INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR
End Autumn Semester Examination, 2011-12

Date :   Time : 3 hours   Full Marks : 50   No. of Students : 98
Sub. No. : **CE31001**   Sub. Name : Design of RC Structures
Third Year B.Tech(H) and B. Arch(H) students of Department of Civil Engineering and Architecture

Note. 1. Assume suitable data wherever necessary
        2. Use Concrete grade : M20 and Steel grade : Fe415
        3. Answer ALL questions

1. (a) The rectangular RCC beam of span 3m (width 250mm and Depth 300mm) is provided from architectural aspect. Provide tensile and shear reinforcement as per codal provision for minimum reinforcement.

   (b) The length of a square column (350mm X 350mm) is 4 m. Provide longitudinal and lateral reinforcement as per codal provision for minimum reinforcement.

   (c) The design bond stress in limit state method for plain bars in tension for concrete grade of M20 is 1.2 N/mm^2. The stress in bar is 361 N/mm^2. Find the development length for HYSD bar of diameter 16 mm which is under compression.

   (d) Calculate additional moment and shear force due to torsion of 50kNm applied on a rectangular beam of width 250mm and depth 300mm.   *(2+2+2+2=8)*

2. (a) The effective length of a column is 5m. The width of the column is 350mm. Design axial load is 1500kN. The design moment about major axis is 100kNm and the design moment about minor axis is 50kNm. Calculate additional moment. Find the depth of the column, longitudinal and lateral reinforcement. Show the reinforcement detailing. The column interaction chart provided in page 2 may be used for any d'/D   *(2+3+2+3=10)*

   (b) The width of the column is 250mm and the depth of the column is 300mm. 4 nos. of 16 dia HYSD bars are provided as longitudinal reinforcement. Calculate axial and bending moment capacity (about major axis) of columns when the neutral axis is lying at the edge of the column.   *(4)*

3.   The floor to floor height of a building is given as 3.5m. Design a longitudinal staircase for a live load of 5kN/m^2. The width of the staircase is 1.5m. Provide suitable dimensions of rise, tread, going of the staircase. Design the staircase. Also show the reinforcement detailing.
                                     (5+5+4=14)

4.   A series of beams placed at 3m centres are supported on masonry walls and the effective span of the beam is 5.5 m. The slab thickness is 120mm and the ribs below the slab are 250mm wide and 300mm deep. If the slab and beams are so cast as to act together, determine the reinforcements at mid span for the T beam to carry an imposed load of 4kN/m^2 on the slab. Also design for shear.   *(8+6=14)*

OR

5.   An isolated square footing has to transfer a dead load of 1050kN and an imposed load of 650kN from a square column 500 X 500 mm (with 12-20mm bars). The safe bearing capacity of soil is 200 kN/m^2. Design the footing and show reinforcement detailing.
                                      (2+2+2+2+2+4=14)

Part of Table 19 : IS456:2000 for Design Shear Strength of Concrete, τ_c (N/mm^2)

100As /bd	≤0.15	0.25	0.5	0.75	1.0	1.25	1.50	1.75	2.00	2.25	2.50 and above
M20	0.28	0.36	0.48	0.56	0.62	0.67	0.72	0.75	0.79	0.81	0.82

For M20, τ_{cmax} = 2.8 N/mm^2

Chart 44 COMPRESSION WITH BENDING — Rectangular Section — Reinforcement Distributed Equally on Four Sides