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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Eighth Semester, B.E. - Civil Engineering

Semester End Examination; July - 2021

Design of Prestressed Concrete Structure

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer any **FIVE** full questions.*
ii) Use of IS-1343-2012 is permitted. iii) Missing data, if any, may be suitably assumed.

1. Write short notes on the following:
   a) Stress corrosion and embrittlement of steel b) Non-Prestressed reinforcement in PSC 20
   c) Tendon splices d) Applications of prestressed concrete

2 a. Explain briefly various methods of imparting pre-compression to concrete. 10

b. What is pressure line? Explain its significance with neat sketches. 10

3 a. What are the basic assumptions in prestressed concrete? 5

b. The cross section of precast concrete slab unit for a bridge floor is as shown in Fig. Q. 3(b). Each slab unit is supported at 10 m intervals. The slab unit is subjected to a prestressing force of 375 kN applied at 45 mm from the soffit. Determine the extreme stresses in concrete for the mid-span section;
   i) When the beam is subjected to dead load and prestressing force
   ii) When the beam is subjected to dead load, live load and the prestressing force.
   The live load on the beam is 5.75 kN/m. Also sketch stress variation diagram. 15

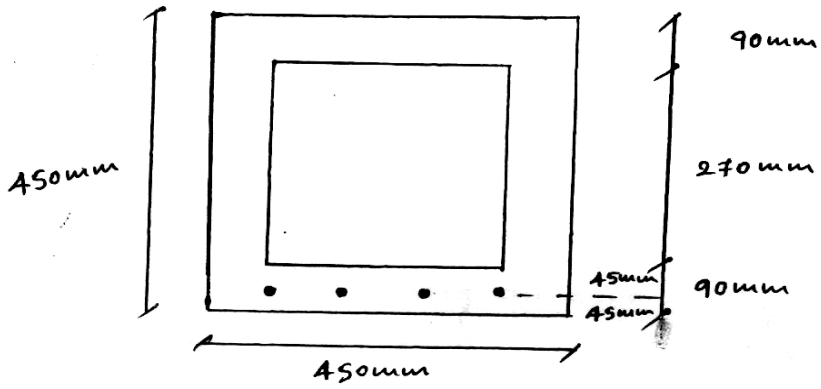

Fig. Q3(b): Precast Concrete Slab

4. A simply supported beam has a span of 10 m and is (300 × 600 mm) in section. It is prestressed with an initial prestress of 700 kN which is located at 100 mm from soffit of beam. The beam carries a load of 12 kN/m in addition of its own weight. Assuming the loss as 15%, determine extreme fibre stresses in concrete at mid-span for the following conditions: 20
   a) Transfer of prestress b) Working load condition
   Also sketch stress variation diagram.

Contd… 2

5 a. Explain briefly the loss of prestress due to Elastic shortening of concrete, creep, shrinkage and anchorage slip. 10

b. A pretensioned concrete beam (200 × 300 mm) and span 6 m is initially prestressed by a force of 400 kN applied at a constant eccentricity of 70 mm by tendons of area 400 mm^2. 10

If $E_s = 2\times10^5\, N/mm^2$, $E_C = 0.333\times10^5\, N/mm^2$, creep coefficient in concrete = 2, shrinkage strain in concrete = 0.0002, stress relaxation in steel = 3%. Find percentage loss in tendon.

6 a. What are the various factors influencing deflection of a PSC beam? 6

b. A prestressed concrete beam spanning over 8 m is of rectangular section, 150 mm wide and 300 mm deep. The beam is prestressed by a parabolic cable having an eccentricity of 75 mm below centroidal axis at the center of span and an eccentricity of 25 mm above the centroidal axis at the support sections. The initial force in the cable is 350 kN. The beam supports three concentrated loads of 10 kN each at intervals of 2 m. 14

Take; $E_C = 38\ kN/mm^2$.

i) Neglecting losses of prestress, estimate the short term defelection due to (Prestress + selfweight)

ii) Allowing for 20% loss in prestress, estimate the long term deflection under (prestress + selfweight + live load) assuming creep coefficient as 1.80.

7 a. A pre-tensioned beam of rectangular section 400 mm wide by 1000 mm overall depth is prestressed by 800 mm^2 of high tensile steel wires at an eccentricity of 300 mm. If $f_{ck} = 40\ N/mm^2$, $f_p = 1600\ N/mm^2$, estimate the ulitmate flexural strength of the section. 8

b. A post-tensioned unbounded prestressed concrete beam of T-section having a flange width of 1200 mm and thickness of flange 150 mm, thickness of web being 300 mm is prestressed by 4700 mm^2 of high tensile steel located at an effective depth of 1600 mm. 12

If $f_{ck} = 40\ MPa$, $f_p = 1600\ MPa$, span to effective depth ratio is 20 and the effective prestress after all losses is 1000 N/mm^2. Estimate the ultimate flexural strength of the unbounded section.

8 a. Discuss briefly the modes of failure due to shear. 6

b. A concrete beam of rectangular section has a width of 250 mm and depth of 600 mm. The beam is prestressed by a parabolic cable carrying an effective force of 1000 kN. The cable is concentric at supports and has a maximum eccentricity of 100 mm at the center of span. The beam spans over 10 m and supports a live load of 20 kN/m. Estimate; 14

i) The maximum principal stress developed in the section of the beam at a distance of 300 mm from the support

ii) The prestressing force required to nullify the shear force due to dead and live loads at the support section.

Contd… 3

9 a. Define end block. What is bursting force and end zone reinforcement ? 8

b. The end block of prestressed concrete beam of rectangular in section is 150 mm wide and 400 mm deep. An effective prestressing force of 400 kN is transmitted to concrete by a distribution plate of 150 mm wide and 120 mm deep concentrically located at the ends. Calculate the the reinfocement for the end block for maximum transverse tension and sketch the details of reinforcement . Use Fe-250 grade steel in anchorage reinforcement. 12

10 a. What is transmission length? List the various factors influencing transmission length. 6

b. The end block of a post tensioned beam is 300 mm wide and 400 mm deep. A prestressing wire 12 - 5 mm dia and 10 numbers are stressed to 1200 N/mm^2. The wires are located at a constant eccentricity of 100 mm below the centroidal axis. Design the end block and detail the reinforcement. If the anchorage plate is (200 $\times$ 200 mm) and the dia of the duct is 100 mm, permissible stress in concrete at transfer $f_{ci} = 20\ N/mm^2$. Permissible shear stress in steel is 94.5 N/mm^2. Determine the thickness of anchorage plate. 14

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