

Prestressing of Concrete

Prestressing of concrete is a technique commonly adopted in diverse construction work in order to render concrete members or structures stronger, smaller in sections and thus lighter in weight, more economical as compared to ordinary reinforced concrete members. There are also a host of other benefits that come as a package with prestressed concrete. This is a common topic in civil engineering and is discussed in great detail in innumerable sources including civil engineering textbooks, technical papers, articles and so on.

The purpose of this post is not to discuss all those details. Nor do I claim to know or remember each and every aspect of prestressed concrete. The purpose is to dispel certain misconceptions that some of us have regarding prestressing of concrete.

In spite of the fact that this topic is well addressed in great many textbooks, somewhere down the line I began to regard prestressing and post-tensioning of concrete as two completely different techniques or methods for reasons not known to me. For a long time, I had been under the impression that the method in which tensile stresses are introduced in the steel reinforcement before the concrete members are cast is called prestressing and the one that involves introduction of tensile stresses in the steel wires or cables after completion of casting of the concrete members is called post-tensioning.

The thought strengthened its roots further when I realised that some others too see the matter in the same light. It was only when I had to take some involvement in post-tensioning related matters in a project involving bridge construction that I took a bit more interest in this area and did a little bit of study to refresh my memory. Then I realised that the thought about it was only partially correct.

Yes, application of stresses to the steel prior to and after concreting can be called prestressing and post-tensioning respectively. Then what is this post all about? Actually both are two different ways or methods of prestressing concrete. In other words, both are prestressed concrete. Both are actually two branches or techniques of inducing (pre)stresses to concrete.

Prestressing involves purposeful induction of certain amount of initial stresses to concrete through the steel wires or cables within it in order to improve the performance of concrete members as compared to ordinary reinforced concrete. As already mentioned, prestressing technique is further sub-divided into two classes namely pre-tensioning and post-tensioning. When stress is introduced to steel prior to concreting it is called pre-tensioning and when the same is introduced to steel after concreting it is called post-tensioning.

Both are called prestressed concrete because in both cases the concrete members are already (pre) stressed even before they are subjected to actual loads. To be more specific, one can be called pre-tensioned concrete while the other post-tensioned concrete. Apparently, the term prestressing is more commonly used in stead of the term pre-tensioning but that does not make any difference as long as one is clear about the definitions. In both cases, the pre-induced stresses in the concrete have to be strictly opposite to those developed in it when it is subjected to actual loads.

Pre-tensioning technique involves application of calculated amount of initial tensile stresses to high ultimate tensile strength steel wires inside a formwork and then casting the member. Once the concrete is sufficiently strong the stressed wires are released which in turn induce stresses of opposite nature in the concrete itself. These stresses become part & parcel of the concrete member. When the member (say, a beam) is subjected to loads these pre-induced stresses neutralise the stresses developed due to the loads as both are opposite in nature. This enhances the capacity of the member substantially as already mentioned in the beginning.

Post-tensioning technique involves introduction of high ultimate tensile strength steel wires or cables inside already cast and sufficiently strong concrete members through ducts already left within the concrete. Calculated amount of tensile stresses are then applied to the steel wires which are anchored using anchor blocks. Usually, ducts are grouted after completion of stressing.

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