

735 - PRECAST REINFORCED CONCRETE BOX

SECTION 735

PRECAST REINFORCED CONCRETE BOX

735.1 DESCRIPTION

Install the specified sizes of precast reinforced concrete boxes at the locations designated in the Contract Documents.

Unless specified otherwise in the Contract Documents, the Contractor has the option to substitute precast reinforced concrete boxes for the cast-in-place reinforced concrete boxes shown in the Contract Documents.

Submit all working drawings according to **SECTION 105**.

BID ITEM

Reinforced Concrete Box (*) (Precast)
*Size

UNITS

Linear Foot

DESIGN:

- Design the precast concrete box units in accordance with the AASHTO LRFD Bridge Design Specifications, latest version.
- Precast wings and headwalls are prohibited at stream crossings.
- Cast-in-place end sections shall conform to KDOT Standard BR031.

For fill heights less than or equal to 3 feet:

- Use epoxy coated reinforcing steel and air entrained concrete
- Use a distribution slab meeting the requirements of KDOT Standard BR031.
- Use an approved “non-coal tar” bridge backwall protection system to cover the middle 1/3 of the top of precast arch culverts, the complete top slab of precast rigid frame culverts and the uppermost 12 inches of the outside walls.
- Indicate on the shop drawings the limits of the bridge backwall protection system.

Prior to beginning foundation construction, submit complete design calculations, including loadings, for the Engineer’s review. Design calculations and loadings may be submitted prior to the working drawing submittal. Submit design calculations sealed by a Kansas licensed Professional Engineer.

Prior to fabrication, submit to the Engineer for review and approval, working drawings including the supplier’s manufacturing specifications, details of all phases of construction, including layout, joint details, lifting devices, casting methods, construction placement and details of any cast-in-place sections. Submit working drawings according to **SECTION 105**.

Designate proposed transportation methods, and submit over-height and overload permits, if required, with the working drawings.

When required, submit falsework plans and calculations sealed by a Kansas licensed Professional Engineer according to **SECTION 708**.

PRECAST CONCRETE BOX LOAD RATING:

Include a Load Rating Table on the working drawings and provide the State Bridge Office with a LFR and LRFR rating and support calculations for the structure. The load rating shall take into consideration varying fill depths and KDOT live load criteria. For LFR Load Rating, include HS-20-44, KDOT rating vehicles for Inventory and Operating rating factors. Rate the Heavy Equipment Transport (HET) vehicle for Operating rating factor. For LRFR, use HL-93 for Inventory and Operating. Submit a Load Rating Report along with the working drawings. Include in the Load Rating Report a summary rating table, assumptions used in the load rating, the depth of fill, material strengths and any other significant information required to load rate the precast culvert. The Load Rating will include all elements of the proposed system including, but not limited to stub-walls and connections.

735.2 MATERIALS

a. General. Use materials that comply with the applicable requirements:

Grade 4.0 and 4.0 (AE) Concrete	SECTIONS 401 & 402*
Commercial Grade Concrete for Seal Course	SECTIONS 401 & 402

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Aggregate for Concrete Not On Grade	SECTION 1102
Reinforcing Steel (Grade 60)	DIVISION 1600
Reinforcing Steel (Epoxy Coated) (Grade 60)	DIVISION 1600
Welded Wire Fabric	DIVISION 1600
Quality Control Program for Precast Concrete Products.....	DIVISION 1900
Drilling and Grouting	DIVISION 800
Joint Seals.....	DIVISION 1500
Geotextile Fabric	DIVISION 1700
Bridge Backwall Protection.....	DIVISION 1700

*For precast reinforced concrete boxes constructed according to this specification, KT-73 testing is not required.

b. Precast Reinforced Concrete Box. Provide precast reinforced concrete box sections complying with ASTM C 1577 and this specification.

Exceptions and additions to the above requirements are:

(1) ASTM Section 11. PERMISSIBLE VARIATIONS. Revise the first sentence of subsection 11.1 to read: The internal dimensions may not vary more than 1% or $\frac{3}{4}$ inch, whichever is less, from the design dimensions.

(2) ASTM Section 11. PERMISSIBLE VARIATIONS. Add the following subsections:

(a) 11.8 Deviation from straightness of mating edge: $\pm \frac{1}{4}$ inch.

(b) 11.9 Squareness of ends (vertical and horizontal): $\pm \frac{1}{4}$ inch.

(c) 11.10 With any new production start-up or change in set-up, join a minimum of the first 5 production units at the fabrication plant for inspection of joint fit-up and alignment of boxes. Continue joining each unit until production is satisfactory. Check approximately 10% of the remaining production at random, using a minimum 3 unit assembly. The Engineer may order a 3 or more unit assembly at any time measurements or observations indicate a problem exists.

(3) Design multiple-cell precast reinforced concrete boxes according to the criteria used to develop the single-cell precast boxes.

(4) Member thickness shall be the thickness specified by ASTM C 1577, $\frac{3}{4}$ the thickness of the corresponding member of an equivalent KDOT Standard cast-in-place rigid frame box culvert, or six inches, whichever is larger. When calculating the minimum thickness of the bottom slab, deduct $\frac{1}{2}$ inch from the cast-in-place thickness before factoring by $\frac{3}{4}$.

(5) Provide minimum clearances to reinforcing of $1\frac{1}{4}$ inches $\pm \frac{1}{4}$ inch from all faces except when the depth of fill is less than 2 feet. In that case, make the clearance in the top of the top slab $2\frac{1}{2}$ inches $\pm \frac{1}{4}$ inch. Develop all reinforcement according to the AASHTO LRFD Bridge Design Specifications.

(6) For fill heights less than or equal to 2 feet, use either epoxy coated reinforcement in the top slab or an approved "non-coal tar" "Bridge Backwall Protection System" to cover the top slab and uppermost 12 inches of the outside walls. Indicate on the shop drawing which option was used.

(7) Provide a minimum of 0.06 square inches per foot of longitudinal reinforcing for shrinkage and temperature requirements in each face, except at the joint as shown in the Contract Documents.

(8) Provide minimum transverse steel areas in each face of 0.19 square inches per foot of barrel.

(9) The maximum shear reinforcement (in lip of joint) spacing in the longitudinal direction is 6 inches.

(10) Do not weld reinforcing bars or steel fabric, except the original welding required to manufacture the wire fabric.

(11) Air entrained concrete is not required for dry-cast units. Use air entrained concrete for wet-cast units where the depth of fill will be less than 2 feet, as shown in the Contract Documents.

(12) Minimum length of a precast section is 4 feet.

(13) A single-cell box of equivalent area may be substituted for a double-cell box with cell spans less than or equal to 6 feet. Do not modify the cell height shown on the Contract Documents, unless approved by the Engineer. Two single-cell boxes may be substituted for a double-cell box, when approved by the Engineer.

(14) Prior to fabrication, submit working drawings to the Engineer for approval (see **SECTION 105**). Detail all phases of construction including layout, joint details, lifting devices, casting methods, construction placement and details of any cast-in-place sections. Note the proposed transportation methods on the working drawings.

(15) Legibly mark this information on an inside face of each box section using waterproof paint or other approved means:

- Date of manufacture;
- Name or trademark, and location of the manufacturer;

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- Weight of box section in tons; and
- The top of the box.

Allow the Engineer free access to the manufacturing plant at all times for the purpose of inspecting materials, plant facilities and manufacturing and curing procedures. Inform the Engineer of planned concrete placement and curing schedule 5 business days before work is started.

Precast reinforced concrete boxes will be accepted according to **SECTION 1902**, and when deemed necessary by the Engineer, satisfactory results of material tests performed by the Engineer, compliance with dimensional requirements and visual inspection at the point of production or usage.

c. Foundation Materials for Precast Boxes. Provide either crushed stone or concrete seal course for the foundation of the precast box.

Provide crushed stone free of soapstone, shale, shale-like or other easily disintegrated material. Provide crushed stone with adequate gradation to provide a uniform foundation. The Engineer will accept the crushed stone based on visual inspection at the point of usage.

For concrete seal course, provide commercial grade concrete, or use any other concrete acceptable for use on the project.

735.3 CONSTRUCTION REQUIREMENTS

a. Foundation Preparation. Excavate and prepare the foundation according to **DIVISION 200**. Construct a 6-inch (minimum) thickness of crushed stone, or 3 inches of concrete seal course of commercial grade concrete for the foundation of the precast box.

b. Installation of Precast Boxes. Install the precast reinforced concrete box culvert with the groove end of each section up-grade. Join the sections tightly.

c. Sealing Joints of Precast Boxes. Seal the joints using one of the options shown in the Contract Documents. Install the joint sealant according to the manufacturer's recommendations.

If geotextile is used to wrap the joint:

- Use only geotextile that has been properly stored;
- Limit the exposure to the elements (between placement and covering) of the geotextile to a maximum of 7 calendar days;
- Do not drop any D_{50} backfill larger than 6 inches onto the geotextile from a height greater than 1 foot;
- Do not drop any D_{50} backfill smaller than 6 inches onto the geotextile from a height greater than 3 feet; and
- Do not contaminate the geotextile with grease, mud or other foreign substances. Replace contaminated or damaged geotextile. If approved by the Engineer, repair damaged geotextile by placing a patch over the damaged area and sewing the patch to the geotextile. Extend the patch a minimum of 1 foot beyond the perimeter of the damaged area. Replace contaminated or damaged geotextile, or repair if approved, at the Contractor's expense.

Fill the lifting holes with precast plugs sealed with mastic or mortar.

d. Distribution Slab Requirements.

(1) Fill heights less than 2 feet require a distribution slab. Precast distribution slabs may be used for fill heights less than 2 feet but greater than 1 foot, otherwise use cast-in-place.

Construct or place the distribution slab to extend a minimum of 2 feet beyond the exterior walls of the barrel. Construct or place the distribution slab to the outside edge of the roadway shoulders.

Place a minimum of 3 inches of granular material between the box and a concrete distribution slab.

Cast-in-place distribution slabs require one of the following combinations of steel reinforcement:

- 1 layer of mesh and 1 layer of reinforcement bars, or
- 1 layer of reinforcement bars.

(2) Fill heights less than or equal to 1 foot.

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Construct a cast-in-place distribution slab a minimum of 6 inches thick, reinforced with #4 bars spaced at 18 inches placed transverse to the centerline of the box, and #5 bars spaced at 12 inches placed parallel to the centerline of the box. Uniformly consolidate the concrete without voids. An equivalent welded wire fabric is acceptable.

(3) If the fill height is greater than 1 foot, but less than or equal to 2 feet.

- Use the cast-in-place criteria above.
- Use precast distribution slab sections constructed with the same criteria as the cast-in-place distribution slab above. Do not locate precast slab joints near precast box joints.
- Reinforced concrete pavement with reinforcement as specified for a cast-in-place slab mentioned above (minimum 6 inches thick) shall meet the requirements of a distribution slab.
- Asphalt pavement (minimum 6 inches thick) shall meet the requirements of a distribution slab with 6 inches of granular material provided between the asphalt and the precast box. Place a geogrid on top of the granular material.

(4) A special design is required for the distribution slab if the above options are not geometrically possible.

e. Cast-In-Place Construction. Unless otherwise approved by the Engineer, construct cast-in-place collars at horizontal and vertical changes in RCB alignment.

Construct the cast-in-place sections, end sections and wingwalls, according to **DIVISION 700**, and as detailed in the Contract Documents.

- Construct the cast-in-place box sections at a minimum to the member thicknesses and reinforcement shown in the Contract Documents. When the thicknesses between the cast-in-place and precast members are different, transition at a maximum rate of 4:1 without reducing the box opening size.
- Skewed precast structures with fill heights greater than 10 feet will not be attached to the cast-in-place end section(s).
- Do not drill and grout dowel bars in the field, but detail on the working drawings and install by the Fabricator.
- Use 16 foot minimum cast-in-place end section for structures where precast sections are not attached (unreinforced open joint) to the cast-in-place sections.
- For multiple precast sections placed on a skew, submit for approval by the Engineer, working drawings (sealed by a Kansas licensed Professional Engineer) with details of cast-in-place end sections.
- When the thicknesses between the cast-in-place and precast members are different, transition at a maximum rate of 4:1 without reducing the box opening size.

f. Top Slab Protection. When required by **subsection 735.2b.(6)**, cover the entire exterior face of the top slab and the uppermost 12 inches of the outside walls and both sides of the joint with a Bridge Backwall Protection System from the KDOT's prequalified list. Remove any dirt or latent concrete before applying the coating per the manufactures directions. Lap ends and stagger joints according to the manufacture's recommendation. Repair any flaws or damage to the coating before backfilling the structure.

735.4 MEASUREMENT AND PAYMENT

The Engineer will measure precast reinforced concrete boxes by the linear foot. Precast end sections, and cast-in-place end sections and wingwalls will not be measured for payment.

When shown as a bid item in the contract, foundation stabilization and concrete seal course will be measured and paid for according to **SECTION 204**. When not shown as a bid item in the contract, foundation stabilization and concrete seal course are subsidiary.

Payment for "Reinforced Concrete Box (Precast)" at the contract unit price is full compensation for the specified work.

When not shown as a bid item in the contract, the "Bridge Backwall Protection System" will be subsidiary to other bid items.

If constructed as an option to cast-in-place RCB's, the Engineer will not measure the precast reinforced concrete boxes for payment. The cast-in-place quantities are the basis of payment. Payment of the cast-in-place quantities at the contract unit prices is full compensation for the specified work.