500 STRUCTURES

ITEM 515 - PRESTRESSED CONCRETE BRIDGE MEMBERS

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515.01 Description. This item consists of preparing shop drawings and manufacturing, transporting, storing and erecting of prestressed concrete bridge members.

515.02 Fabricator Approval Procedure. *Select fabricators who are pre-qualified and evaluated by the City.*

515.03 Levels of Fabricator Qualification. *There are three levels of Fabricator qualification. The City will classify each Fabricator at the highest level of fabrication it is qualified to perform.*

Level	*Description of Capabilities*
1.	*Straight strand prestressed box beam members*
2.	*Straight strand prestressed I-beam members*
3.	*Draped strand prestressed I-beam members*

515.04 General. Fabricator approval will be in accordance with Section 501.04. Shop drawings are to be prepared, submitted and approved according to pertinent paragraphs of Sections 501.05 and 513.02.

Produce all members according to Item 511, except as otherwise specified herein.

515.05 Fabricator Documentation Responsibility. *The Fabricator shall keep and maintain documentation records for each project bid line number concerning:*

1. Fabricator approval.

2. Shop drawing approval.

3. Material test reports.

4. Welding qualification.

5. Quality control inspection.

At the City's request, provide access to the above documents for audit, inspection and copying. Archive the documentation for at least 5 years from the date of final shipment from the fabrication shop.

Document quality control activities that thoroughly inspect fabrication, and verify that fabrication conforms to specification requirements. Quality control activities include material quality checks, dimensional checks, weld inspections, strand tensioning procedures, release procedures, and concrete release and final strengths. The City's evaluation of the Fabricator's performance includes validation of the Fabricator's actual records of inspection. The validation is intended to assure that rating of an individual component reflects the overall quality of all components.

515.06 Shop Drawing. *Provide shop drawings conforming to 501.05 and the following requirements:*

Include details, dimensions, size of materials, piece mark diagrams for field connection and erection of steel members, and other information necessary for the complete fabrication and erection of prestressed members.

515.07 Pre-Fabrication Meeting. *At least 7 days after the City receives shop drawings, conduct a pre-fabrication meeting at the Fabricator's facilities, or at another location agreed to by all parties. The Fabricator and its quality control specialist, the Inspector, and the Contractor or its designated representative are to attend the meeting. The purpose of this meeting is to review fabrication issues, including information on shop drawings, inspection, hold points, unique fabrication items, and special processes. The meeting will be conducted by the fabrication quality control specialist who will record and distribute meeting minutes that document all issues discussed. Begin fabrication after the pre-fabrication meeting is complete and all issues are resolved.*

515.08 Materials. Furnish materials conforming to the following:

Concrete	515.17
Aggregate *	703.02
Portland cement.	701.01 thru 701.06
Air-entraining admixture	705.10
Chemical admixtures for concrete	705.12
Prestressing steel	711.27
Reinforcing steel.	509
Transverse tie rods.	711.01

** For fine aggregate, use natural sand for members without a separate wearing course. Modify coarse aggregate as follows:*

Deleterious materials, maximum 0.4%

For gradation, use No. 57, 6, 67, 68, 7, 78 or 8 standard size coarse aggregate.

515.09 Materials Approval. *The Fabricator is responsible for controlling, testing and validating material requirements for all materials either incorporated into the prestressed fabricated item or supplied under Item 515 as component parts of the fabricated items. The Fabricator must provide supporting documentation to the inspector at the time of final inspection.*

The City will not sample materials at the Fabricator's shop for City approval; however, the City may randomly sample materials to check the Fabricator.

515.10 Plant Requirements. Certify all fabricators of prestressed concrete members in accordance with the Precast/Prestressed Concrete Institute's (PCI) Plant Certification Program. Certify fabricators in Group B3 or B4 for prestressed straight strand bridge members. For prestressed draped strand bridge members, certify the Fabricator in Group B4. Fabricators in Group B3 cannot fabricate draped strand bridge members.

The City will approve plants for the manufacture of precast pretensioned bridge elements before bridge elements are produced. Submit requests for such approvals to the City at least three weeks prior to the date of manufacture of elements. Requests must include details of the plant facilities, documentation to verify PCI plant certification, and the production method the manufacturer intends to use.

515.11 Casting Beds. Use casting beds constructed of steel or concrete that are set above grade to insure that the beds reamin above the accumulation of water as a result of curing operations. Design beds and abutments capable of safely resisting all forces applied to them without appreciable movement or deflection. These forces include compression and eccentric forces due to end-jacking operations, forces at hold-down

points when draped strands are used and downward forces due to the dead weight of the members.

515.12 Cold Weather Operations. Conform to the requirements of this subsection if the ambient air temperature is below 50° F (10° C). Heat mixing water, aggregates or both as necessary to result in concrete temperatures from 50° F (10° C) to 70° F (21° C) when placed. Do not allow water heated above 150° F (66° C) to directly contact with the cement. Do not place concrete that contacts forms, reinforcing steel, prestressing strand or other hardware materials with temperatures less than 32° F (0° C) If W casting bed temperatures are less than 30° F (-1°), Tension the prestressing strand to provide the design tension at 50° F (10° C).

515.13 Equipment. Provide hydraulic jacks of sufficient capacity and stroke to tension strands. Use either single or multiple strand tensioning . Provide tensioning jacks equipped with automatic cutoff valves and equipped with gages with a minimum diameter of 6 inches and 500-pound (2 kN) increments. Calibrate gages for the jacks with which they are to be used. Have a graph or table showing the calibration available for the inspector. Two calibrated gages shall be provided for jacks, one of which shall be used during routine stressing, while the other is locked out and used only by the inspector to verify the accuracy of the working gage. Maintain calibration documentation as part of the project's QC inspection records.

Design the jacking system to insure uniform stress in all strands. If simultaneously tensioning multiple strands, use approved types of dynamometers to equalize the initial stress on all strands before applying the full tensioning load with the master jack. Provide dynamometers with sufficient capacity to insure that the desired readings are in the middle to upper range.

515.14 Inspection Facilities. The Fabricator is required to provide the inspector office accommodations with a minimum floor area of 120 square feet (11 m^2) . This area shall be adequately heated and ventilated and equipped with necessary desks, chairs, tables, telephone, and electrical outlets.

515.15 Construction Methods. Use metal forms capable of producing members within the tolerances shown on the plans. Forms made of material other than metal may be used for bulkheads and voids. Insure that the surfaces of the forms in contact with the concrete are smooth, and that the joints between panels are tight. The soffit form is to have a plane surface at right angles to the vertical axis of the members. Bevel the two bottom edges 3/4 inch (19 mm) with a triangular strip built into the forms.

Increase the length of the forms for elastic shortening and normal concrete shrinkage, and design the forms to accommodate this movement.

Use water-resistant forms, constructed of a material that resists breakage and deformation during placement of concrete. *The form material is not to excessively increase the dead load of the beams.*

Prevent the release agent from contacting the prestressing strands or other reinforcing steel.

Install and assemble reinforcing steel according to the approved shop drawings. If authorized, weld reinforcing cages, using welders qualified to AWS D1.4. Do not weld epoxy-coated or galvanized reinforcing steel unless approved by the City. Repair all coating areas damaged by welding according to the coating manufacturer's instructions. Reject reinforcing steel with a loss of cross-section of reinforcing caused by welding. Accurately place strands in the positions shown on the shop drawings. Do not use strands with kinks, bends, nicks, broken wires, scale, loose rust or other defects. The Contractor may use slightly rusted reinforcing steel provided the rust is not sufficient to cause visible pits. Before placing the concrete, carefully clean the strands of all dirt, grease, oil, or other foreign matters. Do not splice strands within a member.

Tension strands uniformly to the stress indicated on the shop drawings. If multiple strands are stressed simultaneously, use dynamometers to equalize the initial stress on all strands before applying full tension load with master jack. Measure the required stress in the strands using the jacking equipment gages, and check the measured stress by the elongation of the strands. If the stress from the gages and the measured elongation are not within a 5 percent tolerance of the design, stop stressing the strands and determine the reason for the differences. The Quality Control Specialist must keep a record of all jacking forces and elongations.

Secure the strands by suitable anchorage devices capable of developing at least 85 percent of the ultimate strength of the strands. The anchorage shall not allow the strand to slip after the tensioning operation.

If using draped strands the loss of stress due to friction shall not exceed 5 percent. *The Quality Control Specialist will measure the loss due to friction by a procedure approved by the City.* Tension the strands at both ends. Place hold-down points within 12 inches (0.3 m) of the locations shown on the plans.

515.16 Concrete. The Fabricator shall submit the concrete mix designs to the City along with test data confirming the mix conforms to the required 28 day strength while cured with the method to be used for beam fabrication.

Mix the concrete according to Item 499, except that 499.03 does not apply. *The plastic air content of the concrete before placement is to be 6 +/- 2 percent. Add an approved corrosion-inhibiting admixture at the approved dosage.*

Maintain the slump according to the manufacturer's submitted mix design. No slump will be allowed which causes segregation of the mix. Provide a specified water/cement ratio with the mix design and maintain production of the concrete within that limit at all times. If a slump increase is required to conform to the mix design

slump, add a chemical admixture conforming to 705.12, Type F or G. Do not use calcium chloride or admixtures containing calcium chloride.

Proportion the concrete materials to provide a minimum cylinder strength of 5500 psi. (38 MPa) or plan specified strength in 28 days. Make at least 2 cylinders for samples from both the first and last loads placed on each casting bed, each day. Determine strength, for both strand release and final shipping, by testing a group of cylinders which consists of 1 cylinder from every sample location. Each group of cylinders shall have an average strength of at least what is specified in the shop drawings, and no individual cylinder shall have less than 95 percent of the specified strength. If producing more than 200 feet (60 m) of beam on the same bed, make at least 2 additional cylinders for each additional interval up to 200 feet (60 m). The quality control specialist shall determine the sample location for the additional cylinders (generally from the load placed in the middle of the additional beam length).

The Inspector may require additional cylinder samples from any location that does not appear to conform to mix design or placement requirements. Include these additional cylinders in the group of cylinders for determining strength.

The Fabricator may place concrete in the bottom flange of a box beam before placing the interior forms and reinforcement for the upper portion of the member, provided continuous placement is not interrupted for more than 45 minutes.

Screed the top surfaces of non-composite members and finish the surface with a burlap drag, or other means to provide a uniform surface with a gritty texture suitable for waterproofing. Screed the top surface of composite members and finish the surface with a wire broom finish, in a transverse direction, penetrating the finished surface approximately 1/4 inch (6.4 mm).

Immediately after the final concrete placement, accelerate the cure by covering the concrete with an enclosure suitable to contain live steam or radiant heat. Until applying the steam or radiant heat, maintain an ambient temperature inside the enclosure of at least 50° F (10° C). The allowable temperature rise and range of the plastic concrete before initial set shall not be greater than 10° F (5° C) per hour; shall not have a total rise of greater than 40° F (22° C) and shall not exceed a maximum temperature of 100 ° F (38° C).

Start the initial application of the steam or heat from two to four hours after the final concrete placement. If using retarders, start applying the steam or heat from four to six hours after final concrete placement. If determining the time of initial set according to by ASTM C 403, these time limits do not apply.

During the initial application of live steam or radiant heat, the ambient temperature within the curing enclosure shall increase at an average rate not to exceed 40° F (4° C) per hour until reaching the curing temperature. Do not allow a maximum curing temperature

to exceed 160° F (71° C). *The Fabricator may use a maximum curing temperature of 180° F (82° C) if the Fabricator can document to the City that delayed ettringite or alkali silica reaction is not at issue.* Maintain the maximum temperature until the concrete has reached the required release strength. De-tension the strands immediately upon completing the accelerated curing.

1. **Curing with low Pressure Steam.** Do not apply live steam directly onto the concrete forms if it causes localized high temperatures.

2. **Curing with Radiant Heat.** Apply radiant heat using pipes circulating steam, hot oil or hot water, or by using electric heating elements. Minimize moisture loss by covering all exposed concrete surfaces with plastic sheeting, 705.06, or by applying a liquid membrane curing compound, 705.07, to all exposed concrete surfaces. Before bonding field-cast concrete or other materials in the finished structure, remove the curing compound from the shear faces of composite members and other surfaces. Neatly fill cavities in the exposed surface of an exterior line of beams with non-shrink grout. Clean the concrete, and apply and cure the grount according to the manufacturer's published recommendations. Reject beams with honeycombing that impairs the member's performance.

515.17 Release of Prestressing Strands. Do not release prestressed strands until the concrete reaches a minimum strength of at least 4000 psi. (28 Mpa), or plan defined release strength. Determine strength by testing pairs of concrete cylinders (made according to AASHTO T 23 and cured by the same method used to cure the beam), and tested according to AASHTO T 22. Test these cylinders in the manufacturer's laboratory. Notify the Inspector in advance of the testing. The Inspector may observe the testing of the cylinders .

Before releasing prestressed strands, loosen or remove forms and hold-downs that restrict either horizontal or vertical movement of prestressed members. Release the strands immediately upon completing accelerated curing by steam

Burn or heat release all strands simultaneously at selected exposed points between anchorages and follow an approved predetermined pattern to equalize the forces being transferred to the various areas of the cross section of the member. For heat release, use a low-oxygen flame to uniformly heat at least a 4 inch (100 mm) length of strand.

515.18 Transportation, Storage and Erection. Do not ship prestressed members until the concrete obtains its 28 day design strength *and until receiving the Inspector's approval.*

Transport, store and erect the members in an upright position. Apply approximately the same points of support and direction of reactions during storage and transportation as those applied when the members are in their final position. During storage, provide unyielding horizontal supports capable of maintaining the members in a

vertical position. If it is necessary to transport the members in a position other than vertical, it shall be done only with the written approval of the City. At the City's discretion, repair or replace members damaged by improper handling, storing, transportation or erection.

Use lifting devices capable of withstanding the required loads to lift and erect the members. Accurately place the prestressed beams to insure a correct fit of the keyways and to insure proper grouting of the keyways. Use keyway grouts, 705.22, approved by the City. Mix, install and cure the grout according to the manufacturer's published recommendations to obtain a design compressive strength of 5000 psi (34.5 MPa).

Do not allow vehicular load on an individual prestressed concrete box beam until the grout in the keyway obtains the specified design strength of 5000 psi (34.5 Mpa).

If erection of prestressed members requires placing cranes or launching devices on previously erected spans, submit erection procedures for approval according to Item 501.

515.19 Method of Measurement. The City will measure Prestressed Concrete Bridge Members by number of members, or the linear feet (meters) of members for the type used.

515.20 Basis of Payment. The City will pay for accepted quantities at the contract prices as follows:

Item	Unit	Description
515	*Each, Linear foot (Meter)*	*Prestressed Concrete Non-Composite Box Beam Bridge Members, Level 1*
515	*Each, Linear foot (Meter)*	*Prestressed Concrete Composite Box Beam Bridge Members, Level 1*
515	*Each, Linear foot (Meter)* `	*Straight Strand Prestressed Concrete Bridge I-Beam Members, Level 2*
515	*Each, Linear foot (Meter)*	*Sraight Strand Prestressed Concrete Bridge I-Beam Members, Level 3*

Payment includes all inserts, sleeves, fittings, reinforcing steel fully or partially encased in the members, and all transverse tie rods necessary to complete this work.

Concrete diaphragms, 511; Steel diaphragms, 513, Misc.; and bearing plates or pads or other expansion materials, 516, will be paid for as separate items.

The City will not pay for repaired or replaced members damaged by improper handling, storing, transporting, or erecting.