

ITEM 01563.01 M - POST TENSIONING PIER CAP BEAM

DESCRIPTION

This work shall consist of furnishing, installing, stressing post-tension prestressing steel in accordance with the details shown on the plans and the requirements of these specifications.

It shall also include the installation of any appurtenant items necessary for the particular post-tension system required to resist stresses caused by anchorage assemblies.

Any prestress system proposed by the contractor shall comply with the following:

- A. Materials and devices used in the post-tensioning system shall conform to the requirements set forth herein.
- B. The net compressive stress in the concrete after all losses is at least as large as that provided by the system shown on the plans.
- C. The distribution of individual prestressing bars at each section generally conforms to the distribution shown on the plans.
- D. Stresses in the concrete and prestressing steel at all sections and at all stages of construction meet the requirements of the design criteria noted on the plans.
- E. All provisions of the design criteria, as noted on the plans, shall be satisfied.

Prestress anchorage devices shall effectively distribute prestressing loads to the concrete and shall conform to the following requirements:

At Service Load:

$f_{cp} < 0.6f_c'$ - Using Bearing Area of the Anchorage

At Transfer Load:

$f_{cp} < 0.8f_c'$ - Using Bearing Area of the Anchorage

f_c' = Compressive Strength of Concrete - USE 20.7 mPa

f_{cp} = Permissible Concrete Compressive Stress

Bending stresses in the plates or assemblies induced by the pull of the prestressing steel shall not exceed the yield point of the material in the anchorage plate when 95 percent of the ultimate strength of the bar is applied. Nor shall it cause visual distortion of the anchor plate as determined by the Inspector.

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MATERIAL REQUIREMENTS

- A. Steel prestressing bars shall meet the requirements of ASTM-A722 M and Grade 150 DYWIDAG or approved equal. Minimum ultimate steel stress > 1030 mPa.
- B. Steel anchorage plates shall meet the requirements of NYS DOT Standard Specifications Section 715-06.
- C. Hi-strength bolts, washers and nuts shall meet the requirements of NYS DOT Standard Specifications Section 715-14.
- D. Reinforcing steel shall meet the requirement of NYS Standard Specifications Section 709-04.

SAMPLING AND TESTING. All testing shall be done in accordance with ASTM Specifications. The following samples of materials and devices selected at locations designated by the Inspector shall be furnished by the Contractor at his expense:

- 1. Three 2.25 m long samples of prestressing bar for each size from each heat number or production Lot.
- 2. One unit of each prestress anchorage to be used.

The State reserves the right to reject for use any material or device which is obviously defective or was damaged subsequent to testing.

Testing of prestress anchorage devices shall be performed using samples of the type of prestressing steel to be used in the work. The test specimen shall be assembled in an unbonded state and, in testing, the anticipated set shall not be exceeded.

Anchorage devices shall be arranged so that the prestressing force in the bar may be verified prior to removal of the stressing equipment.

MANUFACTURER'S LOTS. The manufacturer of prestressing steel, prestress anchorages, and bar couplers shall assign an individual number to each Lot of bar or devices at the time of manufacture. Each bundle or package shipped to the project shall be identified by tag or other acceptable means as to Manufacturer's Lot number. The Contractor shall be responsible for establishing and maintaining a procedure by which all prestressing materials and devices can be continuously identified with the Manufacturer's Lot number. Items which at any time cannot be positively identified as to Lot number shall not be incorporated into the work.

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The Contractor shall furnish manufacturer's certified reports covering the tests required by this Specification. A certified test report stating the guaranteed minimum ultimate tensile strength, yield strength, elongation and composition shall be furnished for each Lot of prestressing steel. Stress-strain curves for prestressing steel shall be furnished. A certified test report stating strength when tested using the type of prestressing steel to be used in the work shall be furnished for each Lot of prestress anchorage devices.

BASIS OF ACCEPTANCE

The post-tensioning system shall be accepted for incorporation in the respective pier capbeam based on the approved shop drawing for the bridge.

SHOP DRAWINGS

The Contractor shall submit detailed shop drawings which include, but are not limited to:

- A. A complete description of and details covering each of the post-tensioning systems to be used for permanent prestressing bar. This shall include:
 - i. Designation of the specific prestressing steel, anchorage devices, bar couplers and accessory items to be used.
 - ii. Properties of each of the components of the post-tensioning system.
 - iii. Details covering assembly of each type of post-tensioning bar.
 - iv. Equipment to be used in the post-tensioning operation.
 - v. Procedure and sequence of operations for prestressing and securing bars.
 - vi. Procedure for releasing the prestressing steel elements.
- B. A table detailing the post-tensioning-jacking sequence, jacking forces and initial elongation of each tendon at each stage of erection for all post-tensioning.
- C. Complete details of the anchorage system for post-tensioning including certified copies of the reports covering tests performed on prestress anchorage devices as required by this specification and details for any reinforcing steel needed due to stresses imposed in the concrete by anchorage plates.
- E. Calculations to substantiate the post-tensioning system and procedures to be used including stress-strain curves typical of the prestressing steel to be furnished, required jacking forces, elongation of prestressing bar during tensioning, seating losses, short-term prestress losses, long-term prestress losses, temporary overstress, and stresses in prestress anchorages including anchorage plates. These

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calculations shall show a typical tendon force after applying the expected friction coefficient and anticipated losses for the stressing system to be used including anchor set losses. The modulus of elasticity of the prestressing steel shown in the general notes in the Plans shall be used in elongation calculations. Field adjustments of the elongations shall be made based on the bar area and modulus of elasticity shown in the suppliers Test Reports described in this specification.

- F. Complete details of the apparatus and method to be used by the Contractor for the test required in these Special Provisions.

CONSTRUCTION DETAILS

1. **FORCES IN PRESTRESSING BARS.** The design of the structure is based on the jack forces, stressing method (one end, alternate end, or both end stressing), assumed friction and wobble coefficient shown in the Plans.

All post-tensioning steel shall be tensioned by means of hydraulic jacks so that the force of the prestressing steel shall not be less than the value shown on the approved shop drawings. The maximum temporary tensile stress (jacking stress) in prestressing steel shall not exceed 80 percent of the specified minimum ultimate tensile strength of the prestressing steel. The prestressing steel shall be anchored at initial stresses in a way that will result in the ultimate retention of permanent forces of not less than those shown on the approved shop drawings, but in no case shall the initial stress at the anchors, after anchor set, exceed 70 percent of the specified minimum ultimate tensile strength of the prestressing steel. Permanent force and permanent stress will be considered as the force and stress remaining in the prestressing steel after all losses, relaxation of steel, losses in post-tensioned prestressing steel due to sequence of stressing, friction and take-up of anchorages, and all other losses peculiar to the method or system of prestressing have taken place or have been provided for.

2. **STRESSING JACKS.** Each jack used to stress tendons shall be equipped with a pressure gauge having an accurate reading dial at least 150 mm in diameter for determining the jack pressure. Prior to use for stressing on the project, each jack and its gauge shall be calibrated as a unit by a testing laboratory approved by the Inspector. Calibration shall be done with the cylinder extension approximately in the position that it will when applying the final jacking force and with the jacking assembly in an identical configuration to that which will be used at the job site (i.e., same length hydraulic lines). Certified calibration calculations and a calibration chart, both in English units of measure, shall be furnished to the Inspector for each jack.

Recalibration of each jack shall be done at six-month intervals and at other times when requested by the Inspector. At the option of the Contractor, calibrations subsequent to the initial laboratory calibration may be accomplished by the use of a master gauge. The master gauge shall be supplied by the Contractor in a protective waterproof container capable of protecting the calibration of the master gauge during shipment to a laboratory. The Contractor shall provide a quick-attach coupler next to the permanent gauge in the hydraulic lines which enables the quick

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and easy installation of the master gauge to verify the permanent gauge readings. The master gauge shall remain in the possession of and be calibrated by the Inspector for the duration of the project. If any repair to or

modification of a jack is accomplished, such as replacing the seals or changing the length of the hydraulic lines, the jack shall be recalibrated by the approved testing laboratory. No extra compensation will be allowed for the initial or subsequent jack calibrations or for the use and required calibration of a master gauge.

3. **STRESSING OF PRESTRESSING BARS.** The tensioning process shall be so conducted that tension being applied and the elongation of the prestressing steel may be measured at all times. A permanent record shall be kept of gauge pressures and elongations at all times and shall be submitted to the Inspector. The post-tensioning force may be verified as deemed necessary by the Inspector. The prestressing bar force measured by gauge pressure shall agree within five percent of the theoretical elongation or the entire operation shall be checked and the source of error determined and remedied to the satisfaction of the Inspector before proceeding with the work. Elongations shall be measured to the nearest 1.5 mm. Equipment for tensioning the prestressing bar must be furnished by the manufacturer of the system. Should agreement between pressure gauge readings and measured elongations fall outside the acceptable tolerances, the Inspector may require without additional compensation to the Contractor, additional in-place friction tests in accordance with these Special Provisions.

Prestressing steel shall be cut using an abrasive saw within 20 mm to 40 mm away from the anchoring device

PROTECTION OF PRESTRESSING STEEL. All prestressing steel shall be protected against physical damage at all times from manufacture to grouting or encasing in concrete. Prestressing steel that has sustained physical damage at any time shall be rejected.

Prestressing steel shall be packaged in containers or shipping forms for protection of the steel against physical damage and corrosion during shipping and storage. A corrosion inhibitor, which prevents rust or other results of corrosion, shall be placed in the package or form, or shall be incorporated in a corrosion inhibitor carrier type packaging material, or when permitted by the Inspector, a corrosion inhibitor may be applied directly to the steel. The corrosion inhibitor shall have no deleterious effect on the steel or concrete or bond strength of steel to concrete. Inhibitor carrier type packaging material shall conform to the provisions of Federal Specification MIL-P-3420. Packaging or forms damaged from any cause shall be immediately replaced or restored to original condition.

The prestressing steel shall be stored in a manner which will at all times prevent the packaging material from becoming saturated with water and allow a free flow of air around the packages. If the useful life of the corrosion inhibitor in the package expires, it shall immediately be rejuvenated or replaced.

At the time the prestressing steel is installed in the work, it shall be free from loose rust, loose mill scale, dirt, paint, oil, grease or other deleterious material. Removal of tightly adhering rust or mill scale will not be required. Prestressing steel which has experienced rusting to the extent that it exhibits pits visible to

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the naked eye shall not be used in work. The shipping package or form shall be clearly marked with the heat number and with a statement that the package contains high strength prestressing steel, and care is to be used in handling. The type and amount of corrosion inhibitor used, the date when placed, safety orders and instructions for use shall also be marked on the package or form.

When the Plans provided for prestressing steel to be installed in one unit with a length of prestressing steel left projecting to be threaded into another unit during erection all of the prestressing steel shall be protected from corrosion from immediately after it is installed in the first unit until the tendon is grouted as provided below.

METHOD OF MEASUREMENT

The quantity to be paid for under this item shall be the number of pier cap beams post tensioned in accordance with the details shown on the plans and the requirements of these specifications.

BASIS OF PAYMENT

Payment will be made at the unit price bid for each pier capbeam post-tensioned in accordance with this specification and enclosed in Class A concrete (paid separately under Item 555.0105 M).

The unit bid price per pier capbeam shall include the cost of all labor and materials necessary to complete this work.