Unit-IV

- Transfer of Prestress in Pretensioned Members
- Anchorage Zone Stresses

Learning Objectives

- • Explain transfer of prestress by bond
- • Understand transmission length
- • Analyze anchorage zone stresses
- • Study IS code provisions

Introduction

- In pretensioned members, prestressing force is transferred from steel to concrete through bond after the tendons are released. In post-tensioned members, force is transferred through anchorages, creating high local stresses.

Transfer of Prestress by Bond

- Bond develops due to adhesion, friction and mechanical interlock. As the tendon tries to contract after release, the surrounding concrete resists movement and gradually receives the prestressing force.

Mechanism of Bond Transfer

- 1. Tendons are stressed.
- 2. Concrete hardens.
- 3. Tendons are released.
- 4. Force is transferred gradually along the tendon through bond.

Transmission Length

- Transmission length is the distance required to transfer the full prestressing force from the tendon to the surrounding concrete. It depends on concrete strength, tendon type, surface condition and release method.

Factors Affecting Transmission Length

- • Concrete strength
- • Tendon diameter
- • Surface roughness
- • Initial prestress
- • Method of release

Flexural Bond Stresses

- Flexural bond stress develops when bending causes changes in steel force along the member. Adequate bond prevents slip and ensures composite action.

IS Code Provisions

- Overview of provisions related to transmission length, bond requirements, cover and development in prestressed members as per IS 1343.

Anchorage Zone

- In post-tensioned members, concentrated anchorage force produces high compressive and transverse tensile stresses near the end block.

End Block Stress Distribution

- Stress is non-uniform near the anchorage and becomes nearly uniform away from the end block. Bursting and spalling stresses require reinforcement.

Guyon's Method

- Guyon idealized stress distribution in end blocks and estimated bursting tensile forces for reinforcement design.

Magnel Method

- Magnel developed simplified elastic solutions to determine stress distribution and bursting forces in anchorage zones.

Zielinski Method

- Zielinski proposed elastic analysis considering end-block geometry and load dispersion for practical design.

Rowe's Method

- Rowe's method provides another elastic solution for estimating tensile stresses and reinforcement requirements.

Comparison of Methods

- Compare assumptions, applicability, complexity and design outputs of Guyon, Magnel, Zielinski and Rowe methods.

Bursting and Spalling Stresses

- Bursting stresses occur inside the end block, while spalling stresses occur near the loaded face. Both require reinforcement.

Anchorage Zone Reinforcement

- Provide closed stirrups, spirals or mesh reinforcement to resist bursting and spalling forces and improve ductility.

IS Provisions for Anchorage Zones

- IS 1343 recommends reinforcement detailing, minimum cover, anchorage spacing and end-block design checks.

Design Procedure

- Determine anchorage force → Analyze end block → Calculate bursting force → Design reinforcement → Verify code requirements.

Worked Example Steps

- Identify data, compute transmission length or bursting force, apply code provisions and check stresses.

Applications

- Bridges, sleepers, girders, tanks and long-span buildings.

Common Exam Questions

- Definitions, derivations, end-block analysis, comparison of methods and numerical problems.

Summary

- Transfer by bond, transmission length, anchorage zone analysis and IS provisions are essential for safe PSC design.