

SECTION 509

PRECAST REINFORCED CONCRETE BOX CULVERTS

DESCRIPTION

509.01.01 GENERAL

- A. This work shall consist of furnishing and placing Precast Reinforced Concrete Box (RCB) Culvert of the size and dimensions and at locations shown on the plans.
- B. The precast RCB culvert shall be constructed to the lines and grades given by the Engineer and in accordance with the design shown on the plans.
- C. Precast RCB culvert sections shall be monolithic.
- D. Square or rectangular precast RCB sections shall be designed and constructed conforming to ASTM C1577, as controlled by the height of cover shown on the plans and specified herein. The design cover and loading calculations shall be included in the working drawing submittal.
- E. Design calculations and working drawings shall be submitted for precast RCB sections for review and approval according to **Subsection 105.02 "Plans and Working Drawings"**. Working drawings shall include the contract number, the jobsite name of the structure as shown on the plans, bridge number (if applicable), material designations, bill of materials, complete fabrication details, and guidelines for handling and assembly. Calculations and working drawings shall be prepared and stamped by a Nevada Registered Professional Civil Engineer.

MATERIALS

509.02.01 GENERAL

- A. The materials used shall conform to the requirements in the following subsections:

Materials	Section/Subsection
<i>Structure Excavation</i>	<u>206</u>
<i>Structure Backfill</i>	<u>207</u>
<i>Trench Excavation and Backfill</i>	<u>208</u>
<i>Selected Material Subbase</i>	<u>301</u>
<i>Portland Cement Concrete</i>	<u>501</u>
<i>Reinforcing Steel</i>	<u>505</u>
<i>Hydraulic Cement</i>	<u>701</u>
<i>Concrete Curing Materials and Admixtures</i>	<u>702</u>
<i>Grout and Mortar Sand</i>	<u>706.03.04</u>
<i>Joint Material</i>	<u>707</u>

- B. Manufacturer Certification and Qualification. The manufacturer of the precast RCB shall

submit for approval, substantial evidence of qualification to produce the product. Such evidence of qualification shall include the following:

1. Plant produced concrete products proposed for use will require either National Precast Concrete Association (NPCA) or American Concrete Pipe Association (ACPA) certification.
 2. Written evidence of successful completion of at least three (3) projects of size and scope similar to the project for which the manufacturer wishes to be pre-qualified. The projects shall have been performed within the previous three (3) years. Such evidence shall include references for said work.
 3. A written document detailing the manufacturer's Quality Control Program that demonstrates conformance to the requirements of these specifications.
- C. Concrete. Concrete shall be as specified in **Section 501, "Portland Cement Concrete"**. A copy of the concrete mix design which will be used in the manufacture of the precast RCB shall be submitted for review and approval. The mix design shall identify the type of casting process (wet or dry casting), in addition to the requirements of **Section 501**.
1. When a wet cast manufacturing process is used, concrete shall be Class A Modified or Class AA Modified. A wet cast manufacturing process is defined as one in which forms are removed after 6 hours or more.
 2. When a dry cast manufacturing process is used, concrete shall be Class A Modified. A dry cast manufacturing process is defined as one in which the concrete is densified by continuous vibration, and forms are removed immediately. If approved, alternative aggregate gradations from those specified in **Section 501** and **Section 706** may be allowed.
- D. Product Certification. A certificate of compliance issued by the manufacturer of the precast RCB shall be submitted at the time of shipment. The certificate shall include the following:
1. The specification under which the box sections were manufactured.
 2. All project identification information as noted for working drawings above.
 3. The number of box sections of each size which are being shipped.
 4. A statement that the construction of the box sections, and all materials used therein, are in compliance with the requirements of the applicable ASTM or AASHTO specifications.
 5. Copies of the Quality Control test results, and compressive strength for that lot shall be kept at the plant and available for review.
- E. The Engineer may, at their option, inspect the precast facility operations including, but not limited to, the reinforcing assembly, forming equipment, concrete batching equipment; placement, curing, and handling equipment; and testing and inspection equipment and procedures.
- F. The manufacturer of the precast RCB shall maintain, for a period of seven (7) years following shipment, a copy of the appropriate test reports and other documentation, including compressive strength tests, necessary to support the certificates of compliance.
- G. If the RCB culverts have not been cast prior to the notice to proceed date, written notification shall be given two (2) weeks in advance of performing casting operations for the project.
- H. All materials will be subject to inspection for acceptance as to condition at the latest practicable time the Engineer has the opportunity to check for compliance prior to or during incorporation of materials in the work.
- I. Reinforcement shall conform to the requirements of **Section 505, "Reinforcing Steel"**,

unless otherwise noted.

- J. All joints of the precast boxes shall be sealed with a flexible, butyl-blend, watertight, preformed joint material with a minimum cross-section width of 1 ¼ square inches, installed according to the manufacturer's recommendations. Joint material shall conform to ASTM C990.
1. Joint surfaces of the precast box shall be clean, dry and free of any foreign material, including mud, aggregate base, and leveling course. Apply primer in accordance with manufacturer's recommendations. Install sealant to form a continuous seal around the perimeter of the joint. The sealant may be placed on the lower portion of the groove of the downstream box and upper portion of the tongue of the upstream box, provided there are three (3) inches of overlap of the sealant on each side of the box.

CONSTRUCTION

509.03.01 EARTHWORK

- A. Excavation and backfill shall conform to the requirements of **Section 206, "Structure Excavation,"** and **Section 207, "Structure Backfill,"** or **Section 208, "Trench Excavation and Backfill,"** when the precast RCB is constructed in a trench.
1. The precast RCB shall be bedded as shown in the plans or as specified in the Special Provisions.
 2. When no bedding class is specified, the requirements for normal bedding as shown in the Uniform Standard Drawings 503 or 503.2 shall apply.
 3. The lines and grades shall be established by the Engineer or as designated in the contract documents.
- B. Where precast RCB sections are to be installed in new embankments on a steep slope or in a difficult location, the height of new embankments may be varied as directed by the Engineer.
- C. When headwalls are not required and granular materials are used for backfilling, the fill at the ends of the structure shall be sealed against the infiltration of water by bedding the ends of the structure using Class II CLSM or concrete.
- D. Subgrade preparation shall conform to the requirements of **Section 301, "Selected Material Subbase"**.

509.03.02 HEADWALLS

- A. Where shown on the plans, inlet and outlet headwalls shall be constructed or installed in connection with precast box sections.
- B. Where headwalls are constructed or installed, the ends of precast RCB sections shall be placed flush or cut off flush with the headwall face, unless otherwise permitted by the Engineer.
- C. Headwalls shall be constructed to conform to **Section 501, "Portland Cement Concrete"** and **Section 502, "Concrete Structures."**

509.03.03 LAYING PRECAST REINFORCED CONCRETE BOX CULVERTS

- A. Construction installation shall comply with AASHTO LRFD Bridge Design Specifications, most current edition, **Section 208, "Trench Excavation and Backfill"**, and these specifications.
- B. Inspection of precast RCBs prior to laying:

1. Written notification shall be given twenty-eight (28) days in advance of performing casting operations.
 2. No precast box shall be laid which is excessively cracked per **Subsection 509.03.04**, (i.e., cracked, spalled, or damaged) and shall be removed from the work. Precast RCB culverts which show defects due to handling will be rejected at the site of installation regardless of prior acceptance.
 3. Fine cracks and checks on the surface of the member which do not extend to the plane of the nearest reinforcement will not be cause for rejection unless they are numerous and extensive. Cracks which extend into the plane of the reinforcing steel shall be repaired in an approved manner.
 4. Small damaged or honeycombed areas which are purely surface defects in nature shall be repaired in an approved manner. Excessive damage, honeycomb, or cracking will be subject to structural review at the Contractor's expense. All repairs shall be made sound, properly finished, and cured according to the pertinent specifications. When fine cracks or hair checks on the surface indicate poor curing practices, the production of precast boxes shall be discontinued until corrections are made and proper curing is provided.
- C. All precast boxes shall be carefully handled during loading, unloading, transporting, and laying.
- D. Precast box laying shall begin at the downstream end of the box except for extensions of existing boxes. Place the bottom of the box in contact with the bedding throughout its full length. The first section of box to be laid shall be firmly placed to the designated line and grade at the outlet end with the groove end pointing upstream. Construction loads shall be considered by the design engineer. Design loads shall not be exceeded at any time. Boxes shall be inspected before any backfill is placed. Contractor shall ensure that no rocks greater than three (3) inches or other rigid or jagged material is present in the bedding material where box will be laid directly on the material.
- E. The box segments shall be joined in such a manner that the ends are fully entered and the inner surfaces are flush and even. The maximum tolerable nominal horizontal gap between joints is 0.75 inch, or the manufacturer's maximum joint gap tolerance, whichever is less. This gap shall be checked immediately after laying each section. Any annular space existing in the interior portion of the joint shall be filled with an approved mortar and finished flush with the interior surfaces of the box units. If the inner surfaces are not flush or there is an adverse slope, a procedure to repair the vertical gap must be submitted to the Engineer for approval.
- F. After laying, the box culvert segments shall be checked for alignment and grade. The culvert shall be installed within the tolerances for horizontal and vertical location and gradient as follows:
1. Horizontal location within 0.05 feet of location shown on plans.
 2. Vertical location within 0.05 feet of elevation shown on plans.
 3. Gradient shall not vary by more than ten percent (10%) of slope shown on plans.
- G. The Contractor shall remove and relay or replace box that is out of alignment, damaged, or has unduly settled at no cost to the Contracting Agency.
- H. The interior of the precast box sections shall be kept free of dirt and other foreign material as the box laying progresses and be left clean at the completion of the work. Boxes which are not in true alignment, which show any undue settlement, or are damaged shall be taken up and re-laid at the Contractor's expense. The bottom of the trench shall be graded and prepared to provide a firm and uniform bearing throughout the entire length of the box for the leveling course to be placed on. Blocking shall not be used to bring the box to grade.

Box sections shall be checked for alignment and grade at the time of joining the sections.

- I. The box culverts shall be laid with nominal three (3) inch space between multiple box culverts. The annular space shall be grouted. The grout shall be a workable mix suitable for pumping without segregation and shall conform to the requirements of **Section 706.03.04, "Grout and Mortar Sand."** The grout shall be placed by pumping or an approved alternate method and consolidated by mechanical vibration or rodding during placement. The grouting shall be performed by a continuous placement in lifts not exceeding six (6) feet. Vertical grout barriers may be used to control the flow of grout horizontally. The grout shall attain a minimum compressive strength of 2,500 psi in 28 days when tested according to ASTM C39.
- J. The backfill material shall comply with the requirements of **Section 208**. If the Contractor cannot fit compaction equipment between the box and the trench wall, or the conditions are unsafe for compaction and/or testing, CLSM must be used.
- K. The Contractor shall provide box culverts with beveled ends where the radius of the center line alignment exceeds the manufacturer's minimum radius of curvature allowed using pulled joints. The maximum bevel angle shall not exceed 5 degrees. The Contractor may provide elbows, with a maximum deflection angle of 22 ½ degrees, where the radius of the center line alignments is less than the manufacturer's minimum radius of curvature for a 5-degree bevel.

509.03.04 INSPECTION

- A. All precast RCB joints and lengths shall be 100 percent inspected.
- B. Inspection and Testing shall be performed by the contractor during and after installation to ensure proper performance.
- C. Installation of bedding and backfill materials, as well as their placement and compaction, shall adhere to the requirements of this section and other applicable sections.
- D. Errors in line and grade, as well as any improper placement or backfill techniques, shall be corrected prior to placing significant backfill or trench fill.
- E. Joints shall be properly assembled to prevent the infiltration of soil fines. Flexible joint material shall be properly placed to prevent groundwater infiltration and shall be uniformly oriented around the precast RCB.
- F. Shallow cover installations shall be checked to ensure the minimum cover level is provided.
- G. The Contractor shall complete an internal quality inspection a minimum of thirty (30) days after final backfill has been placed and prior to final acceptance by the Contracting Agency. The culvert shall be cleaned and inspected for cracks and joint gaps using visual physical measurement or other devices, including but not limited to calibrated television or video cameras, subject to approval by the Engineer.
- H. Cracks in precast RCB culverts (both longitudinal and circumferential) that are less than 0.10 inch in width are generally considered non-structural flaws and need not be repaired. Cracks that are equal to or exceed 0.10 inch in width shall require an evaluation by a Nevada licensed professional engineer. The Contractor's engineer shall provide a recommendation regarding removal or repair in accordance with ASTM C1577 standards and subject to approval by the Contracting Agency.
- I. Precast RCB joints and lengths that do not meet the specification shall be repaired or replaced at the Contractor's expense. Any replacement precast RCB shall also be subject to the same testing.

- J. All inspection and testing results shall be submitted and approved by the Contracting Agency before final payment. The Agency Engineer shall be allowed access to randomly inspect at least 10 percent of the total number of precast RCB runs.

509.03.05 BACKFILL

- A. Precast RCB culvert section backfill shall conform to the requirements of **Section 207, "Structure Backfill"**, unless otherwise noted.
- B. Prior to placing backfill material, all handing holes in RCB culverts shall be completely filled with grout or other acceptable methods.

509.03.06 EXTENDING EXISTING CULVERTS

- A. Where shown on the plans or directed by the Engineer, existing culverts shall be extended in accordance with the provisions for installing new culverts and the following additional provisions.
- B. Existing headwalls shall be demolished, removed, and disposed of per **Section 202, "Removal of Structures and Obstructions"**, or moved to the extended location as indicated on the plans or ordered by the Engineer.
- C. A headwall that is not to be reset shall be demolished without injury to the existing culvert and removed and disposed of in accordance with the provisions of **Section 202, "Removal of Structures and Obstructions."** If shown on the plans or ordered by the Engineer, a new concrete headwall shall be constructed in accordance with the provisions of **Section 501, "Portland Cement Concrete,"** of these specifications or a flared end section shall be attached thereto.

METHOD OF MEASUREMENT

509.04.01 MEASUREMENT

- A. The materials to be paid for under these specifications will be listed in the contract items by size, class, type, gauge, or whatever information is necessary for identification.
- B. The quantity of precast RCB culvert to be measured for payment will be the actual number of linear feet of culvert, complete and in place.
- C. Precast RCB culvert bends, wyes, tees, and other branches will be measured and paid for by the linear foot for the sizes of culvert involved. Wyes, tees, and other branches will be measured along centerlines to the point of intersection.
- D. All measurements will be made in accordance with **Subsection 109.01, "Measurement of Quantities."**

BASIS OF PAYMENT

509.05.01 PAYMENT

- A. The accepted quantities of precast RCB culvert measured as specified in **Subsection 509.04.01, "Measurement"**, will be listed under the respective sections of precast RCB.
- B. The accepted quantity of [X]-FT X [X]-FT precast RCB culvert will be paid for at the contract unit price per linear foot shall include all labor, equipment and materials necessary to complete the work.
- C. Full compensation for furnishing precast RCB culvert with end finish, including distortion if required, will be considered as included in the price paid per linear foot for the precast RCB involved and no additional compensation will be allowed therefor. Full

compensation for bedding will be considered included in the price paid per cubic yard for backfill or granular backfill as the case may be and such payment shall include compensation for all the materials, labor, tools, and incidentals necessary to complete the work.

- D. All payments will be made in accordance with **Subsection [109.02](#), "Scope of Payment."**

PAY ITEM

PAY UNIT

(Size) Precast Reinforced Concrete Box CulvertLinear Foot