



# IS 456:2025 (Preliminary Draft) – The New Era of Structural Concrete

A Comprehensive Overview of the 5th Revision  
of the Code of Practice (CED 2(27096)P)

## Context Box

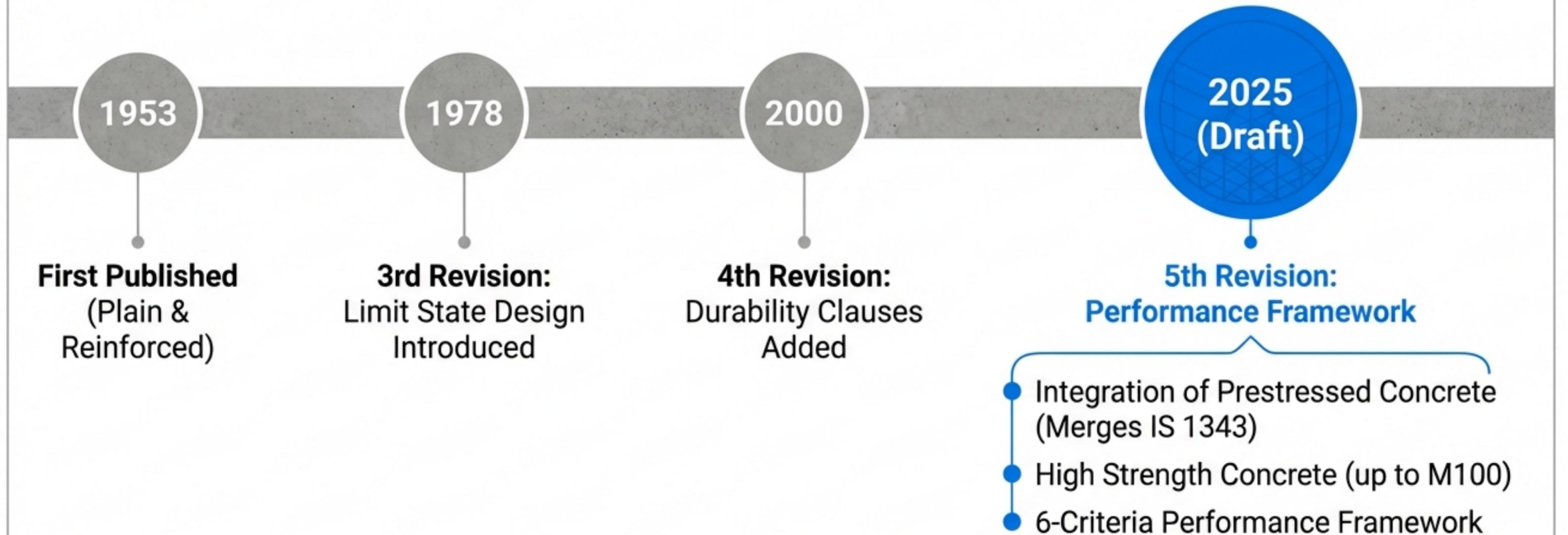
**Status:** Preliminary Draft

**Released:** January 01, 2025

**Action Required:** Public Comments Due by January 31, 2025

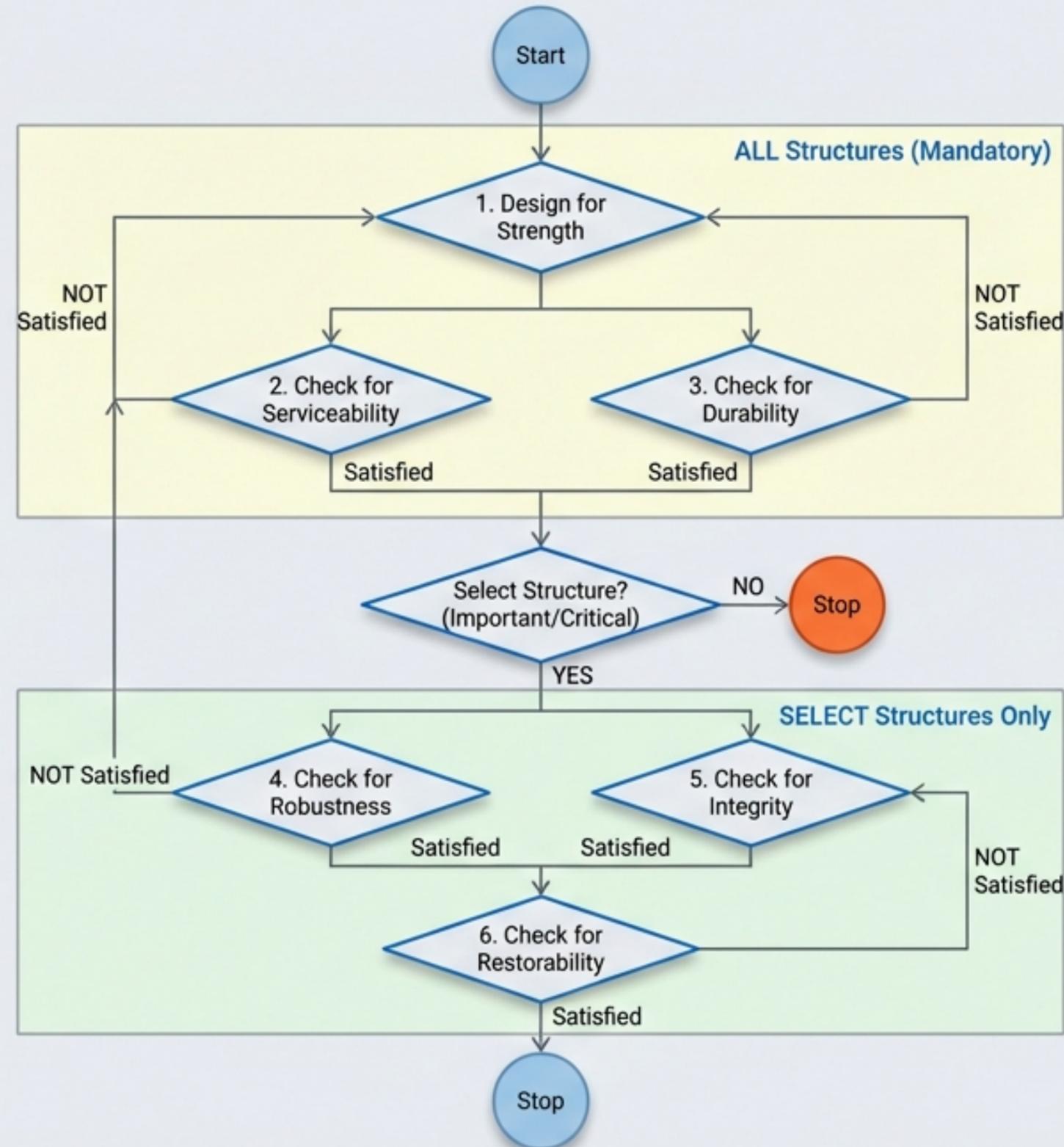
Unified Code for Plain, Reinforced, and Prestressed Concrete

# Evolution of the Standard: From Strength to Performance



This revision merges IS 456 (Plain/Reinforced) and IS 1343 (Prestressed) into a single, unified code, addressing modern challenges like high-strength materials and extreme loading events.

# The Paradigm Shift: The Closed-Loop Design Process

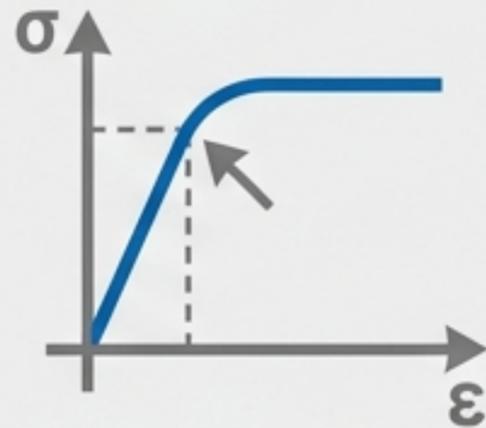


**The Shift:** From a Prescriptive Process (Old) to a Performance Process (New).

# The Essentials: Strength, Serviceability, & Durability

Criteria applicable to ALL structures

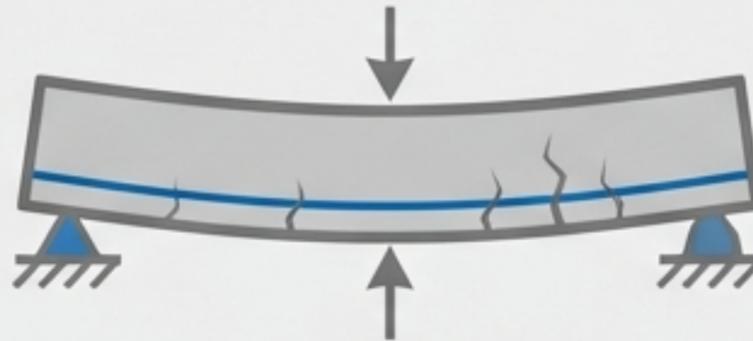
## 1. Strength



**Method:** Revised estimation based on principles of mechanics and limiting strain values.

**Key Change:** No longer based on secondary compression failure. Capacity based on reaching limiting strains in steel and concrete.

## 2. Serviceability



**Goal:** Stiffness, cracking, and deflection control.

**Updates:** Rationalized limits for stress, crack width, and deformation. Ensures no significant nonlinearities or corrosion-inducing cracks under basic loads.

## 3. Durability



**Goal:** Resistance to environmental degradation.

**Key Change:** Now quantitative. Introduces 'Design Service Life' explicitly.

**Parameters:** Defined by cement content, water-cement ratio, and cover depth based on specific environmental actions.

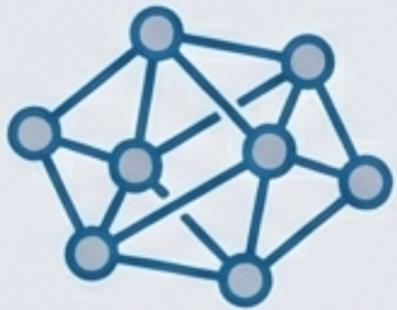
# The New Guard: Robustness, Integrity, & Restorability

Criteria applicable to SELECT (Critical/Important) structures



## 4. Robustness

**Goal:** Resistance to extreme events (Fire, Blast, Impact).  
Limit progressive collapse. Ensure heat transmission time to steel is controlled.



## 5. Integrity

**Goal:** Structural redundancy and alternate load paths. The structure must hold together under ground shaking or settlement. Vertical members require large cross-sections for initial stiffness.

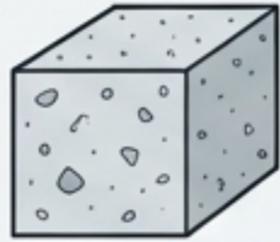


## 6. Restorability

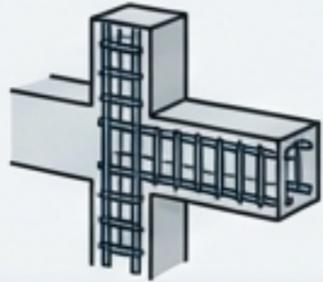
**Goal:** Sustainability and Repair. Design for repair at the outset. Ensure damage occurs in accessible locations (e.g., beam ends). Maintenance schedules must be provided at the design stage.

# Expanded Scope & Applicability

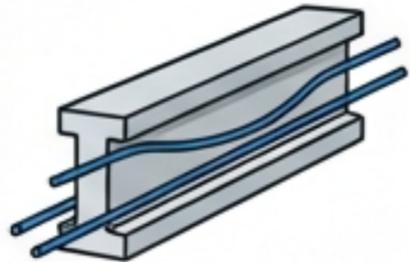
## IN SCOPE



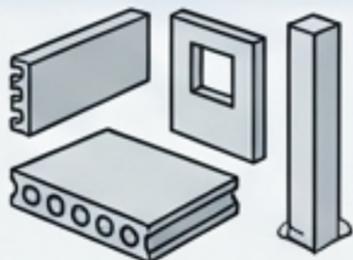
**Plain Concrete:** Reinforcement ignored in strength determination.



**Reinforced Concrete:** Buildings, bridges, liquid retaining structures, silos, chimneys.



**Prestressed Concrete:** Post-tensioned (internal/external) and Pre-tensioned.

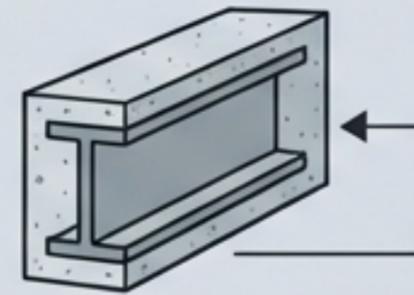


**Precast Components:** Individual elements.

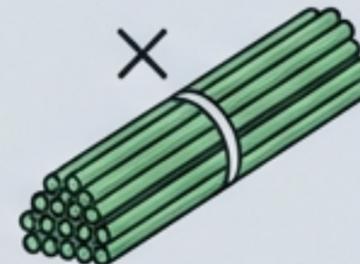
## EXCLUDED / SPECIALIST



**Lightweight/Heavyweight Aggregates:** General formulas do not apply; refer to specialist literature.



**Steel-Concrete Composite:** Only the concrete component is covered by this code.



**FRP Bars:** Not applicable for normal structures; restricted to low-risk durability applications.

# A Scientific Classification of Loads

Explicit separation of External Actions vs. Internal Effects

## Force Loads (External Actions)

- Dead, Imposed, Snow, Wind
- Liquid Pressure
- **New:** Blast & Impact
- **New:** Machine Vibration
- **Critical Check:** Construction Load (Shoring/Reshoring sequences)

## Deformation Loads (Internal/Environmental)

- Creep & Shrinkage
- Elastic Shortening
- Temperature (Ambient & Fire)
- Earthquake Ground Shaking
- Foundation Settlement

**Design Basis Report (DBR):** All loads must be explicitly declared in the DBR before design begins.

# Load Combinations & Safety Factors

| Combination Set          | Purpose  | Typical Factors ( $\gamma_L$ )                    |
|--------------------------|--|---|
| <b>Set 1: Basic</b>      | Strength, Serviceability, Durability (Normal Operations) | DL (1.5) + IL (1.5)                               |
| <b>Set 2: Accidental</b> | Robustness (Fire, Blast, Impact)                         | DL (1.2/0.9) + IL (1.0/0.5) + Accident Load (1.0) |
| <b>Set 3: Extreme</b>    | Integrity, Restorability (Earthquake, Collapse)          | DL (1.2/0.9) + Earthquake/Extreme Load (1.0)      |

Explicit Partial Safety Factors introduced:  $\gamma_L$  (for loads) and  $\gamma_M$  (for materials).

# Materials: Concrete Technology & Grading

## The New Hierarchy

### Ordinary:

M10 – M20 (Nominal mix allowed only here)

### Standard:

M25 – M60

### High Strength:

M65 – M100 (**New Addition**)

## Sustainable Ingredients & Mixes

- **Permitted Additions:** Recycled Aggregates, Iron/Copper Slag, Fly Ash, Metakaolin.
- **Mix Design:** Mandatory for all grades above M20. Design mix preferred for all.
- **Density:** Unit weights defined for Light, Medium, Normal (24 kN/m<sup>3</sup>), Heavy, and Very Heavy aggregates.

# Materials: Steel & Prestressing Systems

## Reinforcement

**Grades:** Fe 250, Fe 415, Fe 500, Fe 550

**Welding:** Not permitted.

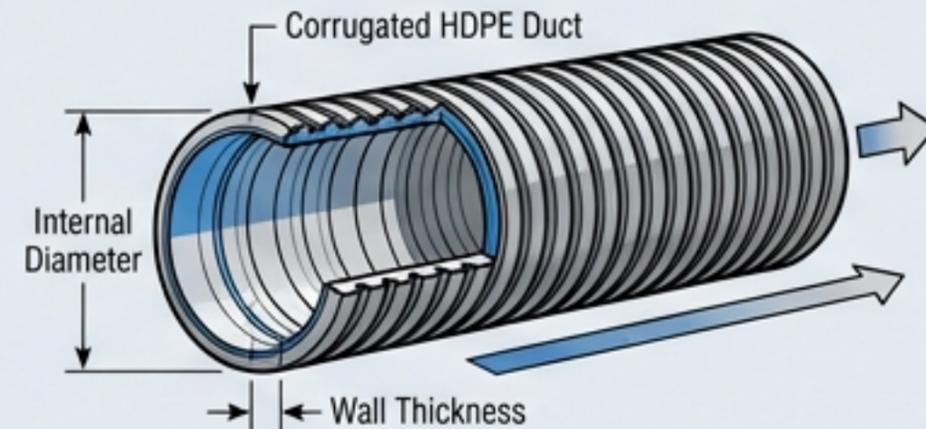


**PROHIBITED:** Epoxy Coated Bars. Bars must be free from coating or paint.

## Prestressing Materials

**Steel:** Plain/Indented wires, Multi-ply strands, High tensile bars.

**Ducts:** Mild Steel or Corrugated HDPE.



**Grouting:** Strict specs for fluidity, bleeding, and volume change.

# Time-Dependent Behavior: Creep & Elasticity

## Modulus of Elasticity ( $E_{ck}$ )

$$E_{ck} = 10000 \cdot f_{ck}^{0.3}$$

Base: Quartzite/Granite.

Adjustments: Limestone (-10%),  
Sandstone (-30%), Basalt (+20%).

## Creep Classification Levels

**Level 1:** Normal structures, lifespan < 75 years.

**Level 2:** Tall buildings (<100m),  
Bridges (<80m), lifespan up to 75 years.

**Level 3:** Major infrastructure (Dams, Nuclear), lifespan > 75 years.

Explicit formulas provided for Autogenous ( $\epsilon_{ca}$ ) vs. Drying Shrinkage ( $\epsilon_{cd}$ ).

# Structural Analysis Framework

## Linear Analysis (Standard)

**Used for:** Strength/  
Serviceability design.

**Requirement:** 3D modeling of  
geometry/boundary conditions.

**Input:** Effective stiffness using  
cracked section properties  
(e.g., Beams  $I_{eff} = 0.35 I_g$ ).

## Non-Linear Analysis (Advanced)

**Mandatory for:** Robustness &  
Integrity checks.

**Required for:** Assessment of  
existing structures.

## Simplified Methods

**Restricted to:** Simple,  
symmetric residential buildings  
< 10m height.

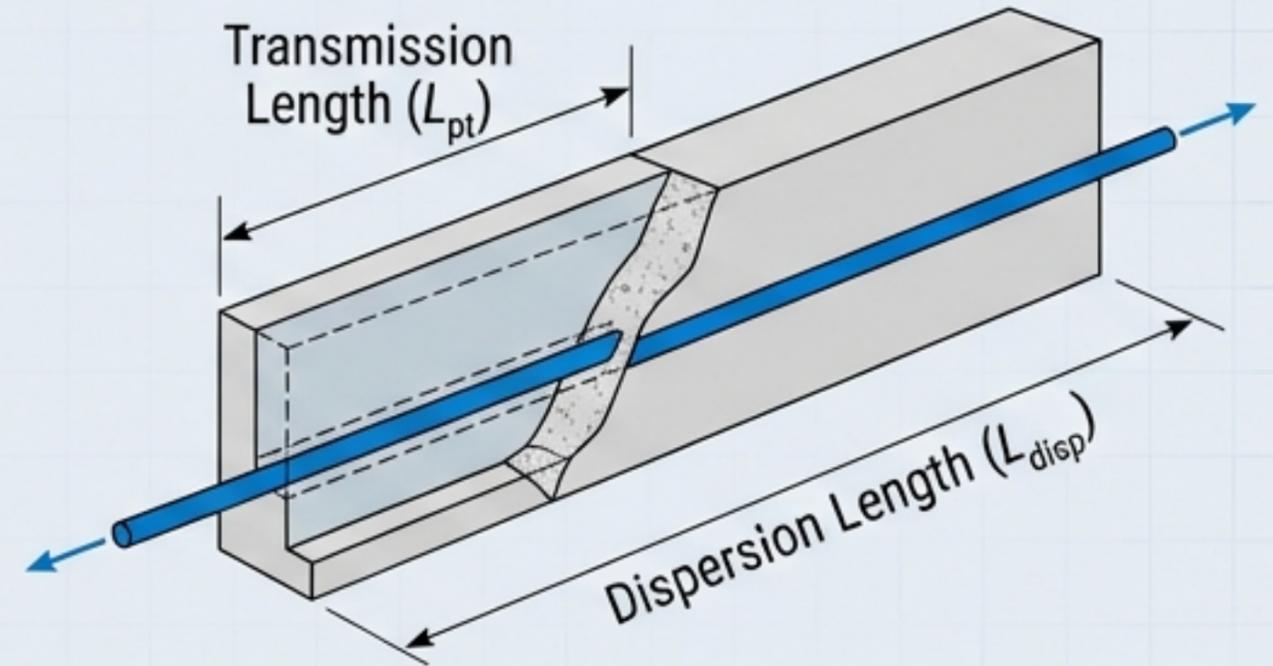
# Special Provisions: Prestressing Systems

## Design Constraints

**No Inelasticity:** Prestressing members must remain elastic; no inelastic deformation permitted in tendons.

**Seismic Caution:** Extreme caution required for PSC in seismic zones due to stress reversals.

## Detailing Requirements



**Transmission Length ( $L_{pt}$ ):** Force transfer to concrete.

**Deviators:** Radius  $\geq 40 \times$  diameter of strand.

**Couplers:** Limited to 50% of tendons at one cross-section.

# Quality Assurance & Construction Protocols

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## QA vs. QC

### Quality Control (QC):

The Constructor's internal process.

### Quality Assurance (QA):

Independent third-party monitoring.

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## The Design Basis Report (DBR)



Mandatory document declaring all loads, standards, field investigations, and methods *before* design begins.

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## Construction Ops

- Stripping times adjusted for admixtures.
- Grouting: Colloidal mixers (1000 RPM); Temp < 25°C.

# Summary & Call to Action

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## Recap of the Paradigm Shift

- 1. Introduction of **6-Criteria Performance Framework**.
- 2. Inclusion of **Prestressed & High Strength Concrete**.
- 3. Focus on **Life-Cycle (Durability/Restorability)**.

## Submit Your Comments

**Draft Reference:** CED 2(27096)P

**Deadline:** 31 January 2025

**Email:** [ced2@bis.gov.in](mailto:ced2@bis.gov.in)

## Format for Sending Comments

| Sl No | Clause/Para | Comments | Justification |
|-------|-------------|----------|---------------|
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