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Fifth Semester B.E. Degree Examination, July/August 2021

Design of RCC Structural Elements

Time: 3 hrs.

Max. Marks:100

Note: 1. Answer any FIVE full questions.
2. Use of IS456-2009 and SP16 is permitted.
3. Assume missing data if any suitably.

1.
 - a. What are the inadequacies of working stress and ultimate load methods? How are they overcome in limit state method of design? (05 Marks)
 - b. What are load and material partial safety factors? Why are load partial safety factors called enhancement factors and material partial safety factors called reduction factors? (05 Marks)
 - c. Derive an expression for limiting values of x_n/d ratios for different grades of steel. What are their values? (05 Marks)
 - d. Derive an expression for balanced moment of resistance of the form $K f_{ck} b d^2$. Determine K for different grades of steel. (05 Marks)

2.
 - a. A RC section has following details:
 $b = 300\text{mm}$, $d = 500\text{mm}$, $D = 550\text{mm}$, grades of concrete and steel are M_{20} and Fe500 respectively. Determine ultimate moment of resistance for i) Minimum steel reinforcement as per code for beams ii) Maximum acceptable reinforcements for beam (balanced). (06 Marks)
 - b. Determine the reinforcements required for a beam with following details: $b = 300\text{mm}$, $D = 500\text{mm}$, factored moment = 320kN.m . Grades of concrete and steel are M_{25} and Fe415 respectively. (06 Marks)
 - c. Determine limiting area of steel and moment of a flanged beam with following details: $b_f = 1000\text{mm}$, $D_f = 100\text{mm}$, $b_w = 300\text{mm}$, $d = 450\text{mm}$, effective cover = 50mm , grades of concrete and steel are M_{20} and Fe415 respectively. (08 Marks)

3.
 - a. Check the preliminary dimensions of a singly reinforced rectangular cantilever beam of span 4m using M_{20} and Fe415 grade of concrete and steel. The other details are as shown in Fig.Q.3(a). (06 Marks)

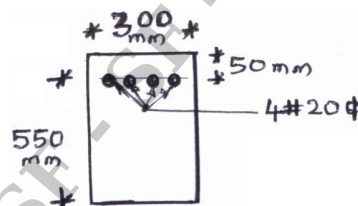


Fig.Q.3(a)

- b. A simply supported beam of rectangular section 250mm wide by overall depth of 550mm is used over an effective span of 4.5m . The beam is reinforced with $3\# 20\phi$ Fe415 grade steel bars at an effective depth of 400mm and spaced at 60mm c/c . Two hanger bars of $10\text{mm } \phi$ are provided. The self weight of beam together with dead load on the beam is 4kN/m . Service live load is 10kN/m . Using M_{20} grade concrete and Fe415 grade steel compute
 - i) Short term deflection (08 Marks)
 - ii) Crack width as per IS code and check as per codal provisions. (06 Marks)

- 4 Design a cantilever beam using the following data:
 Clear span 3m, working live load = 15kN/m. The cantilever beam is monolithically cast with reinforced concrete column of 300mm width and 600mm overall depth. Use M₂₀ grade concrete and Fe415 grade steel. Sketch the reinforcements details for flexure with curtailment of bars, shear, development length. **(20 Marks)**
- 5 a. Differentiate one way slab and two way slab action. How is their depths proportioned as per IS code. **(05 Marks)**
 b. Design a corner slab if the columns are spaced at 4m c/c in north-south and 5m c/c in east-west direction over beams of width 200mm. The slab is to carry a characteristic load of 3kN/m² in addition to floor finish of 1kN/m² and dead load. Use M₂₀ grade concrete and Fe415 grade steel. Sketch the details of placing main and corner steel. **(15 Marks)**
- 6 a. Design a square short tied column $b = D = 500\text{mm}$ to carry a total factored load of 4000kN using M₂₀ grade concrete and Fe415 grade steel. Draw the reinforcement diagram. **(08 Marks)**
 b. A short RC column shown in Fig.Q.6(b) is subjected to $P_u = 1620\text{kN}$ and $M_u = 170\text{kNm}$. Analyze the safety of the column if grade of concrete is M₂₅ and grade of steel is Fe415. **(12 Marks)**

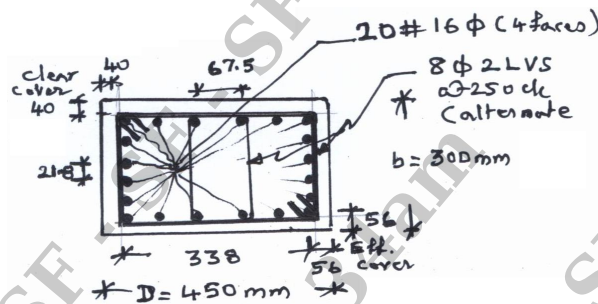


Fig.Q.6(b)

- 7 Design an isolated footing for a square column 400mm × 400mm of uniform depth supporting an axial service load of 1500kN with M₂₀ grade concrete and Fe415 grade steel. The safe bearing capacity of soil is 250kN/m² at a depth of 1m below ground level. **(20 Marks)**
- 8 Design a dog legged stair case for a building with clear room size of 5.7m × 3.15m. The floor height is 3.2m. Flights are supported on 300mm walls at the outer edges of landing slab in the direction of flight. The finish loads and live loads are 1kN/m² and 5kN/m² respectively. Use riser, R = 160mm and tread, T = 270mm (equal number of treads and risers in each flight). Concrete grade M₂₀ and steel grade Fe415. Sketch the reinforcement for landing to floor slab flight. **(20 Marks)**

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