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DESIGN BASIS REPORT

FOR

M/S.GREAT HEIGHTS DEVELOPERS LLP

THE PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING WITH 64 DWELLING UNITS AT PERUMAL KOVIL STREET, J.J.NAGAR, MADHAVARAM,CHENNAI-600 060. COMPRISED IN OLD S.NO. 347 & 347/P, T.S.NO.13/2,3,4,5,6,7,8 AND 9 (AS PER PATTA) WARD:B, BLOCK NO:38, MADHAVARAM VILLAGE, MADHAVARAM TALUK, GREATER CHENNAI CORPORATION. ZONE: III, DIVISION: 27

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Grade-I (SE) in CMDA
Reg. No. SE/GR-1/2024/02/009 dt. 27.02.2024
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Reg. No. RSE 100302019 Dt. 30.09.2019
Door No.50, Kirupasankari Street,
West Mambalam, Chennai-600 033.

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1.0 OBJECTIVE

The Design basis covers the basic requirement that will be followed for the design of THE PROPOSED CONSTRUCTION OF RESIDENTIAL BUILDING WITH 64 DWELLING UNITS FOR M/S.GREAT HEIGHTS DEVELOPERS LLP AT PERUMAL KOVIL STREET, J.J.NAGAR, MADHAVARAM,CHENNAI-600 060. COMPRISED IN OLD S.NO. 347 & 347/P, T.S.NO.13/2,3,4,5,6,7,8 AND 9 (AS PER PATTA) WARD:B, BLOCK NO:38, MADHAVARAM VILLAGE, MADHAVARAM TALUK, GREATER CHENNAI CORPORATION. ZONE: III, DIVISION: 27

The building is designed for Basement Part Floor + Stilt + 5 Floors. The structure is R.C.C framed 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

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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. All floors = 2 KN/m^2
2. 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

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. 1.0 (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

8.1.0DL+0.8LL+0.8SQZ+1

9.1.0DL+0.8LL+0.8SQZ-1

10.1.5(DL+LL)

11.1.2(DL+LL+EQX+1)

13.1.2(DL+LL-EQX-1)

14.1.2(DL+LL+EQZ+1)

15.1.2(DL+LL-EQZ-1)

16.1.5(DL+EQX+1)

17.1.5(DL+EQX-1)

18.1.5(DL+EQZ+1)

19.1.5(DL+EQZ-1)

20.0.9DL+1.5EQX+1

21.0.9DL+1.5EQX-1

22.0.9DL+1.5EQZ+1

23.0.9DL+1.5EQZ-1

The above load combinations will be considered and effect of worst combinations Will be taken for design of various building elements.

3.0ANALYSISMETHODS

The analysis of the structures is carried out using the STAADPRO.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 perrelevant IS code clauses, for most unfavorable effects are chosen for design. Various load cases considered in the analysis are briefed above.

4.0DESIGNASSUMPTION

4.1.1 The Base of the Foundation is assumed to be fixed.

4.1.2 SBC of soil is taken as 120 kN/m^2 at a depth of 2.50m.

4.1.3 All Concrete elements shall be designed inaccordance with IS456:2000 Limit State Design.

4.1.4 Appropriate loads and its combinations ,as per relevant clauses, for the mostunfavorableeffectsarechosenfordesign.(ReferLoadCombination below).

5.0MATERIALS

Theself-

weightofthevariouselementsarecomputedbasedontheunitweightofmaterialsasgivenb

S.no	Materials	UnitweightKN/m^3
1	ReinforcedCementConcrete	25
2	SolidBlock/Brick	20
3	Steel	78.50

StructuralconcreteshallbeofgradeM20forallstructuralElements.

SteelreinforcementshallbeofGradeFe415confirmingtoIS:1786-2008.

7.0NOMINALCOVERTOREINFORCEMENT

FromDurabilityrequirement,exposureconditionisassumedasmildforstructuralelementsabovegroundlevelandmoderateforstructuralelementsbelowgroundlevel.

TheClearcovertoreinforcementtomeetdurabilityrequirementshallbeasfollows:

Column–40mm

Footing50mm

Beam25mm

Slab–20mm

Beamsize:230mmx450mm

Bendingmomentatsupport = 140kNm

Bendingmomentatmidspan = 133kNm

Shearforce,Vu = 149kN

Bending moment at support, M_u = 140kNm

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

= 3.64

$Pt/100 = Ast/bd$ = $fck/2fy$ [1-Sq.rt (1-4.598xR/fck)\

fck = 20 N/mm^2

fy = 415 N/mm^2

Pt = 1.19%

Ast required = 1119 mm^2

Provide 6nos of 16Y

Ast provided = 1206 mm^2

Hence safe.

Bending moment at mid span, M_u = 133kNm

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

= 3.46

Pt = 1.1%

Ast required = 1035 mm^2

Provide 6nos of 16Y

Ast provided = 1206 mm^2

Hence it is safe

Shear force, V_u, = 149kN

τ_v = V_u/bd

= $(149 \times 10^3)/ 230 \times 409$

= 1.58 N/mm^2

Hence ok.

<u>Shear capacity of concrete:</u>

Pt = 1.28 %

τ_c = 0.68

= τ_c bd

= 0.68 X 230 X 409

= 63968 N (or) 64 kN

Shear to be carried by stirrups

Vu = Vs – τ_c bd

= 149 – 64 kN

= 85kN

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

Bending moment at support = 132kNm

Bending moment at mid span = 111kNm

Shear force, Vu = 96kN

Bending moment at support, Mu = 132kNm

R = $(132 \times 10^6)/230 \times 484^2$

= 2.44

Pt/100 =Ast/bd = fck/2fy [1-Sq.rt (1-4.598xR/fck)\

fck = 20 N/mm^2

fy = 415 N/mm^2

Pt = 0.81%

Ast required = 781 mm^2

Provide 4nos of 16Y

Ast provided = 804 mm^2

Hence safe.

Bending moment at mid span, Mu = 111kNm

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

= 2.06

Pt = 0.55%

Ast required = 612 mm^2

Provide 4 nos of 16Y

Ast provided = 804 mm^2

Hence it is safe

Shear force, Vu, = 96kN

τv = Vu/bd

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

= 0.86 N/mm^2

Hence ok.

<u>Shear capacity of concrete:</u>

Pt = 0.72 %

τc = 0.55

= τc bd

= 0.55 X 230 X 484

= 61226 N (or) 61.23Kn

<u>Shear to be carried by stirrups</u>

Vu = Vs – τc bd

= 96 – 61.23kN

= 35kN

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 Strip Footing

Total load = 14678 kN

Total Area required = 161.5 m^2

Total Area provided = 188 m^2

DESIGN OF RAFT BEAM RB1

Width (b) = 1.35m

Net upward pressure = 14678/ 188

= 78 kN/m^2

Max bending moment = 401 kNm

Factored bending moment = 602 kNm

$d = \text{Sq.rt } (602 \times 10^6)/(0.138 \times 20 \times 450)$

d = 696mm

Provided depth = 900mm

d = 900-100-10-10-25/2 = 767 mm

$Mu/bd^2 = (602 \times 10^6) / (450 \times 767^2)$

Ast required = 2557mm^2

Ast provided = 2946 mm^2

Check for shear

Shear force = 420 kN

$\tau v = (420 \times 10^3)/(450 \times 767) = 1.21 N/mm^2$

% of Ast = 0.43%

From table No.61 SP 16: 1980

$\tau c = 0.66 N/mm^2$

Shear taken by stirrups = (1.21-0.66) x 450 x 767 = 190 kN

As per table no. 62 SP 16: 1980

$$190/77 = 2.47 \text{ kN/cm}$$

Provide 4 Legged 10sY @ 125mm c/c

Design of Slab

Projection of slab = 0.675m

Net upward pressure = 78 kN/m2

Bending moment = $78 \times 0.675^2/2 = 17.7$ kNm

Mu = $1.50 \times 17.7 = 26.6$ kNm

$$d = \text{Sq.rt}\ (26.6\text{x}10^6)/(0.138\text{x}20\text{x}1000)$$

$$d = 98 \text{ mm}$$

Provide D = 450 mm, d = 450 – 50 – 10/2 = 395 mm

$Mu/bd^2 = (17.7 \text{ x}10^6) / (1000\text{x}395^2)$

Ast req = 157 m2

Ast provided = 780 m2

Provide 10Y @ 100mm c/c

Provide 8Y @ 150mm c/c as Distributor

Factored Shear = 38 kN

$\tau v = (38\text{x}10^3)/(1000\text{x}395) = 0.1 \text{N/mm}^2$

$\tau c = 0.36$ N/mm2

$\tau v < \tau c$

Hence safe in shear

DESIGN OF COLUMN C1

Length of column	D	750	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	1314	kN
Factored moment (longer direction)	Mux	97	kNm
Factored moment (shorter direction)	Muz	45	kNm
Charac. comp strength of concrete	f_{ck}	20	N/mm^2
Yield stress of steel	f_y	415	N/mm^2
Dia of bar used	Φ	20	mm
Clear cover		40	mm
Effective cover	d'	50	mm
Effective depth	d	700	mm
Check for slenderness			
Longer Direction			
Slenderness ratio	L_{ex}/D	2.88	**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		20	
Area of reinforcement	Ast	6280	
Provided steel		20 nos Y20	
Percentage of reinforcement	p_t	3.641	%
Area of concrete	Ag	172500	mm^2
Ultimate axial load (without moments)	P_{uz}	3451	kN
Calculation of P_b:			
Longer Direction			
	d'/D	0.067	
Coefficient k_1(from TABLE 60 of SP:1980)	k_{1x}	0.215	From Sp16
Coefficient k_2(from TABLE 60 of SP:1980)	k_{2x}	0.505	
Axial load corresponding to balanced failure	P_{bx}	1059	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}	707	kN
Reduction factor for additional moments	k_y	0.779	
Moment due to slenderness	M_{ax}	**0.00**	kN-m
Check for moments due to min. eccentricity			
Longer Direction			
Minimum eccentricity	e_x	30.40	mm

Moment due to min. eccentricity	M_x	39.95	kN-m
Moment in longer direction	M_{ux}	97.00	kNm
Shorter direction			
Minimum eccentricity	e_y	13.07	mm
Moment due to min. eccentricity	M_y	17.17	kN-m
Moment in shorter direction	M_{uy}	45	kNm
Final design moments			
Moment in longer direction	M_{ux}	**97.00**	kNm
Moment in shorter direction	M_{uy}	**45.00**	kNm
Check for interaction			
	d'/D	0.067	
	d'/b	0.217	
p/f_{ck}	p/f_{ck}	0.182	
$P_u/f_{ck}bD$ value	$P_u/f_{ck}bD$	0.381	
$M_{ux1}/f_{ck}bD^2$ value (from SP 16:1980 charts)	$M_{ux1}/f_{ck}bD^2$	0.160	
Uniaxial moment capacity (longer direction)	M_{ux1}	**414**	kNm
$M_{uy1}/f_{ck}bD^2$ value (from SP 16:1980 charts)	$M_{uy1}/f_{ck}bD^2$	0.135	
Uniaxial moment capacity (shorter direction)	M_{uy1}	**107.1225**	kNm
P_u/P_{uz} ratio	P_u/P_{uz}	**0.381**	
Value of exponent		1.302	
Interaction ratio		**0.474**	
Percentage reinforcement satisfactory or not		**safe**	
b/D ratio	b/D	0.30666667	
Status of dimensions		**OK**	
Gross area	A_g	172500	mm^2
Area of core	A_k	108800	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}	67.17	mm^2

DESIGN OF COLUMN C2

Length of column	D	750	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	1177	kN
Factored moment (longer direction)	Mux	25	kNm
Factored moment (shorter direction)	Muz	71	kNm
Charac. comp strength of concrete	f_{ck}	20	N/mm^2
Yield stress of steel	f_y	415	N/mm^2
Dia of bar used	Φ	20	mm
Clear cover		40	mm
Effective cover	d'	50	mm
Effective depth	d	700	mm
Check for slenderness			
Longer Direction			
Slenderness ratio	L_{ex}/D	2.88	**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		18	
Area of reinforcement	Ast	5652	
Provided steel		18 nos Y20	
Percentage of reinforcement	p_t	3.277	%
Area of concrete	Ag	172500	mm^2
Ultimate axial load (without moments)	P_{uz}	3261	kN
Calculation of P_b:			
Longer Direction			
	d'/D	0.067	
Coefficient k_1(from TABLE 60 of SP:1980)	k_{1x}	0.215	From Sp16
Coefficient k_2(from TABLE 60 of SP:1980)	k_{2x}	0.505	
Axial load corresponding to balanced failure	P_{bx}	1027	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}	698	kN
Reduction factor for additional moments	k_y	0.813	
Moment due to slenderness	M_{ax}	**0.00**	kN-m
Check for moments due to min. eccentricity			
Longer Direction			
Minimum eccentricity	e_x	30.40	mm

Moment due to min. eccentricity	M_x	35.78	kN-m
Moment in longer direction	M_{ux}	35.78	kNm
Shorter direction			
Minimum eccentricity	e_y	13.07	mm
Moment due to min. eccentricity	M_y	15.38	kN-m
Moment in shorter direction	M_{uy}	71	kNm
Final design moments			
Moment in longer direction	M_{ux}	**35.78**	kNm
Moment in shorter direction	M_{uy}	**71.00**	kNm
Check for interaction			
	d'/D	0.067	
	d'/b	0.217	
p/f_{ck}	p/f_{ck}	0.164	
$P_u/f_{ck}bD$ value	$P_u/f_{ck}bD$	0.341	
$M_{ux1}/f_{ck}bD^2$ value (from SP 16:1980 charts)	$M_{ux1}/f_{ck}bD^2$	0.190	
Uniaxial moment capacity (longer direction)	M_{ux1}	**491.625**	kNm
$M_{uy1}/f_{ck}bD^2$ value (from SP 16:1980 charts)	$M_{uy1}/f_{ck}bD^2$	0.170	
Uniaxial moment capacity (shorter direction)	M_{uy1}	**134.895**	kNm
P_u/P_{uz} ratio	P_u/P	**0.361**	
Value of exponent		1.269	
Interaction ratio		**0.479**	
Percentage reinforcement satisfactory or not		**safe**	
b/D ratio	b/D	0.30666667	
Status of dimensions		**OK**	
Gross area	A_g	172500	mm^2
Area of core	A_k	108800	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}	67.17	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 415	
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)		=	3.15	m
Effective Longer Span (Ly)		=	3.75	m
Aspect ratio Ly/Lx		=	1.19	**Two way slab**

Edge Condition : **Two adjacent Edges Discontinous**

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	1.1	→	0.04	
	1.2	→	0.045	
	for 1.19 αx	=	0.045	
Positive moment Mx	0.045 x 9.94 x 3.15 ^2	=	**4.39**	KN-m
ax for negative moment	1.1	→	0.053	
	1.2	→	0.060	
	for 1.19 αx	=	0.059	
Negative moment Mx :	0.059 x 9.94 x 3.15 ^2	=	**5.85**	KN-m

Long Span Direction

For positive moment	αy	=	0.035	
Positive moment My :	0.035 x 9.94 x 3.15 ^2	=	**3.45**	KN-m
For negative moment	αy	=	0.047	
Negative moment My :	0.047 x 9.94 x 3.15 ^2	=	**4.63**	KN-m

Shear force V_u = 9.94 x 3.2 x 0.5 = **15.65** KN

Check Effective Depth for Bending

Depth required = $(M_x / (0.138x\ fck \times b))^{1/2}$ = 46.04 mm

Depth provided = 125 - 15 - 8 /2 = 106 mm

Hence O.K

Reinforcement calculations

Short Span Direction @ Support

$$Mu/bd^2 = \frac{5.85 \times 10^6}{1000 \times 106 \times 106} = \mathbf{0.521}$$

Pt = **0.15** %

Area of steel Ast	= 0.00149	x	1000 x	106	=	157.82	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 /	157.82	=	318.33	mm
Ast provided					=	335.1	mm^2

Check for Spacing

Minimum of

1) 3d = 318 mm
2) = 300 mm
3) = 318.33 mm

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

Short Span Direction @ Mid Span

$$Mu/bd^2 = \frac{4.39 \times 10^6}{1000 \times 106 \times 106} = 0.391$$

Pt = 0.111 %

Area of steel Ast	= 0.00111	x	1000 x	106	=	117.47	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	=	334.93	mm
Ast provided					=	335.1	mm^2

Check for Spacing

Minimum of

1) 3d = 318 mm
2) = 300 mm
3) = 334.93 mm

Therefore provide Y **8** @ **150** mm C/C 100

Provided % of Tension Reinforcement (pt) = **0.316** %

Long Span Direction @ Support

$$Mu/bd^2 = \frac{4.63 \times 10^6}{1000 \times 106 \times 106} = 0.412$$

Pt = 0.117 %

Area of steel Ast =	0.00117	x	1000 x	106	=	124.17 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	=	334.93 mm
Ast provided					=	335.1 mm^2

Check for Spacing

Minimum of
1) 3d = 318 mm
2) = 300 mm
3) = 334.93 mm

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

Long Span Direction @ mid Span

$$Mu/bd^2 = \frac{3.45 \times 10^6}{1000 \times 106 \times 106} = 0.307$$

Pt = 0.087 %

Area of steel Ast =	0.00087	x	1000 x	106	=	91.874 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	=	334.93 mm
Ast provided					=	335.1 mm^2

Check for Spacing

Minimum of
1) 3d = 318 mm
2) = 300 mm
3) = 334.93 mm

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

<u>Check for Deflection:</u>

Basic Span/depth Ratio	= 23	
% of Tension Reinforcement provided (pt)	= 0.316	%
Service stress of steel (fs) : 0.58fy(Ast_r/Ast_p)	= 84.38	N/mm^2
Modification Factor for Tension Reinforcement (F1)	= 2.00	
Allowable Span/Eff Depth Ratio	= 46	
Actual Span/Eff Depth Ratio = 3.15 x 1000 / 106	= 29.72	

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 415	
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)	=	3.375	m
Effective Longer Span (Ly)	=	3.8	m
Aspect ratio Ly/Lx	=	1.13	**Two way slab**

Edge Condition : **Four 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	1.1	→	0.064	
	1.2	→	0.072	
	for 1.13 αx	=	0.066	
Positive moment Mx	0.066 x 9.94 x 3.375 ^2	=	**7.48**	KN-m
ax for negative moment	1.1	→	0.000	
	1.2	→	0.000	
	for 1.13 αx	=	0.000	
Negative moment Mx :	0.000 x 9.94 x 3.375 ^2	=	**0.00**	KN-m

Long Span Direction

For positive moment	αy	=	0.056	
Positive moment My :	0.056 x 9.94 x 3.375 ^2	=	**6.34**	KN-m
For negative moment	αy	=	0.000	
Negative moment My :	0.000 x 9.94 x 3.375 ^2	=	**0.00**	KN-m

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Shear force V_u = 9.94 x 3.4 x 0.5 = **16.77** KN

Check Effective Depth for Bending

Depth required = $(M_x / (0.138 x\ fck \times b))^{1/2}$ = 52.06 mm

Depth provided = 125 - 15 - 8 /2 = 106 mm

Hence O.K

Reinforcement calculations

Short Span Direction @ Support

$Mu/bd^2 = \frac{0.00 \times 10^6}{1000 \times 106 \times 106}$ = **0.000**

Pt = **0.00** %

Area of steel Ast	= 0.00000	x 1000 x	106	=	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				=	402.12	mm^2

Check for Spacing

Minimum of
1) 3d = 318 mm
2) = 300 mm
3) = 0.00 mm

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

Short Span Direction @ Mid Span

$Mu/bd^2 = \frac{7.48 \times 10^6}{1000 \times 106 \times 106}$ = 0.666

Pt = 0.192 %

Area of steel Ast	= 0.00192	x 1000 x	106	=	203.64	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 /	203.64	=	246.71	mm
Ast provided				=	402.12	mm^2

Check for Spacing

Minimum of
1) 3d = 318 mm
2) = 300 mm
3) = 246.71 mm

Therefore provide Y **8** @ **125** mm C/C 100

Provided % of Tension Reinforcement (pt) = **0.379** %

Long Span Direction @ Support

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$$Mu/bd^2 = \frac{0.00 \times 10^6}{1000 \times 106 \times 106} = 0.000$$

Pt = 0.000 %

Area of steel Ast	= 0.00000	x	1000 x	106	= 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					= 335.1	mm^2

Check for Spacing

Minimum of

1) 3d = 318 mm
2) = 300 mm
3) = 0.00 mm

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

Long Span Direction @ mid Span

$$Mu/bd^2 = \frac{6.34 \times 10^6}{1000 \times 106 \times 106} = 0.564$$

Pt = 0.162 %

Area of steel Ast	= 0.00162	x	1000 x	106	= 171.47	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 /	171.47	= 293	mm
Ast provided					= 335.1	mm^2

Check for Spacing

Minimum of

1) 3d = 318 mm
2) = 300 mm
3) = 293.00 mm

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

Check for Deflection:

Basic Span/depth Ratio	= 20	
% of Tension Reinforcement provided (pt)	= 0.379	%
Service stress of steel (fs) : 0.58fy(Ast_r/Ast_p)	= 121.89	N/mm^2
Modification Factor for Tension Reinforcement (F1)	= 2.00	
Allowable Span/Eff Depth Ratio	= 40	
Actual Span/Eff Depth Ratio = 3.375 x 1000 / 106	= 31.84	

Hence O.K

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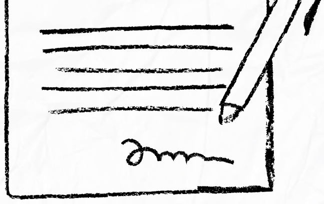

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