Unit-V

- Composite Beams and Deflections in Prestressed Concrete

Learning Objectives

- Understand composite beams, stress distribution, differential shrinkage, deflections and IS code provisions.

Introduction to Composite Beams

- Composite beams consist of precast prestressed members acting together with cast-in-situ concrete to improve strength, stiffness and economy.

Advantages

- Efficient use of materials, longer spans, reduced self-weight, faster construction and improved durability.

Types of Composite Beams

- Fully composite, partially composite, steel-concrete composite and prestressed concrete composite beams.

Propped Composite Beams

- Temporary props support the precast unit during casting. The precast beam carries little or no fresh concrete load until composite action develops.

Unpropped Composite Beams

- No temporary supports are used. The precast beam carries its own weight and wet concrete before composite action.

Comparison: Propped vs Unpropped

- Construction sequence, stress levels, economy, applications, advantages and limitations.

Stress Distribution

- Stress distribution before and after composite action. Compression and tension zones under service loads.

Analysis of Composite Beams

- Determine stresses at transfer, casting and service stages considering transformed section properties.

Differential Shrinkage

- Cast-in-situ concrete shrinks more than precast concrete, causing additional stresses and deflections.

Effects of Differential Shrinkage

- Redistribution of stresses, interface forces, long-term deflections and cracking if neglected.

General Design Considerations

- Shear connectors, interface bond, serviceability, ultimate strength and construction stages.

Introduction to Deflections

- Deflection is vertical displacement due to loads, prestress and time-dependent effects.

Importance of Deflection Control

- Ensures serviceability, aesthetics, durability, occupant comfort and structural safety.

Factors Influencing Deflections

- Prestressing force, tendon profile, span, loading, creep, shrinkage, concrete strength and section properties.

Short-Term Deflections

- Immediate deflection due to dead load, live load and prestressing in uncracked beams.

Deflection Due to Prestress

- Upward camber produced by eccentric prestressing offsets downward load deflection.

Long-Term Deflections

- Creep, shrinkage and relaxation increase deflections with time and must be predicted.

Prediction of Long-Term Deflections

- Use creep coefficients, shrinkage strain and effective prestress for estimating final deflections.

Deflection Calculations

- Total deflection = Initial deflection + Creep deflection + Shrinkage effects ± Prestress camber.

IS Code Requirements

- Permissible deflection limits, serviceability checks and recommendations as per IS 1343.

Worked Design Procedure

- Calculate section properties, evaluate stresses, estimate short-term and long-term deflections, verify code limits.

Important Exam Questions

- Theory questions, derivations and numerical problems related to composite beams and deflections.

Summary

- Composite beams improve efficiency while proper deflection control ensures satisfactory long-term performance.