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10CV74

Seventh Semester B.E. Degree Examination, Dec.2014/Jan.2015
Design of Pre-stressed Concrete Structures

Time: 3 hrs. Max. Marks:100

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

PART – A

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

b. Explain with neat sketches, 'Fryssinet' system of pre-stressing. **(06 Marks)**

c. A pre-stressed concrete beam supports a live load of 4 kN /m over a simply supported span of 8 m. The beam has an I – section with an overall depth of 400 mm. The thickness of flanges and web are 60 and 80 mm respectively. The width of the flanges is 200 mm. The beam is to be pre-stressed by an effective force of 235 kN at a suitable eccentricity such that the resultant stresses at the soffit of the beam at the contre of span is zero.

i) Find the eccentricity required for the force

ii) If the tendon is concentric, what should be the magnitude of the pre-stressing force for the resultant stress to be zero at the bottom fibre of the central span section? **(08 Marks)**

2 a. Explain concept of load balancing in pre-stressed concrete design. **(06 Marks)**

b. A concrete beam with a "double overhang" has the middle span equal to 10 m and the equal overhanging on either side is 2.5 m. Determine the profile of the pre-stressing cable with an effective force of 250 kN which can balance a uniformly distributed load of 8 kN/m on the beam, which includes the self weight of the beam. Sketch the cable profile marking the eccentricity of cable at the support and mid-span. **(14 Marks)**

3 a. List the various types of losses in pre-stressed concrete members and the equations used to determine them. **(06 Marks)**

b. A rectangular beam 180 mm wide by 400 mm deep is simply supported over a span of 8 m and is reinforced with 3 wires of 8 mm dia meter. The wires are located at a constant eccentricity of 80 mm and are subjected to an initial stress of 1200 N/mm^2. Calculate the percentage loss of stress in the wires if the beam is i) pre tensioned ii) post tensioned. Take E_s = 210 kN/mm^2, modular ratio = 6, slip at anchorage = 0.8 mm, friction coefficient = 0.002/m, relaxation of steel stress = 6%. Adopt creep and shrinkage co-efficient as per IS : 1343 code specifications. **(14 Marks)**

4 a. Explain the significance of long term deflections in PSC beams and indicate how it is calculated. **(06 Marks)**

b. What are the factors influencing the deflection of PSC beams? Briefly discuss them. **(04 Marks)**

c. A concrete beam having a rectangular section 150 mm wide by 300 mm deep is pre –stressed by a parabolic cable having an eccentricity of 75 mm at centre of span towards the soffit and an eccentricity of 25 mm towards the top at support sections. The effective force in the cable is 350 kN. The beam supports a concentrated load of 20 kN at the centre of span in addition to the self weight. If the modulus of elasticity of concrete is 38 kN/mm^2 and span is 8 m,, calculate,

i) Short term deflection at centre of span under prestress, self weight and live load

ii) Long term deflection assuming the loss ratio as 0.8 and creep co-efficient as 1.6. **(10 Marks)**

PART – B

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

b. A double Tee section having a flange 1200 mm wide and 150 mm thick is pre-stressed by 4700 mm^2 of high tensile steel located at an effective depth of 1600 mm. The ribs have a thickness of 1500 mm each. The cube strength of concrete is 40 N/mm^2 and tensile strength of steel is 1600 N/mm^2. Determine the flexural strength of the double tee girder using IS : 1343 code provisions. **(07 Marks)**

c. A post – tensioned beam with "unbounded tendons" is of rectangular cross section 500 mm × 1000 mm. The cross sectional area of pre-stressing steel is 3000 mm^2. The effective pre-stress after considering all losses is 1000 MPa. The effective span of the beam made M40 concrete is 15 m. Estimate the ultimate moment of resistance of the section using codal provisions. **(07 Marks)**

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

b. A concrete beam of rectangular section, 200 mm wide and 600 mm deep, is pre-stressed by a parabolic cable located at an eccentricity of 100 mm at mid-span and zero at the supports. If the beam has a span of 10 m and carries a uniformly distributed live load of 4 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. **(07 Marks)**

c. A PSC beam 250 mm wide and 150 mm deep is subjected to a shearing force of 900 kN. The fibre stress under working loads is 4 N/mm^2. If the effective pre-stresses is 1000 N/mm^2 and area of cables 1500 mm^2. Design the shear reinforcement. The cables are inclined at an angle of $\sin^{-1}(\frac{1}{6})$ with horizontal. **(08 Marks)**

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

b. The end block of a post tensioned beam is 300 mm wide by 300 mm deep and is pre-stressed concentrically by a Fryssinet cylindrical anchorage of 150 mm diameter with a jacking force of 800 kN. Design suitable anchorage zone reinforcement and sketch the details. **(12 Marks)**

8 Design a pre-tensioned symmetrical I – beam for an effective span of 7 m to support a super imposed load of 6 kN/m. The beam is to be pre cast in a factory and is to be designed for handling at any point along length during transport and erection. Load factors against failure by bending or shear. For dead load = 1.5, for live load = 2.5

Permissible stresses :

At transfer,

Compressive stress = 1.4 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.

The specified 28 day cube strength of concrete is 50 N/mm^2. The pre-stressing force is to be provided by 5 mm diameter high – tensile wires having an ultimate tensile strength of 1600 N/mm^2. The loss ratio is 0.8. Design the beam and sketch the cross – section showing the arrangement of wires. **(20 Marks)**

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