**DERRY-LONDONDERRY EXIT 4A**
**13065**

February 4, 2020

# SPECIAL PROVISION

## SECTION 529 -- PRECAST CONCRETE COMPONENTS

### Item 529.002XX - Precast Concrete Box Culvert (Bridge)

*This special provision provides for a precast concrete box culvert considered a bridge, due to a span over 10 feet, with either precast or cast-in-place wing walls, headwalls, collars, cutoff walls, and/or footings.*

### Description

**1.1** This work shall consist of designing, detailing, manufacturing, storing, transporting, and installing precast concrete box culvert sections and appurtenances (i.e.; box culverts, footings, wing walls, headwalls, collars, cutoff walls) herein referred to as "components", in accordance with these specifications and in conformance with the lines, grades, design and dimensions shown on the Base Technical Concept plans.

**1.1.1** This work shall also include field placement of grout for shear keys, and construction joints between abutting components during field assembly, when shown on the plans.

**1.1.2** This work shall also include designing precast components as described herein, or as indicated on the Base Technical Concept plans. Plans and calculations for all Design-Build Team designed components shall be provided in accordance with 1.2 and 1.3.

**1.1.2.1** Design-Build Team designed components for this project are as follows:

- Box culvert
- Headwalls
- Footings
- Wing walls
- Cutoff walls

**1.2 Requirements for Design-Build Team Designed Components.** The Design-Build Team shall submit plans and calculations for all Design-Build designed components for approval in accordance with 105.02.

**1.2.1** The plans and calculations shall be prepared, stamped and signed by a Licensed Professional Engineer licensed in the State of New Hampshire.

**1.2.2** The calculations shall be a complete and thorough set of calculations that are specific to this project. The calculations shall include all applicable references to the LRFD specifications. A detailed explanation of any symbols and computer programs used in the design shall be provided. Calculations shall be performed in English units, with the final calculation results shown in English units.

**1.3 Design Criteria for Design-Build Designed Components.** Design-Build Team designed components shall meet all requirements of the current AASHTO LRFD Bridge Design Specifications for

the applicable Strength and Extreme Event limit states and NHDOT Standard Specification for Road and Bridge Construction.

**1.3.1** Minimum clear cover on reinforcement for pre-cast members shall be 1.5 inches except for clear cover on the top mat of reinforcement in the top slab shall be 2 inches.

**1.3.2** Minimum clear cover on reinforcement for cast-in-place appurtenances shall be 2.5 inches or as detailed on the plans.

**1.3.3** All box culvert installations with clear spans greater than 6 feet shall include a cutoff wall at the inlet and outlet extending a minimum of 2 feet below the bottom of the bottom slab. The cutoff wall shall be made integral with the culvert.

**1.3.4** A minimum of one weeper is required per wingwall. Weepers shall be 4 inches in diameter, centered 12 inches above the bottom of the wall and sloped to drain with a 12:1 slope. Weepers shall be placed no more than 10 ft. from each end of the headwall. More than one weeper may be required.

**1.3.5** A load rating of the pre-cast box culvert using the Load and Resistance Factor Rating (LRFR) method shall be performed in accordance with AASHTO Manual for Bridge Evaluation (MBE). The NHDOT Form 4 - Bridge Capacity Summary completed and stamped by a Licensed Professional Structural Engineer registered in the State of New Hampshire shall be submitted with the shop drawings.

**1.4 Definitions.**

**1.4.1** For the purposes of this special provision, the following terms are as defined:

**1.4.1.1** Fabricator – Self-performing Design-Build Team or Precast Plant Fabricator

**1.4.1.2** Shop – Self-performing Design-Build Teams' Yard/Construction Site or Precast Fabricator's Plant

## Materials

**2.1 Concrete.**

**2.1.1** Precast concrete materials shall conform to the requirements of Section 520 for Class AAA with a minimum 28-day compressive strength of 5,000 psi, unless otherwise noted on the plans.

**2.1.2** Cast-in-Place concrete for headwalls, collars, and wing walls shall conform to the requirements of Section 520 Class A.

**2.1.3** Cast-in-Place concrete for footings and cutoff walls shall conform to the requirements of Section 520 Class B.

**2.1.3** Concrete shall be controlled, mixed, and handled as specified in the pertinent portions of Section 520, unless otherwise specified herein.

**2.1.4 Mix Design.** The Fabricator shall design and submit for approval the proportions and test results for a concrete mix which shall attain the following: a minimum design compressive strength as detailed on the plans for test cylinders sampled in accordance with the requirements of AASHTO T 141, molded and cured in accordance with the requirements of AASHTO T 23, and tested in accordance with

the requirements of AASHTO T 22; a surface resistivity greater than 15 kilohm-centimeter (kΩ-cm) at 56 days using AASHTO TP 95. The minimum average compressive strength of the proposed mix shall be determined using the procedures in Section 528 Appendix D. Air entrainment shall be targeted at a value of 6.0 percent +/-1.5 percent. Testing shall be in accordance with AASHTO T 119 and T 152.

**2.1.4.1** Sixty (60) days prior to the start of fabrication, the mix design shall be submitted to the Department's Bureau of Materials and Research for approval. No concrete shall be placed within the forms until the concrete mix design is approved.

**2.1.4.2** The Fabricator shall supply laboratory test reports that contain data on the mineralogy and potential reactivity for all aggregates being used in the concrete mix. All aggregates shall be tested in accordance with the requirements of AASHTO T 303 to determine alkali-silica reactivity. The laboratory supplying the test results shall provide evidence that the laboratory is properly equipped and qualified to perform the test methods. All test results submitted for alkali-silica reactivity shall be from tests conducted within one calendar year from the date the mix design is submitted to the Department.

**2.1.4.3** Mix designs using potentially alkali reactive aggregates shall include mitigation for reactivity and shall be submitted to the Department for approval. Mitigation of potentially reactive aggregates shall consist of one or more of the following methods: use of low alkali cement (less than 0.6 percent $Na_2O$ equivalent); use of a mineral admixture; or use of a chemical admixture. The proposed mitigation method will be accepted for use after the Department's Bureau of Materials and Research reviews test results supplied by the Design-Build Team that show the effectiveness of the mitigation. An effective mitigation technique should reduce the mean expansion to below 0.10% for alkali-silica reactivity when tested in accordance with AASHTO T 303.

**2.1.4.4** Should a change in sources of material be made, a new mix design shall be established and approved prior to incorporating the new material. When unsatisfactory results or other conditions make it necessary, the Engineer will require a new mix design.

**2.2 Reinforcement** for concrete shall conform to the requirements of Section 544. Steel reinforcement shall be uncoated unless otherwise noted on the Base Technical Concept plans.

**2.3 Grout and Concrete for Component Connections, Joints, and Bedding.**

**2.3.1** Grout for shear keys and construction joints between abutting components shall be an approved grout as listed in the Qualified Products List under Section 528 A. High-Strength, Impact-Resistant Non-Shrink Grout. High early strength concrete conforming to the requirements of Section 520 for Concrete Class AA, high early strength, shall be used to fill footing shear keys and joints.

**2.3.1.1** The compressive strength of the grout shall be equal to or greater than the joined components, unless otherwise noted on the plans.

**2.3.2.2** The grout when thoroughly mixed shall be readily pourable so that it completely fills the shape of the joint.

**2.3.2** Grout for bedding of components shall be an approved flowable non-shrink grout. A non-excavatable flowable fill, conforming to the requirements of the special provision amendment to Section 520 for Concrete Class F (non-excavatable), shall be used under the footings when shown on the plans.

**2.4** Flexible watertight gaskets between sections shall meet the physical requirements of AASHTO M198.

**2.5** Water repellent shall be silane/siloxane and conform to Section 534.2.2.

**2.6** Granular backfill material shall conform to Section 209.

**2.7** Barrier membrane shall conform to Section 538 with protection board.

**2.8** Structural fill shall conform to Section 508.

## Construction Requirements

### 3.1 General.

**3.1.1 Specifications.** Fabrication, transportation and erection of precast concrete components shall conform to the applicable requirements of the current: AASHTO LRFD Bridge Construction Specifications, Section 8: Concrete Structures; AASHTO LRFD Bridge Design Specifications, Section 5: Concrete Structures; PCI MNL-116 Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products; and PCI MNL-135 Tolerance Manual for Precast and Prestressed Concrete Construction; except as modified herein. In the case of conflicting specifications, the most stringent shall apply.

**3.1.2 Approval.** Prior to performing any work under Section 529, the Design-Built Team must have received approval for all shop drawings and any special contract requirements. The Design-Build Team shall bear full responsibility and costs for all materials ordered or work performed prior to approval or written authorization from the Engineer.

### 3.2 Special Contract Requirements.

**3.2.1** All precast components covered under Section 529 shall be produced by the same fabricator.

**3.3 Qualification of the Fabricator.** All shops manufacturing components for the Department shall satisfy the following minimum requirements:

**3.3.1 Certification.** The precast concrete manufacturing plant shall be certified by the Prestressed Concrete Institute Plant Certification Program in product Group B, certification category B1 or higher or National Precast Concrete Association (NPCA) Plant Certification. The Fabricator shall submit proof of certification prior to the start of production. This requirement is waived for self-performing Design-Build Teams.

**3.3.2 Engineering / Drafting.** The Fabricator shall have trained, knowledgeable, and experienced drafting personnel available who can produce and check legible, complete, and accurate shop detail drawings.

**3.3.3 Specifications.** The Fabricator shall have available in the shop all pertinent specifications governing the work.

**3.3.4 Technician.** The Fabricator shall provide a technician having a minimum of five (5) years continuous experience in the manufacture of precast components, who shall supervise the work.

**3.3.5 Quality Control.** The Fabricator shall perform quality control functions to insure that the work is in accordance with contract documents and specifications.

**3.4 Shop Drawings.** The Design-Build Team shall prepare and submit detailed shop drawings for approval in accordance with 105.02. Deviation from the approved shop drawings will not be permitted without written order or approval of the Engineer.

**3.4.1** The shop drawings shall be properly titled as to project location and bridge components similar to the title box on the contract plans. The shop drawings shall include, but not necessarily be limited to, the following:

a. Fully and accurately dimensioned views showing the geometry of the components including all projections, recesses, notches, openings, blockouts, connections, joints and keyways, etc.

b. Reinforcing bar lists, details, and bending schedules showing the size, spacing, location, and clear cover of reinforcing steel, including any reinforcing steel required, but not shown on the contract plans. Reinforcing steel or ties provided under lifting devices shall be shown in detail.

c. Details and locations of all items to be cast in the components (whether detailed on the contract drawings or provided for the Design-Build Team's convenience) such as inserts, lifting devices, temporary supports, CMP voids, grout ports, etc.

d. Details and locations of all leveling bolts used to make fast and accurate adjustments to the vertical position of the components.

e. Size and spacing of ports for placing grout for bedding of components based on component size and flowable grout characteristics. The ports shall be arranged so that the grouting operation may progress in a manner that avoids air pockets.

f. All necessary modifications to components to resist handling stresses resulting from the proposed method of handling and erection.

g. Quantities for each component (concrete volume, reinforcing steel weight and total weight).

h. Description of method of curing, handling, storing, and transporting the components.

i. Details and locations of all blocking used to support components during storage, and transportation.

j. Description of protective measures taken to prevent damage to the concrete by freezing.

k. Site plan detailing the inlet and outlet of the culvert. This plan shall be used to confirm the limits (elevations and lengths) of the proposed headwalls, wingwalls, cutoff walls, etc. are adequate for use at the site.

**3.5 Shop Inspection.** A Department representative will inspect the fabrication for quality assurance. This inspection will include the examination of materials, work procedures, and the final fabricated components.

**3.5.1** Fabrication shall only be done in the presence of an authorized inspector representing the Department. The Department's authorized quality assurance inspector is herein referred to as the "Inspector".

**3.5.2 Notice.** A minimum of fourteen (14) days prior to the scheduled start of casting of any component, the Fabricator shall contact the Department's Bureau of Materials and Research to provide notice of the scheduled start date. The Bureau of Materials and Research will assign an Inspector to the

scheduled work to provide quality assurance testing. The Inspector will coordinate directly with the Fabricator to determine the casting schedule.

**3.5.2.1** In addition to the requirements of 3.5.2, the Fabricator shall contact the Department's Bureau of Materials and Research at least two (2) days before the actual work begins to allow scheduling of independent quality assurance testing.

**3.5.3 Cooperation.** The Fabricator shall fully cooperate with the Inspector in the inspection of the work in progress.

**3.5.3.1** The Fabricator shall allow the Inspector unrestricted access to the necessary areas of the shop during work hours. Work done while the Inspector has been refused access will be automatically rejected.

**3.5.4 Authority.** The Inspector will have the authority to reject any material or workmanship that does not meet the requirements of the contract documents.

**3.5.4.1** Inspection at the shop is intended as a means of facilitating the work and avoiding errors. It does not constitute final approval and will not relieve the Design-Build Team from any responsibility in regard to imperfect material or workmanship and the necessity for replacing same.

**3.5.5 Acceptance.** The Inspector will affix an acceptance stamp to components ready for shipment. This mark will be made by paint or ink stamp in a location that will not be visible when the structure is completed.

**3.5.5.1** The Fabricator shall present the Inspector with a copy of the shipping invoice to be stamped for verification of inspection and approval prior to shipment.

**3.5.5.2** The Inspector's acceptance implies that, in the opinion of the Inspector the components were fabricated from accepted materials and processes and loaded for shipment in accordance with the contract requirements. The Inspector's stamp of acceptance for shipment does not imply that the components will not be rejected by the Engineer if subsequently found to be defective.

**3.6 Fabrication of Components.**

**3.6.1 Reinforcing.** Reinforcing shall be furnished, handled and installed in accordance with Section 544.

**3.6.1.1** All reinforcing shall be free of dirt, rust, oil, grease, and other deleterious substances.

**3.6.1.2** Clearance from the forms shall be maintained by supports, spacers, or hangers in accordance with 544.3.4, and shall be of approved shape and dimension.

**3.6.2 Inserts and Hardware.** All items cast in the concrete shall be accurately placed in the position shown on the approved shop drawings and firmly held during the placing and setting of the concrete.

**3.6.2.1** Recesses shall be provided around lifting devices to facilitate removal and grouting after erection.

**3.6.2.2** Components shall not be fired or drilled into for attachment purposes.

**3.6.2.3** All inserts and hardware shall be galvanized unless otherwise noted on the plans.

**3.6.3 Forms.** Forms shall conform to 520.3.2, and be subject to the approval of the Engineer.

**3.6.3.1** Forms shall be made and maintained true to the shapes and dimensions shown on the approved shop drawings. The surface of forms shall be smooth, and if necessary, joints shall be treated so that a minimum of joint marks are evident in the finished component.

**3.6.3.2** Forms shall be cleaned before each use.

**3.6.4 Concrete Placement and Curing.** Concrete shall be controlled, mixed, and handled in accordance with Section 520, unless otherwise specified herein.

**3.6.4.1** Concrete shall not be deposited in the forms until the Inspector has approved the placement of the reinforcing. Concrete shall be deposited only in the presence of the Inspector, and in accordance with 520.3.5.

**3.6.4.2** Consolidation of concrete shall conform to 520.3.5.4, or as ordered.

**3.6.4.3** Continuously wet cure components utilizing water retaining material for a minimum of seven (7) days. Water retaining material shall be burlap conforming to 520.2.6.1, or cotton mats conforming to 520.2.6.4.

**3.6.4.4** When the average daily temperature falls below 35°F for more than one day, protective measures shall be taken to prevent damage to the concrete by freezing. Components shall be protected from freezing temperatures (32°F) for five days or until attaining the minimum 28-day compressive strength indicated on the plans, whichever comes first.

**3.6.5 Removing Forms and Finish of Components.** Proper care and precautions shall be exercised in removing forms so that no damage results to finished surfaces.

**3.6.5.1** All components shall receive a Class 1, Ordinary Finish in accordance with 520.3.12, unless otherwise noted on the plans.

**3.7 Dimensional Tolerances.** The PCI Northeast Region Guidelines for Accelerated Bridge Construction Using Precast / Prestressed Concrete Elements Including Guideline Details, Report Number PCINE-14-ABC, available online at: www.pcine.org/index.cfm/resources/bridge/Accelerated_Bridge_Construction, shall be used in conjunction with this specification for determining appropriate dimensional fabrication tolerances for precast components.

**3.8 Component Damage / Cracking and Repair.** The PCI Northeast Region Bridge Member Repair Guidelines, Report Number PCINER-01-BMRG, available online at: www.pcine.org/index.cfm/resources/bridge/Specification_and_Guidelines, shall be used in conjunction with this specification to help identify damage and appropriate repair procedures, and determine the potential cause and remedial action.

**3.8.1** The Engineer may approve repairs to occasional, non-recurring, and isolated defects. The Design-Build Team shall submit procedures and materials for repairs to the Engineer for approval.

**3.8.2 Rejection.** Any of the following are considered defects that may constitute cause for rejection of a precast concrete component:

a. Fabrication not in conformance with the contract documents or plans.

b. Concrete breakage, full-depth cracking, extensive partial-depth cracking, or other damage determined to be significant by the Engineer.

c. Defects indicating concrete proportioning, placement and / or consolidation not in conformance with the contract documents or plans.

d. Components not in conformity with the dimensional fabrication tolerances given herein.

e. Damaged shear key or construction joint surfaces where such damage would prevent making a satisfactory joint as determined by the Engineer.

f. Discontinuity or crack in the concrete that would permit moisture to reach the reinforcing steel.

g. Significant component damage sustained during handling, transportation, or erection as determined by the Engineer.

h. Rock pockets or honeycombs over 6 square inches in area and over 1 inch deep.

i. Any section having more than one honeycomb area per side or surface even though the area is of a smaller scope than defined above.

j. Extensive fine hair cracks or checks.

k. Box culvert sections produced by racked or otherwise unsquared forms.

### 3.9 Concrete Strength Testing.

**3.9.1** Each component cast shall have a minimum of two cylinders made available for testing by the Department at 28 days for quality assurance. Acceptance of the concrete for strength will be based on successfully attaining the minimum 28-day compressive strength indicated on the plans for the two cylinders.

**3.9.2** The concrete test cylinders, prepared from fresh concrete at the time of placing, shall be cured under the same temperature and moisture conditions as the precast components.

### 3.10 Handling, Storing, and Shipping.

**3.10.1** Components shall be lifted at the designated points by approved lifting devices embedded in the concrete and proper hoisting procedures.

**3.10.2** Storage areas shall be smooth, well compacted, and sufficiently rigid to prevent damage due to differential settlement. Stacks of components may be supported by means of continuous blocking located as indicated on the approved shop drawings. Intermediate blocking between components shall be located directly over the blocking below.

**3.10.3** Components may be loaded on a trailer as described above. Shock-absorbing cushioning material shall be used at all bearing points during transportation. Tie-down straps shall be located at the lines of blocking only.

**3.10.4** Components shall not be subject to damaging torsional or impact stresses. Damaged components shall be repaired or replaced as directed by the Engineer, at no cost to the Department.

**3.10.5 Shipping.** Components shall not be transported from the manufacturing plant until they have reached a minimum age of seven (7) days, and the concrete has attained the minimum 28-day compressive strength indicated on the plans, as verified by test cylinders in accordance with 3.9. Components ready for shipment shall have received an acceptance stamp in accordance with 3.5.5.

**3.11 Erection of Precast Concrete Components.**

**3.11.1 Delivery and Field Inspection.** Material, workmanship and condition after shipment will be inspected after delivery to the construction site, with this and any previous inspections constituting only partial acceptance.

**3.11.2** After components are in their final erected positions they shall be subject to the inspection and approval of the Engineer. Furnish necessary facilities, including scaffolding and supports, to provide access to the structure to allow for inspection of workmanship.

**3.11.3 Sealing of Lifting Holes, Grout Ports, and Leveling Bolts**. After components are in their final erected positions, all lifting device recesses, grout ports, leveling bolt recesses, and other recesses used for erection purposes shall be filled with an approved high-strength non-shrink grout.

**3.11.4** Box culvert sections shall be installed as shown on the approved shop drawings. The box culvert shall be set on a 1 foot minimum thickness of structural fill or as detailed on the plans.

**3.11.5 Barrier Membrane with Protection Board** shall be used on all installations. Grout the exterior of all joints to provide a smooth surface to apply the membrane.

**3.11.5.1** For culverts with 5 feet of cover or more: a 2 foot strip of barrier membrane shall be applied to all joints in the top slab and extend 1 foot down wall.

**3.11.5.2** For culverts with less than or equal to 5 feet of cover: the entire top slab shall be covered with barrier membrane and extend down 1 foot.

**3.11.6** Excavation shall conform to Section 206.3.

**3.11.7** The Design-Build Team shall provide temporary diversion of water to construct the culvert.

**3.11.8** If the plan calls for extending an existing box culvert, the Design-Build Team shall connect the new precast box culvert to the existing box culvert using a cast-in-place collar as shown on the plans or as ordered by the Engineer.

**3.11.9** End sections, headers, and other appurtenances shall be furnished and installed as precast units or constructed as cast-in-place units in accordance with the plans and specifications.

**3.11.10** Coat all exposed concrete surfaces of headers and end sections (except interior of box culvert) to one foot below fill lines with silane-siloxane water repellent.

**3.11.11** Box culvert sections shall be backfilled with a granular backfill material a minimum of 3 feet from the outside face of the culvert or distance detailed on the plans.