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CMR INSTITUTE OF TECHNOLOGY, BENGALURU — CMRIT — CELEBRATING 25 YEARS — ACCREDITED WITH A+ GRADE BY NAAC

Internal Assessment Test 2 – Nov. 2017									
Sub:	Design of RCC structural elements				Sub Code:	15CV51	Branch:	Civil	
Date:	7/11/17	Duration:	90 min's	Max Marks: 50	Sem / Sec:	5^{th} sem		OBE	
Answer any Three Full questions. Assume any missing data suitably. Use of IS 456 and sp 16 is permitted							MARKS	CO	RBT
PART A - Compulsory question									
1	A tee beam slab floor of an office comprises of a slab 150mm thick spanning between ribs spaced at 3m centers. The effective span of the beam is 5m. Live load on floor is 4KN/m^2. Using M20 grade concrete and Fe 415 HYSD bar. Design the intermediate beam, design the shear reinforcement and sketch the reinforcement details.						[20]	CO12	[illegible]
PART B – Answer any two question									
2	Design A cantilever balcony slab projecting 1.2m from a beam adopts live load of 2.5 kN/m^2. Use M 20m grade concrete and Fe 500 steel. Design the bond length and sketch the reinforcement details.						[15]	CO12	[illegible]
3	Design a dog legged stair case for a residential building hall measuring 2.2 m x 4.7 m. The width of the landing is 1m. The distance between floors to floor is 3.3 m. The rise and tread may be taken as 150mm and 270mm respectively. The weight of floor finish is 1 kN/m^2. The materials used are M20 grade concrete and Fe415 grade steel. Sketch the details of steel. Here flight and the landing slabs spans in the same direction i.e, Flight spans longitudinally. Sketch the reinforcement details.						[15]	[illegible]	[illegible]
4	A rectangular reinforced concrete beam, located inside a building in a coastal town, is simply supported on a two 230 mm thick and 6m apart masonry wall. The beam has to carry, in addition to its own weight, a distributed live load of 10kN/m and a dead load of 5kN/m. Design the beam for maximum moment at mid span. Assume Fe415 steel.						[15]	CO3	L3

Selected

Paper-2

IAT - 2.

Scheme and Solution.

Part A.

Q.1. $D = 150mm$.

$l_{eff} = 5m$.

$LL = 4\ KN/m^2$.

$f_{ck} = 20\ Mpa$.

$f_y = 415\ Mpa$.

$l/d = \frac{5000}{20 \times 0.8} = ~~140mm~~\ 320$

$d = 320mm \quad d' = 30mm$.

$D = ~~170mm~~\ 350mm$

$b_f = \frac{5000}{6} + 300 + 6 \times 150 = 2.033m$

load calculation

1. $DL = 25 \times 0.15 \times 3 = 11.25\ KN/m$.
2. web $= 25 \times 0.3 \times 0.2 = 1.5\ KN/m$.
3. $LL =$ 4
4. $FF =$ 1

$17.75\ KN/m$.

$W_u = 26.625\ KN/m$

Moment

$M_u = \frac{W_u l^2}{8} = 83.20\ KN\,m$

$V_u = \frac{W_u l}{2} = 66.56\ KN$.

Assume $x_u < D_f$ i.e $M_u < M_{uf}$.

$\therefore M_{uf} = 0.36 f_{ck} b_f D_f (d - 0.42 D_f)$

$= 0.36 \times 20 \times 10^3 \times 2.033 \times 0.15 (0.32 - 0.42 \times 0.15)$

Here it be behaves like Rectangular.

Q.5. Design a Cantilever balcony slab projecting 1.2m from a beam. Adopt live load of 2.5 KN/m². Use M20 grade concrete & Fe415 steel.

$\frac{L}{d} = 7 = \frac{1200}{7} = 171.4mm. \simeq 175mm.$

$\therefore D = 200mm.$

Since it is a balcony D may be reduced from 200 to 100mm.

Self wt of Slab $= 1 \times (\frac{0.2+0.1}{2}) \times 25 = 3.75$

Floor finish	=	$1 KN/m^2$.
Live load	=	$2.5 KN/m^2$
Total load	=	$7.25 KN/m^2$

BM & SF.

$BM = Mu = \frac{Wu L_{ef}^2}{2} = \frac{1.5 \times 7.25 \times 1.2^2}{2} = 7.83 KN\text{-}m.$

$Vu = Wu l_{ef} = 1.5 \times 7.25 \times 1.2 = 13.05 KN.$

$Mu_{lim} = 0.138 f_{ck} b d^2$

$= 0.138 \times 20 \times 1000 \times 175^2$

$= 84.5 KN\text{-}m$. $> Mu$ Hence Under reinforced.

Ast calculation.

$Mu = 0.87 f_y Ast\, d \left(1 - \frac{f_y Ast}{f_{ck} bd}\right)$

$7.83 \times 10^6 = 0.87 \times 415 \times Ast \times 175 \left(1 - \frac{Ast}{1000 \times 175} \times \frac{415}{20}\right)$

$Ast = 125.8 mm^2.$

Distribution Steel: $\frac{0.12}{100} \times 1000 \times 200 = 240 mm^2.$

Scanned by CamScanner

Here minimum reinf. is greater than Ast calculated
So provide $A_{st} = 240 mm^2$.

$$\text{Spacing} = \frac{\pi \times 10^2}{4 \times 240} \times 1000 = 330 \text{ mm c/c}, \quad 3d = 525, \quad 300 \text{ c/c}.$$

Provide 10mm ϕ @ 300 c/c as main reinf in l_x direction.

Provide 10 mm ϕ @ 330 c/c as Distribution reinf in l_y direction.

Check for deflection.

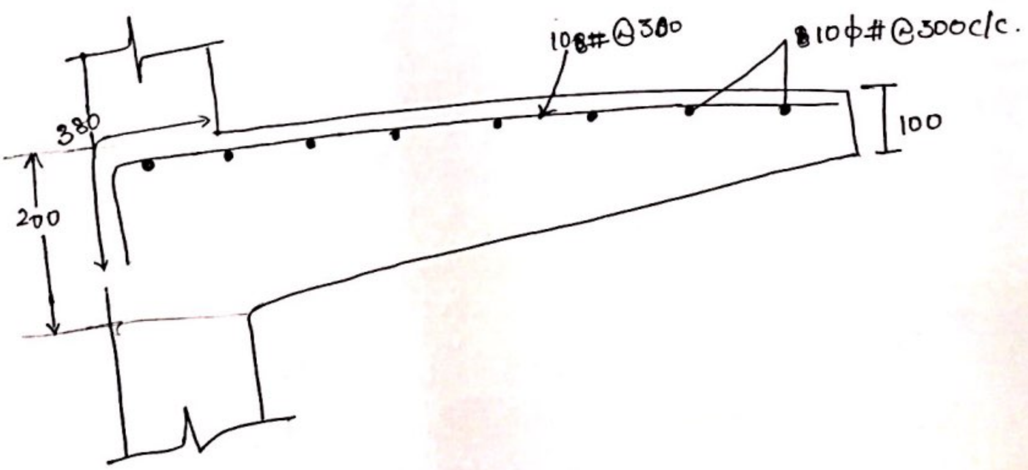
$$\frac{L}{d} \text{ provided} = \frac{1200}{175} = 6.857.$$

$$\frac{L}{d} \text{ Basic} = 7.$$

$$\left(\frac{L}{d}\right)_{allo} = \left(\frac{L}{d}\right)_{basic} K_t K_c K_f$$

$$= 7 \times 2 \times 1 \times 1$$

$$\left(\frac{L}{d}\right)_{allow} = 14 > \left(\frac{L}{d}\right)_{provid} = 6.87.$$ Hence Safe against deflection.



Q. 3.

- Given.
- Geometrical design.

NO. of Rise in each flight = 12

NO of Tread in —"— = 11

- Load calculation.

Load on flight = w_u = 16.74 kN/m

Load on landing. = w_u = 11.625 kN/m.

— Analysis.

R_A = 36.675 kN.

R_B = 35.84 kN.

x = ~~1.36 m~~ 2.53 m

M_{x-x} = 54.3 kN·m

→ Check for depth.

$d_{req.}$ = Safe.

→ Area of steel calculation

Main Steel = Ast = 1260 mm^2

~~[illegible]~~ Spacing = 100 mm c/c

Dist. Steel = 198 mm^2

Spacing = 250 c/c

→ Check for Shear.

τ_v = 0.276

τ_c = 0.59.

Comparing τ_v & τ_c, $\tau_v < \tau_c$ – Safe.

Q.4.

Given.

- l/d = ∴ $d = 300mm \simeq 450mm$.

  $D = 450+30 = 480mm$.

- $l_{eff} = 6.23m$.

- $w = 15 KN/m$

  $w_u = 15 \times 1.5 = 22.5 KN/m$.

- $M_u = 109.6 KN.m$

  $V_u = 70.08 KN$

- Check for depth.

  $d_{req} = < d_{prov}$ = Safe.

- Area of steel.

  $A_{st} = 800.26 mm^2$.

  $A_{st\,min} = 216.97 mm^2$

  # = 3no.

  $A_{st\,prov} = 942.47 mm^2$.

- Check for shear.

  $\tau_v = 0.677$.

  $\tau_c = 0.9106$.

  $\tau_v < \tau_c$ Hence provide Shear Reinf.

  Spacing 300 c/c