14/12/22

10:30 am Sem-VII-C-1a-Reg. CE (R-19)

Duration: 3 Hours **Total Marks: 80**

N. B: 1. Q1 is compulsory. Attempt any three out of remaining five questions.
2. Assume suitable data if required and mention it clearly.
3. Support answers and solutions with suitable sketches.
4. IS 1343:2012 is permitted in examination.

Q1

A Why high strength steel and high grade concrete is used in prestressed concrete structures? **04**

B Develop the equations for minimum sectional modulus required for section to be safe in limit state of serviceability maximum compression in flexure and cracking. **04**

C Differentiate between the losses of stresses in steel in pre-tensioned and post-tensioned elements. What are different factors influences the loss of stresses in steel due to shrinkage in concrete? **04**

D How different factors influence deflection of the beam? Calculate permissible limits of deflection of an 8 m long beam corresponding to different stages. **04**

E Steel with ultimate tensile strength 1600 MPa is used for prestressing. Determine the following. **04**
- **(i)** Maximum permissible initial stress in steel
- **(ii)** Maximum possible stress in steel at failure of section in limit state of collapse flexure
- **(iii)** Minimum stresses effectively available after all losses
- **(iv)** Loss of stress in steel due to relaxation, if initial stress in steel is 1200 MPa. Consider normal relaxation.

Q2

A A 5 m long simply supported beam 200 mm x 450 mm is prestressed by a parabolic cable carrying an effective force of 600 kN. Cable is located at 150 mm below centroid at mid span and concentric at supports. The beam supports a factored load of 90 kN/m (inclusive of self weight). Calculate the principal tensile stresses at support section at following mentioned fibers and compare with limiting value. Use M40 concrete. **10**
- **(i)** 100 mm above centroidal axis
- **(ii)** 100 mm below centroidal axis

B Define kern points and derive equation for top & bottom kern point. Also determine the efficiency of rectangular section of dimensions 'b x d' and circular section of diameter 'd'. **05**

C Explain the concept of load balancing. Sketch a load balancing cable for a concrete beam with a single overhang. Beam is simply supported at A & B over a span of 8 m and the overhang BC is 2 m. The beam supports uniformly distributed load over the entire span. **05**

Q3

A A posttensioned beam of rectangular section 200 mm x 450 mm is prestressed by a cable made up of 12 - 8 mm ϕ wires. Cable is linear with maximum eccentricity at mid span. It is located at 100 mm from soffit of the beam at mid span and concentric at supports. The wires are initially stressed to 1100 MPa. Jacking force is applied from one end only. **15**
Take $\mu = 0.15$, $K = 0.0066$ / m, anchorage slip = 2 mm, span = 6 m simply supported, $E_s = 210$ kN/mm^2, $E_c = 35$ kN/mm^2, shrinkage strain in concrete $(\varepsilon_{ca} + \varepsilon_{cd}) = 300 \times 10^{-6}$, creep coefficient = 1.6, consider 6 % relaxation loss.
Estimate loss of stress, loss of strain, percentage loss of stress and percentage loss of strain in steel.

B A prestressed concrete beam 150 mm wide and 400 mm deep of span 10 m is simply supp
It is subjected to a live load of 10 kN/m at service. Initially a prestressing force of 400 k
applied at a constant eccentricity of 50 mm. Take unit weight of concrete and characteris
strength of concrete as 24 kN/m^3 and 40 MPa respectively. Assume loss ratio as 0.85. Determin
shear strength of the section and comment on requirement of shear reinforcement.

Q4

A A concrete beam of 10 m simply supported span has 300 mm wide and 500 mm deep rectangular section. It is prestressed by 2 post-tensioned cables of area 600 mm^2 each. They are initially stressed to 1600 N/mm^2. The cables are located at 150 mm below neutral axis throughout the length. Take E_c = 38 kN/mm^2 and γ_c = 24 kN/m^3. **10**

(i) Neglect all losses, find the deflection at the center of the span at transfer stage.

(ii) Allowing 20 % loss in prestress, find the deflection at the center of the span when it carries an imposed load of 25 kN/m.

B A posttensioned concrete beam of simply supported span 16 m is of rectangular section 400 mm wide and 1200 mm deep. A tendon consists of 3300 mm^2 area is made of steel having characteristic strength 1700 N/mm^2. The tendon is located at 870 mm from the top face of the beam. If f_{ck} = 60 N/mm^2, estimate the ultimate flexural strength of the section and corresponding safe uniformly distributed load on the beam. Take γ_c = 25 kN/m^3. **10**

Q5

A post-tensioned unsymmetrical I-section having the following properties is used as a 30 m long simply supported bridge girder. **20**

Overall depth = 1000 mm, position of the centroid from top edge = 440 mm, area of C/s = 345000 mm^2, Z_t = 95 x 10^6 mm^3, Z_b = 75 x 10^6 mm^3

Consider type-1 element and M55 concrete with f_{ci} = 38.5 MPa, imposed load 3 kN/m, η = 0.75, γ_c = 25 kN/m^3

The girder is safe in limit state of serviceability maximum compression in flexure and cracking. Determine prestressing force and corresponding eccentricity. Ensure that CGS is at minimum 100 mm from soffit. Also locate safe cable zone.

Q6

A A 6 m long simply supported beam has rectangular C/s 200 mm x 450 mm. It is prestressed by a cable consisting of 20 H T wires of 4 mm ϕ each having f_i = 1000 MPa. Beam carries 8 kN/m impose load. Consider 20 percent loss in prestress at service. Cable is parabolic and placed with zero eccentricity at supports and maximum 125 mm towards soffit at mid span. Determine stresses at mid span, quarter span and support section at transfer and service stage. **15**

B Explain concept of thrust line? Sketch expected thrust line at transfer stage and service stage for a simply supported beam subjected to uniformly distributed load. Beam is prestressed by a parabolic cable, located below neutral axis at mid span and concentric at supports. **05**

****