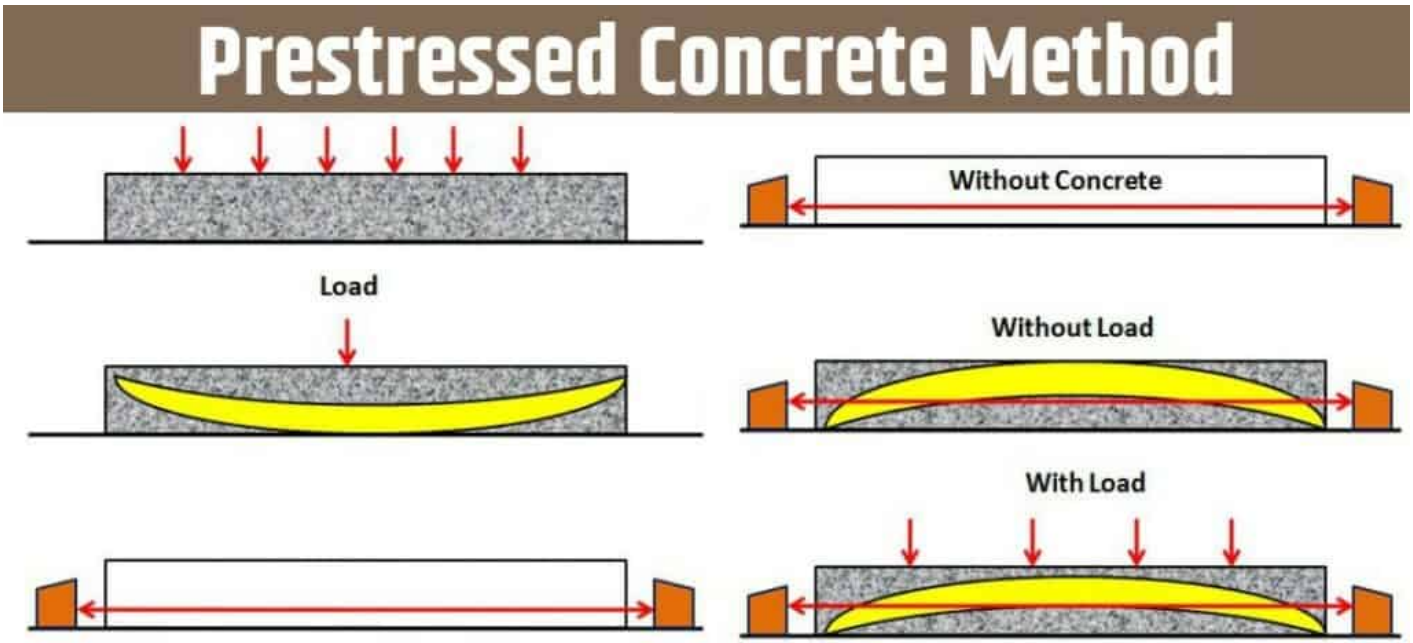
Prestressed Concrete – Method, Advantages & Disadvantages

by Mike Mahajan25/11/20191 Comment



Prestressed Concrete is simply concrete that is stressed before concrete is poured in from work with the help of jack and tension embed in it.

As we generally know that **concrete is the mixture of three main ingredients** which are cement (fine mixture of clay, limestone, and small amount of gypsum ground up to the desired degree of fineness), sand (only river sand or obtained through pit) and aggregate (Made form blasting and grinding from rocky soil) and when we add water (free from impurities) in this mixture it creates concrete which we use for various civil work.

Prestressed Concrete

One of the main important characteristics of concrete or drawback of concrete is, that it is **weak in tension and strong in compression** because the material which is used in concrete is rigid and

posse's low tensile/flexural strength. That's why in order to resist the tensile load or stress which structure has to resist after actual loading.

Engineers come with the solution to introducing High strength steel bars into concrete members. Using this method they have overcome the problem of tensile stress which has allowed the engineer to achieve various possibilities such as reducing the size of member increasing span length etc.

But when we consider the structure such as bridges, where the span is so long and load is also high, we can't simply adopt a normal reinforced concrete structure as the size of member become larger, crack developed and it's become uneconomical. Under such a circumstance we have to adopt different kinds of method and one of the most commonly adopted methods is the prestressing of concrete.

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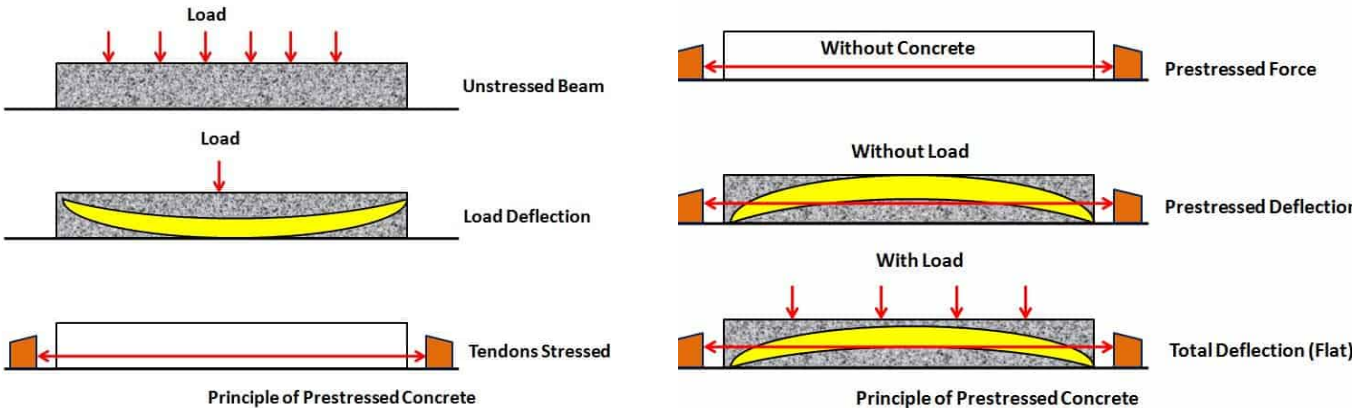
Conventional concrete has embedded with high tensile strength steel bars which have great compressive strength to form ideal structural material which is good in both compression and tensile. In the case of prestressed concrete, a high strength prestressed steel bars produce tension in a concrete member before actual loads are applied which will be balanced by the tensile stresses imposed in the member during service period or after commissioning.

As you can see in fig. 1 which is a normal R.C.C beam where no prestressing is done beam will deflect under loading and crack will develop.



Where in fig. 3 to 6 you can see that if we apply pre-stress force before actual loading, we will see a positive deflection caused by applied compression force but as the actual load applied on beam our beam will become straight or flat.

Some of the benefit of prestressed concrete over conventional R.C.C is that we can construct member having less crack, less shrinkage and temperature effects. As a result, the ingression of detrimental agents is prevented which helps in avoiding reinforcement corrosion. It is also becoming a tool to go beyond the design limitation of concrete members placed on span and load and permits the building of roofs, floors, bridges, and walls with longer unsupported spans.

This allows architects and engineers to design and build lighter and reduce its C/S area without losing strength but the construction process in prestressed concrete requires extensive monitoring and complicated devices and equipment at all stages.

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Prestress Tendons

Steel Wires – wire is a single unit made of steel.

Strands – Group of wire not more than 7 wounded to form a prestressing strand.

Tendon – Number of strands or wires are packaged together to form a prestressing tendon.

Cable – When a number of tendons are grouped together and form single wire then it is called Cable.

Based upon the concrete-steel interface it can be classified into two-part:

Unbounded tendon – This tendon is those which are not bonded or in which not concrete grouting is done after prestressing.

Bonded tendon – This tendon is bounded by injecting concrete grout.

Further prestressed concrete is divided into two parts:

Pre-tensioning of Concrete

the pre-tensioning process steel tendon is stretched before the concrete is poured in the formwork. Than High-strength steel tendons are placed between two abutments and stretched as per the require deflection or strength. After that Concrete is poured into molds and around the tendons and allowed to cure. Tendons are kept stretched until the desired concrete strength reached after curing. As the steel reacts to regain its original length, the tensile stresses are translated into compressive stress in the concrete. The most popular prestressed concrete elements are roof slabs, piles, poles, bridge girders, wall panels, and railroad ties.

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Post-Tensioning

The post-tensioning process tendons are stretched after the concrete hardens. First,a Concrete is cast around, but not in contact with unstretched tendons. In many situations, a duct is formed in the concrete unit using thin-walled steel forms. As the concrete hardened to the required strength, the steel tendons are then inserted and stretched against the ends of the unit and anchored off externally, placing the concrete into compression. Post-tensioned concrete is used for cast-in-place concrete and for bridges, large girders, floor slabs, shells, roofs, and pavements.

- In concrete, a large prestressing force is applied by tendons embedded into it to develop high bearing stresses at the ends by the anchoring devices. These anchoring devices are generally designed for high strength concrete work.
- Too high tensile stresses are likely to be developing in concrete members and that cannot be satisfactorily resisted by low strength concrete work.
- Stress transfer to concrete is done by and between concrete and tendons, the concrete should have a high strength concrete.
- Shrinkage cracks will occur during the safer of stresses from tendon to concrete.
- High strength concrete has a high modulus of elasticity and therefore the elastic and creep strain are very small resulting in smaller loss of pre-stress in all steel reinforcement.