<table>
<thead>
<tr>
<th>CELL / MODEL NAME</th>
<th>DESCRIPTION</th>
<th>DATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIPES-DCB-PSSP-ZS (1 of 2)</td>
<td>Cast-in-Place End Section for Double Cell Precast Box Culvert, Permanent Steel Sheet Pile Wingwalls, Zero Skew</td>
<td>8/11/2017</td>
</tr>
<tr>
<td>CIPES-PSSP-ZS-DETAILS (2 of 2)</td>
<td>Details for Cast-in-Place End Section for Precast Box Culvert, Permanent Steel Sheet Pile Wingwalls, Zero Skew</td>
<td>8/11/2017</td>
</tr>
<tr>
<td>CIPES-SCB-PSSP-ZS (1 of 2)</td>
<td>Cast-in-Place End Section for Single Cell Precast Box Culvert, Permanent Steel Sheet Pile Wingwalls, Zero Skew</td>
<td>8/11/2017</td>
</tr>
<tr>
<td>CIPES-TCB-PSSP-ZS (1 of 2)</td>
<td>Cast-in-Place End Section for Triple Cell Precast Box Culvert, Permanent Steel Sheet Pile Wingwalls, Zero Skew</td>
<td>8/11/2017</td>
</tr>
<tr>
<td>DCB-GPE</td>
<td>Double Cell Precast Box Culvert with Apron End Section, General Plan and Elevation Sheet</td>
<td>2/17/2017</td>
</tr>
<tr>
<td>MCB-AES (1 of 2)</td>
<td>Multi-Cell Precast Box Culvert Apron End Section Details</td>
<td>2/17/2017</td>
</tr>
<tr>
<td>MCB-AES (2 of 2)</td>
<td>Multi-Cell Precast Box Culvert Apron End Section Details</td>
<td>2/17/2017</td>
</tr>
<tr>
<td>MCB-TES (1 of 2)</td>
<td>Multi-Cell Precast Box Culvert Tapered End Sections</td>
<td>2/17/2017</td>
</tr>
<tr>
<td>MCB-TES (2 of 2)</td>
<td>Multi-Cell Precast Box Culvert Tapered End Sections</td>
<td>2/17/2017</td>
</tr>
<tr>
<td>SCB-AES (1 of 2)</td>
<td>Single Cell Precast Box Culvert Apron End Section Details</td>
<td>2/17/2017</td>
</tr>
<tr>
<td>SCB-AES (2 of 2)</td>
<td>Single Cell Precast Box Culvert Apron End Section Details</td>
<td>2/17/2017</td>
</tr>
<tr>
<td>SCB-GPE</td>
<td>Single Cell Precast Box Culvert with Apron End Section, General Plan and Elevation Sheet</td>
<td>2/17/2017</td>
</tr>
<tr>
<td>SCB-TES (1 of 2)</td>
<td>Single Cell Precast Box Culvert Tapered End Section</td>
<td>2/17/2017</td>
</tr>
<tr>
<td>SCB-TES (2 of 2)</td>
<td>Single Cell Precast Box Culvert Tapered End Section</td>
<td>2/17/2017</td>
</tr>
<tr>
<td>TCB-GPE</td>
<td>Triple Cell Precast Box Culvert with Apron End Section, General Plan and Elevation Sheet</td>
<td>2/17/2017</td>
</tr>
<tr>
<td>TPGBC-ZS (1 of 2)</td>
<td>Traversable Pipe Grate for Box Culverts, Zero Skew</td>
<td>2/17/2017</td>
</tr>
<tr>
<td>CELL / MODEL NAME</td>
<td>DESCRIPTION</td>
<td>DATE</td>
</tr>
<tr>
<td>-------------------</td>
<td>--------------------------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>TPGBC-ZS (2 of 2)</td>
<td>Traversable Pipe Grate for Box Culverts, Zero Skew</td>
<td>2/17/2017</td>
</tr>
</tbody>
</table>
**Bill of Material**

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Box Culvert End Sections, Culvert No.</td>
<td>Each</td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
- The design fill height for this structure is **feet**.
- The precast concrete box culvert sections shall conform to the standard designs of ASTM C 1577.
- The box culvert end section shall be built in the field and a precast option is not allowed except the cutoff wall may be precast. If the Contractor elects to use a precast cutoff wall, shop drawings and a proposed construction sequence shall be submitted to the Engineer for approval.
- Areas of the precast box culvert in contact with cast-in-place concrete shall be sandblasted, cleaned, and wetted prior to placing concrete in the field according to Article 503.09(b).
- The ends of the precast box sections adjacent to the end section shall be formed without male and female shapes.
- The joints between precast box sections shall be sealed, all voids filled with a mastic joint sealer. In addition, the joints shall be externally sealed on all four sides with a 13 inch wide external sealing band. The seal shall be centered over the joint, secured in place and protected during the backfilling process.
- Till h2 and h3 bars as required to maintain clearance.
- Extend precast concrete box culvert welded wire reinforcement into end section. Bend as necessary to provide 10' clear cover.
- See sheet of for culvert construction sequence.
- See sheet of for Section A-A, B-B and C-C.
- See sheet of for additional wing wall details.

**State of Illinois**

**Box Culvert End Section Details**

**Structure No.**

**CIPES-SCB-PSSP-ZS**

**8-11-2017**

**User Name**

**Model:**

**File Name:**

**Plot Scale:**

**Plot Date:**

**Designed:**

**Rev.:**

**Drawn:**

**Checked:**

**Checked by:**

**Drawn by:**

**Reviewed by:**

**Sheet of Sheets**

**Contract No.:**

**Page Dimensions:** 1224.0x792.0

**Plan**

**Section**

**Count**

**Details**

**ILLINOIS**

**DEPARTMENT OF TRANSPORTATION**

**FED. AID PROJECT**

- **Item:**
  - **Unit:**
  - **Total:**
**Plan View**

- Symmetrical about v1
- Symmetrical about h6

**Section F-F**
- 5-#5 v1 bars spaced as shown
- 3-#6 h4 bars back face of headwall
- 2 x 2-#6 h5 bars front face of headwall
- 3-#5 v3 bars spaced as shown in Section E-E

**Section C-C**
- 2 x 2-#6 h4 bars back face of headwall
- 3-#5 v bars threaded into flared coil loop anchors at 12" cts. See Section B-B.
- 4 x 2-#5 h1 bars back face of cutoff wall
- 4 x 2-#6 h5 bars front face of cutoff wall

**Details**
- 4-#5 v1 bars at 12" cts. (Upstream end)
- 2 x 2-#6 h5 bars front face of headwall
- 2 x 2-#6 h4 bars back face of headwall
- 3-#5 v bars at 12" cts. (Upstream end)

**End Elevation**

- Mandatory Const. joint
- Const. joint

**Bill of Material**

<table>
<thead>
<tr>
<th>Item</th>
<th>Unit</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
- The design fill height for this structure is 10 feet. The precast concrete box culvert sections shall conform to the standard designs of ASTM C 1577. The box culvert end section shall be built in the field and a precast option is not allowed except the cutoff wall may be precast. If the Contractor elects to use a precast cutoff wall, shop drawings and a proposed construction sequence shall be submitted to the Engineer for approval.
- Areas of the precast box culvert in contact with cast-in-place concrete shall be sandblasted, cleaned, and wetted prior to placing concrete in the field according to Article 503.09(b).
- The ends of the precast box sections adjacent to the end section shall be formed without male and female shapes. The joints between precast box sections shall be sealed, all voids filled with a mastic joint sealer. In addition, the joints shall be externally sealed on all four sides with a 13 inch wide external sealing band. The seal shall be centered over the joint, secured in place and protected during the backfilling process.
- Tin h2 and h3 bars as required to maintain clearance. The ends of the precast box sections adjacent to the end section shall be formed without male and female shapes. The joints between precast box sections shall be sealed, all voids filled with a mastic joint sealer. In addition, the joints shall be externally sealed on all four sides with a 13 inch wide external sealing band. The seal shall be centered over the joint, secured in place and protected during the backfilling process.
- Tin h2 and h3 bars as required to maintain clearance. The seal shall be centered over the joint, secured in place and protected during the backfilling process.
- Tin h2 and h3 bars as required to maintain clearance. The seal shall be centered over the joint, secured in place and protected during the backfilling process.
GENERAL NOTES

Box Culvert End Sections shall be constructed according to the requirements of Section 560 of the Standard Specifications except as modified herein. End sections will be paid for at the contract unit price per each for Box Culvert End Sections.

Box section dimensions, materials, and reinforcement details for Box Culvert End Sections shall be in accordance with the requirements for ASTM C 1577 as required for the design of the portion of the culvert within the limits of Precast Concrete Box Culverts except as modified herein.

Details for Double Cell Box Culvert shown. Details for Triple Cell Box Culvert Similar.

The details contained herein are for constructing the end sections using cast-in-place (CIP) construction. The Contractor may propose to furnish the end sections using precast construction methods and the end sections. The details consist of multiple precast concrete segments. The Contractor shall be responsible for determining all details associated with the precast option including any strengthening or stiffening provisions necessary for handling the precast segments prior to placement. Conceptual details followed by shop drawings and design calculations shall be submitted by an Illinois licensed Structural Engineer for review and approval. Elements of the precast option shall be reviewed and a minimum radius in the same wingwall geometry and not have a thickness less than that detailed herein. The option to construct the end sections using precast construction methods shall be at no additional charge.

Shop drawings that detail slab thickness and reinforcement layout for the Box Culvert End Sections shall be provided to the Engineer for review and approval. Reinforcement bars not detailed herein shall be detailed with a clear distance at the end of the reinforcement not less than 1" nor not more than 2".

The contractor may use reinforcement bars in lieu of welded wire reinforcement (WWR). Reinforcement bars shall be limited to the sizes of #3 through #5 bars, a maximum spacing of the lesser of 8" or the number thickness, and shall result in an area of reinforcement equal to or greater than that provided by the WWR. Minimum lap lengths detailed herein are applicable to WWR and reinforcement bars.

Reinforcement (circumferential and longitudinal) in the precast concrete box culvert segments immediately adjacent to the box culvert end sections is that being capped with the end section reinforcement shall not be less than that required by ASTM C 1577 for the design thickness of the reinforcement detailed for the end section, whichever is greater.

One drain hole shall be provided in each wingwall for end sections of box culverts having an opening with a clear rise greater than 3'. The drain hole shall be located within 1/3 of the clear rise of the box culvert and shall conform to the requirements of Article 505.11 of the Standard Specifications.

APRON END SECTION DIMENSIONS

<table>
<thead>
<tr>
<th>Span (ft)</th>
<th>Rise (ft)</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>Concrete Cu Ft.</th>
<th>E</th>
<th>Concrete Cu Ft.</th>
</tr>
</thead>
<tbody>
<tr>
<td>7'-0&quot;</td>
<td>2'-0&quot;</td>
<td>8</td>
<td>4-3</td>
<td>3-3</td>
<td>2-11</td>
<td>8-2</td>
<td>23-9-0&quot;</td>
<td>8.0</td>
<td></td>
</tr>
<tr>
<td>7'-0&quot;</td>
<td>2'-0&quot;</td>
<td>8</td>
<td>4-3</td>
<td>2-3</td>
<td>3-11</td>
<td>8-2</td>
<td>23-9-0&quot;</td>
<td>8.0</td>
<td></td>
</tr>
<tr>
<td>7'-0&quot;</td>
<td>2'-0&quot;</td>
<td>8</td>
<td>4-3</td>
<td>1-3</td>
<td>4-11</td>
<td>8-2</td>
<td>23-9-0&quot;</td>
<td>8.0</td>
<td></td>
</tr>
<tr>
<td>7'-0&quot;</td>
<td>2'-0&quot;</td>
<td>8</td>
<td>4-3</td>
<td>1-3</td>
<td>5-11</td>
<td>8-2</td>
<td>23-9-0&quot;</td>
<td>8.0</td>
<td></td>
</tr>
<tr>
<td>7'-0&quot;</td>
<td>2'-0&quot;</td>
<td>8</td>
<td>4-3</td>
<td>1-3</td>
<td>6-11</td>
<td>8-2</td>
<td>23-9-0&quot;</td>
<td>8.0</td>
<td></td>
</tr>
<tr>
<td>7'-0&quot;</td>
<td>2'-0&quot;</td>
<td>8</td>
<td>4-3</td>
<td>1-3</td>
<td>7-11</td>
<td>8-2</td>
<td>23-9-0&quot;</td>
<td>8.0</td>
<td></td>
</tr>
<tr>
<td>7'-0&quot;</td>
<td>2'-0&quot;</td>
<td>8</td>
<td>4-3</td>
<td>1-3</td>
<td>8-11</td>
<td>8-2</td>
<td>23-9-0&quot;</td>
<td>8.0</td>
<td></td>
</tr>
</tbody>
</table>

DEPARTMENT OF TRANSPORTATION

STATE OF ILLINOIS

MULTI-CELL PRECAST CONCRETE BOX CULVERT APRON END SECTION DETAILS - STRUCTURE NO.

MCB-AES

2-27-2007

(Part 1 of 2)
TOEWALL CONSTRUCTION SEQUENCE

1. Perform excavation and construct toewall.
2. Backfill accordingly and prepare bedding for box culvert end sections.
3. Construct remainder of box culvert end sections.

Note:

If soil conditions permit, the toewall may be poured monolithically with the bottom slab at the end section using Alt. Section D-D subject to approval from the Engineer.
**GENERAL NOTES**

Box Culvert End Sections shall be constructed according to the requirements of Section 340 of the Standard Specifications except as modified herein. This work will be measured for payment as each with each end of each culvert being one each. End sections will be paid for at the contract unit price per each for Box Culvert End Sections of the culvert number specified.

Typical box section dimensions, materials, and reinforcement details for Box Culvert End Sections shall be according to the requirements of ASIN 1577 as required for the design of the portion of the culvert within the limits of Precast Concrete Box Culverts except as modified herein.

Number of segments shown in Elevation is for example only. Length and number of precast box sections required to construct Box Culvert End Sections shall be determined by the Contractor.

See roadway plans for embankment slope (W/H).

1" Ø anchor rods for the culvert ties shall conform to the requirements of ASIN 500.4. Structural steel for tie plate and restraint angle shall conform to the requirements of Article 1006.04 of the Standard Specifications. All components of the culvert tie detail shall be galvanized according to the requirements of A2206.082 or A2206.022 as applicable. 2" 1/2 x 21/2 x 1/8 plate washers shall be provided under each nut required for the anchor rods. Anchor rods connecting precast sections shall be brought to a snug tight condition followed by an additional 1/4 turn once all the nuts for anchor rods installed in the walls. Match marks shall be provided on the bolt and nut to verify relative rotation between the bolt and the nut. Holes in the walls for the culvert tie assembly may be drilled using core bits in lieu of using formed holes.

All costs associated with furnishing and installing or constructing the frontwall and culvert ties will not be measured for payment but shall be included in the contract unit price for Box Culvert End Sections at the culvert number specified. Drain holes shall conform to the requirements of Article 3031.11 of the Standard Specifications unless noted otherwise. Nonwoven geotextile fabric shall conform to the requirements of Article 1080.01. The minimum weight of the fabric shall be 6 oz. / sq. yd.

For end sections with traversable pipe grade systems, see grate detail sheet for required modifications. The 2" nominal space between adjacent end sections shall be filled with geotextile fabric centered over the drain hole. Fabrics shall be sealed to the concrete with mastic. Drain detail will not be measured for payment but shall be included in the contract unit price for Box Culvert End Sections of the culvert number specified. For double cell box culvert shown. Details for other multi-cell box culverts similar.

**ELEVATION**

- Precast box culvert end sections joins with a total vertical height less than 8'-0" shall only require one culvert tie placed at midheight.

- 3" Ø Plane hole in culvert walls (to be removed with formwork).

- Concrete Box Culverts

- See General Notes regarding number of required segments.

- Typical box section dimensions, materials, and reinforcement details for Box Culvert End Sections shall be according to the requirements of ASIN C 1577 as required for the design of the portion of the culvert within the limits of Precast Concrete Box Culverts except as modified herein.

**PLAN**

- Fill with Class SI concrete

- Restraint angle detail

- 1/8" x 1/8" x 6" block of CAS, CAD, or loose stone aggregate placed over drain opening. Blocks of aggregate shall be completely wrapped in nonwoven geotextile fabric.

- Provide a double layer of 12" x 12" nonwoven geotextile fabric centered over the drain hole. Fabric shall be sealed to the concrete with mastic.

- 3" PVC drain cast with the concrete (adjust location to clear reinforcement).

- 1/8" Square foam block around PVC drain (to be removed with formwork).

**TIE PLATE DETAIL**

- 1" Ø anchor rods with 2 1/2" x 2 1/2" x 1/8 plate washers installed in 1/8" formed holes in culvert walls.

- Restraint angle detail

**SECTION B-B**

(Showing end section tie details)

- 3" Ø anchor rods with 2 1/2" x 2 1/2" x 1/8 plate washers installed in 1/8" formed holes in culvert walls.

- Restraint angle detail

- Section B-B

**RESTRAINT ANGLE DETAIL**

- 1/8" x 1/8" x 6" block of CAS, CAD, or loose stone aggregate placed over drain opening. Blocks of aggregate shall be completely wrapped in nonwoven geotextile fabric.

- Provide a double layer of 12" x 12" nonwoven geotextile fabric centered over the drain hole. Fabric shall be sealed to the concrete with mastic.

- 3" PVC drain cast with the concrete (adjust location to clear reinforcement).

- 1/8" Square foam block around PVC drain (to be removed with formwork).
1. Perform excavation and construct toewall.
2. Backfill according to the applicable paragraphs of Article 502.10 of the Standard Specifications and place bedding for precast box culvert end sections.
3. Set precast box culvert end section.
4. Drill and epoxy grout reinforcement in toewall in accordance with Article 1040.04 of the Standard Specifications.
5. Pressure grout voids using non-shrink grout conforming to Section 584 of the Standard Specifications.

Notes:
- The Contractor may furnish a precast or cast-in-place toewall.
- The Contractor shall be responsible for the strength and stability of the precast toewall during handling. Additional lifting points may be required depending upon the length of the toewall or the Contractor may need to modify the design of the toewall for the proposed handling method.
- The Contractor shall be responsible for the strength and stability of the precast toewall during handling. Additional lifting points may be required depending upon the length of the toewall or the Contractor may need to modify the design of the toewall for the proposed handling method.
- If soil conditions permit, the sides of the toewall may be poured directly against the soil. The clear cover on the sides of the toewall shall be increased to 3" by increasing the thickness of the toewall.
- The Contractor may need to modify the design of the toewall for the proposed handling method.
Box Culvert End Sections shall be constructed according to the requirements of Section 540 of the Standard Specifications except as modified herein. End sections will be paid for at the contract unit price per each for Box Culvert End Sections.

The Contractor may furnish the end section as a single precast concrete piece or construct the end section in the field using cast-in-place (CIP) construction. For CIP construction, the bottom slab thickness shall be increased by 2" and the clear distance at the end of the reinforcement shall be increased to 5".

Box Culvert End Sections shall be in accordance with the requirements for Box Culvert End Sections as defined in the General Notes. Culvert ties are not required for Box Culverts and will be dependent upon the length of box culvert furnished by the Contractor. Culvert ties are not required for the design fill height or the reinforcement than that provided by the WWR. Minimum lap lengths detailed herein are provisions necessary to handle the precast segment. Any required lap lengths beyond those provided shall be included in the unit price for Box Culvert End Sections of the culvert number specified.

Shop drawings that detail slab thickness and reinforcement layout for the Box Culvert End Sections shall be provided to the Engineer for review and approval. Reinforcement bars not detailed herein shall be detailed with a clear distance at the end of the reinforcement not less than 1/4" nor more than 2". For the precast option, it shall be the Contractor's responsibility for determining a method of handling and a construction procedure shall be included on the shop drawings. The Contractor shall determine and detail the shop drawings any necessary strengthening or stiffening provisions necessary to handle the precast segment, any required modifications shall be at no extra charge.

The Contractor may use reinforcement bars in lieu of welded wire reinforcement (WWRI). Reinforcement bars shall be limited to the sizes of #1 bars having a maximum size of the lesser of 1" or the number of #2 bars having a maximum size of 1-1/4" or the number thickness, and shall result in an area of reinforcement equal to or greater than that provided by the WWR. Minimum lap lengths detailed herein are applicable to WWRI and reinforcement bars.

Reinforcement (confined and longitudinal) on the culvert barrel portion of the end section shall be presented in each wingwall for end sections at box culverters having a clear rise greater than 3' 6". The drain hole shall be located within the lower 1/3 of the clear rise of the box culvert and shall conform to the requirements of Article 503.11 of the Standard Specifications.

Note: Two sets of apron end section dimensions are shown above for some box culvert sizes due to the top and bottom slabs having different thicknesses per ASTM C 1577 for design fill heights less than 2 ft. (Sheet 1 of 2)
INDEX OF SHEETS
1. General Plan and Elevation
2.-3. Precast Concrete Box Culvert Apron End Section Details

GENERAL NOTES
The design fill height for this box is ft. The precast box culvert sections shall conform to the requirements of ASME 1-1957.

Drain holes shall be provided on exterior culvert walls for each precast box segment with a clear rise greater than 3 ft. The drain hole shall be located within 1/3 of the clear rise of the box culvert, shall not intercept the haunch, and shall conform to the requirements of Article 53.11 of the Standard Specification.

The 6 in. thick layer of porous granular material required for the precast concrete box culvert per Art. 54.06 of the Standard Specifications shall also apply to the end sections. Cost of the porous granular material will not be paid separately but shall be included in the unit price of the work for which it is required.

Nonwoven geotextile fabric shall conform to the requirements of Art. 1080.01 of the Standard Specifications. The minimum weight of the fabric shall be 6 ounces per square yard.

Precast concrete box culverts and box culvert end sections shall be backfilled with Porous Granular Embankment below the top of the box culvert extending to a vertical plane 2 ft from the exterior sides of the culvert, 2 ft from the back face of the end sections, and not closer than 2 ft from the face of embankment.

TOTAL BILL OF MATERIAL

<table>
<thead>
<tr>
<th>ITEM</th>
<th>UNIT</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name Plates</td>
<td>Each</td>
<td>2</td>
</tr>
<tr>
<td>Box Culvert End Sections, Culvert No.</td>
<td>Each</td>
<td>2</td>
</tr>
<tr>
<td>Precast Concrete Box Culverts</td>
<td>Each</td>
<td>2</td>
</tr>
<tr>
<td>Porous Granular Embankment</td>
<td>Cu. Yd.</td>
<td>3</td>
</tr>
</tbody>
</table>

LOADING HL-93

DEMONSTRATIONS
2012 AASHTO LRFD Bridge Design Specifications
6th Edition with 2013 interims

DESIGN STRESSES

$\tau_s = 5,000 \text{ psi}$

$f_y = 65,000 \text{ psi}$ (Welded Wire Reinforcement)

STATE OF ILLINOIS
DEPARTMENT OF TRANSPORTATION

F.A. RTE. SEC.
COUNTY
STATION
S.N. -
**GENERAL NOTES**

Box Culvert End Sections shall be constructed according to the requirements of Section S40 of the Standard Specifications except as modified herein. This work will be measured for payment as each, with each end of each culvert being one each. End sections will be paid for at the contract unit price per each for Box Culvert End Sections of the culvert number specified.

Typical box section dimensions, materials, and reinforcement details for Box Culvert End Sections shall be according to the requirements of ASTM C 1577 as required for the design of the portion of the culvert within the limits of Precast Concrete Box Culverts except as modified herein.

Number of segments shown in Elevation is for example only. Length and number of precast box sections required to construct Box Culvert End Sections shall be determined by the Contractor.

See roadway plans for embankment slope (V:H).

1" Ø anchor rods for the culvert ties shall conform to the requirements of ASTM F1554, Grade 105. Structural steel for tie plate and restraint angle shall conform to the requirements of Articles 1006.04 of the Standard Specifications. All components of the culvert tie detail shall be galvanized according to the requirements of ASME Y13M 111 or M 323 as applicable. 2½" x 2½" x ½" plate washers shall be provided under each nut required for the anchor rods. Anchor rods connecting precast sections shall be brought to a snug tight condition followed by an additional turn on one of the nuts for anchor rods installed in the walls. Match marks shall be provided on the bolt and nut to verify relative rotation between the bolt and the nut. Holes in the walls for the culvert tie assemblies may be drilled using core bits in lieu of using formed holes.

All costs associated with furnishing and installing or constructing the tie wall and culvert ties will not be measured for payment but shall be included in the contract unit price for Box Culvert End Sections of the culvert number specified.

Drain holes shall conform to the requirements of Article 503.11 of the Standard Specifications unless noted otherwise. Nonwoven geotextile fabric shall conform to the requirements of Article 1089.01. The minimum weight of the fabric shall be 6 oz. / sq. yd.

For end sections with traversable pipe grate systems, see grate detail sheet for required modifications.

**Concrete Box Culverts**

Precast box culvert end section joints with a total vertical height less than 8'-6" shall only require one culvert tie placed at midheight.

**Culvert End Section Length (See Roadway Plans)**

See General Notes regarding number of required segments.

**Typical box section dimensions, materials, and reinforcement details for Box Culvert End Sections shall be according to the requirements of ASTM C 1577 as required for the design of the portion of the culvert within the limits of Precast Concrete Box Culverts except as modified herein.**

Number of segments shown in Elevation is for example only. Length and number of precast box sections required to construct Box Culvert End Sections shall be determined by the Contractor.

See roadway plans for embankment slope (V:H).

1" Ø anchor rods for the culvert ties shall conform to the requirements of ASTM F1554, Grade 105. Structural steel for tie plate and restraint angle shall conform to the requirements of Articles 1006.04 of the Standard Specifications. All components of the culvert tie detail shall be galvanized according to the requirements of ASME Y13M 111 or M 323 as applicable. 2½" x 2½" x ½" plate washers shall be provided under each nut required for the anchor rods. Anchor rods connecting precast sections shall be brought to a snug tight condition followed by an additional turn on one of the nuts for anchor rods installed in the walls. Match marks shall be provided on the bolt and nut to verify relative rotation between the bolt and the nut. Holes in the walls for the culvert tie assemblies may be drilled using core bits in lieu of using formed holes.

All costs associated with furnishing and installing or constructing the tie wall and culvert ties will not be measured for payment but shall be included in the contract unit price for Box Culvert End Sections of the culvert number specified.

Drain holes shall conform to the requirements of Article 503.11 of the Standard Specifications unless noted otherwise. Nonwoven geotextile fabric shall conform to the requirements of Article 1089.01. The minimum weight of the fabric shall be 6 oz. / sq. yd.

For end sections with traversable pipe grate systems, see grate detail sheet for required modifications.

**Concrete Box Culverts**

**Structural Steel for Tie Plate and Restraint Angle**

1" Ø anchor rods for the culvert ties shall conform to the requirements of ASTM F1554, Grade 105. Structural steel for tie plate and restraint angle shall conform to the requirements of Article 1006.04 of the Standard Specifications. All components of the culvert tie detail shall be galvanized according to the requirements of ASME Y13M 111 or M 323 as applicable. 2½" x 2½" x ½" plate washers shall be provided under each nut required for the anchor rods. Anchor rods connecting precast sections shall be brought to a snug tight condition followed by an additional turn on one of the nuts for anchor rods installed in the walls. Match marks shall be provided on the bolt and nut to verify relative rotation between the bolt and the nut. Holes in the walls for the culvert tie assemblies may be drilled using core bits in lieu of using formed holes.

All costs associated with furnishing and installing or constructing the tie wall and culvert ties will not be measured for payment but shall be included in the contract unit price for Box Culvert End Sections of the culvert number specified.

Drain holes shall conform to the requirements of Article 503.11 of the Standard Specifications unless noted otherwise. Nonwoven geotextile fabric shall conform to the requirements of Article 1089.01. The minimum weight of the fabric shall be 6 oz. / sq. yd.

For end sections with traversable pipe grate systems, see grate detail sheet for required modifications.

**Precast Box Culvert End Section Details**

See General Notes regarding number of required segments.

**Typical Box Section Dimensions, Materials, and Reinforcement Details for Box Culvert End Sections**

See General Notes regarding number of required segments.

**Drain Holes**

Drain holes shall conform to the requirements of Article 503.11 of the Standard Specifications unless noted otherwise.

Nonwoven geotextile fabric shall conform to the requirements of Article 1089.01. The minimum weight of the fabric shall be 6 oz. / sq. yd.

For end sections with traversable pipe grate systems, see grate detail sheet for required modifications.

**Concrete Box Culverts**

Precast box culvert end section joints with a total vertical height less than 8'-6" shall only require one culvert tie placed at midheight.

**Culvert End Section Length (See Roadway Plans)**

See General Notes regarding number of required segments.
TOEWALL CONSTRUCTION SEQUENCE

1. Perform excavation and construct toewall.
2. Backfill according to the applicable paragraphs of Article 502.10 of the Standard Specifications and place bedding for precast box culvert end sections.
3. Set precast box culvert end sections.
4. Drill and epoxy grout reinforcement in toewall in accordance with Section 584 of the Standard Specifications.
5. Pressure grout voids using non-shrink grout conforming to Section 584 of the Standard Specifications.

Notes:
- Alternate Section D-D is provided to allow the Contractor the option of casting the bottom slab of the end section first followed by construction of the sidewalls using conventional forming methods. Shop drawings that detail slab thickness and reinforcement layout shall be submitted to the Engineer for review and approval when using Alternate Section D-D.
- The size and spacing of the v2 bars shall provide a minimum reinforcement area along each face of the walls (in.2/ft.) equal to 1.10*(As1m). v2 bars may consist of #3 thru #6 size reinforcement bars and the longitudinal spacing shall not exceed the lesser of the wall thickness or 8 inches.
- Bonded construction joints shall be prepared according to Article 503.09 of the Standard Specifications.

* The Contractor may furnish a precast or cast-in-place toewall. The Contractor shall be responsible for the strength and stability of the precast toewall during handling. Additional lifting points may be required depending upon the length of the toewall or the Contractor may need to modify the design of the toewall for the proposed handling method.

** If soil conditions permit, the sides of the toewall may be poured directly against the soil. The clear cover on the sides of the toewall shall be increased to 2 ft by increasing the thickness of the toewall.
**Pay Limits for Box Culvert End Sections**

- **Removal of Existing Structures**: Name Plates, Foot Plates, Each; Box Culvert End Sections, Culvert No. _

**FIELD UNITS**

- **Material**: Porous Granular Embankment

**GENERAL NOTES**

1. The design fill height for this box is ft. The precast box culvert sections shall conform to the requirements of Art 1080.01 of the Standard Specifications. The minimum width of the fabric shall be 6 ounces per square yard.
2. Precast concrete box culverts and box culvert end sections shall be backfilled with Porous Granular Embankment below the top of the box culvert extending to a vertical plane 2 ft from the exterior sides of the culvert, 2 ft from the back face of the end sections, and not closer than 2 ft from the face of embankment.

**TOTAL BILL OF MATERIAL**

<table>
<thead>
<tr>
<th>ITEM</th>
<th>UNIT</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precast Concrete Box Culverts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Box Culvert End Sections</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pay Limits for Precast Concrete Box Culverts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pay Limits for Box Culvert End Sections</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**LOADING HL-93**

**DESIGN STRESSES**

- **PRECAST UNITS**: Fc = 5,000 psi, Fy = 65,000 psi (Welded Wire Reinforcement)
- **FIELD UNITS**: Fc = 3,500 psi, Fy = 65,000 psi (Welded Wire Reinforcement)

**GENERAL PLAN AND ELEVATION**

IL RTE. OVER

**LOCATION SKETCH**

STA. _

STATE OF ILLINOIS

DEPARTMENT OF TRANSPORTATION
**LONGITUDINAL SECTION**

- Provide intermediate support for grate pipe lengths > 20'-0''.

**PLAN VIEW**

- Equal intermediate support spaces at 12'-0" max.

**VIEW A-A**

- 1/8" Ø bolt in 3/8" hole.

**SECTION B-B**

- 3/8" Ø anchor pipe.

**SECTION D-D**

- Measured perpendicular to top of culvert wall. In addition, formed hole shall be located a minimum of 6" measured horizontally from any vertical joints necessary for construction of the culvert end section.

**DETAIL A**

- Formed hole using 3/4" (Nom.) steel pipe.

- 3/8" Ø they bolt w/ 3/4" x 2 1/2" x 3/4" washer (typ. each side)

**DETAIL B**

- 3/8" Ø (Nom.) steel anchor pipe w/ 3/8" x 2 1/2" x 3/4" washer

- 3/4" Ø (Nom.) steel runner pipe

- Single 3/8" Ø inspection hole in steel rubber pipe

**GENERAL NOTES**

The minimum edge distance from the center of a hole to the free edge of a structural shape or plate shall be 1/3" unless noted otherwise.

This standard shall only be used on concrete culvert sections not skewed more than ±15 degrees with roadways.

The Contractor may install the thru bolts using drilling and grouting in lieu of providing a formed hole using steel pipe. Installation shall be in accordance with Article 509.06 using a method that results in the annulus surrounding the bolt being completely filled with adhesive. The method of drilling shall not result in spalled concrete at the exit face. Epoxy grouted thru bolts shall be snug tightened followed by an additional 1/2 turn on the interior nut at final installation. Cost included with Traversable Pipe Grate.

**STATE OF ILLINOIS**

**DEPARTMENT OF TRANSPORTATION**

**TRAVERSABLE PIPE GRATE FOR BOX CULVERTS**

**STRUCTURE NO.**

**SHEET 1 OF 2**

**FILE NAME**

**USER NAME**
<table>
<thead>
<tr>
<th>Precast Box Culvert Dimensions</th>
<th>Main Pipe / Length</th>
<th>No. / Length</th>
<th>Total Pipe / Length</th>
<th>Int. Support / Length</th>
<th>Total Length of Pipe</th>
<th>Int. Support / Length</th>
<th>Total Length of Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>2</td>
<td>3</td>
<td>110'-10&quot;</td>
<td>N/A</td>
<td>110'-10&quot;</td>
<td>N/A</td>
<td>110'-10&quot;</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>3</td>
<td>127'-6&quot;</td>
<td>9'-2&quot;</td>
<td>136'-8&quot;</td>
<td>9'-2&quot;</td>
<td>136'-8&quot;</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>3</td>
<td>144'-10&quot;</td>
<td>3'-4&quot;</td>
<td>147'-4&quot;</td>
<td>3'-4&quot;</td>
<td>147'-4&quot;</td>
</tr>
<tr>
<td>7</td>
<td>5</td>
<td>3</td>
<td>161'-10&quot;</td>
<td>9'-2&quot;</td>
<td>170'-10&quot;</td>
<td>9'-2&quot;</td>
<td>170'-10&quot;</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>6</td>
<td>171'-8&quot;</td>
<td>9'-2&quot;</td>
<td>170'-10&quot;</td>
<td>9'-2&quot;</td>
<td>170'-10&quot;</td>
</tr>
<tr>
<td>9</td>
<td>3</td>
<td>3</td>
<td>187'-8&quot;</td>
<td>9'-2&quot;</td>
<td>186'-10&quot;</td>
<td>9'-2&quot;</td>
<td>186'-10&quot;</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>3</td>
<td>204'-10&quot;</td>
<td>N/A</td>
<td>204'-10&quot;</td>
<td>N/A</td>
<td>204'-10&quot;</td>
</tr>
<tr>
<td>Date</td>
<td>Revision History</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>----------------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08-11-2017</td>
<td>- Revised fabricated steel cap of sheet pile wingwall to a “U” shaped bent plate cap</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>