**THREE-SIDED CONCRETE CULVERT DETAILS**

**GENERAL NOTES:**

- **LIVE LOAD:** HL-93.
- **CONSTRUCTION LOADING:** It is the construction Contractor's responsibility to provide for supporting construction loads that exceed AASHTO HL-93, and any construction load applied prior to 2 feet of compacted fill placed above the top slab.

**SURFACE FINISH:** All concrete surfaces shall receive a general surface finish.

**SKEWED CONSTRUCTION JOINTS:** Construction joints in barrels of C-I-P Culverts with skewed Wingwalls may be placed parallel to the Headwalls and the reinforcing steel, and the slabs may be cut provided that the cut reinforcing steel extends beyond the construction joint enough for splices to be made in accordance with Table 1 on this sheet. The cost of construction joints and additional reinforcing shall be at the expense of the Contractor.

**REINFORCING STEEL:** ASTM A615, see the “Three-Sided Culvert Data Tables” in Contract Plans for grade and bar spacing. See the Reinforcing Bar List in the Contract Plans for bar sizes and bar bending details for wingwalls and spread footings. Equal area substitution of ASTM A1064, deformed welded wire reinforcement is permitted.

**CONSTRUCTION:** Culvert Barrels and Headwalls may be precast or cast-in-place, Wingwalls and Slabs may be cast-in-place unless otherwise shown in the Contract Plans.

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**TABLE 1 - MINIMUM BAR SPLICE LENGTHS FOR LONGITUDINAL REINFORCING**

<table>
<thead>
<tr>
<th>BAR #</th>
<th>CLASS II (3400 psi)</th>
<th>CLASS IV (5500 psi)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#3</td>
<td>1'-0&quot;</td>
<td>1'-0&quot;</td>
</tr>
<tr>
<td>#4</td>
<td>1'-4&quot;</td>
<td>1'-4&quot;</td>
</tr>
<tr>
<td>#9</td>
<td>2'-0&quot;</td>
<td>2'-0&quot;</td>
</tr>
<tr>
<td>#12</td>
<td>2'-0&quot;</td>
<td>2'-0&quot;</td>
</tr>
</tbody>
</table>

**TABLE 2 - HEADWALL SKEW LIMITS**

<table>
<thead>
<tr>
<th>BAR #</th>
<th>RECOMMENDED SKEW RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>#3</td>
<td>-13° to +13°</td>
</tr>
<tr>
<td>#4</td>
<td>-20° to +20°</td>
</tr>
<tr>
<td>#9</td>
<td>-5° to +5°</td>
</tr>
<tr>
<td>#12</td>
<td>-9° to +9°</td>
</tr>
</tbody>
</table>

**TABLE 3 - PERMITTED THREE-SIDED CULVERT SECTIONS**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>DESCRIPTION</th>
<th>SINGLE BARREL</th>
<th>MULTIPLE BARRIERS</th>
<th>DESIGN NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>D</td>
<td>Flat Top (Rectangular)</td>
<td></td>
<td></td>
<td>Contractor Design</td>
</tr>
<tr>
<td>E</td>
<td>Arch Top (Proprietary)</td>
<td></td>
<td></td>
<td>Contractor Design</td>
</tr>
<tr>
<td>F</td>
<td>Two-Piece Arch Top (Proprietary)</td>
<td></td>
<td></td>
<td>Not Permitted</td>
</tr>
</tbody>
</table>

**TABLE 1 NOTE:** Splice lengths are based on an AASHTO Class B tension lap splice for the Specification Section 346 concrete class shown.
WINGWALL NOTES:
1. Align construction joint perpendicular to Wingwall.
2. In the vicinity of the construction joint, field bend reinforcement as necessary to maintain minimum reinforcement cover.
3. For constant height Wingwalls, variable length Bars 403, 405 & 408 are not required, and as such the limits of Bars 401 & 407 extend the full length of the Wingwall, and the limits of Bars 402 & 404 extend to the full height of the Wingwall.

WINGWALL ELEVATION - Variable Height
(Left End Shown - Other Corners Similar)

WINGWALL NOTES:
1. Align construction joint perpendicular to Wingwall.
2. In the vicinity of the construction joint, field bend reinforcement as necessary to maintain minimum reinforcement cover.
3. For constant height Wingwalls, variable length Bars 403, 405 & 408 are not required, and as such the limits of Bars 401 & 407 extend the full length of the Wingwall, and the limits of Bars 402 & 404 extend to the full height of the Wingwall.
END ELEVATION - MULTIPLE BARREL CULVERT
(Arched Top Culvert shown; Flat Top Culvert similar)

DETAIL "D" - PLAN VIEW
WINGWALL TO CULVERT SIDE CONNECTION
(Left Begin Corner Shown, Other Corners Similar)

DETAIL "E" - PLAN VIEW
ALTERNATE WINGWALL TO CULVERT END CONNECTION
FOR WINGWALL SKEW (SW) ≥ 135°
(Left Begin Corner shown, other Corners similar)

CROSS REFERENCES:
See Sheet 5 and 6 for location of Detail "D".
See Sheet 6 for location of Detail "E".

DEVELOPMENTAL DESIGN STANDARDS
THREE-SIDED CONCRETE CULVERT DETAILS
INDEX NO. D296 SHEET NO. 3 of 6
NOTES:
2. Single Barrel Culvert (Skewed Culvert With Parallel Wingwalls)
   - Single Barrel Culvert with parallel wingwalls is shown.
   - One of the ends is sketched with squared end showing C-I-P barrel & slab foundation (left side).
   - The other end is sketched with squared end showing precast barrel & spread footing (right side).
   - Apron length varies (see Plans).
   - Apron (Concrete Slab shown, see Plans for Apron requirements and limits).
   - Edge of Channel Bottom.
   - Left End Wingwall.
   - Right Begin Wingwall.
   - Center of Traffic Lanes.
   - Depth of Fill.
   - Apron (Concrete Slab shown, see Plans for Apron requirements and limits) 3'-0" Min.
   - Apron length varies (see Plans).
   - Inside Face of Culvert Barrel Wall (Typ.)
   - Inside Face of Culvert Barrel Wall (Typ.)
   - Apron (Concrete Slab shown, see Plans for Apron requirements and limits) 3'-0" Min.
   - Apron (Concrete Slab shown, see Plans for Apron requirements and limits) 3'-0" Min.

LONGITUDINAL SECTION THRU CULVERT (Reinforcing Not Shown For Clarity)
- Nine horizontal sections are shown:
  - 4'-0" Min. vertical section.
  - 6'-0" vertical section.
  - 8'-0" vertical section.
  - 10'-0" vertical section.
  - 12'-0" vertical section.
  - 14'-0" vertical section.
  - 16'-0" vertical section.
  - 18'-0" vertical section.
  - 20'-0" vertical section.
- Note 1.

See Detail H, (Sheet 4)
See Detail J, (Sheet 4)
See Detail L, (Sheet 4)
PARTIAL PLAN - SQUARED END
SHOWING SKEWED WINGWALLS & CONCRETE SLAB FOUNDATION
(Left Side)

PARTIAL PLAN - SKewed END
SHOWING SKEWED WINGWALLS & SPREAD FOOTINGS
(Right Side - Rubble Riprap Channel Lining)

MULTIPLE BARREL CULVERT
(Skewed Culvert With Skewed Wingwalls Shown)

NOTES: