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Total No. of Questions : 08

M.Tech (Structural Design) (2016 & Onwards) (Sem.-1)

PRE-STRESSED CONCRETE DESIGN

Subject Code : MTSD-103

Paper ID : [74244]

Time : 3 Hrs. Max. Marks : 100

INSTRUCTION TO CANDIDATES :

1. Attempt any FIVE questions out of EIGHT questions.
2. Each question carries TWENTY marks.
3. Missing data may be assumed suitably.
4. Use of IS : 1343 is permitted.

Q1. (a) Explain the reasons why mild steel bars are not used for prestressing. (5)

(b) Explain the concept of load balancing in the design of prestressed concrete members. (5)

(c) An unsymmetrical I-section beam is used to support an imposed load of 3.5 kN/m over a span of 8 m. The sectional details are top flange 320 mm wide and 80 mm thick; bottom flange are 150 mm wide and 80 mm thick; thickness of the web is 80 mm; overall depth of the beam is 440 mm. At the centre of the span, the effective prestressing force of 120 kN is located at 50 mm from the soffit of the beam. Estimate the stresses at the centre of span section of the beam for the following load conditions:

i) prestress + self weight

ii) prestress + self weight + live load. (10)

Q2. (a) A post tensioned simply supported beam of 8 m span is provided with a curved cable of area 1000 mm^2 with a slope of 1 in 20 at each end and is initially stressed to 1200 N/mm^2. Young's modulus of elasticity is 210 kN/mm^2. Calculate :

i) The loss of prestress due to friction if the coefficients of friction between duct and cable is 0.5, wave effect is 0.0015/m.

ii) The loss due to slip of 2 mm at the tacking end during anchoring.

iii) The final force in the cable and percentage loss of prestress due to friction and slip. (12)

(b) What are loop anchorages? Explain with sketches Baur- Leonhardt system of post - tensioning. (8)

Q3. (a) A T section has following sectional details, Top flange 550 × 200 mm, web 150 × 750 mm, bottom flange 300 × 200 mm, Shear force across the section is 300 N. Effective prestress in cable is 1500 kN. Inclination of tendon at given section is Sin^{-1} (1/20). Fibre prestress in concrete varies linearly from 11 N/mm^2 compression at top 1 N/mm^2 at the bottom. Determine maximum principal tension developed in the section. If M35 concrete is used. (10)

(b) Sketch the typical arrangement of reinforcement in end blocks of post - tensioned prestressed concrete beams with single and multiple anchorages. (5)

(c) Explain the strain compatibility method of computing the flexural strength of concrete sections with tension and compression reinforcement. (5)

Q4. (a) A prestressed concrete beam having a cross sectional area of 6.5 x 10^4 mm^2 is simply supported over a span of 12 m. It supports a uniformly distributed imposed load of 3.5 kN/m, half of which is non - permanent. The tendon follows a trapezoidal profile with an eccentricity of 120 mm with in 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 =380 mm^2 have effective prestress of 1290 N/mm^2 immediately after transfer. Using the following data, calculate

i) Short term deflection, and

ii) Long term deflection

Consider, $I_g = 5.2 \times 10^8$ mm^4, E_c = 34 kN/mm^2, A = 5.5 x 10^4 mm^2, E_s = 200 kN/mm^2 Density of concrete = 23 kN/m^3, Creep coefficient = 2, Concrete shrinkage = 450 × 10^{-6}, Relaxation of steel stress = 10%. (15)

(b) Outline the various factors influencing the effective moment of inertia of cracked concrete sections. (5)

Q5. A post - tensioned bonded prestressed concrete beam of rectangular section, 350 mm wide by 700 mm deep, is prestressed by an effective force of 175 kN, acting at an eccentricity of 190 mm. At service load conditions, a section of the beam is subjected to a bending moment of 280 kNm, a torsional moment of 100 kNm and a transverse shear force of 100 kN. If f_{ck} = 40 N/mm^2, f_y = 415 N/mm^2, f_p= 1600 N/mm^2, design suitable longitudinal and transverse reinforcements in the section using IS: 1343-1980 code recommendations. (20)

Q6. (a) A prestressed concrete beam 350 mm wide and 500 mm deep has 2 anchorages of 150 mm diameter with the center at 120 mm from the top and bottom of the beam. The force transmitted by each cable is 800 kN. Estimate the maximum tension and bursting force. (12)

(b) How do you compute the bursting tension in an end block subjected to evenly distributed forces using Guyon's method? (08)

Q7. Design a post tensioned girder which are spaced at 2.50 m c/c and have an effective span of 8 m. Live load is 15 KN/m^2 and dead load is 4 kN/m^2 inclusive of self weight of concrete. Concrete weights 25 KN/m^3, permissible compressive stress in concrete at transfer and working load is 14 N/mm^2 and 12 N/mm^2 respectively. Permissible tension in concrete at all stages of loading is 1.2 N/mm^2. The loss ratio is 78 %. Also detrermine the number of 7 mm diameter wires required. If permissible tension in steel is 1000 N/mm^2. Minimum cover required for C.G.S. is 120 mm. (20)

Q8. (a) What are hypothetical tensile stresses? Discuss their use in Class -3 type members. (5)

(b) Write a note on limit state of serviceability. (5)

(c) A post tensioned beam with unbounded tendons is of rectangular section, 400 mm wide with an effective depth of 800 mm. The cross sectional area of the pre tensioning steel is 2840 mm^2. The effective prestress in the steel after all losses is 900 N/mm^2. The effective span of the beam is 16 m. Estimate the ultimate moment of resistance of the section using IS 1343 recommendations by considering f_{ck} 40 N/mm^2. (10)