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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SECOND SEMESTER M.TECH DEGREE EXAMINATION, MAY 2016

Civil Engineering

(**Computer Aided Structural Engineering)**

10CE6122 Advanced Prestressed Concrete Design

Max. Marks: 60 Duration:3 hours

Part A

(Answer any two questions : 9 x 2 = 18 Marks)

1. What are the different types of flexural failure modes observed in prestressed concrete beams ?
2. A post tensioned prestressed concrete beam of unsymmetrical T section has the following section properties width and thickness of flange =1500 and 200mm respectively, thickness of the web=300mm. The tendons (bonded) with a cross section of 5000mm^2 are located at an effective depth of 1800mm.Given f_{cu}=40N/mm2 and f_{pu}=1600N/mm^2.Estimate the ultimate flexural strength.
3. A prestressed concrete beam supports a live load of 4kN/m over a simply supported span of 8m.The beam has an I section with an overall depth of 400mm.The thickness of the flange and web are 60 and 80mm,respectively. The width of the flange is 200mm.The beam is to be prestressed by an effective prestressing force of 235kN at a suitable eccentricity such that the resultant stress at the soffit of the beam at the centre of the span is zero.
   a) Find the eccentricity required for the force.
   b) If the tendon is concentric what should be the magnitude of the prestressing force for the resultant stress to be zero at the bottom fibre of the central span section.

Part B

(Answer any two questions : 9 x2 = 18 Marks)

4. What is the transmission length? List the various factors influencing transmission length?
5. A floor slab spanning 8m is to be designed as a one way prestressed concrete slab with parallel post tensioned cables. The deck slab is required to support a uniformly distributed live load of 10kN/m^2.The permissible stresses in concrete should not exceed 14N/mm^2 in compression and no tension is permitted at any stage. Design a suitable thickness for the slab and find the spacing of the cables(12 of 5mm diameter initially stressed to 1200N/mm^2) and their position at mid span section. Assume loss ratio is 0.8.
6. A prestressed concrete beam of rectangular section, 90mm wide and 180mm deep, is to be designed to support two imposed loads of 3.5kN, each located at one-third points over a

span of 3m. If there is to be no tensile stress in concrete at transfer and service loads, Calculate the minimum prestressing force and the corresponding eccentricity,
Dc = 24kN/m^3.Loss ratio=0.8.

Part C

(Answer any two questions : 12 x2 = 24 Marks)

7. What are the different types of joints used between the walls and floor slab of prestressed concrete tanks?
8. A two span continuous beam ABC(AB=BC=15m)is of rectangular section,250mm wide and 600mm deep. The beam is prestressed by a cable parallel to the axis and having an eccentricity of 200mm .The effective force in cable is 500kN.
   a) Determine the secondary and resultant moment developed at the mid support section B.
   b) If the beam supports an imposed load of 2.4kN/m, calculate the resultant stresses developed at the top and bottom of the beam at B. Also locate the resultant line of thrust through the beam AB.
9. a) What are the advantages of using composite construction with prestressed and in situ concrete in structural members?
   b) Explain differential shrinkage?

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Part A

(Answer any two questions : 9 x 2 = 18 Marks)

1. a) What are tendon splices? Sketch some common types of tendon splices? (5 marks)

   b) Why Post tensioned members do not suffer the loss of stress due to elastic shortening? (4 marks)

2. A concrete beam of rectangular section 250mm wide 650mm overall depth is subjected to a torque of 20kNm and a uniform prestressing force of 150kN.Calculate the maximum principal tensile stress. Assuming 15 percent loss of prestress, calculate the prestressing force necessary to limit the principal tensile stress to 0.4N/mm^2.
3. A rectangular concrete beam,100mm wide by 250mm deep spanning over 8m is prestressed by a straight cable carrying an effective prestressing force of 250kN located at an eccentricity of 40mm.The beam supports a live load of 1.2kN/m.

a) Calculate the resultant stress distribution for the central cross section of the beam. The density of concrete is 24kN/m^3.

b) Find the magnitude of the prestressing force with an eccentricity of 40mm which can balance the stresses due to dead and live loads at the bottom fibre of the central section of the beam.

Part B

(Answer any two questions : 9 x2 = 18 Marks)

4. A prestressed concrete beam with a cross section 120mm wide and 300mm deep is used to support a uniformly distributed live load of 3 kN/m over an effective span of 6m.The beam is prestressed by a straight cable carrying an effective prestressing force of 180kN at a constant eccentricity of 50mm.Given Ec=38kN/mm^2,the modulus of rupture=5N/mm^2,area of the cable=200mm^2 and modular ratio=6,estimate the deflection of the beam at the following stages:

   a) working load b)cracking load c)1.5 times cracking load.
5. Design a pre tensioned symmetrical I beam for an effective span of 7m to support a superimposed load of 6kN/m.The beam is to be precast in a factory and is to be designed for

handling at any point along its length during transport and erection. Load factors against failure by bending or shear:

For dead load =1.5

For live load= 2.5

Permissible stresses:

At transfer,

Compressive stress = 14N/mm^2

Tensile stress=1.4N/mm^2

At working load,

Compressive stress=16N/mm^2

Tensile stress=1.4N/mm^2

The specified 28 day strength of concrete is 50N/mm^2.The prestressing force is to be provided by 5mm diameter high tensile wires having an ultimate tensile strength of 1600N/mm^2.The loss ratio is 0.8.

6. What are salient design features of prestressed concrete one way slab and two way slab panels?

Part C

(Answer any two questions : 12 x2 = 24 Marks)

7. A rectangular pretensioned concrete beam has a breadth of 100mm and depth of 230mm and the prestress after the losses have occurred is 12N/mm^2 at the soffit and zero at the top. The beam is incorporated in a composite T-beam by casting a top flange of breadth 300mm and depth 50mm.Calculate the maximum uniformly distributed live load that can be supported on a simply supported span of 4.5m,without any tensile stresses occurring ,if
   a) the slab is externally supported while casting and
   b) the pretensioned beam supports the weight of the slab while casting.

8. a) What are cap cables ? Where are they used?
   b) What are the advantages of Partial or limited Prestressing ?

9. A prestressed concrete pipe of 1.2m diameter and a core thickness of 75mm is required to withstand a service pressure intensity of 1.2N/mm^2.Estimate the pitch of a 5mm diameter high tensile wire winding if the initial stress is limited to 1000N/mm^2.Permissible stresses in concrete are 12.5N/mm^2 in compression and zero in tension. The loss ratio is 0.8.If the direct tensile strength of concrete is 2.5N/mm^2, Estimate the load factor against cracking.

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Civil Engineering

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10CE6122 Advanced Prestressed Concrete Design

Max. Marks: 60 Duration:3 hours

Part A

(Answer any two questions : 2 x 9 = 18 Marks)

1. What are the different types of flexural failure modes observed in prestressed concrete beams ?
2. A rectangular concrete beam,100mm wide by 250mm deep spanning over 8m is prestressed by a straight cable carrying an effective prestressing force of 250kN located at an eccentricity of 40mm.The beam supports a live load of 1.2kN/m.

a) Calculate the resultant stress distribution for the central cross section of the beam. The density of concrete is 24kN/m^3.

b) Find the magnitude of the prestressing force with an eccentricity of 40mm which can balance the stresses due to dead and live loads at the bottom fibre of the central section of the beam.

3. A double T-section having a flange 1200mm wide and 150mm thick is prestressed by 4700 N/mm^2 of high tensile steel located at an effective depth of 1600mm.The ribs have a thickness of 150mm each. If the cube strength of concrete is 40 N/mm^2 and tensile strength of steel is 1600N/mm^2,determine the flexural strength of the double T-girder using IS:1343 provisions.

Part B

(Answer any two questions : 2 x9 = 18 Marks)

4. What is the transmission length? List the various factors influencing transmission length?

5. What are salient design features of prestressed concrete one way slab and two way slab panels?

6. A high tensile cable comprising 12 strands of 15mm diameter(12K-15 of PSC Freyssinet System) with an effective force of 2500kN is anchored concentrically in an end block of a post tensioned beam. The end block is 400mm wide by 800mm deep and the anchor plate is 200mm wide by 260mm deep. Design suitable anchorage zone reinforcement using Fe-415 HYSD bars using IS:1343 code.

Part C

(Answer any two questions : 2 x12 = 24 Marks)

7. What are the different types of joints used between the walls and floor slab of prestressed concrete tanks?
8. Explain the pre tensioned and post tensioned bridge decks commonly used in the construction of bridges ? List out the advantages of prestressed concrete bridges ?
9. A prestressed concrete pipe of 1.2m diameter and a core thickness of 75mm is required to withstand a service pressure intensity of 1.2N/mm^2.Estimate the pitch of a 5mm diameter high tensile wire winding if the initial stress is limited to 1000N/mm^2.permissible stresses in concrete are 12.5N/mm^2 in compression and zero in tension. The loss ratio is 0.8.If the direct tensile strength of concrete is 2.5N/mm^2, Estimate the load factor against cracking.