Code: 13A01805 **R13**

B.Tech IV Year II Semester (R13) Advanced Supplementary Examinations July 2017

PRESTRESSED CONCRETE

(Civil Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) What grade of concrete is used for pretensioned concrete members?

(b) Differentiate concentric prestressing from eccentric prestressing.

(c) What shall be the eccentricity of a cable carrying a prestressing force of 500 kN at mid span of a rectangular PSC beam of size 400 mm x 800 mm, used for a span of 10 m, making the resultant of fiber stresses at mid span to pass through the centroid of the cross section, for dead load condition. Dead weight of concrete is 24 kN/m^3.

(d) The elastic stress at the level of tendons in a pre tensioned beam is 5 MPa compressive. If the modular ratio is 10, what would be the loss of prestress due to elastic shortening of concrete?

(e) Write an expression for the cracking moment of a rectangular PSC beam in terms of the cross sectional dimensions, prestressing force and eccentricity of tendons.

(f) Mention any two parameters that improve the shear resistance of PSC member.

(g) Differentiate propped construction from un-propped construction in PSC.

(h) What is transmission length?

(i) What is the effect of differential shrinkage in composite construction of PSC?

(j) Mention any two methods to control deflection of PSC members.

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 (a) List out any five major differences between PSC and RCC.

(b) Explain the magnet system of pre stressing with the help of neat sketches.

OR

3 A pre stressed concrete beam supports a live load of 4 kN/m over a simply supported span of 8 m. The beam has an I-section with an overall depth of 400 mm. The thickness of the flange and web are 60 and 80 mm respectively. The width of the flange is 200 mm. The beam is to be pre stressed by an effective pre stressing force of 235 kN at a suitable eccentricity such that the resultant stress at the soffit of the beam at the center of the span is zero.

(i) Find the eccentricity required for the force.

(ii) If the tendon is concentric, what should be the magnitude of the pre stressing force for the resultant stress to be zero at the bottom fiber of the central span section?

UNIT – II

4 A post tensioned concrete beam, 100 mm wide and 300 mm deep is pre stressed by three cables, each with a cross sectional area of 50 mm^2 and with an initial stress of 1200 N/mm^2. All the three cables are straight and located 100 mm from the soffit of the beam. If the modular ratio is 6, calculate the loss of stress in the three cables due to elastic deformation of concrete for only the following cases:

(i) Simultaneous tensioning and anchoring of all the three cables.

(ii) Successive tensioning of the three cables, one at a time.

OR

5 A post tensioned pre stressed beam of span-length of 10 m has a rectangular section 1300 mm wide 900 mm deep. The beam is pre stressed by a parabolic cable connectric at the support and with an eccentricity of 250 mm at the centre of span. The cross-sectional area of high-tensile wires in the cable is 500mm^2. The wires are stressed by using a jack at the left end so that the initial force in the cable at the right end is 250 kN. Using the following data, calculate:

(i) The total loss of stress in the wires.

(ii) The jacking force required at the left end.

Coefficient of friction for curvature effect = 0.55; Friction coefficient for wave-effect = 0.003/m; Anchorage slip at the jacking end = 3 mm; Relaxation of steel stress = 4 percent; Shrinkage of concrete = 0.0002; Creep coefficient = 2.2; Modular ratio = 7; Modulus of elasticity of steel = 210 kN/mm^2

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UNIT – III

6 A simply supported prestressed concrete beam spanning over 10 m is of rectangular section 500 mm wide by 750 mm deep. The force in the cable is 1600 kN. If the beam supports a total uniformly distributed load of 40 kN/m, which includes the self-weight, evaluate the cable zone limits at the support and quarter span of the beam for the following allowable stresses.

$f_{cw} = f_{ct} = 12.5$ MPa; $f_{tt} = f_{tw} = -1.0$ MPa. Loss of prestress = 15%.

OR

7 Design the details of a simply supported PSC beam supporting a live load of 20 kN/m over a span of 12 m. Use M_{30} grade concrete. Allowable stresses are $f_{cw} = f_{ct} = 14$ MPa; $f_{tt} = f_{tw} = 0$ MPa. Also design the end block reinforcement. Breadth to depth ratio of the cross section is 0.25.

UNIT – IV

8 A cantilevered portion of a pre stressed concrete bridge with a rectangular cross section, 600 mm wide and 1650 mm deep is 8 m, carries a reaction of 350 kN from the suspended span at the free end, together with the uniformly distributed load of 60 kN/m inclusive of its own weight. Time beam is pre stressed by seven cables each carrying a force of 1000 kN, of which three are located at 150 mm, 3 at 400 mm and 1 at 750 mm from the top edge. Calculate the magnitude of the principle stress at appoint 550 mm from the top of the cantilever at the support section.

OR

9 A PSC beam of rectangular section 300 mm wide and 600 mm deep is pre stressed by a parabolic cable located at an eccentricity of 120 mm at mid span and zero at the supports. If the beam has a span of 10 m and carries a uniformly distributed live load of 8 kN/m, design the shear reinforcement at the supports and quarter span section. Grade of concrete is M_{40}. Yield stress of tendons is 2000 MPa. Area of the tendons is 1000 mm^2. Effective stress in the tendons is 1500 MPa.

UNIT – V

10 A PSC beam with a symmetrical I-section has flange width and depth of 200 mm and 60 mm respectively. The thickness of the web is 80 mm and the overall depth is 400 mm. The beam is pre stressed by a cable carrying a force of 1000 kN. The span of the beam is 8 m. The center line of the cable is 150 mm from the soffit of the beam at the center of span, linearly varying to 250 mm at the supports. Compute the initial deflection at mid span due to prestress and the self weight of the beam, assuming $E_c = 38$ kN/mm^2. Compare the deflection with the limiting deflection permitted in IS: 1343 ($D_c = 24$ kN/m^3).

OR

11 A prestressed concrete beam having a cross sectional area of 5×10^4 mm^2 is simply supported over a span of 10 m. It supports a uniformly distributed 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 linearity from the third span point to zero at the supports. The area of tendons is $A_p = 350$ mm^2 have an effective pre stress of 1290 MPa immediately after transfer. Using the following data calculate long term deflection.

$I_g = 4.5 \times 10^8$ mm^4, $E_c = 34$ GPa, $E_s = 200$ GPa. Density of concrete 24 kN/m^3. Creep coefficient = 2.0, Shrinkage strain = 450×10^{-6}, Relaxation of steel stress = 10%.

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