

SECTION 500 - STRUCTURES

506.00 Pre-stressing Concrete.

General. Pre-stressing is specialized work that is done by crews trained and experience in this operation. The responsibility for pre-stressing lies with the Contractor, however the Engineer and the inspector should be familiar with the operation. Normally an experienced representative of the Central Materials Lab or an approved consultant will perform the actual pre-stressing inspection. It is important that these individuals are given ample notice so that arrangements can be made for the inspection.

The Contractor will submit and the Bridge Section will approve any subcontractors involved and the working plans which will show the type of pre-stressing, the bed layouts, calculations for elongation, friction losses, sequences for stressing and de-tensioning, etc. The most current version of the [Pre-cast/Prestressed Concrete Institute's Manual for Quality Control for Plants and Production of Structural Pre-cast Concrete Products](#) is incorporated into the [Standard Specifications](#), and will be adhered to on tolerances for the fabrication of pre-cast and pre-stressed concrete items. Each district must have a minimum of one copy of this publication on hand.

Pre-stressing Methods. Pre-stressing may be accomplished by pre-tensioning, post-tensioning, or a combination of both methods.

- A. **Pre-tensioning:** The stressing tendons are tensioned before the concrete is placed. After the concrete has developed a specified strength, the anchorages for the tendons are released and the forces in the tendons are transferred to the concrete.
- B. There are two systems of pre-tensioning the tendons. One system is the tensioning of each strand individually. This is referred to as single strand tensioning. The other system consists of pulling two or more strands simultaneously. This is referred to as multiple strand tensioning.
- C. **Post-Tensioning:** The stressing tendons are installed in voids or ducts within the concrete, and are stressed and anchored after the concrete has developed a specified strength. As a final operation, the voids or ducts are pressure grouted. This method requires more attention to the details of the construction from the Engineer and his or her inspectors.
- D. **Combination Method:** Some of the stressing tendons are pre-tensioned and some are post-tensioned. In this method, requirements for pre-tensioning and post-tensioning apply to the respective stressing elements used.

See [Sections 502](#) and [503](#) for inspection of the concrete and metal reinforcement respectively.

Special attention should be given the location of the reinforcing bars extending out of pre-cast members. Bars which are to be used as connecting bars between pre-cast and poured-in-place construction should be extended from the pre-cast member the distance and at the exact location shown on the plans. Mortar coatings adhering to bars protruding beyond the surface of pre-cast members must be removed. Bending of these bars to facilitate moving or handling must be kept to an absolute minimum.

In the event that stressing is not done in a continuous operation, members should not be handled before they are sufficiently stressed to sustain all forces and bending moments due to handling.

When handling beams, it is imperative that they be maintained in a plumb, upright position at all times, setting on blocks and picked up and supported only near the ends using the devices installed for this purpose. Disregard of handling requirements may induce stresses that lead to damage or collapse of the member. Carefully document all improper handling, storage or potential damage with photos or video.

It can be difficult to establish fixed criteria regarding the acceptability of pre-stressed concrete members with respect to appearance. However, to ensure a reasonable appearance only clean, steel forms in good condition should be used. Pre-stressing steel is susceptible to corrosion and needs to be stored and protected from the weather and any corrosive agents. Likewise it must be free of silt, clay, grease, paint or any other deleterious material. All members should be fabricated in a workmanlike manner without cracks or other defects and true to the dimensions shown on the plans. However, it is recognized that certain cracks and surface defects may not be detrimental from the standpoint of structural integrity and may be harmless if remedied by the proper repairs. Small voids or honeycombs on the sides of beams can be repaired with grout having the same proportion of sand and cement as the concrete. These repairs must be made and cured prior to releasing the stress. The same is true for voids and honeycomb on the bottom of the beams except when these are located at or near the bearings. Voids here are grounds for rejection. The Bridge Section must be consulted when cracks or other defects are found, both as to the method of repairing the defect and the final acceptability of the member. The Construction/Materials Section should be advised of all problems and developments as well. All repair procedures must be approved by the Bridge Section before and after implementation.

If the concrete has been steam cured, it will be whiter in appearance than concrete made with the same materials which is not steam cured. Substitution of from one-third to one-half of the cement with white Portland cement in mixes made for patching and hand rubbing is common practice.

Each member should be marked in accordance with the erection drawing for identification.

Pre-cast, pre-stressed beams start creeping up immediately after pre-stressing strands are released. This creates the “upward bow” or camber in the member. The design camber at mid span should be checked against the actual camber measured in the field after beam erection to note if it is within specification tolerances.

Beams or girders shall not be placed on the finished piers or abutments until the concrete in these members reaches the time and strength requirements as indicated in Table 502.03-5 in [Subsection 502.03.E](#). If grout pads are required they shall be constructed and cured as required by the plans and specifications before loading. If elastomeric bearing pads are used, the lower contact surface of the pads must be bonded to the structure with approved rubber cement to hold them in the position shown in the plans.

Each District should consult the Bridge Section for the most current guidance and literature on pre-stressing and key personnel should review it prior to stressing operations. Perhaps “just-in-time

training” can be arranged as well. It should be noted that some of this information may be just guidance and not specification requirements.

Pre-stressing Guidelines. It is recommended that the following procedures be used before and during all pre-stressing operations:

- A. No tendons should be stressed until elongation calculations have been adjusted for the materials being used.
- B. In order to accomplish this, the correct value of the modulus of elasticity must be obtained for the strands being used.
- C. On any pre-stress operation, an electrohydraulic type load cell and qualified operator should be on the job to monitor enough tendons to assure the provided calibration curve is not in error.
- D. All jacks used for pre-stressing purposes shall be calibrated within 6 months of their use.
- E. All equipment necessary to check the minimum efflux time of the grout should be on the job site in advance of the post-tensioning operation.

Safety. Pre-stressing operations can be dangerous and a safety meeting is advised prior to beginning these activities. Special safety precautions are required when working around pre-stressed stringers because of their size and the stress contained in them and the auxiliary equipment. Some of these are:

- No person should be directly behind either end of a tendon when stress is being applied.
- Do not stand, reach or walk under stringers which are being supported by a crane.
- Stand clear when stringers are being raised, as they may swing when coming off the ground.

Documentation for Pay Quantity. See [Section 502](#).

Reports. See [Section 502](#).