QUESTION BANK

CE2404 – PRESTRESSED CONCRETE STRUCTURES

UNIT 2 - DESIGN FOR FLEXURE AND SHEAR

PART – A (2 marks)

1. Define partial prestressing.

(AUC May/June 2013, Nov/Dec 2011)

The degree of prestress applied to concrete in which tensile stresses to a limited degree are permitted in concrete under working load. In this case, in addition to tensioned steel, a considerable proportion of untensioned reinforcement is generally used to limit the width of cracks developed under service load.

2. Mention any two functions of end blocks.

(AUC May/June 2013, Nov/Dec 2013)

1. Provide Lateral (horizontal) stability from wind and other horizontal (Racking) loads.
2. Provide additional vertical load capacity for the ends of the joists from point loads above.

3. Define anchorage zone.

(AUC Nov/Dec 2011)

Prestressed concrete contains tendons which are typically stressed to about 1000 MPa. These tendons need to be anchored at their ends in order to transfer (compressive) force to the concrete. The zone of region is called Anchorage zone.

4. How can PSC beam be considered to carry its own weight?

(AUC Nov/Dec 2012)

By providing an external initial stress (the prestress) which compresses the beam. Now they can only separate if the tensile stress induced by the self-weight of the beam is greater than the compressive prestress introduced.

5. Mention the advantages of partial prestressing.

(AUC Nov/Dec 2012 & 2013)

1. Limited tensile stresses are permitted in concrete under service loads with controls on the maximum width of cracks and depending upon the type of prestressing and environmental condition.
2. Untensioned reinforcement is required in the cross-section of a prestressed member for various reasons, such as to resist the differential shrinkage, temperature effects and handling stresses.
3. Hence this reinforcement can cater for the serviceability requirements, such as control of cracking, and partially for the ultimate limit state of collapse which can result in considerable reduction in the costlier high tensile steel.
4. Saving in the cost of overall structure.

6. Write any two assumptions on the compatibility of strains.

(AUC Apr/May 2012)

1. The stress distribution in the compression zone of concrete can be defined by means of coefficients applied to the characteristic compressive strength and the average compressive strength stress and the position of the centre of compression can be assessed.
2. The distribution of concrete strain is linear (plane sections normal to axis remain plane after bending).
3. The resistance of concrete in tension is neglected
4. The maximum compressive strain in concrete at failure reaches a particular value.

7. What is effective reinforcement ratio?

(AUC Apr/May 2012)

Ratio of effective area of reinforcement to the effective area of concrete at any section of a structural member is known as effective reinforcement ratio.

8. At initial stage what forces are considered in prestressed concrete design?

(AUC Apr/May 2011)

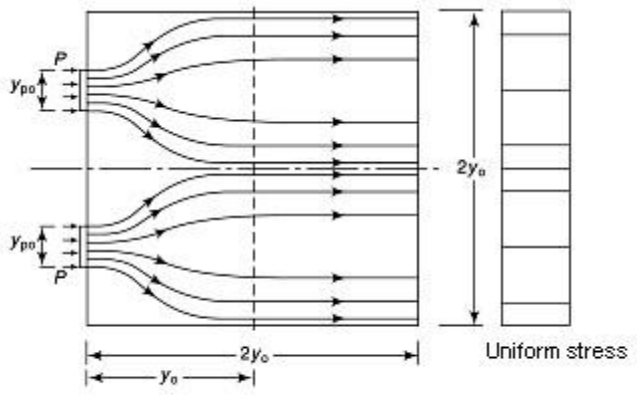
Prestressing force is considered in prestressed concrete design at initial stage.

9. Why anchorage zone has to be given special attention in design?

(AUC Apr/May 2011)

Because the main reinforcement in the anchorage zone should be designed to withstand the bursting tension, which is determined by the traverse stress distribution on the critical axis, usually coinciding with the line of action of the largest individual force.

10. Draw a sketch showing the stress distribution in end block by double anchor plate. **(AUC Apr/May 2010)**



Double anchor plate

11. Explain conventional failure of an over reinforced prestressed concrete beam. (AUC Apr/May 2010)

An Over reinforced members fail by the sudden crushing of concrete. The failure being reinforced members fail by the sudden crushing of concrete. The failure being characterized by small deflections and narrow cracks, the area of steel being comparatively large, the stresses developed in steel at failure of the member may not reach the tensile strength.

12. What is meant by end block in a post tensioned member? (AUC Nov/Dec 2010)

The zone between the end of the beam and the section where only longitudinal stress exists is generally referred to as the anchorage zone or end block.

13. List any two applications of partial prestressing. (AUC Nov/Dec 2010)

1. Used in large diameter concrete pipes
2. Used in railway sleepers
3. Water tanks
4. Precast concrete piles to counter tensile stress during transport and erection.
5. Used in bridges construction

14. Define degree of prestressing.

A measure of the magnitude of the prestressing force related to the resultant stress occurring in the structural member at working load.

15. Define Bursting tension.

The effect of transverse tensile stress is to develop a zone of bursting tension in a direction perpendicular to the anchorage force resulting in horizontal cracking.

16. Define Proof stress.

The tensile stress in steel which produces a residual strain of 0.2 percent of the original gauge length on unloading.

17. Define cracking load.

The load on the structural element corresponding to the first visible crack.

18. Define Debonding.

Prevention of bond between the steel wire and the surrounding concrete.

19. Write formula for Moment of resistance in BIS code.

$$Mu = A_{pb}\, A_{ps}\, (d - d_n)$$

20. What are the types of flexural failure?

1. Fracture of steel in tension
2. Failure of under-reinforced section
3. Failure of over-reinforced section
4. Other modes of failure

PART – B

(16 marks)

1. Explain in detail the concept of strain compatibility method.

(AUC Nov/Dec 2011)

2. Discuss briefly about the stress distribution in end block.

(AUC Nov/Dec 2011)

3. Discuss in detail about limit state design criteria for prestressed concrete members. **(AUC Nov/Dec 2011)**

4. Explain the inadequacies of the elastic and ultimate load methods in the design of prestressed concrete members. Discuss on the philosophy of limit state design explaining various limit states.

(AUC Apr/May 2011)

5. The end block of a post tensioned PSC beam 300 mm wide and 300 mm deep is subjected to a concentric anchorage force of 800 kN by a freyssinet anchorage system of area 11000 mm^2. Design and detail the anchorage reinforcement for the end block.

(AUC Nov/Dec & Apr/May 2012 & 2010)

6. A pretensioned T – section has a flange 1200 mm wide and 150 mm thick. The width and depth of rib are 300 mm and 1500 mm respectively. The high tensile steel has an area 4700 mm^2 and is located at an effective depth of 1600 mm. if the characteristic cube strength of the concrete and the tensile strength of steel are 40 and 1600 N/mm^2 respectively; calculate the flexural strength of the T – section.

(AUC Nov/Dec 2013, Apr/May 2010)

7. The end block of a prestressed concrete beam, rectangular in section, is 100 mm wide and 200 mm deep. The prestressing force of 100 kN is transmitted to concrete by a distribution plate, 100 mm wide and 50 mm deep, concentrically located at the ends. Calculate the position and magnitude of the maximum tensile stress on the horizontal section through the center and edge of the anchor plate. Compute the bursting tension on these horizontal planes. **(AUC Nov/Dec 2013, May/June 2013)**

8. A prestressed concrete beam of effective span 16 m is of rectangular section 400 mm wide and 1200 mm deep. A tendon consists of 3300 mm^2 of strands of characteristic strength 1700 N/mm^2 with an effective prestress of 910 N/mm^2. The strands are located 870 mm from the top face of the beam. If f_{cu} = 60 N/mm^2, estimate the flexural strength of the section as per British code provisions for the following cases.

i. Bonded tendons

ii. Unbounded tendons

(AUC May/June 2013) (AUC Apr/May 2012)

9. What is meant by partial prestressing? Discuss the advantages and disadvantages when partial prestressing is done**.**

(AUC Nov/Dec 2010)

10. The end block of a post tensioned beam is 80 mm wide and 160 mm deep. A prestressing wire 7 mm in diameter stressed to 1200 N/mm^2 has to be anchored against the end block at the centre. The anchorage plate is 50 mm by 50 mm. the wire bears on the plate through a female cone of 20 mm diameter. Given the permissible stress in concrete at transfer, f_{ci} as 20 N/mm^2 and the permissible shear in steel as 94.5 N/mm^2. Determine the thickness of the anchorage plate. **(AUC Nov/Dec 2010)**

11. The end block of a prestressed beam 200 mm wide and 300 mm deep has two freyssinet anchorages (100 mm diameter) with their centres at 75 mm from top and bottom of the beam. The force transmitted by each anchorage being 200 kN, estimate the maximum tensile stress and the bursting tension developed**.** **(AUC Nov/Dec 2010)**

12. The end block of a post tensioned prestressed member is 550 mm wide and 550 mm deep. Four cables each made up of 7 wires of 12 mm diameter strands and carrying a force of 1000 kN are anchored by plate anchorages, 150 mm by 150 mm located with their centres at 125 mm from the edges of the end block. The cable duct is of 50 mm diameter. The 28 day cube strength of concrete f_{cu} is 45 N/mm^2. The cube strength of concrete at transfer f_{ci} is 25 N/mm^2. Permissible bearing stresses behind anchorages should confirm with IS: 1343. The characteristic yield stress in mild steel anchorage reinforcement is 260 N/mm^2. Design suitable anchorages for the end block. **(AUC Apr/May 2011)**

13. A post tensioned bonded prestressed concrete beam of rectangular cross section, 400 mm wide by 550 mm deep, is subjected to a service load bending moment of 166.6 kNm, torsional moment of 46.6kNm and shear force of 66.6 kN. The section has an effective prestressing force, determined from service load requirements of magnitude 500kN at an eccentricity of 150 mm, provided by 5numbers of 12.5 mm stress relieved strands of cross sectional area 506 mm^2 with an ultimate tensile strength of 1820 N/mm^2. If the cube strength of concrete is 40 N/mm^2, design a suitable longitudinal and transverse reinforcements in the beam using IS: 1343 – 1980 code recommendations based on the skew bending approach.

(AUC Nov/Dec 2012)