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10CV74

Seventh Semester B.E. Degree Examination, Dec.2018/Jan.2019

Design of Pre-stressed Concrete Structures

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

PART – A

1 a. Explain different methods of imparting precompression to concrete. **(05 Marks)**

b. State why high strength concrete and high strength steel is used in Prestressed Concrete stress. **(05 Marks)**

c. Explain with neat sketches, Fressinet system of post tensioning. **(05 Marks)**

d. Describe with three examples significance of using different cable profile in PSC beams. **(05 Marks)**

2 a. A concrete beam of symmetrical I section of simply supported span 10 m has a width and thickness of flange 250 mm and 80 mm respectively. The overall depth is 500 mm. The thickness of web is 80 mm. The beam is prestressed by a parabolic cable with an eccentricity of 150 mm below centroidal axis at midspan and concentric at supports. The effective prestress in the cable is 200 kN. The beam supports a liveload of 3 kN/m. Compute the fibre stress at midspan under working load. At what eccentricity the fibre stress at bottom become zero at working load? **(12 Marks)**

b. A prestressed simply supported beam of span 12 m and size $300\text{mm} \times 600\text{mm}$ has a parabolic cable with zero eccentricity at support and eccentricity of 125 mm below centroida axis at midspan. The effective prestress in steel is 820 Mpa and area of steel is 1600 mm^2. If no tensile stresses are permitted at service load (uniformly distributed load), determine the load factor against cracking, assuming modulus of rupture of concrete as 4.2 MPa. **(08 Marks)**

3 a. List the various factors influencing loss of pre stress in pre tensioned and post tensioned PSC beams. **(04 Marks)**

b. A PSC beam 200 mm × 300 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 loss of stress in wires if, (i) the beam is pre tensioned (ii) the beam is post tensioned using following data:

$E_S = 210\,\text{kN/mm}^2$; $E_C = 35\ \text{kN/mm}^2$

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 coefficient = 1.6, Slip at anchorage = 2 mm, Coefficient of friction between concrete and cable = 0.55, Friction coefficient for wave effect = 0.0015/m. **(16 Marks)**

4 a. Why PSC members will have relatively lesser deflection compared to RCC member under working loads? **(03 Marks)**

b. A post tensioned beam (bonded) $300mm \times 600mm$ 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. **(17 Marks)**

PART – B

5 a. A double T section post tensioned bonded beam having a flange 1200 mm wide and 150 mm thick is prestressed by 4700 mm^2 of HTS at an effective depth of 1600 mm. The ribs have thickness of 150 mm each. If 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 double T girder using IS 1343 provisions. **(12 Marks)**

b. A post tensioned beam with unbounded tendons is of rectangular section 400 mm wide with an effective depth of 800 mm, is prestressed by steel cables of area 2840 mm^2 with an effective force of 900 MPa. The effective span of beam is 16 m. If fck = 40 MPa, estimate the ultimate moment of resistance using IS 1343 code provisions. **(08 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. fck = 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 (fpt) = 19.3 MPa. Calculate the ultimate shear resistance of beam at that section. **(10 Marks)**

b. The support section of PSC beam is $100mm \times 250mm$ shear force at that section is 70 kN. The compressive prestress at the centroidal axis 5 MPa. fck = 40 MPa, fy = 415 MPa. Cover to reinforcement is 50 mm. Design suitable shear reinforcement as per IS 1343 provisions. **(10 Marks)**

7 a. Write a note on transmission length in pre tensioned members. **(06 Marks)**

b. The end block of a post tensioned beam is $450mm \times 550mm$. Four cables, each made up of 8 wires of 12 mm diameter strands and carrying a force of 1150 kN are anchored by plate anchorages, $150mm \times 150mm$, located with their centres at 125 mm from the edges of the end block. The cable duct is of 50 mm diameter. The cube strength of concrete at transfer is 25 N/mm^2. Check for bearing stress as per IS 1343 provisions. Design suitable anchorage for the end block. **(14 Marks)**

8 Design a pre tensioned PSC I section for roof purlin to suit the data below:
Effective span = 6 m, Applied load = 6 kN/m, Load factors for dead load = 1.5 and for live load = 1.6. Permissible compressive stress at transfer and working load = 15 N/mm^2, Permissible stresses in tension at transfer = 1 N/mm^2. No tensile stress at working load is permitted. 7 mm HTS wires of ultimate tensile strength = 1600 N/mm^2 are available for use. Take fck = 50 N/mm^2, E_C = 34 N/mm^2, Loss ratio = 0.75. Tensile strength of concrete $f_t = 1.7$ N/mm^2. **(20 Marks)**

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