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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/July - 2015

Design of Pre-stressed 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) Use of IS:1343 code permitted.

PART - A

1. a. Explain advantages and disadvantages of post tensioning. 5

b. Explain the advantages and disadvantages of PCS over RCC. 4

c. Explain Magnel Blaton method of post tensioning with a neat sketch. 6

d. Explain stress corrosion and Hydrogen embrittlement. 5

2 a. Derive an equation for resultant direct stress along any longitudinal concrete fibre in a given PSC section. Hence derive expression for extreme fibre stresses in concrete at. 6

i) Transfer of pre stress and ii) Working load condition.

b. Figure Q.2(b) shows the mid span section of a simply supported girder of span 16 m. It is pre stressed with 8 cables each of cross sectional area 200 mm^2. Effective prestress in the cable is 800 N/mm^2. The beam is required to carry a control concentrated load in addition to its own weight. Determine the magnitude of this central load so that the bottom fibre stress will be nullified. Also determine the load causing cracking of the section, if modulus of rupture of concrete is 6 N/mm^2. 14

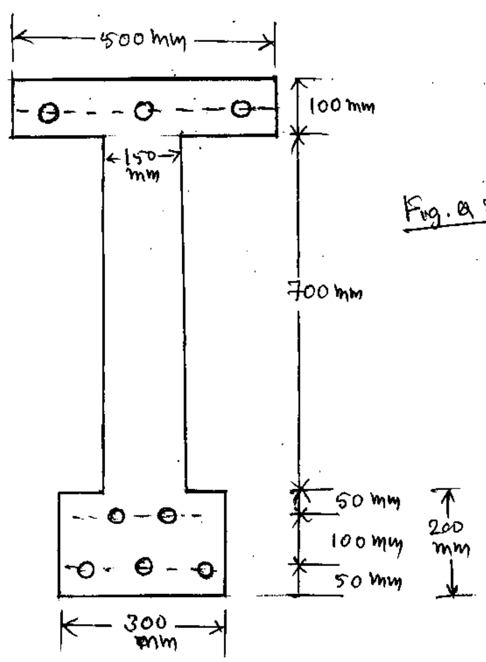

Fig. Q 2(b)

3 a. Explain loss of pre stress due to i) Shrinkage and ii) Creep of concrete. 6

b. A post tensioned beam 300 mm x 500 mm is pre stressed 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. Span of beam is 10 m. Parabolic cable consists of 24 parallel wires each of 7 mm diameter. 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 100 MPa could be obtained. Hence compute the final design stress in tensioned steel.

Assume the following 14

Creep co-efficient = 2.2 – 1.0 = 1.2

Shrinkage strain of concrete = 1.5×10^{-4} mm/mm

Anchorage slip = 2 mm per end

Co-efficient of friction = 0.4

Wobble effect constant = 0.0015/m

$E_s = 2.1 \times 10^5$ MPa, $E_c = 0.35 \times 10^5$ MPa

Relaxation of steel = 2%

4 a. i) Name and explain factors affecting deflection in PSC.

ii) Load deflection curve. 6

b. A beam 250 mm x 400 mm in section is simply supported over a span of 6 m. It is prestressed with a cable whose eccentricity varies linearly from 60mm at supports to 140mm below the centroid at midspan. Initial pre stress in the cable is 900 kN. Assuming loss ratio of 80% Determine maximum deflection of the beam under the following, 14

i) At transfer of pre stress ii) At working load of 20 kN/m

Assume M 40 concrete, density of concrete as 25 kN/m^3.

PART - B

5 a. A double T – section having a flange 1200 mm wide and 150 mm thick is pre stressed by 4700 mm^2 of high tensile steel located at an effective depth of 1600 mm. The ribs have a thickness of 150 mm each. If the cube strength is 40 N/mm^2 and tensile strength of steel is 1600 N/mm^2. Determine the flexural strength of double T – girder using IS:1343 code provisions. 10

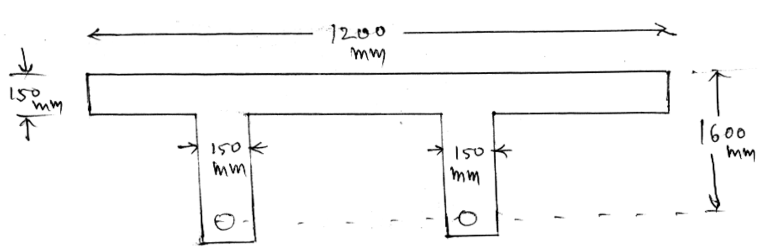

Fig. Q. 5(a)

b. A pre stressed concrete girder of box section 1m x 1m overall dimension has a uniform wall thickness of 200 mm. The girder is post tensioned by high tensile wire of area 2250 mm^2 located at an effective depth of 900 mm. If f_{ck} = 40 N/mm^2 and f_p = 1600 N/mm^2. Calculate the ultimate flexure strength of the box girder section. Fig. Q. 5(b) 10

6. a. i) Sketch shear stress variation diagram for standard sections.
ii) Explain method of improving shear resistance or factors reducing principal tensions. 6

b. A simply supported beam of span 6 m is 120 mm x 300 mm in section. It is prestressed with a parabolic cable which carries an effective pre stress of 200 kN. The cable has a maximum eccentricity of 100 mm at mid span and minimum eccentricity of 50 mm at supports. Determine the principal tension at 20 mm above the centroidal fibre in a section which is located at 0.6 m from left support. The beam caries an all inclusive load of 15 kN/m. 14

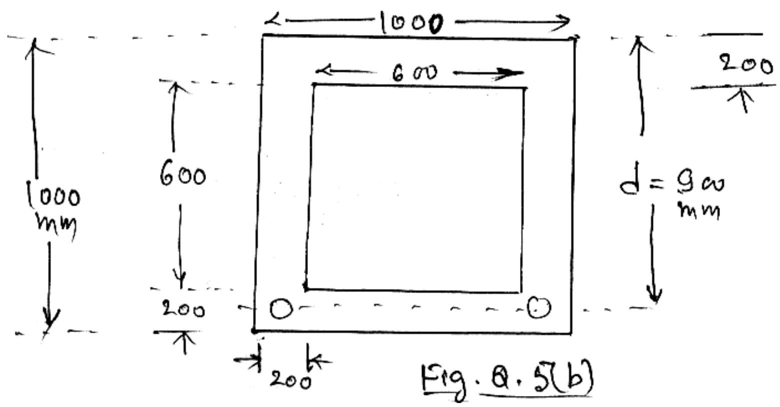

Fig. Q. 5(b)

7 a. Discuss the anchorage zone stresses in PSC beams and sketch typical reinforcement details. 8

b. The end block of a post tensioned beam is 300 mm wide and 400 mm deep. Prestressing wires – 12 cables each consisting of 12 strands of 5 mm diameter are stressed to 1400 N/mm^2. They are located at a constant eccentricity of 100 mm below the centroidal axis. Design a detail the end blocks. determine the thickness of the plate if the size is 200 mm x 200 mm and the diameter of the duct is 100 mm. Permissible stress in concrete at transfer = 20 N/mm^2 and shear stress in steel = 95 N/mm^2. 12

8 a. Write briefly about the limiting zone for cables in PSC members. 6

b. Design a symmetrical I – section for the following requirements. Effective span of the girder is 20m. Live load is 12 kN/m in addition to a central concentrated load of 50 kN. Compressive and tensile stresses in concrete are limited to 14 N/mm^2 and 1.4 N/mm^2 respectively. Loss ratio is 85%. Permissible tensile in steel is 1000 N/mm^2. Use density of concrete as 24 kN/m^3. 14

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