Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 21266

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Seventh Semester

Civil Engineering

CE 2404/CE 1402/CE 74/10111 CE 704 — PRESTRESSED CONCRETE STRUCTURES

(Regulations 2008/2010)

(Common to PTCE 2404/10111 CE 704 – Prestressed Concrete Structures for B.E. (Part-Time) Sixth Semester Civil Engineering – Regulations 2009/2010)

Time : Three hours Maximum : 100 marks

Use of IS : 1343 – 1980, 3370 (Part 4) – 1967 and 784 code is permitted.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Why high strength steel is essential for prestressed concrete?

2. List down the factors that influence the deflection of prestressed concrete members.

3. What are the assumptions made in the strain compatibility method?

4. What is an end block?

5. What are the different types of joints used between the walls and floor slab of prestressed concrete tanks?

6. How circular prestressing is achieved?

7. What is meant by propped construction?

8. How will you achieve the composite action in composite construction?

9. Sketch the typical cross section of pre-tensioned prestressed concrete bridge deck.

10. List the advantages of prestressed concrete bridges.

PART B — (5 × 16 = 80 marks)

11. (a) Explain the systems and methods of prestressing with neat sketches. (16)

Or

(b) A prestressed concrete beam of span 8 m having a rectangular section of 150 mm × 300 mm. the beam is prestressed by a parabolic cable having an eccentricity of 75 mm below the centroidal axis at the centre of the span and an eccentricity of 25 mm above the centroidal axis at the support sections. The initial force in the cable is 350 kN. The beam supports three concentrated loads of 10 kN each at intervals of 2 m. $E_c = 38$ kN/mm^2.

(i) Neglecting losses of prestress, estimate the short term deflection due to (prestress + self weight)

(ii) Allowing for 20% loss in prestress, estimate long term deflection under (prestress + self weight + live load), assume creep co-efficient as 1.80. (16)

12. (a) A post-tensioned bridge girder with unbounded tendons is of box section of overall dimensions 1200 mm wide and 1800 mm deep, with wall thickness of 150 mm. The high tensile steel has an area of 4000 mm^2 and is located at an effective depth of 1600 mm. The effective prestress in steel after all losses is 1000 N/mm^2 and the effective span of the girder is 24 m. If f_{ck} = 40 N/mm^2 and f_p = 1600 N/mm^2, estimate the ultimate flexural strength of the section. (16)

Or

(b) The end block of a post-tensioned prestressed concrete beam of 300 mm wide and 300 mm deep is subjected to a concentric anchorage force of 832.8 kN by a Freyssinet anchorage of area 11720 mm^2. Design and detail the anchorage reinforcement for the end block. (16)

13. (a) A cylindrical prestressed concrete water tank of internal diameter 30 m is required to store water over a depth of 7.5 m. The permissible compressive stress in concrete at transfer is 13 N/mm^2 and the minimum compressive stress under pressure is 1. The loss ratio is 0.75. Wires of 5 mm diameter with an initial stress of 1000 N/mm^2 are available for circumferential winding and Freyssinet cables made up of 12 wires of 8 mm diameter stressed to 1200 N/mm^2 are to be used for vertical prestressing. Design the tank walls assume the base as fixed. Adopt M40 grade concrete. (16)

Or

(b) Design a non-cylinder prestressed concrete pipe of internal diameter 500 mm to withstand a working pressure of 1 N/mm^2. High-tensile wires of 2 mm diameter stressed to 1200 N/mm^2 at transfer are available for use. Permissible maximum and minimum stresses in concrete at transfer and working loads are 13.5 N/mm^2 and 0.8 N/mm^2 (compression) respectively. Loss ratio = 0.8, E_s = 210 kN/mm^2 and E_c = 35 kN/mm^2. Calculate, (i) the minimum thickness of concrete for the pipe, (ii) number of turns of wire per metre length of the pipe, (iii) the test pressure required to produce a tensile stress of 0.7 N/mm^2 in the concrete when applied immediately after tensioning, and (iv) the winding stress in the steel. (16)

14. (a) A rectangular pre tensioned concrete beam has a breadth of 100 mm and depth of 230 mm, and the prestress after loss is 12 N/mm^2 at the soffit and zero at the top. The beam is incorporated in a composite T-beam by casting a top flange of breadth 300 mm and depth 50 mm. Calculate the maximum uniformly distributed live load that can be supported on a simply supported span of 4.5 m, without any tensile stresses occurring, if

(i) The slab is externally supported while casting

(ii) The pre-tensioned beam supports the weight of the slab while casting. (16)

Or

(b) A composite T-section girder consists of a pre-tensioned rectangular beam, 120 mm wide and 240 mm deep, with an in situ cast slab, 360 mm wide and 60 mm deep, laid over the beam. The pretensioned beam contains 8 wires of 5 mm diameter, located 30 mm from the soffit. The tensile strength of the high tensile steel is 1600 N/mm^2 and the cube strength of concrete in the top slab is 20 N/mm^2.

(i) Estimate the flexural strength of the composite section.

(ii) Calculate the ultimate shear which will cause separation of the two parts of the girder if the contact surface is roughened to withstand a shear stress of 1 N/mm^2. (16)

15. (a) Discuss the design procedure involved in the design of pre-tensioned prestressed concrete bridge decks. (16)

Or

(b) Design a interior slab panel for the post-tensioned prestressed concrete T-beam slab bridge deck for a National Highway crossing to suit the following data

Effective span = 30 m

Width of road = 7.5 m

Kerbs = 600 mm on each side

Footpath = 1.5 m wide on each side

Thickness of wearing coat = 80 mm

Live load = IRC class AA tracked vehicle

Loss ratio = 0.85

Spacings of cross girder = 5 m

Adopt M20 grade concrete for the deck slab and Fe415 grade HYSD bars, 12 high tensile strands of 7 mm diameter stressed to 1200 N/mm^2. (16)