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10CV74

Seventh Semester B.E. Degree Examination, Aug./Sept.2020
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.

PART – A

1 a. Explain in detail, the need for high strength steel and concrete in casting of PSC elements. **(06 Marks)**

b. Describe briefly the pretensioning and post-tensioning methods in PSC members. **(08 Marks)**

c. With the help of a neat diagram, explain the concept of 'THURST LINE' or 'PRESSURE LINE'. **(06 Marks)**

2 a. A prestressed concrete T-beam having a cross-section of Flange 1200mm wide and 200mm thick, the rib is 240mm wide and 1000mm deep. The beam consists a load of 12 kN/m, due to 'Dead load' at the initial stage over a span of 16 mtr. Determine the pre-stressing force and its eccentricity to reduce net stresses equal to zero and 12 MPa at the top and bottom fibres. **(10 Marks)**

b. A PSC beam rectangular in shape has a span of 12 mtr and cross-section 400mm × 800mm. Two point loads of 20 kN each are acting at middle third points. If the eccentricity at the middle third portion is 150mm. Suggest a suitable cable profile and also calculate the effective pre-stressing force required using the concept of 'LOAD BALANCING'. Also determine the initial pre-stressing force in the cable for the above profile, if the result tensile stress at mid-span is zero. **(10 Marks)**

3 a. Explain with relevant equations and the terms used in the equations for determining various losses in pre-tensioned and post-tensioned beams. **(06 Marks)**

b. A post tensioned concrete beam, 100mm wide and 300mm deep, spanning over 10 mtr is stressed by successive tension and anchoring of three cables 1, 2 and 3 respectively. The cross-sectional area of each cable is 200 mm^2 and initial stress in cable is 1200 N/mm^2. Modular ratio = 6.0. The first cable parabolic with an eccentricity of 50 mm below centroidal axis at the centre of span and 50mm above centroidal axis at support sections. The second cable is parabolic with zero eccentricity at supports and an eccentricity of 50mm at the centre of span. The third cable is straight with a uniform eccentricity of 50mm below centroidal axis. Estimate percentage loss of stress in each of cables, if they are successively tensioned and anchored. **(14 Marks)**

4 a. Explain short term deflection and long term deflections in case of PSC members with necessary expressions and terms involved. **(04 Marks)**

b. A PSC beam of rectangular section 150mm wide and 400mm depth is stressed by 4 cables, each carrying an effective force of 250 kN. The span of the beam is 12 mtr. The first cable is parabolic with an eccentricity of 50mm below the centroidal axis at midspan and 50mm above the centroidal axis at supports. The second cable is also parabolic with zero eccentricity at support and an eccentricity of 50mm at mid-span. The 3^{rd} and 4^{th} cable are straight with a constant eccentricity of 50mm below centroidal axis. If the beam supports a UDL of 10 kN/m and E_c = 40 kN/mm^2, estimate the instantaneous deflection at the following stages.

(i) Prestress + self weight of beam (ii) Prestress + self weight + Live load

If the loss ratio is 0.8 and creep co-efficient is 1.6. Estimate the long term deflection. **(16 Marks)**

PART – B

5 a. A pre-tensioned T-beam has flange 1200mm wide and 150mm thick, the width and depth of rib are 300mm and 1500 mm respectively. The high strength tensile wires have an area of 4700mm^2 and are located at an effective depth of 1600 mm. If F_{ck} and F_p are 40 MPa and 1600 MPa, calculate the ultimate Flexural Strength of T-section. **(10 Marks)**

b. A post-tensioned bridge girder with unbounded tendons is of box-section of overall dimensio1200 mm width and 1800 mm depth, with a wall thickness of 150 mm. The high tensile steel has cross-section of 4000 mm^2 and is located at an effective depth of 1600mm from the top. The effective pre-stress in steel after all losses is 1000 N/mm^2 and the effective span of girder is 24 mtr. F_{ck} = 40 N/mm^2 and F_y = 1600 N/mm^2. Estimate the ultimate Flexural strength of the section. **(10 Marks)**

6 a. A post-tensioned beam of rectangular cross-section 200mm wide and 400mm deep is 10 mtr long and carries an applied load of 8 kN/m on the beam. The effective pre-stressing force in the cable is 500 kN. The cable is parabolic and concentric at supports with a maximum eccentricity of 140 mm at the centre of the span. Calculate the principal stresses at the supports and what will be the magnitude of the principal stresses at supports in the absence of pre-stress. **(10 Marks)**

b. A I-section has the following sectional details, Top flange = 600mm × 200mm, Web = 150mm × 800mm, Bottom flange = 300mm × 200mm, Shear force across the section = 250 kN, effective pre-stressing force in cable = 1500 kN. Inclination of tendon at the section is $\sin^{-1}(1/20)$. Fibre-stress distribution across the section varies linearly from 11 N/mm^2 [Compressive] at top to 01 N/mm^2 [Tension] at soffit. Determine maximum principal tension developed in the section. **(10 Marks)**

7 a. Write a brief explanatory note on TRANSMISSION LENGTH and factors influencing Transmission length. **(08 Marks)**

b. A Freyssinet anchorage 100mm in diameter carrying 12 wires of 7mm diameter 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 Design a pretensioned roof purlin to suit the data given below:
Effective span = 6m   Applied load = 5 kN/m
Load factors:
For Dead load = 1.4   For Live load = 1.6
Concrete cube strength, f_{cu} = 50 N/mm^2
Cube strength at Transfer f_{ci} = 30 N/mm^2
Tensile strength of concrete, f_t = 1.7 N/mm^2
Modulus of elasticity of concrete, E_c = 34 kN/mm^2
Loss ratio, η = 0.8
Permissible stresses : At transfer : Compressive stress, f_{ct} = 15 N/mm^2
Tensile stress, f_{tt} = – 1 N/mm^2
At working load : Compressive stress, f_{cw} = 17 N/mm^2
Tensile stress, f_{tw} = 0
7mm high-tensile steel wires having an ultimate tensile strength, f_{pu} = 1600 N/mm^2 are available for use. **(20 Marks)**

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