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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 $f_{ck} = 25\text{ N/mm}^2$ and $f_y = 415\text{ N/mm}^2$. (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 $4.5\text{m} \times 5.5\text{m}$ with four edges discontinuous and corners held down. The LL on the slab is 3kN/m^2 . Assume floor finish as 0.6 kN/m^2 and ceiling finish as 0.4kN/m^2 . 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 $2.8\text{m} \times 5.8\text{m}$, clear distance between floors is 3.6m . The width of the flight is to be 1.25m . Assume Live load of 3kN/m^2 . 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 $300\text{mm} \times 400\text{mm}$ has an effective length of 3.6m and is subjected to $P_u = 1100\text{kN}$ and $M_u = 150\text{ kN m}$ 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 $300\text{mm} \times 500\text{mm}$ supporting an axial load of 1500 kN factored. Assume SBC of soil as 185 kN/m^2 . Use M_{20} grade concrete and Fe415 steel. Sketch the reinforcement and perform the necessary checks. **(20 Marks)**

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