



**SPECIAL PROVISIONS
FOR
PRECAST REINFORCED CONCRETE THREE-SIDED CULVERTS**

**JOHNSON COUNTY
STP-S-C052(89)--5E-52**

**EFFECTIVE DATE
December 20, 2011**

THE STANDARD SPECIFICATIONS, SERIES 2009, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

096046.01 DESCRIPTION.

This specification is for precast concrete three-sided culverts constructed on site cast concrete footings or a full width site cast concrete floor. The precast reinforced concrete three sided culvert shall be fabricated in accordance with Materials I.M. 445 by an approved source in accordance with Materials I.M. 445.02.

A. Designation.

Precast reinforced concrete three-sided culvert units manufactured in accordance with this specification shall be designated by span and rise. Precast reinforced concrete culvert, wingwalls and headwalls manufactured in accordance with this specification shall be designated by length, height, and deflection angle.

B. Shop Drawings.

The Contractor shall submit design computations and shop drawings for review. These documents shall be signed and sealed by a Professional Engineer licensed in the State of Iowa and shall include the following:

- Reactions at the base of the arch legs, and the base of wingwalls,
- Quantity and weight of anchor blocks at wingwalls,
- Dimensions of the arch, wingwalls, and anchor blocks at wingwalls,
- Connection details at base of arch to footing, base of wingwall to footing,
- Connection details of wingwall to arch, headwall to arch, and
- Connection details between arch sections.

Fabrication shall not to begin until review by Engineer is completed.

096046.02 MATERIALS.

Refer to Section 2407 of the Standard Specifications.

A. Steel Reinforcement and Hardware.

Reinforcing steel for precast elements shall be fabricated and placed according to the detailed shop drawings submitted by the manufacturer.

1. Steel Reinforcement.

Reinforcing steel shall be in accordance with Section 2404 of the Standard Specifications. Reinforcement consists of welded wire reinforcing conforming to AASHTO M 55 (ASTM A 185) or AASHTO M 221 (ASTM A 497) or deformed billet steel bars conforming to AASHTO M 31 (ASTM A 615) Grade 60. Longitudinal distribution reinforcement may consist of welded wire reinforcing or deformed billet-steel bars.

2. Hardware.

Bolts and threaded rods for wingwall connections shall conform to ASTM A 307. Nuts shall conform to AASHTO M 292 (ASTM A 194) Grade 2H. All bolts, threaded rods and nuts used in wingwall connections shall be mechanically zinc coated in accordance with ASTM B 695 Class 50. Structural Steel for wingwall connection plates and plate washers shall conform to AASHTO M 270 (ASTM A 709) Grade 36 and shall be hot dip galvanized as per AASHTO M 111 (ASTM A 123). Wingwalls shall be connected with bolted steel plates meeting the above specifications. Hook Bolts used in attached headwall connections shall be ASTM A 307. Mechanical splices for reinforcing bars shall be in accordance with Materials I.M. 451.

096046.03 DESIGN.

A. Minimum Stresses.

Precast element dimensions and reinforcement details shall be as prescribed in the plans and the shop drawings provided by the manufacturer, subject to the provisions of Section 4. Minimum concrete compressive strength shall be 4000 psi. Minimum steel yield strength shall be 60,000 psi.

B. AASHTO Specification.

Precast elements are designed in accordance with the "AASHTO LRFD Bridge Design Specifications" 4th Edition, adopted by AASHTO, 2007. Minimum of 1 foot of cover above the crown of culvert units is required in the installed condition (unless noted otherwise on the shop drawings and designed accordingly). Design live load shall be HL-93.

C. Placement of Reinforcement in Precast Culvert Units.

Cover of concrete over the outside circumferential reinforcement shall be 2 inches minimum. Cover of concrete over the inside circumferential reinforcement shall be 1.5 inches minimum, unless otherwise noted on the shop drawings. Clear distance of the end circumferential wires shall not be less than 1 inch nor more than 2 inches from the ends of each section. Reinforcement shall be assembled utilizing single or multiple layers of welded wire reinforcing (not to exceed 3 layers) supplemented with a single layer of deformed billet-steel bars, when necessary. Welded wire reinforcing shall be composed of circumferential and longitudinal wires meeting the spacing requirements of Article **096046.03**, F, and shall contain sufficient longitudinal wires extending through the culvert unit to maintain the shape and position of the reinforcement. Longitudinal distribution reinforcement may be welded wire reinforcing or deformed billet-steel bars and shall meet the spacing requirements of Article **096046.03**, F. The ends of the longitudinal distribution reinforcement shall be not more than 3 inches and not less than 1.5 inches from the ends of the culvert unit.

D. Placement of Reinforcement for Precast Wingwalls and Headwalls.

Cover of concrete over the longitudinal and transverse reinforcement shall be 2 inches minimum. The clear distance from the end of each precast element to the end transverse reinforcing steel shall not be less than 1 inch nor more than 2 inches. Reinforcement shall be assembled utilizing a single layer of welded wire reinforcing, or a single layer of deformed billet-steel bars. Welded wire reinforcing shall be composed of transverse and longitudinal wires meeting the spacing requirements of Article **096046.03**, F, and shall contain sufficient longitudinal wires extending through the element to maintain the shape and position of the reinforcement. Longitudinal reinforcement may be welded wire reinforcing or deformed billet-steel bars and shall meet the

spacing requirements of Article **096046.03**, F. The ends of the longitudinal reinforcement shall be not more than 3 inches and not less than 1 1/2 inches from the ends of the walls.

E. Laps, Welds, and Spacing for Precast Culvert Units.

Tension splices in the circumferential reinforcement shall be made by lapping. The overlap shall meet the requirements of AASHTO 5.11.2. The overlap for welded wire reinforcing shall be measured between the outermost longitudinal wires of each fabric sheet. For splices other than tension splices, the overlap shall be a minimum of 12 inch for welded wire reinforcing or deformed billet-steel bars. The spacing center-to-center of the circumferential wires in a wire reinforcing sheet shall be not less than 2 inches or more than 4 inches. The spacing center-to-center of the longitudinal wires shall not be more than 8 inches. The spacing center-to-center of the longitudinal distribution steel for either line of reinforcing in the top slab shall be not more than 16 inches.

F. Laps, Welds, and Spacing for Precast Wingwalls and Headwalls.

Splices in the reinforcement shall be made by lapping. The overlap shall meet the requirements of AASHTO 5.11.2. Spacing center-to-center of wires in a wire reinforcing sheet shall be not less than 2 inches nor more than 8 inches.

G. Structural Design.

Structural design shall consider the following assumptions:

1. Foundation design shall consider the lateral forces caused by arching action.
2. Culvert leg to footing connection shall not transfer design moments. Vertical and horizontal force components shall be resisted by the footing.
3. The wingwall to footing connection shall not transfer design moments. An anchor block system will resist the soil overturning forces. Wingwall footings will not be designed to resist soil overturning forces.
4. Headwall connections and wingwalls shall be designed for sliding and overturning.
5. Continuity shall exist between the main structure footing and the wingwall footing.

096046.04 DESIGN DIMENSION TOLERANCES.

A. Culvert Units.

1. Internal Dimensions.

Internal dimensions shall vary not more than 1% from design dimensions nor more than 1.5 inches, whichever is less. Haunch dimensions shall vary not more than 0.75 inch from design dimension.

2. Slab and Wall Thickness.

Slab and wall thicknesses shall not be less than that shown in the design by more than 0.25 inch. A thickness more than that required in the design shall not be cause for rejection.

3. Length of Opposite Surfaces.

Variations in laying lengths of two opposite surfaces of the culvert unit shall not be more than 0.50 inch in any section, except where beveled ends for laying of curves are specified by the purchaser.

4. Length of Section.

The underrun in laying length of a section shall not be more than 0.50 inch in any culvert unit.

5. Position of Reinforcement.

Maximum variation in position of the reinforcement shall be ± 0.50 inch. In no case shall the cover over the reinforcement be less than 1.50 inches for the outside circumferential steel or less than 1 inch for the inside circumferential steel as measured to the external or internal surface of the culvert. These tolerances or cover requirements do not apply to mating surfaces of the joints.

6. Area of Reinforcement.

The areas of steel reinforcement shall be the design steel areas as shown in the manufacturer's shop drawings. Steel areas greater than those required shall not be cause for rejection. The permissible variation in diameter of any reinforcement shall conform to the tolerances prescribed in the ASTM specification for that type of reinforcement.

B. Wingwalls and Headwalls.

1. Wall Thickness.

Wall thickness shall not vary from that shown in the design by more than 0.50 inch.

2. Length / Height of Wall sections.

The length and height of the wall shall not vary from that shown in the design by more than 0.50 inch.

3. Position of Reinforcement.

Maximum variation in position of reinforcement shall be ± 0.50 inch. In no case shall cover over reinforcement be less than 1.50 inches.

4. Size of Reinforcement.

Permissible variation in diameter of reinforcing shall conform to tolerances prescribed in the ASTM specification for that type of reinforcing. Steel area greater than that required will not be cause for rejection.

096046.05 CONSTRUCTION.

A. Footings.

Culvert units and wingwalls shall be installed on cast-in-place concrete footings. Design size and elevation of footings shall be as shown on the plans. Keyways shall be compatible with precast arch system. A keyway shall be formed in the top surface of footing and 3 inches minimum clear of inside and outside faces of culvert units, unless specified otherwise on the plans. Footings shall be given a smooth float finish and shall reach a compressive strength of at least 2000 psi before placement of culvert and wingwall elements. Completed footing surface shall be constructed in accordance with grades shown on the plans. When tested with a 10 foot straight edge, the surface shall not vary more than 0.25 inch in 10 feet.

B. Placement of the Culvert Units, Wingwalls, and Headwalls.

Culvert units, wingwalls, and headwalls shall be placed as shown on the plans. Special care shall be taken in setting the elements to the true line and grade. Culvert units and wingwalls shall be set on 6 inch by 6 inch masonite or steel shims. A minimum of 0.50 inch gap shall be provided between the footing and the bottom of the culvert's vertical legs or the wingwall. This gap shall be filled with non shrink cement grout with a minimum 28-day compressive strength of 4000 psi and shall comply with Materials I.M. 491.13.

C. External Protection of Joints.

Butt joints made by two adjoining culvert units shall be covered with a 7/8 inch by 1 3/8 inch piece of preformed bituminous joint sealant and a minimum of a 9 inch wide joint wrap. Surface shall be free of dirt before applying the joint material. A primer compatible with the joint wrap shall be applied for a minimum width of 9 inches to each side of the joint. The joint shall be covered

continuously from the bottom of one culvert section leg, across the top of the arch and to the opposite culvert section leg. Any laps that result in the joint wrap shall be a minimum of 6 inches long with the overlap running downhill.

In addition to the joints between culvert units, the joint between the end culvert unit and the headwall shall also be sealed as described above. If precast wingwalls are used, the joint between the end culvert unit and the wingwall shall be sealed with a 2 foot wide strip of filter fabric. Also, if lift holes are formed in the arch units, they shall be primed and covered with a 9 inch by 9 inch square of joint wrap.

D. Joints.

Culvert units shall be produced with flat butt ends. The ends of the culvert units shall be such that when the sections are laid together they will make a continuous line with a smooth interior free of appreciable irregularities, all compatible with the permissible variations in Article 090117.04 above. The joint width shall not exceed 0.75 inches.

096046.06 METHOD OF MEASUREMENT.

A. Precast Concrete Three-Sided Culvert.

Linear feet as shown on the plans.

B. Precast Concrete Wingwalls.

The number of wingwalls as shown on the plans.

096046.07 BASIS OF PAYMENT

A. Precast Concrete Three-Sided Culvert.

Payment will be the contract unit price per linear foot for the number of linear feet constructed in a satisfactory manner. Payment will be full compensation for providing all equipment, materials including concrete, reinforcing steel, connecting plates, bolts, non shrink grout, material testing, tools, shipping, and incidentals necessary to construct the culvert and headwalls.

B. Precast Concrete Wingwalls.

Payment will be the contract unit price for each wingwall constructed in a satisfactory manner. Payment will be full compensation for providing all equipment, materials including concrete, reinforcing steel, connecting plates, bolts, non shrink grout, material testing, tools, shipping, labor, and incidentals necessary to construct the wingwalls.