APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
FIRST SEMESTER M.TECH DEGREE EXAMINATION
Civil Engineering
(Structural Engineering and Construction Management)
04CE6415 - PRESTRESSED CONCRETE STRUCTURES

Time: 3 hrs Max. Marks: 60

IS: 456, IS:1343, IS: 3370(Part IV) may be permitted

PART A

(Answer all questions. Each question carry 3 marks).

1. Distinguish between cable line and pressure line with sketches in atypical prestressed concrete beam.
2. Write the equation for deflection due to prestressing in (i) straight tendons and (ii) parabolic tendon with eccentricity.
3. Explain the importance of longitudinal prestressing in prestressed concrete pipes.
4. List out the advantages of prestressed concrete piles.
5. Explain partial prestressing.
6. Sketch the stress distribution in propped composite construction.
7. Explain with sketches the tendon reaction or the method of equivalent loads for analysing the statically indeterminate prestressed concrete structures.
8. List the commonly used methods to analyse secondary moments in prestressed concrete continuous members.

PART B

(Each full question carries 6 marks).

9. A pre-tensioned T section has a flange 300 mm wide and 200 mm thick. The rib is 150 mm wide and 350 mm deep. The high tensile steel has an area of 200 mm^2 and is located at an effective depth of 500 mm. If the characteristic cube strength of concrete and tensile strength of steel are 50 and 1600 N/mm^2 respectively, calculate the flexural strength of the steel section.

OR

10. A prestressed concrete beam having a symmetrical I-Section is to be designed to support a live load of 15 kN/m over an effective span of 12 m. The I-section is made of flanges 300 mm wide and 150 mm thick. The web is 120 mm thick and 450 mm deep. The permissible stress in concrete may be assumed as 14 N/mm^2 in compression and 1.4 N/mm^2 in tension. The loss of stress is 15%. Check the adequacy of the section provided to resist the service loads. Determine the maximum prestressing force and corresponding eccentricity. Check the adequacy of the section provided to resist the service loads.

11. A slab spanning 10 m is to be designed as a one way prestressed concrete slab with parallel post tensioned cables carrying an effective force of 650 kN. The deck slab is required to support a uniformly distributed live load of 25 kN/m^2. The permissible stresses in concrete should not exceed 15 N/mm^2 in compression and no tension is permitted at any stage. Design the spacing of cables and their position at mid-span section. Assume loss of prestress as 20%.

OR

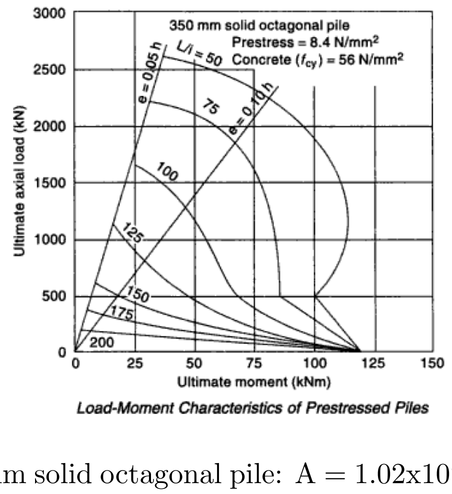
12. A post tensioned prestressed concrete beam of span 8 m with a rectangular section 300 mm x 400 mm is prestressed by a cable containing high tensile wires of cross-sectional area 2000 mm^2. If the beam supports a live load of 20 kN/m including self-weight, compute the initial deflection due to prestress self-weight and live loads for the following cases:
(a) The cable profile is straight with constant eccentricity of 100 mm.
(b) The cable profile is parabolic with a dip of 100 m at mid-span and concentric at supports.
Assume E_c = 36 kN/m^2.

13. A prestressed concrete pipe of 1.2 m diameter and a core thickness 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 internal stress is limited to 1000 N/mm^2. Permissible stresses in concrete are 12.5 N/mm^2 in compression and 0 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

14. The end block of a post tension beam is 80 mm wide and 160 mm deep. A prestressing wire 7 mm in diameter, stressed to 1200 N/mm^2 has to be anchored against the end block at the centre. The anchorage plate is 50 mm x 50 mm. The wire bears on the plate through a female cone of 20 mm diameter. Given the permissible stress in concrete at transfer as 20 N/mm^2 and permissible shear in steel as 90 N/mm^2. Determine the thickness of anchorage plate.

15. A multi-storeyed building is to be supported on prestressed concrete pile foundation. The piles have an effective height of 4.5 m and they have to support a total axial service load of 1100 kN together with a design moment of 75 kNm. Design the pile to support these loads using a 350 mm solid octagonal pile. Assume a uniform load factor of 2 against collapse. Check whether the pile is safe against handling stresses.



Load-Moment Characteristics of Prestressed Piles

Sectional properties of 35mm solid octagonal pile: A = 1.02x10^5 mm^2, Weight = 2.45 kN/m, Z = 4.70x10^6 mm^3, i = 90 mm

OR

16. Design the prestressing force required for the tie member of reinforced concrete truss. The service-load tension in the tie member is 360 kN and the thickness of the member is fixed as 150 mm. The permissible compressive stress in concrete at transfer is 15 N/mm^2 and tension is not allowed under service loads. The loss ratio is 0.8. High tensile wires of 7 mm diameter with an ultimate tensile strength of 1500 N/mm^2 with an initial stress of 1000 N/mm^2 are available for use. The direct tensile strength of concrete is 2.5 N/mm^2. A load factor of 1.70 against collapse and 1.20 against cracking is to be ensured in the design.

17. A precast pretensioned beam of rectangular section has a breadth of 100 mm and depth of 200 mm. The beam with an effective span of 5 m, is prestressed by tendons with their centroids coinciding with the bottom kern. The initial force in the tendons is 150 kN. The loss of prestress may be assumed to be 15%. The beam is incorporated in a composite T beam by casting a top flange of breadth 400 mm and thickness 40 mm. If the composite beam supports a live load of 8 kN/m^2, calculate the resultant stresses developed in the precast and insitu cast concrete assuming pre-tensioned beam as (a) unpropped and (b) propped during the casting of the slab. Assume the same modulus of elasticity for concrete in precast beam and in situ cast slab.

OR

18. Design a precast prestressed inverted T section to be used in a composite slab of total depth 600 mm and width 300 mm. The composite slab is required to support an imposed load of 16 kN/m^2 over a span of 14 m. The compressive stress in concrete at transfer and tensile stress under working loads may be assumed to be 20 and 1 N/mm^2 respectively. The loss ratio is 0.85. Determine the prestressing force required for the section.

19. A prestressed beam having a rectangular cross-section with width 120 mm and depth 300 mm is continuous over two spans AB = BC = 8 m. The cable with 0 eccentricity at the ends and an eccentricity of 50 mm towards the top fibres of the beam over the central support carries an effective force of 500 kN.
(a) Calculate the secondary moment developed at B
(b) If the beam supports concentrated loads of 20 kN each at midpoints of span, evaluate the resultant stresses at the central support section B.
(c) Locate the position of pressure line at the section.

OR

20. Explain with sketches the tendon reaction or the method of equivalent loads for analysing statically indeterminate prestressed concrete structures.