Hall Ticket No | | | | | | | | | | | Question Paper Code: ACEC40

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal-500043, Hyderabad

B.Tech VII SEMESTER END EXAMINATIONS (REGULAR) - DECEMBER 2023
Regulation: UG-20
PRESTRESSED CONCRETE STRUCTURES

Time: 3 Hours **(CIVIL ENGINEERING)** **Max Marks: 70**

Answer ALL questions in Module I and II
Answer ONE out of two questions in Modules III, IV and V
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE – I

1. (a) Enumerate the need for using high strength steel and concrete in pre-stressed concrete structures. [BL: Understand| CO: 1|Marks: 7]

   (b) A pre-stressed concrete beam of section 120 mm wide by 300 mm deep is used over an effective span of 6 m to support a uniformly distributed load of 4 kN/m, which includes the self-weight of the beam. The beam is pre-stressed by a straight cable carrying a force of 180 kN and located at an eccentricity of 50 mm. Determine the location of the thrust-line in the beam and plot its position at quarter and central span sections. [BL: Apply| CO: 1|Marks: 7]

MODULE – II

2. (a) Summarize about the loss of stress due to successive tensioning of curved cables. [BL: Understand| CO: 2|Marks: 7]

   (b) A rectangular concrete beam, 300 mm deep and 200 mm wide, is pre-stressed by means of 15 numbers of 5 mm diameter wires located 65 mm from the bottom of the beam and three 5 mm wires, located 25 from the top of the beam. If the wires are initially tensioned to a stress of 840 N/mm^2, calculate the percentage loss of stress in steel immediately after transfer, allowing for the loss of stress due to elastic deformation of concrete only. [BL: Apply| CO: 2|Marks: 7]

MODULE – III

3. (a) Elucidate about any two flexural failures encountered in pre-stressed concrete members. [BL: Understand| CO: 3|Marks: 7]

   (b) A post-tensioned beam having a rectangular section, 150 mm wide by 350 mm deep has an effective cover of 50 mm. If $A_p = 461\ mm^2$, $f_{ck} = 40$ N/mm^2, $f_p = 1600$ N/mm^2, estimate the ultimate moment capacity of the section assuming the ratio of effective depth to span as 20 and the effective stress in tendons after all losses as 800 N/mm^2. [BL: Apply| CO: 3|Marks: 7]

4. (a) How do you compute the failure due to web-shear cracks? Demonstrate the computation of failure due to flexure-shear cracks. [BL: Understand| CO: 4|Marks: 7]

   (b) The support section of a pre-stressed concrete beam 100 mm wide by 250 mm deep is required to support an ultimate Shear force of 60 kN. The compressive prestress at centroid is 5 N/mm^2, $f_{ck} = 40$ N/mm^2, effective cover to reinforcement = 50mm. If $f_y = 415$ N/mm^2, design suitable shear reinforcement in the section using IS: 1343 code recommendations. [BL: Apply| CO: 4|Marks: 7]

MODULE – IV

5. (a) Discuss about the stress distribution in end block with the help of neat sketches.
[BL: Understand| CO: 5|Marks: 7]

(b) A Freyssinet anchorage (125 mm diameter) carrying 12 wires of 7 mm diameter, stressed to 950 N/mm^2 is embedded concentrically in the web of an I – section beam at the ends. The thickness of the web is 225 mm. Evaluate the maximum tensile stress and the bursting tensile force in the end block using Rowe's method. Design the reinforcement for the end block.
[BL: Apply| CO: 5|Marks: 7]

6. (a) Summarize about the bond stresses developed between concrete and steel in the pre-tensioned beams. [BL: Understand| CO: 5|Marks: 7]

(b) A pre-tensioned beam is pre-stressed using 5 mm diameter wires with an initial stress of 80% of the ultimate tensile strength of steel (f_{pu} = 1600 N/mm^2). The cube strength of concrete is at transfer is 30 N/mm^2.

i) Calculate the transmission length

ii) Compute the bond stress at ¼ and ½ the transmission length from the end and

iii) Calculate the overall average bond stress. [BL: Apply| CO: 5|Marks: 7]

MODULE – V

7. (a) Outline the method of computing deflections of beams with different cable profiles.
[BL: Understand| CO: 6|Marks: 7]

(b) A precast pre-tensioned beam of rectangular section has a breadth of 100 mm and a depth of 200 mm. the beam with an effective span of 5 m, is pre-stressed by tendons with their centroids coinciding with the bottom kern. The initial force in the tendons is 150 kN. The loss of prestress may be assumed to be 15%. The beam is incorporated in a composite T-beam by casting a top flange of breadth 400 mm and thickness 40mm. if the composite beam supports a live load of 8 kN/m^2, calculate the resultant stresses developed in the precast and in situ cast concrete assuming the pre-tensioned beams as i) Unpropped ii) Propped during the casting of the slab. Assume the same modulus of elasticity for concrete in precast beam and in situ cast slab.
[BL: Apply| CO: 6|Marks: 7]

8. (a) Write short notes on the differential shrinkage in composite members. Explain in detail about the factors influencing deflections. [BL: Understand| CO: 6|Marks: 7]

(b) A concrete beam with a rectangular section, 100 mm wide and 300 mm deep, is stressed by 3 cables, each carrying an effective force of 240 kN. The span of the beam is 10m. the first cable is parabolic with an eccentricity of 50 mm below the centroidal axis at the centre of span and 50 mm above the centroidal axis at the supports and an eccentricity of 50 mm at the centre of span. The third cable is straight with a uniform eccentricity of 50 mm below the centroidal axis. If the beam supports a uniformly distributed live load of 5 kN/m and Ec = 38 kN/mm^2, estimate the instantaneous deflection at the following stages:

i) Prestress + self weight of beam

ii) Prestress + self weight + live load. [BL: Apply| CO: 6|Marks: 7]

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