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SECTION 1085—PRECAST REINFORCED CONCRETE BOX CULVERT

1085.1 DESCRIPTION—This work is the manufacture, storage, delivery, installation, and assembly of precast reinforced concrete box culvert segments into one continuous unit.

1085.2 MATERIAL—

- (a) **Class A Cement Concrete.** Section 704, [Section 1085.2\(e\)](#), ~~and ACI 211~~
- (b) **Deformed Welded Wire Fabric.** Section 709.4
- (c) **Galvanized Specialized Assembly and Tightening Hardware, Sleeves, Lug Plates, Bolts, Nuts, and Washers.** Section 1105.02(d)

- (d) **Nonshrink Grout.** Section 1080.2(c)

(e) **Precast Reinforced Concrete Box Culvert Segments.** From a manufacturer listed in Bulletin 15. Furnish, test, and place cement concrete as specified in Section 714.7; except, with a minimum 28-day compressive strength of 5,000 pounds per square inch or as shown on the approved shop drawings. [Provide concrete conforming to Section 704, ACI 211, and meeting the specified compressive strength or other requirements shown on the approved shop drawings.](#) AASHTO M 259/M 259M or M 273/M 273M; except, modify Section 11, Permissible Variations [in accordance with TR-28 and](#) as follows:

- **11.1 Internal Dimensions**—Do not allow the internal dimensions to vary from design by more than 1% with a maximum variation of 1 inch. Do not allow the internal diagonal dimensions to vary by more than 1 inch. Do not allow the haunch dimensions to vary more than 1/4 inch from design dimensions.
- **11.2 Slab and Wall Thickness**—Do not allow slab and wall thickness to vary from design dimensions by more than [plus 1/4 inch or](#) minus 3/16 inch.
- **11.3 Length of Opposite Surface** [\(when applicable square segments only\)](#)—Do not allow [laying length of laying length of any two](#) opposite [or opposing](#) surfaces of the box ~~section segment~~ to vary more than 1/8 inch/foot of the internal span, with a maximum of 5/8 inch.
- **11.5 Position of Reinforcement**—Do not allow the position of the reinforcement to vary from the approved shop drawings by more than 1/2 inch in any direction. Place reinforcement so the indicated cover clearance does not deviate more than $\pm 1/4$ inch. Provide 1 1/2 inch minimum cover at the mating surface, as measured to the end of the joint.

Certify as specified in Section 106.03(b)3.

- (f) **Reinforcement Bars.** Section 1002.2

- (g) **Waterproofing.** Section 680.2

- (h) **Selected Borrow Excavation - Structure Backfill.** As shown on the Standard Drawings.

- (i) **Concrete Bonding Compound.** Section 706

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(j) **Rock Protection, Class R-5.** Section 850.2(a)

(k) **Joint Sealing Compound.** Section 705.4(e)

(m) **Neoprene Joint Material.** Identify neoprene material according to the type, class, and grade. Print, stencil, or otherwise affix this code to each pad at intervals of not more than 24 inches and in letters and numerals of not less than 1/4-inch height. Additional information such as lot or batch numbers, date, plant and place of manufacture, trademark, or name of manufacturer may also be added. Certify as specified in Section 106.03(b)3.

1. Closed-Cell Neoprene Sponge. Pads may be manufactured as sponge neoprene or expanded neoprene and may be composed of laminations. Use material conforming to the following:

- ASTM D1056, Type 2, Class C, Grades [3](#), [4](#), and [5](#), including the requirements of suffixes B3 and F1
- ASTM D 1171, Quality Retention Rating of 100% after 6 weeks exposure

(n) **Post Tensioning Strands.** Section 1108.02(g)

1085.3 CONSTRUCTION—Construct as indicated and according to Article 12.11 of the AASHTO LRFD Specifications.

(a) **Design.** Design according to AASHTO specifications, as supplemented by PennDOT Design Manual, Part 4.

(b) **Shop Drawings.** Obtain approval of shop drawings before fabricating precast box culverts.

Show segment length on drawing. Provide segments of maximum length compatible with hauling equipment in order to minimize the number of joints.

Provide shop drawings as specified in Section 105.02(d).

Provide shop drawings clearly showing all items incorporated into the box culvert including all reinforcing. List items such as chairs and inserts by source, type, and supplier.

(c) **Inspection.** The Department will inspect precast segments during the entire fabrication process. The necessary facilities for inspection include a plant office as specified in Section 714.5(a).

(d) **QC**

1. General. Establish a level of QC based on uniform production practices. Submit the plant's QC Plan and mix design(s) to the Structural Materials Engineer, LTS, for review and approval. Include with the QC Plan a company organizational chart indicating a separate chain of command from the QC Manager to the Owner/Plant Manager, independent of the Production Manager. Resubmit the QC Plan, mix design, and organizational chart if processes, materials, or personnel change.

2. QC Manager. Provide a QC Manager who has overall responsibility for the adequacy of production facilities, QC, sampling and testing, and fabrication of the product, and who will ensure that items are fabricated as designed and as specified.

3. QC Personnel. Assign sufficient qualified personnel with precast concrete experience, to be responsible for QC and sampling and testing during the complete fabrication process, storage, and shipment. Technicians responsible for concrete sampling and testing are required to provide written evidence that they successfully completed the certification requirements for an ACI Grade I, Field Technician or have approval from the Structural Materials Engineer as a technician-in-training. Do not proceed with production until qualified personnel are present and approved by the Department. After initially obtaining the ACI certification, technicians are not required to obtain

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recertification-unless there has been more than a 6 month interval where actual plastic concrete testing has not been performed by the technician.

4. Plant Acceptance. Section 714.4, except, register and certify the plant under either the National Precast Concrete Association (NPCA), American Concrete Pipe Association (ACPA) box culvert or Prestressed Concrete Institute (PCI), box culvert plant certification program. Submit an annual endorsed copy to the Structural Materials Engineer for continued qualification.

(e) Handling and Storage. Handle and store precast reinforced concrete box culvert segments so that damage will not occur to the concrete or reinforcing steel. Provide suitable lifting devices for handling and installing precast reinforced concrete box culvert segments. Galvanize metal devices as specified in Section 1105.02(s). Prior to shipping, verify gasket material is sufficiently adhered to the joint. Verify gaps are not present between strips of adjacent gasket material. If gaps are present, a minimum of 6 inches must be replaced to assure material is tight. Apply gasket material a maximum of 72 hours prior to shipping.

(f) Delivery. ~~Repair or r~~Replace precast reinforced concrete box culvert segments damaged by improper storing, handling, transporting, or erection. Minor damage may be repaired in the field as per Publication 145 or according to an approved repair procedure. Submit major repair procedures beyond the scope of Publication 145 to the Chief Structural Materials Engineer for evaluation and disposition acceptance. Replace any segment that cannot be repaired to the satisfaction of the Representative.

The Representative will inspect the segments at the site for possible damage and cracking during shipment and for tolerances and other dimensions required for acceptance.

Do not ship segments until the 28-day minimum compressive strength is attained.

Provide 24-hour advance notice of loading and shipping schedule. Have the Department representative verify Form CS-4171 and properly tag segments before shipping. Do not ship unapproved items.

All temporary lifting or handling devices, which are for in-plant use only, must be patched prior to shipping. Patching must be performed using appropriate Bulletin 15 approved materials.

If temporary lifting or handling devices are deemed necessary to be used during shipping to and/or handling at the job site, they must be detailed on the approved shop drawings.

1. These temporary lifting or handling devices shall be patched at the job site using appropriate Bulletin 15 approved materials.

(g) Architectural Treatment (When Indicated). As specified in Section 1086.3(d) and as indicated:

1. Prefabrication Meeting. Two (2) weeks prior to fabrication, conduct a pre-fabrication meeting at the Fabricator's location to verify shop drawing, catalog cuts, staining materials, and fabrication information.

2. Test Sections (samples). Fabricate ~~test surfaces (samples)~~ for acceptance before normal fabrication and after acceptance of the shop drawings and catalog cuts for the architectural treatment. Fabricate samples using the same process and materials that will be used for production. Erect samples at place of manufacture and store outdoors to allow for proper lighting for comparisons during manufacturing and inspection.

Apply penetrating stain, where specified, to one half of sample, to show the final finish after the sample wall is constructed.

~~Use test sections to determine the acceptability of the various surface treatments, uniform color, free of surface blemishes, quality of construction, and overall appearance. Provide uniform color consistency, free of discoloration or blemishes.~~

~~View architectural treatments for the sample and subsequent production pieces for acceptance at a distance of 20 feet, unless otherwise specified.~~

Once test sections are fabricated, nNotify the Department, at least ~~14~~seven days before ~~the construction of the test sections~~ normal fabrication, so the appropriate Department Representatives may be present to determine acceptability of the test sections. Department Representatives may include the Environmental Manager, Project Manager, Design Staff, Construction Staff, and any other project team member designated by the Department.

Use test sections to determine the acceptability of the various surface treatments based on quality and overall appearance. Provide surfaces uniform in color, and free of surface blemishes, quality of construction, and

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overall appearance. Provide uniform color consistency, free of discoloration or blemishes.

View architectural treatments for the sample and subsequent production pieces for acceptance at a distance of 2030 feet, unless otherwise specified.

Produce additional samples until an acceptable product is produced if initial test sections are found to be unacceptable.

Accepted test samples will be used for comparative purposes for accepting production pieces. Additional test sections may be required if test sections are needed at the project site location.

Acceptable samples fabricated to the accepted shop drawings are allowed to be incorporated into the project in the final stage of construction, after all production has been completed and accepted.

(hg) Installation Requirements. Conduct a pre-installation meeting ~~prior~~ at least two (2) weeks prior to placement of box culvert. The superintendent in charge of the setting operation, a representative from the company ~~providing~~furnishing/utilizing the crane, and a Department Representative must be in attendance. Prior to meeting, submit a plan, ~~for showing~~ detailing the box ~~sections~~segments, location of the crane, dimensions of crane pad, crane swing radii, any obstruction or utilities to avoid, crane capacities, other lifting devices, and communication system that will be used during the placement. The plan must be signed by the crane company representative. Submit the plan to the Representative, for review and acceptance, prior to beginning work.

1. Foundation Material. Construct foundation as specified in Section 206, excluding Section 206.2(a)1.e. Provide uniform bedding material within 1/2² inch of the elevations shown on the plans. Use templates, screeds, and/or string lines to grade bedding within tolerance.

If unsuitable foundation material or rock is encountered, remove all unsuitable material or rock at least 12 inches below bottom of box culvert and backfill with No. 2A or AASHTO No. 8 Coarse Aggregate, as shown on the Standard Drawings, graded in close conformity with the stream bed grade to provide proper bedding conditions. Accurately shape bedding material with a template to provide uniform contact (90% of bearing).

2. Grouting. Grout hand holes, pockets, bolt sleeves, tie rod holes, and lifting lugs after joints are sealed and hardware is installed.

3. Placement. Place box culverts as indicated. Do not disturb the bedding or damage the box culvert. Prevent aggregate from entering box culvert ~~section~~segment joints during placement. Place ~~b~~Box culvert ~~sections~~segments ~~should be placed~~ by matching the interior floor, haunches, and wall lines from ~~section~~segment to ~~section~~segment.

4. Backfill. Backfill reinforced concrete box culverts to limits shown on Standard Drawing RC-12M. Backfill trench as specified in Section 601.3(f).

5. Compaction of Cover. If cover or fill is indicated, do not traverse top of box culverts with construction equipment until after cover or fill has been placed, unless cover exceeds 5 feet. Do not use vibratory rollers to compact cover or fill over, or directly adjacent to, box culverts.

6. Waterproofing. Apply waterproofing as specified in Section 680.3 and as shown on the Standard Drawings. Use an approved sealant material to correct joints on the exterior of the box ~~section~~segments which exceed 1/2² inch difference across the joint. Ensure waterproofing membrane will have full support and contact across the joint prior to placement.

(ih) Guide Rails. If indicated, install guide rail over box culverts as follows:

For fill heights greater than 24 inches at post locations, provide guide rail as shown on Standard Drawing RC-52M, "Type 2 Strong Post Guide Rail."

For fill heights 24 inches or less at post locations, provide structure mounted guide rail as shown on Standard Drawing ~~BD-632M, "R.C. Box Culvert Precast,"~~ BC-706M, "PA Structure Mounted Guiderail Barrier," and furnish a Class A cement concrete headwall.

(ji) Cutoff Walls. If indicated, provide cast-in-place or precast cutoff walls of 12-inch thick by 42-inch deep

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Class A cement concrete, or less if directed, and install upstream and downstream.

(kj) Wingwalls. If indicated, provide cast-in-place Class A cement concrete wing walls.

(lk) Aprons. If indicated, provide aprons of 6-inch thick Class A cement concrete, reinforced as shown on the Standard Drawings.

(ml) Concrete Bonding Compound. If cutoff walls or wing walls are indicated, bond to box culvert by coating the contact surfaces with concrete bonding compound.

(nm) Protective Coating. If indicated, apply two spray coats of coal tar epoxy, conforming to the requirements of SSPC-PS 16-82, to the top of the box and exposed end faces and to the entire height of the outside walls.

(on) Curing. Section 714.8; except, maintain box culvert segments, after stripping and during secondary curing, in a minimum 50F environment until they have reached a compressive strength of 70% of the required 28-day minimum concrete design strength shown on the approved shop drawings.

(po) Post-Tensioning. Install precast culvert segments as shown on the Standard Drawings, as indicated, and as specified in Section 1108 and as described below:

1. Post-Tensioning Sequence. Provide a post tensioning sequence that will not cause misalignment of box culvert sections/segments. Skewed sections/segments may require tensioning of corners prior to internal post-tensioning locations. Determine post-tensioning sequence, staging, etc. based on the weight of sections/segments being tensioned. Deviating from the established post-tensioning sequence, due to field adjustments, must be approved by the District Bridge Engineer, or their designee.

2. Gasket Material. Provide full contact of the gasket material around the perimeter of each joint. Remediate joints that are not sealed to the satisfaction of the Representative.

13. Grouting Strand Ducts. If grouting is not going to be performed during the same day the tendons are stressed, then within 4 hours after stressing, protect the tendons and grout ducts against corrosion and debris by temporarily sealing all openings and vents, cleaning rust and other debris from all metal surfaces to be covered by the grout cap; and placing the grout cap, including a seal, over the anchor plate until the tendon is grouted.

Grout ducts within 3 calendar days after tensioning.

Failure to grout the ducts within 3 calendar days after tensioning will require the contractor to demonstrate the ducts are unobstructed to achieve complete grouting. If obstruction(s) are present, clean ducts to remove obstructions and re-inspect prior to grouting.

1085.4 MEASUREMENT AND PAYMENT—

(a) Precast Reinforced Concrete Box Culvert. Lump Sum

The price includes the following component items:

- **Class A Cement Concrete.** Section 1001.4(a)
- **Deformed Welded Wire Fabric.** Pound
Annealed iron wire, chairs, and ties are incidental to the deformed wire fabric.
- **Precast Reinforced Concrete Box Culvert Segments.** Linear Foot
The unit price includes post-tensioning, if indicated.
- **Reinforcement Bars.** Section 1002.4

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- **Membrane Waterproofing.** Section 680.4
- **Selected Borrow Excavation - Structure Backfill.** Section 1001.4(g)
- **Rock Protection.** Section 850.4(a)
- **Protective Coating (Coal Tar Epoxy).** Square Yard

Work to divert running water according to the accepted Erosion and Sedimentation Control Plan is incidental to box culvert construction.

(b) **Guide Rail.** Section 620.4

(c) **Excavation for Unsuitable Material or Rock.** Section 204.4

(d) **Backfill for Unsuitable Material or Rock Excavation.** Cubic Yard
The Department will pay as specified in Section 110.03.