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Fifth Semester B.E. Degree Examination, June/July 2015
Design of RCC Structural Elements

Time: 3 hrs.

Max. Marks: 100

- Note:** 1. Answer any FIVE full questions, selecting atleast TWO questions from each part.
 2. Use of IS456-2000 and SP-16 is permitted.
 3. Assume missing data, if any, suitably.

PART – A

- 1 a. What is meant by normal distribution in statistics and what is the relationship between mean value and characteristic value in such distribution assuming 5% confidence limit? (05 Marks)
 b. Derive an expression for limiting values of x_u/d ratio from basic for different grades of steel used in RCC beam design. What is their importance? (05 Marks)
 c. For a given data of a beam subjected to bending show that

$$\frac{x_u}{d} = 1.2 - \sqrt{(1.2)^2 - \left(\frac{6.68 M_u}{f_{ck} b d^2} \right)}. \text{ Data: } b, d, M_u, f_{ck} \text{ and } f_y. \quad (05 \text{ Marks})$$

- d. Explain the terms balanced, over-reinforced and under reinforced section in beam subjected to flexure with neat sketches. Which of these should be recommended in design? And why? (05 Marks)

- 2 a. Determine the flexural steel reinforcement at mid span for a simply supported beam of effective span of 5.25m. The characteristic dead and live loads shall be 15kN/m and 20 kN/m respectively. The cross sectional dimensions are width is 300mm and effective depth is 675mm. Adopt M₂₀ grade concrete and Fe415 grade steel. (10 Marks)
 b. A RC beam of section 250mm × 500mm overall dimension is reinforced with 5 bars of 25mm diameter on tension side and 5 bars of 12mm diameter on compression side with an effective cores of 50mm for both. Determine the ultimate moment of resistance of the section. Adopt M₂₅ grade concrete and Fe415 grade steel. (10 Marks)

d'/d	0.15	0.10
Fe415, f_{sc}	342 N/mm ²	353 N/mm ²

- 3 a. Determine the ultimate shear strength of the support section of a RC beam with following data: width, $b = 300\text{mm}$, effective depth, $d = 600\text{mm}$, $A_{st} = 4$ bars of 25mm ϕ , 8mm ϕ 2 legged vertical stirrups at 150mm c/c, 2 bars of 25mm ϕ are bentup at 45° near the support. Adopt M₂₅ grade concrete and Fe415 grade steel. (10 Marks)
 b. Determine the ultimate moment of resistance of flanged beam as shown in Fig.Q.3(b). Adopt M₂₀ grade concrete and Fe415 grade steel. (10 Marks)

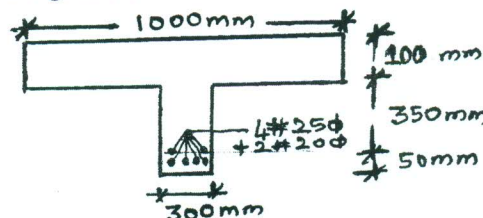


Fig.Q.3(b)



- 4 A simply supported RC beam supports a service live load of 8 kN/m over a clear span of 3 m . Support width is 200 mm . Adopt M_{20} grade concrete and Fe415 grade steel. Design the beam for flexure and shear. Check the beam depth for control of deflection using empirical method. Sketch the reinforcement details. (20 Marks)

PART – B

- 5 Design a two way slab of $5 \text{ m} \times 7 \text{ m}$ (clear dimensions) with all four edges discontinuous and corners held down. The slab has a support width of 300 mm on all the four edges. The live load on the slab is 3 kN/m^2 . Adopt M_{25} grade concrete and Fe415 steel grade. Sketch the reinforcement details. (20 Marks)
- 6 a. Design a circular pin ended column of 400 mm diameter with helical reinforcement, with unsupported length of 4 m . The column is to carry a factored axial load of 1500 kN . Adopt M_{20} grade concrete and Fe415 grade steel. Sketch the reinforcement details. (10 Marks)
- b. ARC column of size $300 \text{ mm} \times 400 \text{ mm}$ has an unsupported length of 3 m and effective length 3.6 m . Determine the longitudinal steel and transverse steel if the column is subjected to a factored load of $P_u = 1000 \text{ kN}$ and $M_u = 210 \text{ kN-m}$. Adopt M_{25} grade concrete and Fe415 grade steel. Assume $d' = 60 \text{ mm}$. Sketch the reinforcement details. (10 Marks)
- 7 Design an isolated rectangular footing of uniform depth for the column size of $230 \text{ mm} \times 300 \text{ mm}$ supporting an axial service load of 850 kN-m . The safe bearing capacity of soil is 150 kN/m^2 . Adopt M_{20} grade concrete and Fe415 grade steel. Sketch the reinforcement details. (20 Marks)
- 8 Design a dog legged staircase for a building in which the vertical distance between floors is 3.5 m . The stair hall measures $2.1 \text{ m} \times 5.0 \text{ m}$. Take live load of 2 kN/m^2 . The flights are supported on 230 mm walls at the ends of outer edges of landing slab, so that it spans in the direction of going. Adopt M_{20} grade concrete and Fe415 grade steel. Sketch the reinforcement details. (20 Marks)

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