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Question Paper Code : 71595

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Seventh Semester

Civil Engineering

CE 6702 – PRESTRESSED CONCRETE STRUCTURES

(Regulations 2013)

Time : Three hours Maximum : 100 marks

(Use Code book IS 1343, IS 3370 (Part I, II, III & IV), IS 784 are permitted)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is the need for the use of high strength concrete and tensile steel in prestressed Concrete?
2. What is meant by pressure line?
3. How will you classify a structure as Type II or Class 2 structure?
4. How to calculate ultimate shear strength of uncracked section in flexure as per IS 1343?
5. Why control of deflection is very essential?
6. Mention the functions of end block.
7. What are the advantages of composite construction in PSC?
8. What is unpropped construction in composite PSC construction?
9. List the different types of prestressing adopted for the walls of a water tank.
10. Define Circular prestressing.

PART B — (5 × 16 = 80 marks)

11. (a) A PSC beam supports an imposed load of 3 kN/mm over a simply supported span of 10 m. The beam has I section with an overall depth of 450 mm. The thickness of flange and web are 75 mm and 100 mm respectively. The flange width of the beam is 200 mm. It is constructed with a concrete having unit weight of 24 kN/m^3. The beam is prestressed with an effective prestressing force of 350 kN at a suitable eccentricity such that the resultant stress at the soffit of the beam at mid span is zero. Find the eccentricity required for the force. Also calculate the stresses at the top of the section.

Or

(b) A prestressed concrete beam of 250 mm wide 400 mm deep and 12 m span is prestressed with 10 wires of 7 mm diameter located at a constant eccentricity of 75 mm and carrying an initial stress of 1200 N/mm^2. The modulus of elasticity of steel and concrete are 210 kN/mm^2 and 38 kN/mm^2 respectively. The relaxation of stress in steel is assumed as 6% of initial stress. Take creep coefficient as 1.8 and slip at anchorage as 1 mm. The shrinkage of concrete is 350×10^{-6} for pretensioning and 160×10^{-6} for post tensioning. Take the frictional coefficient for wave effect as 0.0012 per m. Calculate the % of loss of stress if

(i) the beam is pretensioned; and

(ii) the beam is post tensioned. (16)

12. (a) A post tensioned prestressed beam of rectangular section 300 mm wide is to be designed for an imposed load of 14 kN/m over a span of 10 m. The stress in concrete must not exceed 17 N/mm^2 in compression and 1.4 N/mm^2 in tension at any time. The loss of prestress may be assumed as 18%. Calculate

(i) the minimum possible depth of the beam;

(ii) the minimum prestressing force required for the given section; and

(iii) the minimum eccentricity for the above prestressing force. (16)

Or

(b) Design a post tensioned girder for a span of 22 m to support a live load of 6 kN/m. The M50 grade mix is used for construction with a permissible compressive stress of 35 N/mm^2, and a tensile stress of 1.7 N/mm^2. The permissible stress in concrete shall not exceed 17.5 N/mm^2 and 16.5 N/mm^2 in compression and 1.15 N/mm^2 and zero in tension for both transfer and working loads respectively. Take the modulus of elasticity of concrete as 38 kN/mm^2. The loss of prestress at transfer is 15%. High tensile strength wires of 8 mm diameter and having a characteristic tensile strength of 1600 N/mm^2 should be used for prestressing the member. The modulus of elasticity of wires is 210 kN/mm^2. Design the beam as a class 1 structure and carryout the flexural and shear check alone. (16)

13. (a) A simply supported beam is having dimensions 200 mm × 450 mm is post tensioned with two cables of each having area of 150 mm^2. The first cable is parabolic with an eccentricity of 70 mm at mid span and zero at support whereas the second cable is having straight profile with uniform eccentricity of 70 mm throughout. The initial prestress applied to each cable is 1100 mm^2. The modulus of elasticity of concrete is 40 kN/mm^2.

The length of beam is 7.5 m carry two point loads of 25 kN at 1/3rd of span. Determine

(i) the instantaneous deflection at the centre of span, and

(ii) the deflection at the centre of span after two years, assuming 18% loss in prestress and effective modulus of elasticity to be 3/4th of the short term modulus of elasticity. (16)

Or

(b) (i) Briefly explain about the stress distribution in anchorage zone of a post tensioned prestressed member. (8)

(ii) Write short note on: Magnel's method; Guyon's Method; IS Code Provisions. (8)

14. (a) A precast pretensioned beam of 150 mm wide and 300 mm deep is prestressed with tendons with their centroids coinciding with the bottom kern. The length of beam is 9 m and prestressing force applied to the tendons is 400 kN with a loss of prestress of 15%. A cast in situ slab of size 500 mm × 50 mm is constructed over the pretensioned beam to form the composite construction. If the composite beam supports a live load of 3 kN/m^2, calculate the resultant stresses developed in the precast and in situ cast concrete by assuming the pretensioned beam as: (i) Unpropped; and (ii) Propped during the construction. The modulus of elasticity of concrete is 38 kN/mm^2 for both precast and a cast-in-situ elements. The unit weight of concrete is 24 kN/m^3. (16)

Or

(b) A continuous prestressed concrete beam ABC (AB = BC = 8 m) has a uniform rectangular section of width 100 mm and depth 250 mm. The cable carrying an effective prestressing force of 300 kN is parallel to the axis of the beam and located at 75 mm from the soffit. Take density of concrete as 24 kN/m^3.

(i) determine the secondary and resultant moment at central support B;

(ii) if the beam supports an imposed load of 1.2 kN/m, calculate the resultant stresses at top and bottom of the beam at B; and

(iii) locate the resultant line of thrust through beam AB. (16)

15. (a) (i) Define Partial Prestressing. Explain the merits and demerits of partial prestressing. (8)

(ii) Briefly explain the various steps involved in designing of a prestressed concrete circular pipes. (8)

Or

(b) Design a free edge water tank with base hinged of diameter of 36 m to store water to a depth of 6 m. The permissible compressive stress in concrete at transfer is 15 N/mm^2 and minimum compressive stress under working pressure is 1.2 N/mm^2. The loss of prestress is 12 %. For circumferential winding use 6 mm diameter wires with an initial prestress of 1200 N/mm^2. The 8 mm diameter Freyessinet cables with initial prestress of 1500 N/mm^2 are available for vertical prestressing. M45 grade concrete is used for the construction. (16)