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## A CASE STUDY ON PRE-TENSIONING & POST TENSIONING SYSTEMS OF A PRESTRESSED CONCRETE

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### Abstract:

*In Present days the pretensioning and post tensioning systems are very popularly using in the major constructions of a structure. The Pre-tensioning and Post-tensioning both methods are used under pre-stressing process. In which has few edges over the orthodox non-stressed structures like greater span to depth ratio, higher moment and shear capacity. These methods are generally adopted in the making of PSC girders, sleepers, Bridges, Slabs in buildings, Concrete Pile, Repair and Rehabilitations, Nuclear Power Plant etc.*

**Keywords:** *Pretensioning; Posttensioning; Prestressing; Structure; Prestressed Concrete.*

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## 1. Introduction

### 1.1. Pre tensioning Systems

In this method, the concrete is pre stressed with tendons before it is placing in position. This method is developed due to bonding between the concrete and steel tendons. Pre tensioning is preferred when the structural element is small and easy to transport. In this method, similar pre stressed members are prepared. Pre-tensioning members are produced in mould.

### 1.2. Post tensioning Systems

Pre stressing systems have developed over the years and various companies have patented their products. Detailed information of the systems is given in the product catalogues and brochures published by companies. There are general guidelines of pre stressing in Section 12 of IS 1343: 1980. The information given in this section is introductory in nature, with emphasis on the basic concepts of the systems. The pre stressing systems and devices are described for the two types of pre stressing, pre-tensioning and post-tensioning, separately. This section covers post-tensioning in IS:1343-1980 codebook Section 1.3, "Pre-tensioning Systems and Devices", covers pre-tensioning. In post tensioning, the tension is applied to the tendons after hardening of the concrete. The stages of post-tensioning are described next.

## 2. Materials Used

The following materials are used in the pre tensioning and post tensioning systems of a concrete:

- Cement
- Concrete
- Steel

### ***Cement:***

Mainly the four types of cements are used in a concrete

- Ordinary Portland cement
- Portland slag cement
- Rapid hardening Portland cement
- High strength Ordinary Portland cement

Minimum cement content of 300kg/m is prescribed for the durability requirement.

### ***Concrete:***

In pre and post tensioning concrete members, the concrete should be high strength concrete which has high compressive strength comparatively higher tensile strength than ordinary concrete. The concrete is material should be composed of gravels or crushed stones, sand, cement. The concrete for the members shall be air-entrained concrete composed of Portland cement, fine and coarse aggregates, admixtures and water. The air-entraining feature may be obtained by the use of either air-entraining Portland cement or an approved air-entraining admixture. The entrained air content shall be not less than 4 percent or more than 6 percent. The water content should be as low as possible.

- The minimum grade of concrete for pre tensioned members: M<sub>40</sub>
- The minimum grade of concrete for post tensioned members: M<sub>30</sub>

### ***Steel:***

High tensile steel, tendons, strands or cables

*Tendon:* A stretched element used in a concrete member of structure to impart pre and post tensile members to the concrete.

*Strands:* A few wires are spun together in a helical form to form a pre stressing strand. The different types of strands are as follows. 1) Two-wire strand: Two wires are spun together to form the strand.

- *Two wire strand:* Two wires are spun together to form a helical shape of a strand.
- *Three wire strand:* Three wires are spun together to form a helical shape of a strand.
- *Seven-wire strand:* In this type of strand, six wires are spun around a central wire. The central wire is larger than the other wires.

The following figure shows about the types of strands:

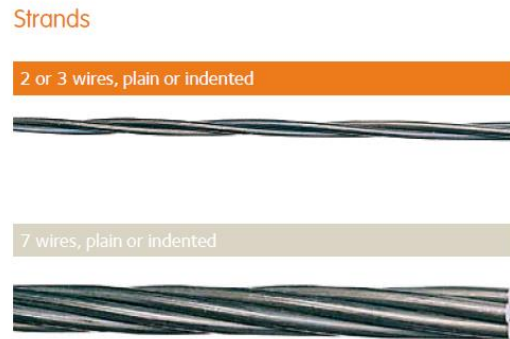


Figure 1: Strands

**Cables:**

A group of tendons form a pre stressing cable. The cables are used in bridges.



Figure 2: Cables

**Bars:**

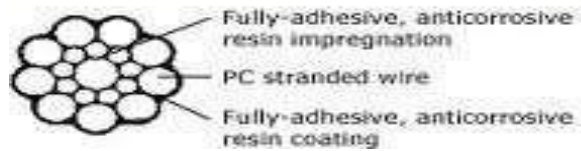
A tendon can be made up of a single steel bar. The diameter of a bar is much larger than that of a wire. Bars are available in the following sizes: 10, 12, 16, 20, 22, 25, 28 and 32 mm.



Figure 3: Steel bars



▲ Prestressing steel strand



The following figure shows the different forms of pre stressing steel.

The steel used in priestess shall be any one of the following:-

- Plain hard-drawn steel wire conforming to IS1785 (Part-I & Part-III)
- Cold drawn indented wire conforming to IS6003
- High tensile steel wire bar conforming to IS2090
- Uncoated stress relived strand conforming to IS6006

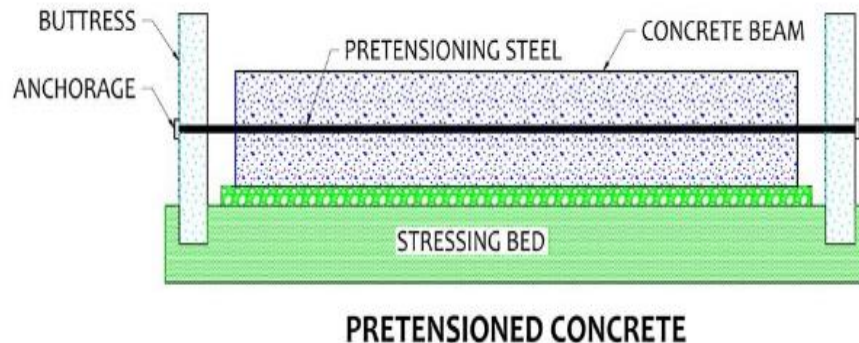
High strength steel contains:

- a) 0.7 to 0.8% carbons,
- b) 0.6% manganese,
- c) 0.1% silica

### 3. Pre-Tensioning

In which the tendons are tensioned before the concrete is placed, tendons are temporarily anchored and tensioned and the pre stress is transferred to the concrete after it is hardened.

- 1) In this method, the concrete is prestressed with tendons before it is placing in position.
- 2) This method is developed due to bonding between the concrete and steel tendons.
- 3) Pre tensioning is preferred when the structural element is small and easy to transport.
- 4) In this method, similar prestressed members are prepared.
- 5) Pre-tensioning members are produced in mould.



#### Advantages of Pre Tensioning:

The relative advantages of pre-tensioning as compared to post-tensioning are as follows:

- Pre-tensioning is suitable for precast members produced in bulk.
- In pre-tensioning large anchorage device is not present.

#### Disadvantages of Pre Tensioning:

The relative disadvantages are as follows:

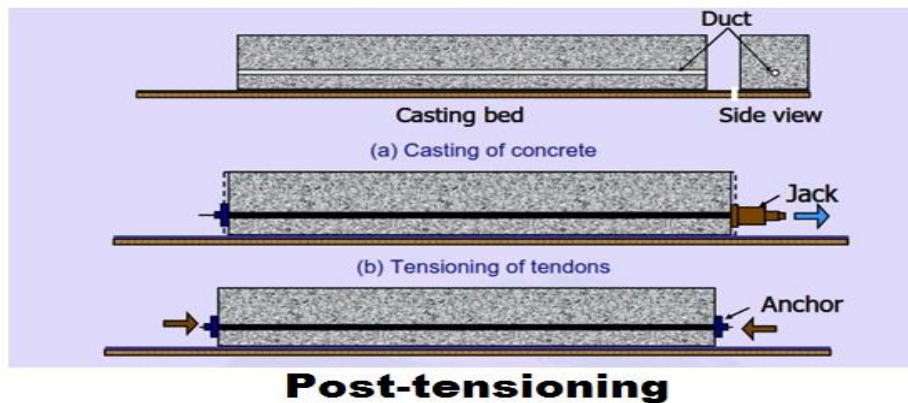
- A pre stressing bed is required for the pre-tensioning operation.
- There is a waiting period in the pre stressing bed, before the concrete attains sufficient strength.
- There should be good bond between concrete and steel over the transmission length.

### 4. Post-Tensioning

In which the tendon is tensioned after concrete has hardened. Tendons are placed in sheathing at suitable places in the member before casting and later after hardening of concrete.

- 1) In this method pre stressing is done after the concrete attains sufficient strength.
- 2) This method is developed due to bearing.
- 3) Post tensioning is preferred when the structural element is heavy.

- 4) In this method, products are changed according to structure.
- 5) Cables are used in place of wires and jacks are used for stretching.



#### Advantages of Post Tensioning:

- Longer clear spans
- Thinner slabs
- Lesser floor to floor height
- Shorter building height
- Lesser weight
- Improved seismic performance
- Faster construction cycle

#### Disadvantages of Post Tensioning:

- The relative disadvantage of post tensioning as compared to pre tensioning is the requirement of anchorage device and grouting equipment.

#### 5. Conclusion

Among the types of concrete's such as generally normal concrete, reinforced cement concrete, prestressed concrete is the best concrete for obtaining much strength in the major constructions of a structure and also for getting more life span of a structure.

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