Prestressed Concrete

Introduction

Reinforced Concrete

- Concrete is strong in compression weak in tension.
- Steel in strong in tension and compression
- Reinforced concrete uses concrete to resist compression and to hold bars in position and uses steel to resist tension.
- Tensile strength of concrete is neglected (i.e. zero)
- R.C beams allows crack under service load.

What is Prestressed Concrete

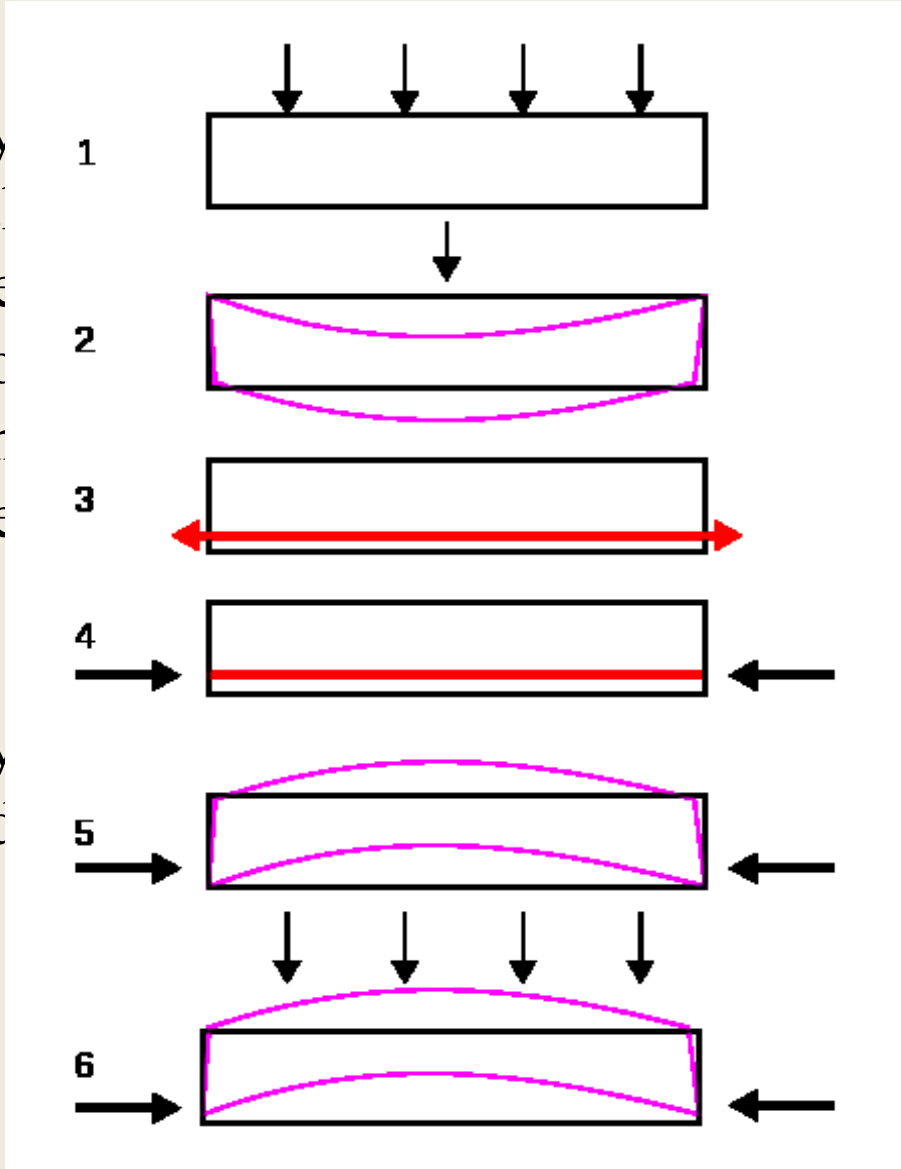
It is a method of applying pre-compression to control the stresses resulting due to external loads below the neutral axis of the beam.

Pre-compression resulting either no tension or compression.

Basic Concept of Prestressed Concrete

Prestressed concrete is basically concrete in which internal stresses of a suitable magnitude and distribution are introduced so that the stresses resulting from the external loads are counteracted to a desired degree.

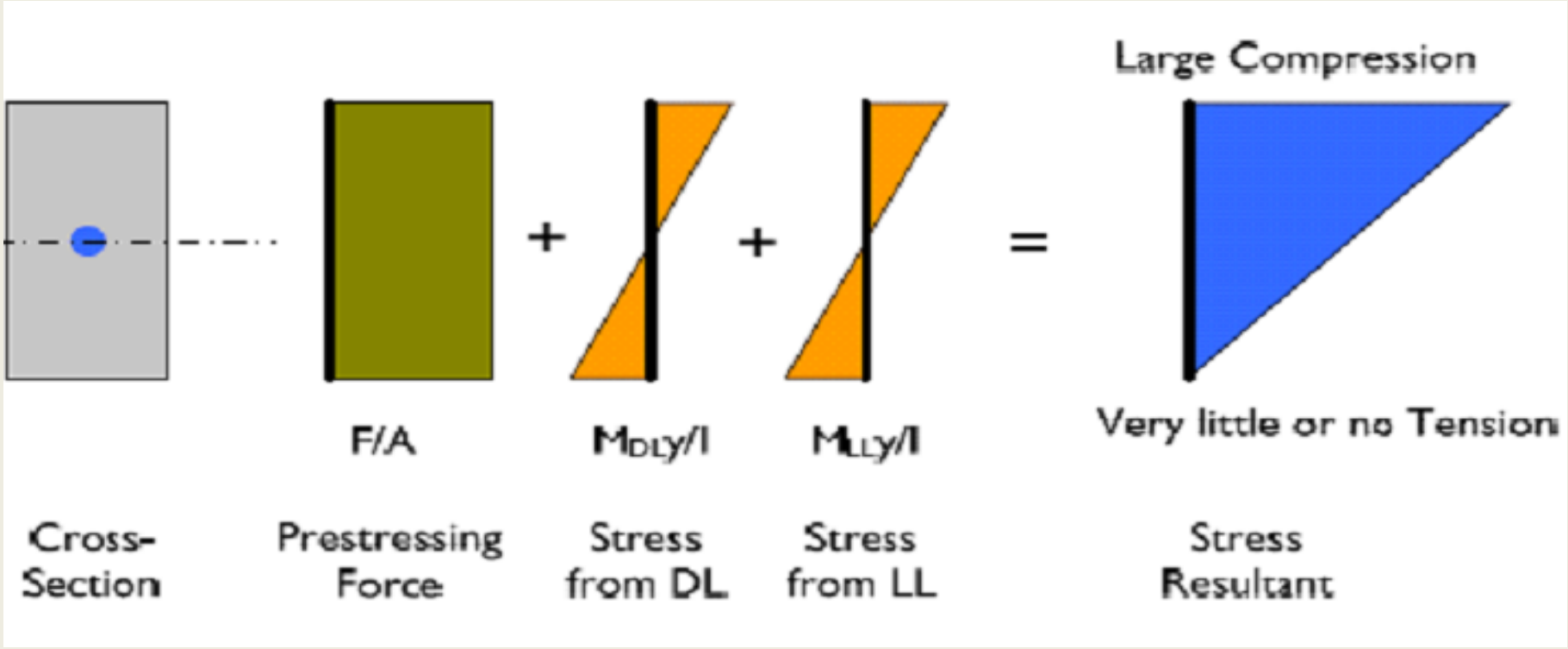
Pre-stress is introduced by stretching steel wire and anchoring them against concrete



Principle of pre-stressing

- Pre-stressing is a method in which compression force is applied to the reinforced concrete section.
- The effect of pre stressing is to reduce the tensile stress in the section to the point till the tensile stress is below the cracking stress. Thus the concrete does not crack.
- It is then possible to treat concrete as a elastic material.
- The concrete can be visualized to have two compressive force
  - i . Internal pre-stressing force.
  - ii . External forces (d.l , l.l etc)
- These two forces must counteract each other.

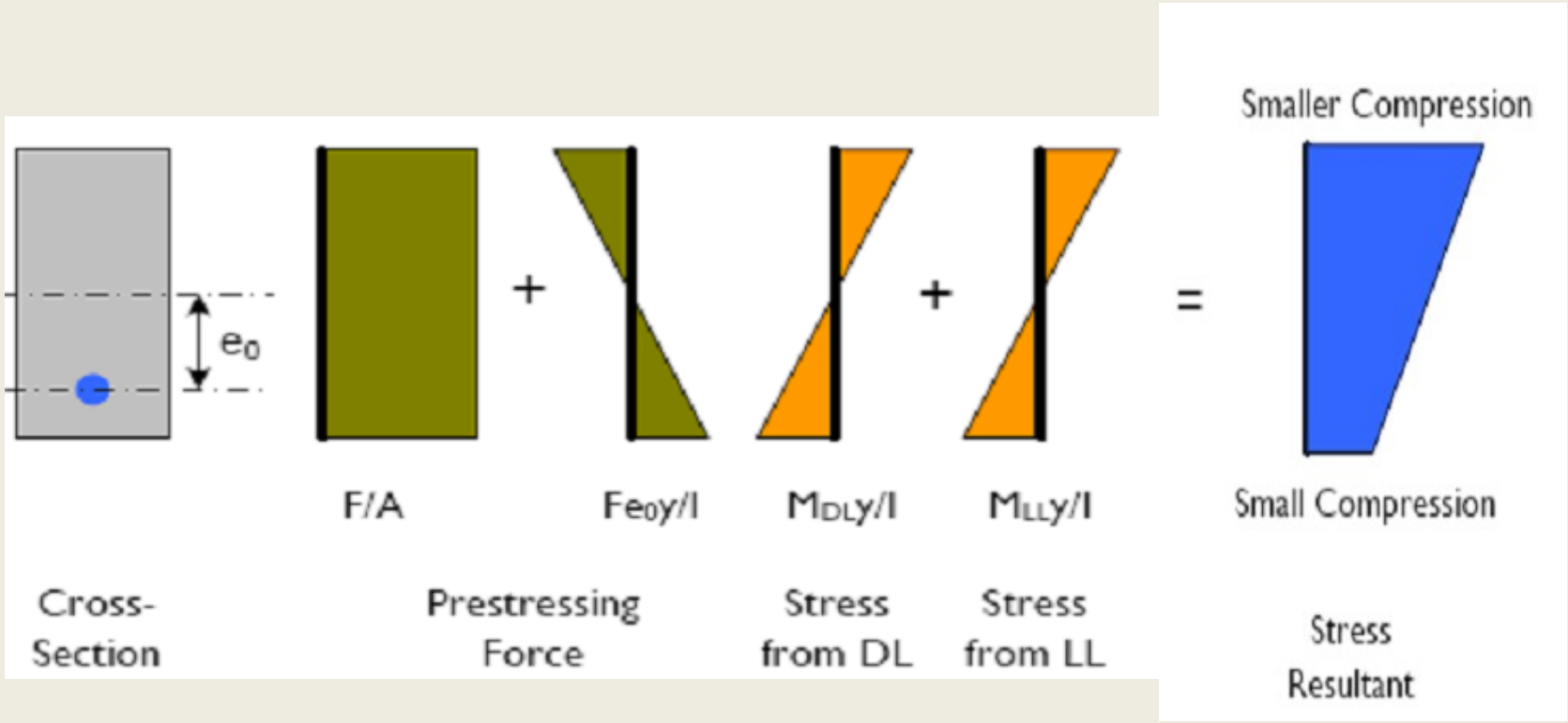
Principle of pre-stressing



- Stress in concrete when pre stressing is applied at the c.g of the section

Principle of pre-stressing

- Stress in concrete when pre stressing is applied eccentrically with respect to the c.g of the section .



Pre-stressed Concrete: Methods

There are two basic methods of applying pre-stress to a concrete member

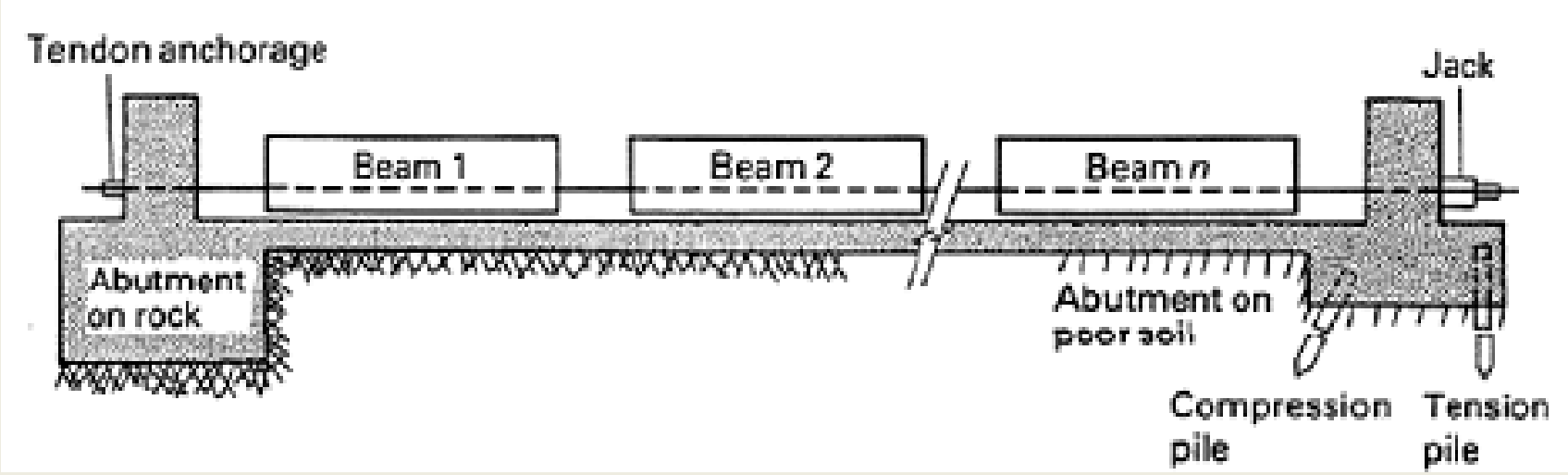
Pre-tensioning – most often used in factory situations

Post-tensioning – site use

Pre-stressed Concrete: Methods

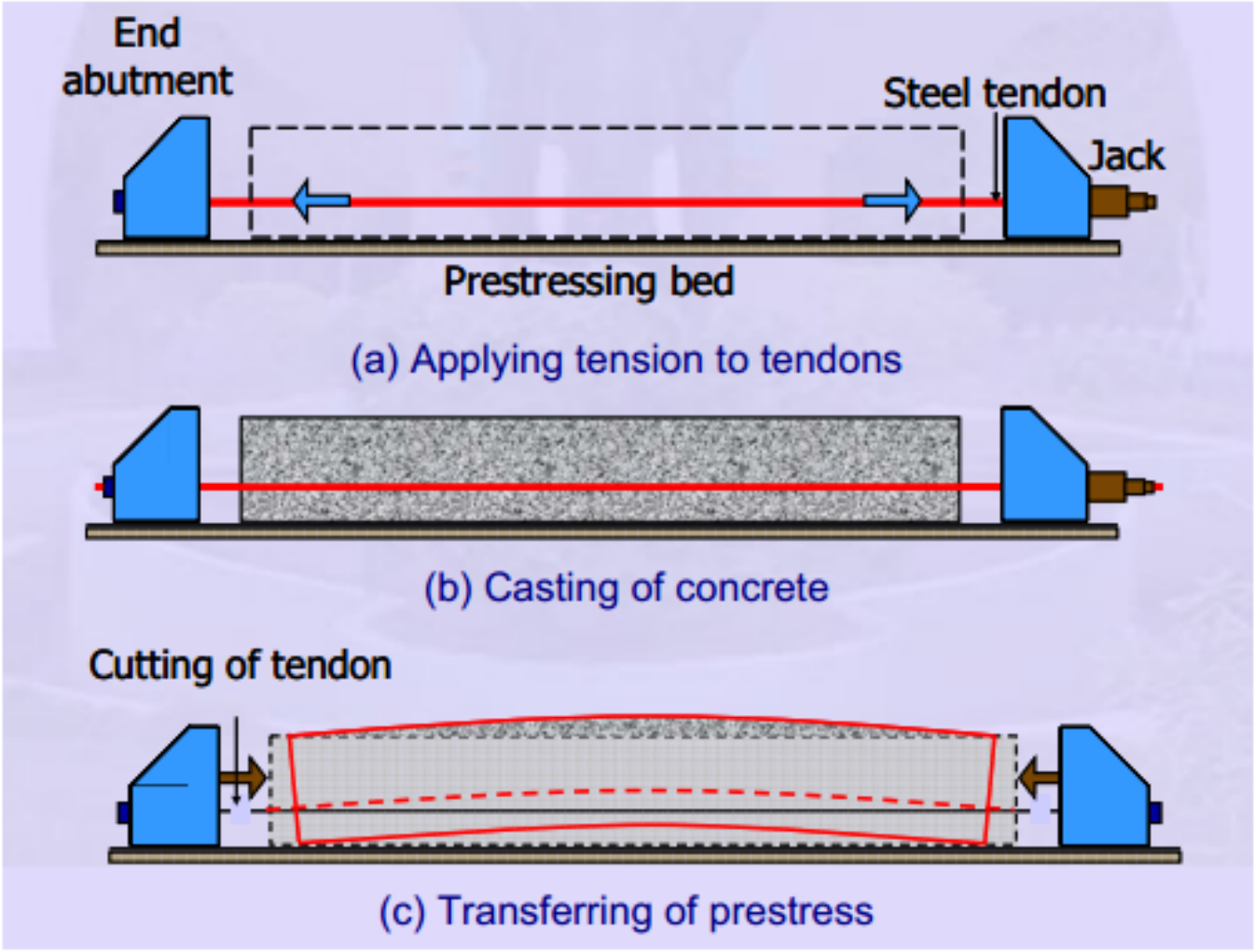
I . Pre-tensioning

In Pre-tension, the tendons are tensioned against some abutments before the concrete is place. After the concrete hardened, the tension force is released. The tendon tries to shrink back to the initial length but the concrete resists it through the bond between them, thus, compression force is induced in concrete. Pretension is usually done with precast members



Pre-stressed Concrete: Methods

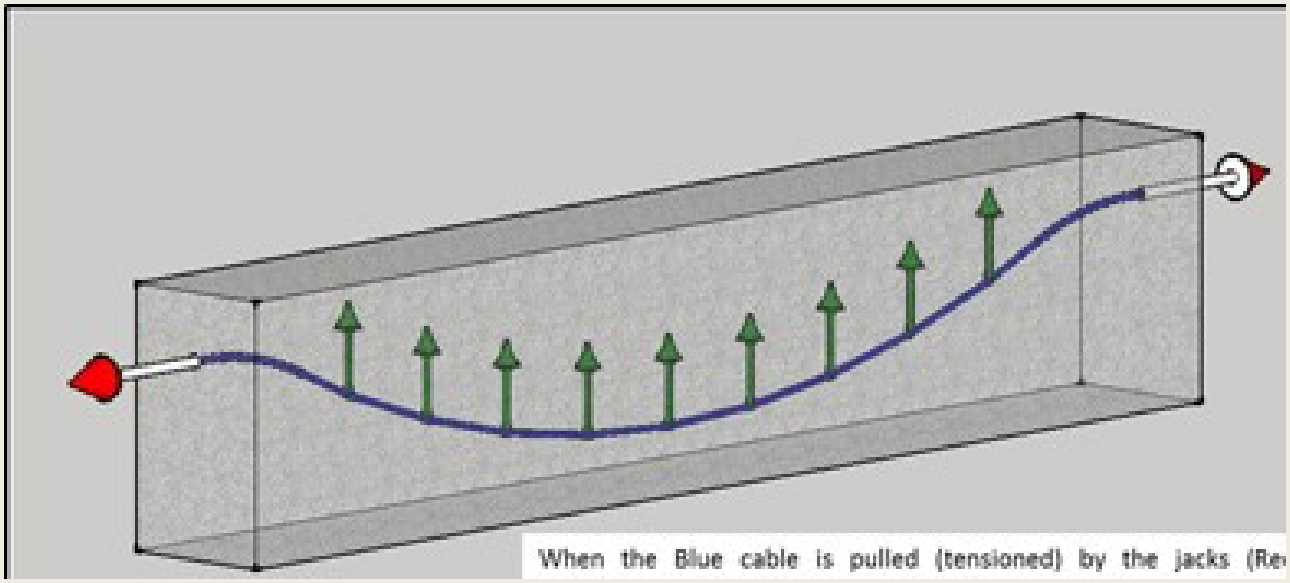
I . Pre-tensioning



Pre-stressed Concrete: Methods

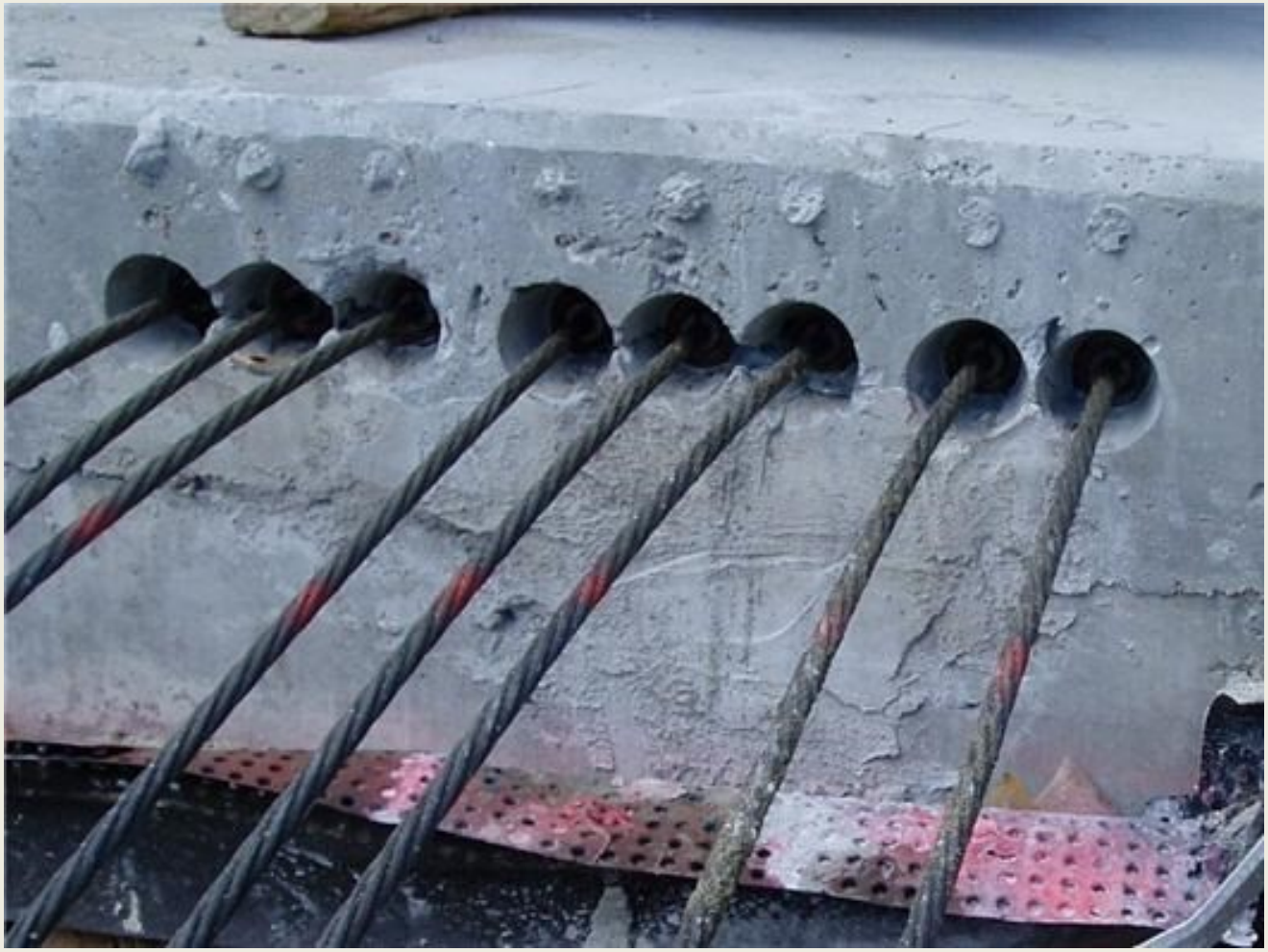
II. Post-tensioning

In Post tension, the tendons are tensioned after the concrete has hardened. Commonly, metal or plastic ducts are placed inside the concrete before casting. After the concrete hardened and had enough strength, the tendon was placed inside the duct, stressed, and anchored against concrete. Grout may be injected into the duct later. This can be done either as precast or cast-in-place.



Pre-stressed Concrete: Methods

II. Post-tensioning



Advantages of Prestressing

- Take full advantages of high strength concrete and high strength steel
- Need less materials
- Smaller and lighter structure
- No cracks
- Use the entire section to resist the load
- Good for water tanks and nuclear plant
- Very effective for deflection control
- Better shear resistance

Disadvantages compared to RC:

- Need higher quality materials
- More complex technically
- More expensive
- Harder to re-cycle

Prestress Concrete Material

 # Concrete:

Pre-stress concrete requires high strength concrete, which has high compressive strength comparatively higher tensile strength than ordinary concrete.In pre-stress concrete compressive strength used is 28-55 MPa

#Steel:

High tensile steel, tendons, strands.

In pre-stress concrete high tensile steel with tensile strength around 2000MPa.

Prestress Concrete Material

#Steel:

- Very high breaking strengths
- Very high elastic properties

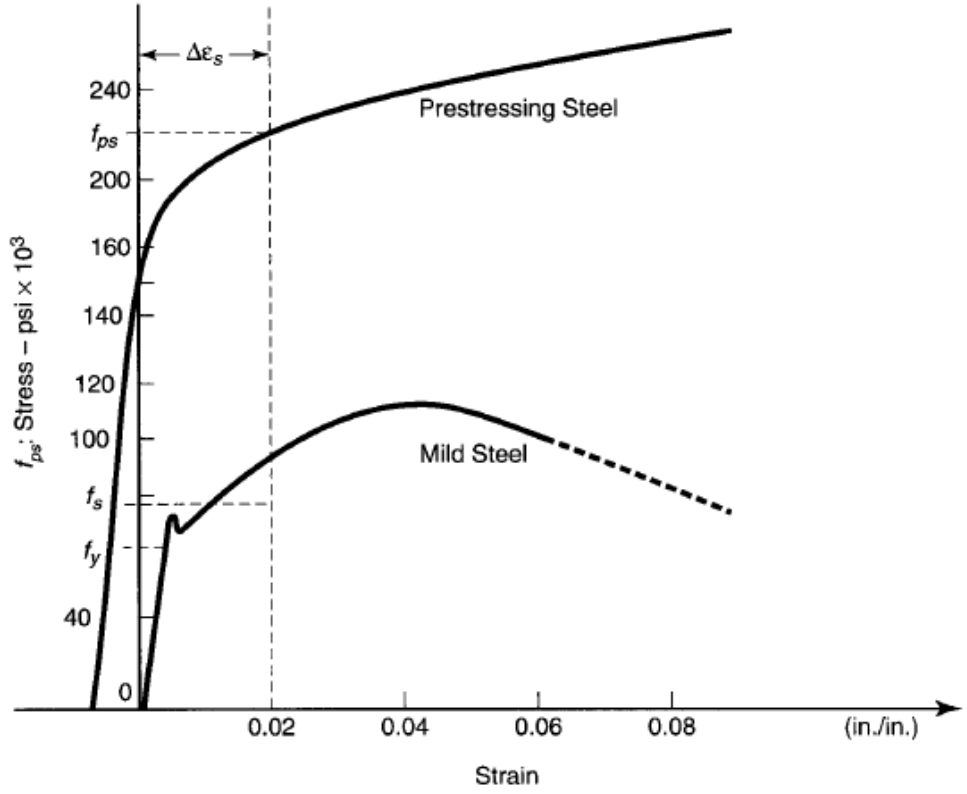
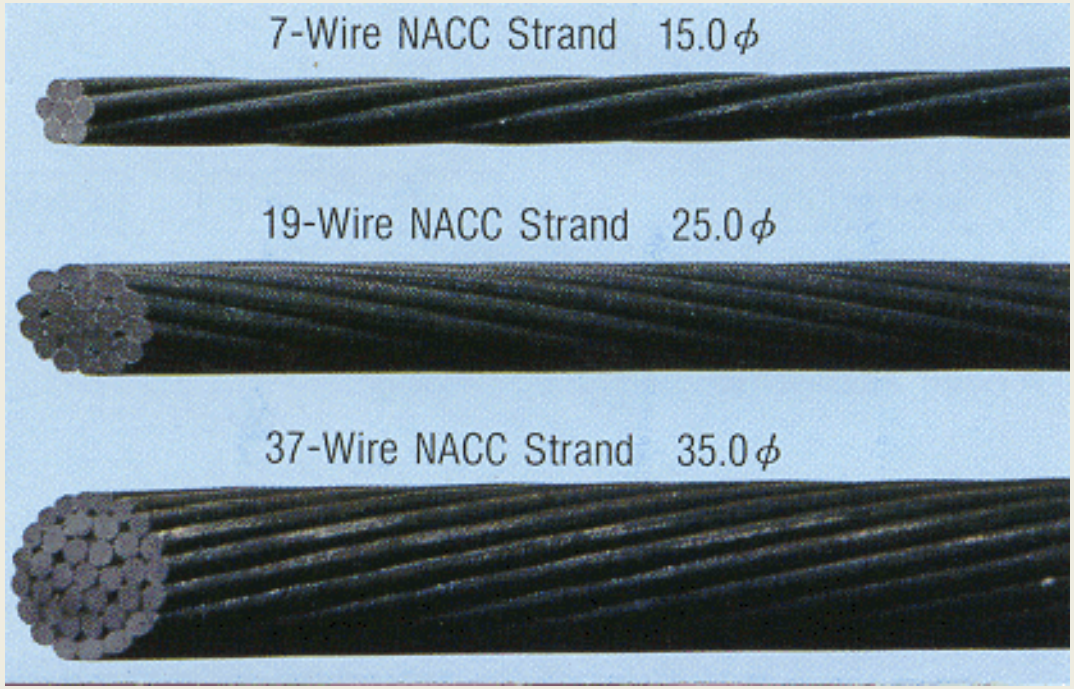


Figure 2.18(b) Stress-Strain Diagram for Prestressing Steel Strands in Comparison with Mild Steel Bar Reinforcement.

Prestress Concrete Material

- Strands are made of several wires.
- Standard is 7 wire strand conforming to ASTM A416.
- The wires are twisted to form a single element.



Prestressed Beam for Lab

Concrete Strength= 40 MPa
Longitudinal Steel= Grade 60
High Strength prestressing Bar= G250