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Seventh Semester B.E. Degree Examination, June/July 2017
Design of Pre-Stressed Concrete Structures

Time: 3 hrs.

Max. Marks:100

- Note: 1. Answer any FIVE full questions, selecting at least TWO questions from each part.**
2. Use of IS : 1343 – 1980 is permitted.
3. Missing data, if any, may be suitably assumed.

PART – A

- 1
 - a. Explain why high strength steel and high strength concrete are used in pre-stressed concrete. (08 Marks)
 - b. Define pre-stressed concrete. State its advantages over reinforced concrete. (06 Marks)
 - c. What is pressure line? Explain its significance. (06 Marks)

- 2
 - a. Distinguish between the pre-tensioning and post-tensioning methods of pre-stressing. Explain with suitable example. (06 Marks)
 - b. A pre-stressed concrete beam, 200 mm wide and 300mm deep is used over an effective span of 6m to support an imposed load of 4 kN/m. The density of concrete is 25 kN/m³. At the quarter span section of the beam, find the magnitude of :
 - i) Concentric pre-stressing force necessary for zero fibre stress at the soffit when the beam is fully loaded
 - ii) The eccentric pre-stressing force located 100mm from the bottom of the beam, which would nullify the bottom fibre stress due to loading. (14 Marks)

- 3
 - a. List and explain the various types of loss of pre-stress in pre-tensioned and post-tensioned members. (06 Marks)
 - b. A post tensioned concrete beam, 100mm wide and 300mm deep, spanning over 10m is stressed by successive tensioning and anchoring of three cables 1, 2 and 3 respectively. The cross-sectional area of each cable is 200mm² and initial stress in cable is 1200 N/mm². Modular ratio = 6. The first cable is parabolic with an eccentricity of 50mm below centroidal axis at the center of span and 50mm above centroidal axis at support sections. The second cable is parabolic with zero eccentricity at supports and an eccentricity of 50mm at the centre of span. The third cable is straight with a uniform eccentricity of 50mm below centroidal axis. Estimate percentage loss of stress in each of the cables, if they are successively tensioned and anchored. (14 Marks)

- 4
 - a. What are the factors influencing deflections of a PSC beam? (06 Marks)
 - b. A concrete beam with a cross-sectional area of $32 \times 10^3 \text{ mm}^2$ and radius of gyration of 72mm is pre-stressed by a parabolic cable carrying an effective stress of 1000 N/mm². The span of the beam is 8m. The cable, composed of 6 – 7mm diameter, has an eccentricity of 50mm at the center and zero at the supports. Neglecting all losses, find the central deflection of the beam as follow :
 - i) Self – weight + pre-stress, and
 - ii) Self-weight + pre-stress + live load of 2 kN/m. Take $E = 38 \text{ kN/mm}^2$ and density of concrete 24 kN/m³. (14 Marks)

PART – B

- 5 a. What are the different types of flexural failure modes observed in pre-stressed concrete beam? Explain with neat sketches. (06 Marks)
- b. A post-tensioned beam with unbounded tendons is of rectangular section, 400mm wide with an effective depth of 800mm. The cross-sectional area of the pre-stressing steel is 2840 mm². The effective pre-stress in the steel after all losses is 900 N/mm². The effective span of the beam is 16m. $f_{ck} = 40 \text{ N/mm}^2$, estimate the ultimate moment of resistance of section using IS : 1343 recommendations. (14 Marks)
- 6 a. Explain different methods of improving the shear resistance of PSC members. (04 Marks)
- b. The support section of a pre-stressed concrete beam 120 mm wide and 240mm deep is required to support an ultimate shear force of 75kN. The compressive pre-stress at the centroidal axis is 5 MPa, $f_{ck} = 40 \text{ MPa}$, $f_y = 415 \text{ MPa}$. Concrete cover to shear reinforcement is 50mm. Design a suitable shear reinforcement as per IS 1343 recommendations. (16 Marks)
- 7 a. What is transmission length? Explain factors influencing transmission length. (06 Marks)
- b. The end block of a post tensioned beam is 500mm × 1000mm. Two cables each comprising 55 numbers of 7mm dia high tensile wires carrying a force of 2800 kN are anchored using a plate of side 305mm. The anchor plate centers are located symmetrically at 250mm from top and bottom edges of beam. Using Fe415 grade yield bars, design suitable reinforcement in the end block using IS : 1343 code recommendations. (14 Marks)
- 8 a. Write briefly about the limiting zone for cables in PSC members. (06 Marks)
- b. A pre-tensioned PSC beam of rectangular cross-section is required to support a design ultimate moment of 120 kN-m. Design the section, take $f_{ck} = 50 \text{ N/mm}^2$ and $f_p = 1600 \text{ N/mm}^2$. (14 Marks)

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