structural elements below ground level.

The Clear cover to reinforcement to meet durability requirement shall be as follows:

Column – 40mm

Pile cap – 100mm

Beam – 25mm

Slab – 20mm

DESIGN OF BEAM: 1

Beam size: 230mm x 450mm

Bending moment at support = 140kNm

Bending moment at mid span = 133kNm

Shear force, V_u = 149kN

Bending moment at support, M_u = 140kNm

$$R = (140 \times 10^6) / 230 \times 409^2$$

$$= 3.64$$

$$P_t/100 = A_{st}/bd = f_{ck}/2f_y [1 - \sqrt{1 - 4.598 \times R/f_{ck}}]$$

$$f_{ck} = 20 \text{ N/mm}^2$$

$$f_y = 500 \text{ N/mm}^2$$

$$P_t = 1.07\%$$

$$A_{st} \text{ required} = 1013 \text{ mm}^2$$

Provide 6nos of 16Y

$$A_{st} \text{ provided} = 1206 \text{ mm}^2$$

Hence safe.

Bending moment at mid span, M_u = 133kNm

$$R = (133 \times 10^6) / 230 \times 409^2$$

$$= 3.46$$

$$P_t = 1.0\%$$

$$A_{st} \text{ required} = 944 \text{ mm}^2$$

Provide 6nos of 16Y

$$A_{st} \text{ provided} = 1206 \text{ mm}^2$$

Hence it is safe

$$\begin{aligned}\text{Shear force, } V_u &= 149\text{kN} \\ \tau_v &= V_u/bd \\ &= (149 \times 10^3)/230 \times 409 \\ &= 1.58 \text{ N/mm}^2\end{aligned}$$

Hence ok.

Shear capacity of concrete:

$$\begin{aligned}P_t &= 1.0 \% \\ \tau_{cc} &= 0.62 \\ &= \tau_{cc} bd \\ &= 0.62 \times 230 \times 409 \\ &= 58323 \text{ N (or) } 58 \text{ kN}\end{aligned}$$

Shear to be carried by stirrups

$$\begin{aligned}V_u &= V_s - \tau_{cc} bd \\ &= 149 - 58 \text{ kN} \\ &= 91\text{kN}\end{aligned}$$

Therefore, provide 2 legged 10Y @ 150 mm C/C at the supports.

Provide 2 legged 10Y @ 200mm C/C at the midspan.

DESIGN OF BEAM: 2

Beam size: 230mm x 525mm

$$\text{Bending moment at support} = 132\text{kNm}$$

$$\text{Bending moment at mid span} = 111\text{kNm}$$

$$\text{Shear force, } V_u = 96\text{kN}$$

$$\text{Bending moment at support, } M_u = 132\text{kNm}$$

$$\begin{aligned}R &= (132 \times 10^6)/230 \times 484^2 \\ &= 2.44\end{aligned}$$

$$P_t/100 = A_{st}/bd = f_{ck}/2f_y [1 - \sqrt{1 - 4.598xR/f_{ck}}]$$

$$f_{ck} = 20 \text{ N/mm}^2$$

$$f_y = 500 \text{ N/mm}^2$$

$$P_t = 0.65\%$$

$$A_{st} \text{ required} = 725 \text{ mm}^2$$

Provide 4nos of 16Y

$$A_{st} \text{ provided} = 804 \text{ mm}^2$$

Hence safe.

$$\text{Bending moment at mid span, } M_u = 111 \text{ kNm}$$

$$R = (111 \times 10^6) / (230 \times 484^2)$$

$$= 2.06$$

$$P_t = 0.53\%$$

$$A_{st} \text{ required} = 593 \text{ mm}^2$$

Provide 4 nos of 16Y

$$A_{st} \text{ provided} = 804 \text{ mm}^2$$

Hence it is safe

$$\text{Shear force, } V_u = 96 \text{ kN}$$

$$\tau_{cv} = V_u/bd$$

$$= 96 \times 10^3 / (230 \times 484)$$

$$= 0.86 \text{ N/mm}^2$$

Hence ok.

Shear capacity of concrete:

$$P_t = 0.65 \%$$

$$\tau_{cc} = 0.53$$

$$= \tau_{cc} bd$$

$$= 0.53 \times 230 \times 484$$

$$= 58999 \text{ N (or) } 59 \text{ kN}$$

Shear to be carried by stirrups

$$\begin{aligned} V_u &= V_s - \tau_c b d \\ &= 96 - 59 \text{ kN} \\ &= 37 \text{ kN} \end{aligned}$$

Therefore, provide 2 legged 8Y @ 100 mm C/C at the supports.

Provide 2 legged 8Y @ 200 mm C/C at the midspan.

Design of Pile Cap :

$$\begin{aligned} \text{Safe load for 600mm Dia pile} &= 1130 \text{ KN} \\ \text{Concrete grade for pile cap} &= \text{M20} \\ \text{Un factored Column load} &= 1442 \text{ KN} \\ \text{No of piles required} &= 1442/1130 = 1.28 \\ \text{Provide 2 nos of Pile (600}\varnothing\text{)} & \\ \text{Spacing of Piles} &= 1800 \text{ mm} \\ &= 1.8 \text{ m} \\ \text{Factored load} &= 1442 \times 1.5 \\ &= 2163 \\ \text{Bending moment WL/4} &= 2163 \times 1.8 / 4 \\ &= 973 \text{ KNM} \\ R = MU/bd^2 &= 973 \times 10^6 / 975 \times 875^2 \\ &= 1.3 \\ f_{ck} &= 20 \text{ N/mm}^2 \\ f_y &= 500 \text{ N/mm}^2 \\ P_t/100 = A_{st}/bd &= f_{ck}/2f_y [1 - \sqrt{1 - 4.598 \times R/20}] \end{aligned}$$

$$A_{st} \text{ required} = 2739 \text{ mm}^2$$

Provide 7 nos of 25 Dia bar

$$A_{st} \text{ provided} = 3437 \text{ mm}^2$$

$$A_{st} \text{ required} > A_{st} \text{ provided}$$

Hence it is safe.

DESIGN OF COLUMN C1

Length of column		D	450	mm
Breadth of column		b	230	mm
Unsupported length (longer direction)		L_x	2700	mm
Unsupported length (shorter direction)		L_y	2700	mm
Eff. Length (longer direction)		L_{ex}	2160	mm
Eff. Length (shorter direction)		L_{ey}	2160	mm
Factored Load		P_u	1051	kN
Factored moment (longer direction)		M_{ux}	65	kNm
Factored moment (shorter direction)		M_{uz}	21	kNm
Charac. comp strength of concrete		f_{ck}	20	N/mm ²
Yield stress of steel		f_y	500	N/mm ²
Dia of bar used		Φ	20	mm
Clear cover			40	mm
Effective cover		d'	50	mm
Effective depth		d	400	mm
Check for slenderness				
Longer Direction				
Slenderness ratio		L_{ex}/D	4.80	short
Additional moment due to slenderness		M_{ax}	0	kN-m
Shorter Direction				
Slenderness ratio		L_{ey}/b	9.39	short
Additional moment due to slenderness		M_{ay}	0	kN-m
Calculation of P_{uz}				
No of bars used			8	
Area of reinforcement		A_{st}	2512	
Provided steel			8 nos Y20	
Percentage of reinforcement		p_t	2.427	%
Area of concrete		A_g	103500	mm ²
Ultimate axial load (without moments)		P_{uz}	1851	kN
Calculation of P_b:				
Longer Direction				
		d'/D	0.111	
Coefficient k_1 (from TABLE 60 of SP:1980)		k_{1x}	0.204	From Sp16
Coefficient k_2 (from TABLE 60 of SP:1980)		k_{2x}	0.398	
Axial load corresponding to balanced failure		P_{bx}	523	kN
Reduction factor for additional moments		k_x	1.000	
Moment due to slenderness		M_{ax}	0.00	kN-m
Shorter Direction				
		d'/b	0.217	
Coefficient k_1 (from TABLE 60 of SP:1980)		k_{1y}	0.179	
Coefficient k_2 (from TABLE 60 of SP:1980)		k_{2y}	0.143	
Axial load corresponding to balanced failure		P_{by}	406	kN
Reduction factor for additional moments		k_y	0.554	
Moment due to slenderness		M_{ay}	0.00	kN-m
Check for moments due to min. eccentricity				
Longer Direction				
Minimum eccentricity		e_x	20.40	mm

Moment due to min. eccentricity		M_x	21.44	kN-m
Moment in longer direction		M_{ux}	65.00	kNm
Shorter direction				
Minimum eccentricity		e_y	13.07	mm
Moment due to min. eccentricity		M_y	13.73	kN-m
Moment in shorter direction		M_{uy}	21	kNm
Final design moments				
Moment in longer direction		M_{ux}	65.00	kNm
Moment in shorter direction		M_{uy}	21.00	kNm
Check for interaction				
		d'/D	0.111	
		d'/b	0.217	
p/f_{ck}		p/f_{ck}	0.121	
$P_u/f_{ck}bD$ value		$P_u/f_{ck}bD$	0.508	
$M_{ux1}/f_{ck}bD^2$ value (from SP 16:1980 charts)		$M_{ux1}/f_{ck}bD^2$	0.130	
Uniaxial moment capacity (longer direction)		M_{ux1}	121.095	kNm
$M_{uy1}/f_{ck}bD^2$ value (from SP 16:1980 charts)		$M_{uy1}/f_{ck}bD^2$	0.110	
Uniaxial moment capacity (shorter direction)		M_{uy1}	52.371	kNm
P_u/P_{uz} ratio		P_u/P_{uz}	0.568	
Value of exponent			1.614	
Interaction ratio			0.595	
Percentage reinforcement satisfactory or not			safe	
b/D ratio		b/D	0.51111111	
Status of dimensions			OK	
Gross area		A_g	103500	mm ²
Area of core		A_k	60800	mm ²
Spacing of lateral ties		S	57.5	mm
Larger dimension of the hoop		H	230	mm
Cross sectional area of hoop		A_{sh}	66.87	mm ²

DESIGN OF COLUMN C2					
Length of column		D	375	mm	
Breadth of column		b	300	mm	
Unsupported length (longer direction)		L_x	2700	mm	
Unsupported length (shorter direction)		L_y	2700	mm	
Eff. Length (longer direction)		L_{ex}	2160	mm	
Eff. Length (shorter direction)		L_{ey}	2160	mm	
Factored Load		P_u	895	kN	
Factored moment (longer direction)		M_{ux}	41	kNm	
Factored moment (shorter direction)		M_{uz}	11	kNm	
Charac. comp strength of concrete		f_{ck}	20	N/mm ²	
Yield stress of steel		f_y	500	N/mm ²	
Dia of bar used		Φ	16	mm	
Clear cover			40	mm	
Effective cover		d'	48	mm	
Effective depth		d	327	mm	
Check for slenderness					
Longer Direction					
Slenderness ratio		L_{ex}/D	5.76	short	
Additional moment due to slenderness		M_{ax}	0	kN-m	
Shorter Direction					
Slenderness ratio		L_{ey}/b	7.20	short	
Additional moment due to slenderness		M_{ay}	0	kN-m	
Calculation of P_{uz}					
No of bars used			8		
Area of reinforcement		A_{st}	1607.68		
Provided steel			8 nos Y16		
Percentage of reinforcement		p_t	1.429	%	
Area of concrete		A_g	112500	mm ²	
Ultimate axial load (without moments)		P_{uz}	1601	kN	
Calculation of P_b :					
Longer Direction					
		d'/D	0.128		
Coefficient k_1 (from TABLE 60 of SP:1980)		k_{1x}	0.200	From Sp16	
Coefficient k_2 (from TABLE 60 of SP:1980)		k_{2x}	0.358		
Axial load corresponding to balanced failure		P_{bx}	508	kN	
Reduction factor for additional moments		k_x	1.000		
Moment due to slenderness		M_{ax}	0.00	kN-m	
Shorter Direction					
		d'/b	0.160		
Coefficient k_1 (from TABLE 60 of SP:1980)		k_{1y}	0.193		
Coefficient k_2 (from TABLE 60 of SP:1980)		k_{2y}	0.281		
Axial load corresponding to balanced failure		P_{by}	479	kN	
Reduction factor for additional moments		k_y	0.629		
Moment due to slenderness		M_{ay}	0.00	kN-m	
Check for moments due to min. eccentricity					
Longer Direction					
Minimum eccentricity		e_x	17.90	mm	

Moment due to min. eccentricity			M_x	16.02	kN-m
Moment in longer direction			M_{ux}	41.00	kNm
Shorter direction					
Minimum eccentricity			e_y	15.40	mm
Moment due to min. eccentricity			M_y	13.78	kN-m
Moment in shorter direction			M_{uy}	13.783	kNm
Final design moments					
Moment in longer direction			M_{ux}	41.00	kNm
Moment in shorter direction			M_{uy}	13.78	kNm
Check for interaction					
			d'/D	0.128	
			d'/b	0.160	
p/f_{ck}			p/f_{ck}	0.071	
$P_u/f_{ck}bD$ value			$P_u/f_{ck}bD$	0.398	
$M_{ux1}/f_{ck}bD^2$ value (from SP 16:1980 charts)			$M_{ux1}/f_{ck}bD^2$	0.090	
Uniaxial moment capacity (longer direction)			M_{ux1}	75.9375	kNm
$M_{uy1}/f_{ck}bD^2$ value (from SP 16:1980 charts)			$M_{uy1}/f_{ck}bD^2$	0.090	
Uniaxial moment capacity (shorter direction)			M_{uy1}	60.75	kNm
P_u/P_{uz} ratio			P_u/P_{uz}	0.559	
Value of exponent				1.599	
Interaction ratio				0.466	
Percentage reinforcement satisfactory or not				safe	
b/D ratio			b/D	0.8	
Status of dimensions				OK	
Gross area			A_g	112500	mm ²
Area of core			A_k	70150	mm ²
Spacing of lateral ties			S	75	mm
Larger dimension of the hoop			H	230	mm
Cross sectional area of hoop			A_{sh}	74.98	mm ²

DESIGN OF SLAB S1

ROOF LEVEL SLAB

Design of two way Slab

Basic Data

Grade of concrete (fck)	=	M 20	
Grade of steel (fy)	=	Fe 500	
Thickness of slab (D)	=	125	mm
Clear cover (cc)	=	15	mm
Effective thickness of slab (deff) = 125 - 15 - 8 / 2	=	106	mm
Unit weight of concrete	=	25	KN/m ³
Effective Shorter Span (Lx)	=	3.18	m
Effective Longer Span (Ly)	=	3.467	m
Aspect ratio Ly/Lx	=	1.09	Two way slab
Edge Condition : Two adjacent Edges Discontinuous			

Load Data

Dead Load	=	0.13 x 25	=	3.125	KN/m ²
Floor finish	=		=	1.50	KN/m ²
Imposed Load	=		=	2.00	KN/m ²
Total load	=		=	6.63	KN/m ²
Design load (Wu) = 1.5 x 6.625	=		=	9.94	KN/m ²

Moment and Shear Calculations

Short Span Direction

ax for positive moment	1	→	0.035	
	1.1	→	0.04	
	for 1.09 αx	=	0.040	
Positive moment Mx	0.040 x 9.94 x 3.18 ^2	=	3.97	KN-m
ax for negative moment	1	→	0.047	
	1.1	→	0.053	
	for 1.09 αx	=	0.052	
Negative moment Mx	0.052 x 9.94 x 3.18 ^2	=	5.27	KN-m

Long Span Direction

For positive moment	αy	=	0.035	
Positive moment My	0.035 x 9.94 x 3.18 ^2	=	3.52	KN-m
For negative moment	αy	=	0.047	
Negative moment My	0.047 x 9.94 x 3.18 ^2	=	4.72	KN-m

$$\text{Shear force } V_u = 9.94 \times 3.2 \times 0.5 = 15.80 \text{ KN}$$

Check Effective Depth for Bending

$$\begin{aligned} \text{Depth required} &= (M_x / (0.133 \times f_{ck} \times b))^{1/2} = 44.50 \text{ mm} \\ \text{Depth provided} &= 125 - 15 - 8 / 2 = 106 \text{ mm} \end{aligned}$$

Hence O.K

Reinforcement calculations

Short Span Direction @ Support

$$Mu/bd^2 = \frac{5.27 \times 10^6}{1000 \times 106 \times 106} = 0.469$$

$$Pt = 0.11 \%$$

$$\begin{aligned} \text{Area of steel } A_{st} &= 0.00111 \times 1000 \times 106 = 117.55 \text{ mm}^2 \\ \text{Minimum area of steel} &0.0012 \times 1000 \times 125 = 150.00 \text{ mm}^2 \\ \text{Spacing of Y 8 bars} &50.27 \times 1000 / 150.00 = 334.93 \text{ mm} \\ \text{Ast provided} &= 335.1 \text{ mm}^2 \end{aligned}$$

Check for Spacing

$$\begin{aligned} \text{Minimum of} \quad &1) 3d = 318 \text{ mm} \\ &2) = 300 \text{ mm} \\ &3) = 334.93 \text{ mm} \end{aligned}$$

Therefore provide Y 8 @ 150 mm C/C

Short Span Direction @ Mid Span

$$Mu/bd^2 = \frac{3.97 \times 10^6}{1000 \times 106 \times 106} = 0.353$$

$$Pt = 0.083 \%$$

$$\begin{aligned} \text{Area of steel } A_{st} &= 0.00083 \times 1000 \times 106 = 87.982 \text{ mm}^2 \\ \text{Minimum area of steel} &0.0012 \times 1000 \times 125 = 150.00 \text{ mm}^2 \\ \text{Spacing of Y 8 bars} &50.27 \times 1000 / 150.00 = 334.93 \text{ mm} \\ \text{Ast provided} &= 335.1 \text{ mm}^2 \end{aligned}$$

Check for Spacing

$$\begin{aligned} \text{Minimum of} \quad &1) 3d = 318 \text{ mm} \\ &2) = 300 \text{ mm} \\ &3) = 334.93 \text{ mm} \end{aligned}$$

Therefore provide Y 8 @ 150 mm C/C 100

$$\text{Provided \% of Tension Reinforcement (pt)} = 0.316 \%$$

Long Span Direction @ Support

$$\begin{aligned} \mu/bd^2 &= \frac{4.72 \times 10^6}{1000 \times 106 \times 106} = 0.420 \\ p_t &= 0.099 \% \end{aligned}$$

$$\begin{aligned} \text{Area of steel } A_{st} &= 0.00099 \times 1000 \times 106 = 105.09 \text{ mm}^2 \\ \text{Minimum area of steel} &0.0012 \times 1000 \times 125 = 150.00 \text{ mm}^2 \\ \text{Spacing of Y } 8 \text{ bars} &50.27 \times 1000 / 150.00 = 334.93 \text{ mm} \\ A_{st} \text{ provided} &= 335.1 \text{ mm}^2 \end{aligned}$$

Check for Spacing

$$\begin{aligned} \text{Minimum of} \quad &1) 3d = 318 \text{ mm} \\ &2) = 300 \text{ mm} \\ &3) = 334.93 \text{ mm} \\ \text{Therefore provide Y } 8 &\text{ @ } 150 \text{ mm C/C} \end{aligned}$$

Long Span Direction @ mid Span

$$\begin{aligned} \mu/bd^2 &= \frac{3.52 \times 10^6}{1000 \times 106 \times 106} = 0.313 \\ p_t &= 0.073 \% \end{aligned}$$

$$\begin{aligned} \text{Area of steel } A_{st} &= 0.00073 \times 1000 \times 106 = 77.742 \text{ mm}^2 \\ \text{Minimum area of steel} &0.0012 \times 1000 \times 125 = 150.00 \text{ mm}^2 \\ \text{Spacing of Y } 8 \text{ bars} &50.27 \times 1000 / 150.00 = 334.93 \text{ mm} \\ A_{st} \text{ provided} &= 335.1 \text{ mm}^2 \end{aligned}$$

Check for Spacing

$$\begin{aligned} \text{Minimum of} \quad &1) 3d = 318 \text{ mm} \\ &2) = 300 \text{ mm} \\ &3) = 334.93 \text{ mm} \\ \text{Therefore provide Y } 8 &\text{ @ } 150 \text{ mm C/C} \end{aligned}$$

Check for Deflection:

$$\begin{aligned} \text{Basic Span/depth Ratio} &= 22 \\ \% \text{ of Tension Reinforcement provided (} p_t \text{)} &= 0.316 \% \\ \text{Service stress of steel (} f_s \text{) : } 0.58f_y(A_{st_r}/A_{st_p}) &= 76.14 \text{ N/mm}^2 \\ \text{Modification Factor for Tension Reinforcement (} F_1 \text{)} &= 2.00 \\ \text{Allowable Span/Eff Depth Ratio} &= 44 \\ \text{Actual Span/Eff Depth Ratio} &= 3.18 \times 1000 / 106 = 30.00 \end{aligned}$$

Hence O.K

DESIGN OF SLAB S2**ROOF LEVEL SLAB****Design of two way Slab****Basic Data**

Grade of concrete (fck)	=	M 20
Grade of steel (fy)	=	Fe 500
Thickness of slab (D)	=	125 mm
Clear cover (cc)	=	15 mm
Effective thickness of slab (deff) = 125 - 15 - 8 / 2	=	106 mm
Unit weight of concrete	=	25 KN/m ³
Effective Shorter Span (Lx)	=	3.35 m
Effective Longer Span (Ly)	=	3.467 m
Aspect ratio Ly/Lx	=	1.03 Two way slab
Edge Condition : Two adjacent Edges Discontinuous		

Load Data

Dead Load	=	0.13 x 25	=	3.125	KN/m ²
Floor finish	=		=	1.50	KN/m ²
Imposed Load	=		=	2.00	KN/m ²
Total load	=		=	6.63	KN/m ²
Design load (Wu) = 1.5 x 6.625	=		=	9.94	KN/m ²

Moment and Shear Calculations**Short Span Direction**

ax for positive moment	1	→	0.035	
	1.1	→	0.04	
	for 1.03 αx	=	0.037	
Positive moment Mx	0.037 x 9.94 x 3.35 ^2	=	4.10	KN-m
ax for negative moment	1	→	0.047	
	1.1	→	0.053	
	for 1.03 αx	=	0.049	
Negative moment Mx	0.049 x 9.94 x 3.35 ^2	=	5.48	KN-m

Long Span Direction

For positive moment	α_y	=	0.035
Positive moment M_y	$: 0.035 \times 9.94 \times 3.35^2$	=	3.90 KN-m
For negative moment	α_y	=	0.047
Negative moment M_y	$: 0.047 \times 9.94 \times 3.35^2$	=	5.24 KN-m

S. P. S. INBARAJAN,
M.E. (Struct) A.M.I.E.,
Structural Consultant
Registered Structural Engineer
Grade-I (SE) in CMDA
Reg. No SE/GR-1/2024/02/009 Dt. 27.02.2024
Door No.50, Kirupasankari Street,
West Mambalam, Chennai-600 033.

$$\text{Shear force } V_u = 9.94 \times 3.4 \times 0.5 = 16.65 \text{ KN}$$

Check Effective Depth for Bending

$$\text{Depth required} = (M_u / (0.133 \times f_{ck} \times b))^{1/2} = 45.37 \text{ mm}$$

$$\text{Depth provided} = 125 - 15 - 8 / 2 = 106 \text{ mm}$$

Hence O.K

Reinforcement calculations

Short Span Direction @ Support

$$M_u / b d^2 = \frac{5.48 \times 10^6}{1000 \times 106 \times 106} = 0.487$$

$$P_t = 0.12 \%$$

$$\text{Area of steel } A_{st} = 0.00115 \times 1000 \times 106 = 122.33 \text{ mm}^2$$

$$\text{Minimum area of steel} = 0.0012 \times 1000 \times 125 = 150.00 \text{ mm}^2$$

$$\text{Spacing of Y 8 bars} = 50.27 \times 1000 / 150.00 = 334.93 \text{ mm}$$

$$A_{st} \text{ provided} = 402.12 \text{ mm}^2$$

Check for Spacing

$$\text{Minimum of } 1) 3d = 318 \text{ mm}$$

$$2) = 300 \text{ mm}$$

$$3) = 334.93 \text{ mm}$$

Therefore provide Y 8 @ 125 mm C/C

Short Span Direction @ Mid Span

$$M_u / b d^2 = \frac{4.10 \times 10^6}{1000 \times 106 \times 106} = 0.365$$

$$P_t = 0.086 \%$$

$$\text{Area of steel } A_{st} = 0.00086 \times 1000 \times 106 = 90.868 \text{ mm}^2$$

$$\text{Minimum area of steel} = 0.0012 \times 1000 \times 125 = 150.00 \text{ mm}^2$$

$$\text{Spacing of Y 8 bars} = 50.27 \times 1000 / 150.00 = 334.93 \text{ mm}$$

$$A_{st} \text{ provided} = 402.12 \text{ mm}^2$$

Check for Spacing

$$\text{Minimum of } 1) 3d = 318 \text{ mm}$$

$$2) = 300 \text{ mm}$$

$$3) = 334.93 \text{ mm}$$

Therefore provide Y 8 @ 125 mm C/C 100

$$\text{Provided \% of Tension Reinforcement (pt)} = 0.379 \%$$

Long Span Direction @ Support

S. P. S. INBARAJAN,
M.E., (Struct) A.M.I.E.,
Structural Consultant
Registered Structural Engineer
Grade-I (SE) in CMDA
Reg. No SE/GR-1/2024/02/009 Dt. 27.02.2024
Door No.50, Kirupasankari Street,
West Mambalam, Chennai-600 033.

$$\begin{aligned} \mu/bd^2 &= \frac{5.24 \times 10^6}{1000 \times 106 \times 106} = 0.467 \\ P_t &= 0.110 \% \end{aligned}$$

$$\begin{aligned} \text{Area of steel } A_{st} &= 0.00110 \times 1000 \times 106 = 116.96 \text{ mm}^2 \\ \text{Minimum area of steel} &0.0012 \times 1000 \times 125 = 150.00 \text{ mm}^2 \\ \text{Spacing of Y } 8 \text{ bars } &50.27 \times 1000 / 150.00 = 334.93 \text{ mm} \\ \text{Ast provided} &= 335.1 \text{ mm}^2 \end{aligned}$$

Check for Spacing

$$\begin{aligned} \text{Minimum of} \quad &1) 3d = 318 \text{ mm} \\ &2) = 300 \text{ mm} \\ &3) = 334.93 \text{ mm} \\ \text{Therefore provide Y } 8 \text{ @ } &150 \text{ mm C/C} \end{aligned}$$

Long Span Direction @ mid Span

$$\begin{aligned} \mu/bd^2 &= \frac{3.90 \times 10^6}{1000 \times 106 \times 106} = 0.347 \\ P_t &= 0.082 \% \end{aligned}$$

$$\begin{aligned} \text{Area of steel } A_{st} &= 0.00082 \times 1000 \times 106 = 86.458 \text{ mm}^2 \\ \text{Minimum area of steel} &0.0012 \times 1000 \times 125 = 150.00 \text{ mm}^2 \\ \text{Spacing of Y } 8 \text{ bars } &50.27 \times 1000 / 150.00 = 334.93 \text{ mm} \\ \text{Ast provided} &= 335.1 \text{ mm}^2 \end{aligned}$$

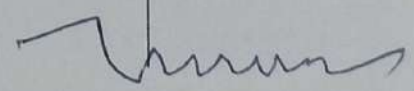
Check for Spacing

$$\begin{aligned} \text{Minimum of} \quad &1) 3d = 318 \text{ mm} \\ &2) = 300 \text{ mm} \\ &3) = 334.93 \text{ mm} \\ \text{Therefore provide Y } 8 \text{ @ } &150 \text{ mm C/C} \end{aligned}$$

Check for Deflection:

$$\begin{aligned} \text{Basic Span/depth Ratio} &= 22 \\ \% \text{ of Tension Reinforcement provided (} P_t \text{)} &= 0.379 \% \\ \text{Service stress of steel (} f_s \text{) : } 0.58f_y(A_{st_r}/A_{st_p}) &= 65.53 \text{ N/mm}^2 \\ \text{Modification Factor for Tension Reinforcement (} F_1 \text{)} &= 2.00 \\ \text{Allowable Span/Eff Depth Ratio} &= 44 \\ \text{Actual Span/Eff Depth Ratio} = 3.35 \times 1000 / 106 &= 31.60 \end{aligned}$$

Hence O.K


S. P. S. INBARAJAN.
M.E., (Struct) A.M.I.E.,
Structural Consultant
Registered Structural Engineer
Grade-I (SE) in CMDA
Reg. No. SE/GR-1/2024/02/009 Dt. 27.02.2024
Door No.50, Kirupasankari Street,
West Mambalam, Chennai-600 033.