### GENERAL NOTES:

1. The precast for culvert sections are designed for HL-93 live load and earth fills of varying heights.
2. Vertical earth pressure, $p_{v} = 0$ kcf.
3. Horizontal earth pressure, $p_{h} = 0.035 p_{v}$ kcf.
4. The clear distance from face of concrete to near edge or end of reinforcing bar shall be at least as specified herein.
5. The reinforcement supplied for this structure shall be plain or deformed, and/or welded wire reinforcement in accordance with the standard specifications. The reinforcement areas are based on welded wire reinforcement, if reinforcing bars are specified for use. The reinforcement at the reinforcement shall be increased by 6%. The bar used in these standards were designed with plain bars with a $f'c = 5$ ksi.
6. The maximum size of reinforcing steel in accordance with the design specifications. The clear distance from face of concrete to near edge or end of reinforcing bar shall be at least as specified herein.
7. The maximum size of reinforcing bars shall be $#6$, except for parapet reinforcement at $#5$.
8. The maximum size of reinforcing bars shall be $#6$, except for parapet reinforcement at $#5$.
9. The maximum size of reinforcing bars shall be $#6$, except for parapet reinforcement at $#5$.
10. The maximum size of reinforcing bars shall be $#6$, except for parapet reinforcement at $#5$.

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### SPECIFICATIONS:

- Design:
- Construction:
  - Iowa Department of Transportation Standard Specifications for Highway and Bridge Construction 2013 Edition, 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, 5th Ed., Series of 2010:
  - 12. Bar reinforcement: $f'c = 5$ ksi.
  - 13. Welded wire reinforcement in accordance with AASHTO LRFD Section 5, Grade 60.

- Welding:
  - Welding will not be allowed on reinforcing bars or welded reinforcing except that the original welding required to manufacture the reinforcing is acceptable.
  - Welding will not be allowed on reinforcing bars or welded reinforcing except that the original welding required to manufacture the reinforcing is acceptable.

- Bar reinforcement:
  - Bar reinforcement shall be added in accordance with the standard specifications. The clear distance from face of concrete to near edge or end of reinforcing bar shall be at least as specified herein.

- Welding:
  - Welding will not be allowed on reinforcing bars or welded reinforcing except that the original welding required to manufacture the reinforcing is acceptable.

- Deformed reinforcing steel:
  - Deformed reinforcing steel shall be added in accordance with the standard specifications.

- Bar reinforcement:
  - Bar reinforcement shall be added in accordance with the standard specifications.

- Welding:
  - Welding will not be allowed on reinforcing bars or welded reinforcing except that the original welding required to manufacture the reinforcing is acceptable.

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- Welding:
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TYPICAL TIE LAYOUT

NOTES:
- Holes shall be cast or drilled 1'-4" from
  centerline of joints as shown. Holes are
  set up for 1'-0" spacing from outside of joint.

ADJUSTABLE TIE

U BOLT TIE

WELDED PIPE TIE

DOUBLE EYE BOLT TIE

WELDED EYE OR APPROVED EQUAL X

TOP VIEW

LAYERS OF WELDED WIRE FABRIC

FABRIC LAYER DETAIL

NOTES:
- When more than one layer of welded wire fabric is used, the wires of the
  welded wire fabric shall be placed as shown.

SLAB CUT AS NECESSARY TO FIT TONGUE AT CORNERS

REINFORCEMENT BAR OPTION SHOWN

LONGITUDINAL REINFORCEMENT

EYE BOLT TIE

DETAIL "A"

OPTIONAL CANOPY TIE

TONGUE END

WELD COUPLER TO BOLT

u

ADJUSTABLE TIE

ADJUSTABLE TIE

U BOLT TIE

WELDED PIPE TIE

DOUBLE EYE BOLT TIE

EYE BOLT TIE

APPROVED CONCRETE BOX TIES

TONGUE AND GROOVE JOINT DETAIL

CONCRETE BOX CULVERTS

SINGLE PRECAST REINFORCED

STANDARD DESIGN

IOWA DOT

Highway Division

PRCB G2-13

TYPICAL CULVERT BARREL DETAILS

NOTES:
- Culvert ties are to be #8 rods. See this sheet for connection details.
- Reinforcement bars are to be vertical, if horizontal on all box sizes.
- Longitudinal reinforcement denoted as As1 & As7 must be placed in slab,
  floor, and walls and must be 1 1/2" in diameter.
- Optional squared corners with 2" to 2 1/2" chamfer.
- Use U bolt ties required for bike, pedestrian and cattle paths with nuts
  on fill side.

TYPICAL TIE LAYOUT

LONGITUDINAL BARREL SECTION

TRANSVERSE BARREL SECTION

FORMING DETAIL

REINFORCEMENT BAR OPTION SHOWN

TONGUE END

TONGUE AND GROOVE JOINT DETAIL

CONCRETE BOX CULVERTS

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  on fill side.
TYPICAL BARREL SECTION

REINFORCEMENT BARS

WELDED WIRE REINFORCEMENT

BENT BAR DETAILS

NOTES:
1. DIMENSIONS "A", "B" & "C" LISTED IN THE BAR LIST ARE IN INCHES.
2. LATERAL REINFORCEMENT DATIRED AS As5 AND As6 MUST BE PLACED IN SLABS, FLOORS, AND WALLS AND MUST BE 0.04 IN\" MINIMAL.
3. ALL REINFORCEMENT LENGTHS ARE MINIMAL REQUIREMENTS.
4. IF REINFORCING BARS ARE SUBSTITUTED FOR WELDED WIRE, DIMENSION "B" AND/or LENGTH OF THE As7/As8 REINFORCING SHALL BE ADJUSTED TO ENSURE ADEQUATE LAP LENGTH IS PROVIDED.
5. WEIGHT OF SECTIONS ASSUMES A DENSITY OF 150 PCF AND SQUARED LENGTH IS PROVIDED.
6. SEE IOWA DOT CS-43 AND CS-45 FOR ADDITIONAL INFORMATION AND NOTES.
**VARIABLE DIMENSIONS AND QUANTITIES FOR 8’ SPAN BARREL SECTIONS**

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**REINFORCEMENT REQUIREMENTS (IN/FT)**

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**REINFORCEMENT BARS**

- BENT BAR DETAILS
- ALL DIMENSIONS ARE OUT TO OUT.
- MINIMUM CLEAR COVER.
- ALL REINFORCEMENT LENGTHS AND AREAS ARE MINIMUM.
- MIN. CL.

**NOTES:**
1. DIMENSIONS IN”, ”M” & ”C” LISTED IN THE BARS ARE IN INCHES.
2. ALL REINFORCEMENT DETAILS AS AS7 AND AS8 MUST BE PLACED IN SLAB, FLOOR AND WALLS AND MUST BE SLOPED IN.
3. ALL REINFORCEMENT LENGTHS AND AREAS ARE MINIMUM.
4. IF REINFORCING BARS ARE SUBSTITUTED FOR WELDED WIRE, THE REQUIREMENTS OF BENT BARS ARE ADJUSTED TO ENSURE ADEQUATE LAP LENGTH.
5. SQUARED LENGTH IS PROVIDED.
6. WEIGHT OF SECTIONS ASSUMES A DENSITY OF 150 PCF.
7. SEE PRCB G1-13 AND G2-13 FOR ADDITIONAL INFORMATION AND NOTES.
### VARIABLE DIMENSIONS AND QUANTITIES FOR 10' SPAN BARREL SECTIONS

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<td>12'-11</td>
<td>7'-8</td>
<td>0.74</td>
<td>12'-6</td>
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<td>9</td>
<td>0.28</td>
<td>12'-11</td>
<td>7'-8</td>
<td>0.74</td>
<td>12'-6</td>
<td>0.40</td>
<td>4'-8</td>
<td>0.24</td>
<td>9'-0</td>
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</table>

**TYPICAL BARREL SECTION**

**NOTES:**

1. Measurements of A, B, & C listed in the bar list are in inches.
2. Longitudinal reinforcement denoted as As5 and As6 must be placed in slab floor and walls and must be used in 3-ft sections.
3. All reinforcement lengths and areas are minimum requirements.
4. If reinforcing bars are substituted for welded wire reinforcing, dimensions of A, B, and C of the As5 and As6 reinforcing bar shall be adjusted to ensure adequate lap length is provided.
5. Weight of sections assumes a density of 150 PCF and squared reinforcing, dimensions of A, B, and C must be increased if needed to maintain clear cover.

**REINFORCEMENT BARS**

- Bent Bar Details
- Welded Wire Reinforcement

**CULVERT BARREL DETAILS**

- By Span Barrel Sections
- PRCB 12-13
**Construction Notes:**

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

1. Use tongue on inlet end section and groove on outlet end section.
2. Fill walls with group, block, or unit concrete of 1 part cement and 2 parts sand. Use air entrained portland cement, concrete mix shall have a minimum strength of 4,000 psi.
3. Thickness of floor to be 2½ inches and 6 inches for all other spans.
5. Joint option accommodate in walls, floor, and haunch.
6. Haunch dimension to match barrel haunch size.
7. Minimum longitudinal reinforcement shall be 0.01 inches per peripheral foot on all faces of the end sections, except in the tongue and groove area.

**Dowel Setting Note:**

The #5 bars may be set as dowels in drilled holes, holes shall be drilled to the depth required to achieve bar embedment as shown in the "dowel setting" detail. The dowels shall be installed in accordance with the manufacturer's recommendations. Either of the following systems may be used as a bonding agent.

1. Polymer dowel system shall be in accordance with article 50B03 of the Standard Specifications.
2. Bonded dowel system shall be installed in accordance with the manufacturer's recommendations, either of the following systems may be used as a bonding agent.

- **Joint Option A:**
  - See joint "A" on diagram.
  - Joint "A" shall be placed at the haunch.

- **Joint Option B:**
  - See joint "B" on diagram.
  - Joint "B" shall be placed at the haunch.

**Side Elevation**

- **Section 2-2**
  - Joint "A" shown.
  - Joint "B" shown.

**Details**

- **Tongue and Groove Joint Detail**
  - Tongue and groove joint detail shown.

**Plan View**

- **Reinforcement Not Shown**
  - Reinforcement not shown.

**Section Details**

- **Section Y-Y**
  - Section "Y-Y" shown.

**Section Z-Z**

- **Joint Option A**
  - Joint "A" shown.

- **Joint Option B**
  - Joint "B" shown.

- **Details**
  - Detail shown at floors (similar at walls).

**Bent Bar Details**

- **Notes**
  - All dimensions are out to out.
  - C = 4½ inches.

**Table**

- **DIMENS.**
  - Table shows dimensions for additional notes.

- **APRON DIMENS.**
  - Apron dimensions shown.

- **Ah & As 3 Rein.**
  - Required as per note.

- **Note**
  - R is the largest vertical dimension of the section.
**NOTES:**

- **PRECAST BOX CULVERT END SECTIONS SHALL BE CONSTRUCTED IN ACCORDANCE WITH DETAILS AND NOTES AS SHOWN BELOW.**
- **REINFORCING FOR PRECAST END SECTIONS AND CURTAIN WALLS SHALL BE HELD IN PLACE,** **REINFORCING METAL MUST MEET THE REQUIREMENTS OF AASHTO LRFD, SECTION 5. THE CEMENT CONTENT OF THE CONCRETE OVER THE REINFORCING SHALL NOT BE LESS THAN 0.22 CM³ OF CEMENT FOR EACH 0.45 CM³ OF WATER.**
- **REFER TO SHEET PPS 5-14 FOR ADDITIONAL NOTES.**
- **REFER TO FABRIC LAYER DETAIL ON SHEET PPS 5-143 FOR MULTIPLE LAYER DETAILS.**

**DIAGRAM:**

**SECTION A-A**

- **END VIEW**
- **PLAN VIEW**
- **ELEVATION**

**DETAILS:**

- **Ah & As3 REINFORCEMENT**
- **DIMENSIONS**
- **LENGTHS**

**NOTES:**

- **Ah & As3 REINFORCEMENT**
- **DIMENSIONS SHOWN IN TABLES ARE ROUNDED TO THE NEAREST WHOLE INCH.**
- **TOP TIE NOT REQUIRED IF HEIGHT H IS LESS THAN 4.-**
- **uses the largest vertical dimension of the section.**

**TABLES:**

<table>
<thead>
<tr>
<th>SPAN (FT)</th>
<th>Ah (IN)</th>
<th>As3 (IN)</th>
<th>45° SKEW</th>
<th>30° SKEW</th>
<th>15° SKEW</th>
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<td>0.38</td>
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</table>

**LENGTHS:***

- **LENGTH L**
- **LENGTH LL**
- **LENGTH N**
- **LENGTH P**
**NOTES:**

PRECAST LINTEL BEAMS SHALL BE CONSTRUCTED IN ACCORDANCE WITH PRECAST CEMENT AND REINFORCEMENT DETAILS AND NOTES EXCEPT AS MODIFIED BELOW.

REINFORCING FOR PRECAST LINTELS AND PARAPETS SHALL BE EITHER WELDED WIRE REINFORCING MEETING THE REQUIREMENTS OF ASTM A615 OR REINFORCING BARS MEETING THE REQUIREMENTS OF AASHTO M270. WIRE SPACING FOR WWR SHALL NOT EXCEED 2 INCHES FOR PRIMARY STEEL AND 3 INCHES FOR DISTRIBUTION STEEL.

1) PLACE #4 DOWEL 1'-6 INCHES LONG INTO HOLE IN THE TOP OF THE WALL SECTION AT THREE INCH HOLE IN THE LINTEL BEAM, 1-HOLE #4 IN DIAMETER.

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. SEE SKEWED PARAPET REINFORCEMENT TABLE.

4) AREAS SHOWN ARE FOR WELDED WIRE FRAME. IF THE BAR IS USED, 44 AT A MAX. OF 11 INCH SPACING SHOULD BE USED.

BENT BAR DETAILS

<table>
<thead>
<tr>
<th>ALTERNATE 4b1</th>
</tr>
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<tbody>
<tr>
<td>2 REQUIRED</td>
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**NOTE:** ALL DIMENSIONS ARE IN 4" CL. INCHES, 2" DIAMETER.
CONSTRUCTION NOTES:

CLASS E REVETMENT SHOULD BE USED AND PLACED ACCORDING TO ARTICLE 4196.01, B, 3 OF THE STANDARD SPECIFICATIONS. THE ENGINEERING FABRIC SHALL MEET THE MATERIAL REQUIREMENTS IN ACCORDANCE WITH ARTICLE 2507.03 OF THE STANDARD SPECIFICATIONS.

REVETMENT AND ENGINEERING FABRIC.

* = SEE CULVERT PLANS FOR LIMITS OF REVETMENT AND ENGINEERING FABRIC.

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