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Question Paper Code : 80222

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Seventh Semester

Civil Engineering

CE 6702 — PRESTRESSED CONCRETE STRUCTURES

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. List the loss of prestress.
2. Define axial prestressing.
3. What are the different types of flexural failure modes observed in PSC beams?
4. What is strain compatibility method?
5. Define the term end block.
6. What is meant by bursting force?
7. How to achieve compositeness between precast and cast in situ part?
8. Distinguish between propped and unpropped construction methods.
9. What is the stress induced in concrete due to circular prestressing?
10. What are the design criteria for prestressed concrete pipes?

PART B — (5 × 16 = 80 marks)

11. (a) (i) A rectangular prestressed beam 150 mm wide and 300 mm deep is used over an effective span of 10 m. The cable with zero eccentricity at the supports and linearly varying to 50 mm at the centre carries an effective prestressing force of 500 kN. Find the magnitude of the concentrated load located at the centre of the span for the following conditions at the centre of span section :

(1) If the load counteracts the bending effect of the prestressing force (neglecting self weight of beam) and

(2) If the pressure line passes through the upper kern of the section under the action of the external load, self weight and prestress. (10)

(ii) A prestressed concrete beam, 200 mm wide and 300 mm deep is used over an effective span of 6 m to support an imposed load of 4 kN/m. the density of concrete is 24 kN/m^3. Find the magnitude of the eccentric prestressing force located at 100 mm from the bottom of the beam which would nullify the bottom fibre stress due to loading. (6)

Or

(b) (i) A concrete beam with a rectangular section 120 mm wide and 300 mm deep, is stressed by a straight cable carrying an effective force of 200 kN. The span of the beam is 6 m. The cable is straight with a uniform eccentricity of 50 mm. if the beam has an uniformly distributed load of 6 kN/m. E_C = 38 kN/mm^2. Estimate the deflection at centre of span for the following case :

(1) Prestress + self weight of the beam

(2) Prestress + self weight of the beam + Live load. (8)

(ii) A pretensioned beam 200 mm × 300 mm is prestressed by 10 wires each of 7 mm diameter, initially stressed to 1200 MPa with their centroids located 100 mm from the soffit. Estimate the final percentage loss of stress due to elastic deformation, creep, shrinkage and relaxation. Assume relaxation of steel stress = 60 MPa, E_s = 210 GPa, E_C = 36.9 GPa, creep coefficient = 1.6 and residual shrinkage strain = 3×10^{-4}. (8)

12. (a) (i) A pretension T — section has a flange 1200 mm wide and 150 mm thick. The width and depth of rib are 300 mm and 1500 mm respectively. The high tensile steel has an area 4700 mm^2 and is located at an effective depth of 1600 mm. If the characteristic cube strength of the concrete and the tensile strength of steel are 40 N/mm^2 and 1600 N/mm^2 respectively; calculate the flexural strength of the T – section. (8)

(ii) Explain the various methods of flexural failure encountered in pre stressed concrete member. (8)

Or

(b) Design a simply supported Type I prestressed beam with $M_T = 435$ kNm (including an estimated $M_{SW} = 55$ kNm). The height of the beam is restricted to 920 mm. The prestress at transfer $fpo = 1035$ N/mm^2 and the prestress at service $fpe = 860$ N/mm^2. Based on the grade of concrete, the allowable compressive stresses are 12.5 N/mm^2 at transfer and 11.0 N/mm^2 at service. The properties of the prestressing strands are given below.

(i) Type of prestressing tendon 7-wire strand

(ii) Nominal diameter = 12.8 mm

(iii) Nominal area = 99.3 mm^2. (16)

13. (a) The end block of a post tensioned PSC beam 300 mm wide and 300 mm deep is subjected to a concentric anchorage force of 800 kN by a freyssinet anchorage system of area 11000 mm^2. Design and detail the anchorage reinforcement for the end block. (16)

Or

(b) (i) The end block of a pre stressed concrete beam, rectangular in shape, 100 mm wide and 200 mm deep. The pretressing force of 100 kN is transmitted to concrete through distribution plate, 100 mm wide and 50 mm deep, concentrically located at ends. Using, Guyon's method, compute the position and magnitude of maximum tensile stress and bursting tension for the end block with concentric anchor force of 100 kN. (8)

(ii) Estimate the transmission length at the end of a pre-tensioned beam prestressed by 7 mm diameter wires. Assume the cube strength of concrete at transfer as 42 N/mm^2. (8)

14. (a) A precast pretensioned beam of rectangular section has a breadth of 100 mm and a depth of 200 mm. The beam with an effective span of 5 m is prestressed by tendons with their centroids coinciding with the bottom kern. The initial force in the tendons is 150 kN. The loss of prestress may be assumed to be 15 percent. The beam is incorporated in a composite T – beam by casting a top flange of breadth 400 mm and thickness 40 mm. If the composite beam supports a live load of 8 kN/m^2. Calculate the resultant stresses developed in the precast and insitu concrete assuming the pretensioned beam as:

(i) Unpropped,

(ii) Propped during the casting of the slab.

Assume the same modulus of elasticity for concrete in precast beam and insitu cast slab. (16)

Or

(b) (i) Explain the advantages of using precast prestressed elements along with in-situ concrete. (8)

(ii) Write step by step design procedure for composite construction. (8)

15. (a) A non-cylinder PSC pipe of internal diameter 1000 mm and thickness of cone shell 75 mm is required to convey water at a working pressure of 1.5 N/mm². The length of each pipe is 6 m. The toss ratio is 0.8

(i) Design the circumferential wire winding using 5 mm dia wires stretched 1000/mm²,

(ii) Design the longitudinal pre stressing using 7 mm dia wires tensioned to 1000/mm². The max permissible tensile stress under the critical transient loading not greater than 0.8 where fci = 40 N/mm². (16)

Or

(b) A PSC circular cylindrical tank is required to store 24,500 million litres of water. The permissible compressive stress in concrete at transfer should not exceed 13 N/mm² & min compressive stress under working pressure should not be less than 1 N/mm². The loss ratio is 0.75. HYSD wires of 7 mm dia with an initial stress of 1000 N/mm² are available for winding round the tank. Freyssinet cables of 12 wires of 8 mm dia which are stressed to 1200 N/mm² are available for vertical pre stressing. The cube strength of concrete is 40 N/mm². Design the tank walls. (16)
