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

(An Autonomous Institution affiliated to VTU, Belgaum)

Eighth Semester, B.E. - Civil Engineering

Semester End Examination; June - 2016

Design of Prestressed Concrete Structures

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer any **FIVE** full questions, selecting at least **TWO** full questions from each part.*
ii) Assume suitable data for missing details.
iii) Code IS: 1343-2012 is permitted.

PART - A

1 a. Explain stress corrosion and hydrogen embrittlement of steel. 4

b. Explain with sketch Hoyer's long line method of pre tensioning. 4

c. Explain advantages and disadvantages of PSC over RCC. 4

d. Object of using high strength steel and high strength concrete. 4

e. Explain bonded and un-bonded tendons, end anchored and non-end anchored tendons. 4

2 a. i) Explain Non-pre stressed reinforcement (steel) in PSC.
ii) Advantages and disadvantages of post tensioning. 8

b. A simply supported beam has a span of 10 m and is 300 mm x 600 mm in section. It is prestressed with an initial pre stress of 700 kN, which is located at 100 mm from the soffit of the beam. The beam carries a load of 12 kN/m in addition to its own weight. Assuming loss ratio as 15% and density of concrete as 24 kN/m^3. Determine extreme fibre stresses in concrete in concrete under the following conditions : 12

i) At transfer of prestress or unloaded condition ii) At working load or loaded condition

Also draw the stress variation diagram.

3 a. Explain in detail creep of concrete with sketch and equation. Explain in detail shrinkage of concrete. 6

b. A post tensioned beam 200 mm x 500 mm of span 10 m is prestressed with a parabolic cable having zero eccentricities at both supports and maximum eccentricity of 200 mm below centre of gravity of concrete at mid span. Parabolic cable consists of 24 parallel wires each 7 mm diameters. The wires have to be tensioned two at a time from one end to a value of "f_1" so as to overcome friction and then released to a value "f_2" so that immediately after anchoring an initial stress of 1000 MPa could be obtained. Hence compute the final design stress in tensioned steel. Assume the following : 14

Creep coefficient = (2.2-1), Shrinkage strain of concrete=1.4x10^{-4} cm/cm

Anchorage slip = 2 mm per end, Coefficient of friction = 0.4,

Wobble effect constant = 0.0015/m, Young's modulus of steel = 2.1x10^5 MPa (N/mm^2), Relaxation of steel = 2%.

4 a. Distinguish between short term and long term deflection in PSC beam. Explain camber in PSC beam and explain disadvantages of excessive cambering. 6

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b. A beam 240 mm x 500 mm in section is simply supported over a span of 10 m. It is prestressed with a parabolic cable which has maximum eccentricity of 175 mm below centre of gravity of concrete at mid span and minimum eccentricity of 50 mm below C.G.C at supports. Effective prestress in the cable is 1500 kN. Determine; 14

i) Maximum deflection due to pre stress + self weight

ii) Central concentrated load required to nullify this deflection

iii) Uniformly distributed load required to cause resultant deflection of *l*/250, *l* being span of the beam. Assume density of concrete as 25 kN/m^3 use M40 concrete.

PART - B

5 a. A pre tensioned T-section has a flange which is 300 mm wide 200 mm thick. The rib is 150 mm wide × 350 mm deep. The effective depth of the cross-section is 500 mm. Given AP =200 mm^2, f_{ck} = 50 N/mm^2 and f_p = 1600 N/mm^2, Estimate the ultimate moment capacity of the T-section using I.S. code regulations. 8

b. A post tensioned bonded pre-stressed concrete beam of un symmetrical T section has a flange width of 1500 mm and thickness of flange is 200 mm. Thickness of rib is 300 mm. The area of high tensile steel is 5000 mm^2 located at an effective depth of 1800 mm. If the characteristic strength of concrete and steel are 40 N/mm^2 and 1600 N/mm^2 respectively. Calculate the flexural strength of the T-section. 12

6 a. Explain types of shear crack with sketches write short notes on diagonal tension OR Principal tension. Write down equations for f_{n2}. 8

b. A beam 300 x 500 mm in section is simply supported over a span of 10 m. It is prestressed with parabolic cable having zero eccentricity at support and maximum eccentricity of 180 at mid span. Effective Prestress in the cable is 600 kN (Effective Prestressing Force F). The beam carries an all inclusive UDL of 25 kN/m. Determine; 12

i) Maximum principal tension developed in concrete

ii) Vertical Prestress required to reduce principal tensions to zero.

7 a. Write short notes with sketches on stress distribution in end block. Transmission of force in end block (Singular and double anchor plate) end blocks of post tensioned beam (idealized stress paths and bursting tension and splitting order) isobars of transverse tensile stress. 10

b. A post tensioned concrete 400 mm wide and 800 mm deep is pre stressed by an effective beam by an effective pre stressing force of 1100 kN at an eccentricity of 120 mm. The anchor plate is 400 mm wide and 400 mm deep. Calculate the bursting force and design shear reinforcement to resist this force. Sketch the details of reinforcement. 10

8 a. Define Kern point and Kern distances. 4

b. Design a slab for span of 8 m. Assume the following :

Dead load 10 kN/m^2 (all inclusive UDL), Live load 20 kN/m^2.

Permissible compression in concrete is limited to 15 N/mm^2 and 12 N/mm^2 at transfer and at working load respectively. Permissible tension in concrete is limited to 1.5 N/mm^2 and 1 N/mm^2 at transfer and at working load respectively. Loss ratio is 8.5%. Also determine the spacing of cable assuming that each cable consists of 8 wires of 7 mm diameter, Minimum required cover = 35 mm. 16

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