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		Date:	

DESIGN OF FLOOR BEAM

DESIGN PARAMETERS:-

Characteristic strength of concrete	fc'	=	38.00	N/mm^2
Characteristic strength of steel	fy	=	420	N/mm^2

STAAD PRO RESULTS:-

Maximum moments from both the beams are considered for design,   Support moment at col.Face

Maximum bending moment @face of support	M_{sup}	=	219.99	kN-m	Beam No. 58 L/C 102
Maximum bending moment @mid span	M_{span}	=	195.82	kN-m	Beam No. 12 L/C 102
Maximum shear at 'd' distance from support face	V_{umax}	=	291.24	kN	Beam No. 23 L/C 102
Maximum Torsional Moment at Support	T_{umax}	=	4.81	kN.m	Beam No. 60 L/C 102

A) DESIGN FOR BENDING:-

1) DESIGN OF REINFORCEMENTS FOR BENDING:-(AT SUPPORTS)

Width of beam	b	=	300	mm		
Total depth of beam	D	=	500			
Diameter of main reinforcement	dt	=	20	mm	at support	Top steel
Diameter of main reinforcement	db	=	20	mm	at Mid span	Bottom steel
Clear cover to the reinforcement	cc	=	50	mm		
Effective depth of beam for bottom steel	deb	=	(500 - 50 - 10)			
		=	440	mm		
Effective depth of beam for top steel	det	=	(500 - 50 - 10)			
		=	440	mm		

I   Main Reinforcement (Top Steel):-

Bending moment at supports	M_{sup}	=	219.992	kN-m	
Strength reduction factor	ϕ	=	0.9		Cl. 9.3.1 ACI 318
Moment resistance factor	Ru	=	Msup/ϕ x b x det^2		
	Ru	=	219992000 / (0.9 x 300 X440^2)		
		=	4.210		
Steel reinforcement factor	m	=	420/ (0.85 x 38)		
		=	13.000		
Percentage of steel required	ρ_{reqd}	=	1/m x(1- sqrt (1-(2Ru x m / fy))		
		=	1/13 x (1 - sqrt (1- (2 x 4.21 x 13/420)))		
Required percentage of steel	ρ_{reqd}	=	1.078	%	
Minimum percentage of steel	ρ_{min}	=	0.367	%	Cl.10.5.1 ACI 318
Governing percentage of steel	ρ_{Des}	=	1.078	%	
Minimum area of steel required	Asdes	=	0.01078 x 300 x 440		
		=	1422.96	mm^2	
Number of bars required	Nos	=	1422.96 / Pi() / 4 x 20^2		
		=	4.53		

Number and diameter of bar	3	Nos	of	20	mm or equivalent
	3	Nos	of	16	mm or equivalent

Area of steel provided	As_{prov}	=	1545.66	mm^2	
Provided percentage of reinforcement	ρ_{prov}	=	1.030	%	
Maximum percentage of reinforcement	ρ_{max}	=	1.030	%	

Area of steel provided (As prov)> than (As des) Hence Safe

II   Main Reinforcement (At mid span):-

Bending moment at supports	M_{sup}	=	195.823	kN-m	
Strength reduction factor	ϕ	=	0.9		Cl. 9.3.2 ACI 318
Moment resistance factor	Ru	=	Msup/ϕ x b x det^2		
	Ru	=	195823000 / (0.9 x 300 X440^2)		
		=	3.750		
Steel reinforcement factor	m	=	1.078/ (0.85 x 0.36692940493863)		
		=	3.460		

Percentage of steel required	ρ_{reqd}	=	1/m x(1- sqrt (1-(2Ru x m / fy))	
		=	1/3.46 x (1 - sqrt (1- (2 x 3.75 x 3.46/1.078)))	
Required percentage of steel	ρ_{reqd}	=	0.907 %	
Minimum percentage of steel	ρ_{min}	=	0.367 %	Cl.10.5.1 ACI 318
Governing percentage of steel	ρ_{Des}	=	0.907 %	
Minimum area of steel required	Asdes	=	0.00907 x 300 x 440	
		=	1197.2 mm^2	
Number of bars required	Nos	=	1197.24 / Pi() / 4 x 16^2	
		=	5.9546	
Number and diameter of bar	**3** Nos	of	**16** mm or equivalent	
	3 Nos	of	**16** mm or equivalent	
Area of steel provided	As$_{prov}$	=	1206.37 mm^2	
Provided percentage of reinforcement	ρ_{prov}	=	0.804 %	
Maximum percentage of reinforcement	ρ_{max}	=	0.804 %	

Area of steel provided (As prov)> than (As des) Hence Safe

III Design of shear

Maximum Shear force(from STAAD)	Vu	=	291.242 kN	from staad out put
Maximum Torsional Moment	Tu	=	4.808 kNm	
Width of beam	B	=	300 mm	
Effective depth of beam for top steel	d	=	440 mm	
Total Area of Section	Acp	=	150000 sq.mm	
Total Perimeter	Pcp	=	1600 mm	

Check if Torsion Shall be neglected or not :   Compatability Method

	Tcr	=	4x Sqrt(fc) x(A2cp/Pcp)	
		=	346.7	
	Tu	=	4.808 φ = 0.75	Cl. 11.6.3.6
	φTcr/4	=	65.015304	ACI 318
Note:		=	Design of torsion not required	

i)   If, Tu > φTcr. The beam to be designed for torsion
ii)   If, Tu < φTcr, Design of torsion not required

Design for Torsion

Φ = 45
CotΦ = 1
Cl.11.6.3.6
ACI 318

	At/s	=	Tu / (φ*2*Ao*fy* CotΦ)	
Gross area enclosed shear path	Aoh	=	80000 mm^2	
	Ao	=	Ao h *0.85	
		=	68000	
	At/s	=	0.00022 mm²/m/Leg	

Design for Shear

Permissible shear stress	φVc	=	1/6 x φ x Sqrt(fc') x b x d	
		=	101.71283 kN	
Check Shear Section Capacity	φVs	=	Vu - φ Vc	
		=	291.242 - 101.7	
		=	189.529	
		=	Shear reinft Reqd	

If, Vu > φ Vc, Shear reinforcement Reqd
if, Vu < φ Vc, Shear reinforcement not Reqd

Capacity of section		=	2/3 x φ x Sqrt(f'c) x b x d	
		=	406.851 kN	
		=	Section depth ok	
Shear reinforcement	Av/s	=	φ Vs / (φ x fy x d)	

		=	1.36745	mm²/m/ 2 Legs	

For Combined Shear & Torsion :

		=	At/s	+	Av/s	
		=	0.00022 +		1.37	
		=	1.36768	mm²/m/ 2 Legs		Cl.11.6.3.8
Diameter of stirrups	ds	12 mm	branches	2		ACI 318

Cl. 11.4.5

Area of steel	As	=	226.08	mm²	ACI 318
Spacing required	S	=	165.302	mm	
	S Max1	=	150	mm	
	S Max2	=	-		
Use	**12** mm Dia @	**150**	mm c/c		

Check minimum Stirrups Area

minimum Stirrups Area	Av + 2 At	=	$0.062 \times \sqrt{f'c} \times b \times S / f_{yt}$
		=	40.95 mm²
but not less than $0.35 \times b \times S / fy$		=	37.50 mm²
Actual Stirrups Area Provided		=	753.6 mm²
		=	Hence safe

Calculate longitudinal torsion reinforcement

Here Tu < φcr

So No need to design for Tosion and longitudinal torsion reinft

Design Summary :

Top Rebar	**3**	Nos	**20**	Dia	+	**3**	Nos	**16**	Dia
Bottom Rebar	**3**	Nos	**16**	Dia	+	**3**	Nos	**16**	Dia
Stirrups	**12**	Use	@	**150**	C/C				

Beam Cross Section