Single Precast Reinforced Concrete
Box Culvert Standards

General Notes:
1. The precast RCB culvert sections are designed for HL-93 live load and
   earth fills of varying heights.
2. Vertical earth pressure, Ey = 0.120 kcf.
3. Horizontal earth pressure, Ehmax = 0.060 kcf max, Ehmin = 0.030 kcf min.
4. The clear distance from face of concrete to near edge or end of reinforcing
   bar to be 1/2" min. and 2" max., unless otherwise noted.
5. The reinforcement supplied for this structure shall be plain and/or
   deformed welded wire reinforcement (WW WR) fy = 65 ksi, and/or Grade 60
   reinforcing steel in accordance with the standard specifications. The
   reinforcement areas are based on welded wire reinforcement. If reinforcing
   bars are substituted for welded wire reinforcement, the reinforcement
   areas shall be increased by 8%. The barrel sections in these standards
   were designed with plain WW WR fy = 65 ksi.
6. All dimensions are in feet and inches unless otherwise noted or shown.
7. Any of the following combinations of reinforcement may be used:
   a. 1 layer of welded wire reinforcement or
   b. 1 layer of welded wire reinforcement and 1 layer of reinforcement bars or
   c. 1 layer of reinforcement bars.
   The reinforcement shall be developed in accordance with AASHTO LRFD
   specifications.
8. The maximum size of reinforcement shall be #4, except for parapet
   reinforcement as noted.
9. The maximum welded wire reinforcement size shall be a W23/D23 per
   layer (maximum of 2 layers).
10. The spacing center to center of the transverse wires or bars shall not be
   less than 2" nor more than 4". The spacing center to center of the
   longitudinal wires or bars shall not be more than 8".
11. Welding will not be allowed on reinforcement bars or welded wire
    reinforcement, except that the original welding required to manufacture the
    wire reinforcement is acceptable.
12. When reinforcement is cut, additional reinforcement shall be added on
    both sides of the cut member to replace or exceed the cut reinforcement.
13. Eriksson Culvert software version 4.3.1.0 was used for the design of the
    barrel sections as noted on culvert barrel detail standards, for end section
    design fc = 5 ksi.

Index for Precast Culvert Standards:
PRCB G1-20: Index & General Notes
PRCB G2-20: Typical Culvert Barrel Details
PRCB 6-20: Culvert Barrel Details, 6' Spans
PRCB 8-20: Culvert Barrel Details, 8' Spans
PRCB 10-20: Culvert Barrel Details, 10' Spans
PRCB 12-20: Culvert Barrel Details, 12' Spans
PRCB 14-20: Culvert Barrels, 14' Spans
PRCB 16-20: Culvert Barrels, 16' Spans
PES 1-20-T1: Type 1 End Section Details, Up to 7.5° Skews, 6' to 12' Spans, Sheet 1 of 2
PES 1-20-T3: Type 3 End Section Details, Up to 7.5° Skews, 6' to 12' Spans, Sheet 1 of 2
PES 4-20-T1: Type 1 End Section Details, Up to 7.5° Skews, 6' to 12' Spans, Sheet 2 of 2
PES 4-20-T3: Type 3 End Section Details, Up to 7.5° Skews, 6' to 12' Spans, Sheet 2 of 2
PES 5-20-T1: Type 1 End Section Details, 7.5° to 45° Skews, 6' to 12' Spans, Sheet 1 of 2
PES 5-20-T3: Type 3 End Section Details, 7.5° to 45° Skews, 6' to 12' Spans, Sheet 2 of 2
PES 6-20-T1: Type 1 End Section Details, 7.5° to 45° Skews, 6' to 12' Spans, Sheet 1 of 2
PES 6-20-T3: Type 3 End Section Details, 7.5° to 45° Skews, 6' to 12' Spans, Sheet 2 of 2
PES 7-20-T1: Type 1 End Section Details, 7.5° to 45° Skews, 6' to 12' Spans, Sheet 1 of 2
PES 7-20-T3: Type 3 End Section Details, 7.5° to 45° Skews, 6' to 12' Spans, Sheet 2 of 2
PES 8-20-T1: Type 1 End Section Details, 7.5° to 45° Skews, 14' to 16' Spans, Sheet 1 of 2
PES 8-20-T3: Type 3 End Section Details, 7.5° to 45° Skews, 14' to 16' Spans, Sheet 2 of 2
PES 9-20-T1: Type 3 Beam Details, 0° to 45° Skews, 6' to 12' Spans
PES 9-20-T3: Type 3 Beam Details, 0° to 45° Skews, 14' to 16' Spans
PES 10-20-T3: Type 3 Beam Details, 0° to 45° Skews, 14' to 16' Spans
PES 11-20: Alternate Curtain Wall Details
PES 12-20: Embankment Protection Details, 0° to 45° Skews

Specifications:
Design:
Construction:
Iowa Department of Transportation Standard Specifications for
Highway and Bridge Construction, current series, plus applicable
General Supplemental Specifications, Developmental Specifications,
Supplemental Specifications and Special Provisions

Design Stresses:
Design stresses for the following materials are in accordance with
the AASHTO LRFD Bridge Design Specifications, 8th Ed., Series of 2017:
Bar reinforcement in accordance with AASHTO LRFD Section 5, Grade 60.
Welded wire reinforcement in accordance with AASHTO LRFD Section 5.
Concrete in accordance with AASHTO LRFD Section 5. Fz for barrel
sections as noted on culvert barrel detail standards, for end section
design fc = 5 ksi.

Table:

<table>
<thead>
<tr>
<th>English Size</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
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<tr>
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<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
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</tbody>
</table>

14. These culvert standards label all reinforcing steel with English notation (#3 is 1/4 inch diameter bar). English reinforcing steel received at the precast
    plant may display the following "bar designation". The "bar designation"
    is the stamped impression on the reinforcing bars, and is equivalent to
    the bar diameter in millimeters.

15. The first precast barrel section adjacent to the outlet precast end section
    may be a double groove barrel to facilitate placement of outlet end sections
    and allow inlet and outlet end sections to be similar.
As6
"A ", "B ", or "C ", or bevel optional. Small radius (typ.)

1/2" Min.

1" Clr. Min.

4" to 2" chamfer.

Notes:

1. Culvert ties are to be 1" rods. See this sheet for connection details.
2. Haul off sizes are to be 12" vertical, 12" horizontal on all box sizes.
3. Longitudinal reinforcement denoted as As5 & As6 must be placed in slab, floor, and walls and must be 0.06 IN./FT. MIN.
4. Refer to applicable end section detail sheet for barrel to end section connection tie hole locations.
5. Optional squared corners with 5" to 2" chamfer.
6. U bolt ties are required for cattle paths with nuts on fill side.

**Typical Tie Layout**

Note: Holes shall be cast or drilled 1'-4" from centerline of joints as shown above, unless forms are set up for 1'-4" spacing from outside of joint.

**Fabric Layer Detail**

Note: When more than one layer of welded wire fabric is used to obtain the required reinforcement areas, the wires of the welded wire fabric shall be placed as shown.

**Longitudinal Barrel Section**

(Restrained Bar Option Shown)

**Transverse Barrel Section**

(Restrained Bar Option Shown)

**Concrete Box Culverts**

December, 2020

**IOWA DOT**

Standard Design

Single Precast Reinforced Concrete Box Culverts

December, 2020

**Typical Culvert Barrel Details**

PRCB G2-20
### Variable Dimensions and Quantities for 6' Span Barrel Sections

<table>
<thead>
<tr>
<th>Size</th>
<th>As1</th>
<th>As2</th>
<th>As3</th>
<th>As4</th>
<th>As5</th>
<th>As6</th>
<th>As7</th>
<th>As8</th>
<th>Weight (LB/FT)</th>
</tr>
</thead>
<tbody>
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<td>5.0</td>
<td>2770</td>
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<td>6'x7'</td>
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<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
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<td>5.0</td>
<td>2770</td>
</tr>
<tr>
<td>6'x8'</td>
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<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
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<td>2770</td>
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<td>2770</td>
</tr>
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</table>

**Notes:**
1. Longitudinal reinforcement denoted as As5 and As6 must be placed in slab, floor, and wall and must be 0.06 in/ft minimum.
2. All reinforcement lengths and areas are minimum requirements.
3. If reinforcing bars are substituted for welded wire reinforcing, dimension "M" and/or length of the As7/As8 reinforcement shall be adjusted to ensure adequate lap length is provided.
4. Weight of sections assumes a density of 130 lb/ft and squared corners.
5. See PRCB G1-20 and G2-20 for additional information and notes.
Variable Dimensions and Quantities for 8' Span Barrel Sections

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Reinforcement Requirements</th>
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<tbody>
<tr>
<td>Size</td>
<td>A1</td>
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<td>7' x 10'</td>
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</tr>
<tr>
<td>8' x 10'</td>
<td>0.44</td>
</tr>
<tr>
<td>9' x 10'</td>
<td>0.44</td>
</tr>
<tr>
<td>6' x 10'</td>
<td>0.44</td>
</tr>
<tr>
<td>7' x 9'</td>
<td>0.44</td>
</tr>
<tr>
<td>8' x 9'</td>
<td>0.44</td>
</tr>
<tr>
<td>9' x 8'</td>
<td>0.44</td>
</tr>
<tr>
<td>6' x 8'</td>
<td>0.44</td>
</tr>
</tbody>
</table>

Reinforcement Requirements

- A1: Bars
- A2: Area (in²/ft)
- A3: Length
- A4: Area (in²/ft)
- A5: Length
- A6: Area (in²/ft)
- A7/A8: Area (in²/ft)
- Weight (lb/ft)

Variable Dimensions and Quantities for 8' Span Barrel Sections

- Size
- Class
- D (in)
- C (in)
- A (in)
- B (in)
- H (in)
- E (in)
- F (in)
- G (in)
- M (in)
- N (in)
- O (in)
- P (in)
- Q (in)
- R (in)
- S (in)
- T (in)
- U (in)
- V (in)
- W (in)
- X (in)
- Y (in)
- Z (in)

Reinforcement Requirements

- A1: Bars
- A2: Area (in²/ft)
- A3: Length
- A4: Area (in²/ft)
- A5: Length
- A6: Area (in²/ft)
- A7/A8: Area (in²/ft)
- Weight (lb/ft)

Notes:

1. Longitudinal reinforcement denoted as A5 and A6 must be placed in slab, floor, and walls and must be 0.86 in²/ft minimum.
2. All reinforcement lengths and areas are minimum requirements.
3. If reinforcing bars are substituted for welded wire reinforcing, dimension "M" and/or length of the A5/A6 reinforcement shall be adjusted to ensure adequate lap length is provided.
4. Weight of sections assumes a density of 150 PCF and squared corners.
5. See PRCB G1-20 and G2-20 for additional information and notes.
### Variable Dimensions and Quantities for 10' Span Barrel Sections

<table>
<thead>
<tr>
<th>Size</th>
<th>Dimensions</th>
<th>Reinforcement Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>As1 (in²/ft)</td>
<td>As2 (in²/ft)</td>
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<tr>
<td>10x6</td>
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<tr>
<td>16x6</td>
<td>1.31</td>
<td>0.96</td>
</tr>
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</table>

**Notes:**

1. Longitudinal reinforcement denoted as As5 and As6 must be placed in slab, floor, and walls and must be 0.06 in²/ft minimum.

2. All reinforcement lengths and areas are minimum requirements.

3. If reinforcing bars are substituted for welded wire reinforcing, dimension "M" and/or length of the As7/As8 reinforcement shall be adjusted to ensure adequate lap length is provided.

4. Weight of sections assumes a density of 150pcf and squared corners.

5. See PRCB G1-20 and G2-20 for additional information and notes.
### Variable Dimensions and Quantities for 12’ Span Barrel Sections

<table>
<thead>
<tr>
<th>Size</th>
<th>As1 (IN²/FT)</th>
<th>As2 (IN²/FT)</th>
<th>As3 (IN²/FT)</th>
<th>As4 (IN²/FT)</th>
<th>As5 (IN²/FT)</th>
<th>As6 (IN²/FT)</th>
<th>Weight (LB/FT)</th>
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</thead>
<tbody>
<tr>
<td>12'+0&quot;</td>
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<td>1.33</td>
<td>1.33</td>
<td>1.33</td>
<td>6.10</td>
</tr>
<tr>
<td>12'+2&quot;</td>
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<td>1.34</td>
<td>1.34</td>
<td>1.34</td>
<td>1.34</td>
<td>1.34</td>
<td>6.11</td>
</tr>
<tr>
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<td>1.35</td>
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<td>1.35</td>
<td>1.35</td>
<td>6.12</td>
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<tr>
<td>12'+4&quot;</td>
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<td>1.36</td>
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<td>1.36</td>
<td>1.36</td>
<td>1.36</td>
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<tr>
<td>12'+5&quot;</td>
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<td>1.37</td>
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<td>12'+6&quot;</td>
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<td>1.39</td>
<td>6.16</td>
</tr>
</tbody>
</table>

### Typical Barrel Section

**Notes:**
1. Longitudinal reinforcement denoted as As5 and As6 must be placed in slab, floor, and walls and must be 0.06 in. minimum.
2. All reinforcement lengths and areas are minimum requirements.
3. If reinforcing bars are substituted for welded wire reinforcing, dimension "M" and/or length of the As5/As6 reinforcement shall be adjusted to ensure adequate lap length is provided.
4. Weight of sections assumes a density of 150 PCF and squared corners.
5. See PRCB G1-20 and G2-20 for additional information and notes.
## Variable Dimensions and Quantities for 14' Span Barrel Sections

<table>
<thead>
<tr>
<th>Size</th>
<th>Cost</th>
<th>B (FT)</th>
<th>D (FT)</th>
<th>E (FT)</th>
<th>A (IN)</th>
<th>R (IN)</th>
<th>C (IN)</th>
<th>Area (IN²/FT)</th>
<th>Reinforcement Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>14'x4</td>
<td>1</td>
<td>5.0</td>
<td>2.8</td>
<td>14.0</td>
<td>5.0</td>
<td>5.0</td>
<td>4.0</td>
<td>1.04</td>
<td>10'-0&quot;</td>
</tr>
<tr>
<td>14'x4</td>
<td>2</td>
<td>5.0</td>
<td>9.2</td>
<td>14.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>2.04</td>
<td>10'-10&quot;</td>
</tr>
<tr>
<td>14'x4</td>
<td>3</td>
<td>5.0</td>
<td>13.16</td>
<td>14.0</td>
<td>11.0</td>
<td>11.0</td>
<td>11.0</td>
<td>1.55</td>
<td>12'-10&quot;</td>
</tr>
<tr>
<td>14'x4</td>
<td>1</td>
<td>5.0</td>
<td>2.8</td>
<td>14.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>2.00</td>
<td>10'-10&quot;</td>
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<tr>
<td>14'x4</td>
<td>2</td>
<td>5.0</td>
<td>9.2</td>
<td>14.0</td>
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<td>5.0</td>
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<td>14'x4</td>
<td>3</td>
<td>5.0</td>
<td>13.16</td>
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<td>14'x4</td>
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<td>2.00</td>
<td>10'-10&quot;</td>
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<tr>
<td>14'x4</td>
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<td>5.0</td>
<td>9.2</td>
<td>14.0</td>
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<td>5.0</td>
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<td>5.0</td>
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<td>11.0</td>
<td>11.0</td>
<td>1.55</td>
<td>12'-10&quot;</td>
</tr>
</tbody>
</table>

### Typical Barrel Section

- **As5**
- **As6**
- **As7**
- **As8**
- **As9**

### Reinforcement Requirements

- **As5**: min. 0.24 in²/ft minimum
- **As6**: min. 0.23 in²/ft minimum
- **As7**: min. 0.20 in²/ft minimum
- **As8**: min. 0.19 in²/ft minimum

### Notes:

1. Longitudinal reinforcement denoted as As5 and As6 must be placed in slab, floor, and walls and must be 0.86 inches minimum.
2. All reinforcement lengths and areas are minimum requirements.
3. If reinforcing bars are substituted for welded wire reinforcing, the spacing of reinforcement shall be adjusted to ensure adequate lap is provided.
4. Weight of sections assumes a density of 150 PCF and squared corners.
5. See PRCB G1-20 and G2-20 for additional information and notes.
### Variable Dimensions and Quantities for 16’ Span Barrel Sections

<table>
<thead>
<tr>
<th>Size</th>
<th>11'-6”</th>
<th>13'-6”</th>
<th>16'-6”</th>
<th>9'-6”</th>
<th>12'-6”</th>
<th>16'-6”</th>
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<td>14'-6”</td>
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</table>

#### Notes:
1. Longitudinal reinforcement denoted as As5 and As6 must be placed in slab, floor, and walls and must be 0.86 ksi minimum.
2. All reinforcement lengths and areas are minimum requirements.
3. If reinforcing bars are substituted for welded wire reinforcing, dimension "M" and/or length of the As5/As6 reinforcement shall be adjusted to ensure adequate lap length is provided.
4. Weight of sections assumes a density of 150 PCF and squared corners.
5. See PRCB G1-20 and G2-20 for additional information and notes.
## Parapet Longit. Reinforcing

<table>
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<th>Span (FT)</th>
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## Apron Dimens.

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## Reinf. Section Ht.

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<th>(\text{Span} \times \text{Rise} )</th>
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## Constr. Notes:

- Use tongue on inlet end section and groove on outlet end section.
- Fill holes with grout. Grout shall consist of 1 part cement and 2 parts sand. Use air entrained portland cement. Grout mix shall have a maximum slump of 4 inches.
- Floor thickness (Th) shall be, \(Th = 8\) in. for 6 foot span, \(Th = 10\) in. for all other spans.
- Joint "Option A": Provide joint in walls and floor. Terminate joint at haunch. See "Detail A" on Sheet PES 1-20-T1.
- Joint "Option B": Provide continuous joint in walls, floor and haunch.
- Haunch dimension to match barrel haunch size.
- Minimum longitudinal reinforcement shall be 0.08 sq. inches per peripheral foot on all faces of the end section, except in the tongue and groove area.
- Lap splices shall be Class B and shall be designed according to the AASHTO LRFD Bridge Design Specifications, Section 5.
- Optional eyebolts shall conform to ASTM A307. Eyebolts and nuts shall be galvanized in accordance with ASTM A153. The eye of the eyebolt shall be cast flush with the concrete surface.

## Dowel Setting Note (Fence Anchor):

The 5fa bars or eyebolt may be set as dowels in drilled holes. Holes shall be drilled to the depth required to achieve bar embedment as shown in the "Side Elevation" or "Detail C." The dowels shall be installed in accordance with the manufacturer’s recommendations. Either of the following systems may be used as a bonding agent:

A. Polymer grout system shall be in accordance with Article 2001.03, E, of the Standard Specifications.

B. Hydraulic cement grout systems. Drilled holes are to be 2 times the dowel diameter and are to be blown clean with compressed air immediately prior to placing grout. The hydraulic cement grout shall be one of those approved by Materials M. 491.13.
### Construction Notes:

Precast box culvert end sections shall be constructed in accordance with details and notes, as shown below:

Reinforcing for precast end sections & curtain walls shall be welded wire reinforcing (WWR) meeting the requirements of AASHTO LRFD Section 5. The concrete cover over the reinforcing steel shall not be less than 1.5 inches or greater than 2.0 inches.

Refer to sheets PRCB G1-20 & PRCB G2-20 for additional notes & details.

Refer to "Fabric Layer Detail" on sheet PRCB G2-20 for multiple WWR layers.

1. Use tongue on inlet end section and groove on outlet end section, to match barrel section.
2. Fill holes with grout. Grout shall consist of 1 part cement and 2 parts sand. Use air entrained portland cement. Grout mix shall have a maximum slump of 4 inches.
3. Lap splice bars shall be Class B and shall be designed according to the AASHTO LRFD Bridge Design Specifications, Section 3.
4. Joint "Option A": Provide joint in walls and floor. Terminate joint at haunch. See "Detail A" on Sheet PES 3-20-T1.
5. Joint "Option B": Provide continuous joint in walls, floor and haunch.
6. Haunch dimension to match barrel haunch size.
7. Minimum longitudinal reinforcement shall be 0.06 sq. inches per peripheral foot on all faces of the end section, except in the tongue and groove area.
8. Wall thickness (Tc) shall be 8 inches when the Section Height (H) is less than or equal to 12 feet. For "H" equal to 13 to 14 feet, wall thickness shall be 9 inches.
9. Minimum longitudinal reinforcement shall be 0.06 sq. inches per peripheral foot on all faces of the end section, except in the tongue and groove area.
10. Wall thickness may be increased up to 2" max. provided cover is 1” min. to 2” max.

### Dowel Setting Note (Fence Anchor):

The 5/8" bars or eyebolt may be set as dowels in drilled holes. Holes shall be drilled to the depth required to achieve bar embedment as shown in the "Side Elevation" or "Detail C". The dowels shall be installed in accordance with the Manufacturer’s recommendations. Either of the following systems may be used as a bonding agent:

A. Polymer grout system shall be in accordance with Article 2301.03, E. of the Standard Specifications.
B. Hydraulic cement grout systems. Drilled holes are to be 21/2 times the dowel diameter and are to be blown clean with compressed air immediately prior to placing grout. The hydraulic cement grout shall be one of those approved in Materials IM 491.13.

### Notes:

- See sheet PES 3-20-T1 for details used in conjunction with this sheet.
Plan View
(Reinforcement not shown)

Detail C

Side Elevation

Note: L based on 3.1 foreslope.

Bent Bar Details

Note: All dimensions are out to out. D = pin diameter.

Section Z-Z

Section Y-Y

Tongue and Groove Joint Detail

Detail A
(Detail shown at floor, similar at walls)

Joint "Option A" shown

Top of Concrete End Section

Top Tie Not Required If Height, "H" is Less Than 4'-0"

Flow Line

4# Doweled
1'-0" Long

#3 Bars @ 1'-0" Spacing (Typ.)

2'-0" Holes (Typ.)

Joint "Option A" shown

L based on 3.1 foreslope.

Concrete Box Culverts

Single Precast Reinforced

December, 2020

Standard Design

Sheet 1 of 2
### Construction Notes:

Precast box culvert end sections shall be constructed in accordance with details and notes, as shown below.

- Reinforcing for precast end sections & curtain walls shall be welded wire reinforcing (WWR) meeting the requirements of AASHTO LRFD Section 5. The concrete cover over the reinforcing steel shall not be less than 1.5 inches or greater than 2.0 inches.
- Refer to sheets PRCB G1-20 & PRCB G2-20 for additional notes and details.
- Refer to "Fabric Layer Detail" on sheet PRCB G2-20 for multiple WWR layers.

1. Use tongue on inlet end section and groove on outlet end section.
2. Fill holes with grout. Grout shall consist of 1 part cement and 2 parts sand. Use air entrained portland cement. Grout mix shall have a maximum slump of 4 inches.
3. Floor thickness (Tb) shall be: Tb = 8 in. for 6 foot span, Tb = 10 in. for all other spans.
5. Joint "Option B": Provide continuous joint in walls, floor and haunch.
6. Haunch dimension to match barrel haunch size.
7. Minimum longitudinal reinforcement shall be 0.06 sq. inches per peripheral foot on all faces of the end section, except in the tongue and groove area.
8. Lap splices shall be Class B and shall be designed according to the AASHTO LRFD Bridge Design Specifications, Section 5.
9. Optional eyebolts shall conform to ASTM A307. Eyebolts and nuts shall be galvanized in accordance with ASTM A153. The eye of the eyebolt shall be cast flush with the concrete surface.

### Dowel Setting Note (Fence Anchor):

The 5fa bars or eyebolt may be set as dowels in drilled holes. Holes shall be drilled to the depth required to achieve bar embedment as shown in the "Side Elevation" or "Detail C". The dowels shall be installed in accordance with the Manufacturer's recommendations. Either of the following systems may be used as a bonding agent:

- A. Polymer grout system shall be in accordance with ASTM A1201.03, E, of the Standard Specifications.
- B. Hydraulic cement or Neoprene grout systems. Drilled holes are to be 2½ times the dowel diameter and are to be blown clean with compressed air immediately prior to placing grout. The hydraulic cement grout shall be one of those approved in Materials I.M. 491.13.

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### Table: Apron Dimens. and Ah & As3 Reinf.

<table>
<thead>
<tr>
<th>Apron Length (FT)</th>
<th>Apron Dimens.</th>
<th>Ah &amp; As3 Reinf.</th>
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</thead>
<tbody>
<tr>
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<td>Height (FT)</td>
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Note: "H" is the largest vertical dimension of the section.
Plan View
(Reinforcement not Shown)

Section Y-Y

Section Z-Z

Detail A
(Detail Shown at Floor; Similar at Walls)

Detail C

Bent Bar Details

Note:
- All dimensions are out to out.
- D = pin diameter.

A P P R O V E D  B Y  B R ID G E  E N G IN E E R

IOWA DOT

Standard Design
Single Precast Reinforced
Concrete Box Culverts
December, 2020

Type 3 End
Section Details
For Spans up to 7.5’; 14’-16’ Spans
PES 3-20-T3
Sheet 1 of 2

Note: See Sheet PES 4-20-T3 for additional information and notes used in conjunction with this sheet.
### Apron Details

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### Apron Dimens. (In. 20")

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Note: "H" is the largest vertical dimension of the section.

### Construction Notes:

Precast box culvert end sections shall be constructed in accordance with details and notes, as shown below:

Reinforcing for precast end sections & curtain walls shall be welded wire reinforcing (WWR) meeting the requirements of AASHTO LRFD Section 5. The concrete cover over the reinforcing steel shall not be less than 1.5 inches or greater than 2.0 inches.

Refer to sheets PRCB G1-20 & PRCB G2-20 for additional notes and details.

Refer to "Fabric Layer Detail" on sheet PRCB G2-20 for multiple WWR layers.

Use tongue on inlet end section and groove on outlet end section.

Fill holes with grout. Grout shall consist of 1 part cement and 2 parts sand. Use air entrained portland cement. Grout mix shall have a maximum slump of 4 inches.

Minimum longitudinal reinforcing shall be 0.06 sq. inches per peripheral foot on all faces of the end section, except in the tongue and groove area.

Joint "Option A": Provide joint in walls and floor. Terminate joint at haunch. See "Detail A" on Sheet PES 3-20-T3.

Joint "Option B": Provide continuous joint in walls, floor, and haunch.

Haunch dimension to match barrel haunch size.

Wall thickness (Tc) shall be 8 inches when the Section Height (H) is less than or equal to 12 feet. For "H" equal to 13 to 14 feet, wall thickness shall be 9 inches.

Wall thickness (Tc) shall be 8 inches when the Section Height (H) is less than or equal to 12 feet. For "H" equal to 13 to 14 feet, wall thickness shall be 9 inches.

Lap splices shall be Class B and shall be designed according to the AASHTO LRFD Bridge Design Specifications, Section 5.

Optional eyebolts shall conform to ASTM A307. Eyebolts and nuts shall be galvanized in accordance with ASTM A153. The eye of the eyebolt shall be cast flush with the concrete surface.

Bottom slab thickness may be increased up to 2" max, provided cover is 1 1/2" min. to 2" max.

### Dowel Setting Note (Fence Anchor):

The 3/16 bars or eyebolt may be set as dowels in drilled holes. Holes shall be drilled to the depth required to achieve bar embedment as shown in the "Side Elevation" or "Detail C". The dowels shall be installed in accordance with the Manufacturer's recommendations. Either of the following systems may be used as a bonding agent:

A. Polymer grout system shall be in accordance with Article 2301.3, C, of the Standard Specifications.

B. Hydraulic cement grout systems. Drilled holes are to be blung clean with compressed air immediately prior to placing grout. The hydraulic cement grout shall be one of those approved in Materials Lab, 491.13.
**Construction Notes:**

Precast culvert end sections shall be constructed in accordance with details and notes, as shown below.

Reinforcing for precast end sections & curtain walls shall be welded wire reinforcing (WWR) meeting the requirements of AASHTO LRFD Section 5. The concrete cover over the reinforcing steel shall not be less than 1.5 inches or greater than 2.0 inches. Refer to sheets PRCB G1-20 & PRCB G2-20 for additional notes and details.

Refer to “Fabric Layer Detail” on sheet PRCB G2-20 for multiple WWR layers.

1. For skew angles over 7°30’ up to 22°30’, use a 15° skew end section. For skew angles over 22°30’ up to 37°30’, use a 30° skew end section. For skew angles over 37°30’ up to 45°, use a 45° skew end section.

2. For skew angles over 7°30’ up to 22°30’, use a 15° skew end section. For skew angles over 22°30’ up to 37°30’, use a 30° skew end section. For skew angles over 37°30’ up to 45°, use a 45° skew end section.

3. Fill holes with grout. Great shall consist of 1 part cement and 2 parts sand. Grout mix shall have a maximum slump of 4 inches.

4. Fill holes with grout. Great shall consist of 1 part cement and 2 parts sand. Grout mix shall have a maximum slump of 4 inches.

5. Floor thickness (Tb) shall be, Tb = 8 in. for 6 foot span and Tb = 10 in. for all other spans.

6. End of wall may be cut square as shown or follow the skew.

7. Joint "Option A": Provide joint in walls and floor. Terminate joint at haunch. See “Detail A” on PES 5-20-T3.

8. Joint "Option B": Provide continuous joint in walls, floor, and haunch.

9. For the first section adjacent to the barrel, see A4d table.

10. Minimum longitudinal reinforcement shall be 0.06 sq. inches per peripheral foot on all faces of the end section, except in the tongue and groove area.

11. Use tongue on inlet end section and groove on outlet end section.

12. lap splices shall be class b and shall be designed according to the AASHTO LRFD Bridge Design Specifications. Section 5.

13. Optional eyebolts shall conform to ASTM A307. Eyebolts and nuts shall be galvanized in accordance with ASTM A153. The eye of the eyebolt shall be cast flush with the concrete surface.

**Dowel Setting Note (Fence Anchor):**

The 5fa bars or eyebolt may be set as dowels in drilled holes. Holes shall be drilled to the depth required to achieve bar embedment as shown in the “Elevation” or “Detail C”. The dowels shall be installed in accordance with the Manufacturer’s recommendations. Either of the following systems may be used as a bonding agent.

- **A**: Polymer grout system shall be in accordance with Article 3301.03, E, of the Standard Specifications.
- **B**: Hydraulic cement grout systems. Drilled holes are to be 2½ times the dowel diameter and are to be blown clean with compressed air immediately prior to placing grout. The hydraulic cement grout shall be one of those approved in Materials I.M. 491.13.

**Construction Notes:**

1. For skew angles over 7°30’ up to 22°30’, use a 15° skew end section. For skew angles over 22°30’ up to 37°30’, use a 30° skew end section. For skew angles over 37°30’ up to 45°, use a 45° skew end section.

2. For skew angles over 7°30’ up to 22°30’, use a 15° skew end section. For skew angles over 22°30’ up to 37°30’, use a 30° skew end section. For skew angles over 37°30’ up to 45°, use a 45° skew end section.

3. Fill holes with grout. Great shall consist of 1 part cement and 2 parts sand. Grout mix shall have a maximum slump of 4 inches.

4. Fill holes with grout. Great shall consist of 1 part cement and 2 parts sand. Grout mix shall have a maximum slump of 4 inches.

5. Floor thickness (Tb) shall be, Tb = 8 in. for 6 foot span and Tb = 10 in. for all other spans.

6. End of wall may be cut square as shown or follow the skew.

7. Joint "Option A": Provide joint in walls and floor. Terminate joint at haunch. See “Detail A” on PES 5-20-T3.

8. Joint "Option B": Provide continuous joint in walls, floor, and haunch.

9. For the first section adjacent to the barrel, see A4d table.

10. Minimum longitudinal reinforcement shall be 0.06 sq. inches per peripheral foot on all faces of the end section, except in the tongue and groove area.

11. Use tongue on inlet end section and groove on outlet end section.

12. Lap splices shall be class b and shall be designed according to the AASHTO LRFD Bridge Design Specifications. Section 5.

13. Optional eyebolts shall conform to ASTM A307. Eyebolts and nuts shall be galvanized in accordance with ASTM A153. The eye of the eyebolt shall be cast flush with the concrete surface.

**Dowel Setting Note (Fence Anchor):**

The 5fa bars or eyebolt may be set as dowels in drilled holes. Holes shall be drilled to the depth required to achieve bar embedment as shown in the “Elevation” or “Detail C”. The dowels shall be installed in accordance with the Manufacturer’s recommendations. Either of the following systems may be used as a bonding agent.

- **A**: Polymer grout system shall be in accordance with Article 3301.03, E, of the Standard Specifications.
- **B**: Hydraulic cement grout systems. Drilled holes are to be 2½ times the dowel diameter and are to be blown clean with compressed air immediately prior to placing grout. The hydraulic cement grout shall be one of those approved in Materials I.M. 491.13.
Plan View

Detail C

Plan View

Detail A

(Detail Shown at Floor; Similar at Walls)

Detail B

Tongue and Groove Joint Detail

Section A-A

Elevation

Bent Bar Details

Note:
Details shown are for left ahead skew.
See Situation Plan for actual direction of skew.
Details for right ahead skew similar.
See sheet PES 8-20-T3 for additional information and notes used in conjunction with this sheet.

Note:
All dimensions are out to out. D = pin diameter.

Standard Design
Single Precast Reinforced Concrete Box Culverts
December, 2020

Type 3 End Section Details
For Skews of 7.5° to 45°, 14'-16' Spans
Sheet 1 of 2
### Construction Notes:

Precast culvert end sections shall be constructed in accordance with details and notes, as shown below:

- Reinforcing for precast end sections & curtail walls shall be welded wire reinforcing (WWR) meeting the requirements of AASHTO LRFD Section 5. The concrete cover over the reinforcing steel shall not be less than 1.5 inches or greater than 2.0 inches.

- Lap splices shall be Class B and shall be designed according to the AASHTO LRFD Bridge Design Specifications, Section 5.

- Reinforcing for precast end sections & curtain walls shall be welded wire reinforcing (WWR) as shown below:

- The 5fa bars or eyebolt may be set as dowels in drilled holes. Holes shall be drilled to the depth required to achieve bar embedment as shown in the "Elevation" or "Detail C". The dowels shall be installed in accordance with the Manufacturer's recommendations. Either of the following systems may be used as a bonding agent:
  - A. Polymer grout system shall be in accordance with Article 2501.03, E, of the Standard Specifications.
  - B. Hydraulic cement grout systems. Drilled holes are to be 2 times the dowel diameter and are to be blown clean with compressed air immediately prior to placing grout. The hydraulic cement grout shall be one of those approved in Materials I.M. 491.13.

### Note:

- "H" is the largest vertical dimension of the section.

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<table>
<thead>
<tr>
<th>Dimens.</th>
<th>Ah &amp; As3 Reinforcement</th>
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<tr>
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</tbody>
</table>

Note: Dimensions shown in tables are rounded to the nearest whole inch.
Precast lintel beams shall be constructed in accordance with precast barrel and end section details and notes, except as modified below.

Reinforcement for precast lintels and parapets shall be either welded wire reinforcing (WWR) meeting the requirements of AASHTO LRFD Section 5 or reinforcing bars meeting the requirements of ASTM A615 (60 KSI). Wire spacing for WWR shall not exceed 4 inches for primary steel and 8 inches for distribution steel.

1. Place #4 dowel, 2'-0" long into 2 inch dia. hole in the top of the wall section and 3 inch dia. hole in the lintel beam. Fill holes with grout.
2. Cast additional 3 inch holes to maintain a 4 foot maximum hole spacing.
3. Check the location to determine whether a tongue or a groove is used. Tongue and groove to terminate at culvert radius.
4. See “Skewed Parapet Reinforcement” table.
5. Areas shown are for welded wire fabric. If rebar is used, #4 at a max. of 12 inch spacing should be used.

**Notes:**

- Precast lintel beams shall be constructed in accordance with precast barrel and end section details and notes, except as modified below.
- Reinforcement for precast lintels and parapets shall be either welded wire reinforcing (WWR) meeting the requirements of AASHTO LRFD Section 5 or reinforcing bars meeting the requirements of ASTM A615 (60 KSI). Wire spacing for WWR shall not exceed 4 inches for primary steel and 8 inches for distribution steel.
- Place #4 dowel, 2'-0" long into 2 inch dia. hole in the top of the wall section and 3 inch dia. hole in the lintel beam. Fill holes with grout.
- Cast additional 3 inch holes to maintain a 4 foot maximum hole spacing.
- Check the location to determine whether a tongue or a groove is used. Tongue and groove to terminate at culvert radius.
- See “Skewed Parapet Reinforcement” table.
- Areas shown are for welded wire fabric. If rebar is used, #4 at a max. of 12 inch spacing should be used.

**Bent Bar Details**

**Alternate 4b1 (2 Required)**

**Standard Design**

**Single Precast Reinforced Concrete Box Culverts**

**Type 3 Lintel Beam Details**

For Skews 0° to 45°, 6' - 12' Spans
Alternates 1 & 2 (Galvanized Steel Sheet Piling)

Alternates 3 & 4 (Galvanized Steel Sheets)

Notes:
- Use of alternate curtain walls shall be approved by the Engineer.
- All curtain wall material, including bolts, nuts, washers, and angles shall be galvanized per I.D.O.T. Standard Specifications. Bolts, nuts and washers shall conform to Article 4153.06, A, of the I.D.O.T. Standard Specifications.
- 2½"x⅞" or 2½"x⅞" corrugated 132 gauge or heavier galvanized steel sheets.
- Fasten the steel sheets to the front edge of the apron with 3½"x4" bolts and approved anchorages (10" center to center, to the nearest valley). Anchors shall have a minimum pull out strength of 2000 pounds based on 4000 psi concrete.
- Fasten the L8"x4"x⅜" or L6"x4"x⅜" with ¾"x6" or ¾"x4" bolts, 1" O.D. washer and an approved anchorage (2'-0" spacing). Anchors shall have a minimum pull out strength of 2000 pounds based on 4000 psi concrete.
- Fasten the steel sheets to the front edge of the apron with ¾"x6" cast-in-place bolts with nut and lock washer (10" center to center, to the nearest valley).
- Galvanized corrugated (12 gauge or heavier) steel sheet piling, interlocking or Type A.
- ¾"x1" bolt with nut, to lap steel sheets.
- Galvanized steel sheet piling, section PS 27.5 or equal.
- Fill the voids as shown, with Class O concrete or concrete grout, as approved by the Engineer.
- Caulk joint between top of end section floor and angle. Caulking material shall be neutral cure and non-sag silicone. Three products meeting these criteria are Dow 888, CSL 342 joint sealant, and Crafco Road Saver Silicone.
- Placement of Culvert End Section
- Use of alternate curtain walls shall be approved by the Engineer.
- Notes:
  - L8"x4"x⅜" bolt with nut, to lap steel sheets.
  - L6"x4"x⅜" or L8"x4"x⅜" corrugated (12 gauge or heavier) galvanized steel sheets.
  - Galvanized corrugated (12 gauge or heavier) steel sheet piling, interlocking or Type A.
  - ¾"x1" bolt with nut, to lap steel sheets.
  - Galvanized steel sheet piling, section PS 27.5 or equal.
  - Placement of Culvert End Section
  - Use of alternate curtain walls shall be approved by the Engineer.
  - Notes:
    - L8"x4"x⅜" bolt with nut, to lap steel sheets.

Alternates 3 & 4 (Galvanized Steel Sheets)

Notes:
- Use of alternate curtain walls shall be approved by the Engineer.
- All curtain wall material, including bolts, nuts, washers, and angles shall be galvanized per I.D.O.T. Standard Specifications. Bolts, nuts and washers shall conform to Article 4153.06, A, of the I.D.O.T. Standard Specifications.
- 2½"x⅞" or 2½"x⅞" corrugated 132 gauge or heavier galvanized steel sheets.
- Fasten the steel sheets to the front edge of the apron with 3½"x4" bolts and approved anchorages (10" center to center, to the nearest valley). Anchors shall have a minimum pull out strength of 2000 pounds based on 4000 psi concrete.
- Fasten the L8"x4"x⅜" or L6"x4"x⅜" with ¾"x6" or ¾"x4" bolts, 1" O.D. washer and an approved anchorage (2'-0" spacing). Anchors shall have a minimum pull out strength of 2000 pounds based on 4000 psi concrete.
- Fasten the steel sheets to the front edge of the apron with ¾"x6" cast-in-place bolts with nut and lock washer (10" center to center, to the nearest valley).
- Galvanized corrugated (12 gauge or heavier) steel sheet piling, interlocking or Type A.
- ¾"x1" bolt with nut, to lap steel sheets.
- Galvanized steel sheet piling, section PS 27.5 or equal.
- Fill the voids as shown, with Class O concrete or concrete grout, as approved by the Engineer.
- Caulk joint between top of end section floor and angle. Caulking material shall be neutral cure and non-sag silicone. Three products meeting these criteria are Dow 888, CSL 342 joint sealant, and Crafco Road Saver Silicone.
- Placement of Culvert End Section
- Use of alternate curtain walls shall be approved by the Engineer.
- Notes:
  - L8"x4"x⅜" bolt with nut, to lap steel sheets.
  - L6"x4"x⅜" or L8"x4"x⅜" corrugated (12 gauge or heavier) galvanized steel sheets.
  - Galvanized corrugated (12 gauge or heavier) steel sheet piling, interlocking or Type A.
  - ¾"x1" bolt with nut, to lap steel sheets.
  - Galvanized steel sheet piling, section PS 27.5 or equal.
  - Placement of Culvert End Section
  - Use of alternate curtain walls shall be approved by the Engineer.
  - Notes:
    - L8"x4"x⅜" bolt with nut, to lap steel sheets.

Alternates 3 & 4 (Galvanized Steel Sheets)

Notes:
- Use of alternate curtain walls shall be approved by the Engineer.
- All curtain wall material, including bolts, nuts, washers, and angles shall be galvanized per I.D.O.T. Standard Specifications. Bolts, nuts and washers shall conform to Article 4153.06, A, of the I.D.O.T. Standard Specifications.
- 2½"x⅞" or 2½"x⅞" corrugated 132 gauge or heavier galvanized steel sheets.
- Fasten the steel sheets to the front edge of the apron with 3½"x4" bolts and approved anchorages (10" center to center, to the nearest valley). Anchors shall have a minimum pull out strength of 2000 pounds based on 4000 psi concrete.
- Fasten the L8"x4"x⅜" or L6"x4"x⅜" with ¾"x6" or ¾"x4" bolts, 1" O.D. washer and an approved anchorage (2'-0" spacing). Anchors shall have a minimum pull out strength of 2000 pounds based on 4000 psi concrete.
- Fasten the steel sheets to the front edge of the apron with ¾"x6" cast-in-place bolts with nut and lock washer (10" center to center, to the nearest valley).
- Galvanized corrugated (12 gauge or heavier) steel sheet piling, interlocking or Type A.
- ¾"x1" bolt with nut, to lap steel sheets.
- Galvanized steel sheet piling, section PS 27.5 or equal.
- Fill the voids as shown, with Class O concrete or concrete grout, as approved by the Engineer.
- Caulk joint between top of end section floor and angle. Caulking material shall be neutral cure and non-sag silicone. Three products meeting these criteria are Dow 888, CSL 342 joint sealant, and Crafco Road Saver Silicone.
- Placement of Culvert End Section
- Use of alternate curtain walls shall be approved by the Engineer.
- Notes:
  - L8"x4"x⅜" bolt with nut, to lap steel sheets.
  - L6"x4"x⅜" or L8"x4"x⅜" corrugated (12 gauge or heavier) galvanized steel sheets.
  - Galvanized corrugated (12 gauge or heavier) steel sheet piling, interlocking or Type A.
  - ¾"x1" bolt with nut, to lap steel sheets.
  - Galvanized steel sheet piling, section PS 27.5 or equal.
  - Placement of Culvert End Section
  - Use of alternate curtain walls shall be approved by the Engineer.
  - Notes:
    - L8"x4"x⅜" bolt with nut, to lap steel sheets.

Alternates 3 & 4 (Galvanized Steel Sheets)

Notes:
- Use of alternate curtain walls shall be approved by the Engineer.
- All curtain wall material, including bolts, nuts, washers, and angles shall be galvanized per I.D.O.T. Standard Specifications. Bolts, nuts and washers shall conform to Article 4153.06, A, of the I.D.O.T. Standard Specifications.
- 2½"x⅞" or 2½"x⅞" corrugated 132 gauge or heavier galvanized steel sheets.
- Fasten the steel sheets to the front edge of the apron with 3½"x4" bolts and approved anchorages (10" center to center, to the nearest valley). Anchors shall have a minimum pull out strength of 2000 pounds based on 4000 psi concrete.
- Fasten the L8"x4"x⅜" or L6"x4"x⅜" with ¾"x6" or ¾"x4" bolts, 1" O.D. washer and an approved anchorage (2'-0" spacing). Anchors shall have a minimum pull out strength of 2000 pounds based on 4000 psi concrete.
- Fasten the steel sheets to the front edge of the apron with ¾"x6" cast-in-place bolts with nut and lock washer (10" center to center, to the nearest valley).
- Galvanized corrugated (12 gauge or heavier) steel sheet piling, interlocking or Type A.
- ¾"x1" bolt with nut, to lap steel sheets.
- Galvanized steel sheet piling, section PS 27.5 or equal.
- Fill the voids as shown, with Class O concrete or concrete grout, as approved by the Engineer.
- Caulk joint between top of end section floor and angle. Caulking material shall be neutral cure and non-sag silicone. Three products meeting these criteria are Dow 888, CSL 342 joint sealant, and Crafco Road Saver Silicone.
- Placement of Culvert End Section
- Use of alternate curtain walls shall be approved by the Engineer.
- Notes:
  - L8"x4"x⅜" bolt with nut, to lap steel sheets.
  - L6"x4"x⅜" or L8"x4"x⅜" corrugated (12 gauge or heavier) galvanized steel sheets.
  - Galvanized corrugated (12 gauge or heavier) steel sheet piling, interlocking or Type A.
  - ¾"x1" bolt with nut, to lap steel sheets.
  - Galvanized steel sheet piling, section PS 27.5 or equal.
  - Placement of Culvert End Section
  - Use of alternate curtain walls shall be approved by the Engineer.
  - Notes:
    - L8"x4"x⅜" bolt with nut, to lap steel sheets.
Protection Details

Construction Notes:
Class E revetment should be used and placed according to Article 2507.03 of the Standard Specifications.
The engineering fabric shall meet the material requirements in accordance with Article 4196.01, B, 3, of the Standard Specifications.