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

W 6454

M.E. DEGREE EXAMINATION, JANUARY 2008.

Elective

Structural Engineering

ST 1632 — PRESTRESSED CONCRETE

(Regulation 2005)

Time : Three hours Maximum : 100 marks

Use of IS 1343, IS 3370 (Pt I, III and IV), IS 784 and IS 3935 is permitted.

Assume suitable data required if any.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Why did the early attempts in prestressing using ordinary mild steel fail?

2. List the various types of tensioning devices used in prestressed concrete.

3. What is 'Effective reinforcement Ratio'?

4. Under what situations and types of structures would you recommend the use of unbonded tendons?

5. What is the effect of torsion on prestressed concrete sections?

6. Sketch the typical tensile stress distribution in an end block of a post-tenstional beam with a single anchorage.

7. What are cap cables? Where are they used?

8. What is 'Linear Transformation'?

9. Distinguish with sketches the difference between cylinder and non-cylinder types of prestressed concrete pipes.

10. State the importance of differential shrinkage in composite construction.

PART B — (5 × 16 = 80 marks)

11. (a) A pretensioned beam of rectangular section 300 mm wide and 700 mm deep is stressed by 1600 mm^2 of high-tensile steel located at an effective depth of 600 mm. The effective stress in the tendons after all losses is 800 N/mm^2. The beam is reinforced with supplementary reinforcement consisting of 4 bars of 25 mm diameter of Fe 500 grade steel located 100 mm from the soffit. Estimate the ultimate flexural strength of the section according to Indian code regulations. Assume the characteristic cube strength of concrete as 40 N/mm^2

Or

(b) A post tensioned PSC beam, 200 mm wide and 300 mm deep is prestressed with wires (area = 320 mm^2) located at a constant eccentricity of 50 mm and carrying an initial stress of 1000 N/mm^2. The span of the beam is 10 m. Calculate the percentage loss of prestress using the following data.

E_S = 210 KN/mm^2, E_C = 35 KN/mm^2.

Relaxation of steel stress = 5% of the initial stress shrinkage of concrete = 200×10^{-6}.

Creep coefficient = 1.6, slip at anchorage = 1mm.

Frictional coefficient for wave effect = 0.0015/m.

12. (a) A PSC beam of rectangular section 150 mm wide and 300 mm deep is to be designed for a super imposed load of 2 KN/m at service state. Over a span of 3 m. The member is to be of type I. Loss ratio = 0.8. Determine the minimum prestressing force and the corresponding eccentricity.

Or

(b) A simply supported PSC beam of rectangular section with effective span 10 m is to carry a central concentrated load of 100 KN at service state. If the maximum permisible stresses are 14 N/mm^2 in compression and zero in tension and loss ratio is 0.8, design the mid span section (cross section dimension, prestressing force and its eccentricity) using stress range approach.

(a) A PSC beam simply supported with effective span 15 m with a rectangular cross section 200 mm × 300 mm deep is prestressed by a parabolic cable with zero eccentricity at support and 100 mm at mid span. Effective prestressing force is 150 KN. The beam carries a live load of 3 KN/m. Design the shear reinforcement at 1/6 of span from left support.

Or

(b) The end block of a prestressed concrete beam 500 mm wide and 1000 mm deep contains 6 freyssinet cables, each carrying a force of 260 KN anchored through 100 mm diameter anchorages, which are spaced 150 mm apart at the end of the beam. Calculate the maximum tensile stress and the bursting tension. Design the reinforcement for the end block.

14. (a) A two span continuous beam ABC (AB = BC = 10 m) is of rectangular section 200 mm wide and 500 mm deep. The beam is prestressed by a parabolic cable, concentric at the end supports and having an eccentricity of 100 mm towards the soffit of the beam at centre of spans and 200 mm towards the top of beam at mid support B. The effective force in the cable is 500 KN. Show that the cable is concordant and locate the pressure line in the beam when it supports an imposed load of 5.6 KN/m, in addition to its self weight.

Or

(b) A portal frame is fixed at column bases, has column heights 4 m each and beam length 8 m. Both columns and beam have the same cross section 100 mm × 200 mm deep. The beam carries a prestressing force of 200 KN. Find the ratio of prestressing force shared by the column and beam. Also calculate the secondary moment developed in the portal frame.

15. (a) A prestressed concrete pipe of 1.2 m diameter and a core thickness of 75 mm is required to with stand a service pressure intensity of 1.2 N/mm^2. Estimate the pitch of a 5 mm diameter high tensile wire winding if the initial stress is limited to 1000 N/mm^2. Permissible stresses in concrete are 10 N/mm^2 in compression and zero in tension. The loss ratio is 0.8. If the direct tensile strength of concrete is 2.5 N/mm^2, estimate the load factor against cracking.

Or

(b) A composite T-beam is made up of a pre-tensioned rib 100 mm wide and 200 mm deep, and a cast in situ slab 400 mm wide and 40 mm thick having a modulus of elasticity of 28 KN/mm^2. If the differential shrinkage is 100 × 10^{-6} units, determine the shrinkage stresses developed in the precast and cast in situ Units.
