| G 6516 |

M.E. DEGREE EXAMINATION, MAY/JUNE 2007.

Elective

Structural Engineering

ST 1632 — PRESTRESSED CONCRETE

(Regulation 2005)

Time : Three hours　　　　　　　　　　　　　Maximum : 100 marks

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

Assume suitable data required if any.

Use M 40 concrete unless otherwise specified.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is load balancing concept?

2. Give the stress-strain diagram of Fe 415 RCC reinforcement and prestressing wire on the same figure, bringing out the nature of the diagram and the range of their ultimate stress values.

3. What do you mean by a limit state design?

4. Sketch the permissible cable zone for Type II beams indicating the salient features.

5. Give the lines of transfer of prestressing force over an end block of a post tensioned member.

6. Indicate a shear-flexure crack and web shear crack in a beam using a sketch.

7. What is the advantage of a concordant cable in a continuous beam?

8. Why are tertiary moments caused in a prestressed frame?

9. Why is longitudinal prestressing done to PSC pipes?

10. When is prestressing advantageous to columns?

PART B — (5 × 16 = 80 marks)

11. (a) A rectangular concrete beam of cross section 200 mm × 400 mm deep is prestressed by 12 wires of 7 mm diameter located at 70 mm from the soffit and 2 wires of 7 mm diameter 30 mm from top. The effective prestress in steel is 800 N/mm². The beam has an effective span of 6 m and supports a super imposed load of 10 kN/m. Locate the thrust line and hence calculate the maximum stresses in concrete at mid span section at final condition.

Or

(b) A bonded prestressed concrete beam with rectangular cross section of dimension 300 mm × 600 mm deep is prestressed by high tensile steel with area 1500 mm² at an effective cover of 100 mm. The effective stress in the tendon is 800 N/mm² and characteristic strength of the tendon material is 1500 N/mm². The beam is reinforced with complementary reinforcement of 3 numbers of 20 mm diameter Fe 415 bars at an effective cover of 50 mm. Calculate the ultimate flexural strength of the section from first principles.

12. (a) A PSC beam of rectangular section 100 mm wide and 200 mm deep is to be designed for a super imposed load of 1.5 kN/m at service state, over a span of 3 m. The member is to be 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 75 kN at service state. If the maximum permissible stresses are 14 N/mm² 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.

13. (a) A PSC beam simply supported with effective span 12 m with a rectangular cross section 150 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 200 kN. The beam carries a live load of 4 kN/m. Design the support section for shear using IS provisions.

Or

(b) The end block of a PSC member is 150 mm wide by 300 mm deep, transferring a prestressing force of 200 kN through an anchor plate 100 mm wide × 80 mm deep at an eccentricity of 50 mm. Design the end block. Transfer takes place after 28 days.

14. (a) A two span continuous PSC beam with 10 m effective span each has a rectangular cross section 100 mm × 300 mm deep uniform through out. The profile of the centre of gravity of steel varies linearly with an eccentricity of 50 mm towards soffit at the end supports to 50 mm towards the top at mid support. The prestressing force is 350 kN. Calculate the secondary moment at mid support section and hence determine the concordancy of the cable profile.

Or

(b) A portal frame is fixed at column bases, has column heights 4 m each and transom length 8 m. Both columns and transom have the same cross section 100 mm × 250 mm deep. The transom carries a prestressing force of 150 kN. Find the ratio of prestressing force shared by the column and transom. Also calculate the tertiary moment developed in the portal frame.

15. (a) Design values of a cylindrical PSC water tank are hoop tension 720 kN per metre height of the wall and a vertical moment of 70 kNm per metre length along the circumference of the tank. 5 mm diameter HTS wires at an initial stress of 1000 N/mm² and Freyssinet cables 12 numbers of 7 mm diameter stressed to 1200 N/mm² are available for circumferentail and vertical stressing respectively. Design the thickness of the wall, spacing of circumferential wire winding and spacing of vertical cables. Loss ratio = 0.8.

Or

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(b) A rectangular composite beam (precast PSC and insitu concrete) of gross dimension 500 mm × 750 mm deep, consists of an inverted T (PSC) with flange 500 mm width × 250 mm thick and web 150 mm × 400 mm deep. M 40 concrete for precast and M 30 for insitu concrete are used. The composite section is subjected to an all inclusive total moment of 600 kN-m. Prestressing force and eccentricity in precast section is 1800 kN and 110 mm respectively. Determine the maximum stress at the bottom fibre of the composite beam.