M.E DEGREE EXAMINATIONS: JUNE 2013

Second Semester

STRUCTURAL ENGINEERING

SEE562: Pre-stressed Concrete

(Use of IS:1343, IS:3370 Part-1,2 & 4 are permitted)

Time: Three Hours   **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 2 = 20 Marks)

1. What is the minimum concrete strength requirements prescribed for pre-stressed concrete members in IS:1343 code?

2. What are the various methods by which pre-compression are imparted to concrete?

3. A pre-tensioned pre-stressed concrete beam having a rectangular section, 150 mm wide and 350 mm deep, has an effective cover of 50 mm. If f_{ck}=40 N/mm^2, f_p=1600 N/mm^2, and the area of pre-stressing steel A_p=461 mm^2, calculate the ultimate flexural strength of the section using IS: 1343 code provisions.

4. What are the various types of flexural failures encountered in pre-stressed concrete members?

5. Draw a neat sketch showing the forces on the end block of a post-tensioned concrete member.

6. What are the various methods used for the investigation of anchorage zone stresses?

7. What are the advantages of continuity in pre-stressed concrete construction?

8. What is meant by a thrust line?

9. Draw typical cross-sections of bridge decks with different types of composite pre-stressed precast units.

10. What is the significance of differential shrinkage in composite (precast pre-stressed units and in-situ concrete) construction?

PART B (5 x 16 = 80 Marks)

11. a)   a) A concrete beam with a section 90 mm wide and 180 mm deep is pre-stressed by two wires of 7 mm diameter initially stressed to 920 N/mm^2. The wires are located in a parabolic profile with an eccentricity of 36.8 mm at the centre span (3m) and concentric at the supports: the beam supports two concentrated live loads of 7 kN each spaced 1m apart. The modulus of elasticity of concrete is 30.9 kN/mm^2. Compute the initial deflection of the beam at the centre of span under (prestress + self-weight) and the final deflection, including live loads, assuming 15 per cent loss in pre-stress due to various causes. Compare these

deflections with the limits prescribed in the IS: 1343. Assume creep coefficient as 1.6.

(OR)

b) A pre-tensioned beam, 200 mm wide and 300 mm deep, is pre-stressed by 10 wires of 7mm diameter initially stressed to 1200 N/mm^2, with their centroids located 100 mm from the soffit. Find the maximum stress in concrete immediately after transfer, allowing only for elastic shortening of concrete.

If the concrete undergoes a further shortening due to creep and shrinkage while there is a relaxation of 5 per cent of steel stress, estimate the final percentage loss of stress in the wires using the Indian standard code (IS: 1343-1980) regulations and the following data: E_s=210 kN/mm^2; E_c=5700$(f_{cu})^{1/2}$; f_{cu}=42 N/mm^2; creep coefficient = 1.6; total residual shrinkage strain = 30,000.

12. a) The cross-sectional area of an unsymmetrical pre-stressed I beam designed to carry a central point load on a simply supported span of 15m is 194000 mm^2. The second moment of area is equal to 197 x 10^8 mm^4. The overall depth of the section is 900 mm, with the centroid located at 520 mm from the soffit. The maximum permissible stresses are 14 N/mm^2 in compression and zero in tension. The loss ratio is 0.8. Calculate:

    i) The breadth of a rectangular section, having the same depth designed for the same loading. (8)

    ii) The maximum eccentricities of the cable at mid span for the two sections. (8)

(OR)

b) The cross-section of a symmetrical I-section pre-stressed 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-days strength of concrete in compression 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 per cent effective, determine the moment capacity of the section. (Adopt IS: 1343 provisions).

13. a) A post tensioned bonded pre-stressed concrete beam of rectangular cross-section, 400 mm wide by 550 mm deep, is subjected to a service load bending moment of 166.6 kNm, torsional moment of 46.6 kNm and shear force of 66.6 kN. The section has an effective pre-stressing force, determined from service

load requirements, of magnitude 500 kN at an eccentricity of 150 mm, provided by 5 numbers of 12.5 mm stress-relieved strands of cross sectional area 506 mm^2 with an ultimate tensile strength of 1820 N/mm^2. If the cube strength of concrete is 40 N/mm^2, design suitable transverse reinforcements in the beam using IS: 1343 code recommendations based on the skew bending approach.

(OR)

b) The end block of a post-tensioned pre-stressed member is 550 mm wide and 550 mm deep. Four cables, each made up of 7 wires of 12 mm diameter strands and carrying a force of 1000 kN, are anchored by plate anchorages, 150 mm by 150 mm, located with their centers at 125 mm from the edges of the end block. The cable duct is of 50 mm diameter. The 28-day cube strength of concrete f_{cu} is 45 N/mm^2. The cube strength of the concrete at transfer f_{ci} is 25 N/mm^2. Permissible bearing stresses behind anchorages should conform with IS: 1343. The characteristic yield stress in mild steel anchorage reinforcement is 260 N/mm^2. Determine suitable anchorages for the end block.

14. a) a) A continuous beam ABC (AB=BC=10m) has a rectangular section 400 mm wide by 650 mm deep. The beam is pre-stressed by a concordant cable having a cross-sectional area of 1200 mm^2, located 50 mm from the soffit at mid-span points and 50 mm from the top of beam at B. If the beam supports two concentrated loads of 200 kN each at mid-span points, determine the load factor against collapse assuming:

    i)   elastic distribution of moments   (8)

    ii)   complete redistribution of moments   (8)

(OR)

b) Design a pre-stressed concrete beam continuous over two equal spans of 9 m to support live loads of 30 kN each at the centre of span. The loads may be applied independently or jointly. Permissible stress being zero in tension and 15 N/mm^2 in compression. Loss ratio = 0.85. Determine a concordant profile and show it on an elevation of the beam. Allowing for a minimum cover of 100 mm, sketch a suitable transformed profile to reduce the slope of the tendons at the central support to a minimum. Check for the limit states of serviceability and collapse.

15. a) i) What are the various types and cross-sectional shapes of pre-stressed concrete piles?   (8)

    ii)   List the advantages of pre-stressed concrete piles.   (8)

(OR)

b)   A cylindrical pre-stressed concrete water tank of internal diameter 30m is required to store water over a depth of 7.5m. The permissible compressive stress in concrete at transfer is 13 N/mm^2 and the minimum compressive stress under working pressure is 1 N/mm^2. The loss ratio is 0.75. Wires of 5mm diameter with an initial stress of 1000 N/mm^2 are available for circumferential winding and Freyssinet cables made up of 12 wires of 8mm diameter stressed to 1200 N/mm^2 are to be used for vertical pre-stressing. Design the tank walls assuming the base as fixed. The cube strength of concrete is 40 N/mm^2.

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