U.S.N | | | | | | | | | | |

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; May/June - 2018

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.

UNIT - I

1. a Define pre-stressed concrete. State the basic principle of pre-stressing. 6

b. State the advantages and disadvantages of pre-stressed concrete over reinforced concrete. 8

c. Explain Magnel-Blaton post tensioning system with a neat sketch. 6

2 a. Distinguish between pre-tensioning and post-tensioning. 6

b. Explain the basic principles of post-tensioning. 6

c. Explain Freyssinet system of post-tensioning with a neat sketch. 8

UNIT - II

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

4 a. Explain load balancing concept in a pre-stressed concrete member. 4

b. A PSC beam of 400 mm x 600 mm provided with a tendon having parabolic cable of 100 mm at mid span and zero at supports. If the total external load on the beam is 35 kN/m on the 6 m span. Calculate the extreme stresses for the mid span section. The tendon comes a pre-stressing force of 1000 kN. 16

UNIT - III

5 a. List the various losses in pre-stress and explain types of losses in pre-stress. 10

b. A pre tensioned concrete beam 200 mm x 300 mm and span 6 m is initially pre stressed by a force of 400 kN applied at a constant eccentricity of 70 mm by tendons of area 400 mm^2. If $E_s = 2 \times 10^5$ N/mm^2, $E_c = 0.333 \times 10^5$ N/mm^2, Creep coefficient in concrete = 2, Shrinkage strain in concrete = 0.0002, stress relaxation in steel = 3%. Find percentage loss in tendon. 10

6 a. A post tensioned rectangular beam 300 mm x 600 mm in section is pre-stressed with an initial pre-stress of 950 N/mm^2. There are 4 straight cables of each of an area 250 mm^2. The cables are situated at 100 m from the soffit. Determine percentage loss of pre-stress due to concrete. Assume, shrinkage strain of concrete = 2×10^{-4}, Modular ratio, $\alpha_e = 6$; ultimate creep strain of concrete = 4×10^{-6}. The cables are pulled 'one by one'. 16

b. Explain the factors affecting deflection. 4

UNIT - IV

7 a. List the different types of flexural failure in a PSC beam. 4

b. A PSC beam rectangular in cross section 200 mm x 500 mm deep is pre-stressed by tendons having an area of 600 mm^2 located at 100 mm from the soffit of the beam.

Given f_{ck} = 40 kN/mm^2 and F_p = 1600 N/mm^2. Estimate the flexural strength of the beam for following cases as per IS code recommendation : 16

i) If beam is pre-tensioned

ii) If beam is post-tensioned with effective bond.

8 a. Discuss briefly the modes of failure due to shear. 4

b. A tee beam has a flange width and thickness of 500 mm and 200 mm respectively. The web is 200 mm thick and 600 mm deep. The beam spanning over 16 m is pre-stressed using a cable carrying an effective force of 2000 kN. The cable is parabolic with an eccentricity 600 mm at the centre of span and 300 mm at support. Estimate ultimate shear resistance of support section assuming M-40 grade concrete. Also evaluate maximum service load on beam assuming a load factor of 2 as per IS: 1343 code specification. 8

c. A PSC beam 150 x 300 mm is to resist a shear of 100 kN. The pre-stress at centroid axis is 5 N/mm^2. f_{ck} = 40 N/mm^2. The cover of tension reinforcement is 45 mm. Check the section for shear and design suitable shear reinforcement. 8

UNIT - V

9 a. What is transmission length? List the factor affecting it. 6

b. Explain Hoyer's effect with a neat sketch. 6

c. Calculate the transmission length at the end of a pre-tensional beam as per Hoyer's method using following data: Span of beam = 50 m; dia of wire used = 7 mm; coefficient of friction between steel and concrete = 0.1; Poisson ratio for steel and concrete = 0.3 and 0.15; E_S = 210 kN/mm^2 and E_C = 30 kN/mm^2; ultimate tensile strength of steel wire, f_{pu} = 1500 N/mm^2; initial stress of steel f_{pi} = 0.7 f_{pu}; effective stress in steel f_{pe}= 0.6 f_{pu}. 8

10 a. Explain end zone reinforcement. 4

b. The end block of PSC beam of rectangular section is 150 mm wide and 400 mm deep. An effective pre-stressing force of 400 kN is transmitted to concrete by a distribution plate of 150 mm and 120 mm deep. Concentrically located at the ends. Calculate the maximum bursting force. Design the reinforcement for end block for maximum transverse tension. Sketch the details of reinforcement. Use Fe415 steel. 8

c. The end block of post tensioned pre stressed member is 550 mm wide and 550 mm deep. Four cables each made of 7 wires of 12 mm dia strands and carrying a force of 1000 kN are anchored by plate anchorage 150 mm by 150 mm located with their centres at 125 mm from edges of end block. The cable duct is of 50 mm dia. The 28 day cube strength of concrete f_{cu} = 45 N/mm^2. The cube strength of concrete at transfer = 25 N/mm^2 permissible bearing stress should conform with IS: 1343. The characteristic yield stress is 260 N/mm^2. Design suitable anchorage for end block. 8

* * * *