PRESTRESSED CONCRETE STRUCTURES
UNIT-I INTRODUCTION – THEORY AND BEHAVIOUR

1. What are the advantages of PSC construction?

- In case of fully prestressed member, which are free from tensile stresses under working loads, the cross section is more efficiently utilized when compared with a reinforced concrete section which is cracked under working loads.
- The flexural member is stiffer under working loads than a reinforced concrete member of the same length.

2. Define Pre tensioning and Post tensioning.

- **Pre tensioning:** A method of Pre stressing concrete in which the tendons are tensioned before the concrete is placed. In this method, the prestress is imparted to concrete by bond between steel and concrete.
- **Post tensioning:** A method of pre stressing concrete by tensioning the tendons against hardened concrete. In this method, the prestress is imparted to concrete by bearing.

3. What is the need for the use of high strength concrete and tensile steel in Pre stressed concrete?

(i) High strength concrete is necessary for prestress concrete as the material offers highly resistance in tension, shear bond and bearing. In the zone of anchorage the bearing stresses being hired; high strength concrete is invariably preferred to minimizing the cost. High strength concrete is less liable to shrinkage cracks and has lighter modulus of elasticity and smaller ultimate creep strain resulting in a smaller loss of prestress in steel. The use of high strength concrete results in a reduction in a cross sectional dimensions of prestress concrete structural element with a reduced dead weight of the material longer span become technically and economically practicable.

(ii)Tensile strength of high tensile steel is in the range of 1400 to 2000 N/mm^2 and if initially stress upto 1400 N/mm^2 their will be still large stress in the high tensile reinforcement after making deduction for loss of prestress. Therefore high tensile steel is made for prestress concrete.

4. Define Kern Distance.

Kern is the core area of the section in which if the load applied tension will not be induced in the section

$K_t = Z_b/A, \qquad K_b = Zt/A,$

If the load applied at 'K' compressive stress will maximum at the top most fiber and zero stress will be at the bottom most fiber. If the load applied at K_b compressive stress will be the maximum at the bottom most fiber and zero stress will be at the top most fiber.

5. What is Relaxation of steel?

When a high tensile steel wire is stretch and maintained at a constant strain the initially force in the wire does not remain constant but decrease with time. The decrease of stress in steel at constant strain is termed relaxation of steel.

6. What is concordant prestressing?

Pre stressing of members in which the cable follow a concordant profile. In case of statically indeterminate structures, it does not cause any changes in support reaction.

7. Define bonded and non-bonded prestressing concrete.

- **Bonded prestressing:** Concrete in which prestress is imparted to concrete through bond between the tendons and surrounding concrete. Pre tensioned members belong to this group.
- **Non-bonded prestressing:** A method of construction in which the tendons are not bonded to the surrounding concrete. The tendons may be placed in ducts formed in the concrete members or they may be placed outside the concrete section.

8. Define Axial prestressing.

Members in which the entire cross-section of concrete has a uniform compressive p r e s t r e s s . In this type of prestressing, the centroid, of the tendons coincides with that of the concrete section.

9. Define Prestressed concrete.

It is basically concrete in which internal stresses of a suitable magnitude and distribution are introduced so that the stresses resulting from external loads (or) counteracted to a desire degree in reinforced concrete member the prestress is commonly introduced by tensioning the steel reinforcement.

10. Define anchorage.

A device generally used to enable the tendon to impart and maintain prestress to the concrete is called anchorage. E.g. Fressinet, BBRV systems,etc.

UNIT-II DESIGN CONCEPT

1. **What is meant by end block in a post tensioned member?**

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.

2. **List any two applications of partial prestressing.**

a. Used in large diameter concrete pipes b. Used in railway sleepers

c. Water tanks d.Precast concrete piles

3. **What is meant by partial prestressing?**

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.

4. **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.

5. **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.

6. **Define Proof stress.**

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

7. **Define cracking load.**

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

8. **Define Debonding.**

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

9. **Write formula for Moment of resistance in BIS code.**

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

10. **What are the types of flexural failure?**

- Fracture of steel in tension
- Failure of under-reinforced section
- Failure of over-reinforced section
- Other modes of failure

UNIT-III CIRCULAR PRESTRESSING

1.What are the advantages of continuous members?

(i) The bending moments are more evenly distributed between the centre of span and the supports of members.

(ii)Reduction in the size of members results in lighter structures.

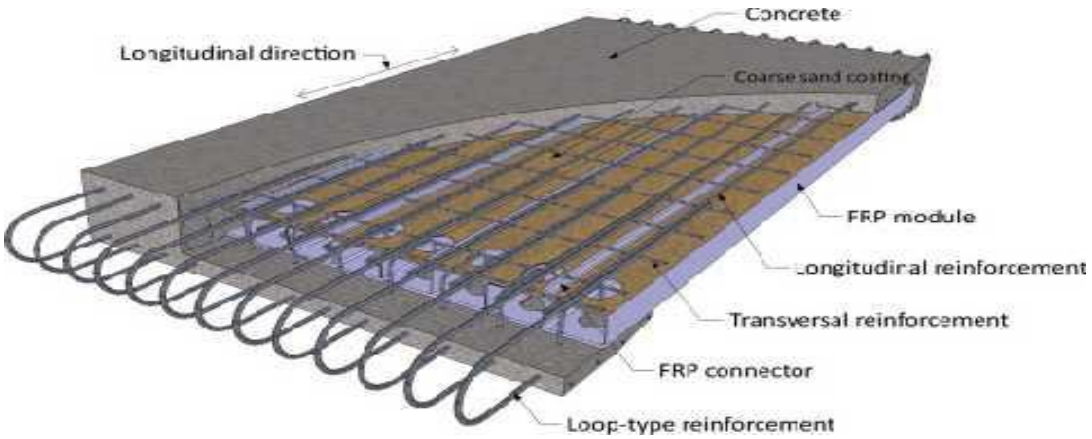
(iii)continuity of members in framed structures leads to increased stability.

2.What are the advantages of prestressed concrete sleepers?

a. It is economical.

b. Full cross-section of member is utilized.

3. **Sketch the loop reinforcement, hair-pin bars in end blocks.**



4. **Sketch the correct arrangement of sheet cage in anchorage zone.**

FIG.15

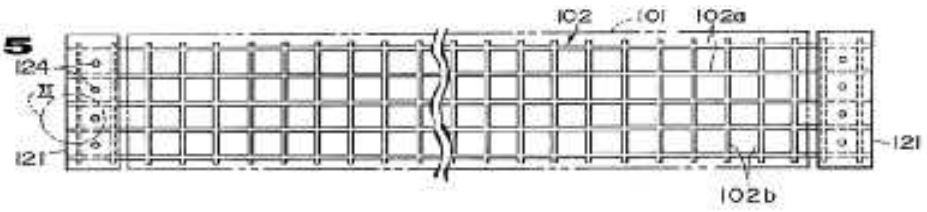


FIG.16

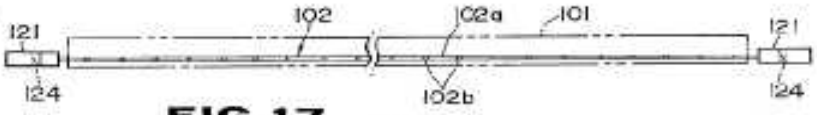
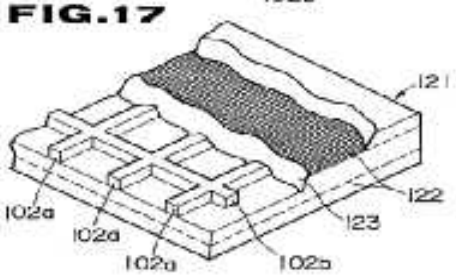


FIG.17



5. **Define two stage constructions.**

- *One-stage construction*: Construct and initialize the object in one stage, all with the constructor.
- Two-*stage construction*: Construct and initialize the object in two separate stages.
- The constructor creates the object and an initialization function initializes it.

6. **Write any two general failures of prestressed concrete tanks.**

- Deformation of the pre-cast concrete units during construction
- Manufacturing inaccuracies led to out of tolerance units being delivered to the site
- Under investigation and may have affected the ability to achieve a good seal.

7. **Mention the importance of shrinkage in composite construction.**

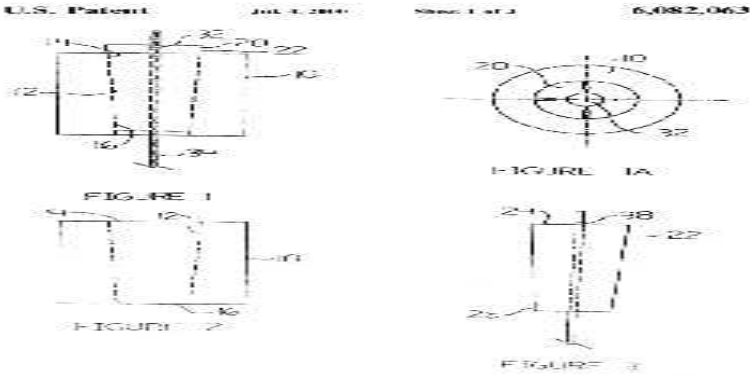
The time dependent behavior of composite prestressed concrete beams depends upon the presence of differential shrinkage and creep of the concretes of web and deck, in addition to other parameters, such as relaxation of steel, presence of untensioned steel, and compression steel etc.

8.What is circular prestressing?

The term refers to prestressing in round members such as tanks and pipes.Liquid retaining structures such as circular pipes, tanks and pressure vessels are admirably suited for circular prestressing.

UNIT-IV COMPOSITE CONSTRUCTION

1.Sketch the arrangement of Tendons & anchorages in circular prestressing of concrete pipe.



2. Give the advantages of precast prestressed units.

1. The C/S is more efficiently utilized when compared with a RC section
2. Effective saving in use of materials.
3. Improves the ability of material for energy absorption under impact load
4. The economy of PSC is well established for long span structures.
5. There is considerable saving on the quantity of materials used in it.

3.Formula for propped and unpropped construction methods.

(a) For unpropped construction

$$f = -\frac{P_s}{A} \pm \frac{P_e ec}{I} \pm \frac{(M_{SW} + M_{C/P})c}{I} \pm \frac{M_{LL}c'}{I'}$$

(b) For propped construction

$$f = -\frac{P_e}{A} \pm \frac{P_e ec}{I} \pm \frac{M_{SW}c}{I} \pm \frac{(M_{C/P} + M_{LL})c'}{I'}$$

Here,

A = area of the precast web
c = distance of edge from CGC of precast web
c = distance of edge from CGC of composite section
e = eccentricity of CGS
I = moment of inertia of the precast web
I = moment of inertia of the composite section.

4.Define full prestressing.

Prestressed concrete in which tensile stresses in the concrete are entirely obviated at working loads by having sufficiently high prestress in the members.

5.Define Tendons.

A stretched element used in a concrete member of structure to import prestress to the concrete.

Generally, high-tensile steel wires,bars cables or strands are used as tendons.

6.Define the term pretensioning.

A method of prestressing concrete in which the tendons are tensioned before the concrete is placed. In this method, the prestress is imparted to concrete by bond between steel and concrete.

7. Define the term post-tensioning.

A method of prestressing concrete by tensioning the tendons against hardened concrete.In this method the prestress is imparted to concrete by bearing.

8.What is meant by moderate prestressing?

Members in which the entire cross-section of concrete has a uniform compressive prestress.In this

Type of prestressing ,the centroid ,of the tendons coincide s with that of the concrete section.

9.Define creep-coefficient.

The ratio of the total creep strain to elastic strain in concrete.

UNIT-V PRESTRESSED CONCRETE BRIDGES

1.What are the advantages of prestressed concrete bridges?

i) High-strength concrete and high-tensile steel,besides being economical,make for slender sections.

ii)In comparison with steel bridges, prestressed concrete bridge require very little maintenance.

2.What is meant by pretensioned prestressed concrete bridge?

Pretensioned Prestressed concrete bridge decks generally comprise precast pretensioned units used in conjunction with cast in situ concrete,resulting in composite bridge decks which are ideally suited for small and medium spans.

3. Define the term post- tensioned prestressed concrete bridge decks.

Post-tensioning is idally suited for prestressing long span girders at the site of construction,without the need for costly factory type installation s like pre tensioning beds.

4.What are the types of prestressed concrete bridge decks?

i)Pre-tensioned Prestressed concrete bridge

ii)Post-tensioned prestressed concrete bridge

5.What is meant by creep in concrete?

Progressive increases in the inelastic deformation of concrete under sustained stress component.

6.Define the term 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.

7.What is meant by eccentric prestressing?

A section at which the tendons are eccentric to the centroid ,resulting in a triangular or trapezoidal compressive stress distribution.

8.Define pretensioned prestressed concrete bridge decks.

The bridge decks generally comprise precast pretensioned units used in conjunction with cast in situ concrete, resulting in composite bridge decks which are ideally suited for small and medium spans in the range of 20m to30m.

9.Define post- tensioned prestressed concrete bridge decks.

Post- tensioning is ideally suited for prestressing long-span girders at the site of construction, with out the need for costly factory –type installations like pre-tensioning beds. Its generally adopted for longer spans exceeding 20m.

PART-B

1. What are the advantages of Prestressed Concrete?
2. Describe briefly Fressinet system of post tensioning.
3. Discuss about the importance of control of deflections and the factors influencing the deflection of PSC beams.
4. Describe the various types of losses in prestress. What steps may be taken to reduce these losses.
5. What is meant by partial prestressing? Discuss the advantages and disadvantages when partial prestressing is done.

6. Explain about the types of flexure failure occurs in prestressed concrete section.
7. Discuss about the anchorage zone reinforcement. The end block of a post tensioned PSC beam 300mm x 300mm is subjected to concentric anchorage force of 800KN by a Freyssinet anchorage of area 10000mm^2. Design and detail the anchorage reinforcement for the block.
8. Explain concept of limit states, partial safety factor.
9. The end block of a post-tensioned PSC beam, 300 x 300 mm is subjected to a concentric anchorage force of 832.8 kN by a Freyssinet anchorage of area 11720 mm^2. Design and detail the anchorage reinforcement for the end block.
10. Explain the different types of joints between the walls and floor slab of prestressed concrete tanks.
11. Explain the effect of varying the ratio of depth anchorage to the depth of end block on the distribution of bursting tension.
12. Explain the general features of prestressed concrete tanks.
13. Explain the junctions of tank wall and base slab with neat sketch.
14. What are the different types of joints used between the slabs of prestressed concrete tanks.

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