

Section 513—Precast Reinforced Concrete Box Culverts, Barrel Sections, and End Sections

513.1 General Description

This work consists of constructing, transporting, joining, and finishing precast box culvert installations (normally as alternates to cast-in-place box culverts) according to Plan details and these Specifications.

Use precast boxes only in these situations:

- Under allowable fill heights designated on the Plan details
- As approved

Design numbers for precast barrel sections refer to Plan designations.

Precast ends refer to precast wingwalls, parapets, apron sections, toewalls, and baffles for outlets.

513.1.01 Definitions

General Provisions 101 through 150.

513.1.02 Related References

A. Standard Specifications

[Section 207—Excavation and Backfill for Minor Structures](#)

[Section 500—Concrete Structures](#)

[Section 506—Expanded Mortar](#)

[Section 834—Masonry Materials](#)

[Section 843—Concrete Pipe](#)

[Section 848—Pipe Appurtenances](#)

[Section 852—Miscellaneous Steel Materials](#)

B. Referenced Documents

ASTM C 789

AASHTO M 259

AASHTO M 36

AASHTO M 252

513.1.03 Submittals

General Provisions 101 through 150.

513.2 Materials

Materials shall meet the requirements of the following Specifications:

Material	Section
Concrete (for Precast Boxes)	843.2.01
All Other Concrete	500
Reinforcing Steel	853

Barrel Sections, and End Sections

Material	Section
Steel Bolts, Nuts, and Washers	852.2.01
Anchor Bolts	852.2.02
Bituminous Plastic Cement	848.2.05
Preformed Plastic Gaskets	848.2.06
Grout or Mortar	834.2.03
Expanded Mortar	506
Corrugated Steel Pipe (Sleeves)	AASHTO M 36
Corrugated Plastic Pipe (Sleeves)	AASHTO M 252
Backfill	207

513.2.01 Delivery, Storage, and Handling

General Provisions 101 through 150.

513.2.02 Precast Reinforced Concrete Box Culvert Barrel and End

A. Requirements

Refer to the Standard Specifications or Plan details for the reinforcement steel requirements, concrete strength, maximum fill heights, and minimum cover. Use the design number for the specified size and fill height.

1. Components

- a. Use precast end components that are according to Plan details, notes, and [Section 500](#).
- b. Ensure that the precast wingwalls and aprons are built so that the corrugations of the pipe sleeve insets lock into the concrete and still has the reinforcement steel maintained all around the pipe sleeve insets.
- c. Use modified connector boxes of the type required for connections to precast ends or cast-in-place ends.
- d. Have the manufacturer of the precast ends galvanize and provide all steel bolts, nuts, steel plates, and anchor bolts.
- e. Use pipe sleeves rigid enough to withstand concrete placement, anchoring, and construction loads without damage or excessive deformation.

2. Alternates

The Contractor may, at no additional payment, use precast box sections with a greater span or height than specified on the Plans under the following conditions:

- Minimum cover required for the design number is retained.
- No detrimental effects result from using the larger size.

The Contractor also may substitute a combination for multiple line culverts if the clear height and total clear spans are at least equal to that specified on the Plans.

Submit any alternate designs, alternate materials, or alternate methods of manufacturing to the Department for approval. Include all the necessary details and/or Specifications in the submission.

3. Certification

Submit to the Engineer a certificate from the manufacturer of the precast boxes and precast ends stating that all of the precast box sections and all of the precast end components manufactured in this plant for the use of the Department contain at least the minimum requirements of reinforcement steel specified herein.

Barrel Sections, and End Sections

- a. Ensure that the certificate is sworn to for the manufacturer by a person having legal authority to bind the company.
- b. Submit the manufacturer's certificate with a guarantee providing the following:
 - 1) All precast box and/or all precast end components will be replaced without cost to the purchaser, if the reinforcement steel does not meet these Specifications.
 - 2) Language so that the guarantee remains in effect as long as the manufacturer continues to furnish precast box culvert barrel sections and precast end sections for use by the Department.

The manufacturer's certificate will not limit the right of the Department to make inspections and checks of the materials in manufactured precast sections prior to and during the construction of the culvert line.

B. Fabrication

Except as otherwise specified on the Plans or in the Specifications, manufacture precast box culvert barrel sections according to AASHTO M 259 or ASTM C 789 and applicable parts of [GDT 16](#).

1. **Lifting.** Cast no more than four handling devices or lifting holes in the top of each box, in each precast wing section, and in each precast apron section.
 - a. Make holes no more than 2 in. (50 mm) in diameter nor more than 2 in (50 mm) square.
 - b. Do not cast lifting holes in the sides or bottom of the boxes.
 - c. Do not lift apron sections or wingwall sections by or through the pipe sleeve insets.
2. **Finishing and Marking.** Put a Type I, ordinary formed surface finish on the precast boxes and precast end components as in [Subsection 500.3.05.AB](#).
 - a. Ensure that the precast boxes and precast end components (except baffles) have the following markings made either by indenting into the concrete or with waterproof paint.
 - 1) Name or trademark of the manufacturer
 - 2) Date of manufacture
 - 3) Box sections (span, rise, maximum fill height, minimum cover, and concrete design strength)
 - 4) Ensure that the top of each precast box is clearly indented by marking into either the inner or outer surface of the concrete during manufacture.
 - 5) Ensure that the word "TOP" is painted on the inside top surface of each box in waterproof paint. Ensure that this marking comes from the manufacturer at the plant.
 - 6) When so indicated on the Plans, number and match-mark the sections.
 - 7) Ensure each section bears the Department Inspector's approval stamp.
3. **Precast Parapets.** You may allow the manufacturer to bolt precast parapets to connector box Type P at the manufacturer's plant or at the construction site.

Have the manufacturer check all precast components for fit and connections before transporting the components to the project.

C. Testing and Inspection

1. Use applicable parts of [GDT 16](#).
2. Determine concrete compressive strength from cylinder or core tests as required by the laboratory.

D. Materials Warranty

General Provisions 101 through 150.

513.3 Construction Requirements

513.3.01 Personnel

General Provisions 101 through 150.

513.3.02 Equipment

General Provisions 101 through 150.

513.3.03 Preparation

A. Excavation, Bedding, and Backfill

Excavate, place bedding, and backfill according to [Section 207](#) and the Plan details.

Place bedding as follows:

1. Place bedding between graded forms set at least 18 in (450 mm) outside each outside wall of the boxes or from the edge of the precast apron sections.
2. Shape the bedding material to fit the bottom of the precast sections.
3. Screed off the graded forms.
4. Grade the bedding surface essentially perfect. The maximum tolerance is plus or minus 1/8 in (3 mm).
5. Ensure that the bedding is level in the plane perpendicular to the culvert center line.
6. Check the grade of the bedding surface on both sides before installing precast sections.
7. After placing the precast sections on the graded bedding, remove and reuse the forms, if needed.

513.3.04 Fabrication

General Provisions 101 through 150.

513.3.05 Construction

Install the structures as required by the Specifications and the Plan details, or as directed by the Engineer. Provide necessary temporary drainage.

A. Install Barrels

Install barrels according to the manufacturer's recommendations.

1. **Multiple Barrel Box Culverts.** Install these box culverts as follows:
 - a. Lay precast box culvert sections in the prepared trench with socket ends pointing upstream.
 - b. Joint the sections with either bituminous plastic cement or preformed plastic gaskets using these guidelines:
 - In bituminous plastic cement joints, fill the annular space with joint material and wipe smooth the inside of each joint in the barrel.
 - Pull box sections together with a come-a-long or mechanical puller to provide jointing satisfactory to the Engineer.
2. **Multiple Line Box Culverts.** These precast box culverts are the alternative to cast-in-place multiple barrel box culverts.

Where multiple lines are skewed, determine the end treatment method including the positions of the connector boxes, the parapet alignment, and the lengths of wingwalls needed for proper slope intercepts. This must occur before barrel installation begins.

Install multiple culvert lines adjacent to one another according to Plan details.

Use grout (see [Subsection 834.2.03](#), "Mortar and Grout"), a concrete mix, or other material approved by the Engineer as filler material between multiple lines.

Barrel Sections, and End Sections

B. Protect Structures from Traffic and Loads

Before allowing traffic or loads on the box culvert, provide the depth and width of compacted backfill as shown on the Plans to protect the structure from damage or displacement.

Damaged or displaced structures subjected to construction loads or erosion during installation and backfill shall be repaired at the Contractors expense.

C. Use Ends for Precast Barrels

Use precast or cast-in-place ends as follows:

1. Precast Ends

Precast ends are allowed in the following situations:

- Where either single line or multiple line precast barrels are normal to the roadway
- With skewed single lines or skewed multiple lines at locations shown on the Plans or approved by the Engineer

Do not use precast ends with skewed culverts if the installation would be incompatible with roadway geometrics or would cause other detrimental effects.

- Precast Ends on Skewed Culverts.** Where precast ends are allowed on skews, extend the barrel length so that the precast wing end on the acute side falls approximately at the same point that the cast-in-place long wing end would have fallen, with additional embankment warped to fit.
- Aprons for Precast Wingwalls.** Use precast wingwalls with 8 in (200 mm) thick reinforced concrete aprons for anchor connections.

For sleeve inset fill, use either expanded mortar (see [Section 506](#)) or non-shrinking mortar (used immediately after mixing) approved by the Engineer. Do not subject anchors to loads until the mortar sets up.

Use precast or cast-in-place aprons that are multi-piece or monolithic.

- 1) **Precast Aprons.** Carefully place sections to grade upon the screeded bedding described in [Subsection 513.3.03.A](#), "Excavation, Bedding, and Backfill."

Ensure that forms hold bedding for toewalls according to the Plan details and as directed by the Engineer.

Make joints between apron sections water tight.

- 2) **Cast-in-Place Aprons.** Ensure that concrete is set up before installing the wingwalls. Connect wingwalls to apron anchors according to Plan details.

2. Cast-in-Place Ends.

When required and when not using precast ends, use cast-in-place ends as follows:

- a. Use cast-in-place ends at the ends of precast box culvert barrels (either skewed or normal).
- b. Use cast-in-place ends of the same design as cast-in-place box culvert barrels.
- c. Use aprons with cast-in-place wingwalls only where specified on the Plans or Special Provisions.
- d. Use cast-in-place ends with multiple precast lines as follows:
 - 1) Minimally increase the standard parapet and toewall widths to accommodate the double inside walls.
 - 2) Use Type C connector boxes between the standard precast boxes and the cast-in-place construction.
- e. Where there is a skewed alignment or other nondescript alignment condition, the Contractor may cast-in-place a fraction of the barrel between the connector box and the parapet.

D. Finish the Culvert

After precast sections are set in their final position, do the following:

1. Repair spalled areas around the holes.
2. Fill the lift holes with mortar or concrete.

Barrel Sections, and End Sections

3. Cure the concrete as directed in [Subsection 500.3.05.Z](#), “Cure Concrete.”

513.3.06 Quality Acceptance

General Provisions 101 through 150.

513.3.07 Contractor Warranty and Maintenance

General Provisions 101 through 150.

513.4 Measurement

Unless otherwise specified, the Contract includes alternate plans for both precast and cast-in-place box culverts. Plan quantities and payment are based upon the cast-in-place alternate.

A. Precast Box Culvert Barrels

The required linear feet (meter) of culvert will be converted for payment into cubic yards (meters) of Class A Concrete and pounds (kilograms) of reinforcement steel. These measurements will come from the standard or special design computation tables for cast-in-place box culverts.

Multiple line precast box culverts will be measured as a multiple barrel cast-in-place box culvert of the specified size.

B. Ends for Barrels

Wingwalls, parapets, toewalls, and aprons may be either precast or cast-in-place. Plan quantities and payment for these items are based upon the cast-in-place design quantities.

C. Backfill

Foundation backfill material Type II, when required, will be measured according to [Subsection 207.4](#), “Measurement”.

513.4.01 Limits

No additional payment will be made when barrel lengths, apron areas, backfilling, or other items are increased due to using the precast alternate.

The following items will not be paid for:

- Connecting hardware
- Mortar
- Joint materials
- Filler material used between multiple precast culvert lines

513.5 Payment

Payment for Precast Reinforced Concrete Box Culvert Barrel Sections and End Sections will be based on the cast-in-place alternate and will include conversions when using the precast design. Cast-in-place concrete will be paid for under [Section 500](#) and reinforcing steel will be paid for under [Section 511](#).

Payment for Foundation Backfill Type II will be made according to and [Subsection 207.5](#), “Payment.”

513.5.01 Adjustments

General Provisions 101 through 150.