Verified RealEstate™

Your trusted partner for buying, selling, and managing property, ensuring hassle-free service with 100% transparency.

3/350/2 Mettukuppam,
OMR Thoraipakkam,
Chennai, India

hello@verified.realestate
+91 9996 12 9996

Official Property Record

Digitally Verified Record - Powered by Verified RealEstate™



AKR®
CONSULTANTS

STABILITY CERTIFICATE

The detailed engineering and structure design of the proposed building comprising of Non High –rise Residential Building with 1 Block consisting of Stilt floor + 4 floors (part) Stilt floor + 5 floors, totally 36 Dwelling units, at Door No. 206 & 208, Padmavathy Nagar Extension Road, Velachery, Chennai. Comprised in Old S.No. 643, T.S.No.1/60, Block No.176 of Velachery Village (Part-1) has been done by me/us based on the report of geotechnical investigation (soil test) done by MARS SYNERGY GEOTECH Pvt Ltd, Report No: MSGTPL/SI-5949/23-24 and considering the functional requirement of the building.

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

3. I/We further certify that:

(i) The minimum grade of concrete is M25.

(ii) The design and analysis has been done using the code of practice for plain and reinforced concrete as per IS 456 - 2000, design loads as per IS Codes No IS: 875 - Part 1, IS: 875 - Part 2, IS: 875 - Part 3 and design of earthquake resistant structure as per IS Code No IS: 1893 - Part 1 - 2016, IS: 13920 – 2016.

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

Stamp and Signature

I.R

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-I/2024/03/013,
Greater Chennai Corporation, Regn, No.RSE100482019,
No:10, 9th St, 2nd Sector, K.K. Nagar, Chennai - 78

Encl.: Structural Design Calculation

CHENNAI METROPOLITAN DEVELOPMENT AUTHORITY
'ThalamuthuNatarajan Building', No.1, Gandhi Irwin Road,
Egmore, Chennai-600 008.

PROFESSIONAL REGISTRATION CERTIFICATE

This is to certify that the **Thiru. I.R. ARUNKUMAAR** has enrolled as **RegisteredStructural Engineer Grade-I (SE)** with Chennai Metropolitan Development Authority (CMDA) who has the qualification of **M.E.,(Structural Engg.)** and experience in the relevant field for **11years**.

He has been given the Registration No.**SE/GR-I/2024/03/013** on **01.03.2024.** 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 **29.02.2029**.



CHENNAI METROPOLITAN DEVELOPMENT AUTHORITY
CHENNAI-600 008.

1/3/24.

(A. MEGANATHAN)
Superintendent

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-I/19/03/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.

DESIGN BASIS REPORT – STRUCTURAL

PROPOSED CONSTRUCTION OF NON HIGH- RISE RESIDENTIAL BUILDING WITH 1 BLOCK STILT +4 FLOORS (Part) STILT +5 FLOORS TOTALLY 36 DWELLING UNITS AT PADMAVATHY NAGAR EXTENION ROAD, VELACHERY VILLAGE, GREATER CHENNAI CORPORATION.

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-I/19/03/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.

TABLE OF CONTENTS

1.0 OBJECTIVE

2.0 DESIGN LOADS

2.1 Dead Loads

2.2 Imposed Loads

2.3 Earthquake Loads

2.4 Wind Loads

2.5 Load Combinations

3.0 ANALYSIS METHOD

4.0 DESIGN ASSUMPTION

5.0 FOUNDATION DESIGN

6.0 MATERIALS

7.0 NOMINAL COVER TO REINFORCEMENT

8.0 LIST OF CODES & REFERENCES

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-I/19/03/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.

1.0 OBJECTIVE

The Design basis covers the basic requirement that will be followed for the design of Proposed Construction of Non High Rise Residential Building at Padmavathy Nagar Extension Road,Velachery,Chennai.

The Structure is designed for Non High Rise Residential Building with 1 Block consisting of Stilt + 4 Floors (part) Stilt +5 Floors, Totally 36 Dwelling Units

Considering the length and shape of the building, the same is divided into two blocks with expansion joint wherever necessary.

The structure is supported on columns in turn resting on Pile foundation. The structural system comprises columns, beams and slab 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 130 mm thick – 3.25 KN/m²
2. Slab is assumed to be 150 mm thick – 3.75 KN/m²
3. Floor finish - 1.5 KN/m²
4. AAC Block work masonry walls 200 & 100 mm thick are proposed to be used (location of walls per Architectural drawings) Unit weight is taken as 8.5 KN/m^3
5. Weathering course in Terrace finish – 3 KN/m^2

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".**

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-1/19/03/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.

1.	Living	=	2 KN/m^2
2.	Bed rooms	=	2 KN/m^2
3.	Staircase	=	4 KN/m^2
4.	Passages & lobbies	=	4 KN/m^2
5.	Toilets	=	2 KN/m^2
6.	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(Part 1)-2016**.

Seismic Zone	=	**III**
Zone factor	=	**0.16**
Response reduction factor	=	**5** (As per Table 7)
Importance factor	=	**1.2** (As per Table 6)

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

2.4 Wind Load

The wind pressure shall be calculated based on the provision laid in **IS: 875 (Part 3) – 2015.** The basic wind speed, terrain category, height factor and structures class etc. required for the wind pressure calculation can be furnished from this codal provisions.

Location : Chennai

Wind Loads : As per IS 875

As per IS 875 Part 3 : Basic Wind speed V_b = 50 m/Sec.

(Table 1) K1 = 1

(Table 2) K2 = Terrain category –III

Class – B 0 to 10m – K2 = 0.91

10 to 15m – K2 = 0.97

15 to 20m – K2 = 1.01

20 to 30m – K2 = 1.06

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-I/19/03/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.

30 to 50m – K2 = 1.12

(Table 3) K3 = 1

(Table 3) K4 = 1.3

At 10m,

Design Wind Speed (V_z) : V_b x K1 x K2x K3xK4

50 x 1.0 x 0.91 x 1.3 = 59.15 m/Sec.

Design Wind Pr : 0.6 x Vz^2

Pz : 0.6 x 59.15^2 = 2099 N /m^2

Pz = 2.0992 KN/m^2

At 15m,

Design Wind Speed (V_z) : V_b x K1 x K2x K3xK4

50 x 1.0 x 0.97 x 1.3 = 63.05 m/Sec.

Design Wind Pr : 0.6 x Vz^2

Pz : 0.6 x 63.05^2 = 2385 N /m^2

Pz = 2.385 KN/m^2

At 20m,

Design Wind Speed (V_z) : V_b x K1 x K2x K3xK4

50 x 1.0 x 1.01 x 1.3 = 63.65 m/Sec.

Design Wind Pr : 0.6 x Vz^2

Pz : 0.6 x 63.65^2 = 2585 N /m^2

Pz = 2.585 KN/m^2

2.5 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:

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-I/19/03/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.

1. 1.0 (DL+LL)
2. 1.0 DL+ 1.0 SQX+1
3. 1.0 DL+ 1.0 SQX-1
4. 1.0 DL+ 1.0 SQZ+1
5. 1.0 DL+ 1.0 SQZ-1
6. 1.0 DL+ 0.8 LL + 0.8 SQX+1
7. 1.0 DL+ 0.8 LL + 0.8 SQX-1
8. 1.0 DL+ 0.8 LL + 0.8 SQZ+1
9. 1.0 DL+ 0.8 LL + 0.8 SQZ-1
10. 1.0 DL+ 1.0 WLX+1
11. 1.0 DL+ 1.0 WLX-1
12. 1.0 DL+ 1.0 WLZ+1
13. 1.0 DL+ 1.0 WLZ-1
14. 1.0 DL+ 0.8 LL + 0.8 WLX+1
15. 1.0 DL+ 0.8 LL + 0.8 WLX-1
16. 1.0 DL+ 0.8 LL + 0.8 WLZ+1
17. 1.0 DL+ 0.8 LL + 0.8 WLZ-1
18. 1.5 (DL+LL)
19. 1.2 (DL+LL+EQX+1)
20. 1.2 (DL+LL-EQX-1)
21. 1.2 (DL+LL+EQZ+1)
22. 1.2 (DL+LL-EQZ-1)
23. 1.5 (DL+EQX+1)
24. 1.5 (DL+EQX-1)
25. 1.5 (DL+EQZ+1)
26. 1.5 (DL+EQZ-1)
27. 0.9 DL + 1.5 EQX+1
28. 0.9 DL + 1.5 EQX-1
29. 0.9 DL + 1.5 EQZ+1

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-I/19/03/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.

30. 0.9 DL + 1.5 EQZ-1

31. 1.2 (DL+LL+WLX+1)

32. 1.2 (DL+LL+WLX-1)

33. 1.2 (DL+LL+WLZ+1)

34. 1.2 (DL+LL+WLZ-1)

35. 1.5 (DL+WLX+1)

36. 1.5 (DL-WLX-1)

37. 1.5 (DL+WLZ+1)

38. 1.5 (DL+WLZ-1)

39. 0.9 DL + 1.5 WLX+1

40. 0.9 DL + 1.5 WLX-1

41. 0.9 DL + 1.5 WLZ+1

42. 0.9 DL + 1.5 WLZ-1

43. 1.5DL+1.5RSX +1

44. 1.5DL+1.5RSX -1

45. 1.5DL+1.5RSZ +1

46. 1.5DL+1.5RSZ -1

47. 0.9DL+1.5RSX +1

48. 0.9DL+1.5RSX -1

49. 0.9DL+1.5RSZ +1

50. 0.9DL+1.5RSZ -1

51. 1.2DL+1.2LL+1.2RSX +1

52. 1.2DL+1.2LL+1.2RSX -1

53. 1.2DL+1.2LL+1.2RSZ +1

54. 1.2DL+1.2LL+1.2RSZ -1

55. 1 DL+0.8 LL+ 0.8 RSX +1

56. 1 DL+0.8 LL+ 0.8 RSX -1

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-I/19/03/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.

57. 1 DL+0.8 LL+ 0.8 RSZ +1

58. 1 DL+0.8 LL+ 0.8 RSZ -1

59. 1.0 (DL+RSX +1)

60. 1.0 (DL+RSX -1)

61. 1.0 (DL+RSZ +1)

62. 1.0 (DL+RSZ -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. Linear Dynamic analysis is performed by adopting Response Spectrum Method. The entire super-structure is modeled using frame elements as appropriate. Beams and columns are modeled as frame elements. Appropriate loads and its combination 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 IS 456: 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

1. Type of Foundation : Pile Foundation. (as per soil report)

2. Safe load Capacity of the pile

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-I/19703/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.

For 450 mm Dia pile : 450 KN

3. Depth of Foundation : 8.5 m from N.G.L + Socketing length (1.5xΦ)

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	20
3	Steel	78.50

Structural concrete shall be of grade M30 for Pile.

Structural concrete shall be of grade M30 for all other structural Elements.

Steel reinforcement shall be of Grade Fe500 confirming 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	–	50mm
Pile cap top	–	50mm
Pile cap bottom	–	100mm
Beam	–	25mm
Slab	–	20mm

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-I/19/03/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.

8.0 LIST OF CODES & REFERENCES:

- IS: 456 2000: Code of practice for Plain and Reinforced Concrete.
- IS: 875 Part 1: Code of Practice for Design of Dead Loads for buildings and structures.
- IS: 875 Part 2: Code of Practice for Design of imposed Loads for buildings.
- IS: 875 Part 3: Design Loads (Other than Earthquake) for Building and Structural.
- IS: 1893 (Part 1)-2016: Criteria for Earthquake resistant Design of structures.
- IS: 13920-1993: Ductile detailing of reinforced concrete structures subjected to seismic forces.
- IS 1786-1985: code of practice for steel.
- SP 16: Design aids for reinforced concrete to IS: 456- 1978.
- SP 34: Hand book on concrete reinforcement detailing.

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-I/19/03/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.

DESIGN OF PILE CAP:

Safe load for 600mm Dia pile	=	1130 KN
Concrete grade for pile	=	M30
Un factored Column load	=	3039 KN
No of piles required	=	3039 / 1130 = 2.68
Provide 4 nos of Pile (600Ø)		
Spacing of Piles	=	1800mm
Depth of Pile cap	=	1100mm
Factored load	=	3039 x 1.5 = 4558 KN
Tension (by Truss theory)	=	$(P/(24*L*d)) \times (3L^2 - a^2)$

Where,

P – Factored Load,

L– Center to center spacing between the piles

d – Effective depth of pile cap

a – Width of column

Tension (Along XX & YY) = $(4558/(24*1800*987))x(3(1800)^2 - (450)^2)$

= 1017 KN

Ast required = $1017 \times 10^3 / 0.87 \times 500$ = 2406 mm^2

Provide 12Y @ 100mm C/C spacing

Ast provided = 3436 mm^2

Ast provided > Ast required

Hence it is safe

Minimum reinforcement at top = 0.12% bd

Ast required = 720 mm^2

Ast provided = 753 mm^2

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-I/19/03/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.

DESIGN OF COLUMN - C1

Length of column	D	450	mm	
Breadth of column	b	300	mm	
Unsupported length (longer direction)	L_x	3000	mm	
Unsupported length (shorter direction)	L_y	3000	mm	
Eff. Length (longer direction)	L_{ex}	2400	mm	
Eff. Length (shorter direction)	L_{ey}	2400	mm	
Factored Load	P_u	857	kN	
Factored moment (longer direction)	Mux	65	kNm	
Factored moment (shorter direction)	Muz	18	kNm	
Charac. comp strength of concrete	f_{ck}	25	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	402	mm	
Check for slenderness				
Longer Direction				
Slenderness ratio	L_{ex}/D	5.33	**short**	
Additional moment due to slenderness	M_{ax}	0	kN-m	
Shorter Direction				
Slenderness ratio	L_{ey}/b	8.00	**short**	
Additional moment due to slenderness	M_{ay}	0	kN-m	
Calculation of P_{uz}				
No of bars used		10		
Area of reinforcement	Ast	2009.6		
Provided steel		10 nos Y16		
Percentage of reinforcement	p_t	1.489	%	
Area of concrete	Ag	135000	mm^2	
Ultimate axial load (without moments)	P_{uz}	2250	kN	
Calculation of P_b:				
Longer Direction				
	d'/D	0.107		
Coefficient k_1(from TABLE 60 of SP:1980)	k_{1x}	0.205	From Sp16	
Coefficient k_2(from TABLE 60 of SP:1980)	k_{2x}	0.409		
Axial load corresponding to balanced failure	P_{bx}	775	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}	706	kN	
Reduction factor for additional moments	k_y	0.902		
Moment due to slenderness	M_{ax}	**0.00**	kN-m	

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-I/19/03/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.

Check for moments due to min. eccentricity				
Longer Direction				
Minimum eccentricity	e_x	21.00	mm	
Moment due to min. eccentricity	M_x	18.00	kN-m	
Moment in longer direction	M_{ux}	65.00	kNm	
Shorter direction				
Minimum eccentricity	e_y	16.00	mm	
Moment due to min. eccentricity	M_y	13.71	kN-m	
Moment in shorter direction	M_{uy}	18	kNm	
Final design moments				
Moment in longer direction	M_{ux}	**65.00**	kNm	
Moment in shorter direction	M_{uy}	**18.00**	kNm	
Check for interaction				
	d'/D	0.107		
	d'/b	0.160		
p/f_{ck}	p/f_{ck}	0.060		
$P_u/f_{ck}bD$ value	$P_u/f_{ck}bD$	0.254		
$M_{ux1}/f_{ck}bD^2$ value (from SP 16:1980 charts)	$M_{ux1}/f_{ck}bD^2$	0.120		
Uniaxial moment capacity (longer direction)	M_{ux1}	**182.25**	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}	**111.375**	kNm	
P_u/P_{uz} ratio	P_u/P_{uz}	**0.381**		
Value of exponent		1.302		
Interaction ratio		**0.354**		
Percentage reinforcement satisfactory or not		**safe**		
b/D ratio	b/D	0.66666667		
Status of dimensions		**OK**		
Gross area	A_g	135000	mm^2	
Area of core	A_k	87400	mm^2	
Spacing of lateral ties	S	75	mm	
Larger dimension of the hoop	H	230	mm	
Cross sectional area of hoop	A_{sh}	84.55	mm^2	

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-I/19/03/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.

Design of Roof Beam

GRB1

Description		Formula / Variable		Result	Unit
General Input Data					
Clear span		l		= 3300	mm
Total depth of beam		D		= 450	mm
Width of beam		b		= 200	mm
Width of left side support				= 450	mm
Width of right side support				= 450	mm
Assumed diameter of bar		Φ		= 25	mm
Clear cover to main reinforcement				= 25	mm
Effective cover to main reinforcement		d'		= 37.5	mm
Effective depth of beam		d		= 412.5	mm
Effective span of beam		L_{eff}		= 3712.5	mm
Factored bending moment	at end span1	M_u	From Staad O/P	= 125	kNm
	at midspan	M_u	From Staad O/P	= 65	kNm
	at end span2	M_u	From Staad O/P	= 125	kNm
Factored shear force	at end span1	V_u	From Staad O/P	= 114	kN
	at midspan	V_u	From Staad O/P	= 0	
	at end span2	V_u	From Staad O/P	= 114	
Material Data					
Grade of Concrete		f_{ck}	M30	= 30	N/mm^2
Yield Strength of Reinforcement		f_y		= 500	N/mm^2
Unit Weight of Concrete		w_c		= 25	kN/m^3
Youngs modulus of steel		E_s		= 200000	N/mm^2
Check for bending moment					
Ultimate limiting of bending moment		$M_{u,lim} = 0.133 \times f_{ck} \times b \times d^2$ (From SP16, Table C, P.No:10)		= 135.78469	kNm

End span 1	M_u <	Mu,lim	Hence	singly	reinforced section is required
Mid span	M_u <	Mu,lim	Hence	singly	reinforced section is required
End span 2	M_u <	Mu,lim	Hence	singly	reinforced section is required

Calculation of limiting neutral axis depth			
Neutral axis depth	$X_{u,lim} = 0.46 \times d$ (From IS456:2000, clause 38.1, P.No:70)	= 189.75	mm
Calculation of tension reinforcement for end and mid span			
Tension reinforcement	$A_{st} = A_{st1} + A_{st2}$		

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-I/19/03/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.

	$A_{st1} = (P_{t,lim} \times b \times d) / 100$ $A_{st2} = (M_{u2}) / (0.87 \times f_y \times (d-d'))$ $P_{t,lim} = (18.87 \times f_{ck}) / (f_y)$ $M_{u2} = (M_u - M_{u,lim})$ (From SP16, Table C, P.No:10)		

End span 1 (top)

Required tension reinforcement = 838 mm^2

		Nos.	Dia.(mm)	% Rft.		
Provided tension reinforcement	Main	2	16	1.25	= 1030	mm^2
	Extra	2	20			

Provided area > Required area HENCE SAFE

Mid span (bottom)

Required tension reinforcement = 393 mm^2

		Nos.	Dia.(mm)	% Rft.		
Provided tension reinforcement	Main	2	16	0.73	= 603	mm^2
	Extra	1	16			

Provided area > Required area HENCE SAFE

End span 2 (top)

Required tension reinforcement = 838 mm^2

		Nos.	Dia.(mm)	% Rft.		
Provided tension reinforcement	Main	2	16	1.25	= 1030	mm^2
	Extra	2	20			

Provided area > Required area HENCE SAFE

Calculation of compression reinforcement

Required compression reinforcement	$A_{sc} = [M_{u2}] / [(f_{sc} - f_{cc}) \times (d - d')]$ $M_{u2} = (M_u - M_{u,lim})$		
Strain at the level of centroid of compression steel	$\varepsilon_{sc} = [0.0035 \times (x_u - d')] / [x_u]$	= 0.00281	
Here value of ε_{sc} is greater than $(0.696 \times f_y)/(E_s)$			
Stress in compression steel	f_{sc} is get from Interpolate ε_{sc} value in Table A, Clause 1.4, SP16, P.No:6	= 414.44005	N/mm^2
Stress in concrete at the level of the centroid of the compression steel	$f_{cc} = 0.447 \times f_{ck}$	= 13.41	N/mm^2

End span 1 (bottom)

Required compression reinforcement = -71.71325 mm^2

		Nos.	Dia.(mm)	% Rft.		
Provided compression rft.	Main	2	16	0.49	= 402	mm^2
	Extra	0	0			

Provided area > Required area HENCE SAFE

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-1/19/93/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.

Mid span (top)

Required compression reinforcement = -470.6858 mm^2

		Nos.	Dia.(mm)	% Rft.			
Provided compression rft.	Main	2	16	0.49	=	402	mm^2
	Extra	0	0				

Provided area > Required area HENCE SAFE

End span 2 (bottom)

Required compression reinforcement = -71.71325 mm^2

		Nos.	Dia.(mm)	% Rft.			
Provided compression rft.	Main	2	16	0.49	=	402	mm^2
	Extra	0	0				

Provided area > Required area HENCE SAFE

Check for ductlity			
End span 1 (bottom)			
Compression rft. limit	$P_{c,limit} = (0.87 \times f_y \times (p_t - p_{t,limit})) / (f_{sc} - (0.447 \times f_{ck}))$	= 0.13	%
$P_{c,limit}$ < $P_{c,provided}$	HENCE SAFE		
Mid span (top)			
Compression rft. limit	$P_{c,limit} = (0.87 \times f_y \times (p_t - p_{t,limit})) / (f_{sc} - (0.447 \times f_{ck}))$	= -0.43	%
$P_{c,limit}$ < $P_{c,provided}$	HENCE SAFE		
End span 2 (bottom)			
Compression rft. limit	$P_{c,limit} = (0.87 \times f_y \times (p_t - p_{t,limit})) / (f_{sc} - (0.447 \times f_{ck}))$	= 0.13	%
$P_{c,limit}$ < $P_{c,provided}$	HENCE SAFE		
Check for deflection			
Condition	$(L/d)_{max} > (L/d)_{actual}$		
	$(L/d)_{max} = (L/d)_{basic} \times K_t \times K_c$		
	$(L/d)_{basic}$ (From IS456:2000, Clause 23.2.1, P.No:37	= 20	
Modification factor for tension rft.	$K_t = 1 / ((0.225) + (0.00322 \times f_s) - (0.625 \times \log10(1/p_t)))$	= 1.335	
Modification factor for compression rft.	$K_c = (1)+((P_c)/(P_c+3)) <= 1.5$	= 1.140	
Steel stress of service loads	$f_s = (0.58 \times f_y \times$ Area of steel req.)/(Area of steel pro.)	= 189	N/mm^2
Maximum allowable deflection	$(L/d)_{max}$	= 30.44	mm
Actual deflection	$(L/d)_{actual}$	= 9.000	mm
$(L/d)_{max}$ > $(L/d)_{actual}$	HENCE SAFE		

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-I/19/03/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.

Check for shear				
Maximum shear force @ end span	V_u	=	114	kN
Nominal shear	$\tau_v = V_u / (b \times d)$ (From IS456:2000, Clause 40.1, P.No:72)	=	1.38	N/mm^2
Design shear strength of concrete	τ_c (From IS456:2000, clause 31.6.3, P. No:58)	=	0.710	N/mm^2
τ_v > τ_c	HENCE SHEAR RFT. REQUIRED			
Provide 8 mm dia of 2 legged vertical stirrup rod				
Strength of shear reinforcement	$V_{us} = V_u - (\tau_c \times b \times d)$	=	55441.2	N
Spacing of stirrups	$S_v = (0.87 \times f_y \times A_{sv} \times d) / (V_{us})$	=	325	mm
Maximum spacing, (0.75 d)		=	309	mm
		=	300	mm
Hence provide 100 mm c/c spacing				

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-I/19/03/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.

DESIGN OF SLAB

Design of two way Slab - S1

Basic Data

Grade of concrete (fck)		=	M 30	
Grade of steel (fy)		=	Fe 500	
Thickness of slab (D)		=	125	mm
Clear cover (cc)		=	20	mm
Effective thickness of slab (deff)	= 125 - 20 - 8 /2	=	101	mm
Unit weight of concrete		=	25	KN/m^3
Effective Shorter Span (Lx)		=	3.23	m
Effective Longer Span (Ly)		=	3.4	m
Aspect ratio Ly/Lx		=	1.05	**Two way slab**

Edge Condition : **Three Edges Discontinuous (One Long Edge Continuous)**

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	→	0.043	
			1.1	→	0.048	
		for	1.05	αx =	0.046	
Positive moment Mx :	0.046 x	9.94 x	3.23 ^2	=	**4.7**	KN-m
ax for negative moment			1	→	0.057	
			1.1	→	0.064	
		for	1.05	αx =	0.061	
Negative moment Mx :	0.061 x	9.94 x	3.23 ^2	=	**6.29**	KN-m

Long Span Direction

For positive moment				αy =	0.043	
Positive moment My :	0.043 x	9.94 x	3.23 ^2	=	**4.5**	KN-m

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-I/19/03/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.

For negative moment						αy	=	0.000	
Negative moment My :	0.000	x	9.94	x	3.23 ^2	=	**0.00**	KN-m	
Shear force V_u =	9.94	x	3.2	x	0.5	=	**16.05**	KN	

Check Effective Depth for Bending

Depth required	= $(M_x / (0.133x \ fck \times b))^{1/2}$	=	39.71 mm
Depth provided	= 125 - 20 - 8 /2	=	101 mm

Hence O.K

Reinforcement calculations

Short Span Direction @ Support

$$Mu/bd^2 = \frac{6.29 \times 10 \wedge 6}{1000 \times 101 \times 101} = \mathbf{0.617}$$

Pt = **0.15** %

Area of steel Ast =	0.00145	x	1000 x	101	=	146.831	mm^2	
Minimum area of steel:	0.0012	x	1000 x	125	=	150.00	mm^2	
Spacing of Y **8** bars	50.27	x	1000 /	150.00	=	334.933	mm	
Ast provided					=	402.125	mm^2	

Check for Spacing

Minimum of	1) 3d	=	303	mm
	2)	=	300	mm
	3)	=	334.93	mm

Therefore provide Y **8** @ **125** mm C/C

Short Span Direction @ Mid Span

$$Mu/bd^2 = \frac{4.73 \times 10 \wedge 6}{1000 \times 101 \times 101} = 0.464$$

Pt = 0.109 %

Area of steel Ast =	0.00109	x	1000 x	101	=	109.721	mm^2	
Minimum area of steel:	0.0012	x	1000 x	125	=	150.00	mm^2	
Spacing of Y **8** bars	50.27	x	1000 /	150.00	=	334.933	mm	
Ast provided					=	402.125	mm^2	
Check for Spacing						Safe		

Minimum of	1) 3d	=	303	mm
	2)	=	300	mm
	3)	=	334.93	mm

Therefore provide Y **8** @ **125** mm C/C 125

Provided % of Tension Reinforcement (pt) = **0.398** %

Long Span Direction @ Support

Er.I.R.ARUNKUMAAR, M.E., (Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-I/19/03/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.

Mu/bd^2 = 0.00 x 10 ^ 6 / 1000 x 101 x 101 = 0.000

Pt = 0.000 %

Area of steel Ast	=	0.00000	x	1000 x	101	=	0	mm^2
Minimum area of steel:		0.0012	x	1000 x	125	=	0.00	mm^2
Spacing of Y **8** bars		50.27	x	1000 /	0.00	=	0	mm
Ast provided						=	335.104	mm^2
Check for Spacing							Safe	

Minimum of

1) 3d = 303 mm

2) = 300 mm

3) = 0.00 mm

Therefore provide Y **8** @ **150** mm C/C

Long Span Direction @ mid Span

Mu/bd^2 = 4.46 x 10 ^ 6 / 1000 x 101 x 101 = 0.437

Pt = 0.102 %

Area of steel Ast	=	0.00102	x	1000 x	101	=	103.282	mm^2
Minimum area of steel:		0.0012	x	1000 x	125	=	150.00	mm^2
Spacing of Y **8** bars		50.27	x	1000 /	150.00	=	334.933	mm
Ast provided						=	335.104	mm^2
Check for Spacing							Safe	

Minimum of

1) 3d = 303 mm

2) = 300 mm

3) = 334.93 mm

Therefore provide Y **8** @ **150** mm C/C

Check for Deflection:

Basic Span/depth Ratio	=	20	
% of Tension Reinforcement provided (pt)	=	0.398	%
Service stress of steel (fs) : 0.58fy(Ast_r/Ast_p)	=	79.13	N/mm^2
Modification Factor for Tension Reinforcement (F1)	=	2.00	
Allowable Span/Eff Depth Ratio	=	40	
Actual Span/Eff Depth Ratio = 3.23 x 1000 / 101	=	31.98	

Hence O.K

Er.I.R.ARUNKUMAAR, M.E.,(Structural), M.I.E.,
Consulting Structural Engineer,
Chartered Civil Engineer (M-165213-8)
CMDA Regn. No. SE/GR-I/19/03/013,
Greater Chennai Corporation, Regn. No.RSE100482019,
No.4, R.K.Shanmugam Road, K.K.Nagar,
Chennai - 600078.



our services doesn't just end there

Buying & Selling Services

Property Buying Assistance, Property Selling Support, Market Price Analysis, Owner Outreach and Negotiation.

Legal & Documentation Services

Certified EC, Patta, legal opinions, property verification, due diligence, litigation solutions, and legal heir certificates.

Property Development & Approvals

Building plan approvals, construction, layout and sub-division approvals, zone conversion, and occupancy certification.

NRI & Investment Services

Escrow Services, Rentals, Litigation Solutions, Property Valuation and Property Management

Compliance & Special Services

Demolition, Vaasthu checks, regularization of unauthorized buildings, and office space solutions.



empowering your real estate decisions with smart tools

Property Valuation & Cost Estimation

Guideline Value, Apartment Composite Value, Stamp Duty & Registration Fees Calculator, Building Value Calculator, Capital Gains Calculator, Area Unit Converter, Length Unit Converter

Ownership, Compliance & Legal Verification

Encumbrance Certificate (EC) Search, Find Your SRO, Temple Property Check, WAQF Property Check, View Patta/Chitta, View FMB, Patta Analyzer, EC Analyzer

Zoning & Land Use Analysis

Land Use Zone Finder, CRZ Zone Check, Aquifer Zone Check, CBA Check, EWS Check, Road Width Check, Proposed Road Widening Check, FSI Calculator

Property Documentation & Workflow Tools

Forms & Templates, Document Generator, Document Translation, Dictionary

Vastu & Property Management Tools

Home Vastu Shastra, Plot Vastu Shastra, Property Management

Verified RealEstate™

We're honored to be part of your real estate journey

3/350/2 Mettukuppam,
OMR Thoraipakkam,
Chennai, India

hello@verified.realestate
+91 9996 12 9996
www.verified.realestate