PRESTRESSED CONCRETE

DECEMBER 2015

(REVISED COURSE)

(3 Hours) [Total Marks : 100]

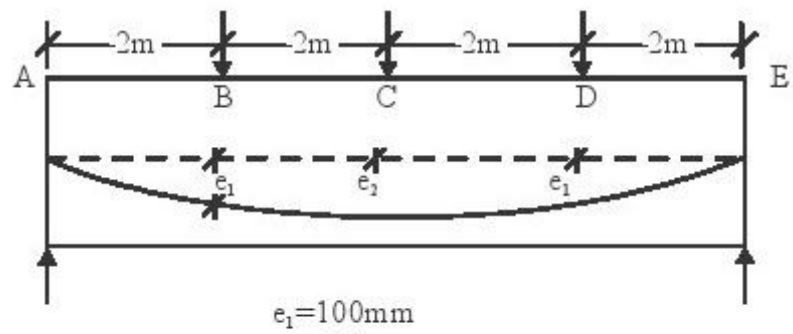
N.B.: (1) Question 1 is compulsory.
(2) Attempt any four from the remaining questions.
(3) Assume data wherever required.
(4) Figures to the right indicate full marks.

1. (a) Why high strength concrete and steel is used in prestressed concrete sections? What are its advantages? 5
(b) A rectangular concrete beam of 3m simply supported span having cross section 250mm × 300mm is prestressed by 750 kN force such that pressure line coincides with neutral axis. The beam supports two concentrated load of 60 kN each at middle third points. Locate cable profile along the span mentioning its eccentricity at supports and below concentrated loads. Neglect effects of self weight. 5
(c) Explain in brief about autogenous shrinkage strain and drying shrinkage strain in concrete. 5
(d) Develop equations for the minimum sectional modulus to be provided for a prestressed concrete section such that section is safe in limit state of serviceability cracking. 5

2. (a) A pre tensioned box girder of 1m × 1m overall dimensions is having a uniform wall thickness of 200mm. The girder has high tensile wires of area 2250mm^2 located at an effective depth of 900mm. Take f_{ck} = 45 Mpa and f_p = 1600 Mpa. Estimate ultimate flexure strength. 10
(b) A 200mm × 600mm beam is prestressed by a parabolic cable with 500 kN PF. Cable is concentric at support and at 200mm eccentricity at mid span. Span is 6m. At service beam carries 30kN/ udl inclusive of self weight. Calculate shear strength of the section and design shear reinforcement if required. Use M50 concrete and Fe415 for shear reinforcement. 10

3. (a) A post tensioned beam of rectangular section 200mm × 450mm is prestressed by a cable made up of 10-8 mm wires. Cable is located at 100mm from soffit of the beam at mid span and it is concentric at supports. The wires are initially stressed to 1050 Mpa. Calculate loss of stress and loss of strain in steel. Jacking force is applied from both ends. 15
Take μ = 0.2, K = 0.0046/m, anchorage slip = 2mm at each end, span = 6m simply supported, Es = 210 kN/mm^2, Ec = 35 kN/mm^2, Shrinkage strain in concrete $(\varepsilon_{ca} + \varepsilon_{cd}) = 300 \times 10^{-6}$
Creep coefficient = 1.6, fp = 1500MPa, consider normal relaxation loss of stress in steel.
(b) Enlist different methods of post tensioning and explain anyone method in detail. 5

4. (a) A prestressed concrete beam AE of 8m simply supported span of cross section 250mm × 450mm is prestressed by a cable with initial PF 400 kN. Beam supports three concentrated loads of 25 kN are in addition to its self weight at an interval of 2m each at B, C and D. Ec = 38 kN/mm
Estimate short term deflection due to initial prestressing force. Self weight of beam and imposed load. Also estimate long time deflection considering Ee of concrete reduces to 2/3 of its initial value and η = 0.8.
Compare deflections with permissible limits. 15



e_1=100mm
e_2=150mm
Cable is lineae betn Ab & BC
with different gradient

(b) A 200mm × 400mm beam is prestressed by a parabolic cable with 200 kN PF. Cable is concentric at support and at 125mm eccentricity at mid span. Beam carries 15kN/m factored udl inclusive of self weight. Compare the principal tensile stresses at critical section with and without prestressing. Span is 8m. 5

5. (a) An unsymmetric I-section having following properties is used for a bridge girder. The thickness of top and bottom flange is 200mm and 250mm respectively. The width of top and bottom flange is 750mm and 450mm respectively. Thickness of web is 150mm, overall depth is 1000mm and area of section is 345000mm^2 $Z_t = 95 \times 10^6$ mm^3, $Z_b = 75 \times 10^6$ mm^3 and the position of the centroid of the service are not exceed top. The permissible tensile and compressive stresses at transfer as well as at service are not to exceed zero in tension and 15 Mpa in compression. Check suitability of sectional modulus. Determine the prestressing force and corresponding eccentricity to resist self weight moment of 1012 kN-m and imposed load moment of 450 kN-m. The loss ratio is 0.85. 15

(b) Two cables each carrying a force of 400 kN are anchored at end section of a beam having C/s 300mm × 500mm. Two anchor plates each of dimension is 100 × 100mm is used. One cable is located at 150 mm from top fiber and other is located at 150mm from bottom fiber. Check safety of end block against punching of anchor plate. Use M50 concrete. Strength of concrete at transfer is 40 Mpa. 5

6. (a) A concrete beam of rectangular cross section 500mm 100 mm deep is continuous over two spans AB = BC = 10m. The beam is prestressed by a cable carrying an initial prestressing force of 2000 kN. The cable is parabolic which is concentric at supports A, B & C and has an eccentricity of 300mm at center of spans. The beam supports an imposed load of 35 kN/m throughout the spans AB & BC.
Locate pressure line at transfer and at service stage. Also calculate resultant stresses at top and bottom fibers at supports A, B & C and at center of spans AB & BC accounting effect of all the forces acting on the beam. Consider loss ratio is 0.8. 20