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Question Paper Code : 20331

B.E./B.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2022.

Fifth Semester

Civil Engineering

CE 8501 — DESIGN OF REINFORCED CEMENT CONCRETE ELEMENTS

(Regulations 2017)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is modular ratio?
2. State the important factors to be considered while designing structural elements.
3. Draw the qualitative stress strain curve for concrete.
4. State the different limit states considered in the design.
5. What are the important factors affecting the shear resistance of a reinforced concrete member without shear reinforcement?
6. What is meant by anchorage bond?
7. Define slenderness ratio. How column are classified based on this ratio?
8. Under which condition a column is designed with axial load and biaxial bending.
9. Write down the formula for calculating bending moment in design of rectangular footings.
10. What is meant by eccentric loading on a footing and under what circumstances does this occur?

PART B — (5 × 13 = 65 marks)

11. (a) A reinforced concrete slab has an effective span of 4 m and carries a uniformly distributed load of 6 kN/m² inclusive of its own weight. Determine (i) effective depth of the slab (ii) steel reinforcement. Use M_{20} concrete and (1) Fe 250 steel (2) Fe 415 steel.

Or

(b) A reinforced concrete beam has 300 mm width and 500 mm effective depth. The shear reinforcement consists of 8 mm diameter 4 legged stirrups spaced at 100 mm centre to centre at the supports. If the beam is subjected to a shear force of 120 kN at the ends calculate the maximum shear stress developed in the shear reinforcement. The beam has 0.5% reinforcement at the ends.

12. (a) A doubly reinforced concrete beam is 400 mm wide and 600 mm deep to the centre of tensile reinforcement. The compression reinforcement consists of 4 bars of 16 mm diameter and is placed with its centre to a depth of 40 mm from the top. The tensile reinforcement consists of 4 bars of 20 mm diameter. The section is subjected to a bending moment of 100 kNm. Determine the stress in concrete and steel. Take m as 16.

Or

(b) An isolated T beam simply supported over a span of 6 m has following dimensions. Width of flange = 750 mm thickness of flange = 125 mm, overall depth 400 mm, width of web 260 mm, effective cover to tensile reinforcement as 40 mm. The beam is reinforced with 4 bars of 20 mm diameter. Determine the moment of resistance of the beam if mild steel bars are used. Take σ_{cbc} as 5 N/mm² and m = 19 in each case.

13. (a) Design a suitable dog legged staircase in a public building to be located in 6 m long, 3.2 m wide and 3.7 m high, with a door of 1.1 m wide in each of the longitudinal walls. The door face each other and are located with their centers at a distance of 0.9 m from the respective corners of the staircase. Use M_{20} mix and Fe 415 steel.

Or

(b) Design a short RC column to take an axial load of 5000 kN. The size of the column is not to be more than 700 mm. Use spiral reinforcement. Use M_{25} concrete and Fe 415 steel.

14. (a) Design a rectangular isolated footing of uniform thickness for RC column bearing a vertical load of 600 kN and having a base size of 400 × 600 mm. The safe bearing capacity of soil may be taken as 120 kN/m². Use M_{20} concrete and Fe 415 steel.

Or

(b) Find the moment of resistance of the beam 200 mm wide and 400 mm effective depth, reinforced with 4 bars of 20 mm diameter for tension and 2 bars of 20 mm diameter for compression. The cover to compression reinforcement is 50 mm. Use M_{20} concrete.

15. (a) Design a rectangular column of 4.5 m unsupported length, restrained in position and direction at both the ends to carry an axial load of 1200 kN. Use M_{20} concrete and Fe 415 steel.

Or

(b) Find the moment of resistance of a T beam having the following data :

Width of flange : 800 mm

Width of rib : 200 mm

Thickness of slab : 120 mm

Effective depth : 400 mm

Tensile steel area : 3500 mm^2

Use M_{20} concrete and Fe 250 steel.

PART C — (1 × 15 = 15 marks)

16. (a) Design a T shaped cantilever retaining wall to retain earth embankment 3 m high above ground level. The unit weight of earth is 18 kN/m^3 and its angle of repose is 30°. The embankment is horizontal at its top. The safe bearing capacity of soil may be taken as 100 kN/m^2 and the coefficient of friction between soil and concrete as 0.5. Use M_{20} mix and Fe 415 bars.

Or

(b) A reinforced concrete beam of M_{20} grade concrete, 300 mm wide and 500 mm deep is required to resist a super imposed moment of 152 kNm at an intermediate support of a continuous beam. Using mild steel bars, calculate A_{st} at top, if 4 nos., of 16 mm diameter bars are required to be continued at bottom from one span to the other. Assume effective cover to compression steel as 45 mm and that to the tension steel as 50 mm. Redesign the beam as doubly reinforced beam, if no Asc is available from adjacent spans.