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10CV74

# Seventh Semester B.E. Degree Examination, Jan./Feb. 2021
## Design of Prestressed Concrete Structures

Time: 3 hrs. Max. Marks:100

**Note:** *1. Answer any FIVE full questions, selecting at least TWO full questions from each part.*
*2. Use of IS:1343-1980 is permitted.*
*3. Assume and indicate missing data, if any.*



### PART – A

1 a. State any six advantages of prestressed concrete over reinforced concrete. **(06 Marks)**

b. Explain why high strength steel and high strength concrete are used in prestressed concrete. **(08 Marks)**

c. Explain pressure line. **(06 Marks)**

2 a. A concrete beam of symmetrical 'I' section spanning 8m, the width and thickness of flanges are 220mm and 60mm respectively, the overall depth of the beam is 410mm, the thickness of web is 80mm, the beam is prestressed by a straight cable with an eccentricity of 150mm with an effective force 150kN, the live load on the beam is 2.5kN/m. The density of concrete is 25kN/m$^2$, draw the stress distribution diagram at the central section for the following condition. Prestress + self weight + live load. **(12 Marks)**

b. The prestressed concrete beam, 200mm wide and 300mm deep is used over an effective span of 6m to support an imposed load of 4kN/m. The density of concrete is 25kN/m$^3$. At the quarter span section of the beam, find the magnitude of the concentric pre stressing force located 100mm from the bottom of the beam, which would nullify the bottom fibre stress due to loading. **(08 Marks)**

3 a. List the immediate and time dependent prestress losses in PSC beam. **(06 Marks)**

b. A post tensioned concrete beam, 100mm wide and 300mm deep, spanning over 10m is stressed by successive tensioning and anchoring of three cables 1, 2 and 3 respectively. The cross-sectional area of each cable is 200mm$^2$ and initial stress in cable is 1200N/mm$^2$. Modular ration = 6. The first cable is parabolic with an eccentricity of 50mm above the centroidal axis at support sections and 50mm below centroidal axis at the centre of span. The second cable is parabolic with zero eccentricity at supports and an eccentricity of 50mm below centroidal axis at the centre of span. The third cable is straight with a uniform eccentricity of 50mm below centroidal axis. Estimate the percentage loss of stress in each of the cables, if they are successively tensioned and anchored. **(14 Marks)**

4 a. What are the factors influencing deflections of a PSC beam? **(06 Marks)**

b. A rectangular concrete beam of cross section 150mm 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:

i) The deflection at mid span when the beam is supporting its own weight and

ii) The concentrated load which must be applied at mid-span to restore it to the level of supports. **(14 Marks)**

## PART – B

5 a. List the different types of flexural failures in PSC beam. **(04 Marks)**

b. 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 $A_p = 461mm^2$. Calculate the ultimate flexural strength of the section using IS:1343 code provisions. **(08 Marks)**

c. A post tensioned prestressed concrete Tee beam having a flange width of 1200mm and flange thickness of 200mm, thickness of web being 300mm is prestressed by $2000mm^2$ of high tensile steel located at an effective depth of 1600mm. If $f_{ck} = 40N/mm^2$ and $f_p = 1600N/mm^2$. Estimate the ultimate flexural strength of the unbounded Tee section, assuming span/depth ratio as 20 and $f_{pe} = 1000N/mm^2$. **(08 Marks)**

6 a. Name the three methods of improving the shear resistance of PSC members. **(03 Marks)**

b. A concrete beam of rectangular section 200mm wide and 650mm deep is prestressed by a parabolic cable located at an eccentricity of 120mm at mid span and zero at the supports. If the beam has a span of 12m and carries a uniformly distributed live load of 4.5kN/m find the effective force necessary in the cable for zero shear stress at the support section. For this condition calculate the principal stresses. The density of concrete is $24kN/m^3$. **(09 Marks)**

c. The support section of a PSC beam 100mm wide and 250mm deep is required to support an ultimate shear force of 90kN. The compressive stress at centroidal axis is $5N/mm^2$. The characteristic cube strength of concrete is $40N/mm^2$, the cover to the reinforcement is 50mm. The characteristic tensile strength of steel in the stirrups is $250N/mm^2$. Design suitable shear reinforcement at the section. **(08 Marks)**

7 a. What is transmission length? List the factors affecting transmission length. **(06 Marks)**

b. The end block of a post tensioned PSC beam is 150mm × 300mm deep. A cable comprising of three members of 12-7mm diameter and stressed to $1200N/mm^2$ is anchored against the end block at 100mm from the soffit of the beam. The anchorage plate is 75mm × 75mm. Design the anchorage reinforcement. Given $f_{ck} = 30N/mm^2$ at transfer, permissible shear stress in steel plate is $100N/mm^2$. Use Fe415 grade of steel for reinforcement and sketch the detailing of reinforcement. Calculate the thickness of the anchorage plate. The diameter of duct is 30mm. **(14 Marks)**

8 A post tensioned PSC beam 300mm wide is to be designed as a rectangular beam to support a UDL of 20kN/m over a simply supported beam of 18m span. The stresses in concrete must not exceed 16MPa in compression and 1.2MPa in tension at any stage of loading. Assume average loss of pre-stress is 17%. Design the beam by calculating depth, prestressing force and eccentricity. **(20 Marks)**

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