SPP00595 (04-01-20) *(This section requires SPP00530*

 *and SPP00540. Requires SPP00591*

 *when waterproofing membrane*

 *is required.)*

# SECTION 00595 - REINFORCED CONCRETE BOX CULVERTS

Replace section 00595 of the Standard Construction Specifications with the following section 00595:

# Description

**00595.00  Scope** - This work consists of constructing cast-in-place reinforced concrete box culverts, precast reinforced concrete box culverts, precast segmental reinforced concrete box culverts, and precast reinforced concrete three-sided structures to the lines, grades, and dimensions shown or directed. Each of these configurations of reinforced concrete box culvert is referred to as RCBC herein.

**00595.02  Definitions:**

**Box Section** - For precast reinforced concrete box culverts, the box section is the individual precast box culvert piece. For precast segmental reinforced concrete box culverts, the box section is made of a top and bottom segment adjoined to form a complete box cross section unit. For precast reinforced concrete three-sided structures, the box section is the individual precast three-sided structure piece. Box sections are placed and joined together to construct the reinforced concrete box culvert.

**Box Segment** - For precast segmental reinforced concrete box culverts, the box segment is the individual piece (top slab, bottom slab, or U-shape) that is adjoined to the mating box segment to form a box section.

**00595.03  Design of Precast Sections** - Perform design according to the current edition of AASHTO LRFD Bridge Design Specifications.

Unless otherwise shown or specified, precast RCBC may be substituted in place of cast-in-place RCBC. Precast substitution is not permitted for headwalls, wing walls, or for features shown as using cast-in-place concrete.

Submit stamped design calculations and stamped working drawings, prepared by the manufacturer, according to 00150.35. Include the following information:

* Structural analysis methods

Structural design criteria and calculations

Structure detail shop drawings

Detailed plans including culvert geometry

Line and grade layout

Joint and connection details

Lifting devices

Submit a stamped installation plan, according to 00150.35. Ensure the installation plan is consistent with the Plans, Specifications and the manufacturer’s design. Include the following information:

* Methods and equipment to be used for handling

Methods to ensure uniform bearing of the RCBC base

Culvert installation

Requirements for construction loads

Do not begin precast culvert fabrication or construction before receiving written approval from the Owner’s Representative.

# Materials

**00595.10  Cast-in-Place Materials** - For cast-in-place RCBC, cast-in-place ends, and cast in place wing walls and aprons, furnish Materials meeting the following requirements:

 Reinforcement 00530

 Concrete 00540

Unless otherwise shown, provide Class 3300 - 1 1/2" or 3/4" portland cement concrete.

**00595.11  Precast Materials** - Furnish materials meeting the following requirements:

 Concrete 02001

 Deformed Bar Reinforcement 02510.10

 Precast Reinforced Concrete Box Culverts ASTM C1577

 Precast Segmental Reinforced Concrete Box Culverts ASTM C1786

 Precast Reinforced Concrete Three-Sided Structures ASTM C1504

Unless otherwise shown furnish joint sealing material per manufacturer design and meeting one or more of the following requirements:

 External Sealing Band ASTM C877

 Preformed Flexible Joint Sealant ASTM C990

 Rubber Gaskets ASTM C1677

 Elastomeric Joint Sealant ASTM C920

Unless otherwise shown, provide portland cement concrete according to the following:

 **Property Value**

 Air Entrainment 4.5 - 7.5%

 Compressive Strength 5000 psi

 Concrete Temperature 50 - 90° F

# Construction

**00595.40  Cast-in-Place** - Construct cast-in-place RCBC, cast-in-place ends, and cast in place wing walls and aprons according to the following:

(**a)  Reinforcement** - Place reinforcing steel according to section 00530.

**(b)  Portland Cement Concrete** - Place portland cement concrete according to section 00540 and the following:

**(1)  Placing Concrete** - Allow base slabs or box culvert footings to set at least 12 hours before constructing the remainder of the box culvert.

When constructing box culverts four (4) feet or less in height, the sidewalls and top slab may be constructed as a monolith, with sidewalls constructed full height. If this method is used, place construction joints vertical and at right angles to the axis of the culvert.

When constructing box culverts more than 4 feet in height, place concrete in the walls to at least the bottom elevation of the top slab. Allow three (3) days before placing the top slab according to 00595.40(b)(2).

Construct each wing wall as a monolith.

**(2)  Removal of Forms and Falsework and Subsequent Loading** - Remove forms and falsework and place subsequent loading according to Table 00540-1 in section 00540.52.

**(3)  Concrete Finish** - Finish all exposed concrete surfaces with a general finish according to 00540.53(a).

**00595.41  Precast** - Fabricate precast boxes according to the following requirements unless detailed otherwise:

 Precast Reinforced Concrete Box Culverts ASTM C1577

 Precast Segmental Reinforced Concrete Box Culverts ASTM C1786

 Precast Reinforced Concrete Three-Sided Structures ASTM C1504

Prepare at least three acceptance test cylinders per day for each concrete strength used in the production of box sections.

Expose cylinders to the same curing conditions as the manufactured box sections and keep cylinders and box sections together until tested.

Transport members from the casting yard only after the following conditions have been met:

* Not less than seven (7) calendar days after casting,

Not less than seven (7) calendar days after all concrete patching and repairing is complete, and

After 28 calendar days compressive strengths have been achieved.

When the compressive strength of the cylinders tested does not conform to the acceptance criteria stated in ASTM C1577, ASTM C1786, or ASTM C1504, as applicable to the precast culvert type, the Owner’s Representative may allow retesting based on compression testing of cores, reject the sections, or assess a price reduction according to 00150.25.

Be responsible for the safety of precast members during all stages of construction.

Provide structural connections at joints between all segments that fit together to form a complete box section unit with a structural key or doweled connection. Provide a structural keyway joint between all mating surfaces of adjacent box sections including adjacent top slabs.

Align all joints. Staggered joints are not allowed.

Place a continuous flexible watertight seal in the joint, on the sides and top, between each precast reinforced concrete box section. Install according to Manufacturer’s recommendations.

Provide a 3/4 inch chamfer on all concrete edges unless otherwise noted.

**00595.42  Precast Fabrication Tolerances**- Shop assemble adjacent full RCBC sections and match-mark adjacent sections before shipping. Sections not meeting the following tolerances will be rejected:

* **Precast Reinforced Concrete Box Culverts** - Provide RCBC sections that meet the permissible variations listed in ASTM C1577.

**Precast Segmental Reinforced Concrete Box Culverts** - Provide RCBC sections that meet the permissible variations listed in ASTM C1786.

**Precast Reinforced Concrete Three-Sided Structures** - Provide RCBC sections that meet the permissible variations listed in ASTM C1504.

**00595.43  Defects in Precast Sections** - Provide repair materials from the QPL according to 02015.30.

Submit proposed repair plans and revised installation plan to the Owner’s Representative for review and acceptance before performing the repairs. Provide written confirmation from the RCBC Design Engineer of Record that the repair methods are appropriate.

Repair or replace damaged precast sections at no additional cost to the Owner, according to the following criteria:

**(a)  Repair Cracked or Damaged RCBC** - Repair cracked or damaged RCBC sections when:

* Cracks 0.01 inch or wider and less than 12 inches long that do not pass through the wall or slab thickness.

Surface defects including honeycomb, bleedout, or spalls less than four (4) percent of surface area of the box section face where the defect is located, or multiple surface defects with cumulative area less than 10 percent of the box section surface where the defect is located.

Chipped or spalled edges one (1) inch and greater in depth from the end of the bell or spigot and not exceeding the depth of the joint provided the cumulative length of chip or damage is not more 50 percent of the RCBC span or rise, whichever is greater, and no individual length of chip or damage is more than 25 percent of the structure’s span or rise, whichever is greater. The repaired sealing surface shall be free of spalls, cracks, or imperfections that would adversely affect the performance of the joint. Sections with chipped or spalled edges exceeding these values must be replaced.

**(b)**  **Replace Cracked or Damaged RCBC** - Replace damaged RCBC sections having defects that that cannot be adequately repaired to full function or design life. Rejectable defects include:

* Inadequate reinforcing cover

Cracks that are full depth of the slab or wall thickness

Any crack that would prevent making a satisfactory joint

Surface defects including honeycomb, bleedout, or spalls having depth greater than the size of the coarse aggregate, exposing reinforcing steel, and having a defect area greater than four (4) percent of surface area of the face where the defect is located, or multiple surface defects with cumulative area greater than 10 percent of the surface where the defect is located are cause for rejection.

**(c)  Minor Defects** - Acceptable minor defects not requiring repair:

* A single end crack that does not exceed the depth of the joint.

Cracks less than 0.01 inch wide and not passing through the wall or slab thickness.

A crack greater than 0.01 inch wide and less than 12 inches long that does not pass through the wall or slab thickness.

**00595.44  Precast Installation:**

* Perform excavation, bedding and leveling course preparation, and backfill according to 00510 and 00405 as applicable.

Cushion RCBC installed over unyielding foundation, including concrete, to prevent non-uniform bearing with a minimum three (3)-inch deep bedding and leveling course of granular material meeting 00405.12. Spread the leveling course the width and length of the RCBC plus a minimum six (6) inches all around. A concrete slab as leveling course is not allowed.

Use lifting, lowering, and pulling construction equipment according to the written installation plan. Do not use excessive force or unapproved equipment to push box sections into place. Handle box sections with care and prevent damage from cracking, dragging, and impact.

Ensure the prepared foundation surface provides uniform bearing and proper line and grade for the RCBC. Do not rut or disturb the prepared foundation bedding and leveling course. If bearing, line and grade are not achieved, remove the RCBC section and make foundation corrections.

Maintain the ends of box sections free of any deleterious materials that would prevent proper joining or sealing of adjacent sections.

Assemble box sections within the following tolerances:

Horizontal and Vertical Joint Variation - The maximum variation between mating surfaces in any assembled transverse joint, between box sections before grouting, shall be no more than 1/2 inch. The joint width shall vary no more than 3/8 inch over the length of the joint.

Longitudinal Surfaces - Fit box sections together to form a smooth, uniform line of sections. The variation between internal surfaces of two adjoining precast box sections shall not be more than 1/4 inch, measured with a 12-foot straight edge across joints.

(Include the following bullet if welding is to be performed. Select the appropriate 00560.26(a) for bridge size culverts or 00560.26(b) for non-bridge culverts. Check with the designer.)

Perform structural steel welding according to section 00560.26.

**00595.80  Measurement** - The quantities of cast-in-place RCBC will be measured on the length basis, along the centerline of the RCBC, from end to end as shown.

The quantities of precast RCBC will be measured on the length basis along the centerline of the RCBC from end to end as shown, including cast in place ends.

No measurement of quantities will be made for wing walls and aprons. Estimated quantities of concrete and reinforcement for wing walls and aprons will be listed in the Contract Documents.

The estimated quantities of reinforcement and concrete for wing walls and aprons are:

(Fill in the appropriate amount of wing wall and apron reinforcement and concrete. Obtain information from the Designer.)

 **Reinforcement** **Concrete**

 **(Pound)** **(Cubic Yard)**

Wing Walls

Aprons

**00595.90  Payment** - The accepted quantities of work performed under this section will be paid for at the Contract unit price, per unit of measurement, for the following items:

(Delete pay item(s) from the list that are not included in the Schedule of Items, but do not change the alpha characters next to the pay items.)

 Pay Item Unit of Measurement

 (a) Cast-In-Place Reinforced Concrete Box Culverts Foot

 (b) Precast Reinforced Concrete Box Culverts Foot

 (c) Precast Split Reinforced Concrete Box Culverts Foot

 (d) Precast Reinforced Concrete Three Sided Structures Foot

 (e) Wing Walls Lump Sum

 (f) Aprons Lump Sum

(Delete pay item letters from the following paragraph if those pay items are not included in the pay item list above. Delete parentheses, "(s)" and "(and)" as applicable. When more than one item is listed, move the word "and" to the appropriate location.)

Item***(***s***)*** (b), (c), ***(***and***)*** (d) include***(***s***)*** ***(***cast-in-place ends***)***.

No separate or additional payment will be made for closure pours, weldments, and structure connection systems; this work is included in payment made for the applicable items in which they are used.

Payment will be payment in full for furnishing and placing all materials, and for furnishing all

equipment, labor, and incidentals necessary to complete the Work as specified.