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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Eighth Semester, B.E. - Civil Engineering

Semester End Examination; June -2017

Design of Pre-stressed Concrete Structure

Time: 3 hrs *Max. Marks: 100*

Note*: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Use of IS 1343 is permitted
iii) Missing data, if any, may be suitably assumed.

UNIT - I

1. a Define pre-stressed concrete. State its advantages over RCC. 6

b. With neat sketch, explain "Hoyer's long line" system of pre-tensioning. 6

c. Define the terms : 8

i) Tendon ii) Transmission length iii) Anchorage iv) Pre-tensioning.

2 a. Explain with neat sketch, "Freyssinet Anchorage system". 8

b. Explain the terms : 12

i) Load Balancing concept ii) Stream concept iii) Centre of Thrust.

UNIT - II

3 a. A rectangular concrete beam of size 100 mm wide of 250 mm deep is spanning over 8 m, pre-stressed by a straight cable carrying an effective pre-stressing force of 250 kN located at an eccentricity of 40 mm. The beam supports a live load of 1.2 kN/m. Calculate the resultant stress for the centre of span section for : 10

i) Pre-stress + self weight

ii) Pre-stress + self weight + live load. Assume density of concrete as 24 kN/m^3.

b. A rectangular concrete beam of C/S 30 cm deep and 20 cm wide is presented by means of 15 wires of 5 mm dia located at 6.5 cm from the bottom of the beam and 3 wires of 5 mm dia located 2.5 cm from the top. Assuming the pre-stresses in steel as 840 N/mm^2, calculate the stresses at the extreme fibres of the mid-span section, when the beam is supporting its own weight over a span of 6 m. If an udl of LL is 6 kN/m, evaluate the maximum working stress in concrete. Density is 24 kN/m^3. 10

4 a. A pre-stressed concrete beam of section 200 mm x 300 mm is used over a span of 6 m to support an imposed load of 4 kN/m. The density of concrete is 24 kN/m^3. At the centre of span section, find the magnitude of :

i) The concentric pre-stressing force necessary for zero fibre stress at the soffit when the beam is fully loaded. 8

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ii) The eccentric pre-stressing force located 100 mm from the bottom of the beam which would nullify the bottom fibre stress due to loading.

b. A rectangular concrete beam is C/S 120 mm x 300 mm is pre-stressed by a straight cable carrying an effective force of 180 kN @ an eccentricity of 50 mm. The beam supports an imposed load 3.14 kN/m over a span of 6 m. If the modulus of rupture is 5 N/mm^2. Evaluate the load factor against cracking. Density is 24 kN/m^3. 12

UNIT - III

5 a. How do you estimate the loss of pre-stress due to, 8

i) Relaxation of steel ii) Shrinkage iii) Elastic deformation iv) creep of concrete?

b. A rectangular concrete beam 300 mm deep by 200 mm wide is pre-stressed by means of 15-5 mm diameter wires located at 65 mm from the bottom and 3-5 mm diameter wires located @ 25 mm from top of the beam. If the wires are initially tensioned to a stress of 840 N/mm^2. Calculate the % of loss of stress in steel immediately after transfer. Take E_s = 210 kN/mm^2 and E_e = 31.5 kN/mm^2. 12

6 a. What are the factors influencing deflection of a PSC beam? 6

b. A concrete beam with a C/S area of 32 x 10^3 mm^2 and radius of gyration of 72 mm is pre-stressed by a parabolic cable carrying an effective stress of 1000 N/mm^2. The span of the beam is 8 m. The cable composed of 6-7 mm dia, has an eccentricity of 50 mm @ the centre and zero @ supports. Neglecting all losses, find the central deflection of the beam, 14

i) Self weight + Pre-stress

ii) Self weight + Pre-stress + LL of 2 kN/m. Take E = 38 N/mm^2 and density = 24 kN/m^3.

UNIT - IV

7 a. List and explain the types of flexural failure. 8

b. An unsymmetrical I section bridge girder as the following sectional properties, width and thickness of top flange 1200 mm x 360 mm and thickness of web is 240 mm, centroid of section is located @ 580 mm from top. The girder is over a span of 40 m and tendons are unbounded with C/S of 7000 mm^2 are parabolic with an eccentricity of 1220 mm @ the centre of span. Given f_{ck} = 45 N/mm^2, f_{pe} = 1200 N/mm^2 (after all losses). Calculate the flexural strength. f_p=1600 N/mm^2. 12

8 a. A simply supported beam of span 7 m is 120 mm x 220 mm in section. It is pre-stressed with a parabolic cable which carries an effective pre-stress of 225 kN. The cable has maximum eccentricity of 100 mm @ midspan and minimum eccentricity of 50 mm @ supports. Determine the principal tension @ 25 mm above the centraoidal fibre in section 0.7 m from the left support. The beam carries an all inclusive load of 12 kN/m. 10

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b. A PSC beam of 250 mm wide and 1500 mm deep is subjected to an ultimate shear force of 900 kN. The compressive stress under working load is 4 N/mm^2. If the effective pre-stress is 1000 N/mm^2 and area of cable is 1500 mm^2, design the shear reinforcement. The cable is inclined at an angle of arc sin^{-1}(1/6), cover is 100 mm, f_{ck} = 40 Mpa and f_y = 415 Mpa. 10

UNIT - V

9 a. Briefly explain the stress distribution in end block. 10

b. The end block of a pre-stressed concrete girder is 200 mm wide by 300 mm deep. The beam is post-tensioned by two Freyssinet anchorages each of 100 mm dia with their centre located @ 75 mm from the top and bottom of the beam. The force transmitted by each anchorage being 200 kN. Compute the bursting force and design suitable reinforcement according to the Indian standard code, sketch the reinforcement f_y = 260 N/mm^2. 10

10 a. The end block of a pre-stressed beam 260 mm wide and 500 mm deep in section is pre-stressed by two cables carrying force of 450 kN each. One of the cable is parabolic, located 125 mm below the centre line at the centre of span 10 m and anchored at a point of 125 mm above the centre line @ the ends. The second cable is straight located 100 mm from the bottom of the beam. The distribution plates for the cables are 100 mm deep and 250 mm wide. Calculate the maximum tensile stress along the axis of the beam. 14

b. A PSC beam 300 mm wide and 500 mm deep has two anchorage of 150 mm dia with the centres @ 125 mm from top and bottom of the beam. The force transmitted by each cable is 800 kN. Estimate the maximum tension and brusting force. 6

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