17083

BRAINWARE UNIVERSITY

Term End Examination 2024-2025
Programme – B.Tech.(CE)]-2021
Course Name – Prestressed Concrete
Course Code - PEC-CE801B
(Semester VIII)

Full Marks : 60 **Time : 2:30 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A
(Multiple Choice Type Question) 1 x 15=15

1. *Choose the correct alternative from the following :*

(i) Identify the main advantage of prestressed concrete.
a) Reduced cracking b) Higher dead load
c) Increased deflection d) Lower durability

(ii) Identify the major type of prestressing system.
a) Heat Treatment b) Welding
c) Cold rolling d) Pre-tensioning

(iii) Identify the common loss in prestressed concrete.
a) Elastic shortening b) Reduced Durability
c) Increased strength d) Enhanced stiffness

(iv) Select the main benefit of prestressing over reinforced concrete.
a) Lower Construction cost b) Higher span-to-depth ratio
c) Increased cracking d) Higher reinforcement

(v) Choose the reason why prestressed concrete requires grouting.
a) To reduce deflection b) To increase dead weight
c) To protect against corrosion d) To improve ductility

(vi) Identify the assumption made in prestress analysis.
a) Plane sections remain plane b) Concrete is always in tension
c) Steel carries no stress d) Shrinkage is ignored

(vii) Identify the basic stress concept in prestressing.
a) Tensile force in concrete b) Tensile force in steel
c) Compressive force in concrete d) No force in steel

(viii) Select the type of stress induced in concrete due to prestressing.
a) Compressive stress b) Tensile stress
c) Shear stress d) No stress

(ix) Choose the correct reason why post-tensioning is used in bridges.
a) Longer spans with minimal deflection b) Lower durability
c) Higher reinforcement d) Increased weight

(x) Identify the main factor affecting deflection in prestressed members.
a) Concrete modulus of elasticity b) Type of reinforcement
c) Water-cement ratio d) Formwork material

(xi) Select the correct factor affecting deflection in prestressed concrete.
a) Span length b) Type of cement

c) Formwork type
d) Type of curing

(xii) Choose the correct IS code for limit state design of prestressed concrete.

a) IS:1343
b) IS:456
c) IS:1893
d) IS:10262

(xiii) Identify the common type of failure in prestressed concrete beams.

a) Brittle failure
b) Shear failure
c) Bond failure
d) Flexural failure

(xiv) Select the structural member that benefits most from prestressing.

a) Beams
b) Walls
c) Columns
d) Slabs

(xv) Choose the correct stress condition in a properly prestressed section.

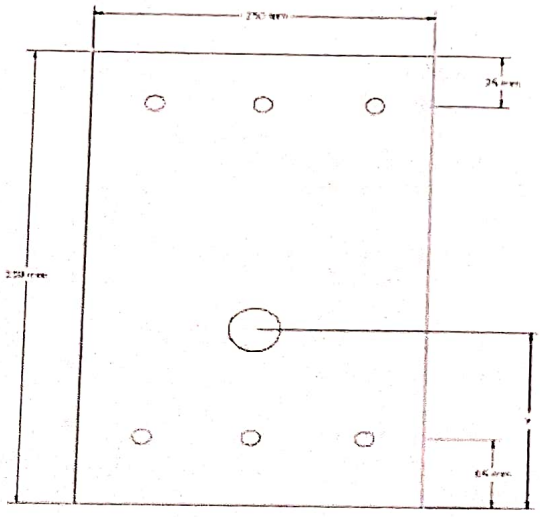
a) Tensile stress at top and bottom
b) Compressive stress at top and bottom
c) Tensile at top, compressive at bottom
d) Compressive at top, tensile at bottom

Group-B

(Short Answer Type Questions) 3 x 5=15

2. Explain the principle of prestressing in concrete. (3)
3. Define prestressing. (3)
4. A rectangular beam of cross section 350 mm deep and 250 mm wide is prestressed by means of 15 wires of 5 mm diameter located 65 mm from the bottom of the beam and 3 wires of diameter of 5 mm, 25 mm from the top. Assuming the prestress in the steel is 840 MPa and the density of concrete is 24KN/m^3 (3)

   a. Calculate the stresses at the extreme fibers of the mid-span section then the beam is supporting its own weight over a span of 6m.



5. A post-tensioned prestressed concrete beam of rectangular section, 200 mm wide by 400 mm deep, is simply supported over a span of 5 m. The beam is prestressed by a parabolic cable containing 16 wires of 7 mm diameter with an eccentricity of 140 mm at the center of the span and concentric at supports. The initial stress in the wires is 1000 N/mm^2. Loss ratio is 0.8. The permanent load on the beam (inclusive of self-weight) is 40 kN/m, whereas the total load (inclusive of non-permanent load) is 50 kN/m. (3)

Calculate the long-term deflection of the beam using the British code BS: 8110–1985, specifications and the following data for the following cases:

1. Neglecting tensile resistance of concrete, and
2. Considering tensile resistance of concrete.

Given Data:

- Modulus of elasticity of steel = 200 kN/mm²
- Modulus of elasticity of concrete = 33 kN/mm²
- Modulus of rupture of concrete = 4 N/mm²
- Creep coefficient, $\phi = 2$ϕ=2
- Concrete shrinkage strain, $\varepsilon_{cs} = 300 \times 10^{-6}$εcs=300×10−6

(i) Neglecting tensile resistance of concrete

6. Differentiate between one-way and two-way prestressed concrete slabs. (3)

OR

A beam with width $b = 300$b=300 mm and depth $d = 600$d=600 mm is to be prestressed. Considering a 15% prestress loss, (3) calculate the value of initial prestressing force PP and eccentricity ee.

A) If the compressive stress is 21 MPa.

B) If the compressive stress at the bottom fiber is 12 MPa and a tensile stress at the top fiber is 2 MPa.

C) If the compressive stress at the top fiber is 16 MPa and zero at the bottom fiber.

Group-C

(Long Answer Type Questions) 5 x 6=30

7. A prestressed concrete beam having a cross-sectional area (A) of $5 \times 10^4$5×104 mm² is simply supported over a span of 10 m. It supports a uniformly distributed imposed load of 3 kN/m, half of which is non-permanent. The tendon follows a trapezoidal profile with an eccentricity of 100 mm within the middle-third of the span and varies linearly from the third-span points to zero at the supports. The area of tendons A_p = 350 mm² have effective prestress of 1290 N/mm² immediately after transfer. Using the following data, compute (5)

    1. The **short-term deflections**, and
    2. The **long-term deflections**

    Given Data:

    - **Moment of Inertia**: $I_g = 4.5 \times 10^8$Ig=4.5×108 mm⁴
    - **Modulus of Elasticity of Concrete**: $E_c = 34$Ec=34 kN/mm²
    - **Cross-sectional Area**: $A = 5 \times 10^4$A=5×104 mm²
    - **Modulus of Elasticity of Steel**: $E_s = 200$Es=200 kN/mm²
    - **Density of Concrete**: 23.6 kN/m³
    - **Creep Coefficient**: 2
    - **Concrete Shrinkage**: $\varepsilon_s = 450 \times 10^{-6}$εs=450×10−6
    - **Relaxation of Steel Stress**: 10%

8. A concrete beam with cross-sectional area of 32×10^3 mm² and the radius of gyration is 72 mm is prestressed by a parabolic cable carrying an effective stress of 1000 N/mm². The span of the beam is 8 m. The cable composed of 6 wires of 7 mm diameter has an eccentricity of 50 mm at the center and zero at the supports. Neglecting all losses, calculate the central deflection of the beam as follows: (5)

    a) Self-weight + prestress

    b) Self-weight + prestress + live load of 2 kN/m

9. Explain the applications of prestressed concrete in construction. (5)

10. Analyze the impact of anchorage slip on prestress losses. (5)

11. A prestressed concrete beam having a rectangular section 100 mm wide and 200 mm deep spans over 2.76 m. The beam is prestressed by a straight cable containing 5 wires of 5 mm diameter stressed to 1200 N/mm² at an eccentricity of 37 mm. Assume the modular ratio $\alpha_e = 6.2\alpha c=6.2$. If the modulus of elasticity of concrete is 34 kN/mm² and the modulus of rupture is 4 N/mm², calculate the maximum deflection of the beam at the following stages: (5)

(a) prestress + self-weight of the beam,
(b) prestress + self-weight + imposed load of 8.4 kN/m,
(c) cracking load,
(d) 1.46 times the working load, and

(e) 1.8 times the working load.

12. Distinguish between different types of prestressed concrete slabs. (5)

OR

Explain the factors affecting the durability of prestressed concrete structures. (5)

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