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DESIGN BASIS REPORT

FOR

MRS.E.SANGEETHA ENIAN W/O P.R.ENIAN

MR.E.EZHILAN S/O P.R.ENIAN

MR.AMUDHAN S/O P.R.ENIAN

PROPOSED RESIDENTIAL BUILDING WITH 50 DWELLING UNITS (BLOCK-1 & BLOCK-2) COMPRISED IN OLD S.NO:58/1,58/2,58/3,AS PER PATTA NEW S.NO:58/1A1A OF KOLAPAKKAM VILLAGE WITH IN THE LIMIT OF KUNDRATHUR PANCHAYAT UNION.

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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 PROPOSED RESIDENTIAL BUILDING FOR MRS.E.SANGEETHA ENIAN W/O P.R.ENIAN MR.E.EZHILAN S/O P.R.ENIAN,MR. AMUDHAN S/O P.R.ENIAN WITH 50 DWELLING UNITS(BLOCK-1 & BLOCK-2) COMPRISED IN OLD S.NO:58/1,58/2,58/3, AS PER PATTA NEW S.NO:58/1A1A OF KOLAPAKKAM VILLAGE WITH IN THE LIMIT OF KUNDRATHUR PANCHAYAT UNION.

The building is designed for Stilt + 5 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

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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. 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

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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.

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4.0DESIGNASSUMPTION

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

4.1.2 AllConcreteelementsshallbedesignedinaccordancewithIS456:2000LimitState Design.

4.1.3 Appropriate loads and its combinations, as per relevant clauses, for themostunfavorableeffectsarechosenfordesign.(ReferLoadCombinationbelow)

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5.0FOUNDATIONDESIGN

Type of Foundation : Pile foundation.

Depth of Foundation : 15m

6.0MATERIALS

Theself-

weightofthevariouselementsarecomputedbasedontheunitweightofmaterialsasgivenb

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

StructuralconcreteshallbeofgradeM25forPile

StructuralconcreteshallbeofgradeM20forPilecap&ColumnStructur

alconcreteshallbeofgradeM20forBeam&Slab

SteelreinforcementshallbeofGradeFe500confirmingtoIS:1786-2008.

7.0NOMINALCOVERTOREINFORCEMENT

FromDurabilityrequirement,exposureconditionisassumedasmildforstructuralelementsabo vegroundlevelandmoderateforstructuralelementsbelowgroundlevel.

The Clearcovertoreinforcementtomeetdurabilityrequirementshallbeasfollows:

Column –40mm

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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, Vu = 149kN

Bending moment at support, Mu = 140kNm

$R = (140 \times 10^6)/230x409^2$

$= 3.64$

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

$fck = 20\ N/mm^2$

$fy = 500\ N/mm^2$

$Pt = 1.07\%$

$Ast\ required = 1013\ mm^2$

Provide 6nos of 16Y

$Ast\ provided = 1206\ mm^2$

Hence safe.

Bending moment at mid span, Mu = 133kNm

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

$= 3.46$

$Pt = 1.0\%$

$Ast\ required = 944\ mm^2$

Provide 6nos of 16Y

$Ast\ provided = 1206\ mm^2$

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Hence it is safe

Shear force, Vu, = 149kN

τ_v = Vu/bd

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

= $1.58\ N/mm^2$

Hence ok.

Shear capacity of concrete:

Pt = 1.0 %

τ_c = 0.62

= τ_c bd

= 0.62X 230 X 409

= 58323 N (or) 58 kN

Shear to be carried by stirrups

Vu = Vs – τ_c bd

= 149 – 58 kN

= 91kN

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 = $(132 \times 10^6)/230x484^2$

= 2.44

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

fck = 20 N/mm^2

fy = 500 N/mm^2

Pt = 0.65%

Ast required = 725 mm^2

Provide 4nos of 16Y

Ast provided = 804 mm^2

Hence safe.

Bending moment at mid span, Mu = 111kNm

R = (111 x 10^6)/230 x 484^2

= 2.06

Pt = 0.53%

Ast required = 593 mm^2

Provide 4 nos of 16Y

Ast provided = 804 mm^2

Hence it is safe

Shear force, Vu, = 96kN

τv = Vu/bd

= 96 x 10^3 / 230 x 484

= 0.86 N/mm^2

Hence ok.

Shear capacity of concrete:

Pt = 0.65 %

τc = 0.53

= τc bd

= 0.53 X 230 X 484

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= 58999 N (or) 59kN

Shear to be carried by stirrups

Vu = Vs – τc bd

= 96 – 59 kN

= 37kN

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 :

Safe load for 600mm Dia pile = 1130 KN

Concrete grade for pile cap = M20

Un factored Column load = 1442KN

No of piles required = 1442/1130 = 1.28

Provide 2 nos of Pile (600Ø)

Spacing of Piles = 1800mm

= 1.8m

Factored load = 1442 x 1.5

= 2163

Bending moment WL/4 = 2163 x 1.8 / 4

= 973KNM

R = MU/bd^2 = $973 \times 10^6 / 975 \times 875^2$

= 1.3

fck = $20N/mm^2$

fy = $500N/mm^2$

Pt/100 = Ast/bd = fck/2fy [1-sqrt (1 - 4.598xR/20)]

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Ast required = 2739 mm^2

Provide 7 nos of 25 Dia bar

Ast provided = 3437mm^2

Ast required > Ast provided

Hence it is safe.

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DESIGN OF COLUMN C1

Length of column	D	1200	mm	
Breadth of column	b	300	mm	
Unsupported length (longer direction)	L_x	2850	mm	
Unsupported length (shorter direction)	L_y	2850	mm	
Eff. Length (longer direction)	L_{ex}	2280	mm	
Eff. Length (shorter direction)	L_{ey}	2280	mm	
Factored Load	P_u	3123	kN	
Factored moment (longer direction)	Mux	10	kNm	
Factored moment (shorter direction)	Muz	185	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	1150	mm	
Check for slenderness				
Longer Direction				
Slenderness ratio	L_{ex}/D	1.90	**short**	
Additional moment due to slenderness	M_{ax}	0	kN-m	
Shorter Direction				
Slenderness ratio	L_{ey}/b	7.60	**short**	
Additional moment due to slenderness	M_{ay}	0	kN-m	
Calculation of P_{uz}				
No of bars used		22		
Area of reinforcement	Ast	6908		
Provided steel		22 nos Y20		
Percentage of reinforcement	p_t	1.919	%	
Area of concrete	Ag	360000	mm^2	
Ultimate axial load (without moments)	P_{uz}	5768	kN	
Calculation of P_b:				
Longer Direction				
	d'/D	0.042		
Coefficient k_1(from TABLE 60 of SP:1980)	k_{1x}	0.219	From Sp16	
Coefficient k_2(from TABLE 60 of SP:1980)	k_{2x}	0.545		
Axial load corresponding to balanced failure	P_{bx}	1953	kN	
Reduction factor for additional moments	k_x	1.000		
Moment due to slenderness	M_{ax}	**0.00**	kN-m	
Shorter Direction				
	d'/b	0.167		
Coefficient k_1(from TABLE 60 of SP:1980)	k_{1y}	0.191		
Coefficient k_2(from TABLE 60 of SP:1980)	k_{2y}	0.265		
Axial load corresponding to balanced failure	P_{by}	1558	kN	
Reduction factor for additional moments	k_y	0.628		
Moment due to slenderness	M_{ax}	0.00	kN-m	
Check for moments due to min. eccentricity				
Longer Direction				
Minimum eccentricity	e_x	45.75	mm	

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Moment due to min. eccentricity		M_x	142.72	kN-m
Moment in longer direction		M_{ux}	142.72	kNm
Shorter direction				
Minimum eccentricity		e_y	15.70	mm
Moment due to min. eccentricity		M_y	49.03	kN-m
Moment in shorter direction		M_{uy}	185	kNm
Final design moments				
Moment in longer direction		M_{ux}	**142.72**	kNm
Moment in shorter direction		M_{uy}	**185.00**	kNm
Check for interaction				
		d'/D	0.042	
		d'/b	0.167	
p/f_{ck}		p/f_{ck}	0.096	
$P_u/f_{ck}bD$ value		$P_u/f_{ck}bD$	0.434	
$M_{ux1}/f_{ck}bD^2$ value (from SP 16:1980 charts)		$M_{ux1}/f_{ck}bD^2$	0.120	
Uniaxial moment capacity (longer direction)		M_{ux1}	**1036.8**	kNm
$M_{uy1}/f_{ck}bD^2$ value (from SP 16:1980 charts)		$M_{uy1}/f_{ck}bD^2$	0.100	
Uniaxial moment capacity (shorter direction)		M_{uy1}	**216**	kNm
P_u/P_{uz} ratio		P_u/P_{uz}	**0.541**	
Value of exponent			1.570	
Interaction ratio			**0.829**	
Percentage reinforcement satisfactory or not			**safe**	
b/D ratio		b/D	0.25	
Status of dimensions			**OK**	
Gross area		A_g	360000	mm^2
Area of core		A_k	259900	mm^2
Spacing of lateral ties		S	75	mm
Larger dimension of the hoop		H	230	mm
Cross sectional area of hoop		A_{sh}	47.84	mm^2

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DESIGN OF COLUMN C2

Length of column	D	1200	mm
Breadth of column	b	300	mm
Unsupported length (longer direction)	L_x	2850	mm
Unsupported length (shorter direction)	L_y	2850	mm
Eff. Length (longer direction)	L_{ex}	2280	mm
Eff. Length (shorter direction)	L_{ey}	2280	mm
Factored Load	P_u	3055	kN
Factored moment (longer direction)	Mux	45	kNm
Factored moment (shorter direction)	Muz	89	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	1150	mm
Check for slenderness			
Longer Direction			
Slenderness ratio	L_{ex}/D	1.90	**short**
Additional moment due to slenderness	M_{ax}	0	kN-m
Shorter Direction			
Slenderness ratio	L_{ey}/b	7.60	**short**
Additional moment due to slenderness	M_{ay}	0	kN-m
Calculation of P_{uz}			
No of bars used		17	
Area of reinforcement	Ast	5338	
Provided steel		17 nos Y20	
Percentage of reinforcement	p_t	1.483	%
Area of concrete	Ag	360000	mm^2
Ultimate axial load (without moments)	P_{uz}	5194	kN
Calculation of P_b:			
Longer Direction			
	d'/D	0.042	
Coefficient k_1(from TABLE 60 of SP:1980)	k_{1x}	0.219	From Sp16
Coefficient k_2(from TABLE 60 of SP:1980)	k_{2x}	0.545	
Axial load corresponding to balanced failure	P_{bx}	1868	kN
Reduction factor for additional moments	k_x	1.000	
Moment due to slenderness	M_{ax}	**0.00**	kN-m
Shorter Direction			
	d'/b	0.167	
Coefficient k_1(from TABLE 60 of SP:1980)	k_{1y}	0.191	
Coefficient k_2(from TABLE 60 of SP:1980)	k_{2y}	0.265	
Axial load corresponding to balanced failure	P_{by}	1517	kN
Reduction factor for additional moments	k_y	0.582	
Moment due to slenderness	M_{ax}	**0.00**	kN-m
Check for moments due to min. eccentricity			
Longer Direction			
Minimum eccentricity	e_x	45.70	mm

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Moment due to min. eccentricity		M_x	139.61	kN-m
Moment in longer direction		M_{ux}	139.61	kNm
Shorter direction				
Minimum eccentricity		e_y	15.70	mm
Moment due to min. eccentricity		M_y	47.96	kN-m
Moment in shorter direction		M_{uy}	89	kNm
Final design moments				
Moment in longer direction		M_{ux}	**139.61**	kNm
Moment in shorter direction		M_{uy}	**89.00**	kNm
Check for interaction				
		d'/D	0.042	
		d'/b	0.167	
p/f_{ck}		p/f_{ck}	0.074	
$P_u/f_{ck}bD$ value		$P_u/f_{ck}bD$	0.424	
$M_{ux1}/f_{ck}bD^2$ value (from SP 16:1980 charts)		$M_{ux1}/f_{ck}bD^2$	0.110	
Uniaxial moment capacity (longer direction)		M_{ux1}	**950.4**	kNm
$M_{uy1}/f_{ck}bD^2$ value (from SP 16:1980 charts)		$M_{uy1}/f_{ck}bD^2$	0.075	
Uniaxial moment capacity (shorter direction)		M_{uy1}	**162**	kNm
P_u/P_{uz} ratio		P_u/P_{uz}	**0.588**	
Value of exponent			1.648	
Interaction ratio			**0.415**	
Percentage reinforcement satisfactory or not			**safe**	
b/D ratio		b/D	0.25	
Status of dimensions			**OK**	
Gross area		A_g	360000	mm^2
Area of core		A_k	259900	mm^2
Spacing of lateral ties		S	75	mm
Larger dimension of the hoop		H	230	mm
Cross sectional area of hoop		A_{sh}	47.84	mm^2

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Reg. No. RSE 100302024 Dt. 09.10.2024
Door No.50, Kirupasankari Street,
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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 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	→	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

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Shear force V_u = 9.94 x 3.2 x 0.5 = **15.80** KN

Check Effective Depth for Bending

Depth required = $(M_x / (0.133x\ fck \times b))^{1/2}$ = 44.50 mm

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

Hence O.K

Reinforcement calculations

Short Span Direction @ Support

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

Pt = **0.11** %

Area of steel Ast = 0.00111 x 1000 x 106 = 117.55 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

Short Span Direction @ Mid Span

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

Pt = 0.083 %

Area of steel Ast = 0.00083 x 1000 x 106 = 87.982 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

Provided % of Tension Reinforcement (pt) = $\frac{100}{0.316}$ %

Long Span Direction @ Support

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$Mu/bd^2 = \frac{4.72 \times 10 \wedge 6}{1000 \times 106 \times 106} = 0.420$

Pt = 0.099 %

Area of steel Ast = 0.00099 x 1000 x 106 = 105.09 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

$Mu/bd^2 = \frac{3.52 \times 10 \wedge 6}{1000 \times 106 \times 106} = 0.313$

Pt = 0.073 %

Area of steel Ast = 0.00073 x 1000 x 106 = 77.742 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

Check for Deflection:

Basic Span/depth Ratio = 22

% of Tension Reinforcement provided (pt) = 0.316 %

Service stress of steel (fs) : 0.58fy(Ast_r/Ast_p) = 76.14 N/mm^2

Modification Factor for Tension Reinforcement (F1) = 2.00

Allowable Span/Eff Depth Ratio = 44

Actual Span/Eff Depth Ratio = 3.18 x 1000 / 106 = 30.00

Hence O.K

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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 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	→	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		αy =	0.035	
Positive moment My	0.035 x 9.94 x 3.35 ^2	=	**3.90**	KN-m
For negative moment		αy =	0.047	
Negative moment	0.047 x 9.94 x 3.35 ^2	=	**5.24**	KN-m

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Shear force V_u = 9.94 x 3.4 x 0.5 = **16.65** KN

Check Effective Depth for Bending

Depth required = $(M_x / (0.133x\ fck \times b))^{1/2}$ = 45.37 mm

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

Hence O.K

Reinforcement calculations

Short Span Direction @ Support

Mu/bd^2 = $\frac{5.48 \times 10 \wedge 6}{1000 \times 106 \times 106}$ = **0.487**

Pt = **0.12** %

Area of steel Ast = 0.00115 x 1000 x 106 = 122.33 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 = 402.12 mm^2

Check for Spacing

Minimum of

1) 3d = 318 mm

2) = 300 mm

3) = 334.93 mm

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

Short Span Direction @ Mid Span

Mu/bd^2 = $\frac{4.10 \times 10 \wedge 6}{1000 \times 106 \times 106}$ = 0.365

Pt = 0.086 %

Area of steel Ast = 0.00086 x 1000 x 106 = 90.868 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 = 402.12 mm^2

Check for Spacing

Minimum of

1) 3d = 318 mm

2) = 300 mm

3) = 334.93 mm

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

Provided % of Tension Reinforcement (pt) = 100 / 125 = **0.379** %

Long Span Direction @ Support

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$Mu/bd^2 = \frac{5.24 \times 10 \wedge 6}{1000 \times 106 \times 106} = 0.467$

Pt = 0.110 %

Area of steel Ast = 0.00110 x 1000 x 106 = 116.96 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

$Mu/bd^2 = \frac{3.90 \times 10 \wedge 6}{1000 \times 106 \times 106} = 0.347$

Pt = 0.082 %

Area of steel Ast = 0.00082 x 1000 x 106 = 86.458 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

Check for Deflection:

Basic Span/depth Ratio = 22

% of Tension Reinforcement provided (pt) = 0.379 %

Service stress of steel (fs) : 0.58fy(Ast_r/Ast_p) = 65.53 N/mm^2

Modification Factor for Tension Reinforcement (F1) = 2.00

Allowable Span/Eff Depth Ratio = 44

Actual Span/Eff Depth Ratio = 3.35 x(1000/ 106 = 31.60

Hence O.K

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