CBCS SCHEME

USN

17CV82

Eighth Semester B.E. Degree Examination, Jan./Feb. 2023
Design of Prestressed Concrete Elements

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. Use of IS1343 is permitted.

Module-1

1 a. Distinguish between pretensioning and post tensioning. **(05 Marks)**

b. What is pressure line or thrust line? Explain its significance with sketches. **(05 Marks)**

c. A rectangular concrete beam of cross section 120mm wide and 300mm deep is prestressed by a straight cable carrying an effective force of 180kN at an eccentricity of 50mm. The beam supports an imposed load of 3.14kN/m over a span of 6m. If the modulus of rupture of concrete is 5N/mm^2, evaluate the load factor against cracking assuming the density of concrete as 24kN/m^3. **(10 Marks)**

OR

2 a. Explain why high strength steel and high strength concrete are used in prestressed concrete. **(06 Marks)**

b. A rectangular concrete beam, 100mm wide by 250mm deep spanning over 8m is prestressed by a straight cable carrying an effective prestressing force of 250kN located at an eccentricity of 40mm. The beam supports a live load 1.2kN/m.
   i) Calculate the resultant stress distribution for the central cross section of the beam. The density of concrete is 24kN/m^3.
   ii) Find the magnitude of prestressing force with an eccentricity of 40mm which can balance the stresses due to dead and live loads at the bottom fibre of the central section of the beam. **(14 Marks)**

Module-2

3 a. List the various types of losses in prestressed concrete members. Explain the types of loss of prestress in post tensioned members only. **(06 Marks)**

b. In a prestressed pretensioned concrete beam of c/s 200mm × 300mm and span 6m, with an initial prestressing force of 400kN, at an eccentricity of 70mm by tendons of area 400mm^2. Assume $E_s = 2 \times 10^5$N/mm^2 and $E_c = 0.33 \times 10^5$N/mm^2, creep coefficient is 2, shrinkage coefficient = 0.0002 and relaxation in steel = 3% of initial stress. Find the percentage loss in prestress. **(14 Marks)**

OR

4 a. List the factors influencing deflections of prestressed concrete members. **(06 Marks)**

b. A post tensioned prestressed concrete beam of span 8m with a rectangular section 300mm wide by 400mm deep is prestressed by a cable containing initial force of 1500kN. If the beam supports a live load of 20kN/m excluding its self weight, compute the initial deflection due to prestress, self weight and live loads for the following cases:
   i) The cable profile is straight with a constant eccentricity of 100mm.
   ii) The cable profile is parabolic with a dip of 100mm at mid span and concentric at supports. Assume the modulus of elasticity of concrete as 36kN/mm^2. **(14 Marks)**

Module-3

5 a. Explain the different types of flexural failures observed in prestressed concrete beam. **(06 Marks)**

b. A prestressed T-section has a flange width of 300mm and the thickness of the flange is 200mm. The rib is 150mm wide by 350mm deep. The effective depth of the cross section is 500mm. Given $A_p = 200mm^2$, $f_{ck} = 50N/mm^2$ and $f_p = 1600N/mm^2$. Determine the flexural strength of the section. **(14 Marks)**

OR

6 A post tensioned prestressed concrete beam of rectangular section 300mm wide is to be designed to resist a live load moment of 360kNm on a span of 12m. Assuming 10% loss and limiting tensile and compressive stress to 1.5MPa and 18MPa respectively. Calculate the minimum possible depth and the prestressing force and corresponding eccentricity. Take $D_C = 24kN/m^3$. **(20 Marks)**

Module-4

7 a. Explain the types of shear cracks in structural concrete. **(06 Marks)**

b. A concrete beam of rectangular section 200mm wide and 650mm deep is prestressed by a parabolic cable located at an eccentricity of 120mm at mid span and zero at the supports. If the beam has a span of 12m and carries uniformly distributed live load of 4.5kN/m, find the effective force necessary in the cable for zero shear stress at the support section. For this condition, calculate the principal stresses. The density of concrete is $24kN/m^3$. **(14 Marks)**

OR

8 a. Explain different methods of improving shear resistance of PSC members. **(05 Marks)**

b. A simply supported beam 120mm × 300mm in section having a span of 7m is prestressed with a parabolic cable which has maximum eccentricity of 100mm at mid span and minimum eccentricity of 20mm at support, both below CGC of concrete. Effective prestressing force in the cable is 300kN. The beam carries a Udl of 30kN/m exclusive of self weight. Determine the principal tension at 0.6m from the left support and 20mm above the centroidal axis. Take density of concrete as $24kN/m^3$. **(15 Marks)**

Module-5

9 A precast tension unit of rectangular section of size 100mm × 200mm is used as a part of composite beam to a span of 5.0m. This unit is prestressed by a tendons with their centroids coinciding with the bottom kern point. The initial force in the tendon is 150kN. The loss of prestress may be assumed to be 15%. The unit is incorporated as web of a composite beam by casting a slab of flange width of 400mm and thickness of 40mm. On the top of the precast unit with the composite beam supports a live load of 8kN/m. Compute the resultant final stresses developed in the precast and cast in situ concrete assuming the pretensioned unit as propped construction. Draw the resultant stress diagrams. **(20 Marks)**

OR

10 A composite T-girder of span 5m is made up of a pretensioned rib 100mm × 200mm, with an in situ cast slab 400mm wide and 20mm thick. The rib is prestressed by a parabolic cable having an eccentricity of 33.33mm at centre of span and zero at supports carrying an initial force of 150kN. The loss of prestress may be assumed to be 15%. Check the composite T-beam for the limit state of deflection if it supports an imposed load of 3.2kN/m for

i) Unpropped construction

ii) Propped construction.

Assume modulus of elasticity of $35kN/mm^2$ for precast beam and in situ cast elements. **(20 Marks)**

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