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10CV74

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

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting atleast TWO questions from each part.***
2. Use of IS – 1343 – 1980 is permitted.

PART – A

1 a. Explain why high strength concrete and high strength steel are used in pre –stressed concrete member. **(06 Marks)**

b. A concrete beam of symmetrical 'I' section spanning 8m, the width and thickness of flanges are 220 mm and 60mm respectively, the overall depth of the beam is 410mm, the thickness of web is 80mm, the beam is pre-stressed by a straight cable with an eccentricity of 150mm with an effective force of 150 kN, the live load on the beam is 2.5 kN/m, draw the stress distribution diagram at the central section for the following condition.
i) Pre-stress + self wt ii) pre-stress + self wt + live load. **(14 Marks)**

2 a. Explain with a neat sketch "Hoyer's long line" system of pretensioning. **(06 Marks)**

b. A PSC 'T' beam is to be designed to support a superimposed load of 4.4 kN/m over a span of 5m. The stress in concrete must not exceed 15 N/mm^2 in compression and zero in tension at any stage of loading. Check for the adequacy of the section and calculate minimum pre-stressing force and corresponding eccentricity assuming 20% loss of pre-stress after transfer. **(14 Marks)**

3 a. How do you estimate the loss of pre-stress due to :
i) Elastic deformation of concrete
ii) Shrinkage of concrete
iii) Friction between cable and duct. **(06 Marks)**

b. A PSC beam of cross section 200mm × 300mm is pre-stressed with steel wires of area 320mm^2 located at a constant eccentricity of 50mm and carrying an initial stress of 1100 N/mm^2, span of the beam is 9m, calculate % loss of stress in wires if beam is : i) post tensioned ii) PRE tensioned. Given E_s = 210 GPa, E_c = 35 GPa. Relaxation of stress in steel = 4.8%, shrinkage of concrete is 300×10^{-6} for pre tensioning, 200×10^{-6} for post tensioning, creep coefficient = 1.6, slip at anchorage is 1mm, frictional coefficient for wave effect is 0.0012/m. **(14 Marks)**

4 a. Explain long term deflection and short term deflection in PSC beam. **(06 Marks)**

b. A rectangular concrete beam of cross section 150mm wide and 300mm deep is simply supported over a span of 8m and is pre-stressed by a symmetric parabolic cable at a distance of 75mm from the bottom of the beam at mid span and 125mm from the top of the beam at support section. If the force in the cable is 350 kN and E_C = 38 GPa, Calculate :
i) The deflection at mid span when the beam is supporting its own weight
ii) The concentrated load which must be applied at mid-span to restore it to the level of supports. **(14 Marks)**

PART – B

5 a. Explain the different types of flexural failures observed in a pre-stressed concrete beam. **(06 Marks)**

b. A pre-tensioned, 'T' section has a flange which is 300mm wide 200mm thick, the rib is 150mm wide and 350mm deep. The effective depth of beam is 500mm, given area of tendons is 200mm^2, f_{ck} = 50 N/mm^2 and f_p = 1600 N/mm^2 estimate the ultimate moment capacity of 'T' section using IS code 1343. **(07 Marks)**

c. A post tensioned beam with unbounded tendon is of rectangular section 400mm wide with an effective depth of 800mm. The cross sectional area of the pre-stressing steel is 2840mm^2. The effective pre-stress in the steel after all losses is 900 N/mm^2. The effective span of the beam is 16m. If f_{ck} = 40 N/mm^2, estimate the ultimate moment of resistance of the section using IS code 1343. **(07 Marks)**

6 a. A concrete beam of rectangular section 200mm wide and 650mm deep in pre-stressed by a parabolic cable located at an eccentricity of 120mm at mid span and zero at the supports. If the beam has a span of 12m and carries a uniformly distributed live load of 4.5 kN/m find the effective force necessary in the cable for zero shear stress at the support section, for this condition calculate the principal stresses. The density of concrete is 24 kN/m^3. **(12 Marks)**

b. The support section of a PSC beam 150mm × 300mm is to resist a shear of 100 kN. The pre-stress at centriodal axis is 5 N/mm^2, f_{ck} = 40 N/mm^2, the cover to tension reinforcement is 45mm check the section for shear and design suitable shear reinforcement, f_t = 1.5 N/mm^2. **(08 Marks)**

7 a. Explain magnal method of end block design. **(08 Marks)**

b. A Freyssient anchorage 100mm dia carrying 12 wires of 7mm dia is embedded concentrically in the web of an 'I' section of web thickness 225mm. Using IS code method determine the tensile and bursting tensile force in the end block. Design the end block and sketch the reinforcement details. **(12 Marks)**

8 A post tensioned PSC beam 300mm wide is to be designed as a rectangular beam to support a UDL of 20 kN/m over a simply supported beam of 18m span. The stresses in concrete must not exceed 16 MPa in compression and 1.2 MPa in tension at any stage of loading. Assume average loss of pre-stress is 17%. Design the beam by calculating depth, pre-stressing force and eccentricity. **(20 Marks)**

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