

W 2725

M.E. DEGREE EXAMINATION, JANUARY 2007.

Elective

Structural Engineering

ST 1632 — PRESTRESSED CONCRETE

(Regulation 2005)

Time : Three hours

Maximum : 100 marks

Use of IS 1343 and IS 456 is permitted.

Use M 40 grade of concrete and high tensile steel of ultimate strength 1500 N/mm^2 for all design problems.

Assume loss of prestress as 20%.

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. Write the assumptions made in the analysis of Prestressed concrete members.
2. Compare the loss of prestress due to elastic shortening in pretensioned and post tensioned members.
3. What are the five loading stages to be investigated in elastic design?
4. What are the three classes of prestressed concrete structures?
5. What are the two factors which reduce the diagonal tensile stress in prestressed concrete?
6. Differentiate between spalling tension and bursting tension.
7. State Guyon's theorem of 'Linear Transformation'.
8. Define concordant cable.
9. What is meant by composite construction in prestressed concrete?
10. What are the merits and demerits of partial prestressing?

PART B — (5 × 16 = 80 marks)

11. (a) (i) What are the various post tensioning anchoring systems? (4)
- (ii) A prestressed concrete pretensioned beam of section 230 mm × 300 mm is prestressed with a parabolic cable of area 300 sq.mm located at an eccentricity of 50 mm above the CGS at supports and 75 mm below the CGS at mid span. The beam is stressed with an initial prestress of 1050 N/mm² transferred at 28th day strength of concrete. Span of the beam is 10 m. Calculate the loss of prestress. Take $E_s = 2 \times 10^5$ N/mm². Relaxation loss is 4%. (12)

Or

- (b) (i) Derive the expression for loss of prestress due to friction. (6)
- (ii) A prestressed beam of section 300 mm × 600 mm has the span of 10 m. At midspan, a cable placed at 200 mm above the soffit, carries an initial prestress of 1200 kN. Find the ultimate moment and uniformly distributed load it can carry. (10)
12. (a) Design a prestressed concrete beam using Lin's method for $M_T = 500$ kNm and $M_D = 60$ kNm by
- (i) Considering tension. (8)
- (ii) Considering no tension. (8)

Or

- (b) Design a post tensioned prestressed concrete beam of symmetrical I section to carry 12 kN/m over a span of 12 m. Adopt Magnel's graphical method. (16)
13. (a) A prestressed concrete beam of section 200 mm × 600 mm is prestressed by a parabolic cable located at an eccentricity of 100 mm at mid span and zero at supports. If the beam has the span of 10 m and carries a uniformly distributed load of 5 kN/m, find the effective force required for zero shear stress at the support section. For this condition calculate the principal stresses. (16)

Or

- (b) A Fressinet anchorage cone of diameter 125 mm, carrying 12 wires of 7 mm diameter stressed to 950 N/mm², is placed concentrically in the web of I-section beam at the ends. The thickness of web is 225 mm. Design the reinforcement for the end block. (16)

14. (a) A two span prestressed concrete continuous beam ABC ($AB = BC = 10$ m) is of section 200 mm \times 500 mm. The prestressing cable is concentric at end supports and 100 mm eccentricity towards soffit at mid span and 200 mm towards the top of the beam at mid support B. The effective force in the cable is 500 kN.

- (i) Check whether the cable is concordant
- (ii) Locate the pressure line in the beam when live load of 5 kN/m acting. (16)

Or

(b) A prestressed concrete two hinged portal frame has column $AB = CD = 4.8$ m and transom $BC = 9$ m. The members have uniform cross section of 125 mm \times 300 mm throughout. The columns are prestressed by a straight cable with an eccentricity of 75 mm towards the outside of the frame at B and C with zero eccentricity at the hinges A and D. The transom is prestressed by a straight cable having an eccentricity of 100 mm below centroid at the centre of BC and 75 mm above the centroid at B and C if all the cables are tensioned in a force of 225 kN, calculate

- (i) the secondary moment developed at B
- (ii) the resultant stress distribution at B and centre BC. (16)

15. (a) A prestressed concrete pipe of 1.2 m diameter and a core thickness of 75 mm is required to withstand a service pressure intensity of 1.5 N/mm². Calculate the pitch of 5 mm diameter wire if the initial stress is 1000 N/mm². If the direct tensile strength of concrete is 2.5 N/mm², calculate the load factor against cracking. (16)

Or

- (b) (i) Explain the terms 'propped construction' and 'unpropped construction' in composite construction. (4)
- (ii) An electric pole 12 m high above ground supports a weight of 2 kN due to wires and has to withstand a reversible wind load of 3 kN acting at its top. Design the pole if it is pretensioned. (12)