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10CV74

Seventh Semester B.E. Degree Examination, Dec.2016/Jan.2017
Design of Prestressed 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.
3. Assume and indicate missing data, if any.

PART – A

1 a. Define pre-stressed concrete. State its advantages over reinforced concrete. **(06 Marks)**

b. Explain why high strength steel and high strength concrete are used in prestressed concrete. **(08 Marks)**

c. Explain with a neat sketch "Hoyer's long line" system of pre-tensioning. **(06 Marks)**

2 a. What is a pressure line? **(02 Marks)**

b. Explain the concept of load balancing in prestressed concrete design. **(06 Marks)**

c. A concrete beam of symmetrical I-section supports a superimposed load of 3 kN/m over a span of 8 m. It is prestressed by a cable carrying a force of 120 kN at an eccentricity of 150 mm at mid span section. The top and bottom flanges of the I-beam are 250 mm wide and 80 mm deep, thickness of web is 80 mm and overall depth is 450 mm. Determine the resultant stresses at mid span section for the following cases of loading:
(i) Prestress + self weight
(ii) Prestress + Self weight + Live load.
Neglect the losses. $\gamma_c = 24$ kN/m^3. **(12 Marks)**

3 a. List the immediate and time dependent prestress losses in a PSC beam. **(04 Marks)**

b. A pre-stressed concrete beam of size 200mm × 300mm is prestressed with $A_s = 160$ mm^2 to an initial prestress of 1000 N/mm^2 at a constant eccentricity of 50 mm. The beam spans 10 m. Calculate the percentage prestress loss, if the beam is post tensioned considering the wires simultaneously tensioned. $E_s = 210$ kN/mm^2, $E_c = 35$ kN/mm^2, relaxation of stress in steel is 5% of initial stress, shrinkage of concrete is 200×10^{-6}, slip and deformation of anchorage is 0.5 mm per anchorage, creep coefficient is 2.0, Wobble coefficient = 0.0015/m. **(16 Marks)**

4 a. List the factors influencing deflections of a prestressed concrete beam. **(04 Marks)**

b. Using Mohr's theorem, obtain an expression for computing deflection at mid span in a PSC beam with straight tendons with constant eccentricity 'e'. **(04 Marks)**

c. A concrete beam with a cross sectional area of 32×10^3 mm^2 and radius of gyration of 72 mm is prestressed by a parabolic cable carrying an effective stress of 1000 N/mm^2. The span of the beam is 3 m. The cable composed of 6 wires of 7 mm diameter has an eccentricity of 50 mm at the centre and zero at the supports. Neglecting all losses, find the central deflection of the beam for the following cases. Assume : $E_c = 38$ kN/mm^2, $D_c = 24$ kN/m^3.
(i) Self weight + pre stress
(ii) Self weight + prestress + live load of 2 kN/m. **(12 Marks)**

PART – B

5 a. List the different types of flexural failures in a PSC beam. Explain failure of under reinforced sections. **(06 Marks)**

b. Compute the flexural strength of a pretensioned T-section having flange width = 1200 mm, flange thickness = 150 mm, rib width = 300 mm, rib depth = 1500 mm. The high tensile steel having an area of 4700 mm^2 is located at an effective depth of 1600 mm. Take: f_{ck} = 40 MPa and f_p = 1600 MPa. **(14 Marks)**

6 a. Discuss briefly the modes of failure due to shear. **(05 Marks)**

b. A simply supported beam 120 mm × 300 mm in section having a span of 7 m is prestressed with a parabolic cable which has maximum eccentricity of 100 mm at midspan and minimum eccentricity of 20 mm at support, both below CGC of concrete. Effective prestress in the cable is 300 kN. The beam carries a udl of 30 kN/m exclusive of self weight. Determine the principal tension at 0.6 m from the left support and 20 mm above the centroidal axis. Take density of concrete as 25 kN/m^3. **(15 Marks)**

7 a. What is transmission length? List the factors affecting transmission length. **(04 Marks)**

b. The end block of a PSC girder is 200 mm × 300 mm. The beam is post tensioned by the anchorages each of 100 mm diameter with their centers located at 75 mm from the top and bottom of the beam. The force transmitted by each anchorage is 2000 kN. Calculate the bursting force and design suitable reinforcement as per IS provisions. Also sketch the arrangement of anchorage zone reinforcement. Use 10 mm diameter links and yield stress of steel is 260 N/mm^2. **(16 Marks)**

8 Design a pretensioned symmetrical I-beam for an effective span of 7 m to support a superimposed load of 6 kN/m. Dead load factor is 1.5 and live load factor is 2.5. Permissible stresses are:

At transfer, Compressive stress = 14 N/mm^2
Tensile stress = 1.4 N/mm^2
At working load, Compressive stress = 16 N/mm^2
Tensile stress = 1.4 N/mm^2

7 mm high tensile steel wires having an ultimate tensile strength of 1600 N/mm^2 are available for use. Take E_c = 34 kN/mm^2, loss ratio = 0.75, f_{ck} = 50 N/mm^2, tensile strength of concrete is 1.7 N/mm^2. **(20 Marks)**

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