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M.Tech/1st/SE(CE) /SE

Advanced Reinforced Concrete Design

Full Marks : 70

Time : 3 hours

Q. No. 1 is compulsory and answer any **five** from the remaining questions

The figures in the right-hand margin indicate marks

Any data missing may be assumed suitably

(Use of IS 456, IS 875 (Part III), IS 1893 (Part I), IS 13920 are permitted)

1. Answer the following questions : 2 × 10

(*i*) What are the different limit states of design ?

(*ii*) Compute the limiting depth of neutral axis for a rectangular cross-section reinforced with Fe 250 and Fe 415 grade of steel.

(Turn Over)

(*iii*) What are the types of shear failures in beam ?

(*iv*) Distinguish between unbraced and braced columns.

(*v*) What are the major factors which influence crack-widths in flexural members ?

(*vi*) Show how long columns can bend in single and double curvatures.

(*vii*) Define ductility of a RCC structure. How it can be increased ?

(*viii*) What is the short column effect ? Explain the constructions resulting in formation of short columns.

(*ix*) How are shear walls classified ?

(*x*) What do you mean by earthquake resistant design of structure ? State the philosophy of earthquake resistant design.

2. Design a RC beam 350 × 5500 mm subjected to a bending moment of 120 kN-m, twisting

moment of 18 kN-m and a shear force of 80 kN at collapse. Use M20 grade concrete and Fe 415 grade steel. 10

3. A beam of width 400 mm, depth 550 mm is reinforced with 4 nos of 20 mm diameter bar. Calculate the crack width when the section is subjected to a bending moment of 400 kN-m at the tension face directly under the bar. Assume $f_{ck} = 25$ N/mm^2 and $f_y = 415$ N/mm^2. Clear cover to reinforcement = 25 mm. 10

4. A reinforced concrete deep beam (4500 mm deep and 350 mm thickness) is continuous over spans of 8 m apart centre to centre. It is supported on columns (900 mm in width). The beam supports a uniformly distributed load of 200 kN/m including its own weight. Design the beam for flexure only. Use $f_{ck} = 25$ MPa and Fe 415 grade steel. 10

5. Determine the curvature ductility of a RC beam reinforced with 3-20 mm dia bars on tension side only. The width and depth of the beam is 300 mm and 600 mm, respectively. Use M20 grade concrete and Fe 250 grade steel. 10

6. Compute the design moments for a bi-axially eccentrically load rectangular column for the following cases :

   (*a*) Column is braced and bends into single curvature

   (*b*) Column is braced and bends into double curvature

   Data given :

   P_u = 2200 kN M_{ux} = 200 kN-m at top and 180 kN-m at bottom M_{uy} = 150 kN-m at top and 75 kN-m at bottom Unsupported length = 6·5 m l_{effx} = 6·0 m l_{effy} = 5·8 m bxD = 400 × 600 mm; Grade of steel = Fe 415 Grade of Concrete = M 20;

   $d'/D = 0{\cdot}1$ $d'/b = 0{\cdot}15$

   Percentage of reinforcement = 2·5% with equal reinforcement along periphery

   $P_{ub} = (K_1 + K_2 p/f_{ck}) x f_{ck} bD$

	d'/D or d'/b	
	0·10	0·15
K_1	0·207	0·196
K_2	0·328	0·203

10

7. Compute the moment of resistance of the shear wall (width = 200 mm and length = 12 m) for a 10 storey building for the following data :

Storey no.	1	2	3	4	5	6	7	8	9	10
Lateral force (kN)	7	14	30	60	75	110	170	200	240	260

   Storey height = 3.5 m; Axial load on shear wall = 9.0 KN
   Building is situated in zone IV; Seismic weight of the building = 70 kN
   Use M25 grade concrete and Fe 415 steel; partial safety factor = 1·5

   The minimum reinforcement is provided in the shear wall and distributed uniformly across the cross section of the wall. 10

8. A cantilever beam 3·0 m long carries a uniformly distributed service load of 16 kN/m, out of which 50% load is due to permanent loads. The beam, rectangular in section of width 350 mm and total depth 600 mm, is reinforced with 3 nos of 25 mm bars on tension side. Compute the short term deflection. 10