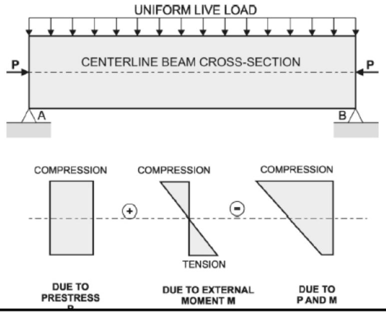

INTRODUCTION TO POSTTENSION CONCRETE

The basic concepts behind prestressed concrete were first formulated in the period from 1885 to 1890 in Germany and the United States by C. F. W. Doehring and P. H. Jackson, respectively? It was not until 1955, however, that the first design criteria for the design of prestressed bridges were published by the Bureau of Public Roads

Prestressed concrete utilizes an applied force that increases internal compression in the concrete beam, thereby reducing or eliminating tensile stresses once the beam is loaded. There are a variety of methods for applying a prestressing force to a concrete member.

- To apply the prestressing force, such as the one depicted in Figure above, jacks can be placed at either end of the beam and made a permanent part of the structure.
- STRESSES AT THE bottom fiber of the beam, that are caused by dead and live loads can only be eliminated if the compressive stress induced by the prestressing force P is equal to the magnitude of the tensile stresses induced by the applied loads.

Like conventional reinforced concrete, prestressed concrete must also account for the effects of shrinkage and creep. If the beam is to eliminate all tensile stresses, then the prestressing force applied must be greater than the tensile stresses alone in order to account for the additional deformational loads.

Pretensioned Beams. In a pretensioned beam, prior to the placement of concrete steel, tendons are stressed by application of a tensile force (usually with hydraulic jacks). The magnitude of the prestressing force varies depending on the beam itself and the loads to be applied. Once the concrete has hardened around the tendons, they are released. The tendons immediately seek to restore themselves to their original length. It is this response that introduces the compressive forces that in turn eliminates tension at the bottom fiber of the beam under service loads.

Pretensioned beams are sometimes fabricated in casting yards where the tendons are anchored between large abutments known as pretensioning beds, which can be as much as 500 ft (152 m) apart. An alternative method to this approach is to embed the anchors within the beam itself.

One major advantage of the pretensioning approach is that it lends itself well to the mass production of beams. As prestressed bridges became more popular, and standard beam sizes accepted, fabricators found themselves producing prestressed pretensioned concrete beams much in the same fashion as steel fabricators had been churning out wide-flange beams.

Posttensioned Beams. In a posttensioned beam, the steel tendons are stressed after the concrete has had time to harden. The tendons are incorporated into the concrete beam in one of the following two fashions:

- Bonded
- Unbonded

Bonded tendons are placed within preformed voids in the concrete member. These voids could be formed by galvanized ferrous metal ducts or polyethylene tubes. After the concrete has hardened and the posttensioning stress is applied, the space between the void and the tendon is filled with grout so that the tendon/tube assembly becomes bonded to the surrounding concrete beam.

Unbonded tendons are simply greased and wrapped in paper. After the posttensioning force is applied, they are left as is or unbonded to the surrounding concrete beam. To protect the tendons, a waterproofing paper is sometimes used to guard against potential corrosion. The grease used may also be provided with an anticorrosion component. With respect to bridge design, bonded tendons are more the norm with unbonded tendons primarily used in building construction. Both of these methods require the incorporation of an anchorage at the ends of the posttensioned member.

Application of Pre- and Post-tensioned Concrete. The general rule of thumb is that pretensioned beams are utilized for short spans and posttensioned beams for longer, more complicated spans. For short spans with simple alignment and clearance constraints, the pretensioned beam offers a straightforward, economical solution.

Larger spans, however, which can be cast in place at or near the project site, are better suited to posttensioning. Another advantage of posttensioned construction is that the tendons can be placed on nonlinear paths (something that is very difficult to do when the beam is pretensioned). Thus, when complicated overpass alignment geometries are present, posttensioning is the preferred approach.

There are three basic groupings of prestressing steels. Specifically, these types of steel are:

- Uncoated low-relaxation seven-wire strand
- Uncoated stress-relived seven-wire strand
- Uncoated high-strength plain or deformed steel bars

References:
A 416, A 416M, A 722, and A 722M

www.esolution-pt.com
info@esolution-pt.com