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M.E./M.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2021
Second Semester
Infrastructure Engineering and Management
ST 5009 – PRESTRESSED CONCRETE
(Common to M.E. Structural Engineering)
(Regulations 2017)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions

PART – A **(10×2=20 Marks)**

1. Define pretensioning and post tensioning.
2. Define Axial prestressing.
3. What are the types of flexural failure ?
4. Define debonding.
5. How do you estimate the ultimate shear strength of PSC sections with web shear and flexture-shear cracks ?
6. What do you understand by concentric prestressing ?
7. How is the shear stress occurred in PSC members ?
8. State the two important combinations required for the design of PSC members.
9. Enlist the advantages of composite prestressed members.
10. Give the significance of partial prestressing.

PART – B **(5×13=65 Marks)**

11. a) Explain in detail about the types and systems of prestressing systems.

(OR)

b) A prestressed concrete beam of rectangular Section 400 mm wide and 600 mm deep is prestressed by a straight tendon of 1000 kN. The beam is subjected to a uniformly distributed load of 15 kN/m over a span of 15 m. Compute the resultant stress at the mid-span of he beam, if the tendon i) coincides with the longitudinal axis. ii) located at an eccentricity of 100 mm below the longitudinal axis. Draw the stress distribution at the central section of the beam by using 1) Stress concept method, 2) Load Balancing Method 3) Strength concept method.

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12. a) A prestressed concrete T-beam is to be designed to support an imposed load of 5 kN/m over an effective span of 7m. The beam has a flange width of 400 mm and a thickness of 40 mm. The rib is 100 mm wide and 200 mm deep. The stress in the concrete must not exceed 13 N/mm^2 in compression and zero in tension at any stage. Check for adequacy of the section provided and calculate the minimum prestressing force necessary and its eccentricity. Assume loss of prestress as 15%.

(OR)

b) A PSC beam of rectangular section 100 mm wide and 200 mm deep is to be designed to support two imposed loads of 5 kN each located at one-third points over a span of 8m. Assume that there is no tensile stress in the concrete at transfer and service loads. Determine the minimum prestressing force and its corresponding eccentricity.

13. a) A pre-tensioned concrete beam of symmetrical I-section has flanges 160 mm wide by 70 mm thick. The thickness of the web is 50 mm. The overall depth of the I-section is 320 mm. The beam is prestressed by four HTS wires of 7 mm diameter at an effective depth of 265 mm. Assume M 50 grade of concrete, tensile strength of HTS steel as 1600 N/mm^2. Compute the ultimate flexural strength of the I-section.

(OR)

b) The PSC girder has a rectangular section of size 100 mm wide and 250 mm deep over a span of 15 m. It is required to support an ultimate shear force of 80 kN. The compressive prestress at the centroidal axis is 5 N/mm^2. Assume the characteristic strength of concrete as 40 N/mm^2. The characteristic tensile strength of steel as 250 N/mm^2. Design suitable reinforcement at the section. Assume an effective cover as 50 mm.

14. a) A PSC beam of rectangular section 120 mm × 360 mm and span 12 m is prestressed by cables in the alternative profiles. In each case the area of the cable is 260 mm^2 and the initial prestress is 1250 N/mm^2.

Cable 1 : straight with a constant eccentricity of 60 mm below the centroidal axis.

Cable 2 : parabolic with zero eccentricity at each end and an eccentricity of 60 mm below the C.G axis at mid-span

Cable 3 : Parabolic with an eccentricity of 60 mm above the C.G axis at each end and 60 mm below the C.G axis at mid-span

If the beam supports a uniformly distributed live load of 5 kN/m and Ec = 38 kN/mm^2, estimate the instantaneous deflection at the following stages :

i) prestress + self – weight of the beam

ii) prestress + self – weight + live load.

(OR)

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b) A beam of rectangular section 125 mm × 250 mm is simply supported over a span 8 m. It is prestressed by a single cable in which the total tensile force of 220 kN is applied. The center line of the cable is parallel to the axis of the beam and 75 mm above the soffit over the middle-third of the span and is curved upward in a parabola over the outer-thirds of the span to a distance of 175 mm above the soffit at the supports. If the modulus of elasticity of concrete as 35 kN/mm^2 and the density of concrete is 24 kN/m^3, calculate

i) the deflection at mid-span due to prestress only

ii) the deflection when the beam is supporting its own-weight.

iii) the magnitude of concentrated loads placed at the third-points of the span, which would result in a limiting short-term deflection of span/500.

15. a) A composite beam consisting of 300 mm × 900 mm precast stem and a cast in situ flange 900 mm × 150 mm. The stem is a pre-tensioned unit which is subjected to an initial prestressing force of 2565 kN. The loss of prestress is 15%. The tendons are provided such that their center of gravity is 200 mm above the soffit. The beam has to support a live load of 27 kN/m over an effective span of 15 m. Determine the resultant stresses in the stem and flange, if the beam is i) unpropped and ii) propped.

(OR)

b) Explain the following :

i) Advantages and applications of partial prestressing. **(7)**

ii) Composite beams connections. **(6)**

PART – C **(1×15=15 Marks)**

16. a) A concrete beam of symmetrical I-section is made up of a flange 200 mm wide and 80 mm thick. The overall depth of the beam is 600 mm and the thickness of the web is 80 mm. The span of the beam is 9m. The beam is prestressed by a parabolic cable with an eccentricity of 80mm at the centre and zero at the supports with an effective force of 400 kN. The ;live load of the beam is 5 kN/m. Draw the stress distribution at the central section of the beam by

i) Stress concept method

ii) Load balancing method

iii) Strength concept method.

(OR)

b) A post-tensioned concrete beam of unsymmetrical I-section has the top flange and bottom flange as 400 mm × 60 mm and 150 mm × 60 mm respectively. The beam has an overall depth of 400 mm. Thickness of web is 80 mm. The beam is used to support a live load of 5 kN/m over a span of 10m. At the centre of span, the effective prestressing force of 100 kN is located at an eccentricity of 50 mm from the soffit of the beam. Determine the extreme fibre stresses at mid-span section when the beam supports

i) Prestress + Self – weight

ii) Prestress + Self – weight + live load.

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