7E4037

B. Tech. VII Semester (Main) Examination-2015

CIVIL ENGINEERING # 7CE6.2A # MODEL PAPER

DESIGN OF PRE-STRESSED CONCRETE STRUCTURES

Time : 3 Hours | **Min. Passing Marks : 24** | **Maximum Marks : 80**

Instruction to Candidates :

Attempt any five questions, selecting one question from each unit. All questions carry equal marks. (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.)

Unit-'I'

1. (a) A post tensioned pre-stressed concrete beam of 9m span has a width of 400mm and depth 800 mm and is pre-stressed to 2500 kN at transfer. The cable has cross-sectional area of $2000mm^2$ and has a parabolic profile with maximum eccentricity of 140 mm at centre of the simply supported span of 9m. Determine the loss of prestress, if $Es = 2\times10^5$ N/mm^2 and $Ec = 3\times10^4$ N/mm^2. [12]

(b) Describe 'long line' method of Pre-tensioning. **OR** [4]

1. (a) Describe Freyssinet system of prestressing in detail showing details with figures, and tables etc. [8]

(b) The end block of a prestressed concrete beam, 100 mm wide and 200mm deep, supports an eccentric prestressing force of 100 kN, the line of action of which coincides with the bottom kern of the section. The depth of the anchor plate is 50mm. Estimate the magnitude and position of the principal tensile stress on a horizontal plane passing through the centre of the anchorage plate. [8]

Unit-'II'

2. A post-tensioned prestressed concrete propped cantilever AC is 9m long, fixed at C and propped at A. The cantilever beam has a been designed to carry its own weight and a live load of 500 kN applied at B, distant 3m from the fixed end. The beam is of uniform rectangular cross section, 400 mm deep. The permissible limits of the tendon zone measured (positive down wards) from the centre line of the beam have been found to be as given below:

Distance From A(m)	0	1.5	3.0	4.5	6.0	7.5	9.0
Upper Limit (mm)	-84	-45	-17.5	+2.5	+15	-85	-120
Lower Limits (mm)	+84	+100	+0.5	+100	+91	+78	-120

(a) Determine a concordant cable profile for this beam and show it on an elevation diagram of the beam. [8]

(b) Assuming that the tendon eccentricity must not exceed 100mm, apply a linear transformation to reduce to a minimum the slope of tendon at C and draw on elevation of the transformed profile. What is the effect of this transformation on the support reaction at A, if the horizontal component of the prestressing force is 520 kN? **OR** [8]

2. A prestressed concrete beam is simply supported over a span of 45m and carries a superimposed distributed load of 16 kN/m. The centre of gravity (C.G.S.) of tendon follows a trapezoidal profile, the tendon eccentricity being 1150mm within the central middle third of span and varies linearly to zero at the supports. The tendon area A is 9500 mm^2 and the effective prestress f is 1300 N.mm^2. The beam is of uniform cross section with the following properties: $A = 12\times10^5$ mm^2, $I = 80\times10^{10}$ mm^4; At transfer, characteristic strength = 50 N/mm^2; $Ec = 3.6\times10^4$ N/mm^2, $Es = 2.1\times10^5$ N/mm^2; Creep coeficient Cc = 3.00; Shrinkage strain = 0.00020; Relaxation of tendon = 10% of f('f' is 1300 N/mm^2) Calculate the short term and long term deflections at midspan for the beam. [16]

Unit-'III'

3. A simply supported prestressed concrete beam of span 22m is prestressed with 20 Nos. 12mm strand with an initial prestressing force of 2100 kN. The tendons are linearly bent with a maximum eccentricity of 290 mm at L/3 from ends, the eccentricity at ends being 130 mm. The beam is T section having bw = 200 mm, D = 620 mm, and bf = 2400 mm. Properties of the sections are $A = 284200$ mm^2, $Icg = 85.4\times10^8$ mm^3, yt = 150 mm and $y_b = 450$ mm. Dead load on the beam = 6.40 kN/m, Live load on the beam = 4.30 kN/m. Losses in prestress = 20%. Design the beam for shear following I.S. 1343. Calculate shear resistance values at D/2 from support and at L/4 and L/2. **OR** [16]

3. Design for flexure a pretensioned rectangular beam with constant eccentricity with an effective simply supported span of 12m, if live load = 11 kN/m. Assume fck = 50 N/mm^2, permissible stresses in compression as 16 N/mm^2 (both at initial and final stages) and in tension as 1.6 N/mm^2. Assume 5mm prestressing wires with maximum permisible prestress at transfer equal to 16000 N/mm^2, stress during initial tension = 80% of maximum permissible prestress and losses equal to 80%. [16]

Unit-'IV'

4. The deck slab of a road bridge of span 12m is to be designed as a one way prestressed concrete slab, with parallel post-tensioned cables in each of which the force at transfer is 550 kN. If the deck slab is required to support a uniformly distributed live load of 24 kN/m^3, with the compressive and tensile stress in concrete at any stage not exceeding 16 and zero N/mm^2 respectively, calculate the maximum horizontal spacing of the cables and their positions at the mid-span section. Assume the loss ratio as 0.80. [16]

OR

4. Design a partially prestressed post tensioned beam to suit the following data. Effective span 28m, Live load = 10 kN/m. Dead load (excluding self wt.) 2.0 kN/m, 28 days cube compressive strength = 50 N/mm^2, strength of concrete at transfer = 35 N/mm^2 Loss ratio = 0.85 Tensile strength of concrete = 17 N/mm^2, permissible tensile stress under service loads not to exceed 0.1 mm, 8mm diameter high tensile wires having an ultimate tensile strength of 1500 N/mm^2 are available for use. [16]

Unit-'V'

5. A prestressed concrete circular cylindrical tank is required to store 2.5×10^{10} liters of water. The permissible compressive stress in concrete at transfer should not exceed 13N/mm^2 and the minimum compressive stress under working pressure should not be less than 1N/mm^2. The loss ratio is 0.78. High tensile steel wires of 7mm diameter with an initial stress of 1000N/mm^2 are available for winding round the tank. Freyssinet cables of 12 wires of 8mm diameter, which are stressed to 1200 N/mm^2, are available for vertical prestressing. The cube strength of concrete is 45 N/mm^2. Design the tank walls supported on elastomeric pads. Assume the coefficient of friction as 0.5. **OR** [16]

5. Design a cylindrical circular water tank of internal diameter 26m and of height 7.5 m considering the joint at base to be free. The tank has free top. Assume that compressive stress in concrete at transfer = 15 N/mm^2, minimum compressive stress under service load = 1.5 N/mm^2, Diameter of wire for prestress = 5mm, prestress in wire at transfer = 1100N/mm^2, Losses in prestress = 20% vertical prestress is provided centrally by cable of 12 Nos. 5mm wires, use coefficient friction at joint as 0.50. [16]