

SECTION 560 PRECAST CONCRETE BOX CULVERT

560.1 DESCRIPTION

This work consists of furnishing and installing precast concrete box culverts.

560.2 MATERIALS

Precast concrete box culvert shall conform to AASHTO M 259 or M 273. Configurations in variance with those provided by AASHTO will be accepted provided the AASHTO materials, design, fabrication specification requirements and the requirements of Section 560 are complied with.

- A. **End Section:** End section (inlet or outlet) materials, design, and fabrication shall conform to AASHTO Standard Specifications for Highway Bridges and Materials Specifications.
- B. **Drainage Fabric:** Drainage fabric shall conform to Section 831.1.
- C. **Concrete:**
 - 1. Fine aggregate shall conform to Section 800.
 - 2. Coarse aggregate shall be the product of crushing limestone, quartzite ledge rock, or other ledge rock and shall conform to Section 820. Coarse aggregate shall meet the gradation requirements of either Size No. 1 or Size No. 1A. The aggregate size shall be consistent throughout the entire structure. One source shall be used to produce each aggregate size.
 - 3. The contractor shall submit a concrete job mix design for approval ten working days prior to fabrication. The job mix design shall include all admixtures proposed for use and the concrete aggregates shall contain a minimum of 58 percent coarse aggregate by weight. When a plant has been in operation and satisfactorily producing precast box culverts, the Contractor will not be required to submit a concrete mix design, unless changes have been made to the preapproved mix design or the materials used in the mix design.

The concrete shall attain a 28 day compressive strength equal to or greater than the minimum compressive strength specified.

The concrete **without HRWA** shall have a maximum slump of five inches (125 mm) and shall contain 6 percent entrained air plus or minus 1.5 percent.

When high range water reducing admixtures (HRWRA) are used, the maximum slump prior to the addition of HRWRA shall be three inches (75 mm), and maximum slump at the time of placement shall be seven inches (175 mm).

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The measurement of slump prior to the addition of HRWRA is for use in determining the proper dosage of HRWRA and is the responsibility of the contractor. The preliminary slump measurement may be by visual inspection or by the use of concrete plant watt or amp meters that are designed to indicate the slump of the mix.

The HRWRA shall be compatible with the concrete mix. The HRWRA shall not be used in amounts that cause segregation or rapid slump loss that would hinder concrete placement.

Steel wire bar supports, in contact with the casting forms, shall be stainless steel, hot dipped galvanized, or plastic tipped extending at least ½ inch (13 mm) from the form surface.

560.3 CONSTRUCTION REQUIREMENTS

A. Design:

1. Precast box culverts shall be designed to specified load conditions. The Design Engineer of the structure must be registered in the State of South Dakota. The design shall conform to the AASHTO design requirements for the depth of fill, including surfacing etc., as well as live load or specified loading. The specified live load shall apply to all barrel sections.
2. Thirty days prior to fabrication of box culvert sections, the Contractor shall furnish shop drawings and a checked design for Department review. A checked design includes, the design calculations, and check design calculations performed by an independent Engineer. The drawings shall be complete and show all reinforcing steel, reinforcing steel placement, reinforcing steel configuration, and total quantities for the complete structure.

A checked design for barrel sections will not be required to be submitted if the proposed fabrication dimensions and reinforcement conform to AASHTO M 259M or M 273M. A checked design for end sections and special sections will be required.

B. Fabrication: The Contractor shall notify the Engineer seven days prior fabrication.

1. The minimum length of precast sections shall be four feet (1200 mm).
2. Joint ties shall be provided on all sections.
3. Steel wire bar supports shall be used to maintain proper reinforcement location and concrete cover. Cutting of reinforcement and bending to the form surface, for support, will not be permitted.
4. Welding of reinforcing steel will not be permitted.

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5. The surface temperature of forms and reinforcing steel (that come in contact with the concrete being placed) shall be raised to a temperature above freezing prior to concrete placement. All deleterious material shall be removed from the forms prior to concrete placement.
6. The dry casting method of fabrication for precast concrete box culverts will not be allowed.
7. The Contractor shall be responsible for curing the precast units.

The precast units shall have sufficient strength to prevent damage to the units during removal of the forms and yarding. Precast units shall have a minimum concrete compressive strength of 800 psi (5.5 MPa) prior to form removal. The Engineer may approve a different minimum concrete strength for form removal, based upon fabricator demonstrated results.

A minimum of one group of test cylinders, for each class of concrete for each days production, not to exceed one group of cylinders per 150 cubic yards (125 cubic meters), shall be made by the fabricator.

A group of test cylinders shall consist of the following:

- a. Two test cylinders are required for the 28 day compression test, with the results averaged.
- b. Two additional cylinders will be required for determining concrete strength, when the Contractor desires to make delivery and obtain acceptance by the Department prior to 28 day compression test.

The precast units will be accepted when the minimum design concrete compressive strength requirements have been met. Accepted precast units represented by that test group of cylinders may be delivered to the project and will not require the 28 day cylinder test.

8. **Concrete Cure:** The concrete may be cured by low pressure steam, radiant heat or as specified in Section 460.3 N. When curing is in accordance with Section 460. N., the concrete temperature requirements of Section 460.3 J. shall apply.

Low pressure steam curing or radiant heat curing shall be done under an enclosure to contain the live steam or the heat and prevent heat loss. The concrete shall be allowed to attain the initial set before application of the steam or heat. The application of the steam or heat shall not begin until three hours after the final placement of the concrete to allow the initial set to take place. If retarders are used, the application of the steam or radiant heat shall not begin until five hours after the final placement of the concrete. When the time of initial set is determined by ASTM C 403, the time limits described above may be waived.

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During the three to five hour waiting period, the minimum concrete temperature within the curing chamber shall not be less than 50EF (10EC) and live steam or radiant heat may be used to maintain the curing chamber at the proper minimum temperature. During the waiting period the concrete shall be kept moist.

Application of live steam shall not be directed on the forms causing localized high temperatures. Radiant heat may be applied by pipes circulating steam, hot oil, hot water, or by electric heating elements. Moisture loss shall be minimized by covering exposed concrete surfaces with a plastic sheeting or by applying an approved liquid membrane curing compound to exposed concrete surfaces. Top surfaces of precast units to be used in composite construction shall be clear of residue of the membrane curing compound unless suitable mechanical means for full bond development are provided.

During the initial application of live steam or radiant heat, the concrete temperature within the curing enclosure shall increase at an average rate not exceeding 40EF (22EC) per hour until the curing temperature is reached. The maximum concrete temperature within the enclosure shall not exceed 160EF (71EC). The maximum temperature shall be held until the concrete has reached the desired strength. After discontinuing the steam or radiant heat application, the temperature of the concrete shall decrease at a rate not to exceed 40EF (22EC) per hour until the concrete temperature is within 20EF (11EC) above the ambient air temperature.

Steam or radiant heat curing may be discontinued when tests indicate that a minimum of 70 percent of the design strength has been attained.

9. All areas damaged during fabrication that require structural repair shall be inspected by the Department prior to repair being initiated. The repair method and materials required shall be agreed upon by the Department and fabricator prior to the repair work commencing. Delamination of the concrete shall be cause for rejection.

C. Installation:

1. **Foundation:** Foundation preparation shall be in accordance with Sections 420, 421, and 450. The foundation shall be shaped to provide a satisfactory template section and density.
2. **Transverse Joints:** The floor joint between adjacent sections shall be sealed with a preformed mastic to a point above the flow line. A strip of drainage fabric shall be placed along the top and walls, to provide a minimum of 2 ½ feet (750 mm) of fabric centered on the joint. Transverse joints in the fabric shall be overlapped at least two feet (600 mm). Sufficient adhesive shall be required along the edge of the fabric to hold it in place while backfilling. The lift holes shall be plugged with an approved nonshrink grout.
3. **Joint Ties:** Each section shall be tied to adjacent sections with joint ties.

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4. **Backfilling:** Backfilling shall conform to Section 450. Hand compaction methods may be required for satisfactory compaction under and adjacent to corners with radius and between culverts on multiple installations.

560.4 METHOD OF MEASUREMENT

- A. **Furnishing Precast Box Culvert:** Furnishing precast box culverts will be measured by the linear foot (0.1 meter), excluding end sections. The length shall be obtained by multiplying the nominal length of the sections by the number of sections.
- B. **Installing Precast Box Culvert:** Installing precast box culvert will be measured by the linear foot (0.1 meter). The length shall be obtained by multiplying the nominal length of sections by the number installed.
- C. **Furnishing Precast Box Culvert End Sections:** Furnishing precast box culvert end sections will be measured per each.
- D. **Installing Precast Box Culvert End Sections:** Installing precast box culvert end sections will be measured per each.

560.5 BASIS OF PAYMENT

- A. **Furnishing Precast Box Culvert:** Furnish precast box culvert will be paid for at the contract unit price per linear foot (0.1 meter). Payment will be full compensation for furnishing the box culvert, joint seal mastic, drainage fabric, and joint ties.
- B. **Installing Precast Box Culvert:** Installing precast box culvert will be paid for at the contract unit price per linear foot (0.1 meter). Payment will be full compensation for precast box culvert installation and will include compensation for foundation preparation, backfilling, and all other incidentals.
- C. **Furnishing Precast Box Culvert End Sections:** Furnishing precast box culverts will be paid for at the contract unit price per each.
- D. **Installing Precast Box Culvert End Sections:** Installing precast box culvert end sections will be paid for at the contract unit price per each.