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18CV53

Fifth Semester B.E. Degree Examination, July/August 2021
Design of RC Structural Elements

Time: 3 hrs.   Max. Marks: 100

Note : 1. Answer any FIVE full questions.
2. Use of IS : 456 – 2000 , SP16 is permitted.
3. Assume suitable data, if necessary.

1   a. Explain the principles of limit state design.   **(06 Marks)**
     b. Explain briefly under reinforced, over reinforced and balanced section with sketch.**(06 Marks)**
     c. A simply supported beam of rectangular section spanning 6m has a width of 300mm and overall depth of 600mm. The beam is reinforced with tensile steel of area 1963mm^2 with an effective cover of 50mm. Diameter of bars is 25mm spaced at 50mm centers. The beam is subjected to a moment of 160KN-m at centre of span. Check the beam for serviceability limit state of cracking. Assume f_{ck} = 25 N/mm^2 and f_y = 415 N/mm^2.   **(08 Marks)**

2   a. Write a brief note on :
         i)   Partial safety factors for materials.
         ii) Characteristic loads.
         iii) Characteristic strength.
         iv) Partial safety factors for loads.   **(12 Marks)**
     b. A simply supported beam of rectangular section spans over 10m and has an effective depth of 700mm. The beam is reinforced with 1% reinforcement on the tension side. Check for the deflection control of the beam by empirical method if :
         i)   Fe415 HYSD bars are used   ii)   Fe500 HYSD bars are used.   **(08 Marks)**

3   a. Derive from fundamentals the expression for the area of stress block 0.36 f_{ck} X_u.   **(08 Marks)**
     b. Determine the moment of resistance of T – beam for the following data :
         Width of the flange = 2500mm , Effective depth = 800mm , Width of Web = 300mm ,
         Depth of flange = 150mm , Number of bars = 8 of 25mm diameter. Assume M$_{20}$ concrete and Fe415 steel.   **(12 Marks)**

4   a. Derive the moment of resistance equation for doubly reinforced rectangular section.
                                                                                                        (10 Marks)
     b. A singly reinforced concrete beam of 250mm × 450mm deep upto the centre of reinforcement with 3 bars of 16mm diameter at an effective cover of 50mm, effective span of 6m. Use M$_{20}$ concrete and Fe415 steel. Determine the central point load that can be supported in addition to the self weight.   **(10 Marks)**

5   A reinforced concrete beam is to be designed over an effective span of 5m to support a design service load of 8 kN/m. Adopt M$_{20}$ grade concrete and Fe415 HYSD bars and design the beam to satisfy the collapse and serviceability limit states.   **(20 Marks)**

6   A T – beam slab floor of an office building comprises of a slab 150mm thick spanning between ribs spaced at 3m centres. The effective span of the beam is 8m. LL on the floor is 4 kN/m^2. Using M$_{20}$ concrete and Fe415 steel, design one of the intermediate T – beams.   **(20 Marks)**

7 Design a RCC slab for an office floor 4.5m × 5.5m with four edges discontinuous and corners held down. The LL on the slab is 3kN/m². Assume floor finish as 0.6 kN/m² and ceiling finish as 0.4kN/m². Use M_{20} grade concrete and Fe415 steel. Sketch the reinforcement. **(20 Marks)**

8 a. Distinguish between one way slab and two way slab. **(04 Marks)**

b. Design a Dog legged stair for an office building in a room measuring 2.8m × 5.8m , clear distance between floors is 3.6m. The width of the flight is to be 1.25m. Assume Live load of 3kN/m². Use M_{20} grade concrete and Fe415 steel. Assume that the stair supported on 230mm at the outer edge of landing stairs. Sketch the reinforcement details. **(16 Marks)**

9 a. What is the role of transverse reinforcement in columns? What are the codal provisions to design transverse reinforcement? **(06 Marks)**

b. Explain the difference between Short columns and Long columns. **(04 Marks)**

c. A column size 300mm × 400mm has an effective length of 3.6m and is subjected to P_u = 1100kN and M_u = 150 kN m about the major axis. Assuming the bars on two sides. Design the column using M_{25} concrete and Fe415 steel. **(10 Marks)**

10 Design an isolated footing for a rectangular column of 300mm × 500mm supporting an axial load of 1500 kN factored. Assume SBC of soil as 185 kN/m². Use M_{20} grade concrete and Fe415 steel. Sketch the reinforcement and perform the necessary checks. **(20 Marks)**

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