Code : 101808

B.Tech 8th Semester Exam., 2022

(New Course)

PRESTRESSED CONCRETE

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

*(ii) There are **NINE** questions in this paper.*

*(iii) Attempt **FIVE** questions in all.*

*(iv) Question No. **1** is compulsory.*

1. Choose the correct answer (any *seven*) : 2×7=14

(a) Which one of the following is categorized as a long-term loss of prestress in a prestressed concrete member?

(i) Loss due to elastic shortening

(ii) Loss due to friction

(iii) Loss due to relaxation of strands

(iv) Loss due to anchorage slip

(b) Most common method of prestressing used for factory production is

(i) long line method

(ii) Freyssinet system

(iii) Magnel-Blaton system

(iv) Lee-McCall system

(c) In axially prestressed members, the concrete is under

(i) tension

(ii) compression

(iii) torsion

(iv) bending

(d) Prestressing losses in post-tensioned and pre-tensioned beams are respectively

(i) 15% and 20%

(ii) 20% and 15%

(iii) 20% and 20%

(iv) 15% and 15%

(e) Freyssinet system is based on the principle of

(i) direct bearing on concrete from bolt heads at the end of wires

(ii) looping of the wires around concrete

(iii) wedge action producing frictional grip between steel and concrete

(iv) None of the above

(f) In Magnel's graphical method of solving eccentricity (e) and prestressing force (P), the value of P is determined corresponding to

(i) maximum e

(ii) minimum e

(iii) both maximum e and minimum e

(iv) average e

(g) A parabolic cable profile with maximum eccentricity at midspan and concentric at supports when stressed results in

(i) zero deflection

(ii) downward deflection

(iii) upward deflection

(iv) minimum deflection

(h) The deflection of a cracked prestressed concrete beam can be computed by

(i) stress-strain diagram

(ii) bending moment diagram

(iii) bilinear moment-curvature relationships

(iv) shear force diagram

(i) Prestressed concrete beam fails suddenly without warning due to

(i) failure of concrete in compression zone

(ii) failure of concrete in tension zone

(iii) failure of steel in tension

(iv) failure of steel in compression

(j) Prestressed concrete sleepers should be designed to resist

(i) static loads

(ii) static and dynamic loads

(iii) dynamic loads

(iv) None of the above

2. A post-tensioned prestressed beam of rectangular section 250 mm wide is to be designed for an imposed load of 12 kN/m, uniformly distributed on a span of 12 m. The stress in the concrete must not exceed 17 N/mm^2 in compression or 1·4 N/mm^2 in tension at any time and the loss of prestress may be assumed to be 15%. Calculate *(a)* the minimum possible depth of the beam and *(b)* for the section provided, the minimum prestressing force and the corresponding eccentricity. 14

3. *(a)* A pre-tensioned beam 250 mm wide and 360 mm deep is prestressed by 10 wires of 8 mm dia, initially stress to 1000 N/mm^2. The centroid of the steel wires is located at 105 mm from the soffit. Determine the maximum stress in concrete immediately after transfer allowing elastic shortening of concrete only at the level of centroid of the steel. If however, the concrete is subjected to additional shortening due to the creep and shrinkage and the steel is subjected to relaxation of stress of 5% of initial stress. Find the final percentage of

loss of stress in steel wires. Take, $E_s = 210\ kN/mm^2$, $E_c = 36{\cdot}85\ kN/mm^2$, $\phi = 1{\cdot}60$ and residual shrinkage strain $= 3 \times 10^{-4}$. 10

(b) Derive the loss due to elastic shortening of concrete. 4

4. *(a)* Explain the stresses developed in the anchorage zone with sketch. Also explain bursting tension and splitting crack. 7

(b) What is partial prestressing? What are the advantages of partial prestressing? What is the use of non-prestress reinforcement in partial prestressing? 7

5. *(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. 10

(b) What are the advantages of prestressed concrete poles? 4

6. *(a)* A concrete beam having a rectangular section 100 mm × 300 mm is prestressed by a parabolic cable with an initial prestressing force of 240 kN. The cable has an eccentricity of 50 mm at the centre and concentric at the supports. If the span of the beam is 10 m and subjected to a live load of 2 kN/m, calculate the short-term deflection at midspan. Assume $E_c = 38$ kN/mm^2, creep coefficient = 2, loss of pre-stress = 20%. Estimate the long-term deflection. 8

(b) Explain the procedure for computing short-term and long-term deflection of PSC beams. 6

7. *(a)* What are the different types of flexural modes observed in prestressed concrete beams? 7

(b) A pre-tensioned prestressed concrete beam having a rectangular section 300 mm wide and 500 mm deep has an effective cover of 40 mm. If $f_{ck} = 40$ N/mm^2, $f_p = 1600$ N/mm^2 and the area of prestressing steel $A_p = 561$ mm^2, calculate the ultimate flexural strength of the section using IS code provisions. 7

8. *(a)* Distinguish between standard strand and compound strand. 4

(b) A beam is of simply supported span 8 m. The size of the beam is 350 mm × 700 mm. A prestressing force of 100 kN was applied. The cable is parabolic with an eccentricity of 100 mm at centre and zero at the supports. It is subjected to an u.d.l. of 20 kN/m. Compute the extreme stresses at the midspan. 10

9. Answer any *four* of the following briefly : 3½×4=14

(a) Distinguish between uniaxial, biaxial and triaxial prestressing.

(b) Explain the principle of post-tensioning.

(c) List out the various types of loss of prestress in post-tensioned members.

(d) What are the different types of flexural failure modes?

(e) List some practical examples of structures subjected to combined bending.

(f) Explain the terms end block and anchorage zone.

* * *