SP-150208b
(Replaces SP-150208a)

SPECIAL PROVISIONS
FOR
FURNISH AND INSTALL ARCH RIB ANCHORAGE ASSEMBLY

Scott County
IM-NHS-074-1(198)5--03-82

Effective Date
April 25, 2017

THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

~~**This is a complete rewrite of the previous version of this special provision. No changes are indicated by shading or strikethrough.**~~

150208b.01 DESCRIPTION.

A. This work consists of furnishing and fabricating the post-tensioning ducts, embedded grillages, Alloy 2507 Duplex Stainless Steel all-thread-bar system (S.S. all-thread-bars), anchorages for the S.S. all-thread-bars, and electrical isolation components for the S.S. all-thread-bars at the arch rib interfaces with Piers 12 and 13. Also included is the installation of all post-tensioning ducts, grillages, S.S. all-thread-bars, anchorages for the S.S. all-thread bars, and electrical isolation components for the S.S. all-thread-bars which are embedded within the concrete at the arch rib interfaces with Piers 12 and 13.

B. Post-tensioning is not included with this item. See the Special Provisions for Post-Tensioning of Arch Rib Bearings. Field milling of the embedded base bearing plate is not included with this item. See the Special Provisions for Arch Rib Bearings in Design No. 617 and Design No. 717.

150208b.02 DEFINITIONS.

Anchorage (Arch Rib Anchorage): Includes the grillage, Alloy 2507 Duplex Stainless Steel all-thread-bar system, bar anchorages for the S.S. all-thread-bars, and electrical isolation components for the S.S. all-thread-bars.

Anchorage (Bar Anchorage): An assembly of various hardware components which secures the S.S. all-thread-bars at their ends after they have been stressed and transfers a compressive force into the concrete or steel arch base. Includes the top cap and associated gaskets and bolts.

Electrical Isolation Components: A series of components intended to electrically isolate the S.S. all-thread-bars from other metallic components. Includes steel isolation washers, isolation sleeves, and isolation sleeves with flanges.

Duct: Material forming a conduit to accommodate S.S. all-thread-bar installation and provides an annular space for the grout.

Grillage: Bottom anchor bearing plate, template, embedded base bearing plate with all welded attachments, and other supporting structural steel framework that is embedded in the concrete. Excludes the shim plate and any structural steel that is part of the arch rib.

Job Site: The location where the post-tensioning is to be performed. Also called the "site".

Set (also Anchor Set): Anchor set is the total movement of a point on the post-tensioning bar during load transfer from the jack to the permanent anchorages.

Tendon: A complete assembly consisting of post-tensioning anchorages, S.S. all-thread-bar, and ducts with grout.

150208b.03 MATERIAL.

A. General.
Furnish S.S. all-thread-bar system from a single supplier.

B. Structural Steel.
ASTM A 709, Gr. HPS 70W steel unless noted otherwise. Painted.

C. S.S. All-Thread-Bar System.

1. Provide stainless steel anchor rods, full load end nuts, jam nuts, custom washers, stop-type couplings (coupling nuts), stressing nuts, and stressing bars conforming to the Special Provisions for High-Strength, Stainless Steel Bars for Post-Tensioned Concrete.

2. Fabricate the S.S. all-thread-bar with sufficient length beyond the top anchor bearing plates to allow for post-tensioning and anchorage device installation as shown in the plans.

D. Steel Isolation Washers.

1. Provide 1/8 inch minimum thickness coated hardened steel isolation washers in accordance with ASTM F436.

2. The dielectric coating shall be from one of the following products:
- GPT HCS / Diamond Hyde / X37 hardened coated washer system.
- Lamons Sealing (HC Washer System).
- Approved Equivalent.

E. Isolation Sleeves and Isolation Sleeves with Flange.
Provide Isolation Sleeves and Isolation Sleeves with Flanges that are constructed from G-10 Epoxy Glass with the following properties:

Property	Test Method	Required Value
Tensile Strength, Lengthwise	ASTM D-638	39,000 psi, minimum
Dielectric Strength, Condition A	ASTM D-149	400 V/mil, minimum
Dielectric Breakdown Voltage, Condition A	ASTM D-149	65 kV, minimum
Water Absorption	ASTM D-229	0.10 % maximum

F. Ducts.

1. General.
The contractor shall verify that the ducts specified in the plans are of sufficient rigidity and strength to withstand all load, pressures, and deformations applied by the contractor's proposed construction sequence. The ducts shall maintain their shape, remain in proper alignment and remain watertight as required in order to obtain a satisfactory final product. If the specified ducts are not sufficient for the contractor's proposed construction method, the contractor shall determine the required size, thickness, material, and detailing for alternate ducts or shall provide alternate support for the ducts and grillages. The contractor shall prepare and submit information regarding these revisions for review and acceptance by the engineer. Alternate ducts and/or alternate supports shall be provided at no additional cost.

2. Round HSS.
Provide round Hollow Structural Sections conforming to ASTM A 1085.

3. Duct Connections and Fittings.
a. All connections and fittings shall be airtight.
b. Provide a duct system that effectively prevents entrance of cement paste or water into the system and effectively contains pressurized grout during grouting of the S.S. all-thread-bar.

4. Shipping, Handling, and Storage of Ducts.
Furnish duct with end caps to seal the duct interior from contamination. Ship ducts which are capped and covered during shipping and storage. Protect ducts against bending, dirt contamination and corrosive elements during transportation, storage, and handling. Do not remove end caps supplied with the duct until the duct is incorporated into the bridge component. Store duct in a location that is dry. Store on a raised platform and completely covered to prevent contamination. If necessary, wash ducts before use to remove any contamination.

G. Leveling Anchor Rod.
ASTM A 307 with ASTM F 844 washers and ASTM A 563 nuts.

H. Post-Tensioning Anchorage.
Secure S.S. all-thread-bars at the ends by means of permanent type anchoring devices as shown in the plans that conform to the Special Provisions for High-Strength, Stainless Steel Bars for Post-Tensioned Concrete.

I. Top Caps.
ASTM A 1085 Hollow Structural Section and ASTM A 588 steel plate with neoprene rubber washer and ASTM A449 Type III, ASTM A449 Type I, or SEA J429 Grade 5 plain finish bolts or cap screws. ASTM A 572 or ASTM A 36 steel plate may be substituted at no additional cost.

J. Grout Tubes.

1. Use grout tubes to allow the escape of air, water, bleed water, and grout. Provide permanent grout tubes and threaded plugs made of ASTM A 240 Type 316 stainless steel, nylon, or polyolefin materials. For products made of nylon, the cell class of the nylon according to ASTM D 5989 shall be S-PA0141 (weather resistant), S-PA0231 or S-PA0401 (ultimate strength not less than 10,000 psi with UV stabilizer added). Product made from polyolefin shall contain antioxidant(s) with a minimum Oxidation Induction Time (OIT) according to ASTM D 3895 of not less than 20 minutes. Perform OIT test on samples taken from the finished product. Test the remolded finished polyolefin material for stress crack resistance using ASTM F 2136 at an applied stress of 348 psi resulting in a minimum failure time of 3

hours. Neither metallic nor plastic components, if selected and approved, shall react with the concrete or enhance corrosion of the post-tensioning steel. Use plastic components free of water soluble chlorides.

2. All grout tubes shall be equipped with pressure rated mechanical shut-off valves or plugs. Grout tubes shall be rated for a minimum pressure rating of 150 psi. Use grout tubes with a minimum inside diameter of 3/4 inch.

K. Testing Requirements.

1. General.
a. Testing shall conform to the applicable ASTM Specifications or Special Provisions for the post-tensioning material used.
b. Furnish all material samples for testing at no additional cost.

2. S.S. All-Thread-Bars.
Furnish samples for testing as described in the Special Provision for High-Strength, Stainless Steel Bars for Post-Tensioned Concrete for the manufacturer of S.S. all-thread-bar to be used on the project.

150208b.04 SUBMITTALS.

A. General.

1. Submit detailed shop drawings, calculations, and manuals for all work related to fabrication and installation of the arch rib anchorages, including methods for supporting the grillage and ducts during construction, and ensuring correct geometric alignment. Provide shop drawings and calculations that are sealed by a Professional Engineer licensed in the State of Iowa. Do not commence work until the submittals have been approved.

2. All submittals are to accurately detail the actual methods, materials, equipment, etc., that will be used in the field on the project. Deviation is not permitted unless approved by the Engineer.

B. Submittals.
At a minimum, submit the following information:

1. A post-tensioning system that meets the requirements of the contract documents.

2. A detailed proposed sequence of construction, including any variations from the suggested sequence provided herein.

3. Specific details regarding the assembly of the post-tensioning assemblies.

4. Properties, dimensions, and designations (where applicable) of each of the components of the post-tensioning assemblies, including the top cap.

5. Appropriate details of changes from the dimensions shown on the plans with clear and concise cross reference to the appropriate plans to which the variations apply.

6. Details of, and supporting calculations for, any modifications to reinforcement at anchorages, made necessary for accommodating the elected post-tensioning system hardware.

7. Duct support detail and spacing and the sequence of operations for securing the tendons.

8. A procedure for geometry control of the grillage and ducts in accordance with the information provided in the contract documents. Specifically include information regarding placement tolerance for lower portion of S.S. all-thread-bars and how those tolerances relate to install-ability of the upper portion of the S.S. all-thread-bars including consideration of tolerances for arch rib section R0 and any other potential sources of misalignment. At the S.S. stop-type coupling, a non-conductive centralizer that allows the passage of grout is recommended to center the coupling within the lower duct and prevent contact between these tendon components. The length of the centralizer shall be limited to one half the length of the stop-type coupling.

9. Details and calculations for the support of the grillage and ducts prior to placement of the concrete.

10. Details of the methods and equipment employed to ensure the proper position of the top surface of the embedded base bearing plate.

11. Actual survey data for the top surface of the embedded base bearing plate. Submit this data after the arch rib anchorage assembly is secured in place, but prior to placement of the concrete.

12. Details of any other equipment used during installation.

13. Any manufacturer's literature, where applicable.

14. Safety procedures.

C. Submittal Procedures.
Unless noted otherwise, submit the above in advance of the start of construction to allow a 30 calendar day review period. All submittals not approved and requiring resubmission shall be subject to the above review time period, with the review time beginning anew for each such submittal. Coordinate all submittals between various subordinates (contractors, suppliers, and engineers) to allow for a reasonable distribution of the review effort required by the Engineer at any given time.

150208b.05 CONSTRUCTION.

A. General.

1. Perform all work in accordance with Sections 2404 and 2408 of the Standard Specifications, where applicable, and as modified or appended herein.

2. Steel isolation washers that exhibit cracked, scratched, or otherwise compromised dielectric coating shall be replaced. Use only steel isolation washers that have a complete, intact, and undamaged dielectric coating.

3. Supply embedded base bearing plates that are at least ¼ inch over the specified thickness indicated in the plans.

B. Protection of S.S. All-Thread-Bars and Hardware.
Protect all S.S. all-thread-bars and hardware as indicated in the Special Provision for High-Strength, Stainless Steel Bars for Post-Tensioned Concrete.

C. Fabrication.

1. General.
Accurately and securely fasten all ducts, miscellaneous hardware, reinforcing bars, and other embedments at the locations shown on the plans or on the approved Shop or Working Drawings or as otherwise approved by the Engineer.

2. Ducts.
- **a.** Accurately align ducts and position at the locations shown on the plans or according to the approved shop or working drawings or as otherwise approved by the Engineer.
- **b.** Carefully check all ducts before placing any concrete.
- **c.** Ensure that all alignments are smooth and continuous with no lips, kinks or dents.
- **d.** After installing the ducts and until grouting is complete, ensure that all ends of ducts are sealed at all times, except for post-tensioning operations.

3. Tolerances.
- **a.** Ensure that tendons (ducts and S.S. all-thread-bars) are accurately positioned to ensure they will allow installation of the upper portions of the S.S. all-thread-bar.
- **b.** If conflicts exist between the concrete reinforcement and post-tensioning duct, the position of the post-tensioning duct shall prevail and the reinforcement shall be adjusted locally with the Engineer's approval.

4. Grout Tubes.
- **a.** Place grout tubes at locations shown in the plans and shop drawings. Equip all grout tubes with positive shut-off devices. Grout tubes shall be installed with plugs or valves in the closed position. The use of duct tape is not permitted. Leave low point grout tubes open to prevent water build-up in the duct.
- **b.** Ensure grout tubes connect to the ducts as close to the high/low spot (as applicable) of each duct section to ensure that each section of duct is vented/drained (as applicable) as effectively as possible considering the final installed position of each duct section in the finished structure.
- **c.** Install grout tubes for injection vents to slope down from the duct to the concrete surface, and extend them a sufficient distance out of the concrete to allow for proper closing of the valves.
- **d.** The number of grout tubes depicted in the contract drawings is the minimum number that will be considered. The contractor shall provide additional grout tubes as required in order to assure complete and satisfactory grouting using the actual proposed construction method and equipment. Additional grout tubes, if required, shall be provided at no additional cost.

5. Isolation Sleeve with Flange.
Provided isolation sleeves shall fit tightly within the hole and counterbore in the top anchor bearing plate such that they will not become dislodged during construction activities.

D. Internal Duct Pressure Test.
Pressure test all duct assemblies constructed on the project. Test the assemblies in their final position just prior to concrete placement by sealing them at their anchorage or construction joint termini and then by applying compressed air to determine if the assembly connections are pressure tight. In the presence of the Engineer, pressurize the duct to 1.5 psi and lock-off the outside air source. Then record the pressure loss for a duration of one minute. If the pressure loss exceeds 0.15 psi, find and repair the leaks in the duct assembly using repair methods approved by the Engineer and retest.

E. Placing Concrete.

1. **Precautions:** Exercise great care when placing and consolidating concrete so as not to displace or damage any of the post-tensioning ducts, reinforcement or other embedment. Do not place concrete until actual survey data of embedded base bearing plate have been approved by the Engineer.

2. **Problems and Remedies:** The Engineer will reject ducts or any part of the work found to be deficient. Perform no remedial or repair work without the Engineer's approval.

F. Stress Relief Heat Treatment.

1. Perform stress relief heat treatment on the completed, embedded base bearing plate weldment in accordance with Article 2408.02, I of the Standard Specifications.

2. After weldment is removed from the heat treating furnace, carefully visually (VT) inspect the weldment at all changes in section and at other locations where stresses have been concentrated. Magnetic Particle (MT) Testing may be required to supplement VT when ordered by the QA shop inspector representing the Engineer.

3. Conduct stress relief heat treatment following the completion and acceptance of the NDT of the welds.

G. Welding.

1. Perform fillet welding of round HSSs to embedded base bearing plates and template plates in accordance with AWS D1.1/D1.1M Structural Welding Code – Steel. MT 100% of these fillet welds.

2. Ultrasonically Test (UT) (Tension Acceptance Criteria) 100% of all complete and partial joint penetration (CJP, PJP) welds in the arch rib anchorage assemblies.

3. MT 100% of all fillet welds in the arch rib anchorage assemblies.

H. Suggested Sequence of Construction.

The suggested sequence of construction is as follows:

1. Assemble the post-tensioning ducts and grillages as follows:
   - **a.** Install jam nut and stop-type coupling on the top of the bottom S.S. all-thread-bar in accordance with the manufacturer's recommendations.
   - **b.** Install the Isolation Sleeve into the holes in the bottom anchor bearing plate and template.
   - **c.** Secure template and bottom anchor bearing plate onto the bottom of the bottom S.S. all-thread-bar with S.S. nuts and steel isolation washers as shown in the plans.
   - **d.** Slide round HSS over bottom S.S. all-thread bar and weld to template plate. Ensure that there is no contact between the duct and the stop-type coupling (see recommendation in 150208b.04, B, 8 regarding to the use of a centralizer).
   - **e.** Place embedded base bearing plate assembly over the tops of the round HSSs, adjust position using leveling rods, and weld.
   - **f.** Temporarily cover the open ends of the post-tensioning ducts to adequately protect from dirt, debris, and water.

2. If the ducts and grillages are not assembled in-place, place the assembly in the pier and position as shown in the plans. Secure the assembly in place and support against movement.

3. Perform a survey of the top surface of embedded base bearing plate.

4. Place reinforcing steel and concrete for the pier in accordance with the contract documents.

I. Temporary Corrosion Protection.
Provide a method of sealing the ducts containing the S.S. all-thread bars until arch rib segment R0 is placed and the final grouting of the tendons is accomplished. At a minimum, the method shall prevent water from collecting inside the duct, while not hindering the future installation of the upper portions of the S.S. all-thread bars or the steel arch segments.

150208b.06 METHOD OF MEASUREMENT.
Lump sum. No method of measurement.

150208b.07 BASIS OF PAYMENT.

A. Payment for the arch rib anchorage assemblies is full compensation for furnishing and fabricating the post-tensioning ducts, embedded grillages, Alloy 2507 Duplex Stainless Steel all-thread-bar system, anchorages for the S.S. all-thread-bars, and electrical isolation components for the S.S. all-thread-bars at the arch rib interfaces. Installation of all post-tensioning ducts, grillages, S.S. all-thread-bars, anchorages for the S.S. all-thread bars, and electrical isolation components for the S.S. all-thread-bars which are embedded within the concrete at the arch rib interfaces is also included with this item. Surveying necessary for installation is also included with this item.

B. Payment for the arch rib bearings and post-tensioning are not included with this work. See Design No. 617 and Design No. 717.