Reg. No. : | | | | | | | | | | |

Question Paper Code: 52263

M.E. DEGREE EXAMINATION, JUNE 2016

Second Semester

Structural Engineering

15PSE203 – DESIGN OF PRESTRESSES CONCRETE STRUCTURES

(Use of code books are permitted)

(Regulation 2015)

Duration: Three hours　　　　　　　　　　　　　　　　Maximum: 100 Marks

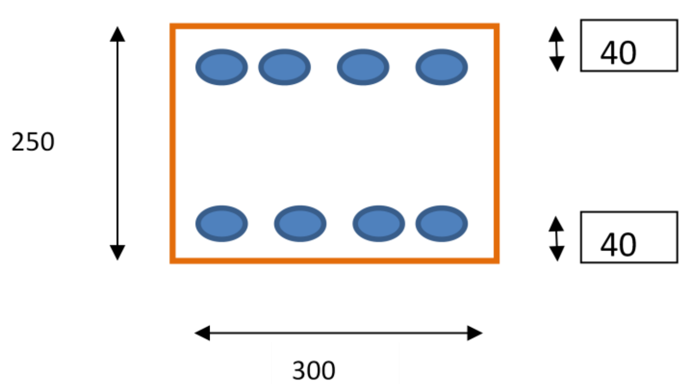
Answer ALL Questions

PART A - (5 x 20 = 100 Marks)

1. (a) (i) A prestressed concrete sleeper produced by pre-tensioning method has a rectangular cross-section of 300*mm*x250*mm*(bxh).It is prestressed with 9 numbers of straight 7*mm* diameter wires at 0.8 times the ultimate stress of 1570N/mm^2.Estimate the percentage loss of stress due to elastic shortening of concrete. Consider m=6, F_{pi}=0.8fy Evaluate the following quantities: (i) Kern levels (ii) Cracking moment (iii) Location of pressure line at midspan at transfer and at service (iv) The stresses at the top and bottom fibers at transfer and at service. Compare the stresses with the following allowable stresses at transfer and at service.

For compression (f_c) comp= -18.0N/mm^2

For tension (fc) tens=1.5N/mm^2



(15)

(ii) Explain the systems and methods of prestressing with neat sketching. (5)

Or

(b) (i) A prestressed concrete beam of span 8*m* having a rectangular section of 150*mm*x300*mm*, the beam is prestressed by a parabolic cable having an eccentricity of 75*mm* below the centroidal axis at the center of the span and an eccentricity of 25*mm* above the centroidal axis at the support sections. The initial force in the cable is 350 *kN*. The beam supports three concentrated loads of 10*kN* each at intervals of 2*m*. $E_c = 38 kN/mm^2$.

(a) Neglecting losses of prestress, estimate the short term deflection due to (prestress+ self-weight).

(b) Allowing for 20% loss in prestress, estimate long term deflection under (prestress+ self- weight+live load), assume creep co-efficient as 1.80.

(15)

(ii) Why high strength steel is essential for prestressed concrete? (5)

2. (a) (i) A concrete beam of rectangular section has a width of 250*mm* and depth of 600*mm*. The beam is prestressed by a parabolic cable carrying an effective force of 1000*kN*. The cable is concentric at supports and has a maximum eccentricity of 100*mm* at the centre of span. The beam spans over 10*m* and supports a uniformly distributed live load of *20kN/m*. Assuming the density of concrete as $24kN/m^{3,}$ estimate (a) the maximum principal stress developed in the section of the beam at a distance of 300*mm* from the support, (b) the prestressing force required to nullify the shear force due to dead and live load at the support section. (10)

(ii) A pretensioned, *T* section has a flange which is 300 wide 200*mm* thick. The rib is 150*mm* wide by 350*mm* deep. The effective depth of the cross section is 500*mm*.Given $A_p = 200mm^2$ $f_{ck} = 50N/mm^2$ and $f_p = 1600N/mm^2$, estimate the ultimate moment capacity of the *T*- section using the Indian standard code regulation. (10)

Or

(b) (i) The end block of a pre-stresed concrete girder is 200*mm* wide by 300*mm* deep. The beam is post-tensioned by two Freyssinet anchorages each of 100*mm* diameters with their centres located at 75*mm* from the top and bottom of the beam. The force transmitted by each anchorage being 2000*kN*. Compute the bursting force and design suitable reinforcements according to the IS 1343.

(10)

(ii) Briefly outline the Magnel's method of computing the horizontal and transverse stresses in end blocks subjected to concentrated force from anchorage. (10)

3. (a) (i) A two-span continuous beam *ABC (AB=BC=10m)* is of rectangular section, 200*mm* wide by 500*mm* deep. The beam is pre-stressed by a parabolic cable, concentric at end supports and having an eccentricity of 100mm towards the soffit of the beam at centre of spans and 200*mm* towards the top at mid-support. The effective force in the cable is 500*kN*.

(a) Show that the cable is concordant.

(b) Locate the pressure line in the beam when it supports a live load of *5.6kN/m* in addition to its self-weight. (10)

(ii) Design a pre-stressed concrete beam continuous over two equal spans of 9*m* to support live loads of 30*kN* each at the centre of span. Permissible stress being zero in tension and $15 N/mm^2$ in compression. Loss ratio= 0.85. (10)

Or

(b) (i) Briefly explain the various steps involved in the design of continuous pre-stressed concrete beam. (10)

(ii) Explain the terms (a) Primary moment (b) Secondary moment (c) Resultant moment. (10)

4. (a) (i) A pre-stressed concrete pipe is to be designed to withstand a fluid pressure of 1.6 N/mm^2. The diameter of the pipe is 1200*mm* and shell thickness is 100*mm*. The maximum compressive stress in concrete at transfer is 16 N/mm^2. A residual compression of 1 N/mm^2 is expected to be maintained at service loads. Loss ratio is 0.8. High tensile wire of 5mm diameter initially stressed to $1 kN/mm^2$ is available for use. Determine (i) The number of turns of wire per metre length (ii) The pitch of wire winding. (10)

(ii) Explain the procedure to design cylindrical pre-stressed concrete pipe. (10)

Or

(b) (i) What are the different types of junctions between tank wall and base slab? Explain. (10)

(ii) Explain with sketch the distribution of ring tension and bending moment in circular tanks with fixed, sliding and hinged base. (10)

5. (a) (i) A rectangular pre-tensioned concrete beam has a breadth of 100*mm* and depth of 230*mm* and the pre-stress after all losses have occurred is 12 N/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 300*mm* and depth 50*mm*. Calculate the maximum UDL that can be supported on a simply supported span of 4.5*m* without any tensile stresses occurring, if (i) slab is supported while casting, and (ii) The pre-tensioned beam supports the weight of the slab while casting. (10)

(ii) What are the advantages of using composite construction with pre-stressed and in-situ concrete in structural members. (10)

Or

(b) (i) What is partial pre-stressing? Explain its advantages and disadvantages. (5)

(ii) A precast pretensioned beam of rectangular section has a breadth of 100*mm* and a depth of 200*mm*. The beam with an effective span of 5*m*, is prestressed by tendons with their centroids coinciding with bottom kern. The initial force in the tendons is 150*kN*. The loss of prestress may be assumed to be 15 percent. The beam is incorporated in a composite T- beam by casting a top flange of breadth 400*mm* and thickness 40*mm*. If the composite beam supports a live load of $8kN/mm^2$, calculate the resultant stresses developed in the precast and in situ cast concrete assuming the pretensioned beam as (a) Unpropped and (b)propped during the casting of the slab. Assume the same modulus of elasticity for concrete in precast beam and insitu cast slab. (15)
