

SECTION 50

PRECAST CONCRETE

50.1 DESCRIPTION

A. General: This work consists of fabricating and furnishing precast concrete items. Fabrication facility shall be on the SD DOT Contractor / Supplier List in order to supply precast concrete products for the City of Rapid City.

B. Related Work:

Section 11	Utility Excavation and Backfill
Section 12	Roadway and Drainage Excavation and Embankment
Section 54	Drainage Pipe Installation
Section 55	Cast in Place Concrete Structures
Section 58	Concrete Box Culvert
Section 62	Drop Inlets
Section 100	Portland Cement
Section 101	Air-Entraining Admixtures
Section 102	Chemical Admixtures for Concrete
Section 103	Fly Ash
Section 104	Water for Use in Portland Cement Concrete
Section 105	Fine Aggregate for Use in Portland Cement Concrete
Section 107	Coarse Aggregate for Use in Portland Cement Concrete
Section 123	Concrete Reinforcement
Section 202	Geosynthetics for Roadways
Section 203	Submittals

50.2 MATERIALS (Not Specified)

A. Concrete:

B. Fine Aggregate: Section 105.

C. Coarse Aggregate: Section 107.

D. Water: Section 104.

E. Chemical Admixtures: Section 101 and 102.

F. Fly Ash: Section 103.

G. Cement: Section 100. Type II cement shall be used, unless otherwise specified. For pretensioned prestressed concrete beams, Type I, II, or III cement may be used.

- H. **Reinforcing Steel:** Section 123. Epoxy coated rebar is not required unless otherwise specified in detailed plans and specifications, or per standard details.
- I. **Drainage Fabric:** Shall meet the requirements of Section 202, Class 2 nonwoven geotextile.

50.3 CONSTRUCTION REQUIREMENTS

- A. **General Requirements:** The Contractor shall satisfy the following for all precast concrete items.
 - 1. **Notification:** The Fabricator shall notify the Engineer seven (7) days prior to the fabrication of precast concrete items. Engineer reserves the right to inspect precast fabrication facility, equipment, and materials.
 - 2. **Concrete Mix Requirements:** The mix design shall include all aggregate sources and admixtures proposed for use. When a plant has been in operation and satisfactorily producing material, the fabricator will only be required to submit a concrete mix design annually for precast concrete, unless changes have been made to the pre-approved mix design or the material used in the mix design.

Shop Drawings: Prior to fabrication, the Contractor shall submit shop drawings to the Engineer for review and approval. If deviating from the standard detail, contractor or supplier shall provide engineered drawings and calculations verifying the structure is designed per HL93. The Contractor shall furnish a checked design with the shop drawings. A checked design includes the design calculations and check design calculations performed by an independent Professional Engineer registered in the State of South Dakota. The Contractor shall not begin fabrication prior to the City's review and final approval of shop drawings. Shop drawing shall be submitted to the Engineer in accordance with Section 203 Submittals. The shop drawings shall consist of fabrication details including reinforcing steel and spacer placement and configurations, total quantities for the complete structure, and all information necessary for fabrication and erection.

a) Wet Cast Concrete Mix Requirements:

- 1) The concrete shall attain a 28 day compressive strength equal to or greater than the minimum compressive strength specified.
- 2) The water/cementitious material ratio shall not exceed that specified in the concrete mix design.
- 3) The absolute volume of the mix design proportions shall yield 27.0 to 27.4 cubic feet.

- 4) The mix design for box culverts shall contain a minimum of 58% coarse aggregate by weight. All other precast products shall contain a minimum of 50% coarse aggregate by weight.
- 5) The entrained air content shall be 6% plus or minus 1.5%.
- 6) Concrete without high range water reducing admixtures (HRWRA) shall have a maximum slump of 5 inches.
- 7) When HRWRA are used, the slump at the time of placement shall be from 4 to 8 inches.
- 8) 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.
- 9) The minimum fresh concrete temperature at time of placement shall be 50°F.
- 10) Equipment and methods used for batching, mixing, and transporting of concrete shall be approved by the Engineer.

b) Dry Cast Concrete Mix Requirements:

- 1) The concrete shall attain a 28 day compressive strength equal to or greater than the minimum compressive strength specified.
- 2) The absolute volume of the mix design proportions shall yield 27.0 to 27.4 cubic feet.
- 3) The minimum fresh concrete temperature at time of placement shall be 50°F.
- 4) Equipment and methods used for batching, mixing, and transporting of concrete shall be approved by the Engineer.

3. Forms: Shall comply with Section 55 and the following:

The forms shall be designed to withstand the fluid pressure of the concrete and the added forces due to vibration and impact without distortion. The forms shall be mortar tight and free from warp. Joints in sectional forms shall have a tight fit without excessive offset.

The form surface area in contact with the concrete shall be treated with an approved form oil or wax before the form is set in position. The forms shall be thoroughly cleaned of all other substances.

4. Fabrication: Welding of mild reinforcing steel will not be permitted.

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. Steel wire bar supports, in contact with the casting forms, shall be stainless steel, hot dipped galvanized, or plastic tipped extending at least 1/2 inch from the form surface.

The surface temperature of the forms and reinforcing steel, which come into 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. For cold weather placements, concrete surfaces shall be protected from freezing throughout the pour and until covered for the waiting period before application of live steam or radiant heat.

The dry casting method of fabrication for precast concrete box culverts will not be allowed except single barrel precast concrete box culverts with dimensions of 7 foot by 7 foot and smaller.

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 prior to form removal. Precast units shall have a minimum concrete compressive strength of 3000 psi prior to yarding. Final 28 day compressive strength shall be minimum 4000 psi, or as specified in detailed plans and specifications. The Engineer may allow a different minimum concrete strength for form removal and yarding, based upon fabricator demonstrated results or as shown on design details submitted with the shop plans.

The fabricator shall make a minimum of one group of test cylinders for each class of concrete for each day's production, not to exceed 150 cubic yards per group of cylinders.

At a minimum, a group of test cylinders shall consist of the following:

- a) Two test cylinders are required for the 28 day compression test.
- b) Additional cylinders will be required for determining concrete strength, when the Contractor desires permission from the Engineer to make delivery prior to the 28 day compression test.

For low pressure steam or radiant heat curing, the test cylinders shall be cured with the unit, or in a similar manner (similar curing method and concrete curing temperature, as approved by the Engineer) as the unit, until minimum compressive strength has been obtained.

The precast units shall be in accordance with Section 55 except that the fabricator shall be responsible for the sampling, preparing, and properly curing of all concrete cylinders for concrete compressive strength, and the fabricator shall

be responsible for all costs. 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 but will still require the 28 day cylinder test be provided to the Engineer.

5. **Concrete Cure:** The concrete shall be cured by low pressure steam, radiant heat, or as specified in Section 55. When curing in accordance with Section 55, the concrete temperature requirements of Section 55 shall apply.

Low pressure steam or radiant heat curing shall be done under an enclosure to contain the live steam or the heat and prevent heat and moisture loss. The initial application of the steam or heat shall be three hours after the final placement of concrete to allow the initial set to occur. When retarders are used, the waiting period before application of the steam or radiant heat shall be five hours. When the time of initial set is determined by ASTM C 403, the time limits described above may be waived.

During the waiting period, the minimum temperature within the curing chamber shall not be less than 50°F and live steam or radiant heat may be used to maintain the curing chamber between 50°F and 80°F. During the waiting period the concrete shall be kept moist.

Application of live steam shall not be directed on the concrete 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 plastic sheeting or by applying an approved liquid membrane curing compound to exposed concrete surfaces. The top surface of concrete members for use in composite construction shall be free of membrane curing compound residue unless suitable mechanical means for full bond development are provided.

During the initial application of live steam or radiant heat, the concrete temperature shall increase at an average rate not exceeding 40°F per hour until the curing temperature is reached. The maximum concrete temperature shall not exceed 160°F. The maximum temperature shall be held until the concrete has reached the specified strength. After discontinuing the steam or radiant heat application, the temperature of the concrete shall decrease at a rate not to exceed 40°F per hour until the concrete temperature is within 20°F of the ambient air temperature.

6. **Surface Finish and Patching:** If a precast item shows stone pockets, honeycomb, delamination, or other defects which may be detrimental to the structural capacity of the item, it will be subject to rejection at the discretion of the Engineer. Minor surface irregularities or cavities, which do not impair the service of the item, and which are satisfactorily repaired will not constitute cause for rejection. Repairs shall not be made until the Engineer has inspected the extent of the irregularities and has determined whether the item can be satisfactorily

repaired. If the item is deemed to be repairable, the repair method and procedures shall be agreed upon by the City and fabricator prior to the work commencing.

If a finishing aid is used, the finishing aid cannot be used for finishing of the concrete surface immediate after application of the finishing aid and the finishing aid must be applied uniformly to the surface of the concrete with a sprayer.

Depressions resulting from the removal of metal ties or other causes shall be carefully pointed with a mortar of sand and cement in the proportions which are similar to the specific class of concrete in the unit. A sack rub finish is also required on sloped surfaces of box culvert end sections.

B. Precast Box Culverts: The following shall apply to box culverts:

- 1. Design:** Precast concrete box culverts shall conform to ASTM C1557 and ASTM C1433. Configurations in variance with those provided by ASTM will be accepted provided the materials, design, fabrication specification, and the requirements of this Section are met.

Box culvert end sections (inlet or outlet) materials, design, and fabrication shall conform to the current edition of the AASHTO Standard Specifications for Highway Bridges and Materials Specifications.

Precast box culverts shall be designed to specified load conditions. 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.

Minimum reinforcing steel clear cover shall be 1 inch for all member faces except box culverts covered by a fill of less than 2 feet, including surfacing, shall have a minimum reinforcing steel clear cover of 2 inches in the top of the top slab.

The Contractor shall furnish a checked design with the shop drawings. A checked design includes the design calculations and check design calculations performed by an independent Professional Engineer registered in the State of South Dakota.

A checked design for barrel sections will not be required to be submitted if the proposed fabrication dimensions and reinforcement conform to ASTM C1557 and ASTM C1433. A checked design for the end sections and special sections will be required.

- 2. Fabrication:** The Contractor shall notify the Engineer seven (7) days prior to fabrication.

The minimum length of precast section shall be 4 feet.

Joint ties shall be provided with all sections.

50.4 METHOD OF MEASUREMENT

- A. Precast Drop Inlets:** Precast drop inlets shall be measured per Section 62.
- B. Precast Box Culvert:** Precast box culvert shall be measured per Section 58.
- C. Precast Concrete Pipe:** Precast concrete pipe shall be measured per Section 54.

50.5 BASIS OF PAYMENT

- A. Precast Drop Inlets:** Payment for precast drop inlets shall be per Section 62.
- B. Precast Box Culvert:** Payment for precast box culvert shall be per Section 58.
- C. Precast Concrete Pipe:** Payment for precast concrete pipe shall be per Section 54.

END OF SECTION