Reg. No. :

**K 4140**

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2009.

Eighth Semester

Civil Engineering

CE 1030 — PRE-STRESSED CONCRETE STRUCTURES

(Common to B.E. (Part-Time) – Seventh Semester – Regulation 2005)

(Regulation 2004)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State the reasons for which high tensile concrete is necessary in prestressed concrete construction.

2. List any four types of post tensioning losses.

3. What are the stages of loading to be considered in design of prestressed concrete section for flexure?

4. What is the zone of transmission in end block of prestressed concrete structures?

5. List any two advantages in partial prestressing.

6. What are the needs of prestressing in compression members?

7. What do you mean by unpropped constructions with reference to composite prestressed concrete structures.

8. Draw any four types of composite pre-stressed concrete sections.

9. State any four advantages of prestressed concrete bridges.

10. Draw the cross section of pretensioned and post tensioned prestressed concrete bridge decks.

PART B — (5 × 16 = 80 marks)

11. (a) A PSC beam supports a live load of 4 kN/m over a simply supported span of 8 m. The beam has an I section with a overall depth of 400 mm. The thicknesses of flange and web are 60 mm and 80 mm respectively. The width of the flange is 200 mm. The beam is to be prestressed by an effective prestressing force of 235 kN at a suitable eccentricity such that the resultant stress at the soffit of the beam at the centre of the span is zero.

(i) Find the eccentricity required for the force.

(ii) If the tendon is concentric, what should be the magnitude of the prestressing force for the resultant stress to be zero at the bottom fibre of the central span section?

Or

(b) A PSC beam of breath 240 mm and depth 300 mm is simply supported on an effective span of 6.0 m. It is prestressed by a parabolic cable with an eccentricity of 75 mm below the centroid at the mid span section and 45 mm above centroid at the support section. Prestressing force is 480 kN. Calculate the initial midspan deflection. Assume the unit weight of concrete as 25 $kN/m^3$ and modulus of elasticity concrete as $2.5\times10^4\ N/mm^2$.

12. (a) The cross-section of a symmetrical I-section prestressed beam is 300 mm by 750 mm (overall), with flanges and web 100 mm thick. The beam is post-tensioned by cables containing 48 wires of 5 mm diameter high-tensile steel wires at an eccentricity of 250 mm. The 28-day strength of concrete in compressing is 40 $N/mm^2$ and the ultimate tensile strength of wires is 1700 $N/mm^2$. Assuming that the grouting of the tendons is 100 percent effective, determine the ultimate moment of the section as per IS 1343.

Or

(b) The end block of a prestressed concrete beam, rectangular in section, is 100 mm wide and 200 mm deep. The prestressing force of 100 kN is transmitted to concrete by a distribution plate, 100 mm wide and 50 mm deep, concentrically located at the ends. Calculate the position and magnitude of the maximum tensile stress on the horizontal, section through the centre and edge of the anchor plate. Compute the bursting tension on these horizontal planes.

13. (a) Design a prestressed concrete pipe of internal diameter 900 mm to withstand and internal pressure of 0.8 $N/mm^2$. The maximum permissible compressive stress in concrete is 18 $N/mm^2$ and no tensile stress is to be permitted. Modular ratio between steel and concrete is 5.8. Adopt 5 mm diameter high tensile wires which can be stretched up to 1100 $N/mm^2$. Expected loss of prestress is 25%

Or

(b) Design an electric pole 12 meters high to support wires at its top at which can exert a. reversible horizontal force of 3 kN. The tendons are initially stressed to 1000 $N/mm^2$ and the loss of stress due to shrinkage and creep is 15%. Maximum compressive stress in concrete shall be limited to 12 $N/mm^2$. Assume the following modular ratio = 6, angle of repose = 30degrees and the specific weight of soil as 18 $kN/m^3$.

14. (a) A precast pre-tensioned beam of rectangular section has a breadth of 100 mm and a depth of 200 mm. The beam, with an effective span of 5m, 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 in situ cast concrete assuming the pre- tensioned beam as :

(i) unpropped, and

(ii) propped during the casting of the slab. Assume the same modulus of elasticity for concrete in precast beam and in situ cast slab.

Or

(b) A composite T girder of span 5 m is made up of a pre-tensioned rib, 100 mm wide by 200 mm deep, with an in situ cast slab, 400 mm wide and 400 mm thick. The rib is prestressed by a straight cable having an eccentricity of 33.33 mm and carrying an initial force of 150 kN. The loss of prestress may be assumed to be 15 percent. Check the composite T-beam for the limit state of deflection if it supports an imposed load of 3.2 kN/m.for :

(i) unpropped construction, and

(ii) propped construction. Assume a modulus of elasticity of 35 $N/mm^2$ for both precast and in situ cast elements.

15. (a) A composite bridge deck is made up of an in situ cast slab 120 mm thick and. symmetrical I-sections of precast pre-tensioned beams having flange width and thickness of 200 mm and 110 mm respectively. Thickness of web 75 mm. Overall depth of I-section = 500 mm. Spacings, of I-beams = 750 mm centre to centre. The modulus of elasticity of in situ slab concrete is 30 $kN/mm^2$. Estimate the stresses developed in the composite member due to a differential shrinkage $100 \times 10^{-6}$ between the precast and cast in situ elements

Or

(b) Write technical notes on

(i) Pre-stressed PSC bridge decks. (5)

(ii) Post-stressed PSC bridge decks. (5)

(iii) Forces to be considered in PSC bridges. (6)