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Question Paper Code: 92062

M.E. DEGREE EXAMINATION, MAY 2014.

Elective

Structural Engineering

01PSE510 - PRESTRESSED CONCRETE STRUCTURES

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

[Use of IS 1343 and IS 3370 (Part - III and Part - IV) are permitted.]

Answer ALL Questions.

PART A - (10 x 2 = 20 Marks)

1. What is Tendon?
2. What is cracking load?
3. What is the effect of torsion on prestressed concrete sections?
4. List out the assumption made in strain compatibility methods.
5. What are cap cables? Where are they used?
6. What are concordant cable profile?
7. What is the effect of circumferential wire winding on longitudinal stresses?
8. What are the advantages of prestressed concrete poles?
9. What are the advantages of using composite construction with prestressed and *in situ* concrete in structural members?
10. What is differential shrinkage?

PART - B (5 x 14 = 70 Marks)

11. (a) A prestressed concrete beam of section 120 mm wide by 300 mm deep is used over an effective span of 6 m to support a uniformly distributed load of 4 kN/m, which includes the self - weight of the beam. The beam is prestressed by a straight cable carrying a force of 180 kN and located at an eccentricity of 50 mm. Determine the location of the thrust - line in the beam and plot its position at quarter and central span sections. (14)

Or

(b) A prestressed concrete beam with a cross - section 120 mm wide and 300 mm deep is used to support a uniformly distributed live load of 3 kN/m over an effective span of 6 m. The beam is prestressed by a straight cable carrying an effective prestressing force of 180 kN at a constant eccentricity of 50 mm. Given Ec = 38 kN/mm^2, the modulus of rupture = 5 N/mm^2, area of thecable = 200 mm^2 and modular ratio = 6, estimate the deflection of the beam at the following stages:

(i) Working load
(ii) cracking load
(iii) 1.5 times the cracking load. (14)

12. (a) A bonded post - tensioned beam of rectangular section 400 mm wide by 1200 mm deep is stressed by 6000 mm^2 of high - tensile steel at an effective depth of 1000 mm. Given f_{pu} = 1600 N/mm^2, f_{ck} = 40 N/mm^2, f'_c = 32 N/mm^2, estimate the ultimate flexural strength of the section using the strain compatibility method. Assume E_s = 210 kN/mm^2 . (14)

Or

(b) The end block of a prestressed beam 500 mm wide and 1050 mm deep contains 6 Freyssinet cables, each carrying a force of 266 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 and design the reinforcement for the end block using Rowe's method. Adopt yield stress in mild steel reinforcement as 260 N/mm^2. (14)

13. (a) A continuous concrete beam ABC (AB = BC = 10 m) has a uniform rectangular cross - section, 100 mm wide and 300 mm deep. A cable carrying an effective prestressing force of 360 kN varies linearly with an eccentricity of 50 mm towards the soffit at the end supports to 50 mm towards the top of beam at mid support B. Determine the resultant moment at B due to pressing only. If the eccentricity of the cable at B is +25 mm, show that cable is concordant. (14)

Or

(b) Design a two - pinned portal frame 7.5 m high with a span of 12 m to support a uniformly distributed live load of 15 kN/m on the beam with stress limits to 14 N/mm^2 compression and zero tension. Assume that the transom and legs have the same section. (14)

14. (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 1.2 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 12.5 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. (14)

Or

(b) A multi - storyed building is to be supported on prestressed concrete pile foundations. The piles have an effective height of 5 m and they have to support a total axial service load of 1100 kN together with a moment of 37.5 kN m. Design a suitable pile to support these loads, assuming a uniform load factor of 2 against collapse. The pile is to be designed to be lifted at any point along its length for installation. (14)

15. (a) A rectangular pre - tensioned concrete beam has a breadth of 100 mm and depth of 230 mm and the prestress after all losses have occurred is 12 N/mm^2 at the soffit and zero at the top. The beam is incorporated in a composite T-beam by casting a top flange of breadth 300 mm and depth 50 mm. Calculate the maximum uniformly distributed live load that can be supported on a simply supported span of 4.5 m, without any tensile stresses occurring, if

(i)The slab is externally supported while casting, and

(ii)The pre-tensioned beam supports the weight of the slab while casting.

(14)

Or

(b) A composite tee beam is made up of a pretensioned rib 300 mm thick and 1000 mm deep and a cast in situ slab of 200 mm thickness and 1500 mm width. The modulus of elasticity of cast *in situ* slab is 28 kN/mm^2. If the differential shrinkage is 0.0001 units, estimate the shrinkage stresses developed in precast and cast *in situ* units (14)

PART - C (1 x 10 = 10 Marks)

16. (a) Briefly explain the various steps involved in the design of continuous prestressed concrete beams and portal frames. (10)

Or

(b) Bring out the advantages of prestressing long span folded plates. Sketch the typical cross section of folded plates showing the distribution of tendons in the section. (10)