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DEPARTMENT OF TRANSPORTATION

SPECIAL PROVISION

FOR

**SEGMENTAL PRECAST CONCRETE BOX CULVERT, SPECIAL**

BRG:KSF 1 of 5 APPR:MJF:DMG:09-21-23

**a. Description.** This work consists of the following:

1. Designing, load rating, manufacturing and constructing precast segmental concrete box culverts and appurtenances including pretensioning and post-tensioning;

2. Furnishing dewatering as necessary;

3. Maintaining the water flow during all construction stages; and

4. Furnishing and installing gaskets, joint tie assemblies, post-tensioning, cold applied joint sealer and geotextile blanket to seal culvert joints.

Perform the work in accordance with the standard specifications and as specified herein.

At the Contractor’s option, the fabrication of the precast concrete box culvert segments may be completed by the Contractor and at an alternate location that meets the requirements of this special provision and the contract. As another alternative, the box culvert can be cast in place with methods meeting the requirements of this special provision and the contract.

**b. Materials.** Furnish materials in accordance with subsection 406.02 of the Standard Specifications for Construction and as specified herein.

1. Cement. The use of Type III cement requires 25-40 percent of the cement, by weight, to be replaced with a supplementary cementitious material (slag cement or fly ash).

2. Aggregate. The use of Class 26A coarse aggregate in the concrete mix design requires 25-40 percent of the cement, by weight, to be replaced with Grade 100 slag cement. Ensure the maximum loss by wash percent passing is 2 percent and physical requirements (not gradation) meet Class 6AA coarse aggregate in accordance with the Standard Specifications for Construction.

3. Joint Tie Assemblies.

A. Threaded Rods. Furnish steel threaded rods in accordance with *ASTM F1554,* *Grade 55, Supplemental Specification S1*.

B. Washers. Furnish steel plate washers in accordance with subsection 906.07 of the Standard Specifications for Construction. Furnish steel lock washers in accordance with *ANSI B18.21.1*.

C. Nuts. Furnish steel heavy hex nuts in accordance with *ASTM A563/A563M, Grade A*.

D. Pipe. Furnish steel pipe in accordance with *ASTM A53/A53M, Grade B, Schedule 80*.

E. Sealant. Furnish a sealant in accordance with subsection 713.02.B of the Standard Specifications for Construction.

4. Prestressing. Pretensioning and Post-Tensioning.

A. Strands and Tendons. Furnish strands and tendons in accordance with subsections 905.07 and 905.08, respectively, of the Standard Specifications for Construction.

B. Hardware. Furnish anchorage hardware as recommended by prestressing supplier that meets the approval of the Engineer. Hardware includes, but is not limited to tendon wedges, wedge plates, bearing plates and rubber gaskets.

C. Grout.

(1) Post-Tensioning. Furnish Type E-1 expansive grout in accordance with section 1005 of the Standard Specifications for Construction.

(2) Horizontal Wall Joints. Furnish Type H-1 non-shrinking grout in accordance with section 1005 of the Standard Specifications for Construction.

D. Mortar. Furnish Type R-2 mortar in accordance with section 1005 of the Standard Specifications for Construction.

E. Seal Washers. Furnish neoprene washers in accordance with *ASTM C509* unless otherwise approved by the Engineer.

5. Inserts. Furnish concrete inserts as shown on the plans.

**c. Design.** Perform design in accordance with subsection 406.03 of the Standard Specifications for Construction.

Account for and furnish all attachments necessary for a complete design and to facilitate construction.

If the top slab is pretensioned, ensure design of pretensioning is in accordance with *AASHTO LRFD Bridge Design Specifications.*

**d. Fabrication.** Perform the work in accordance with subsections 406.03 and 708.03 of the Standard Specifications for Construction and in accordance with the requirements specified herein.

If utilizing the cast in place option, perform the work in accordance with subsections 406.03, 706.03.H and 706.03.J of the Standard Specifications for Construction and as specified herein.

1. Certification. The manufacturing plant must possess current certification from the NPCA or the ACPA in accordance with the *MQAP Manual*.

If the culvert segments are being fabricated by the Contractor, or the culvert is being cast in place, ensure the following conditions are met:

A. Provide third-party QC consultant(s) responsible for developing, training, and implementing a Quality Management System (QMS) that meets the contract requirements (including *NPCA* or *ACPA* program standards) and performs the QC inspections as specified in the QMS. The consultant(s) must have knowledge of specific products and be knowledgeable with Department specifications.

B. The third-party QC consultant responsible for developing, training, and implementing the QMS must have at least 10 years of experience auditing transportation fabrication QMSs and be familiar with the *NPCA* and *ACPA* program standards. The consultant must also have auditors on staff that have an American Society for Quality Certified Quality Auditors certification or equivalent certification.

C. The third-party QC consultant responsible for performing QC inspections must have at least 10 years of experience in transportation fabrication with at least 5 years of experience inspecting concrete culverts and meet all the QC requirements specified in the contract and QMS. The consultant must also be responsible for the implementation of the Contractor’s QMS and ensuring the product meets all project specifications.

2. Design. Sections of culvert may be designed to be manufactured in upper and lower halves, to assist with transportation to the project, and joined at the project to create a complete box. The design must account for temporary and permanent loading conditions of section halves and of the joined box section. If sections are manufactured in halves, ensure upper half vertical wall joints are staggered and not aligned with vertical wall joints of bottom halves when the sections are installed at the project.

The design may incorporate horizontal transverse post-tensioning. The post-tensioning design must satisfy the *AASHTO LRFD Bridge Design Specifications*.

Account for and provide all attachments necessary for a complete design and to facilitate construction.

3. Working Drawings. The working drawings must include all details for the box culvert, joint tie assemblies and post-tensioning, if utilized. The working drawings must specify the post-tensioning force if the design utilizes post-tensioning. Submit the working drawings to the Engineer for review at least 14 calendar days prior to fabrication and manufacturing. No extension of time or additional compensation will be provided in securing the Engineer’s approval. Ensure detailing personnel are able to demonstrate competency to prepare shop drawings in accordance with *PCI Drafting Handbook – Precast and Prestressed Concrete MNL-119*.

4. Fabrication. Fabricate joint tie assemblies in accordance with Standard Plan R-84 Series and section 707 of the Standard Specifications for Construction. Alternative joint tie assemblies may be approved by the Engineer. Galvanize steel components of joint tie assemblies in accordance with *ASTM A123/A123M* or *ASTM A153/A153M* as applicable.

Galvanize concrete inserts in accordance with *ASTM B633, Service Condition 4*.

5. Manufacture. Notify the Engineer at least 14 calendar days prior to manufacturing. Furnsih the Department access to the plant to perform QA inspection.

If sections are manufactured in halves, incorporate a shear key where top and bottom wall sections join.

Form holes in culvert sections to facilitate installation of joint tie assemblies unless an alternate joint tie assembly is approved by the Engineer that incorporates inserts instead of form holes.

Use a PVC conduit approved by the Engineer to form post-tensioning ducts.

Install concrete inserts as required by the design and as shown on the plans.

There must be at least 2 inches of clear cover over post-tensioning anchorages.

6. Installation. Install box culvert components in accordance with the approved working drawings. Install joint tie assemblies to a snug condition across all vertical and horizonal wall joints. Do not tighten joint tie assemblies in an attempt to pull sections together. Install joint tie assemblies prior to backfilling operations. Fill annular space between holes in culvert and joint tie rods with sealant.

Use non-metallic or stainless steel leveling shims as necessary. After culvert sections are installed, fill voids in the horizontal shear key joint with a non-shrinking grout meeting the approval of the Engineer.

Place backfill equally on both sides of the box culvert. Use caution when placing backfill adjacent to joint tie assemblies. Repair or replace damaged joint tie assemblies, as approved by the Engineer, at no additional cost to the contract.

If not post-tensioning, provide joint treatment between box culvert joints in accordance with subsection 406.03.G.3 of the Standard Specifications for Construction. Ensure joints are watertight.

If post-tensioning, satisfy the following requirements unless otherwise approved by the Engineer. Place seal washers, or other devices meeting the Engineer’s approval, between culvert sections at transverse conduit holes. After setting culvert sections in their final position, clean the culverts with water and place mortar in vertical and longitudinal joints. Forming may be required to contain mortar. Use Type R-2 mortar with a slump of 5 inches and place when the air temperature rises above 40 °F. Fill spaces between culvert sections full depth. Rod the mortar into the space to form a tight, solid joint. Cure mortar for at least 48 hours. After the mortar cures, post-tension the sections transversely. Tension tendons to the force required by the design, except do not exceed the yield stress of the material. After tensioning, clean the annular space between the tendon and hole by flushing with water. Remove water with compressed air. With the grouting vent open at one end of the hole, inject Type E-1 grout under pressure to the opposite end. Continue injecting grout until material comes out through the open vents. Close open vents while maintaining grout pressure. Gradually increase pressure to at least 50 psi and hold for 15 seconds. Close the inlet valve.

Remove lifting devices from culvert sections after culverts sections are placed in their final position. Lifting devices may remain in place if they do not extend above the concrete surface. Ensure lifting devices remaining in place are fabricated from stainless steel or be galvanized steel or epoxy coated steel. Fill pockets and voids, associated with lifting devices, with a non-shrink grout to the satisfaction of the Engineer.

**d. Measurement and Payment.** The completed work, as described, will be measured and paid for at the contract unit price using the following pay item:

**Pay Item Pay Unit**

Culv, Segmental Precast Conc Box, (span) foot by (rise) foot, Spec Foot

1. **Culv, Segmental Precast Conc Box, (span) foot by (rise) foot, Spec** will be measured by the foot along the centerline of the structure from fascia to fascia. The unit price for **Culv, Segmental Precast Conc Box, (span) foot by (rise) foot, Spec** includes:

● Designing, manufacturing, load rating and installing the precast elements;

● Forming, furnishing, finishing and curing concrete for cast in place culverts where applicable;

● Precast or cast-in-place headwalls, aprons and curtain walls;

● Cold applied culvert joint sealer;

● Closed-cell rubber extrusion type gaskets;

● External rubber gasket with compatible primer;

● Geotextile blanket for box culvert joints;

● Inserts for reinforcing bars and connection hardware;

● Joint tie assemblies;

● Pretensioning, post-tensioning and associated materials; and

● Dewatering and maintaining the stream flow during all construction stages.

2. The Contractor may select a culvert shape different than what is shown on the plans. The Contractor must bear all costs associated with redesign, plan modifications, additional quantities, and additional pay items. The redesign must address hydraulics, geotechnical engineering, roadway engineering, structural engineering, load rating, and must meet the approval of the Engineer. The redesign must use service vendors, hired by the Contractor, prequalified by the Department in the following classifications:

A. Design - Hydraulics I or Design - Hydraulics II,

B. Design - Geotechnical or Design - Geotechnical: Advanced,

C. Design - Bridges, and

D. Design - Roadway: Intermediate