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QUESTION BANK

Subject with Code: DOPCS (19CE1021) **Course & Specialization**: M.Tech – Structures

Year & Sem: II-M.Tech & I-Sem **Regulation:** R19

UNIT -1

METHODS OF PRESTRESSING

1. (a) Briefly outline the advantages of using high strength concrete & high strength steel in prestressed concrete structures.
   (b) Define the following terms:
      (i) Externally prestressed members.
      (ii) Internally prestressed members
      (iii) Circular prestressing.
   (c) Explain Historical development of prestressed concrete?

2. (a) Explain Pretensioning and Post tensioning of concrete members. What are the advantages of prestressed concrete members over reinforced concrete members?
   (b) Explain Gifford Udall system of Post tensioning with the help of neat sketch.

3. (a) What is the need for using high tension steel instead of mild steel in PSC?
   (b) Why do you go for high grade concrete instead of ordinary concrete in PSC?

4. (a) Explain the Magnel Blaton system of prestressing with the help of a neat sketch.
   (b) Explain in detail Gifford Udall system of post tensioning with the help of neat sketch.

5. (a) Explain Hoyer systems of pre tensioning with sketches.
   (b) Explain Freyssinet system of pre tensioning with sketches.

6. (a) Differentiate between Pretensioning and post tensioning systems? How is prestress Transmitted to the concrete in (i) pretension members and (ii) post tensioned members
   (b) What are the general principals of prestressing? What are the advantages of using high Strength concrete and high strength steel?

7. Write short note on
   (a) Prestressed concrete versus Reinforced concrete.
   (b) Merits and demerits of Prestressed Concrete.
   (c) Pre-tensioning versus post tensioning.
   (d) Advantages of High strength concrete in prestressing concrete.

8. Write short note on
   (a) Freyssinet system
   (b) P.S.C Mono wire system.
   (c) Lee-McCall system.

9. (a) What is the minimum concrete strength requirements prescribed for prestressed concrete Members in IS: 1343 code?
   (b) What are post-tensioning anchorages?
   (c) Where do you adopt circular prestressing?

10. (a) What are the principles of prestressing in pretensioning and post tensioning?
    (b) What are the various states of loading stages to be considered in the design of prestressed concrete structures?

UNIT –II

LOSSES OF PRESTRESS

1. A post tensioning member of 250mm wide and 400mm deep is prestressed by a area of cables 250mm^2 is located at a distance of 125mm from soffit. Te prestressing force applied for a cable is 300kN. What is the loss of stress developed in friction? Take co-efficient of friction between cable and duct is 0.35 and friction co-efficient is 0.0015/m.

2. A concrete beam of 10 m span 100 mm wide and 300 mm deep is prestressed by 3 cables. The area of each cable is 200 mm^2 and the initial stress in the cable is 1200 N/mm^2. Cable 1 is parabolic with an eccentricity of 50 mm above the centroid at supports and 50 mm below at the centre of span. Cable 2 is also parabolic with zero eccentricity at supports and 50 mm below the centroid at the centre of span. Cable 3 is straight with uniform eccentricity of 50 mm below the centroid. If the cables are tensioned from one end only, estimate the percentage loss of stress in each cable due to the effects of friction. Assume μ =0.35 and K=0.0015/M.

3. A straight post tensioned concrete member 15m long with a cross section of 400 * 400mm^2 is prestressed with 900mm^2 of steel wires. This steel is made of four tendons with 225 mm^2 per tendon. The tendons are tensioned to a stress of 1050N/mm^2. Determine the loss of prestress in each tendon due to elastic shortening of concrete. Find also the average percentage loss of prestress. If it is desired that after the last tendon is tightened, a stress of 1050 N/mm^2 be maintained in each tendon, compute the actual stresses to which the individual tendons should be tightened. Take m=16.

4. A pre tensioned beam 200mm wide and 300mm deep is prestressed by 10 wires of 7mm diameter initially stressed to 1200N/mm^2, with their centroid located at 100mm from the soffit. Find the maximum stress in concrete immediately after transfer, allowing only for elastic shortening of concrete. If the concrete undergoes a further shortening due to creep and shrinkage while there is relaxation of 5 percent of steel stress, estimate the final percentage loss of stress in the wires using the Indian standard code (IS: 1343-1980) regulations, and the following data: creep coefficient = 1.6; E_s=210KN/mm^2, E_c=5700$(f_{cu})^{1/2}$, f_{cu} = 42 N/mm^2 and Total residual shrinkage strain = 3x10^{-4}

5. A prestressed concrete beam 200mm wide and 300mm deep is prestressed with wires of area 320 mm^2 located at a constant eccentricity of 50 mm and carrying an initial stress of 1000 N/mm^2. The span of the beam is 10m. calculate the percentage loss of stress in the wires if the beam is (a) the beam is pretensioned and (b) beam is post tensioned, using the following data: Es =210kN/mm^2 and Ec = 35 kN/mm^2; relaxation of steel stress = 5 percent of the initial stress; shrinkage of concrete = 300*10^{-6} for pretensioning and 200*10^{-6} for post tensioning; creep coefficient =1.6; slip at anchorage = 1 mm; frictional coefficient for wave effect = 0.00154 per m.

6. A post-tensioned concrete beam, 100mm wide and 300mm deep, is prestressed by three cables, each with a cross-sectional area 50*mm*^{2} and with an initial stress of 1200=*mm*^{2}. All the cables are straight and located 100mm 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 the only the following cases. Simultaneous tensioning and anchoring of all three cables and successive tensioning of the three cables, one at a time. Assume μ =0.35 and K=0.0015/M

7. A post tensioned concrete beam 200mm wide and 450mm deep, is prestressed by a circular cable (Total area = 800 *mm*^{2}) with zero eccentricity at the ends and 150mm at the centre. The span of the beam is 10m. The cable is to be stressed from one end such that an initial stress of 840N/*mm*^{2} is available in the un jacked end immediately after anchoring. Determine the stress in the wires at the jacking end and the percentage loss of stress due to friction. Coefficient of friction for curvature effect = 0.6 Friction coefficient for wave effect = 0.003/m

8. A post-tensioned cable of beam 10m long is initially tensioned to a stress of 1000*N/mm*^{2} at one end. If the tendons are curved so that the slope is 1 in 15 at each end, with an area of 600*mm*^{2}, Calculate the loss of prestress due to friction given the following data. Coefficient of friction between duct and cable = 0.55, friction coefficient for wave effect = 0.015 per m. During anchoring, if there is a slip of 3mm at the jacking end, calculate the final force in the cable and the percentage due to friction and slip E*s* = 210*kN/mm*^{2}.

9. A rectangular prestressed concrete beam has a span of 12m and has to carry a live load of 15KN/m excluding the self-weight of beam. Given f_c= 16N/mm^2 and f_s=1050N/mm^2, design the beam using 6mm tendons. Weight of concrete is 24KN/m^3. Assume depth= 2 times of width.

10. A concrete beam of 9m span 125mm wide and 300mm deep is prestressed by 3 cables. The area of each cable is 200*mm*^{2} and the initial stress in the cable is 1200*N/mm*^{2}. Cables 1 is

parabolic with an eccentricity of 50mm above the centroid at the supports and 50mm below at the centre of span. Cable 2 is also parabolic with zero eccentricity at supports and 50mm below the centroid at the centre of span. Cable 3 is straight with uniform eccentricity of 50mm below the centroid. Is the cables are tensioned from one end only, estimate the Percentage loss of stress in each cable due to friction. Assume μ=0.35 and K=0.0015 per m.

UNIT-III

DEFLECTIONS

1. a) Write about importance of control of deflections and list the various factors influencing the deflection of prestressing concrete members?
   b) Write about short-term and long-term deflections of un-cracked members

2. A concrete beam having a rectangular section of 100mm wide and 300mm deep is prestressed by a parabolic cable carrying an initial force of 240KN. The cable has an eccentricity of 50mm at the center of the span and is concentric at the supports. If the span of the beam is 10m and the live load is 2KN/m, estimate the short time deflection at the center of the span.
   Assuming E=38KN/mm^2 and creep co-efficient is 2.0, loss of prestress =20 percent of the initial stress after 6 months. Estimate the long time deflection at the center of span at this stage, assuming that the dead and live loads are simultaneously applied after ate release of prestress.

3. A concrete beam with a rectangular section 300mm wide and 500mm deep is prestressed by 2 post-tensioned cables of area 600mm^2 each. Initially stressed to 1600N/mm^2. The cables are located at a constant eccentricity of 100mm throughout the length of the beam having a span of 10m. The modulus of elasticity of steel and concrete is 210 and 38KN/mm^2 respectively.
   (a) Neglecting all losses, find the deflection at the center of span when it is supporting its own weight.
   (b) Allowing for 20% loss in prestress, find the final deflection at the center of the span when it carries an imposed load of 18KN/m. D_c=24KN/mm.

4. A concrete beam with a cross section area of 32*10mm^3 and radius of gyration of 72mm is prestressed by a parabolic cable carrying an effective stress of 1000 N/mm^2. The span of the beam is 8m. The cable, composed of 6 wires of 7mm diameter has an eccentricity of 50mm at the centre and zero at the supports. Neglecting all the losses, and the central defection of the beam as follows:
   a) Self weight + prestress and
   b) self weight + prestress + live load of 2 kN/m.

5. A rectangular concrete beam of cross- section150mm wide and 300mm deep is simply supported over a span of 8m and is prestressed by means of a symmetric parabolic cable, at a distance of 75mm from the bottom of the beam at mid span and 125mm from the top of the beam at support sections. If the force in the cable is 350KN and the modulus of elasticity of concrete is 38KN/mm^2, calculate:
   a) the deflection at mid-span when the beam is supporting its own weight and
   b) the concentrated load which must be applied at mid-span to restore it to the level of supports.

6. a) Explain short term deflections of un-cracked members.
   b) Explain about prediction of long time deflections.

7. A concrete beam having a rectangular section of 150mm wide and 350mm deep is prestressed by a parabolic cable carrying an initial force of 340KN. The cable has an eccentricity of 75mm at the center of the span and is concentric at the supports. If the span of the beam is 10m and the live load is 2.5KN/m, estimate the short time deflection at the center of the span.
Assuming E=38KN/mm^2 and creep co-efficient is 2.0, loss of prestress =20 percent of the initial stress after 6 months. Estimate the long time deflection at the center of span at this stage, assuming that the dead and live loads are simultaneously applied after ate release of prestress.

8. a) List out the various factors influencing deflections of prestressing concrete members?
b) Explain about deflections due to self-weight and imposed loads?

9. A prestressed concrete beam of rectangular section 120mm wide by 300mm deep, span over 6m. The beam is prestressed by a straight cable carrying an effective force of 200KN at an e=50mm, E=38Kn/mm^2. Compute the deflection at centre of span for the following cases:
a) Deflection under (presress + self weight)
b) Find the deflection due to prestess and self-weight.

10. A post tensioned root girder spanning over 30m has an unsymmetrical I-section with a second moment of an area of section 72490X10^6 mm^4 and an overall depth of 1300mm. The effective eccentricity of the group of parabolic cables at the center of span is 580mm towards the top of the beam at supports. The cables carry an initial prestressing force of 3200KN.
The self-weight of the girder is 10.8KN/m and the live load on the girder is 9KN/m, E=34KN/mm^2. If the creep co-efficient is 1.6 and the total loss of prestress is 15%. Estimate the deflections at the following stages and compare them with the permissible values according to IS 1343.
a) Instantaneous deflection due to prestress+ self weight
b) Resultant maximum long term deflection allowing for loss of prestress and creep of concrete

UNIT- IV

FLEXURAL, SHEAR & TORSIONAL RESISTANCE OF CONCRETE MEMBERS

1. A prestressed T-section has flange 1200mm wide and 150 mm thick. The width and depth of rib are 300 and 1500 mm respectively. The high tensile steel has an area of 4700 mm^2 and is located at an effective depth of 1600mm. if the characteristic cube strength of the concrete and tensile strength of steel are 40 and 1600N/mm^2, calculate the flexural strength of the T-section.

2. A prestressed concrete beam span of 10m of rectangular section, 120mm wide and 300mm deep, is axially prestressed by a cable carrying an effective force of 180kN. The beam supports a total uniform distributed load of 5kN/m which includes the self-weight of beam. Compare the magnitude of the principal tension developed in the beam with and without the axial prestress?

3. A cantilever portion of a prestressed concrete bridge with a rectangular cross-section, 600mm wide and 1650mm deep is 8m long and carries a reaction of 350kN from the suspended span at the free end, together with a uniform distributed load of 60kN/m inclusive of its own-weight. The beam is prestressed by seven cables each carrying a force of 1000KN, of which three are located at 150mm, 3 at 400mm, and one at 750mm, from the top edge. Calculate the magnitude of the principle stresses at a point 550mm from the top of cantilever at the support section.

4. A post tensioned beam of rectangular cross section, 200 mm wide and 400 mm deep, is 10m long and carries an applied load of 8kN/m, uniformly distributed on the beam. The effective prestressing force in the cable is 500kN. The cable is parabolic with zero eccentricity at the supports and a maximum eccentricity of 140 mm at the centre of span.
   i) Calculate the principal stresses at the supports
   ii) What will be the magnitude of the principal stresses at the supports in the absence of prestress?

5. Explain briefly about shear and principal stresses due to torsion in members.

6. A pretensioned prestressed concrete beam having a rectangular section, 150mm wide and 350mm deep, has an effective cover of 50mm. If f_{ck}= 40N/mm^2, f_p=1600N/mm^2, and the area of prestressing steel A_p=461 mm^2, calculate the ultimate flexural strength of the section using 18:1343 code provisions.

7. a) Write about shear and principal stresses?
   b) Explain briefly about types of shear cracks?

8. A pretensioned, T-section has a flange which is 300mm wide and 200mm thick. The rib is 150mm wide by 350mm deep. The effective depth of the cross-section is 500mm. Given A_p = 200mm^2, f_{ck}= 50N/mm^2 and f_p=1600N/mm^2, estimate the ultimate moment of the T-section using the Indian standard code regulations.

9. Write briefly about introduction to Limit state Design of Prestressed concrete for flexure.

10. A prestressed T-section has flange 1500mm wide and 200 mm thick. The width and depth of rib are 350 and 1600 mm respectively. The high tensile steel has an area of 5000 mm^2 and is located at an effective depth of 1600mm. if the characteristic cube strength of the concrete and tensile strength of steel are 40 and 1600N/mm^2, calculate the flexural strength of the T-section.

UNIT –V

COMPOSITE SECTIONS & STATICALLY INDETERMINATE STRUCTURES

1. A beam of composite section consists of cast in situ flange 325mmX50mm over a 100mmX250mm precast pre-tension unit. The stress distribution for the precast unit alone due to prestressing force is 12.5N/mm^2. Find the uniformly distributed load for the composite beam on a simply supported span of 6m, for the following two cases:
   i) The flange is supported independently while it is caste
   ii) The weight of the flange and shuttering is supported by the pre-tensioned unit at the stage of casting.
   The weight of the shuttering is removed after the hardening of the flange concrete. The modular ration between flange concrete and the precast concrete is 0.60, the weight of the shuttering is 0.25KN/m, weight of concrete=24KN/m^3.

2. The cross-section of a composite beam is of T- section having a pretensioned rib, 80mm wide and

240mm deep, and an in situ cast slab, 350mm wide and 80mm thick. The pre-tensioned bean is reinforced with eight wires of 5mm diameter with an ultimate tensile strength of 1600N/mm^2, located 60mm from the soffit of the beam. The compressive strength of concrete in the in situ cast and precast elements is 20 and 40 N/mm^2 respectively. If adequate reinforcements are provided to prevent shear failure at the interface, estimate the flexural strength of the composite section.

3. Explain briefly about shear strength of composite sections.

4. A composite beam of rectangular section is made up of a precast prestressed inverted T-beam having a rib, 100mm by 780mm, and a slab, 400mm and 200mm thick. The in situ cast concrete has a thickness of 800mm and a width of 400 mm. The precast T-beam is reinforced with high-tensile wires (f_{pu} =1600N/mm^2) having an area of 800mm^2 and located 100mm from the soffit of the beam. If the cube strength of concrete in the in situ cast slab and prestressed beam is 20 and 40 N/mm^2 respectively, estimate the flexural strength of the composite section.

5. Explain the design procedure for the continuous prestessed concrete beams.

6. Explain the general method for the determination of concordant tendon profile.

7. The cross-section of a composite beam is of T- section having a pretensioned rib, 100mm wide and 270mm deep, and an in situ cast slab, 300mm wide and 80mm thick. The pre-tensioned bean is reinforced with eight wires of 5mm diameter with an ultimate tensile strength of 1500N/mm^2, located 70mm from the soffit of the beam. The compressive strength of concrete in the in situ cast and precast elements is 20 and 40 N/mm^2 respectively. If adequate reinforcements are provided to prevent shear failure at the interface, estimate the flexural strength of the composite section.

8. a)Write about effect of prestressing indeterminate structures.
   b) What are the advantages and disadvantages of continuous members?

9. Write briefly about Primary and secondary moments in continuous prestressed concrete members?

10. Draw neat sketches of cable Layouts for continuous beams and explain.