SECTION 03412

PRESTRESSED CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pretensioning, fabricating, curing, transporting, and storing prestressed concrete.

1.2 RELATED SECTIONS

A. Section 03055: Portland Cement Concrete.

B. Section 03211: Reinforcing Steel and Welded Wire.

C. Section 03390: Concrete Curing.

D. Section 05120: Structural Steel.

1.3 REFERENCES

A. AASHTO M 203: Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.

B. AASHTO M 270: Structural Steel for Bridges.

C. AASHTO Standard Specifications for Highway Bridges, Division II, Article 18.2.

D. ASTM C 150: Portland Cement.

E. Federal Standard TT-P-641: Primer Coating, Zinc Dust-Zinc Oxide (for Galvanized Surfaces.)

1.4 DELIVERY, STORAGE, AND HANDLING

A. Prestressing Steel:
   1. Protect against physical damage and corrosion during shipping, handling, and storing.
   2. Clearly mark the shipping package or form with handling instructions, and information about the corrosion inhibitor including date, place, safety orders, and instructions for use.

B. Transport precast girders in an upright position. Support the girders during transportation in approximately the same point(s) they will be supported when installed.

C. Prevent cracking or damaging precast units during storage, hoisting, and handling.

D. Installation of lifting devices is permitted provided that any portion of the devices that protrudes above the top of the girder is removed when no longer needed.

1.5 SUBMITTALS

A. Certification stating the manufacturer's minimum guaranteed ultimate tensile strength for each sample of prestressing steel.

B. Submit five sets of working shop drawings of the prestressing system before beginning the project or ordering materials.
   1. Show complete details and substantiating calculations of the method and material to be used in operations including any reinforcing steel alterations from those shown on the plans.
   2. Method and sequence of stressing including complete specification and details of the prestressing steel, working stresses, and all other data pertaining to the prestressing operation. Include the proposed arrangement of the prestressing steel in the members.

PART 2 PRODUCTS

2.1 CONCRETE

A. Portland Cement: Type I or Type II, or Type III, low alkali.

B. Type III cement: conform to ASTM C 150, Table 2, for moderate sulfate resistance.

C. Class AA(AE) concrete per Section 03055, except as modified below.
   1. Air entraining admixture to provide 5.0 to 7.5 percent entrained air.
   2. Minimum compressive strength 5,000 psi at 28 days.
   3. Minimum compressive strength for transfer of prestressing force is 4,000 psi.
   4. Maximum slump is 7 inches.
   5. Coarse aggregate gradation meeting the 3/4 inch No. 4 sieve per Section 03055, Table 2.
   6. Minimum cement content must be 611 lbs/yd^3.

7. Water-Cement ratio must not exceed 0.44 by weight, including free-water in the aggregates.

D. Girders: Reject if the average 28-day compressive strength of representative cylinders is less than 94 percent of the specified strength. Core tests are not permitted for compressive strength tests.

2.2 PRESTRESSING STEEL

A. Meet AASHTO M 203. 1/2 inch diameter, Grade 270.

B. Replace prestressing steel that has damage, loose rust, pitting, or serious corrosion. Slight rusting that occurs after placement in the beds is acceptable if it does not cause visible pits.

C. Oiling or greasing the strand is not acceptable.

2.3 REINFORCING STEEL (EPOXY-COATED)

A. As specified. Refer to Section 03211.

2.4 ELASTOMERIC BEARING PADS

A. As specified. AASHTO Standard Specifications for Highway Bridges, Division II, Article 18.2.

2.5 ZINC-RICH PAINT

A. As specified. Federal Standard TT-P-641.

2.6 THREADED RODS

A. Stainless Steel per Section 05120. AASHTO M 270, Grade 250.

2.7 BEARING PLATE

A. As specified. AASHTO M 270, Grade 250.

2.8 SOURCE QUALITY CONTROL

A. Prestressing Steel:
1. Furnish three 5 ft long strand samples from each reel or portion of reel that will be used on the project, at no additional cost to the Department.

2. Testing may require 14 calendar days after the date of receipt without granting an increase in contract time.

3. The contract time is increased by the number of days of delay if test results are not returned within 14 calendar days and construction operations are delayed. Make written notification for any additional claim resulting from delay within 5 working days after approval of the materials.

2.9 QUALITY ASSURANCE

A. Department pre-qualifies Contractor as a supplier of pre-cast concrete products in accordance with "Quality Management Plan: Precast/Prestressed Concrete Structures."

PART 3 EXECUTION

3.1 PREPARATION

A. All equipment (jacks, pressure gauges, load cells) used to stress tendons must be accurate.
   1. Calibrate each jack and its gauge as a unit with the cylinder extension in the final jacking force position.
   2. Furnish a certified calibration chart.

B. Calibrate the load cell and provide an indicator to determine the prestressing force in the tendon. The range of the load cell must be such that the lower 10 percent of the manufacturer's rated capacity is not used in determining the jacking stress.

C. The prestressing force may be tested by Engineer.

D. Provide sufficient labor, equipment, and material to install and support testing equipment at the prestressing tendons, and to remove the equipment when testing is completed.

3.2 PRETENSIONING

A. Install and support testing equipment at the prestressing tendons, and remove the testing equipment after the testing is completed.

B. Tension all prestressing steel with hydralic jacks so that the force in the prestressing steel is not less than the value shown.

C. Do not allow the initial stress to exceed 70 percent of the specified minimum ultimate tensile strength.

D. Average working stress in the prestressing steel must not exceed 60 percent of the specified minimum ultimate tensile strength of the prestressing steel unless otherwise shown.

E. Maximum temporary tensile stress (jacking stress) in prestressing steel to exceed 75 percent of the specified minimum ultimate tensile strength.

F. Working force and working stress are the force and stress remaining in the prestressing steel after all losses peculiar to prestressing have either taken place or been provided for. These losses include creep and shrinkage of concrete, elastic compression of concrete, creep of steel, and take up of anchorages.

G. Anchor the prestressing steel at stresses (initial stress) that result in the ultimate retention of working forces not less than those shown.

H. The loss in stress in pretensioned, prestressing steel due to creep and shrinkage of concrete, creep of steel, and elastic compression of concrete is assumed to be 35,000 psi. If lightweight concrete is used, the loss is assumed to be 40,000 psi.

I. Do not cut or release prestressing steel in pretensioned members until the concrete in the member has attained a compressive strength of not less than the value shown on the plans or 4,000 psi, whichever is the greater.

J. Check prestressing steel strands in pretensioned members, if tensioned individually, for loss of prestress not more than 12 hours before placing concrete for the members. Use methods and equipment acceptable to Engineer.

K. Re-tension all strands that show a loss of prestress in excess of 3 percent.

L. Increase the calculated elongation of the prestressing steel in pretensioned members to compensate for the loss in stress when it is tensioned at a temperature appreciably lower than the estimated temperature of the concrete and the prestressing steel at the time of initial set of the concrete. Do not allow the jacking stress to exceed 75 percent of the specified minimum ultimate tensile strength.

M. Maintain a minimum lateral eccentricity of prestress when cutting and releasing prestressing steel in pretensioned members. Submit a cutting or release pattern to the Engineer for prior approval.

N. Cut off all pretensioned, prestressing steel flush with the end of the member and the exposed ends of the prestressing steel, and then clean and paint a 1 inch strip of adjoining concrete; or cut the strands a minimum of 1 inch back from the girder end, fill the recess with grout, and finish flush with the girder ends.

O. Remove all dirt and residue not firmly bonded to the metal or concrete surfaces.

P. Cover the surfaces with a thick application of zinc-rich paint. Apply two applications to surfaces that are not covered by concrete or mortar. Thoroughly mix the paint at the time of application and work it into voids in the prestressing tendons.

3.3 PLACING CONCRETE

A. Do not place concrete into forms until the placement of the reinforcement and prestressing steel has been Department inspected.

B. Vibrate the concrete internally, externally, or both.

C. Avoid displacing reinforcing steel or strands.

3.4 LIMITATIONS

A. Refer to Section 03055 for hot and cold weather limitations.

B. Remove side forms of the prestressing members within one to two days provided satisfactory arrangement has been made for curing the concrete.

C. Adequately support the members at all times to prevent deadload bending until after the anchorages for pretensioned members have been released.

3.5 CURING

A. Cure as specified in Section 03390.

3.6 INSPECTION

A. Provide free entry to inspectors while the work on the contract is being performed.

B. Materials showing defects during or previous to installation will be rejected.

END OF SECTION