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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; May/ June - 2019

Design of Pre-stressed Concrete Structures

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. Distinguish between Pre-tensioning and Post-tensioning. 6

b. Explain MagneL-Blaton Post-Tensioning system with a neat sketch. 8

c. What are the advantages of Pre-stressed concrete over RCC? 6

2 a. Explain load carrying mechanism of PSC structures. 10

b. Write a short note on; i) Load Balancing Concept ii) Tensioning devices used in PSC 10

UNIT - II

3. A rectangular PSC beam has width = 500 mm and depth = 800 mm. The span of the beam = 10 m. It is pre-stressed with an initial pre-stressing force of 1200 kN. The losses amount to 15%. The cable is parabolic with an eccentricity of 200 mm at midspan and zero eccentricity at supports. Determine the stresses at midspan by stress concept if the beam supports a concentrated live load of 150 kN at midspan. Take density of concrete $\rho = 24$ kN/m^3. 20

4. A Pre stressed concrete beam of the symmetrical I-section is simply supported over a span of 8 m. The width and thickness of the flanges are 250 mm and 80 mm respectively. The overall depth of the beam 500 mm and thickness of the web is 80 mm. The beam is pre-stressed by parabolic cable with eccentricity of 160 mm at the centre and zero at the supports with an effective pre-stressing force 115 kN. The live load on the beam is 2.5 kN/m. Draw the stress distribution diagram at the midspan section for the following loadings : 20

i) Pre Stress + self weight ii) Pre stress+ self weight + live load (density 24 kN/m^3)

UNIT - III

5 a. How do you estimate the loss of Pre Stress due to; 6

i) Relaxation of steel ii) Elastic deformation iii) Creep of concrete

b. A Pre-stressed concrete beam 250 mm wide and 360 mm deep has a span of 12 m. The beam is pre-stressed by steel wires of area of 350 mm^2 provided at a uniform eccentricity of 60 mm with an initial pre-stress of 1250 N/mm^2. Determine the percentage loss of stress in wire.

i) Pre-tensioned beam ii) Post-tensioned beam

Take $E_s = 210$ kN/mm^2, $E_c = 35$ kN/mm^2, Relaxation of steel = 5% of initial stress 14
Anchorage slip = 1.25 mm, Friction coefficient for wave effect K = 0.00051 m
Ultimate creep strain = 45×10^{-6} (Pre-tensioned)
$= 22\times10^{-6}$ (Post-tensioned)
Shrinkage of concrete = 300×10^{-6} (Pre-tensioned)
$= 215\times10^{-6}$ (Post-tensioned) beam

Contd…2

6 a. What are the factors affecting deflection in PSC beam? 6

b. A Pre-stressed concrete beam of 10 m span with rectangular section 200×500 mm is pre-stressed by a parabolic cable having an eccentricity of 50 mm above the neutral axis at the end of the beam and 150 mm at midspan. It carries a uniformly distributed loads of 10 kN/m, in addition to two concentrated loads of 10 kN acting at 2.5 m from both ends sides. The pre-stressing force is 250 kN grade of concrete is M35, creep coefficient is 2. Loss in pre-stressed is 20%, density = 24 kN/m^3. Estimate the short term deflection and long term deflection. Check the adequacy of beam from deflection criteria. 14

UNIT - IV

7 a. A Pre-tensioned PSC beam of I-section with 160 × 70 mm flange with thickness of web 50 mm and overall depth of I-section is 320 mm. The beam is pre-stressed with 4 high strength steel wires of 7 mm at an effective depth of 265 mm. f_{ck} = 50 N/mm^2, F_p = 1600 N/mm^2. Find the ultimate flexural strength. 10

b. A post tensioned beam with unbounded tendons is of rectangular cross section 500 x 1000 mm. The cross sectional area of pre-stressing steel is 3000 mm^2. The effective pre-stress after considering all losses is 1000 N/mm^2. The effective span of beam made of M40 concrete is 15 m. Estimate the ultimate moment of resistance of the section using codal provision. 10

8 a. Explain the methods of improving shear resistance or factors reducing principal tension in PSC beam. 6

b. A Pre-stressed concrete beam of span 10 m has a rectangular section 120 mm wide and 300 mm deep is pre-stressed by a curved cable carrying an effective force of 180 kN. The beam supports a total uniformly distributed load of 5 kN/m which include the self weight of the member. The beam is additionally pre-stressed by vertical cables stress of 2.5 N/mm^2 in the direction of the depth of beam. Estimate the nature of principal stresses developed at the support section. The cable has zero eccentricity at support and an eccentricity of 100 mm below the centroidal axis at midspan section. 14

UNIT - V

9 a. What is transmission length? List the factors influencing transmission length. 8

b. The end block of PSC beam rectangular section is 150 mm wide and 400 mm deep. An effective pre-stressing force of 400 kN is transmitted to concrete by distribution plate of 150 mm wide and 120 mm deep concentrically located at the ends. Calculate the reinforcement for the end block for maximum transverse tension. Sketch the detail of reinforcement. Use Fe 415 grade steel. 12

10. The end block of a post tensioned beam is 300 mm wide and 400 mm deep. Pre-stressing 12 cables each consisting of 12 strands of 5 mm diameter is stressed to 1500 N/mm^2. They are located at a constant eccentricity of 120 mm below the centroidal axis. Design and detail the anchorage reinforcement for the end block. 20

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