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10CV74

Seventh Semester B.E. Degree Examination, July/August 2021
Design of Pre-Stressed Concrete Structures

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions.***
2. ***Use of IS 1343-1980 is permitted.***

1 a. Explain the concept of using high strength concrete and high strength steel in PSC structures. **(06 Marks)**

b. Point out the difference between pre-tensioning and post-tensioning. **(06 Marks)**

c. Explain with a neat sketch "Hoyer long line" system pretensioning. **(08 Marks)**

2 An unsymmetrical I-section is to support an imposed load at 2 KN/m over a span of 8 m. The sectional details are, top flange, 300 mm wide and 60 mm thick, bottom flange, 100 mm and 60 mm thick. Thickness of web = 80 mm, overall depth of beam = 400 mm. At the centre of span, the effective pre stressed force of 100 KN is located at 50 mm from soffit of the beam. Estimate the stresses at the central section of the beam for the following load conditions,

(i) Pre stress + self weight.
(ii) Pre stress + self weight + live load **(20 Marks)**

3 a. What are the important losses of prestress? Explain in detail. **(08 Marks)**

b. A PSC beam $200\text{mm} \times 300\text{mm}$ is prestressed with wires of area 300 mm^2 located at an eccentricity of 100 mm below centroidal axis at midspan and zero eccentricity at supports, carries an initial stress of 1000 N/mm^2. The span of the beam is 10 m. Calculate the percentage of loss of stress in wires if, (i) The beam is pretensioned (ii) The beam is post tensioned using following data:

$E_S = 210\,KN/mm^2$; $E_C = 35\,KN/mm^2$;

Relaxation of stress in steel = 5% of initial stress shrinkage strain in concrete for pretensioning = 300×10^{-6}. Age of concrete at transfer for post tensioned beam = 8 days, Creep co-efficient = 1.6, Slip at anchorage = 2 mm, Co-efficient of friction between concrete and cable = 0.55, Friction co-efficient for wave effect = 0.0015/m. **(12 Marks)**

4 a. List the factor influencing deflections. **(04 Marks)**

b. A posttensioned beam (bonded) 300×600 mm has a prestress of 1560 KN in tendons immediately after prestressing which eventually reduces to 1330 KN due to losses. The beam is simply supported over a span of 12 m and carries concentrated loads of 44.5 KN each at a distance of 4.5 m from supports. The tendon is parabolic with zero eccentricity at support and 120 mm below centroidal axis at midspan. Calculate deflection at midspan due to,

(i) Prestress + self weight
(ii) Prestress + self weight + live load

$E_C = 35\,KN/mm^2$ **(16 Marks)**

5 a. A prestressed concrete beam rectangular in cross section 200×500 mm deep is prestressed by tendons having an area of 600 mm^2 located at 100 mm from soffit of the beam. Given $f_{CK} = 40$ N/mm^2 and $f_p = 1600$ N/mm^2. Estimate the ultimate flexural strength of the beam for the following cases as per IS code recommendations:

(i) If the beam is pretensioned.

(ii) If the beam is post tensioned with effective bond. **(10 Marks)**

b. A post tensioned beam with unbounded tendons is of rectangular cross section b = 500 mm, d = 1000 mm). The cross sectional area of prestressing steel is 3000 mm^2. The effective prestress after considering all losses is 1000 MPa. The effective span of the beam made of M40 concrete is 15 m. Estimate the ultimate moment of resistance of the section using codal provisions. **(10 Marks)**

6 a. A prestressed 'T' section has a flange width of 600 mm and the thickness of the flange is 230 mm. Thickness of rib is 150 mm. Total depth of beam is 1300 mm. f_{CK} = 45 MPa and characteristics strength of tendon is 1500 MPa, Effective stress in tendons after all losses = 900 MPa. Area of steel = 2300 mm^2. At a particular section beam is subjected to an ultimate moment of 2130 KNm and shear force of 237 KN. Effective prestress at extreme tensile face of beam (f_{pt}) = 19.3 MPa. Calculate the ultimate shear resistance of beam at that section. **(10 Marks)**

b. The support section of PSC beam is $100 \text{ mm} \times 250$ mm shear force at that section is 70 KN. The compressive prestress at the centroidal axis 5 MPa, f_{CK} = 40 MPa, f_y = 415 MPa. Cover to reinforcement is 50 mm. Design suitable shear reinforcement as per IS1343 provisions. **(10 Marks)**

7 a. Explain the concept of stress distribution in end block. **(08 Marks)**

b. The end block of a post tensioned prestressed member is 550 mm wide and 550 mm deep. Four cables each made up of 7 wires of 12 mm diameter strands and carrying a force of 1000 KN are anchored by plate anchorages 150 mm by 150 mm located with their centres at 125 mm from the edges of the end block. The cable duct is of 50 mm diameter. The 28 day cube strength of concrete f_{CK} is 45 N/mm^2. The cube strength of concrete at transfer f_{Ci} is 25 N/mm^2 . Permissible bearing stresses behind anchorages should conform with IS1343. The characteristic yield stress in mild steel anchorage reinforcement is 260 N/mm^2. Design suitable anchorage for the end block. **(12 Marks)**

8 Design a rectangle beam for a simply supported span of 10 m. Assume the following : No tension is permitted in concrete, Compressive stresses in concrete are limited to 15 N/mm^2 and 12 N/mm^2 at transfer and at working load respectively. Loss ratio = 80%, Initial stress is steel = 1000 N/mm^2, Minimum required cover = 80 mm, Live load = 12 KN/m. **(20 Marks)**

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