PRESTRESSED CONCRETE

SYLLABUS:

UNIT-1:

Basic concept of Prestressing - Advantages and application of Prestressed concrete, High Strength concrete - Permissible stresses, shrinkage, creep, Deformation charcterstics, High Strength steel - Types, Strength - Permisible Stresses - Relaxation of stress, cover requirments.

UNIT-2:

Prestressing Systems - Introduction, Tensioning devices, Pretensioning systems, post tensioning systems, Basic assumptions in analysis of Prestress and design, Analysis of Prestress, Resultant Stresses at a section - Pressure line - concepts of load balancing - Stresses in Tendons, cracking moment.

UNIT-3:

Losses of Pre-stressing - Loss of prestress in Pre-tensioned and Post tensioned member due to various causes - Elastic Shortening of concrete, Shrinkage of concrete, creep of concrete, Relaxation of stress in steel, slip in anchorage, differential Shrinkage - bending of members and frictional losses - Total losses allowed for design.

UNIT-4:

Design for flexural resistance - types of flexural failure - code procedures, design of section for flexure. control of deflection - Factor influencing deflection - Prediction of short term and long term deflection.

UNIT 5:

Design for shear & tension - shear & principal stresses - Design of shear reinforcements - codal provisions - Design for torsional, Design for combined bending - shear & torsion.

UNIT 6:

Transfer of Prestress in Pre tensioned members - transmission length - Bond Stresses - end zone reinforcement - codal provisions - Anchorage zone Stresses in Post tensioned members - stress distribution in end block - Anchorage zone reinforcement.

BASIC CONCEPT OF PRE-STRESSED CONCRETE :

Pre-Stressed concrete is basically a concrete in which internal stresses of a suitable magnitude and distribution are introduced, so that the stresses resulting from the external loads (or) concrated to a desired degree.

* Reinforced concrete commonly introduced by tensioning the steel reinforcement.

Ex: Example of wooden barrel construction by force fitting of metal bands and shrink fitting of metal tyres on wooden wheels. indicate that the art of Prestressing. as been practied from ancient times.

* The development of earlier cracks in reinforced concrete due to incompactability in the strain of steel and concrete was perhaps the starting point in the development of new material like pre-stressed concrete.

Freyssinet :

In 1904, Freyssinet attempted to introduce Permanetly acting forces in concrete to resist the elastic forces developed under loads and these idea was later developed under the name of "Pre-stressed."

Cracks will occur in Reinforced concrete deformation will occur in Prestressed concrete.

Advantages:

* Members are free from the tensile stress.
* High ability to resist the impact.
* Fatigue resistance is high.
* High live load carrying capacity.
* No crack formation.
* Better corrossion resistance.
* very effective for deflection control.
* Need less material.

Disadvantages:

* More expensive
* more complex technology.
* Hard to recycle.
* Need higher quality materials.

Applications:

During last 60 years pre-stressed concrete has been widely used for long & the construction of long span bridges, slabs, tanks, concrete pile, thin shell structores, off shore platforms, nuclear power plant repair and rehabitation

6/12/19.

High Strength Concrete:

For high strength concrete:

* 28 days → fck 30-70 N/mm².

Low shrinkage minimum creep charcterstics and high value of young's modouls are generally deemed necessary for concrete used for pre stressed members.

Recent days ultra high strength forme concrete formed as increased from fck → 70-100 N/mm².

Strength Requirments:

Minimum 28 days fck IS: 1343

For Pretensioned – 40 N/mm²

For Post tensioned – 30 N/mm²

Permissible Stresses in concrete:

Indian standard code, Permissible compressive Stress in flexure varies from 0.41 for m_{30} grade concrete to a value of 0.35 for m_{60} grade concrete.

Shrinkage of concrete:

It is due to the gradual loss of moisture which results in change in volume.

Is code for purpose of design for

Pre / Post - tensioned member $\frac{8 \times 10^{-4}}{\log_{10}(T+2)}$.

$\therefore T$ = age in days.

Post / Pre tensioned member 3×10^{-4}

Creep of Concrete:

→ Deformation due to externally applied stresses generally refered to as a creep.

→ Deformation which occurs without any externally stresses refred to as a shrinkage

→ Rate of creep decreases with time.

→ 55% of 20 years creep occurs in 3 months.

→ 77% of 20 years creep occurs in 1 year.

After 1 year load is taken as unity.

→ The average value of creep at later age - 1.26 after 10 years.

1.36 after 30 years.

→ As IS : 1343 creep coefficient (C_c)

$$C_c = \frac{\text{Ultimate creep Strain}}{\text{Elastic strain}}$$

Creep values:

C_c - 2.2 for 7 days.

C_c - 1.6 for 28 days

C_c - 1.1 for 1 year

Deformation characteristics of concrete:

$E = 5000\sqrt{F_{ck}}$. (:: IS 1343).

High Strength steel:

High Strength steel (H.S.S) is generally acheived by increasing the carbon content compare to mild steel.

0.6 - 0.85% carbon

0.7 - 1% Magnesium

0.05% Sulphur & phosporow.

High tensile steel bars commonly used in Pre stressing manufacturing in nomial sizes of 10, 12, 16, 20, 22, 25, 28 and 32 mm diameter.

Types:

1. Wires - Single unit of steel.
2. Stands - two/three/seven wires are wound
3. Tendons - Group of stands/wire
4. Cables - Group of tendons.
5. Bars. - A tendon can be made up of a single steel bar. The diameter of bar is increase.

Permissible stress in steel

$$\frac{\text{ultimate strength}}{\text{yield strength}}$$

Relaxation of stress:

decreasing of stress in steel at constant strain.

Stress corrossion & cover Requirment

If the duct of post tensioned members are not grouted their is a possibility of stress corrossion leading to a failure of the structure.

Some of the important protective measurements aganist stress corrossion include Protection from chemical contamination Protective coatings for high tensile steel and grouting of ducts immediately after Pre-stressing operations

cover Requirments

As per IS 1343 - Pre tensioned minimum clean cover is 20mm

- Post tensioned 30mm (or) Site of cable. (taken which ever is greater).

If Pre stressed member are exposed to aggressive environment cover requirment is increased to 10mm.