CBCS SCHEME

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18CV81

Eighth Semester B.E. Degree Examination, June/July 2023
Design of Pre-Stressed Concrete

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of IS 1343 is permitted.

Module-1

1 a. With a neat sketch explain Pretensioning and Post-tensioning system. List out the difference between them [any three]. **(08 Marks)**

b. Define Anchorage. Explain with sketch Freyssinet system of Post-tensioning. **(06 Marks)**

c. Explain the need for High Strength Concrete and High Strength Steel for Prestressed concrete member. **(06 Marks)**

OR

2 a. Define Pressure line. Plot the pressure line for a simply supported rectangular beam of size b × h subjected load and prestressed by force "P" at a constant eccentricity of "h/6" such that bottom fibre stress at mid-span due to all load and "P" equal to "Zero". **(06 Marks)**

b. An unsymmetrical I-section beam is used to support an imposed load of 2 kN/m over a span of 8m. The sectional details are top flange, 300mm wide and 60mm thick; bottom flange, 100mm wide and 60mm thick; thickness of web = 80 mm; overall depth of beam = 400mm. At the centre of the span, the effective prestressing force of 100 kN is located at 50mm from the soffit of the beam. Estimate the stresses at the centre of span section of the beam for the following load condition.

i) Prestress + Self weight

ii) Prestress + Self weight + Live load. **(14 Marks)**

Module-2

3 a. Define losses of Prestress. Explain the different losses of Prestress encountered in the Pretensioning and Post-tensioning system. **(08 Marks)**

b. A pretensioned beam, 200 × 300mm is prestressed by 10 wires of 7mm diameter initially stressed to 1200N/mm^2, with their centroids located 100mm from the soffit. Find the maximum stress in concrete immediately after transfer, allowing only for elastic shortening of concrete. If the concrete undergoes a further shortening due to creep and shrinkage while there is a relaxation of five percent of steel stress. Estimate the final percentage loss of stress in the wires using IS 1343 regulations and following data:

$E_s = 210 kN/mm^2$; $E_c = 5700 (f_{cu})^{1/2}$;

$f_{cu} = 42 N/mm^2$; Creep co-efficient $\phi = 1.6$

Total residual shrinkage strain = 3×10^4. **(12 Marks)**

OR

4 a. Derive the quantification of deflection due to the effect of parabolic tendon profile having eccentricity "e" at the centre and zero at support. **(06 Marks)**

b. What are the factors affecting deflection of PSC beam. **(04 Marks)**

c. A concrete beam with a symmetrical I-section has flange width and depth 200 × 60 mm. Thickness of web is 80mm and overall depth is 400mm. The beam is prestressed by a cable carrying a force of 1000 kN. The span of the beam is 8m. The centre line of the cable is 150mm from the soffit of the beam at the centre of span, linearly varying to 250mm at the supports. Compute the initial deflection at mid-span due to prestress and the self-weight of the beam, assuming $E_c = 38$ kN/mm^2. Compare the deflection with the limiting deflection permitted in IS:1343 [$\gamma_c = 24$ kN/m^3]. **(10 Marks)**

Module-3

5 a. A post-tensioned bridge girder with unbounded tendons is of box section of overall dimensions 1200mm wide by 1800mm deep with wall thickness of 150mm. The high-tensile steel has an area of 4000mm^2 and is located at an effective depth of 1600mm. The effective prestress in steel after all losses is 1000 N/mm^2 and the effective span of the girder is 24m. If $f_{ck} = 40$ N/mm^2 and $f_p = 1600$ N/mm^2. Estimate the ultimate flexural strength of the section. **(10 Marks)**

b. A pretensioned prestressed beam having a rectangular section, 150 mm wide and 300mm deep has an effective cover of 50mm. If $f_{ck} = 40$ N/mm^2, $f_p = 1600$ N/mm^2, and the area of prestressing steel $A_p = 461$ mm^2. Calculate the ultimate flexural strength of the section using IS:1343 code provision. **(10 Marks)**

OR

6 a. Explain the different types of flexural failure observed in PSC members. **(06 Marks)**

b. Determine the effective prestress area of prestressing steel and the area of the section from preliminary design for a simply supported Type1 prestressed beam with $M_T = 435$ kNm (Including an estimated $M_{sw} = 55$ kNm). The height of the beam is restricted to 920 mm. The prestress at service $f_{pe} = 860$ N/mm^2. The allowable compressive stress of concrete at service is 11 N/mm^2.

Type of prestressing tendon = 7 wires strand
Nominal diameter = 12.8 mm
Nominal area = 99.3 mm^2 **(14 Marks)**

Module-4

7 a. Explain the types of shear cracks in PSC. List the different ways of improving the shear resistances by prestressing technique. **(08 Marks)**

b. A concrete beam having a rectangular section 150 × 300mm is prestressed by a parabolic cable having an eccentricity of 100mm at the centre of span, reducing to zero at the supports. Span of beam is 8m. The beam supports a live load of 2 kN/m. Determine the effective force in the cable to balance the dead and live loads on the beam. Estimate the principle stresses at the support section. **(12 Marks)**

OR

8 A PSC beam of symmetrical I-section has overall depth of 2m. Thickness of web is 200mm. Effective span is 40m. The beam is prestressed by cables which are concentric at supports and have eccentricity of 750mm at centre span. Force in the cable is 1200 kN at the transfer stage, $f_{ck} = 60$ N/mm^2. Estimate the ultimate shear resistance at support due to loads is 2834 kN and loss ratio is 0.8, design the suitable shear reinforcement using Fe415 steel. Area of section is 0.88×10^6 mm^2. **(20 Marks)**

Module-5

9 a. Explain the terms i) End Block stress distribution ii) Bursting tension with reference to post-tensioned prestressed members. **(06 Marks)**

b. The end blocks of a prestressed concrete girder is 200mm wide by 300mm deep. The beam is post-tensioned by two Freyssinet anchorages each of 100mm diameter with their centres located at 75mm from the top and bottom of beam. The force transmitted by each anchorage being 2000 kN. Compute the bursting force and design suitable reinforcement according to the IS:1343 code. **(14 Marks)**

OR

10 The end block of a post-tensioned prestressed member is 550 mm wide and 550mm deep four cables, each made up of seven wires of 12mm diameter strands and carrying a force of 1000 kN, are anchored by plate anchorages, 150×150mm, located with their centres at 125mm from the edges of the end block. The cable duct is of 50mm diameter. The 28 days cube strength of concrete f_{cu} = 45 N/mm^2, The cube strength at transfer f_{ci} = 25 N/mm^2. Permissible bearing stresses behind anchorage should conform with IS:1343. The characteristic yield stress in mild steel anchorage reinforcement is 260 N/mm^2. Design suitable anchorage for the end block. **(20 Marks)**

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