### ROUND STRUCTURE BOTTOMS (ALTERNATE A) & ROUND RISERS – TABLE 1

**Wall Thickness (t & t1) and Vertical & Horizontal Areas of Reinforcement (A)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Structure/Riser Diameter (ft)</th>
<th>Cast-In-Place Items</th>
<th>Precast Items</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class III Concrete</td>
<td>ASTM C488</td>
<td></td>
</tr>
<tr>
<td></td>
<td>t1 (Riser in.)</td>
<td>t1 (in.²/ft.)</td>
<td>t1 (in.)</td>
</tr>
<tr>
<td>P 3'-0&quot;</td>
<td>6</td>
<td>0.20</td>
<td>6</td>
</tr>
<tr>
<td>P 4'-0&quot;</td>
<td>6</td>
<td>0.20</td>
<td>6</td>
</tr>
<tr>
<td>J 5'-0&quot;</td>
<td>8</td>
<td>0.20</td>
<td>8</td>
</tr>
<tr>
<td>J 6'-0&quot;</td>
<td>-</td>
<td>0.20</td>
<td>-</td>
</tr>
<tr>
<td>J 7'-0&quot;</td>
<td>-</td>
<td>0.20</td>
<td>-</td>
</tr>
<tr>
<td>J 8'-0&quot;</td>
<td>-</td>
<td>0.20</td>
<td>-</td>
</tr>
<tr>
<td>J 10'-0&quot;</td>
<td>10</td>
<td>0.40##</td>
<td>10</td>
</tr>
<tr>
<td>J 12'-0&quot;</td>
<td>-</td>
<td>0.40##</td>
<td>-</td>
</tr>
</tbody>
</table>

**TABLE 1 NOTES:**
- **A1 = 0.75 sq. in. for riser section height equal to or less than 2'-0" (2 hoop min.)**
- **A1 = 0.50 sq. in. for riser section height equal or less than 2'-0" (2 hoop min.)**
- **A1 = 0.37 sq. in. for riser section height more than 2'-0" up to 4'-0" (3 hoop min.)**
- **Areas of reinforcing for precast items are based on Grade 60 reinforcing.**
- **No reduction in the area of reinforcement is allowed for welded wire fabric in Table 1.**
- **Min. total circumferential reinforcement for continuous steel hoops:**
- **Provide 0.20 sq. in./ft. at each face, 12" max. bar spacing.**
- **Areas of reinforcing for precast items are based on Grade 60 reinforcing.**
- **Provide 0.20 sq. in./ft. at each face, 12" max. bar spacing.**

### SQUARE & RECTANGULAR STRUCTURES (ALTERNATE B) – TABLE 2

<table>
<thead>
<tr>
<th>Type</th>
<th>Wall Length (ft)</th>
<th>Max. Depth (ft)</th>
<th>Wall Thickness (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CIP (in.)</td>
<td>Precast (in.)</td>
<td></td>
</tr>
<tr>
<td>P 3'-0&quot;</td>
<td>40</td>
<td>6</td>
<td>Riser &amp; Bottom 6</td>
</tr>
<tr>
<td>J 4'-0&quot;</td>
<td>40</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>J 5'-0&quot;</td>
<td>27</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>J 6'-0&quot;</td>
<td>15</td>
<td>-</td>
<td>6</td>
</tr>
<tr>
<td>J 9'-0&quot;</td>
<td>40</td>
<td>-</td>
<td>8</td>
</tr>
<tr>
<td>J 10'-0&quot;</td>
<td>26</td>
<td>-</td>
<td>8</td>
</tr>
<tr>
<td>J 12'-0&quot;</td>
<td>40</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>J 16'-0&quot;</td>
<td>35</td>
<td>-</td>
<td>9</td>
</tr>
<tr>
<td>J 20'-0&quot;</td>
<td>40</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>J 20'-0&quot;</td>
<td>25</td>
<td>-</td>
<td>9</td>
</tr>
<tr>
<td>J 20'-0&quot;</td>
<td>30</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

**TABLE 2 NOTES:**
- **See Table 8 for Reinforcing Schedule.**

### GENERAL NOTES

1. **Standard structure bottoms 4'-0" diameter and smaller (Alt. A) and 3'-6" square (Alt. B) are designated Type P. Larger standard structure bottoms are designated Type J. Risers are permitted for all structures. Round risers are designated Type A. Square risers are designated Type B.**

2. **Walls of circular structures (Alt. A) constructed in place may be of brick or reinforced concrete. Precast and rectangular structures (Alt. B) shall be constructed of reinforced concrete only.**

3. **Wall thickness and reinforcement are for either reinforced cast-in-place or precast concrete units except that precast circular units may be furnished with walls in accordance with ASTM C488 (see modified wall thicknesses in Table 1).**

4. **Top and bottom slab thickness and reinforcement are for precast and cast-in-place construction. All concrete shall be of Class III, except use Class IV concrete when shown in the Plans, for special applications of structures located in extremely aggressive environments. Concrete as specified in ASTM C488 (4000 psi) may be used in lieu of Class III concrete for precast items manufactured in accordance with Specifications Section 44B.**

5. **All reinforcement shown is Grade 60 steel, deformed bar. Equivalent area Grade 40 steel or equivalent area smooth or deformed welded wire reinforcement in accordance with Specification Section 931 may be substituted according to Index No. 201, unless otherwise noted.**

6. **Alt. A or Alt. B structure bottoms may be used in conjunction with curb inlet types 1, 2, 3, 4, 5, 6, 9, and 10, and any manhole or junction box unless otherwise shown in the plans or other standard drawings. Alt. B structure bottoms may be used in conjunction with curb inlet types 7 & 8, or any ditch bottom unless otherwise shown in the plans or other standard drawings.**

7. **Rectangular structures may be rotated as directed by the Engineer in order to facilitate connections between the structure walls and the storm sewer pipes.**

8. **Except when ACI hooks are specifically required, reinforcement in top and bottom slab shall be straight embedment.**

9. **All reinforcement must have 2" minimum cover except for 3'-8" diameter precast circular units manufactured under ASTM C488, keyed construction otherwise shown. Additional bars used to restrain hole formers for precast structures with grouted pipe connections, may be left flush with the hole surface. Cut or bend reinforcement at pipe openings to maintain cover. Exposed ends of reinforcing at precast pipe openings and grouted joints must be removed to 1" below the concrete surface and sealed with a Type F epoxy in accordance with Specification Section 926. Horizontal steel in rectangular structures shall be lapped a minimum of 30 bar diameters or by standard hooks at corners.**

10. **The corner fillets shown are necessary for rectangular structures used with circular risers and inlet throats and when used on sides with rectangular risers, inlet and inlet throats. Fillets will be required in the top slab of the Alt. A structure bottoms when used with the Alt. B risers. Each fillet shall be reinforced with two #5 bars.**

11. **Inlet walls, throats, risers or manhole tops shall be secured to structures as shown on Index No. 201 (Sheet 3 of 5) Optional Construction Joints.**

12. **Structures with depths over 1'-6" below the mean high water table are to be checked for foundation by the designer of the drainage project.**

13. **Units larger than specified standards may be substituted at the contractor's option when these units will not cause or increase the severity of utility conflicts. Such larger units shall be furnished at no additional cost to the Department. Larger Alt. A units cannot replace Alt. B units without approval of the Engineer. This note applies to this Index only.**

14. **For manhole and junction box tops, for frames and covers, and, for supplementary details and notes see Index No. 201.**

15. **Type J structure bottoms must have a minimum 6'-0" wall height when possible, for maintenance access.
TABLE 3 - MINIMUM STRUCTURE SIZES FOR SINGLE PIPE CONNECTION PER SIDE

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>DIA. (&quot;))</th>
<th>SINGLE PIPE</th>
<th>2 TO 4 PIPES</th>
<th>MAXIMUM WALL LENGTH (L) FOR MINIMUM WALL LENGTH (L) FOR NUMBER OF PARALLEL PIPES</th>
</tr>
</thead>
<tbody>
<tr>
<td>18&quot;</td>
<td>5'-0&quot;</td>
<td>5'-0&quot;</td>
<td>5'-0&quot;</td>
<td>2'-0&quot;</td>
</tr>
<tr>
<td>24&quot;</td>
<td>6'-0&quot;</td>
<td>7'-0&quot;</td>
<td>7'-0&quot;</td>
<td>2'-0&quot;</td>
</tr>
<tr>
<td>30&quot;</td>
<td>7'-0&quot;</td>
<td>8'-0&quot;</td>
<td>8'-0&quot;</td>
<td>2'-0&quot;</td>
</tr>
<tr>
<td>42&quot;</td>
<td>9'-0&quot;</td>
<td>10'-0&quot;</td>
<td>10'-0&quot;</td>
<td>2'-0&quot;</td>
</tr>
<tr>
<td>48&quot;</td>
<td>10'-0&quot;</td>
<td>11'-0&quot;</td>
<td>11'-0&quot;</td>
<td>2'-0&quot;</td>
</tr>
<tr>
<td>60&quot;</td>
<td>11'-0&quot;</td>
<td>12'-0&quot;</td>
<td>12'-0&quot;</td>
<td>2'-0&quot;</td>
</tr>
<tr>
<td>72&quot;</td>
<td>12'-0&quot;</td>
<td>13'-0&quot;</td>
<td>13'-0&quot;</td>
<td>2'-0&quot;</td>
</tr>
</tbody>
</table>

TABLE 3 NOTES:
1. For Round Structures with variable angles between pipes and variable pipe sizes, refer to the FDOT Storm Drain Handbook.
2. For 7'-0" Precast Square Structure Bottoms, 30" Pipes with similar invert elevations are not permitted in adjacent walls. Use 4'-0" Side Dimensions when 30" pipe openings are required on adjacent walls and the difference in flow lines is less than 3'-0".
3. For 4'-0" Precast Square Structure Bottoms, 36" Pipes with similar invert elevations are not permitted in adjacent walls. Use 5'-0" Side Dimensions when 36" pipe openings are required on adjacent walls and the difference in flow lines is less than 3'-0".
4. For 7'-0" Precast Square Structure Bottoms, 66" Pipes with similar invert elevations are not permitted in adjacent walls. Use 8'-0" Side Dimensions when 66" pipe openings are required on adjacent walls and the difference in flow lines is less than 4'-0".

TABLE 4 - MINIMUM SIZES FOR MULTIPLE PARALLEL PIPE CONNECTIONS FOR RECTANGULAR STRUCTURE BOTTOMS

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>MINIMUM WALL LENGTH (L) FOR NUMBER OF PARALLEL PIPES</th>
</tr>
</thead>
<tbody>
<tr>
<td>18&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
</tr>
<tr>
<td>24&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
</tr>
<tr>
<td>30&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
</tr>
<tr>
<td>42&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
</tr>
<tr>
<td>48&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
</tr>
<tr>
<td>60&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
</tr>
<tr>
<td>72&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
</tr>
<tr>
<td>84&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
</tr>
</tbody>
</table>

TABLE 4 NOTES:
1. Minimum wall lengths based on precast structures, using concrete pipe with maximum skew angles per Table 5.
2. Wall lengths exceeding 20'-0" require special designs.

MAXIMUM PIPE SKEW FOR PRECAST ROUND OPENINGS

<table>
<thead>
<tr>
<th>WALL SPACING</th>
<th>MAXIMUM PIPE SKEW</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Min.)</td>
<td>(Pipe O.D. + 6&quot;)</td>
</tr>
<tr>
<td>1'-0&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
</tr>
<tr>
<td>2'-0&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
</tr>
<tr>
<td>3'-0&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
</tr>
<tr>
<td>4'-0&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
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<tr>
<td>5'-0&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
</tr>
</tbody>
</table>

TABLE 5 - MAXIMUM PIPE SKEW FOR MULTIPLE PIPE CONNECTIONS

<table>
<thead>
<tr>
<th>WALL SPACING</th>
<th>MAXIMUM PIPE SKEW</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Min.)</td>
<td>(Pipe O.D. + 6&quot;)</td>
</tr>
<tr>
<td>1'-0&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
</tr>
<tr>
<td>2'-0&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
</tr>
<tr>
<td>3'-0&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
</tr>
<tr>
<td>4'-0&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
</tr>
<tr>
<td>5'-0&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
</tr>
</tbody>
</table>

TABLE 5 NOTES:
These values are based on 2" clearance for precast structures. Larger skews are possible for Cast-In-Place Structures or elliptical pipe openings when approved by the Engineer.

MULTIPLE PARALLEL PIPE CONNECTIONS DETAIL

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>MINIMUM WALL LENGTH (L) FOR NUMBER OF PARALLEL PIPES</th>
</tr>
</thead>
<tbody>
<tr>
<td>18&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
</tr>
<tr>
<td>24&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
</tr>
<tr>
<td>30&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
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<td>42&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
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<td>72&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
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<tr>
<td>84&quot;</td>
<td>2'-0&quot;, 6'-0&quot;, 8'-0&quot;, 10'-0&quot;, 12'-0&quot;, 14'-0&quot;</td>
</tr>
</tbody>
</table>

TABLE 4 NOTES:
1. Minimum wall lengths based on precast structures, using concrete pipe with maximum skew angles per Table 5.
2. Wall lengths exceeding 20'-0" require special designs.
### Slab and Wall Design Table Notes

1. Size is the inside dimensions of a structure.

2. Slab reinforcement is appropriate for top, intermediate, and bottom slabs.

3. Bottom slabs forPrecast 3'-6" x 3'-6" rectangular structures at 15' depth or less, may be 6" thick.

4. Slab depth is measured from finished grade to top of slab.

5. Wall depth is measured to the top of the bottom slab for precast 3'-6" x 3'-6" rectangular structures at 15' depth or less, may be 6" thick.

6. Wall length is the distance between top of lower slab to bottom of upper slab. Maximum wall height is 17' for wall lengths exceeding 5', or 10' for wall lengths exceeding 12.'
### WALL DESIGNS - RECTANGULAR STRUCTURES (TABLE 8)

#### Vertical Reinforcing

<table>
<thead>
<tr>
<th>WALL DEPTH</th>
<th>SCHEDULE</th>
<th>WALL DEPTH</th>
<th>SCHEDULE</th>
<th>WALL DEPTH</th>
<th>SCHEDULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥1.17'</td>
<td>Inside</td>
<td>Inside</td>
<td>Outside</td>
<td>Inside</td>
<td>Inside</td>
</tr>
<tr>
<td>3'-6'</td>
<td>26'-40'</td>
<td>26'-40'</td>
<td>75</td>
<td>≥1.17'</td>
<td>≥1.17'</td>
</tr>
<tr>
<td>29'-40'</td>
<td>D7</td>
<td>D7</td>
<td>9'</td>
<td>26'-40'</td>
<td>26'-40'</td>
</tr>
</tbody>
</table>

#### Horizontal Reinforcing

<table>
<thead>
<tr>
<th>WALL DEPTH</th>
<th>SCHEDULE</th>
<th>WALL DEPTH</th>
<th>SCHEDULE</th>
<th>WALL DEPTH</th>
<th>SCHEDULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥1.17'</td>
<td>Inside</td>
<td>Inside</td>
<td>Outside</td>
<td>Inside</td>
<td>Inside</td>
</tr>
<tr>
<td>3'-6'</td>
<td>26'-40'</td>
<td>26'-40'</td>
<td>75</td>
<td>≥1.17'</td>
<td>≥1.17'</td>
</tr>
<tr>
<td>29'-40'</td>
<td>D7</td>
<td>D7</td>
<td>9'</td>
<td>26'-40'</td>
<td>26'-40'</td>
</tr>
</tbody>
</table>

#### Wall Thickness

<table>
<thead>
<tr>
<th>WALL DEPTH</th>
<th>SCHEDULE</th>
<th>WALL DEPTH</th>
<th>SCHEDULE</th>
<th>WALL DEPTH</th>
<th>SCHEDULE</th>
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<tbody>
<tr>
<td>≥1.17'</td>
<td>Inside</td>
<td>Inside</td>
<td>Outside</td>
<td>Inside</td>
<td>Inside</td>
</tr>
<tr>
<td>3'-6'</td>
<td>26'-40'</td>
<td>26'-40'</td>
<td>75</td>
<td>≥1.17'</td>
<td>≥1.17'</td>
</tr>
<tr>
<td>29'-40'</td>
<td>D7</td>
<td>D7</td>
<td>9'</td>
<td>26'-40'</td>
<td>26'-40'</td>
</tr>
</tbody>
</table>

*Equivalent Area Welded Wire Reinforcing may be substituted in accordance with Index No. 201, Sheet 4.*
**SUPPLEMENTARY DETAILS FOR MANHOLES & INLITES**

**COVER FOR ALL FRAMES**

**DESIGNER NOTE:**
Consider using the 2-piece cover where depths exceed 5' and manual entry may be required for cleaning. Clearly note the requirement for a 2-piece cover on the Drainage Structure sheets in the plans.

**NOTES (FRAMES, AND COVER):**
1. The standard cover is to be used for all frames Types I, II, III, and the 2-piece cover, and is the replacement cover for all previous frames with 5' deep seats (traffic type). The 185 lb. cover (nontraffic type), 1984 roadway and Traffic Design Standards Index No. 201, is the replacement cover for existing frames with 10' deep seats. Installation of frame with 10' deep seats is not permitted.
2. Use the 2'-0" cover, unless the 2-piece cover is called for in the plans. Except at inlets and manholes with sump bottoms use the 2-piece cover when the sump depth exceeds 2', unless otherwise noted.

**WEIGHT OF CASTINGS (lb)**

<table>
<thead>
<tr>
<th>Frame Type</th>
<th>Cover (Std.)</th>
<th>2'-0&quot; Opening</th>
<th>3'-0&quot; Opening</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>155</td>
<td>190</td>
<td>220</td>
</tr>
<tr>
<td>II</td>
<td>145</td>
<td>190</td>
<td>255</td>
</tr>
<tr>
<td>III</td>
<td>90</td>
<td>190</td>
<td>180</td>
</tr>
</tbody>
</table>

* Includes Type I Adjustable

**DESIGNER NOTE:**
Consider using the 2-piece cover where depths exceed 5' and manual entry may be required for cleaning. Clearly note the requirement for a 2-piece cover on the Drainage Structure sheets in the plans.
Filter Fabric

SECTION

2 Dia (1-Piece Cover)
3 Dia (2-Piece Cover)
Concrete Or
8" Brick
See Note 3

Brick Adjustment or Grade Ring Permitted
(Min. 0" - Max. 12")

Thicknes Of Structure Wall

10°O/D Draft

1/4" Optional

4" Dia.

10° Draft

3'-6" Or
4" Dia.

7-1/2" Rise

3'-6" Or
4" Dia.

Tongue & Groove Joint To Match Riser

2'-3" Or
3'-0"

Riser

Riser

2'-11" Rise

4" Dia.

1/4" Galvanized Hardware Cloth

1/2" X 2' X 2'

Filter Fabric

No. 4 Coarse Aggregate 2' x 2' x 2'

1" Per Ft.

MANHOLE TOPS

NOTES (TOPS)

1. Manhole top Type 7 slabs shall be of Class II concrete. Concrete as specified in ASTM C478 may be used for precast units; see General Note No. 3.

2. Manhole top Type 7 slabs may be of cast-in-place or precast construction. The optional key for precast tops and in two to four holes frame and slab openings are to be omitted when top is used over a junction box.

3. Manhole top Type 8 may be of cast-in-place or precast concrete construction or brick construction. For concrete construction, the concrete and steel reinforcement shall be the same as the supporting wall unit. An eccentric cone may be used.

4. Manhole tops shall be secured to structures by optional construction joints as shown on Sheet 3.

5. Frames can be adjusted a maximum 12" height with brick or precast concrete or steel reinforcement shall be the same as the supporting wall unit. An eccentric cone may be used.

6. Substitution of manhole top Type 8 for manhole top Type 7 is allowed provided that minimum dimensions shown above are not reduced.

7. Substitution of manhole top Type 7 for Type 8 is allowed if the minimum thickness (h) above pipe opening cannot be maintained with manhole top Type 8.

DESIGN NOTES

1. Manhole top Type 8 should be specified in the plans when depths shown above can be maintained.

2. Manhole top Type 7 slabs shall be of Class II concrete. Concrete as specified in ASTM C478 may be used for precast units; see General Note No. 3.

3. Manhole top Type 7 slabs may be of cast-in-place or precast construction. The optional key for precast tops and in two to four holes frame and slab openings are to be omitted when top is used over a junction box.

4. Manhole tops shall be secured to structures by optional construction joints as shown on Sheet 3.

5. Frames can be adjusted a maximum 12" height with brick or precast concrete or steel reinforcement shall be the same as the supporting wall unit. An eccentric cone may be used.

6. Substitution of manhole top Type 8 for manhole top Type 7 is allowed provided that minimum dimensions shown above are not reduced.

7. Substitution of manhole top Type 7 for Type 8 is allowed if the minimum thickness (h) above pipe opening cannot be maintained with manhole top Type 8.

DESIGN NOTES

1. Manhole top Type 8 should be specified in the plans when depths shown above can be maintained.

2. Manhole top Type 7 slabs shall be of Class II concrete. Concrete as specified in ASTM C478 may be used for precast units; see General Note No. 3.

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7. Substitution of manhole top Type 7 for Type 8 is allowed if the minimum thickness (h) above pipe opening cannot be maintained with manhole top Type 8.

DESIGN NOTES

1. Manhole top Type 8 should be specified in the plans when depths shown above can be maintained.

2. Manhole top Type 7 slabs shall be of Class II concrete. Concrete as specified in ASTM C478 may be used for precast units; see General Note No. 3.

3. Manhole top Type 7 slabs may be of cast-in-place or precast construction. The optional key for precast tops and in two to four holes frame and slab openings are to be omitted when top is used over a junction box.

4. Manhole tops shall be secured to structures by optional construction joints as shown on Sheet 3.

5. Frames can be adjusted a maximum 12" height with brick or precast concrete or steel reinforcement shall be the same as the supporting wall unit. An eccentric cone may be used.

6. Substitution of manhole top Type 8 for manhole top Type 7 is allowed provided that minimum dimensions shown above are not reduced.

7. Substitution of manhole top Type 7 for Type 8 is allowed if the minimum thickness (h) above pipe opening cannot be maintained with manhole top Type 8.

DESIGN NOTES

1. Manhole top Type 8 should be specified in the plans when depths shown above can be maintained.
1. One or more types of joints may be used in a single structure, except brick wall structure. Brick wall construction is permitted in circular units only.

2. All grouted joints are to have a maximum thickness of 1".

3. Keyways are to be a minimum of 1/2" deep.

4. Joint dowels are to be #4 bars, 12" long with a minimum of 6 bars per joint approximately evenly spaced for circular structures or at maximum 12" spacing for rectangular structures. Bars may be either Adhesive Bonded Dowels in accordance with Specification Section 416, or placed approximately 6" into fresh concrete leaving the remainder to extend into the secondary cast. Welded wire reinforcement may be substituted for the dowel bar in accordance with the equivalent steel area table on Sheet 4.

5. Minimum cover on dowel reinforcing bars is 2" to outside face of structure.

6. Joints between wall segments and between wall segments and top or bottom slabs may be sealed either by preformed plastic gasket material using the procedures given in Section 430 of the Specifications or by non-shrink grout, in accordance with Section 434 of the Specifications.

7. Insert products approved by the Engineer may be used in lieu of dowel embedment.

OPTIONAL CONSTRUCTION JOINTS

REBAR STRAIGHT END EMBEDMENT FOR TOP AND BOTTOM SLABS

NOTE: NOT APPLICABLE AROUND MANHOLE AND RISER OPENINGS

WALL REINFORCING SPLICE DETAILS
Equivalent Steel Area Table provided. For bars and spacings not given, the steel area required may be adjusted in accordance with the Equivalent Steel Area Table.

Welded Wire Reinforcement Steel Area:

\[
\begin{align*}
\text{Min. Steel Area} &= A_{60} \times \text{Grade} \\
\text{Min. Style Designation} &= \text{Grade} \\
\text{Min. Steel Area} &= A_{65} \times \text{Style} \\
\text{Min. Style Designation} &= \text{Style}
\end{align*}
\]

When increased area of reinforcement is provided, then the maximum bar spacing may be increased by the squared ratio of increased steel area, but not to exceed 12".

Max. Bar Spacing Provided = Max. Bar Spacing Required \times \sqrt{\text{Steel Area Provided}}

In no case will reinforcement with wires smaller than W3.1 or D3.1, or spacings greater than 12" be permitted. Bar reinforcement shall show the minimum yield stress of grade mark or label the number 60 or one (1) grade mark line to be acceptable at the higher value.

Bar reinforcement other than 60 ksi may be used, however only two grades are recognized. Grade 40 and Grade 60. Smooth welded wire reinforcement, will be recognized as having a design strength of 65 ksi and deformed welded wire reinforcement will be recognized as having a design strength of 70 ksi. The area of reinforcement required may be adjusted in accordance with the Equivalent Steel Area Table provided. For bars and spacings not given, the steel area required can be determined by the following equations:

\[
\begin{align*}
\text{Grade 40 Steel Area} &= A_{40} = \frac{60}{65} \times A_{60} \\
\text{Grade 60 Steel Area} &= A_{60} = \frac{60}{60} \\
\text{Smooth Welded Wire Reinforcement Steel Area} &= A_{65} = \frac{65}{60} \times A_{60} \\
\text{Deformed Welded Wire Reinforcement Steel Area} &= A_{70} = \frac{70}{60} \times A_{60}
\end{align*}
\]

General Notes:
1. For square or rectangular precast drainage structures, either deformed or smooth welded wire reinforcement in accordance with Specification Section 931:
   a) Width and length of the unit is four times the spacing of the cross wires.
   b) Wire reinforcement shall be continuous around the box, and lapped in accordance with Option 1 or 2 as shown in the Wall Reinforcing Splice Details.
2. Horizontal steel in the walls of rectangular structures shall be lap spliced in accordance with Option 1, 2 or 3 shown in the Wall Reinforcing Splice Details.
3. Welding of splices and laps is permitted. The requirements and restrictions placed on welding in ASTM A 929 shall apply.
4. Rebar straight end embedment of peripheral reinforcement may be used in lieu of ACI standard hooks for top and bottom sizes except when hooks are specifically called for in the plans or standard drawings.
5. Concrete as specified in ASTM C 478, (4400 psi) may be used in lieu of Class II concrete in precast items manufactured in plants which meet the requirements of Section 449 of the Specifications.

General Notes:
1. For square or rectangular precast drainage structures, either deformed or smooth welded wire reinforcement in accordance with Specification Section 931:
   a) Width and length of the unit is four times the spacing of the cross wires.
   b) Wire reinforcement shall be continuous around the box, and lapped in accordance with Option 1 or 2 as shown in the Wall Reinforcing Splice Details.
2. Horizontal steel in the walls of rectangular structures shall be lap spliced in accordance with Option 1, 2 or 3 shown in the Wall Reinforcing Splice Details.
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4. Rebar straight end embedment of peripheral reinforcement may be used in lieu of ACI standard hooks for top and bottom sizes except when hooks are specifically called for in the plans or standard drawings.
5. Concrete as specified in ASTM C 478, (4400 psi) may be used in lieu of Class II concrete in precast items manufactured in plants which meet the requirements of Section 449 of the Specifications.
PICTORIAL VIEW

NOTE:
1. Submit Shop Drawings of corner openings for approval by the Engineer of Record.
2. \( h_1 \) may be less than 1'-0" when a minimum 1'-0" deep segment, 8" slab or curb inlet is provided above the corner opening.
3. For inlet segments at finish grade elevation substitute a #8 Bar for the top corner bar when 1'-0" \( \leq h_1 < 2'-0" \).

RECTANGULAR SEGMENT WITH PIPE OPENING AT CORNER

### DESIGNER NOTE:
Use only when round structures are not practical, engineer of record approval required.

### PLAN VIEW FOR SKEWS ≤ 45°

- (Not Centered)

### PLAN VIEW FOR SKEWS > 45°

- (Not Centered)

### SECTION AA

(Pipes Not Shown for Clarity)

DETAILS FOR SKEWED PIPES IN RECTANGULAR STRUCTURES
GENERAL NOTES

1. Trench drain is intended for use in gutters and driveways as shown on the typical locations on Sheet 2. Type I is intended for use in Type E, F and drop curbing, and adjacent to traffic separators and standard barrier walls. The width of the channel grate for Type I trench drain shall be 15" throughout varying the depth of the channel neck. Type II may also be used in those locations if an independent laboratory certifies that the grating used has an open area equal to at least 0.27 square feet per linear foot. Type II is primarily intended for use in valley gutter across driveway openings and drop curbing. Type I may also be used in those locations. The width of the channel grate for Type II trench drain shall be the same as the width of the channel. The liner slope or grating for Type II may be manufactured by varying the depth of the channel. Trench drain shall not be placed in pedestrian paths unless ADA compliant grates are used.

2. Unless shown in the plans, outlet pipes and prefomed channel inverts shall be sloped 0.6% or steeper toward the outlet regardless of the surface slope.

3. Trench drain may be stubbed directly into drainage structures, or outlet pipes may be used to connect trench drain to drainage structures.

4. A cleanout port compatible with the manufactured system shall be provided for Type I drains at the upstream end and at intervals not to exceed 50 feet. The cleanout port shall provide an opening 6" to 10" wide (transverse to the trench drain length) and 18" to 24" long. Where cleanouts are placed adjacent to raised curb or separator, the curb or separator shall be formed around the cleanout. The cleanout shall have a removable load resistant cover or grate.

5. Trench excavation must allow for a minimum of 6" of concrete to be placed under and alongside the trench drain channel system. Concrete backfills shall meet the requirements of Section 347 of the Standard Specifications. At the end of all units (Type I or II), the concrete backfill shall extend 6" minimum past the end of the drain opening.

6. Transverse bars for Type I trench drain shall be spaced 4" to 6" on center.

7. Whenever the work disturbs existing conditions or work already completed, restore the same to its original condition in every detail. All such repair and replacement shall meet the approval of the Engineer.

8. Payment to be made under the contract unit price for Trench Drain, LF.

DESIGN NOTES

1. Where placed adjacent to reinforced concrete barrier wall or median barrier wall, the designer shall detail in the plans the position of the drain relative to the barrier wall to avoid conflicts with the barrier wall footing. See Index No. 410.

2. The designer shall identify the following in the plans:
   (a) The type of drain at each location.
   (b) The beginning and ending locations of the Trench Drain.
   (c) The location of the outlet pipe if the Trench Drain is not stubbed directly into a drainage structure.
   (d) The design flow (Q) for the Trench Drain must be shown on the plans.

3. Capture efficiency for Type I trench drain may be computed using the equations for slotted drain in FHWA’s HEC 12 & 22. Grate Type I and Type II must have at least 30% open area.

4. Round pipe alternate is available in 12, 18, 24, and 36 inch.

5. Type II Prefomed Channel with integral anchoring lugs are applicable.
WITHIN TYPE E CURB

WITHIN TYPE F CURB

WITHIN DROP CURB

WITHIN DROP CURB

ADJACENT TO SHOULDER BARRIER WALL

ADJACENT TO TRAFFIC SEPARATOR

ROUND PIPE ALTERNATE SHOWN, BUT PREFORMED POLYETHYLENE ALTERNATE ACCEPTABLE

TYPICAL LOCATIONS FOR TYPE I

TYPICAL LOCATIONS FOR TYPE II

* As Necessary To Provide 6" Of Concrete On This Side Of Drain
INLET TYPE 5 (Curb Inlet Type 6 Symmetrical With Left Half)

GENERAL NOTES

1. The finished grade and slope of the inlet tops are to conform with the finished cross slope and grade of the proposed sidewalk and/or border.

2. For inlets constructed on a curve, refer to the plans to determine the radius, and modify the inlet details accordingly. Bend steel when necessary.

3. All reinforcing steel to be Grade 60 bars with 1½' minimum cover unless otherwise shown, see Sheet 4 for equivalent area Welded Wire Reinforcement details.

4. Inlet tops shall be either cast-in-place or precast concrete. Precast units shall conform to the dimensions shown or in accordance with approved shop drawings. Request for shop drawing approval shall be directed to the State Drainage Engineer.

5. Concrete meeting the requirements of ASTM C478 (4,000 psi) may be used in lieu of Class II concrete for precast units, manufactured in plants which meet the requirements of Section 449 of the Specifications.

6. Corner fillets are required at inlet opening for precast units or C-I-P units used in conjunction with circular inlet bottoms or skewed rectangular inlet boxes. Finish top of fillets flush with drain throat bottom and match slope.

7. For inlet bottoms see Index No. 200. Inlet tops are to be used with Type P bottoms, or Type J bottoms with 3'-6" square (Type B), 3'-6" or 4' round (Type A) risers or top slab openings.

8. These inlet tops are designed for use with standard curb and gutter Type E and Type F. Locate inlet outside of pedestrian crosswalks. For Type E curb, transition the shape of the curb over the gutter transition length to match the face of the inlet (Type F).

9. See Index No. 201 for supplemental details.

10. All steel used for frame and grate shall meet the requirements of ASTM A36/A36M.

11. Either cast iron grates or steel grates may be used.

12. When Alternate "G" grate is specified in the plans either the cast iron grate and galvanized steel frame or the the galvanized steel grate and frame must be used. Grates are to be grouted in accordance with the grouting detail shown on Sheet 5, in lieu of tack welding.

13. Inlet to be paid for under the contract unit price for Inlets (Curb) (Type _), Each.

DESCRIPTION:

REVISED 01/01/10

INDEX NO. 211

SHEET NO. 1 of 5

CURB INLET TOPS TYPES 5 AND 6
ALTERNATE REINFORCING STEEL DETAILS FOR WELDED WIRE REINFORCEMENT (WWR)

WELDED WIRE REINFORCEMENT PIECE NO. 1

PLACEMENT SCHEMATIC FOR WELDED WIRE REINFORCEMENT PIECE NO. 1

WELDED WIRE REINFORCEMENT PIECE NO. 2

PLACEMENT SCHEMATIC FOR WELDED WIRE REINFORCEMENT PIECE NO. 2

WELDED WIRE REINFORCEMENT PIECE NO. 3

PLACEMENT SCHEMATIC FOR WELDED WIRE REINFORCEMENT PIECE NO. 3

CONVENTIONAL REINFORCING STEEL BENDING DIAGRAMS

BILL OF REINFORCING STEEL

REINFORCING STEEL NOTES:
1. All bar dimensions in the bending diagrams are out to out.
2. Bars 4A and 4E may be combined into a single bar.
3. Welded Wire Reinforcement consists of Smooth or Deformed wire meeting the requirements of Specification Section 931.

REINFORCING STEEL DETAILS:

CONVENTIONAL REINFORCING STEEL BENDING DIAGRAMS

BILL OF REINFORCING STEEL

REINFORCING STEEL NOTES:
1. All bar dimensions in the bending diagrams are out to out.
2. Bars 4A and 4E may be combined into a single bar.
3. Welded Wire Reinforcement consists of Smooth or Deformed wire meeting the requirements of Specification Section 931.

REINFORCING STEEL DETAILS:
GENERAL NOTES

1. This inlet is used in Traffic Separators Types I and II, or in separators constructed with Curbs Types A, B and C and sidewalk paving, which cannot accommodate inlets Types 1, 2, 3, 4, 5, or 6. Use of this inlet on through traffic side of the separator is not permitted in medians with Curbs Types A and B. Locate inlet outside of pedestrian way.

2. All reinforcing to be Grade 60 bars with 2" min. cover unless otherwise shown. See Index No. 201 for equivalent area of welded wire fabric. Cut or bend bars out of way of pipe when necessary. Bars to clear pipe by 15".

3. Recommended maximum pipe sizes are 24" longitudinal and 30" transverse. For larger pipe, inlets with All. B bottoms, Index No. 200 are recommended.

4. For supplementary details see Index No. 201.

5. All dimensions are for both precast and cast-in-place inlets unless otherwise shown.

6. Inlet to be paid for under the contract unit price for Inlets (Curb) (Type 7), Each.
GENERAL NOTES

1. This inlet is to be used only in Traffic Separators Types IV and V; or, in separators constructed with Curbs Types D and F and sidewalk paving, which cannot accommodate Inlets Types 1, 2, 3, 4, 5 or 6. Use of this inlet on the through traffic side of the separator should be avoided in medians constructed with Curbs Type D (Curbs Inlets Types 9 or 10 are recommended). Locate inlet outside of pedestrian way.

2. All reinforcing to be Grade 60 bars with 2" min. cover unless otherwise shown. See Index No. 201 for equivalent area of welded wire fabric. Cut or bend bars out of way of pipe when necessary. Bars to clear pipe by 12".

3. Recommended maximum pipe sizes are 24" longitudinal and 30" transverse. For larger pipe, Inlets with Alt. B bottoms, Index No. 200 are recommended. Locate inlet outside of pedestrian way.

4. For supplemental details and notes see Index No. 201.

5. All dimensions are for both precast and cast-in-place Inlets unless otherwise shown.

6. Inlet to be paid for under the contract unit price for Inlets (Curb) (Type 8). Each.
CURB INLET TOP TYPE 9

GENERAL NOTES
1. This inlet is primarily intended for locations with light to moderate flows where right of way does not permit the use of through Curb Inlets Types 1 through 6. The typical application is on curb returns to city streets. The inlet grate shall be oriented with vanes directed toward Predominant Flow.

2. This inlet to be located outside of curb ramp area in vertical faced curbs such as Curb and Gutter Type F. Grate shall be reversible, right or left.

3. For structure bottoms see Index No. 200. For supplemental details see Index No. 201.

4. All steel in slab tops shall have 1½” minimum cover unless otherwise shown. Tops shall be either cast-in-place or precast concrete.

5. For Alternate B applications, top slab openings shall be placed such that 2 edges of inlet frame will be located directly above bottom wall or riser wall.

6. When used on a structure with dimensions larger than those detailed above and risers are not applied, the top slab shall be constructed using Index No. 200 with the slab opening adjusted to 24”x36”. The “Special Top Slab” on Index No. 200 is not permitted.

7. Frame may be adjusted with one to six courses of brick.

8. Vaned grates with approximately equal openings will be permitted that satisfy AASHTO HL-93 loading. Grates shall be reversible, right or left.

INDEX NO. SHEET NO.
2016 DESIGN STANDARDS 214 1 of 1

LAST REVISION 07/01/13 DESCRIPTION:

GRATE DETAIL

SECTION

1½” Bottom Lug (2 Corners) 3½”
12 Equal Spaces 2½”

TOP VIEW

©2016

LONGITUDINAL SECTION

FRAME AND GRATE

TOP VIEW

TRANSVERSE SECTION

GENERAL NOTES
1. This inlet is primarily intended for locations with light to moderate flows where right of way does not permit the use of through Curb Inlets Types 1 through 6. The typical application is on curb returns to city streets. The inlet grate is suitable for pedestrian and bicycle traffic.

2. This inlet to be located outside of curb ramp area in vertical faced curbs such as Curb and Gutter Type F. Grate shall be reversible, right or left.

3. For structure bottoms see Index No. 200. For supplemental details see Index No. 201.

4. All steel in slab tops shall have 1½” minimum cover unless otherwise shown. Tops shall be either cast-in-place or precast concrete.

5. For Alternate B applications, top slab openings shall be placed such that 2 edges of inlet frame will be located directly above bottom wall or riser wall.

6. When used on a structure with dimensions larger than those detailed above and risers are not applied, the top slab shall be constructed using Index No. 200 with the slab opening adjusted to 24”x36”. The “Special Top Slab” on Index No. 200 is not permitted.

7. Frame may be adjusted with one to six courses of brick.

8. Vaned grates with approximately equal openings will be permitted that satisfy AASHTO HL-93 loading. Grates shall be reversible, right or left.
This inlet is primarily intended for locations with light flows where right of way does not permit the use of throated Curb Inlets Types 1 through 6. The typical application is on curb returns to city streets. The inlet grate is suitable for pedestrian and bicycle traffic.

2. This inlet to be located outside of curb ramp area in vertical faced curbs such as Curb and Gutter Type F. Grate shall be oriented with vanes directed toward predominant flow.

3. For structure bottoms see Index No. 200. For supplemental details see Index No. 201.

4. All steel in slab tops shall have 1" minimum cover unless otherwise shown. Tops shall be either cast-in-place or precast concrete.

5. For Alternate B applications, top slab openings shall be placed such that 2 edges of inlet frame will be located directly above bottom or riser walls.

6. When used on a structure with dimensions larger than those detail above and risers are not applied, the top slab shall be constructed using Index No. 200 with the slab opening adjusted to 22"x24". The "Special Top Slab" on Index No. 200 is not permitted.

7. Frame may be adjusted with one to six courses of brick.

8. Vaned grates with approximately equal openings will be permitted that satisfy AASHTO HL-93 loading. Grates shall be reversible.
1. The finished grade and slope of the inlet top are to conform with the finished cross slope and grade of the proposed sidewalk and/or border.

2. When inlets are to be constructed on a curve, refer to the plans to determine the radius and, where necessary, modify the inlet details accordingly. Bend steel when necessary.

3. All steel shall have 2" minimum cover unless otherwise shown. Inlets can be either cast-in-place or precast concrete. Chamfer all exposed edges 90°.

4. All reinforcement is ASTM A615/A615M Grade 60 steel, either smooth or deformed. Equivalent area grade 40 steel or 65 ksi welded wire fabric may be substituted.

5. Inlets to be paid for under the contract unit price for Inlets (Closed Flume) EA.

* Sloped Section to be used w/sidewalk applications only.
** Toe Walls as depicted to be used with sidewalk application only. For endwall without sidewalk see detail on Sheet 2.
**Endwall**

- #4 Steel Tie Bar

**Location Reference**

- 2'-0" (Min.)
- 6" Thick Concrete Slab
- 2" Typ
- Varies
- Varies
- 3'-0" (Min.)

**Section AA**

- Curb & Gutter Type "F"
- 1'-6" Swale or Ditch
- 3'-0" E.P.

**Section BB**

- Curb & Gutter Type "F" (Right)
- 1'-6" Sod (Same As Right)
- 12'-0"

**Plan**

- Swale or Ditch Bottom
- Slab
- 2'-0" (Min.)

**Design Standards**

- 2016

**Flume W/O Sidewalk Inlet (Closed Flume) Type II**

**Single Barrel Flume Depicted**

*Bricks to Dissipate Energy: When Called For In Plans, Bricks To Be Included In The Cost Of The Inlet.*

- The Cost Of The 6"x6" W2.5xW2.5 Min. Welded Wire Reinforcement In The Width Of Sod To Be Included In The Cost Of The Inlet.
**GENERAL NOTES**

1. **Inlet Descriptions:**
   - **Type 1**: Single throat, one side of barrier wall.
   - **Type 2**: Double throats, one side of barrier wall.
   - **Type 3**: Two single throats, opposite side of barrier wall.
   - **Type 4**: Two double throats, opposite sides of barrier wall.

2. For grate details see Index No. 220. The parallel bar grate shall be used unless the reticuline grate is called for in the plans. The reticuline grate shall be specified where bicycle traffic is anticipated, used in areas of occasional pedestrian traffic. Not suitable for use in pedestrian traffic or bicycle way.

3. All exposed edges and corners shall be 1/4" chamfered or rounded to 1/4" radius.

4. For standard concrete barrier wall dimensions, and for dimensions of concrete barrier wall incorporating light standards within the wall, see Index No. 410.

5. **Reinforcing Steel:**
   - **Concrete Barrier Wall:**
     - **Shoulder:** 2" minimum cover.
     - **Horizontal wall reinforcing:** Must be positioned 3" from the inside face unless otherwise shown.

6. **For grate details see Index No. 220.** The parallel bar grate shall be used in areas of occasional pedestrian traffic. Not suitable for use in pedestrian traffic or bicycle way.

7. For supplemental details see Index No. 201.

8. All dimensions are for both precast and cast-in-place inlets unless otherwise noted.

9. **Inlets to be paid for under the contract unit price for Concrete Barrier Wall.**

**PICTORIAL VIEW (TYPE 1 SHOWN)**

**DETERMINATION OF AVERAGE BARRIER WALL UNIT PRICE (FOR BARRIER WALL, LF.)**

Concrete Barrier Wall Transition (To be Paid Under the Contract Unit Price for Barrier Wall).
PICTORIAL VIEW OF INLET COLLAR (TYPES 3, 4, & 5)

TOP VIEW OF INLET COLLAR WITHOUT GRATE

SECTION HH

VIEW KK

PRECAST COLLAR REINFORCING DETAILS (TYPES 3, 4 & 5)
(C-I-P COLLAR REINFORCING DETAILS SIMILAR)

PICTORIAL VIEW OF INLET COLLAR (TYPES 1 & 2)

TOP VIEW OF INLET COLLAR WITHOUT GRATE

SECTION EE

VIEW JJ

PRECAST COLLAR REINFORCING DETAILS (TYPES 1 & 2)
(C-I-P COLLAR REINFORCING DETAILS SIMILAR)
GENERAL NOTES

1. This inlet is primarily intended for use adjacent to concrete barrier walls on paved shoulders. Use of the inlet adjacent to other wall types shall be approved by the Drainage Engineer. The inlet is suitable for bicycle and occasional pedestrian traffic, with roller bar installation (see inset B) but should not be placed in a designated pedestrian travel way. It is not intended for use in curb and gutter or other areas where throated inlets are required, nor areas subject to high debris.

2. Inlets located in embankments constructed with earth anchored retaining wall shall be designed with minimum depths to reduce adverse impact on the anchorage system. Runs of pipe parallel to and near anchored wall shall be avoided wherever practical. Special coordination must be exercised during the design and construction of storm water systems within anchored wall systems.

3. Inlet bottoms and/or tops may be either precast or cast-in-place. Whether cast as a single unit or as multiple segments, and whether precast or cast-in-place, the upper 2'-3" of the inlet shall be reinforced in accordance with sections CC, DD and EE.

4. All exposed edges and corners shall be 1/8 chamfered or tooled to 45° radius.

5. When Alternate G grate is specified in the plans, the grate is to be hot-dip galvanized after fabrication. Field installation of the filter bar called for in Inset B will not be permitted, thereby requiring tolerance adjustment during fabrication and/or casting, or, matching grate to structure prior to galvanizing.

6. All reinforcing is Grade 60 bars. See Index No. 201 for equivalent area of welded wire fabric.

7. All dimensions are for both precast and cast-in-place inlets unless otherwise noted.

8. For supplemental details see Index Nos. 200 and 201.

9. Inlets to be paid for under the contract unit for Inlets (Barrier Wall), Each.

GENERAL NOTES

1. This inlet is primarily intended for use adjacent to concrete barrier walls on paved shoulders. Use of the inlet adjacent to other wall types shall be approved by the Drainage Engineer. The inlet is suitable for bicycle and occasional pedestrian traffic, with roller bar installation (see inset B) but should not be placed in a designated pedestrian travel way. It is not intended for use in curb and gutter or other areas where throated inlets are required, nor areas subject to high debris.

2. Inlets located in embankments constructed with earth anchored retaining wall shall be designed with minimum depths to reduce adverse impact on the anchorage system. Runs of pipe parallel to and near anchored wall shall be avoided wherever practical. Special coordination must be exercised during the design and construction of storm water systems within anchored wall systems.

3. Inlet bottoms and/or tops may be either precast or cast-in-place. Whether cast as a single unit or as multiple segments, and whether precast or cast-in-place, the upper 2'-3" of the inlet shall be reinforced in accordance with sections CC, DD and EE.

4. All exposed edges and corners shall be 1/8 chamfered or tooled to 45° radius.

5. When Alternate G grate is specified in the plans, the grate is to be hot-dip galvanized after fabrication. Field installation of the filter bar called for in Inset B will not be permitted, thereby requiring tolerance adjustment during fabrication and/or casting, or, matching grate to structure prior to galvanizing.

6. All reinforcing is Grade 60 bars. See Index No. 201 for equivalent area of welded wire fabric.

7. All dimensions are for both precast and cast-in-place inlets unless otherwise noted.

8. For supplemental details see Index Nos. 200 and 201.

9. Inlets to be paid for under the contract unit for Inlets (Barrier Wall), Each.
This inlet to be used in conjunction with Concrete Barrier Wall, Curb and Gutter, Index No. 410. The inlet is suitable for bicycle and occasional pedestrian traffic with extended crossbar or bar stub (see KSETS B & B ALTERNATE). Inlet should not be placed in a pedestrian way.

2. All reinforcing is Grade 60 bars. For equivalent area of welded wire fabric for inlet, see Index No. 201. Reinforcing shall have 2" min cover unless otherwise shown. Bars shall be trimmed or bent to provide 1/8" clearance around pipe openings. Cost for additional reinforcing in barrier wall to be included in cost of concrete barrier wall.

3. Barrier wall shall be Class II Concrete, finished surface in accordance with General Note 1, Sheet 1, Index No. 410.

4. All exposed edges and corners shall be 3/4" chamfer or beveled to 1/4" radius.

5. A flat 1"x7/8" drainage slot shall be constructed at the inlet centerline when the inlet is located in a curb sag. For drainage slot construction, no more than two bars shall be trimmed or bent such as type: 4A, 4K, and 4-U-Bar. On each side of drainage slots, vertical and horizontal bars shall be placed to provide 2" minimum concrete cover.

6. Recommended maximum pipe sizes are 18" longitudinal and 38" transverse. For larger pipe, use Alternate B bottom, Index No. 200.

7. Grates can be fabricated with reticuline bars or with either 1/2" or 3/8" or 5/8" electroformed cross bars and bearing bars as detailed on Sheet 3.

8. When Alternate G grate is specified in plans, the grate is to be hot-dip galvanized after fabrication according to Specification 962-9.

9. For Pay Item purposes, the depth of the barrier wall inlet shall be computed using the center of bar grate elevation, less the flow line elevation of the lowest pipe flow line or to the top of the sump floor elevation.

10. All dimensions are for both prestressed and post-tensioned unless otherwise noted.

11. Inlets to be paid for under the contract unit price for Inlets, Barrier Wall, Rigid, Curb & Gutter, Each.

12. Concrete Barrier Wall to be paid for under the contract unit price for Shoulder Concrete Barrier Wall, Rigid-Curb & Gutter, LF.
### Horizontal Wall Reinforcing Schedule (Table 1)

<table>
<thead>
<tr>
<th>WALL DEPTH</th>
<th>REINFORCEMENT</th>
<th>SCHEDULE</th>
<th>AREA/IN.</th>
<th>MAX. SPACING</th>
<th>BARS/M</th>
<th>MM</th>
<th>MAX.</th>
<th>MW</th>
<th>VAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>0'-4'</td>
<td>Bar 4A @ 8&quot; O.C.</td>
<td>0.20</td>
<td>12&quot;</td>
<td>8&quot;</td>
<td>4</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>4'-8'</td>
<td>Bar 4B @ 8&quot; O.C.</td>
<td>0.20</td>
<td>12&quot;</td>
<td>8&quot;</td>
<td>4</td>
<td>6</td>
<td>5</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>8'-12'</td>
<td>Bar 4C @ 8&quot; O.C.</td>
<td>0.24</td>
<td>20&quot;</td>
<td>10&quot;</td>
<td>6</td>
<td>8</td>
<td>6</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>12'-16'</td>
<td>Bar 4D @ 8&quot; O.C.</td>
<td>0.37</td>
<td>30&quot;</td>
<td>15&quot;</td>
<td>6</td>
<td>8</td>
<td>6</td>
<td>8</td>
<td>15</td>
</tr>
</tbody>
</table>

**NOTES:**

1. For dowelled transverse construction joint when abutting segments (less than 40' in length), see detail B, Index 410.
2. For additional information on "Standard Bar Bending Details," see index 21300.

### Reinforcing Notes:

1. Bars L1: Length 11'-7", Straight @ 8" O.C.
2. Bars L2: Length 8'-4" (Single Throat) 11'-0" (Double Throat) @ 8" O.C.
3. Bars L3 & L4: Length 11'-7" Field Bend For 4" Drop (Top Bars) 3" Drop (Bottom Bars) @ 8" O.C.
4. Bars L5: Length 2'-8" Field Bend For Drop Same As L3 & L4 @ 8" O.C.
5. U Bars @ 8" O.C.

### Horizontal Wall Reinforcing

- **Bar 4A:** @ 8" O.C.
- **Bar 4B:** @ 8" O.C.
- **Bar 4C:** @ 8" O.C.
- **Bar 4D:** @ 8" O.C.

---

**Sections:**

- **Section DD:** (18" Dia. Pipe Opening Shown)
- **Section EE:** (Pipe Opening Not Shown)

**Notes:**

- Install grate with extended crossbar options (Sheet 3) to front of inlet.
- Optional haunch shape (See Table 1).
- Drainage slot: 18" x 30" (Depress L1 bars for min. clearance below slot).
- Cast U-bar for 2" clearance above throat.

**Construction Joint:**

- Permitted between these limits. See Index No. 201 for min. dimensions.
Apartment To be Constructed At The Most Downstream Inlet In A Run Of Shoulder Gutter

CONCRETE APRON AT TERMINAL INLETS
ALT. A STRUCTURE BOTTOM FOR INLET TYPE S
**General Notes**

1. This inlet is suitable for village swales, ditches, or other areas subject to heavy vehicular loads, minimum debris. This inlet may be placed in areas subject to occasional pedestrian traffic such as landscaped areas and pavement areas where pedestrians can walk around the inlet. This inlet is not for use in a bicycle way.

2. When alternate "G" grate is specified in plans, the grate is to be hot dip galvanized after fabrication.

3. All reinforcing is Grade 60 bars with 2" min. cover unless otherwise noted. See Index No. 201 for equivalent area of welded wire fabric. Cut or bend bars out of way of pipe to clear pipe 1½".

4. All exposed edges and corners shall be ½" chamfer or tooled to ½" radius.

5. All dimensions are for both precast and cast-in-place inlets unless otherwise noted.

6. For supplementary details see Index No. 201.

7. Inlet to be paid for under the contract unit price for Inlets (Gutter Type V), EA.

**Horizontal Wall Reinforcing Schedule (Table 1)**

<table>
<thead>
<tr>
<th>Wall Depth</th>
<th>Schedule</th>
<th>Area (in²/ft)</th>
<th>Max. Spacing BARS Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 - 5</td>
<td>A12</td>
<td>0.20</td>
<td>12&quot;</td>
</tr>
<tr>
<td>9 - 9</td>
<td>A6</td>
<td>0.20</td>
<td>6&quot;</td>
</tr>
<tr>
<td>9 - 12</td>
<td>A4</td>
<td>0.20</td>
<td>4&quot;</td>
</tr>
<tr>
<td>9 - 15</td>
<td>B5.5</td>
<td>0.24</td>
<td>5½&quot;</td>
</tr>
</tbody>
</table>

**Recommended Maximum Pipe Sizes**

<table>
<thead>
<tr>
<th>Inlet Inside Width</th>
<th>Pipe Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>2'-11&quot; Or 3'-3&quot;</td>
<td>2'-0&quot;</td>
</tr>
<tr>
<td>3'-9&quot; Or 6'-0&quot;</td>
<td>3'-0&quot;</td>
</tr>
</tbody>
</table>

*Note: Recommended sizes are for concrete pipe. Sizes for other types of pipe must be verified for fit in accordance with Index No. 201.*

**Plan (Cast-in-Place Inlet Shown Without Grate; Precast Inlet Similar)**

**Section BB (Cast-in-Place Inlet Shown Precast Inlet Similar)**

**Section AA (Cast-in-Place Inlet)**

**Section BB (Cast-in-Place Inlet Shown Precast Inlet Similar)**

**Section AA (Precast Inlet)**
ALT. A STRUCTURE BOTTOM FOR INLET TYPE V

TOP SLAB OPENINGS

<table>
<thead>
<tr>
<th>DIAMETER</th>
<th>OPENING SIZE</th>
<th>MIN</th>
<th>MAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>5'-0&quot; to 8'-0&quot;</td>
<td>2'-11&quot; x 4'-0&quot;</td>
<td>3'-3&quot; x 3'-10&quot;</td>
<td></td>
</tr>
</tbody>
</table>

SECTION AA

SECTION BB

CENTERED OPENING

Top Slab With Centered Opening

Round Structure Bottom

See Index No. 200 For Structure Bottom Details and Hole Reinforcement.

5'-0" Min. To 8'-0" Max

(Unless Otherwise Shown In The Plans)

ALT. A STRUCTURE BOTTOM FOR INLET TYPE V

TOP SLAB REINFORCING DIAGRAM

#4 Bar Each Corner (2'-0" Min. Length)

#5 Hoop Bar (Peripheral Reinforcement)

2 Way Reinforcement See Tables

TOP SLAB REINFORCING SCHEDULE

<table>
<thead>
<tr>
<th>SCHEDULE</th>
<th>GRADE 46 (BAR) OR #5 KSI &amp; 70 KSI (WIRE FABRIC)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(k/ft)</td>
</tr>
<tr>
<td>A</td>
<td>0.20</td>
</tr>
<tr>
<td>B</td>
<td>0.24</td>
</tr>
<tr>
<td>C</td>
<td>0.29</td>
</tr>
<tr>
<td>D</td>
<td>0.32</td>
</tr>
<tr>
<td>E</td>
<td>0.37</td>
</tr>
<tr>
<td>F</td>
<td>0.43</td>
</tr>
<tr>
<td>G</td>
<td>1.06</td>
</tr>
<tr>
<td>H</td>
<td>1.25</td>
</tr>
</tbody>
</table>

TOP SLAB WITH CENTERED OPENING

<table>
<thead>
<tr>
<th>SLAB DEPTH</th>
<th>SLAB THICKNESS</th>
<th>REINFORCING (2 WAYS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIZE: 5'-0&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5'-3'-0&quot;</td>
<td>95&quot;</td>
<td>C</td>
</tr>
<tr>
<td>3'-0&quot;-6'-0&quot;</td>
<td>95&quot;</td>
<td>B</td>
</tr>
<tr>
<td>SIZE: 6'-0&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5'-3'-0&quot;</td>
<td>95&quot;</td>
<td>C</td>
</tr>
<tr>
<td>3'-0&quot;-6'-0&quot;</td>
<td>95&quot;</td>
<td>D</td>
</tr>
<tr>
<td>SIZE: 8'-0&quot;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.5'-3'-0&quot;</td>
<td>115&quot;</td>
<td>C</td>
</tr>
<tr>
<td>3'-0&quot;-6'-0&quot;</td>
<td>115&quot;</td>
<td>D</td>
</tr>
</tbody>
</table>

DIMENSIONS

See Table For Centered Opening -

9½" For 3'-0"-6'-0" Structure Bottoms

11½" For 8'-0" Structure Bottoms

2" Cl. 2" Cl. 2" Cl.

#8 Bars @ 5" Spacing

2 Way Reinforcement See Tables

GUTTER INLET TYPE V

INDEX NO. 221

SHEET NO. 2 of 2

2016 DESIGN STANDARDS

REV. 07/01/05

DESCRIPTION:

LAST REV.

07/01/05
**SECTION DD**

**Ditch Bottom**

**Flow**

1. Ditch Block (Low Side Of Inlet On Continuous Ditches)
2. Toe Wall Required (Paved Or Unpaved Ditches)

**Normal Ditch Bottom**

**SECTION CC**

**PLAN**

1. **Center Of Box**
2. **Location Reference**
3. **1/2" Preformed Joint Filler**
4. **3" Conc. Ditch Pavt.**
5. **All Around 2' Sod**
6. **Location Reference (See Index No. 201)**

**SECTION BB**

**WALL DEPTH**

1. **A12**
2. **A8**

**SCHEDULE**

1. **0 - 10**
2. **11 - 15**

**AREA**

1. **(in.²/ft.)**
2. **2"**
3. **5"**

**MAX. SPACING**

1. **12"**
2. **8"**

**WWF**

1. **12"**
2. **8"**

**BARS**

1. **4 Bars @ 9" Ctrs.**
2. **4 Bars @ 12" Ctrs.**

**INDEX NO. 200**

**GENERAL NOTES**

1. This inlet is designed for ditches, medians, or other area subject to heavy wheel loads on limited access facilities where debris may be a problem. This inlet is not for use in areas subject to pedestrian and/or bicycle traffic.

2. All reinforcing is Grade 60 bars with 2" min. cover unless otherwise noted. Cut or bend bars out of way of pipe to clear pipe by 1/2". See Index 201 for equivalent area of welded wire fabric.

3. All exposed edges and corners shall be 1/4" chamfer or tooled to 1/4" radius.

4. When alternate "G" grate is specified in plans, the grate is to be hot dip galvanized after fabrication.


6. For supplemental details see Index No. 201.

7. All dimensions are for both precast and cast-in-place inlets unless otherwise noted.

8. Inlet to be paid for under the contract unit price for inlet on continuous ditches (Dt No. 8). Unless otherwise noted. Cut or bend bars out of way of pipe to clear pipe by 1/2". See Index 201 for equivalent area of welded wire fabric.


**SECTION AA**

**Horizontal Wall Reinf. (See Table 1)**

**RECOMMENDED MAXIMUM PIPE SIZES**

<table>
<thead>
<tr>
<th>Inlet Inside Width</th>
<th>Pipe Size</th>
<th>2'-0&quot;</th>
<th>3'-1&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>18&quot;</td>
<td>2'-0&quot;</td>
<td>18&quot;</td>
<td>18&quot;</td>
</tr>
</tbody>
</table>

1. **Note:** Recommended sizes are for concrete pipe. Sizes for other types of pipe must be verified for fit in accordance with Index No. 201. For larger pipe see bottom detail right and Index No. 200.
ALT. A STRUCTURE BOTTOM FOR INLET TYPE A

Top slab with centered opening

Round structure bottom
See index No. 200 for structure bottom details and hole reinforcement.

9½" for 4'-0"/5'-0"/6'-0" structure bottoms
11½" for 8'-0" structure bottoms

#4 bar each corner (2'-0" min. length)

#5 hoop bar (peripheral reinforcement)

Centered opening - see table for dimensions

Section AA

Section BB

Top slab reinforcing diagram

Top slab openings

Diameter opening size

Min.
8'-0" to 8'-0"
2'-0" x 3'-1"
8'-0" min. to 8'-0" max

Top slab with centered opening

Size: 6'-0"

Size: 5'-0"

Size: 4'-0"

Size: 4'-0" to 8'-0"

Top slab reinforcing schedule

Grade 60 (BAR) or 65 KSI & 70 KSI (wire fabric)

Schedule

 reinforc(ing (2 ways))

<table>
<thead>
<tr>
<th>Size</th>
<th>Diameter</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>3'-1&quot; Or 2'-0&quot;</td>
<td>4'-0&quot; min. to 8'-0&quot; max. (unless otherwise shown in the plans)</td>
<td>11½&quot; for 8'-0&quot; structure bottoms</td>
</tr>
<tr>
<td>2'-0&quot; x 3'-1&quot;</td>
<td>#4 bar each corner</td>
<td></td>
</tr>
<tr>
<td>2 Way Reinforcement See Table For Dimensions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Centered opening - See Table For Dimensions
**REVISION NO.**

**INDEX NO.**

**DESCRIPTION:**

**REV. SELECTION 2016 DESIGN STANDARDS**

**INDEX NO.**

**SHEET NO.**

---

**DITCH BOTTOM INLET TYPE B**

---

**ESTIMATED QUANTITIES**

**For Informational Purposes Only**

<table>
<thead>
<tr>
<th>SLOT TYPE</th>
<th>SY</th>
<th>CY</th>
<th>SY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Slot</td>
<td>6.2</td>
<td>0.9</td>
<td>14</td>
</tr>
<tr>
<td>Double Slot</td>
<td>8.3</td>
<td>1.1</td>
<td>19</td>
</tr>
</tbody>
</table>

**CONCRETE INLET PAVEMENT AND SODDING**

---

**SECTION BB**

---

**SECTION AA**

---

**SECTION CC**

---

**SECTION DD**

---

**RECOMMENDED MAXIMUM PIPE SIZES**

<table>
<thead>
<tr>
<th>INLET INSIDE WIDTH</th>
<th>PIPE SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>3'-0&quot;</td>
<td>30&quot;</td>
</tr>
<tr>
<td>4'-0&quot;</td>
<td>36&quot;</td>
</tr>
</tbody>
</table>

---

**Note:** All B Structure Bottom Only. See Index No. 200 for structure bottom details and pipe opening reinforcement. Inlet with Structure Bottom

---

**Table 1**

<table>
<thead>
<tr>
<th>WALL DEPTH</th>
<th>AREA (in²/ft.)</th>
<th>MAX. SPACING</th>
</tr>
</thead>
<tbody>
<tr>
<td>0' - 3'</td>
<td>A-6</td>
<td>0.20</td>
</tr>
<tr>
<td>3' - 6'</td>
<td>A-6</td>
<td>0.20</td>
</tr>
<tr>
<td>6' - 9'</td>
<td>B-5.5</td>
<td>0.24</td>
</tr>
<tr>
<td>9' - 12'</td>
<td>Special</td>
<td>0.267</td>
</tr>
</tbody>
</table>

---

**Note:** Recommended sizes are for concrete pipe. Sizes for other types of pipe must be verified for fit in accordance with Index No. 201. For larger pipe see bottom detail above and Index No. 200.
The general purpose of the inlet top designs are:

- For ditches, medians or other areas subject to heavy wheel loads. This inlet may be placed in areas subject to occasional pedestrian traffic such as landscaped areas and pavement areas where pedestrians can walk around the inlet. Inlet not suitable for bicycle traffic.

- Provide full grate and horizontal slot designs for new construction.

- Provide full grate and horizontal slot designs for replacing the vertical slot tops on existing Inlets Type B and Type X that are in locations subject to occasional pedestrian traffic.

All reinforcing is Grade 60 bars with 2" min. cover unless otherwise noted. See Index No. 201 for equivalent area of welded wire fabric. Bars to be cut or bent for min. 1½" clearance around pipe.

All exposed edges and corners shall be ½" chamfer or tooled to ½" radius.

When Alternate G grates are specified in the plans, the grates are to be hot-dip galvanized after fabrication.

Cost for constructing traversable tops on new inlet boxes shall be included in the contract unit price for Inlets (DT BOT) (Type B), EA., and shall include the cost for surrounding concrete inlet pavement. Existing Inlets Type B and Inlets Type X that are converted to traversable inlet tops shall be paid for under the contract unit price for Inlets (DT BOT) (Type B) (Partial), EA. Unit price and payment shall be full compensation for inlet conversion and shall include the removal of any existing concrete inlet pavement; the removal and stockpiling or disposal of sufficient material from the existing inlet box to facilitate construction of the required inlet top; construction of the required inlet conversion; backfill construction; construction of concrete inlet pavement; reusing, supplementing, transferring or replacing grates as required by plans or as directed by the Engineer; any required earthwork for ditch restoration within 30' of the inlet; and, restoration of disturbed turf.

7. Ditch pavement shall be paid for separate from the inlet and concrete inlet pavement, by pavement types and units as called for in the plans.

8. Sod will be paid for under the contract unit price for Performance Turf, SY.

9. For supplementary details see Index No. 201.

GENERAL NOTES

1. The type of top (single or double slots) depends on the approach ditch configuration and the hydraulic requirements of the site. The designer will stipulate in the plans the type of top to be constructed at each individual inlet location.

2. On existing inlets, conversion grates shall be constructed at the original grate elevations unless other elevations are called for in the plans. When plans call for the inlet top to be constructed to support storm water detention, details for ditch modifications and underdrains shall be shown in the plans.

MAINTENANCE NOTES

1. Traversable inlet tops that are constructed by maintenance contract or by maintenance forces may reuse the existing grates that are determined by the Maintenance Engineer to be functionally sound, and their reuse is so directed by the Maintenance Engineer. Existing grates approved for reuse and new grates may be mixed, matched or replaced as directed by the Maintenance Engineer.
Centered Inlet

Structure Bottom

TOP VIEW

TOP SLAB OPENINGS

<table>
<thead>
<tr>
<th>DIAMETER</th>
<th>OPENING SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>6'-0&quot; to 8'-0&quot;</td>
<td>3'-8&quot; x 4'-2&quot;</td>
</tr>
<tr>
<td>7'-10&quot; x 4'-2&quot;</td>
<td></td>
</tr>
</tbody>
</table>

TOP SLAB REINFORCING DIAGRAM

#4 Bar Each Corner
(2'-0" Min. Length)

2 Way Reinforcement
See Tables

#5 Hoop Bar
(Peripheral Reinforcement)

Centered Opening:
See Table For Dimensions

TOP SLAB REINFORCING SCHEDULE

GRADE #6 (BAR) ON 65 KSI & 70 KSI (WIRE FABRIC)

<table>
<thead>
<tr>
<th>SCHEDULE</th>
<th>MIN.</th>
<th>MAX.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>0.24</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>0.53</td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>0.73</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>1.06</td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>1.45</td>
<td></td>
</tr>
</tbody>
</table>

TOP SLAB WITH CENTERED OPENING

<table>
<thead>
<tr>
<th>SLAB DEPTH</th>
<th>SLAB THICKNESS</th>
<th>REINFORCING (2 WAYS) SCHEDULE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5 &lt; 8&quot;</td>
<td>9/16&quot;</td>
<td>B</td>
</tr>
<tr>
<td>8&quot; &lt; 18&quot;</td>
<td>9/16&quot;</td>
<td>C</td>
</tr>
<tr>
<td>18&quot; &lt; 30&quot;</td>
<td>9/16&quot;</td>
<td>D</td>
</tr>
<tr>
<td>30&quot; &lt; 37&quot;</td>
<td>9/16&quot;</td>
<td>E</td>
</tr>
<tr>
<td>37&quot;-40&quot;</td>
<td>9/16&quot;</td>
<td>G</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SIZE: 8'-0&quot;</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>40&quot;-48&quot;</td>
<td>1&quot;</td>
</tr>
<tr>
<td>48&quot;-56&quot;</td>
<td>1.25&quot;</td>
</tr>
<tr>
<td>56&quot;-60&quot;</td>
<td>1&quot;</td>
</tr>
</tbody>
</table>

SECTION AA

C-I-P Precast

3'-8" Or 4'-2" x 3'-10" Or 4'-2"

6'-0" Min. To 8'-0" Max

Top Slab With Centered Opening

Round Structure Bottom

See Index No. 200 For Structure Bottom Details and Hole Reinforcement.

V/4" For 6'-0" Structure Bottoms
11/4" For 8'-0" Structure Bottoms

SECTION BB

ALT. A STRUCTURE BOTTOM FOR INLET TYPE B

DITCH BOTTOM INLET TYPE B

INDEX NO. 231 SHEET NO. 3 of 3

DESCRIPTION: 2016 DESIGN STANDARDS

LAST REVISION 07/01/05
**Ditch Bottom Inlet Types C, D, E and H**

**General Notes**
- See Sheet 3 of 7.

**Revised:** 07/01/05

**Description:**
- **Recommended Maximum Pipe Size:**
  - 5'-0" Wall - 24" Pipe
  - 6'-7" Wall - 1-60" Pipe
  - Or 2-24" Pipe (5'-3' - 5')

**Horizontal Wall Reinforcing Schedules (Table 4)**

<table>
<thead>
<tr>
<th>WALL DEPTH</th>
<th>SCHEDULE</th>
<th>AREA (in²/ft²)</th>
<th>MAX SPACING</th>
</tr>
</thead>
<tbody>
<tr>
<td>0'-0&quot;</td>
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<td>0.24</td>
<td>5</td>
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<tr>
<td>0'-10&quot;</td>
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<td>0'-15&quot;</td>
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**Horizontal Wall Reinforcing Schedules (Table 5)**

<table>
<thead>
<tr>
<th>WALL DEPTH</th>
<th>SCHEDULE</th>
<th>AREA (in²/ft²)</th>
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<tr>
<td>0'-0&quot;</td>
<td>C-3.5</td>
<td>0.37</td>
<td>3½</td>
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<tr>
<td>0'-10&quot;</td>
<td>C-3.5</td>
<td>0.33</td>
<td>4½</td>
</tr>
</tbody>
</table>

**Type H (2 & 3-grate inlet)**
- Recommended Maximum Pipe Size:
  - 3'-0" Wall - 24" Pipe
  - 5'-0" Wall - 24" Pipe
  - Or 2-24" Pipe (5'-3' - 5')

**Type H (4-grate inlet)**
- Recommended Maximum Pipe Size:
  - 3'-0" Wall - 1-60" Pipe
  - 5'-0" Wall - 1-78" Pipe
  - Or 2-24" Pipe (5'-3' - 5')
STIRLING PSW.png

NOTE: Steel Grates Are Required On Inlets With Traversable Slots And On Inlets Where Bicycle Traffic Is Anticipated.

1. These inlets are suitable for bicycle traffic and are to be used in ditches, medians and other areas subject to infrequent traffic loadings but are not to be placed in areas subject to heavy wheel loads. These inlets may be placed in areas subject to occasional pedestrian traffic such as landscaped areas and pavement areas where pedestrians can walk around the inlet.

2. Inlets subject to minimal debris shall be constructed without slots. Where debris is a problem inlets should be constructed with slots. Slotted inlets located within roadway clear zones and areas subject to pedestrians shall have traversable slots. The traversable slot modification is not adaptable to inlet Type H. Slots may be constructed at either or both ends as shown on plans. Traversable slots shall not be used in areas subject to occasional bicycle traffic.

3. Steel grates are to be used on all inlets where bicycle traffic is anticipated. Steel grates are to be used on all inlets with traversable slots. Either cast iron or steel grates may be used on inlets without slots where bicycle traffic is not anticipated. Either cast iron or steel grates may be used on all inlets with non-traversable slots. Subject to the selection described above, when Alternate G grate is specified in the plans, either the steel grate, hot dip galvanized after fabrication, or the cast iron grate may be used, unless the plans stipulate the particular type.

4. Recommended maximum pipe sizes shown are for concrete pipe. Size for other types of pipe must be checked for fit.

5. All exposed edges and corners shall be 1/8" chamfer or tooled to 1/2" radius.

6. Concrete inlet pavement to be used on inlets without slots and inlets with non-traversable slots only when called for in the plans; but required on all traversable slot inlets. Cost to be included in contract unit price for inlets. Quantities shown are for information only.

7. Traversable slots constructed in existing inlets shall be paid for as inlets partial. For conversion work and method of payment see TRAVERSABLE SLOT INLETS (PARTIAL) FOR EXISTING INLETS.

8. Sodding to be used on all inlets not located in paved areas and paid for under contract unit price for Performance Turf, SY.

9. For supplementary details see Index No. 201.

10. All reinforcing is Grade 60 bars with 2" min. cover unless otherwise noted. Bars to be cut or bent for 1/8" clearance around pipe opening. Provide one additional #4 bar above and at each side of pipe opening.
FOR TRAVERSABLE SLOTS

PAVEMENT AND SODDING QUANTITIES
FOR TRAVERSABLE SLOTS

<table>
<thead>
<tr>
<th>Inlet</th>
<th>Pavement</th>
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<th>Double Slot</th>
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<td>9.37</td>
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</table>

Concrete Inlet Pavement (Hand Shape to Neat Lines)

FLOW

Slope Varies

Ditch Width
Varies (5' Std.)

Slope Varies

Ditch Width
Varies (5' Std.)

TRAVERSABLE SLOTS

DITCH BOTTOM INLET TYPES C, D, E AND H
**SODDING AND PAVEMENT FOR INLETS WITHOUT SLOTS AND INLETS WITH NON-TRAVERSABLE SLOTS**

**SECTION AA**

**SECTION BB**

**NON-TRAVERSABLE SLOTS**

**SECTION CC (CASE I)**

**SINGLE SLOT SHOWN (DOUBLE SLOTS SYMMETRICAL ABOUT CENTERLINE)**

**PAVEMENT AND SODDING QUANTITIES FOR TRAVERSABLE SLOTS**

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**NOTE:**
- For plan view and additional details see Sheet 4 of 7.
- For payment see General Notes Nos. 6 and 7, Sheet 3 of 7.

**DITCH BLOCK FOR INLETS WITH OR WITHOUT SLOTS**

**TRAVERSABLE SLOTS FOR EXISTING INLETS**

For payment see General Notes Nos. 6 and 7, Sheet 3 of 7.
1. The general purpose of these conversions is to remove the hazard of the protruding inlet top, while not creating a hazard by depressing the top too deeply.

2. The corrective procedure depends on the approach ditch grade and hydraulic requirements of the site. The selection of the appropriate case depends on the relationship between inlet top and ditch elevation, and, on the vertical clearance between the top of the uppermost pipe(s) and the grate. The purpose for the Case 1 conversion is to add the traversable slot to an existing inlet where top removal, change in grate elevation and ditch transitions are not required. Case 2 will normally be applicable to ditches with steeper grades adjoining the inlet. Case 3 will normally be applicable to ditches with steeper grades adjoining the inlet where build up of the existing ditch is acceptable.

3. The designer shall stipulate in the plans which case is to be constructed at each individual inlet location.

METHOD OF PAYMENT FOR TRAVERSABLE SLOT INLETS (PARTIAL) FOR EXISTING INLETS

1. Existing inlets converted to traversable slot tops under Cases 1, 2 and 3 shall be paid for as inlets partial, each. Case shall not be included in the pay item description.

2. All ditch reconstruction work within 35 feet of each traversable slot conversion, whether required by these details or as a direct result of the conversion, shall be included as a part of the partial cost. Reconstruction work shall include excavation and removal of surplus materials or borrow materials in place, grading, compaction, shaping and restoration of disturbed turf. Sodding, ditch pavement and underdrain are not included as part of the inlet partial cost and are to be paid separately.

3. Concrete inlet pavement and sodding shall be in accordance with the sections on this detail and with the plans on Sheet 4 and Sections AA, BB and CC (as Case 1) and tabular quantities on Sheet 5.

4. Unit price and payment shall constitute full compensation for inlet conversion (including concrete inlet paving and replacement grate(s)), ditch reconstruction, restoration of disturbed turf, and shall be paid for under the contract price for inlets (DT Bid) (Type 2) (Partial), each.

Sodding shall be paid for under the contract unit price for Performance Turf, SY. Ditch pavement shall be paid for separately from the inlet by pavement type(s) and underdrain are not included as part of the inlet partial cost and are to be paid separately.

The designer shall determine whether tight soil or other conditions at each individual inlet indicates the need for underdrain in Case 3 conversions and shall call for underdrain, Type I in the plans.

Where the existing inlet top is above the existing ditch (Case 2) but borrow material will be required to adjust the ditch (Case 3), and vertical clearance or other conditions do not prevent removal of the inlet top, the designer should call for Case 2. The designer shall determine if ditch reconstruction is required more than 35 feet beyond any traversable slot side and shall include separate pay items in the plans to cover the costs for that portion of ditch reconstruction exceeding the 35 foot limit. The designer shall also determine whether ditch pavement is required for ditch restoration within the 35 foot limit and include that pavement under a pay item separate from the inlets partial.

When the detention ditch concept is to be used with Case 3, the designer shall stipulate Case 3 (Detention) in the plans.

The designer shall determine if ditch pavement is required for ditch restoration within the 35 foot limit and include that pavement under a pay item separate from the inlets partial.

Where the existing inlet top is above the existing ditch (Case 2) but borrow material will be required to adjust the ditch (Case 3), and vertical clearance or other conditions do not prevent removal of the inlet top, the designer should call for underdrain, Type I in the plans.
**ALT. A STRUCTURE BOTTOM FOR INLETS TYPE C, D & E**

**TOP SLAB OPENINGS**

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<th>DIAMETER</th>
<th>OPENING SIZE</th>
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<tr>
<td>4'-0&quot;</td>
<td>2'-0&quot; x 3'-1&quot;</td>
</tr>
<tr>
<td>6'-0&quot;</td>
<td>2'-0&quot; x 3'-1&quot;</td>
</tr>
</tbody>
</table>

**TOP SLAB REINFORCING DIAGRAM**

- **#4 Bar Each Corner** (2'-0" Min. Length)
- **#5 Hoop Bar** (Peripheral Reinforcement)
- **2 Way Reinforcement** See Tables

**TOP SLAB WITH CENTERED OPENING**

<table>
<thead>
<tr>
<th>SLAB DEPTH</th>
<th>SLAB THICKNESS</th>
<th>REINFORCING (2 WAYS) SCHEDULE</th>
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<tr>
<td>≤ 5'-0&quot;</td>
<td>95&quot;</td>
<td>C</td>
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<tr>
<td>5'-0&quot; - 6'-0&quot;</td>
<td>95&quot;</td>
<td>D</td>
</tr>
<tr>
<td>6'-0&quot; - 8'-0&quot;</td>
<td>95&quot;</td>
<td>E</td>
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<tr>
<td>≥ 8'-0&quot;</td>
<td>115&quot;</td>
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<table>
<thead>
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<td>10&quot; - 11&quot;</td>
<td>E</td>
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<tr>
<td>≥ 11&quot;</td>
<td>F</td>
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</table>

**TOP SLAB REINFORCING SCHEDULE**

- **GRADE 60 (BAR)**
- **OR 65 KSI & GRADE 60 (BAR)**

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<th>DESIGN</th>
<th>SCHEDULE</th>
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<td>B</td>
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<tr>
<td>D</td>
<td>1.06</td>
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<tr>
<td>E</td>
<td>1.20</td>
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</table>

**SECTION AA**

- **Centered Inlet Structure Bottom (Minimum Diameter unless Otherwise Shown In The Plans)**

**SECTION BB**

- **#8 Bars**
- **#4 Bar Each Corner**
- **11½ For 4'-0" Structure Bottoms**

**CENTERED OPENING**

- **Top Slab With Centered Opening**
- **Round Structure Bottom See Index No. 200 For Structure Bottom Details and Hole Reinforcement.**

**PIECE OPENING SCHEMATIC**

- **ALT. B STRUCTURE BOTTOM FOR INLETS TYPE C, D & E**

- **See Index No. 200 for structure bottom details and hole reinforcement.**
1. Cost of paving to be included in cost of inlet.
2. Pavement and/or sod to be used only where called for in the plans.

**Notes:**
1. Pavement and/or sod to be used only where called for in the plans.
2. Cost of paving to be included in cost of inlet.
3. Steel Grating, Straight Bars 3x3x16, Reticuline Bars 2x19x16

**SECTION AA**

**SECTION BB**

**SECTION CC**

**SECTION DD**

**RECOMMENDED MAXIMUM PIPE SIZES**

<table>
<thead>
<tr>
<th>INLET INSIDE WIDTH</th>
<th>PIPE SIZE</th>
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</thead>
<tbody>
<tr>
<td>2'-6&quot; (Type F)</td>
<td>18&quot;</td>
</tr>
<tr>
<td>4'-0&quot; (Type F)</td>
<td>30&quot;</td>
</tr>
<tr>
<td>4'-0&quot; / 5'-0&quot; (Type G)</td>
<td>42&quot;</td>
</tr>
</tbody>
</table>

Note: Recommended sizes are for concrete pipe. Sizes for other types of pipe must be verified for fit in accordance with Index No. 201. For larger pipe sizes see Note 3.
**General Notes:**

1. This inlet is designed for use in ditches, medians, pavement areas or other areas subject to heavy wheel loads with minimal dooms. This inlet is not for use in areas subject to bicycle traffic. This inlet may be placed in areas subject to occasional pedestrian traffic such as landscaped areas and pavement areas where pedestrians can walk around the inlet.

2. All reinforcing Grade 60 bars with 2" min. cover unless otherwise noted. See Index No. 201 for areas where pedestrians can walk around the inlet.

3. All exposed edges and corners shall be 1/4" chamfer or tooled to a 45° radius.

4. When alternate C grate is specified in plans the grate is to be hot dip galvanized after fabrication.

5. For supplemental details, see Index No. 201.

6. All dimensions are for both precast and cast-in-place inlets unless otherwise noted.

7. Cost of ditch paving to be included in cost of inlet. Sodding to be paid for under contract unit price for Performance Turf, SY.

---

**PLAN**

(CAST-IN-PLACE INLET SHOWN, WITHOUT GRATE, PRECAST INLET SIMILAR)

- **Location Reference**
  - Center Of Box
  - No. 201
  - See Index
  - Eyebolt

- **Steel Grating**
  - See Detail

- **#4 Bars**
  - @ 12" Ctrs.

---

**INSET A**

(PRECAST OPTION)

- **Horiz. Wall Reinforcement Schedule (Table 1)**

---

**HORIZONTAL WALL REINFORCING**

- **Recommended Maximum Pipe Sizes**

---

**GENERAL NOTES**

- **Performance Turf, SY.**
- **Cost of ditch paving to be included in cost of inlet. Sodding to be paid for under contract unit price for Performance Turf, SY.**
**Ditch Bottom Inlet Type J**

**SECTION CC**
- Ditch Bottom
- Toe Wall Required (Paved or Unpaved Ditches)

**SECTION DD**
- Ditch Block (low side of inlet on continuous ditches)

**PAVEMENT & SODDING**
- 2' Sod All Around
  (Total 9 SY)
- Each End
- 16 5x3x
- 6" Sidewalk

**STEEL GRATING**
- Main Bars 9" x 1/2" (Notched for Cross Bars)
- Cross Bars 1 3/4" x 1/2" (Continuously Welded At Main Bar Notches) Main Bars and Cross Bars Flush on Top.

Note: Two Required Per Inlet
**GENERAL NOTES**

1. This inlet is to be used at locations having high flow rates, usually where an embank could not be utilized without hazardous intake.

2. Inlet length (L) shall be set by the designer for the greater of either curvilinear requirement or inlet pool not to exceed 12' depth. Structures over 6 feet in depth are to be checked for floodway by the designer of project drainage.

3. This inlet is not intended for use with Index 200 structure bottoms.

4. All exposed edges and corners shall be 1/8 chamfer or tooled to 1/8" radius.

5. Inlet and anti-vortex wall to be Class II Concrete.

6. All reinforcing is Grade 60 with 7" min. cover unless otherwise noted. See Index No. 205 for equivalent area of welded wire fabric (WWF).

7. Channel section C 3x6 at 14" max. bar spacing may be used as an alternate for the C 4x5.4 channel at 15" bar spacing.

8. Channels and bars for grate shall be ASTM A242/A242M, A572/A572M or A588/A588M, Grade 50 steel, and galvanized in accordance with Specification Section 975.

9. Fence enclosure shall be Fence Type B (Index No. 802). All posts to be set in concrete. A minimum of 10 posts required. Corner and approach side posts to be 3" nominal diameter.

10. Cost of ditch paving, anti-vortex wall, grate, reinforcing steel and fence enclosure to be included in the cost of inlet. Inlet to be paid under the contract unit price for Inlets (DT Bot) (Type K). Each.

11. Anchor Bolts shall be ASTM F1554 Grade 36 fully threaded headdless bolts, installed in accordance with Specification Sections 416 and 937. Nuts shall be ASTM A563 or A194 and washers shall be ASTM F166 or Type A plain washers. All nuts, bolts and washers shall be galvanized.

**DESIGN STANDARDS**

- **Ditch Bottom Inlet Type K**

**INDEX**

- **NO. 235**

**SHEET NO.**

- **1 of 2**

**SECTION AA**

**INLET LENGTHS (L) LESS THAN OR EQUAL TO 9' (SINGLE LAYER WALL REINFORCING)**

**SECTION BB**

**INLET LENGTHS (L) GREATER THAN OR EQUAL TO 9' (DOUBLE LAYER WALL REINFORCING)**

**PLAN**

- **Anti-Vortex Wall**

**SECTION**

- **BB**

- **AA**

**DESIGN STANDARDS**

- **For Depth > 6'**

- **For Depth ≤ 6'**

**INLET LENGTHS (L) GREATER THAN OR EQUAL TO 9' (DOUBLE LAYER WALL REINFORCING)**

**INLET LENGTHS (L) LESS THAN OR EQUAL TO 9' (SINGLE LAYER WALL REINFORCING)**

**LOCATION REFERENCE**

- **Center Of Box**

**CONSTRUCTION JOINT PERMITTED**

- **Reinforced With 6" x 6" Concrete Ditch Paving**

**DESIGN STANDARDS**

- **Pipe Opening Shown, Grate Not Shown**

**DESIGN STANDARDS**

- **Grate Not Shown**

**DESIGN STANDARDS**

- **Pipe Opening & Grate Not Shown**
1. This skimmer is intended for use on Type C, D, or E Ditch Bottom Inlets that are used as outlet control structures of stormwater management facilities.

2. The side panels are dimensionally symmetric, therefore they may be used on either side of the structure.

3. Two (2) skimmers may be constructed on one structure provided they are on opposite ends.

4. The width of the front panel (dimension W) shall be the same as the outside dimension across the front of the structure.

5. The front panel, side panels, and flat bars are to be hot dip galvanized after fabrication.

6. The location of the reinforcing steel in these structures must conform to the applicable standards to avoid conflict with the expansion anchors used to attach the skimmer.

7. Grates to be used on the inlets unless otherwise specified in the plans.

8. A skimmer consists of two (2) side panels, one front panel, two (2) flat bars, and accessory hardware. The cost of skimmers is to be included in the cost of the inlet.

GENERAL NOTES

1. The designer must show the configuration of the weir slots in the outlet control structure details.

2. Where a grate is not needed for safety reasons and is not desirable for hydraulic or other reasons, the designer may omit the grate by stating so in the outlet control structure details.

3. The configuration of skimmers may be subject to regulatory requirements. The designer should coordinate the outlet control structure details with the permitting agencies.

4. Where this skimmer is used, the designer should reference this index with the outlet control structure details. Where a different skimmer design is needed, the designer should provide skimmer details in the plans.

5. The designer shall evaluate if a grate is needed for safety reasons. Where a grate is not needed for safety reasons and is not desirable for hydraulic or other reasons, the designer may omit the grate by stating so in the outlet control structure details.

6. The designer must show the configuration of the weir slots in the outlet control structure details.

DESIGN NOTES

1. The designer must specify, in the plans, the skimmer height (dimension H) and the sides where the weir slots and skimmers are located. The skimmer height must be one of the dimensions shown in the table on Sheet 2. The skimmer should not be used on structure sides with outside dimensions greater than 6'-4".

2. To minimize hydraulic losses across the skimmer, the flow area under the skimmer should be three times larger than the flow area of the weir slot. The distance between the pond bottom at the structure and the skimmer shall be not less than 1 foot.

3. The location of the reinforcing steel in these structures must conform to the applicable standards to avoid conflict with the expansion anchors used to attach the skimmer.

4. The expansion anchor spacing varies, see Sheet 2.
SKIMMER FOR OUTLET CONTROL STRUCTURES

DIMENSIONS

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<th>E</th>
<th>L</th>
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</table>

Steel Sheet 0.1345" Thick (10 Gage) (6 Holes)

1/4" Dia. (3 Holes)

1/2" Thick x 1 1/2" Wide

Front Panel Width Varies, See General Notes

Top Flange (Cut Away) Bottom Flange

Front Panel

Top View

End View (Front)

Side View

Side Panel

End View

Flange Bar
1. The Frenchdrain Skimmer is a hooded cover, mounted over an outlet in a catchbasin, that prevents oil and floating debris from exiting the basin. Use this skimmer in Frenchdrain Catchbasins and in other locations where there is a need to prevent oil, debris or other floating contaminants from exiting Catchbasins through outlet pipes.

2. Place neoprene gasket material between the skimmer and the catchbasin at all points of contact. Trim the gasket neatly to extend ½ inch beyond the joint on all sides.

3. Skimmer baffles, cleanout pipe and angles shall be primarily constructed of either galvanized steel, aluminum, polyvinyl chloride, polyethylene, fiberglass or acrylonitrite butadiene styrene. All steel components, other than stainless, shall be hot-dip galvanized.

4. Mounting hardware, hinges and latches shall all be stainless steel. Loss prevention device shall be either stainless steel chain or riveted nylon strap.

5. Material used in construction of skimmer bodies (baffles) and cleanout pipe shall comply with Standard Specification 943 for steel, 945 for aluminum or 948 for plastics.

6. All costs for furnishing and installing a Frenchdrain skimmer shall be included in the cost of the basin in which it is installed. Retrofit skimmers shall be paid for as 'modify existing structure'.

7. Plastic Skimmers shall contain a minimum of 1.5% by weight of carbon black for UV protection.

**DESIGN NOTES**

1. The contractor may submit an alternative design prefabricated Frenchdrain Skimmer for approval by the Engineer.

2. Show, in the plans, the location of the basin and indicate the interior side(s) of the basin on which a skimmer will be installed.

3. Type I Skimmer dimensions shall be based on the outlet pipe diameter as shown in the dimension table.

4. Type II Skimmers are to be used only with outlet pipe diameters of 15", 18", and 24". Plastic Skimmers shall contain a minimum of 1.5% by weight of carbon black for UV protection.

**GENERAL NOTES**

- The cleanout part for the Type II skimmer shall be gasketed, with either a threaded screw-in lid or a lid secured by four stainless steel quick-release latches.

- Type I Skimmer dimensions shall be based on the outlet pipe diameter as shown in the dimension table.

- Neoprene gasket material shall be used between the skimmer and the catchbasin at all points of contact. Trim the gasket neatly to extend ½ inch beyond the joint on all sides.

- Skimmer baffles, cleanout pipes, and angles shall be primarily constructed of either galvanized steel, aluminum, polyvinyl chloride, polyethylene, fiberglass, or acrylonitrite butadiene styrene. All steel components, other than stainless, shall be hot-dip galvanized.

- Mounting hardware, hinges, and latches shall all be stainless steel. Loss prevention devices shall be either stainless steel chain or riveted nylon strap.

- Material used in construction of skimmer bodies (baffles) and cleanout pipes shall comply with Standard Specification 943 for steel, 945 for aluminum or 948 for plastics.

- All costs for furnishing and installing a Frenchdrain skimmer shall be included in the cost of the basin in which it is installed. Retrofit skimmers shall be paid for as 'modify existing structure'.

- Plastic Skimmers shall contain a minimum of 1.5% by weight of carbon black for UV protection.

- The Frenchdrain Skimmer is a hooded cover, mounted over an outlet in a catchbasin, that prevents oil and floating debris from exiting the basin. Use this skimmer in Frenchdrain Catchbasins and in other locations where there is a need to prevent oil, debris or other floating contaminants from exiting Catchbasins through outlet pipes.

- Place neoprene gasket material between the skimmer and the catchbasin at all points of contact. Trim the gasket neatly to extend ½ inch beyond the joint on all sides.

- Skimmer baffles, cleanout pipes, and angles shall be primarily constructed of either galvanized steel, aluminum, polyvinyl chloride, polyethylene, fiberglass, or acrylonitrite butadiene styrene. All steel components, other than stainless, shall be hot-dip galvanized.

- Mounting hardware, hinges, and latches shall all be stainless steel. Loss prevention devices shall be either stainless steel chain or riveted nylon strap.

- Material used in construction of skimmer bodies (baffles) and cleanout pipes shall comply with Standard Specification 943 for steel, 945 for aluminum or 948 for plastics.

- All costs for furnishing and installing a Frenchdrain skimmer shall be included in the cost of the basin in which it is installed. Retrofit skimmers shall be paid for as 'modify existing structure'.

- Plastic Skimmers shall contain a minimum of 1.5% by weight of carbon black for UV protection.

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- Place neoprene gasket material between the skimmer and the catchbasin at all points of contact. Trim the gasket neatly to extend ½ inch beyond the joint on all sides.

- Skimmer baffles, cleanout pipes, and angles shall be primarily constructed of either galvanized steel, aluminum, polyvinyl chloride, polyethylene, fiberglass, or acrylonitrite butadiene styrene. All steel components, other than stainless, shall be hot-dip galvanized.

- Mounting hardware, hinges, and latches shall all be stainless steel. Loss prevention devices shall be either stainless steel chain or riveted nylon strap.

- Material used in construction of skimmer bodies (baffles) and cleanout pipes shall comply with Standard Specification 943 for steel, 945 for aluminum or 948 for plastics.

- All costs for furnishing and installing a Frenchdrain skimmer shall be included in the cost of the basin in which it is installed. Retrofit skimmers shall be paid for as 'modify existing structure'.

- Plastic Skimmers shall contain a minimum of 1.5% by weight of carbon black for UV protection.
1. Light duty cast iron cover and frame, see Specifications Section 982.

2. Concrete shall be Class I, except ASTM C479 (4000 psi) concrete may be substituted for precast items manufactured in plants meeting the requirements of Section 449 of the Specifications. Box shall be reinforced with No. 3 bars (Grade 60) on 8" centers both ways, sides and bottom.

3. Concrete apron to be included in the contract unit price for Underdrain Inspection Box.

4. All covers shall be furnished with pick holes. Fitted lifts or handles are not permitted.

5. Manhole Type P Alternate A, Index No. 200, with Type I Frame and Cover, Index No. 203, may be used in lieu of the box detailed on this sheet, and is recommended when high ADT increases chance of the repeated vehicle loadings.
ENDWALL DIMENSIONS (EXCLUSIVE OF MULTIPLE PIPE SPACING)

ENDWALL POSITIONS FOR SINGLE AND MULTIPLE

PIECE AND SPACING FOR MULTIPLE PIPE

GENERAL NOTES

1. Endwall dimensions, locations and positions are for round and elliptical concrete pipe and for round, and pipe-arch corrugated metal pipe. Round concrete pipe shown.

2. Front slope and ditch transitions shall be in accordance with Index No. 280.

3. Endwalls may be cast in place or precast concrete. Reinforcing steel shall be Grades 40 or 60. Additional reinforcement necessary for handling precast units shall be determined by the Contractor or the supplier. Cost of reinforcement shall be included in the contract unit price for Concrete. (Endwalls)

4. All exposed corners and edges of concrete are to be chamfered 1/8".

5. Concrete shall be Class I, except ASTM C478 (4000 psi) concrete may be substituted for precast items manufactured in plants meeting the requirements of Section 449 of the Specifications.

6. On outfall ditches with side slopes flatter than 1:1½, provide 10' transitions from the endwall to the flatter side slopes, right of way permitting.

7. For sodding around endwalls see Index No. 281.

8. Payment for concrete quantities for endwalls skewed to the pipe shall be made on the following basis:
   - Endwall Skew to Pipe Use Tabulated Value
     - 0" to 5" 0'
     - 6" 10'
     - 16" 30'
     - 31" of over 45'

9. Pipe length plan quantities shall be based on the pipe and locations shown in the standard location control and end view, or lengths based on special endwall locations called for in the plans.

10. Payment for pipe in pipe culverts shall be based on plan quantities, adjusted for endwall locations subsequently established by the Engineer.

11. Endwalls to be paid for under the contract unit price for Class I Concrete (Endwalls), CY.
### Data and Estimated Quantities for One Endwall

#### Round Concrete and Corrugated Metal Pipe

**Class I Concrete (CY)**

<table>
<thead>
<tr>
<th>Number and Type of Pipe and Slope Angle of Pipe</th>
<th>Single</th>
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#### Corrugated Metal Pipe Arch

**Class I Concrete (CY)**

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#### Concrete Elliptical Pipe

**Class I Concrete (CY)**

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Note: Use the guidelines of General Note No. 8 for selecting tabular quantities.
1. Straight concrete endwalls are intended for use outside the clear zone.

2. Endwalls may be cast-in-place or precast construction. Cast-in-place endwalls shall conform to the construction details on this Index. Precast construction which adheres to this Index, including any additional reinforcement required for handling which shall be determined by the Contractor or supplier, does not require additional approvals. Deviations from this Index, for precast units, shall require the approval of the State Drainage Engineer prior to construction. For precast construction, see Index No. 201 for opening and grouting details.

3. Reinforcing steel shall be either Grade 40 or 60.

4. Concrete shall be Class II, except ASTM C476 (4000 psi) concrete may be substituted for precast items manufactured in plants meeting the requirements of Section 449 of the Specifications.

5. Chamfer: All exposed edges and corners to be chamfered 1/2" unless otherwise shown.

6. That portion of corrugated metal pipe in direct contact with the concrete slab and extending 12" beyond shall have a continuous bituminous coating of .004" minimum thickness applied prior to placing of the concrete.

7. Sodding shall be in accordance with Index No. 281 and paid for under the contract unit price for Performance Turf, SY.

8. Basis of payment for either cast-in-place or precast construction shall be the estimated quantities tabulated on the Index. Concrete and reinforcing steel shall be paid for under the contract unit prices for Class II Concrete (Endwalls), CY and Reinforcing Steel (Roadway), LB.

OPTIONAL ENTRANCE FOR CONCRETE PIPE
SECTION BB

HALF ELEVATION
(Showing Bars In Front Face Of Wall)

HALF ELEVATION
(Showing Bars In Back Face Of Wall)

TYPICAL SECTION THRU ENDWALL

BILL OF REINFORCING STEEL

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<td>7'-6&quot;</td>
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<td>Field Bend</td>
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<td>Footing &amp; Wall</td>
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BENDING DIAGRAM

NOTE: All bar dimensions are not to scale.

ESTIMATED QUANTITIES

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<th>CMP</th>
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</table>

OPTIONAL ENTRANCE FOR CONCRETE PIPE

STRAIGHT CONCRETE ENDWALLS
SINGLE AND DOUBLE 60° PIPE

DESCRIPTION:

REVISIO N

NO. SHEET

INDEX

PAGE NO.

NOTE: See Sheet 1 of 2 For General Notes.
3. Straight concrete endwalls are intended for use outside the clear zone.

2. Endwalls may be cast-in-place or precast construction. Cast-in-place endwalls shall conform to the details on this Index. Precast construction which adheres to this Index, including any additional reinforcement required for handling which shall be determined by the Contractor or supplier, does not require additional approvals. Deviations from this Index, for precast units, shall require the approval of the State Drainage Engineer prior to construction. For precast construction, see Index No. 201 for opening and grouting details.

4. Concrete shall be Class II except ASTM C492 (4000 psi) concrete may be substituted for precast items manufactured in plants meeting the requirements of Section 449 of the Specifications.

5. Chamfer: All exposed edges and corners to be chamfered ½" unless otherwise shown.

6. That portion of corrugated Metal pipe in direct contact with the concrete slab and extending 12" beyond shall have a continuous bituminous coating of 0.004" minimum thickness applied prior to placing of the concrete.

7. Sodding shall be in accordance with Index No. 281 and paid for under the contract unit price for Performance Turf, SY.

8. Basis of payment for either cast-in-place or precast construction shall be the estimated quantities tabulated on the Index. Concrete and reinforcing steel shall be paid for under the contract unit prices for Class II Concrete (Endwalls), CY and Reinforcing Steel (Roadway), LB.

NOTE: All bar dimensions are out to out.
STRAIGHT CONCRETE ENDWALLS
SINGLE AND DOUBLE 72' PIPE

GENERAL NOTES

1. Straight concrete endwalls are intended for use outside the clear zone.

2. Endwalls may be cast-in-place or precast construction. Cast-in-place endwalls shall conform to the details on this Index. Precast construction which adheres to this Index, including any additional reinforcement required for handling which shall be determined by the Contractor or supplier, does not require additional approvals. Deviations from this Index, for precast units, shall require the approval of the State Drainage Engineer prior to construction. For precast construction, see Index No. 201 for opening and grouting details.

3. Reinforcing steel shall be either Grade 40 or 60.

4. Concrete shall be Class II, except ASTM C478 (4000 psi) concrete may be substituted for precast items manufactured in plants meeting the requirements of Section 449 of the Specifications.

5. Chamfer: All exposed edges and corners to be chamfered ¾ unless otherwise shown.

6. That portion of corrugated Metal pipe in direct contact with the concrete slab and extending 12" beyond shall have a continuous bituminous coating of 0.004" minimum thickness coated applied prior to placing of the concrete.

7. Sodding shall be in accordance with Index No. 281 and paid for under the contract unit price for Performance Turf, SY.

8. Bases of payment for either cast-in-place or precast construction shall be the estimated quantities tabulated on the Index. Concrete and reinforcing steel shall be paid for under the contract unit prices for Class II Concrete (Endwalls), CY and Reinforcing Steel (Roadway), LB.

REVISION

9:28:12 AM
253 1 of 2
SECTION BB

SECTION AA

PLAN

HALF ELEVATION

HALF ELEVATION

TYPICAL SECTION THRU ENDWALL

BENDING DIAGRAM

BILL OF REINFORCING STEEL

ESTIMATED QUANTITIES

NOTE: All bar dimensions are out to out.

NOTE: See Sheet 1 of 2 for General Notes.
1. Straight concrete endwalls are intended for use outside the clear zone.

2. Endwalls may be cast-in-place or precast construction. Cast-in-place endwalls shall conform to the details on this index, design specifications AASHTO 1989. Precast construction which adheres to this index, including any additional reinforcement required for handling which shall be determined by the Contractor or supplier, does not require additional approvals. Deviations from this Index, for precast units, shall require the approval of the State Drainage Engineer prior to construction.

3. Reinforcing steel shall be either Grade 40 or 60.

4. Concrete shall be Class II, except ASTM C476 (4000 psi) concrete may be substituted for precast units manufactured in plants meeting the requirements of Section 489 of the Specifications.

5. Chamfer: All exposed edges and corners to be chamfered 45° unless otherwise shown.

6. That portion of corrugated metal pipe in direct contact with the concrete slab and extending 12" beyond shall have a continuous bituminous coating of 0.004" minimum thickness applied prior to placing of the concrete.

7. Sodding shall be in accordance with Index No. 281 and paid for under the contract unit price for Performance Turf, SY.

8. Basis of payment for either cast-in-place or precast construction shall be the estimated quantities tabulated on the Index. Concrete and reinforcing steel shall be paid for under the contract unit prices for Class II Concrete (Endwalls), CY and Reinforcing Steel (Roadway), LB.

GENERAL NOTES

1. Straight concrete endwalls are intended for use outside the clear zone.

2. Endwalls may be cast-in-place or precast construction. Cast-in-place endwalls shall conform to the details on this index, design specifications AASHTO 1989. Precast construction which adheres to this index, including any additional reinforcement required for handling which shall be determined by the Contractor or supplier, does not require additional approvals. Deviations from this Index, for precast units, shall require the approval of the State Drainage Engineer prior to construction.

3. Reinforcing steel shall be either Grade 40 or 60.

4. Concrete shall be Class II, except ASTM C476 (4000 psi) concrete may be substituted for precast units manufactured in plants meeting the requirements of Section 489 of the Specifications.

5. Chamfer: All exposed edges and corners to be chamfered 45° unless otherwise shown.

6. That portion of corrugated metal pipe in direct contact with the concrete slab and extending 12" beyond shall have a continuous bituminous coating of 0.004" minimum thickness applied prior to placing of the concrete.

7. Sodding shall be in accordance with Index No. 281 and paid for under the contract unit price for Performance Turf, SY.

8. Basis of payment for either cast-in-place or precast construction shall be the estimated quantities tabulated on the Index. Concrete and reinforcing steel shall be paid for under the contract unit prices for Class II Concrete (Endwalls), CY and Reinforcing Steel (Roadway), LB.
SECTION YY

**DESIGN STANDARDS**

**GENERAL NOTES**

1. Straight sand-cement endwalls are intended for use outside the clear zone.

**TABLE OF DIMENSIONS AND QUANTITIES FOR ONE ENDWALL**

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<th>T</th>
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<th>B</th>
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<td>40'-0&quot;</td>
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<td>8'-0&quot;</td>
</tr>
</tbody>
</table>

**FRONT ELEVATION**

Bars shall be driven to one inch below the surface of the bag. The cost of furnishing and installing the bars shall be included in the cost of the riprap.

1. For concrete and corrugated metal pipes, concrete pipe shown.
2. The top row of riprap bags shall be secured by pinning, using #4 reinforcing bars 18 inches in length, as follows:
   a. The end bags shall be secured using two bars per bag, one vertical and one diagonal as shown.
   b. The next to last bag on each end shall be secured with two bars vertically.
   c. Bags located over the pipe shall be secured by a bar which is driven diagonally except that for concrete pipe two bars shall be used for single bags above the pipe.
   d. Intermediate bags shall be secured with a single bar.

Bars shall be driven one inch below the bag. The cost of furnishing and installing the bars shall be included in the cost of the riprap.

**INDEX NO.**

258
**GENERAL NOTES**

1. This endwall is to be used only in the clear zone for the drainage of medians and other areas having low design velocities and negligible debris.

2. Reinforcing steel: All bars are size #4. Spacings shown are center to center. Laps to be 12" minimum. Clearance is 2" except as noted. Square-welded wire fabric (two cages max.) having an equivalent cross sectional area (0.20 sq. in.) may be substituted for bar reinforcement.

3. Grates shall be ASTM A36/A36M, A572/A572M or ASTM A588/A588M, Grade 50 steel. When "Alt. G" grates are specified in the plans, grates shall be galvanized in accordance with Section 975 and 425.3.2 of the Standard Specifications.

4. Endwall to be paid for under the contract unit price for U-Endwall. Each. Payment shall include cost of concrete, reinforcing steel, grate, and accessories. Quantities shown are for estimating purposes only.

5. Sod slopes 5' each side and above endwall. Sodding to be paid for under contract unit price for Performance Turf, SY.

6. Precasting of this endwall will be permitted. Precast units shall conform to the dimensions shown or in accordance with approved shop drawings. Request for shop drawing approval shall be directed to the State Drainage Engineer. Use Index No. 201 for opening details.

7. Concrete shall be Class I except ASTM C490 (4000 psi) concrete may be substituted for precast items manufactured in plants meeting the requirements of Section 449 of the Specifications.

**TABLE OF DIMENSIONS AND QUANTITIES**

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Grade Bars Req'd</th>
<th>Grade (lb)</th>
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</thead>
<tbody>
<tr>
<td>17&quot;</td>
<td>2</td>
<td>28.93</td>
</tr>
</tbody>
</table>

Bars to be evenly spaced across dimension 'D'.

All bars '10' x 2".
Quantities shown are for estimating purposes only. When called for in the plans, steel grating, baffles and accessories shall be in accordance with Index No. 281, and paid for under requirements of Section 449 of the Specifications.

Concrete shall be Class I, except ASTM C478 (4000 psi) concrete may be substituted for precast items manufactured in plants meeting the State Drainage Engineer's requirements. Precasting of this endwall will be permitted.

Sodding shall be in accordance with Index No. 281, and paid for under the contract unit price for Performance Turf, SY. Endwall to be paid for under the contract unit price for U-Endwall, 9.

Concrete shall be Class I, except ASTM C478 (4000 psi) concrete may be substituted for precast items manufactured in plants meeting the State Drainage Engineer's requirements. Precasting of this endwall will be permitted.

Baffles to be constructed only when called for in plans. When steel grating is required on endwall see Sheet 3 of 3 for details. Precasting of this endwall will be permitted. Precast units shall conform to the dimensions shown or in accordance with approved shop drawings. Request for shop drawing approval shall be directed to the State Drainage Engineer. Use Index No. 201 for opening and grouting details.

Baffles to be constructed only when called for in plans. When steel grating is required on endwall see Sheet 3 of 3 for details. Precasting of this endwall will be permitted. Precast units shall conform to the dimensions shown or in accordance with approved shop drawings. Request for shop drawing approval shall be directed to the State Drainage Engineer. Use Index No. 201 for opening and grouting details.

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**DIMENSIONS AND QUANTITIES FOR BAFFLES**

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<th>Y Baffle</th>
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<th>Reinfl. Steel Lbs.</th>
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**DIMENSIONS AND QUANTITIES FOR ONE U-ENDWALL**

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<th>H</th>
<th>W</th>
<th>Baffle Locations (When Required)</th>
<th>Class I Concrete Cu. Yd.</th>
<th>Reinfl. Steel Lbs.</th>
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<td>2'-6&quot;</td>
<td>4'-4&quot;</td>
<td>2'-6&quot;</td>
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<td>1.94 77</td>
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<td>2'-10&quot;</td>
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**DIMENSIONS AND QUANTITIES FOR ONE U-ENDWALL**

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<th>H</th>
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<th>Reinfl. Steel Lbs.</th>
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**ENDWALLS WITH AND WITHOUT BAFFLES FOR 1:3, 1:4 AND 1:6 SLOPES**

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**2016 DESIGN STANDARDS**
**U-TYPE CONCRETE ENDWALLS**
**BAFFLES & GRATE OPTIONAL 15" TO 30" PIPE**
**STEEL GRATING USE CRITERIA**

1. Provide positive debris control at all upgradient openings. Do not install grates unless one or more of the following conditions exist:

   A. Pipe culvert endwalls are located within the designated clear zone.

   B. Drainage area to culvert consists of median or infield areas or areas where debris and/or drift is negligible.

   C. Runoff to culvert is by sheet flow or in such ill defined channels that debris transport is not considered a major problem.

   D. Runoff to culvert is minor except on an infrequent basis (10 to 15 year frequency); for example a drainage basin in flat sandy terrain with normally low ground water table.

   E. Areas where culvert blockage with resultant backwater would not seriously affect roadway embankment, traffic operation or upland property.

2. Steel grating to be used only where called for in plans.

---

**TABLE OF DIMENSIONS AND QUANTITIES FOR ONE GRATE**

<table>
<thead>
<tr>
<th>Rate Of Slope</th>
<th>Pipe Dia.</th>
<th>G</th>
<th>2 Each Bar @ 3' 4&quot;/ft</th>
<th>3 Channels @ 3' 4&quot;/ft</th>
<th>2 Angles @ 3' 4&quot;/ft</th>
<th>Total Weight (lb)</th>
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<tr>
<td></td>
<td></td>
<td></td>
<td>l W-4&quot; lb</td>
<td>(X) Channel lb</td>
<td>(Y) Angle lb</td>
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<td>111 7'-4&quot; 53</td>
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</table>

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**U-TYPE CONCRETE ENDCWALLS**

**BAFFLES & GRATE OPTIONAL**

**15° TO 50° PIPE**

---

**INDEX NO.**

**SHEET NO.**

261

3 of 3
GENERAL NOTES

1. U-type concrete endwall energy dissipators are intended for use outside the clear zone.

2. Chamfer all exposed edges.

3. Concrete shall be Class 1, except ASTM C478 (4000 psi) concrete may be substituted for precast items manufactured in plants meeting the requirements of Section 449 of the Specifications.

4. Reinforcing steel shall have 2" min. cover.

5. Endwall to be paid for under the contract unit price for Class I Concrete (Endwalls), CY and Reinforcing Steel (Roadway), LB. Riprap to be paid for under the contract unit price for Riprap (Sand-Cement) (Roadway), CY. Cost of plastic filter fabric to be included in the contract unit price for riprap.

6. Fencing, when called for in the plans, to be paid for under the contract unit price for Fencing, Type B, LF. See Index No. 802 for details of Type B fencing.

<table>
<thead>
<tr>
<th>Pipe Size (in)</th>
<th>Area (SF)</th>
<th>O (Max)</th>
<th>Feet - Inches</th>
<th>Inches</th>
<th>Concrete Class 1 (CY)</th>
<th>Reinforcing Steel (lb)</th>
<th>Sand-Cement Riprap (CY)</th>
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### BENT BARS TABLE

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<th>A&lt;sub&gt;2&lt;/sub&gt; Spacing (ft-in.)</th>
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<th>D&lt;sub&gt;2&lt;/sub&gt; Spacing (ft-in.)</th>
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<td>4</td>
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Note: Bars A<sub>1</sub>, A<sub>2</sub>, A<sub>3</sub>, A<sub>4</sub>, B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, B<sub>4</sub> are straight bars.

---

**SECTION AA**

- Bars C<sub>1</sub>, D<sub>1</sub>, D<sub>2</sub>, D<sub>3</sub>, D<sub>4</sub>
- Bars A<sub>2</sub>, A<sub>3</sub>, A<sub>4</sub>, B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, B<sub>4</sub>

**SECTION BB**

- Bars C<sub>1</sub>, D<sub>1</sub>, D<sub>2</sub>, D<sub>3</sub>, D<sub>4</sub>
- Bars A<sub>2</sub>, A<sub>3</sub>, A<sub>4</sub>, B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, B<sub>4</sub>

**SECTION CC**

- Bars C<sub>1</sub>, D<sub>1</sub>, D<sub>2</sub>, D<sub>3</sub>, D<sub>4</sub>
- Bars A<sub>2</sub>, A<sub>3</sub>, A<sub>4</sub>, B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, B<sub>4</sub>

**SECTION DD**

- Bars C<sub>1</sub>, D<sub>1</sub>, D<sub>2</sub>, D<sub>3</sub>, D<sub>4</sub>
- Bars A<sub>2</sub>, A<sub>3</sub>, A<sub>4</sub>, B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, B<sub>4</sub>

---

**Note:** Bars C<sub>1</sub> & C<sub>2</sub> (N.S. & F.S.) equivalent in size to C<sub>3</sub> & C<sub>4</sub> (cut and bend as required).

---

**Fill Slope**

- D<sub>1</sub> @ 1'-6"
- B<sub>1</sub> @ 1'-6"
- D<sub>2</sub> @ 1'-0"
- B<sub>2</sub> @ 1'-0"

**Bars:**

- D<sub>1</sub> @ 1'-0"
- B<sub>1</sub> @ 1'-0"
- D<sub>2</sub> @ 1'-0"
- B<sub>2</sub> @ 1'-0"

**Material:**

- Steel in Top of Slab
- Steel in Bottom of Slab

---

**Design Standards**

**2016**

**U-TYPE CONCRETE ENDWALL**

**ENERGY DISSIPATOR 30' TO 72' PIPE**

---

**Revision History:**

- Last Revision: 07/14/14
- Design Standards: 2016

---

**Note:** All bar dimensions are cut to out.
TABLE OF DIMENSIONS AND ESTIMATED QUANTITIES
PIPE CULVERT ENDS WITH U-TYPE WINGS

<table>
<thead>
<tr>
<th>Opening</th>
<th>Area (ft²)</th>
<th>Wall</th>
<th>Footing</th>
<th>Concrete, Class I, Total (CY)</th>
<th>Steel Tie Bar</th>
</tr>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>H</td>
<td>G</td>
<td>K</td>
<td>F</td>
</tr>
<tr>
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<td>1</td>
<td>3 10&quot;</td>
<td>2 7&quot;</td>
<td>2 7&quot;</td>
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<td>Tie Bar</td>
<td>1 20&quot;</td>
<td>1</td>
<td>3 10&quot;</td>
<td>2 7&quot;</td>
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<td>1</td>
<td>3 10&quot;</td>
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</table>

GENERAL NOTES

1. Winged concrete endwalls are intended for use outside the clear zone.
2. Chamfer all exposed edges 90°.
3. Concrete shall be Class I, except ASTM C478 (4000 psi) Concrete may be substituted for precast items manufactured in plants meeting the requirements of Section 469 of the Specifications.
4. Endwall to be paid for under the contract unit price for Class I Concrete.
5. Sodding to be in accordance with Index No. 281, and paid for under the contract unit price for Performance Turf, SY.

PLAN
CONCRETE ENDFALL WITH U-TYPE WINGS FOR PIPE CULVERTS

TABLE OF DIMENSIONS AND ESTIMATED QUANTITIES
PIPE CULVERT ENDS WITH 45° WINGS

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<td>1 2&quot;</td>
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<td>1 15°</td>
<td>1 2&quot;</td>
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</table>

GENERAL NOTES

1. Winged concrete endwalls are intended for use outside the clear zone.
2. Chamfer all exposed edges 90°.
3. Concrete shall be Class I, except ASTM C478 (4000 psi) Concrete may be substituted for precast items manufactured in plants meeting the requirements of Section 469 of the Specifications.
4. Endwall to be paid for under the contract unit price for Class I Concrete.
5. Sodding to be in accordance with Index No. 281, and paid for under the contract unit price for Performance Turf, SY.
Flared end sections shall conform to the requirements of ASTM C76 with the exception that dimensions and reinforcement shall be as prescribed in the table above. Circumferential reinforcement may consist of either one cage or two cages of steel. Fiber-reinforced concrete may be substituted for conventional reinforcement in accordance with Structures Design Guidelines, Section 3.17. Compressive strength of concrete shall be 4000 psi. Shop drawings for Flared end sections having fiber reinforcing or dimensions other than above must be submitted for approval to the State Drainage Engineer.

Connections between the flared end section and the pipe culvert may be any of the following types unless otherwise specified on the plans:

1. Joints meeting the requirements of Section 449 of the Standard Specifications (O-Ring Gasket). Flared end section joint dimensions and tolerances shall be identical or compatible to those used in the pipe culvert joint. When pipe culvert and Flared end section manufacturers are different, the compatibility of joint designs shall be certified to by the manufacturer of the Flared end sections.

2. Joints sealed with preformed plastic gaskets. The gaskets shall meet the requirements of Section 942-2 of the Standard Specifications and the minimum sizes for gaskets shall be as specified for equivalent sizes of elliptical pipe.

3. Reinforced concrete jackets, as detailed on this drawing. Cost of the reinforced concrete jacket to be included in the contract unit price for Flared End Section (Concrete), EA. Reinforcing steel shall also be included in the cost of the Flared End Section (Concrete), EA.

4. On skewed pipe culverts the flared end sections shall be placed in line with the pipe culvert. Side slopes shall be warped as required to fit the flared end sections.

5. Flared End Section to be paid for under the contract unit price for Flared End Section (Concrete), EA. Sodding shall be in accordance with Index No. 281, and paid for under the contract unit price for Performance Turf, SY.

6. Flared end sections shall conform to the requirements of ASTM C76 with the exception that dimensions and reinforcement shall be as prescribed in the table above. Circumferential reinforcement may consist of either one cage or two cages of steel. Fiber-reinforced concrete may be substituted for conventional reinforcement in accordance with Structures Design Guidelines, Section 3.17. Compressive strength of concrete shall be 4000 psi. Shop drawings for Flared end sections having fiber reinforcing or dimensions other than above must be submitted for approval to the State Drainage Engineer.

Design Notes:

1. Flared end sections are intended for use outside the clear zone on median drain and cross drain installation, except that Flared end sections for pipe sizes 12" and 15" are permitted within the clear zone. When the slope interaction permits, 12" and 15" Flared end sections may be located with the culvert opening as close as 8' beyond the outside edge of the shoulder. Flared end sections are not intended for side drain installations.

2. Reinforced concrete jackets shall be used at all locations where high velocities and/or highly erosive soils may cause disjointing. These locations are to be shown on the plans.

3. Toe walls shall be used whenever the anticipated velocity of discharge and soil type are such that erosive action would occur. Toe walls are not required where ditch pavement is provided, except when disjointing would occur if the ditch pavement should fail.
## Single and Multiple Round Concrete Pipe

### Top-View Single Pipe

- **Concrete Slab:** 3" or 5½" thick, reinforced with WWF 6x6-W1.4xW1.4
- **Top-Edge:** 4" above crown of pipe. See section below.
- **Concrete slab shall be deepened to form bridge across crown of pipe.**

### Top-View Multiple Pipe

- See sheet 6 for details and notes.

### Design Standards

**Dimensions and Quantities**

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<th>B</th>
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<td>98</td>
<td>99</td>
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</table>

**Values shown for estimating pipe quantities and are for information only.**

- **1:2** Miter: To pipe for pipes 18" and smaller.
- **1:4** Miter: To pipe for pipes 18" and smaller.
- **1:2** For pipes 24" and larger.
- **2"** Diameter will be used for 8' standard pipe lengths.
- **3"** Diameter will be used for 12' standard pipe lengths.

### Cross Drain Mitered End Section

- See sheet 6 for details and notes.
### Dimensions & Quantities

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<th>Rise R</th>
<th>Span S</th>
<th>X</th>
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<th>B</th>
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<th>E</th>
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### Slope: 1:4
- 1/4:100 for Major Axes For Pipes 34"x58" or Smaller. 1.2 For Pipes 39"x69" And Larger.
- 1/4:100 For Major Axes For Pipes 34"x58" or Smaller. 1.1 For Pipes 32"x67" And Larger.

### General Notes
- No Pipe Joint Permitted unless approved by the Engineer.
- Reinforced with WWF 6x6-WI.4xWI.4.
- See Sheet 5 For 3" Slab Quantities.
- See General Note No. 3.
- Values shown for estimating pipe quantities and are for information only.
- Unless approved by the Engineer.
- No Pipe Joint Permitted.

### Single and Multiple Elliptical Concrete Pipe

**CROSS DRAIN MITERED END SECTION**

**SECTION**

**TOP VIEW - SINGLE PIPE**

**TOP VIEW - MULTIPLE PIPE**

**REVISION:** 01/01/02

**DESCRIPTION:** 2016 DESIGN STANDARDS

**INDEX NO.:** 272

**SHEET NO.:** 4 of 6
### Quantities for 3" Thick Concrete Slabs (CY)

#### Round-Concrete

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#### CROSS DRAIN MITERED END SECTION
CONCRETE PIPE CONNECTOR

**GENERAL NOTES**

1. Unless otherwise designated in the plans, concrete pipe mitered end sections may be used with any type of cross drain pipe; corrugated steel pipe mitered end sections may be used with any type of cross drain pipe except aluminum pipe; and corrugated aluminum mitered end sections may be used with any type of cross drain pipe except steel pipe. When bituminous coated metal pipe is specified for cross drain pipe, mitered end sections shall be constructed with bituminous or concrete pipe. When the mitered end section pipe is dissimilar to the cross drain pipe, a concrete jacket shall be constructed in accordance with Standard Index 280.

2. Corrugated polyethylene pipe (HDPE), polyvinylchloride pipe (PVC) and polypropylene pipe (PPR) for cross drain applications shall utilize either corrugated metal or concrete mitered end sections (MES). When used in conjunction with corrugated (MES), connection shall be by either a formed metal band specifically designated to join HDPE or PVC pipe, with metal pipe or other coupler approved by the State Drainage Engineer. When used in conjunction with a concrete (MES), connection shall be by concrete jacket constructed in accordance with Index No. 280.

3. Mitered end sections for pipe sizes 15", 18" and 24" round or equivalent pipe arch or ellipsoidal pipe are permitted within the clear zone. When the slope intersection permits, the mitered end section may be located with the culvert opening as close as 8' beyond the outside edge of the shoulder.

4. Slope and ditch transitions shall be used when the normal roadway slope must be flattened to place end section outside clear zone. See detail left.

5. The reinforced concrete slab shall be constructed for all sizes of cross drain pipe and cast in place with Class NS concrete. Slabs shall be 5" thick unless 3" thickness called for in plans.

6. Concrete pipe used in the assembly of mitered end sections shall be selective lengths to avoid excessive connections.

7. Corrugated metal pipe galvanizing that is damaged during beveling and perforating for mitered end section shall be repaired.

8. That portion of corrugated metal pipe in direct contact with the concrete slab and extending 12" beyond shall be bituminous coated prior to placing of the concrete.

9. When existing multiple cross drain pipes are spaced other than the dimensions shown in this detail, or have non-parallel axes, or have non-uniform sections, the mitered end sections will be constructed either separately as single pipe mitered end sections or collectively as multiple pipe end sections as directed by the Engineer; however, mitered end sections will be paid for each based on each independent pipe end.

10. The cost of all pipe(s), fasteners, reinforcing, connectors, anchors, concrete, sealants, jackets, and coupling bands shall be included in the cost for sections as directed by the Engineer; however, mitered end sections will be paid for each based on each independent pipe end.

11. Mitered end sections shall be paid for under the contract unit price for Mitered End Section (CD). Each, based on each independent pipe end.

**ANCHOR DETAIL**

**SPECIAL DETAILS AND NOTES**

**CORSS DRAIN MITERED END SECTION**
DESCRIPTION:

Dimensions & Quantities

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SIDE DRAIN MITERED END SECTION

SINGLE AND MULTIPLE ROUND CORRUGATED METAL PIPE

NOTE: See Sheets 6 and 7 for details and general notes.
The specified weld shall be made when the fabricated unit is subject to hazardous hauls and repeated handling. Tack welds are permitted for local or job site fabrication. Galvanizing over welded surface not required.

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### FASTENER UNIT

For all sizes of single and multiple drain pipe.

**Details for Concrete & Corrugated Metal Pipe**

**To be used only when grates are called for in the plans.**

**1974 AASHTO Pipe Arch Sizes.**

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**Note:** 3/8" x 3" bolts are standard for all grate fasteners, except when the contractor elects to use the slotted upper holes for the intermediate fasteners on multiple drain pipes, which will require the following bolt lengths:

<table>
<thead>
<tr>
<th>Grade Size (Std. &amp; X-Stg.)</th>
<th>Bolt Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 1/2</td>
<td>5 1/2</td>
</tr>
<tr>
<td>3</td>
<td>6 1/2</td>
</tr>
<tr>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

---

**The specified weld shall be made when the fabricated unit is subject to hazardous hauls and repeated handling. Tack welds are permitted for local or job site fabrication. Galvanizing over welded surface not required.**
Notes:
- Anchors required for CMP only.
- Anchor, washer and nuts to be galvanized steel.
- Bend anchor where required to center in concrete slab.
- Damaged surfaces to be repaired after bending.
- Anchors are to be spaced a distance equal to four (4) corrugations.
- Place the anchors in the outside crest of corrugation.
- Flat washer to be placed on inside wall of pipe.
- Notes in the mitered end pipe are to be drilled or punched; burning not permitted.

**ANCHOR DETAIL**

For Multiple Drain Pipe Only
- Options for Top Opening:
  - a. 4" or 6" Mill Head Cut, 1" Deep
  - b. 2" diameter Drilled Hole
- c. 1/16" x 2" Slot
- Bottom Opening: 1/16" x 2" Slot.

**FOR SINGLE & MULTIPLE DRAIN PIPE**

**GRATE DETAIL**

See General Notes, Sheet 7.

**SIDE VIEW**

Intermediate and Fastener:

- For Multiple Drain Pipe Only:
  - a. 4" or 6" Mill Head Cut, 1" Deep
  - b. 2" diameter Drilled Hole
  - c. 1/16" x 2" Slot
- Bottom Opening: 1/16" x 2" Slot.

**END VIEW**

Nominal Dia.

**TOP VIEW**

M Less 2'-0" See Tables For Dimensions

- 4 Slot

**CONCRETE PIPE CONNECTOR DETAIL**

Details For Concrete & Corrugated Metal Pipe

All bars, bolts, nuts and washers are to be galvanized steel.

- Bolt diameters shall be 1/8" for 15" to 36" pipe and 1/4" for 42" to 60" pipe.
- Two connectors required per joint, located 60° right and left of bottom center of pipe.
- Bolt holes in pipe shell are to be drilled.
1. Unless otherwise designated in the plans, concrete pipe mitered end sections may be used with any type of side drain pipe; corrugated steel pipe mitered end sections may be used with any type of side drain pipe except aluminum pipe, and corrugated aluminum mitered end sections may be used with any type of side drain pipe except steel pipe. When bituminous coated metal pipe is specified for side drain pipe, mitered end sections shall be constructed with like pipe or concrete pipe. When the mitered end section pipe is dissimilar to the side drain pipe, a concrete jacket shall be constructed in accordance with Index No. 280.

2. Corrugated polyethylene pipe (HDPE), polyvinyl-chloride pipe (PVC) and polypropylene pipe (PPR) for side drain applications shall utilize either corrugated metal or concrete mitered end sections (MES). When used in conjunction with corrugated (MES), connection shall be by either a formed metal band specifically designated to join HDPE or PVC pipe, with metal pipe or other coupling approved by the State Drainage Engineer. When used in conjunction with a concrete (MES), connection shall be by concrete jacket constructed in accordance with Index No. 280.

3. Concrete pipe used in the assembly of mitered end sections shall be of select lengths to avoid excessive connections.

4. Corrugated steel pipe galinganized that is damaged during beveling and perforating for mitered end section shall be repaired.

5. That portion of corrugated metal pipe in direct contact with the concrete slab and extending 12" beyond shall be bituminous coated prior to placing of concrete.

6. When existing multiple side drain pipes are spaced other than the dimensions shown in this detail, or have nonparallel axes, or have non-uniform sections, the mitered end sections will be constructed either as separate single pipe mitered end sections or collectively as multiple pipe and sections as directed by the Engineer; however, mitered and sections will be paid for each, based on each independent pipe end.

7. The reinforced concrete slab shall be constructed for all sizes of side drain pipe and cast in place with Class B5 concrete.

8. Round pipe size 30" or greater, pipe-arch size 35"x24" or greater and elliptical pipe 19"x30" or greater shall be grated unless specified in the plans. Smaller sizes of pipe shall be grated only when called for in plans. The lower grate on trailing downstream ends on divided highways shall be omitted.

9. Grates are to be fabricated from steel ASTM A53, Grade B, pipe. The lower grate on all traffic approach ends shall be Schedule 80 and all remaining grates shall be Schedule 40. Grates subject to salt free and corrosive free environment may be fabricated from galvanized pipe with base metal exposed during fabrication repaired as specified in Section 562, Standard Specifications; or, fabricated from black pipe and hot dip galvanized after fabrication in accordance with ASTM A123. Grates subject to salt or highly corrosive environment shall be hot dip galvanized after fabrication in accordance with ASTM A123.

10. Ditch transitions shall be used on all grades in excess of 3% as directed by the Engineer.

11. The project engineer shall contact the District Drainage Engineer for possible alternate treatment prior to constructing side drain mitered end sections where a minimum spacing of 30' will not result between the toe points of the mitered end sections.

12. The cost of all pipe(s), grates, fasteners, reinforcing, anchors, concrete, sealants, jackets and coupling bands shall be included in the cost for the mitered end section. Sodding shall be paid for separately under the contract unit price for Performance Turf, SY.

13. Mitered end sections shall be paid for under the contract unit price for Mitered End Section (SD), Ea., based on each independent pipe end.

NOTES & INFORMATION

GENERAL NOTES

1. Unless otherwise designated in the plans, concrete pipe mitered end sections may be used with any type of side drain pipe; corrugated steel pipe mitered end sections may be used with any type of side drain pipe except aluminum pipe, and corrugated aluminum mitered end sections may be used with any type of side drain pipe except steel pipe. When bituminous coated metal pipe is specified for side drain pipe, mitered end sections shall be constructed with like pipe or concrete pipe. When the mitered end section pipe is dissimilar to the side drain pipe, a concrete jacket shall be constructed in accordance with Index No. 280.

2. Corrugated polyethylene pipe (HDPE), polyvinyl-chloride pipe (PVC) and polypropylene pipe (PPR) for side drain applications shall utilize either corrugated metal or concrete mitered end sections (MES). When used in conjunction with corrugated (MES), connection shall be by either a formed metal band specifically designated to join HDPE or PVC pipe, with metal pipe or other coupling approved by the State Drainage Engineer. When used in conjunction with a concrete (MES), connection shall be by concrete jacket constructed in accordance with Index No. 280.

3. Concrete pipe used in the assembly of mitered end sections shall be of select lengths to avoid excessive connections.

4. Corrugated metal pipe galinganized that is damaged during beveling and perforating for mitered end section shall be repaired.

5. That portion of corrugated metal pipe in direct contact with the concrete slab and extending 12" beyond shall be bituminous coated prior to placing of concrete.

6. When existing multiple side drain pipes are spaced other than the dimensions shown in this detail, or have nonparallel axes, or have non-uniform sections, the mitered end sections will be constructed either as separate single pipe mitered end sections or collectively as multiple pipe and sections as directed by the Engineer; however, mitered and sections will be paid for each, based on each independent pipe end.

7. The reinforced concrete slab shall be constructed for all sizes of side drain pipe and cast in place with Class B5 concrete.

8. Round pipe size 30" or greater, pipe-arch size 35"x24" or greater and elliptical pipe 19"x30" or greater shall be grated unless specified in the plans. Smaller sizes of pipe shall be grated only when called for in plans. The lower grate on trailing downstream ends on divided highways shall be omitted.

9. Grates are to be fabricated from steel ASTM A53, Grade B, pipe. The lower grate on all traffic approach ends shall be Schedule 80 and all remaining grates shall be Schedule 40. Grates subject to salt free and corrosive free environment may be fabricated from galvanized pipe with base metal exposed during fabrication repaired as specified in Section 562, Standard Specifications; or, fabricated from black pipe and hot dip galvanized after fabrication in accordance with ASTM A123. Grates subject to salt or highly corrosive environment shall be hot dip galvanized after fabrication in accordance with ASTM A123.

10. Ditch transitions shall be used on all grades in excess of 3% as directed by the Engineer.

11. The project engineer shall contact the District Drainage Engineer for possible alternate treatment prior to constructing side drain mitered end sections where a minimum spacing of 30' will not result between the toe points of the mitered end sections.

12. The cost of all pipe(s), grates, fasteners, reinforcing, anchors, concrete, sealants, jackets and coupling bands shall be included in the cost for the mitered end section. Sodding shall be paid for separately under the contract unit price for Performance Turf, SY.

13. Mitered end sections shall be paid for under the contract unit price for Mitered End Section (SD), Ea., based on each independent pipe end.

NOTES & INFORMATION
### SCHEDULE OF BELL REINFORCEMENT

<table>
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<th>Minimum Reinforcement</th>
<th>Design Bell Reinforcement</th>
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<table>
<thead>
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<th>Nominal Pipe Diameter</th>
<th>Bell Diameter, in. per Foot</th>
<th>Nominal Pipe Diameter</th>
<th>Bell Diameter, in. per Foot</th>
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<td>12&quot;</td>
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<td>0.101</td>
<td>108&quot;</td>
<td>0.101</td>
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### MISCELLANEOUS DRAINAGE DETAILS

#### ROUND PIPE SECTIONS

**PREFORMED PLASTIC JOINT**

- **EXISTING PIPE**
- **MAINLINE PIPE**
- **STUB PIPE**

**MASONRY PLUG**

- **8" Pipes To 60°**
- **12°, Pipes 66° To 108°**
- **16°, Pipes Above 108°**

**CONCRETE COLLAR FOR JOINING MAINLINE PIPE AND STUB PIPE**

**CONCRETE COLLAR FOR EXTENSION OF EXISTING PIPE CULVERTS**

**CONCRETE PIPE REINFORCEMENT**

- **All circumferential steel located above this line within 1.75 L is defined as bell reinforcement.**

**DETAIL OF BELL & SPIGOT CONCRETE PIPE JOINT USING ROUND OR PROFILE RUBBER GASKET**

- **Class NS Concrete**

**CONCRETE JACKET FOR CONNECTING DISSIMILAR TYPES OF PIPE AND CONCRETE PIPES WITH DISSIMILAR JOINTS**

- **For reinforcement see elliptical pipe concrete jacket. (All Pipe Sizes)**

**DISSIMILAR TYPES**

- **For reinforcement see elliptical pipe concrete jacket. (All Pipe Sizes)**

---

**DESIGN STANDARDS**

**INDEX NO.**

**SHEET NO.**

**LAST REVISION 07/01/16**

**DESCRIPTION:**

**2016**
CONCRETE GUTTER AND DRAINS AT RETAINING WALLS

Note: PVC pipe, Schedule 40, to be paid for under the contract unit price for Polyvinyl Chloride Pipe Culvert (4").

1:6 vs. 1:4

Not Steeper Than 1:10

The variable front slope shall be done during normal grading operations.

Use Larger Value Of Either:
1. L=10xH (No Maximum)
2. L=10xDitch Offset (Maximum L=100')

METHOD FOR SETTING LIMITS OF VARIABLE FRONT SLOPES AT DRAINAGE STRUCTURES

GUARD AT PIPE ENDS

Note: Guards to be constructed only at locations specifically called for in plans. Guard, plate & clips, bolts, nuts and sleeves to be included in the contract unit price for Reinforcing Steel (Miscellaneous).
METHOD FOR DETERMINING THE LENGTH OF SPECIAL PIPE REQUIRED UNDER RAILROADS

PLAN OF TOP

INLETS, MANHOLES OR JUNCTION BOXES ON INTEGRAL PRECAST CONCRETE RISER FOR CONCRETE PIPE

(1) - Distance standard for yard and industrial tracks.

(2) - Clearance is for casing pipe. All subgrade carrier pipelines and wirelines will be installed within a casing pipe which will extend from Right-of-Way line to Right-of-Way line.

(1) - Distance standard for yard and industrial tracks.

(2) - Clearance is for casing pipe. All subgrade carrier pipelines and wirelines will be installed within a casing pipe which will extend from Right-of-Way line to Right-of-Way line.
**TYPICAL SECTION**

Standard Paved Ditch

- Riprap (Sand-Cement)
- Riprap (Ditch Lining)

**APA**

For use only where side slopes are 1:4 or flatter. Points "A" and "B" are to be used to locate the paved section.

**Standard Paved Ditch**

- Riprap (Sand-Cement)
- Riprap (Ditch Lining)

**Section 530.** Grouting of joints required.

**Section 985** for fabric requirements and application.

**Design Standards**

- Cover for 2.20.13
- For pavements
- Cover for 2.20.13
- For pavements
- Cover for 2.20.13
- For pavements

**GENERAL NOTES**

1. Type of ditch pavement shall be as shown on plans.

2. In concrete ditch pavement, contraction joints are to be spaced at 25' maximum intervals, or as directed by the Engineer. Contraction joints may be either formed (construction joint) or tooled. No open joints will be permitted in concrete ditch pavement.

3. Up at end of ditch pavement shall normally be located downstream of DRI or on flatter grades where there is a decrease in ditch velocity.

4. Shoulders are to be used with all ditch paving. A shoulder is not required adjacent to drainage structures.

5. When directed by the Engineer, weep hole spacing may be reduced to 9' minimum.

6. For junction of R/W ditch spillway and lateral ditch, sides of paving to be 1' high minimum.

7. For ditch pavements requiring filter fabric (see Table 1) place the filter fabric directly beneath the pavement for the entire length and width of the pavement. See Standard Specification Section 985 for fabric requirements and application.

8. When weep holes with aggregate are used, place filter fabric below the aggregate to form a mat continuous with the pavement filter fabric or underlapping the pavement filter fabric, if present.

9. Ditch pavement requiring reinforcement shall be detailed in the plans.

10. Cost of plastic filter fabric to be included in the contract unit price for ditch pavement.

11. Sodding to be paid for under contract unit price for Performance Turf, SY

**REFERENCES & REMARKS**

- Filter Fabric Required.

**PLAN PAVED DITCH END TREATMENT**

- General Notes

**SECTION 00**

- Ditch Pavement and Sodding

**Table 1: Ditch Pavement**

- Dimensions
- Type of Filter Fabric
- References

<table>
<thead>
<tr>
<th>Pavement Type</th>
<th>Dimensions</th>
<th>Payment Unit</th>
<th>Basis of Estimate</th>
<th>Type of Fabric</th>
<th>Range</th>
<th>References &amp; Remarks</th>
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<tbody>
<tr>
<td>Concrete</td>
<td>2' x 2'</td>
<td>T/H</td>
<td>1/sq ft</td>
<td>Low-High</td>
<td>Section 985 of the Standard Specifications.</td>
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<td>Miscellaneous</td>
<td>2' x 2'</td>
<td>T/H</td>
<td>0.5 sq ft</td>
<td>Low-Moderate</td>
<td>Section 339</td>
<td></td>
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<tr>
<td>Riprap</td>
<td>2' x 2'</td>
<td>T/H</td>
<td>0.11 sq ft</td>
<td>Low-Moderate</td>
<td>Section 500 grading of joints required.</td>
<td></td>
</tr>
<tr>
<td>Riprap (Ditch Lining)</td>
<td>2' x 2'</td>
<td>T/H</td>
<td>0.11 sq ft</td>
<td>Moderate-Neg.</td>
<td>Section 530</td>
<td></td>
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</tbody>
</table>

**INDEX NO. 281**

1 of 2
TABLE 2: SOD QUANTITIES (SY)

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>INDEX NO. 250</th>
<th>INDEX NO. 261</th>
<th>INDEX NO. 266</th>
<th>INDEX NO. 270</th>
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<td>SLOPE 12</td>
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<td>12</td>
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<td>SLOPE 14</td>
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<td>SLOPE 16</td>
<td>16</td>
<td>16</td>
<td>16</td>
<td>16</td>
</tr>
</tbody>
</table>

Note: Either option may be used unless otherwise called for in the plans.

SOD PLACEMENT AT PIPE/CULVERT END TREATMENTS

FILTER FABRIC PLACEMENT AT CONCRETE STRUCTURE

Note: Either option may be used unless otherwise called for in the plans.
1. For additional details see Index No. 232.

2. Inlet to be paid for under the contract unit price for Inlets (Ditch Bottom Type C Modified), EA. Handrail to be paid for under the contract unit price for Pipe Handrail, (Material), LF.

INLET TYPE C (MODIFIED)
**Notes:**

1. Maximum pipe size shall be 24" diameter.
2. Grading back of sidewalk varies and shall be done as directed by the Engineer.
3. Concrete quantities shown are for maximum wall heights, and shall be basis for estimate and payment.
4. Riprap quantities shown are for estimate purposes only. Cost of riprap to be included in cost of the endwall.
5. Endwalls to be paid for under the contract unit price for Concrete Class I (Endwalls), CT. Handrail to be paid for under the contract unit price for Pipe Handrail, (Material), LF.

**Special Concrete Endwall**

<table>
<thead>
<tr>
<th>Pipe Size (in)</th>
<th>Concrete Class I (CY)</th>
<th>Sand-Cement Riprap (CY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>2.3</td>
<td>1.1</td>
</tr>
<tr>
<td>18</td>
<td>2.6</td>
<td>1.3</td>
</tr>
<tr>
<td>24</td>
<td>3.3</td>
<td>1.8</td>
</tr>
</tbody>
</table>
YARD DRAIN ITEM INCLUDES:
1. 15" x 15" x 12" Concrete or PVC Tee ± long.
2. Grade diameter = 14-1/2".
   Thickness = 2-1/2".
   Flow area = 45 sq in min.
   Light Duty Cast Iron, see Specification Section 962.
3. 12" pipe as necessary.
4. 0.04 Cubic yards concrete for slab.

YARD DRAINS

Notes:
1. Yard drains to be located outside the R/W. Drainage area should not exceed 750 SF (grate flow 0.1 Cfs).
2. Yard drains may be constructed at the option of the property owner as shown on the plans.
3. Cost of plugs and collars to be included in the cost for 15" pipe, for collar and plug details see Index No. 280.
4. Yard drains to be paid for under the contract unit price for Yard Drains, EA.

SHALLOW DITCHES

Notes:
1. To be constructed at locations as directed by the Engineer.
2. Either cast iron pipe or PVC rigid conduit, U.L. listed for direct sunlight exposure, Schedule 40, may be used.
3. Pipe and Mitered End to be paid for under the contract unit price for either Cast Iron Soil Pipe (Standard) (4").
1" or PVC Pipe For Back of Sidewalk Drainage (4"), 17.

Note: Miter to slope.
Provide Approximately A Minimum Of 0.20% Grade On Gutter, Slightly Warping The Surface Of The Median Pavement If Necessary. Within Limits Of The Median Curb Or Curb And Gutter. Construct A Drainage Flume Or Flumes At The Point Or Points Of Low Grade. See Details.

Provide Smooth Section Match Existing Grade


GRADE TO DRAIN AS SHOWN IN THE PLANS OR AS ADJUSTED BY THE ENGINEER DURING CONSTRUCTION

Slope To Approx. Match That Of Adjoining Pavt. (Breakover 0.02 Min., 0.05 Max.)

Auxiliary Lane

Prop. Pavt. Or Superelevated Pavt. (Exist. Pavt. Or New 4-Lane Pavt.)

Portion Of New 4-Lane Pavt.

Runoff

Prop. Median Pavt., Warp Surface If Necessary To Drain To Prop. Flumes

The Engineer During Construction

Grade To Drain As Shown In The Plans Or As Adjusted By The Engineer During Construction

Runoff

Median Width As Indicated In Detail Plans

Public Rd. Or Crossover

SECTION AA

SECTION BB

SECTION CC

FLUME DETAIL

GENERAL NOTES

1. These details are to apply to projects which provide for the conversion of 2-lane sections to 4-lane divided highway sections and for superelevated sections of new 4-lane divided highways. Layout above is illustration only. Cost of flumes to be included in the contract price for Curb or Curb and Gutter. Sed to be paid for under the contract unit price for Performance Turf, SF.

2. Flumes to be located in low point of noses and at other points as designated in the plans. The locations may be adjusted by the Engineer during construction.

3. Min. Slope 0.02'/ft.
1. Spillway to be paid for as Shoulder Gutter, L.F.

2. If spillway empties into an unpaved ditch, the detail should be modified as necessary.

DETAIL OF CONCRETE SPILLWAY AT END OF SHOULDER GUTTER
(TO BE USED WHERE INLETS, PIPES & ENDWALLS ARE IMPRACTICAL)
GENERAL NOTES
1. Pipe shall be any of the optional types permitted in Section 443 of the Specifications, unless otherwise restricted in the plans. Dissimilar types of pipe will not be permitted in a continuous run of pipe.
2. Concrete pipe shall be placed with the slots positioned on sides.
3. Alignment joints are standard (gaskets not required). Recorrugation of metal pipe ends is not required.
4. The contractor may submit other methods of providing slots having equal or greater area of opening, for approval by the Engineer.
5. Filter fabric shall be Type D-3 meeting the requirements of Section 985. All filter fabric joints shall lap a minimum of one (1) foot.
6. The standard cross section shall be constructed unless other sections are described or detailed in the plans.
7. For supplemental details see Index No. 280.
8. The contractor shall take the necessary precautions to prevent contamination of the trench with sand, silt and foreign materials.
9. French drains shall be paid for under the contract unit price for French Drains, LF. The unit price shall include the cost of pipe, pipe plugs, pipe fittings, coarse aggregate and filter fabric in place, and the cost for trench excavation, backfill and compaction. The unit price shall also include the cost for disposal of surplus excavated materials and cost for restoration of pavement removed or damaged by French drain construction, but shall not include payments for items paid for elsewhere.

DESIGN NOTES
1. Pipe invert should be at or above the water table whenever possible.
2. French drains with minor dimensional changes or otherwise different from the standard cross-section shall be either described or detailed in the plans. French drains with significantly different cross-sections shall be detailed in the plans.
SLOTTED PIPE OPTIONS

OPTION A - ROUND PIPE

OPTION B - ROUND OR ELLIPTICAL PIPE
GENERAL NOTES

1. The underdrain pipe shall be either 4" smooth or 5" corrugated tubing unless otherwise shown in the plans. The size to be furnished will be based on the nominal internal diameter of a pipe with a smooth interior wall. Except when prohibited by the plans, the special provisions or this standard, pipe with a corrugated interior wall may be provided based on the following size equivalencies:

   - 4" smooth interior equivalent to 5" corrugated interior
   - 5" smooth interior equivalent to 6" corrugated interior
   - 6" smooth interior equivalent to 8" corrugated interior
   - 8" smooth interior equivalent to 10" corrugated interior

2. Fine aggregate shall be quartz sand meeting the requirements of Sections 902-4 of the Standard Specifications.

3. Coarse aggregate shall be gravel or stone meeting the requirements of Sections 901-2 or 901-3. The gradation shall meet Section 903, Grades 4, 467, 5, 56 or 57 stone unless otherwise shown restricted in the plans.

4. Underdrain Type I, II, III and V shall be in accordance with Section 440.

5. Filter fabric shall be Type D-3 (See Specifications Section 985). The internal filter fabric of Type V underdrain shall have a permittivity of 0.7 /sec and an AOS of #40 sieve.

6. When Type I is used, a filter fabric sock meeting Section 948 is required.

7. See Index No. 500 for the standard location of Type I, II, and III underdrain. The location of Type V underdrain and nonstandard locations of Type I, II, and III underdrain will be as detailed in the plans.

8. All filter fabric joints shall overlap a minimum of 1'. The internal filter fabric of Type V underdrain shall overlap into the coarse aggregate or the fine aggregate a minimum of 1'.

9. Underdrain outlet pipes shall be nonperforated and all bends shall be made using 45 deg. elbows. 90 deg. bends shall be constructed with two 45 deg. elbows separated by at least 1' of straight pipe. Outlet pipes stubbed into inlets or other drainage structures shall be not less than 6' above the structure flow line.

10. Pay item shall be based on the size of the smooth interior products. The contract unit price for Underdrain Outlet Pipe, LF, shall include the cost of pipe, fittings, aggregate, sock, filter fabric, underdrain cleanouts, and concrete aprons.

   The contract unit price for Underdrain Outlet Pipe, LF, shall be full compensation for trench excavation, pipe and fittings, concrete aprons, hardware cloth for concrete aprons, stubbing into drainage structures, backfill in place, and disposal of excess materials.

   The contract unit price for Underdrain Inspection Box, EA, shall be for the number completed and accepted.

DESIGN NOTES

1. The type of underdrain should be selected to meet design water removal rate and soil conditions. Caution is prescribed in the use of these typical sections since special designs may be required to satisfy project conditions.

2. Type I underdrain is intended for minimum water removal conditions.

3. Type II underdrain is intended for moderate water removal conditions. Where reactive conditions may create chemical clogging, the use of an inert material and/or elimination of the filter fabric may be necessary.

4. Type III underdrain is intended for maximum water removal conditions. Filter fabric is required between the coarse aggregate or fine aggregate including those described in general notes 2 and 3. Design note 3 applies for reactive conditions.

5. Type V underdrain is intended for use in detention basins and other locations which require a filtration system. The standard fine aggregate specified for Type V underdrain conforms to filtration gradation requirements of Chapter 62-25 FAC.

6. The designer should detail in the plans, the location of:
   (a) Type V underdrain, (b) nonstandard locations of Type I, II, and III underdrain, (c) underdrain inspection boxes, (d) cleanouts for Type V underdrain, and (e) underdrain outlet pipes.

7. The designer should specify the flow line elevations at the beginning, bends, junctions and ends of underdrain pipes and outlet pipes.

8. The designer should evaluate whether an external filter fabric envelope is required around underdrain Types I and III. When required, fabric shall be specified in the plans.

INDEX

NO.  SHEET

NO.

286  1 of 2

2016

DESIGN STANDARDS

UNDERDRAIN
NOTE: For Section AA see following Sheets.

**Asphaltic Concrete**

**Alignment of Outlet Pipe**

**Type SP**

**Pavement**

**Exist.**

**Pipe**

**Revs.**

**Description:**

- **Edgedrain 6" Width**
- **Pavement (Varies)**
- **With The Standard Specifications**
- **Hole Pattern In Accordance With The Standard Specifications**

**Hole Pattern Duplicated On Top Side Of Pipe**

**Note Pattern In Accordance With The Standard Specifications**

**Perimeter Sod**

**5" Min. Cover**

**4" Dia. Minimum Outlet Pipe**

**(Nonperforated)**

**Length Varies**

**1:4 Slope**

**4" Dia. Minimum Outlet Pipe**

**(Nonperforated)**

**Length Varies**

**2' Single Pipe**

**3 Double Pipe**

**Class NS Concrete**

**6" Thick**

**(0.19 CY-1:4 Slope)**

**(0.25 CY-1:6 Slope)**

**Trough For 1:4 Slope**

**Trough For 1:6 Slope**

**Sod**

**2' sod**

**Class NS Concrete (6" Thick)**

**1:2 Bevel**

**3.5' Min.**

**5' Min.**

**1:2 Pipe Bevel For 1:4 Slope**

**1:2 Pipe Bevel For 1:6 Slope**

**Galvanized Hardware Cloth**

**Over 12"**

**Trough Slope Shall Match Outlet Pipe Slope**

**Ditch Bottom**

**1:4 Slope**

**SECTION**

**SECTIONS BB**

**4th EDGEDRAIN EDGEDRAIN OUTLET**

**a = 1.75" std. for grassed ditches; 0.9" std. for paved ditches**

**(less is acceptable to provide minimum 0.1% outlet pipe slope)**

**GENERAL NOTES FOR CONCRETE PAVEMENT SUBDRAINAGE**

1. No trench greater than 2' in depth will be allowed overnight. Trenches shall be backfilled at all times.

2. Concrete pavement subdrainage shall be constructed adjacent to the low edge of the roadway pavement and under travel lanes, auxiliary pavement and shoulders, as called for in the plans. When the edge shifts between outside and inside edges of pavement the concrete pavement subdrainage shall extend 50' beyond and begin 50' before the flat point (100' overlap).

Concrete pavement subdrainage shall be placed on the low side of ramps of crossroad terminals.

3. Concrete pavement subdrainage shall be constructed on a grade parallel with the edge of pavement profile, except on profiles flatter than one-tenth percent (0.10%) the concrete pavement subdrainage shall be constructed on a grade of one-tenth percent (0.10%).

4. Immediately prior to placing the filter fabric the entire vertical face of the concrete pavement shall be cleaned to remove adhering base material and soil.

5. The Contractor shall devise a procedure for holding the filter fabric in position on the vertical face of the trench. The procedure must be approved by the Engineer prior to placement of the draincrete.

6. The upper end of each separate run of the concrete pavement subdrainage pipe shall be capped.

7. Outlet pipes shall be constructed at a maximum of 500' intervals.

Elbows or 90° bends shall be used to connect the outlet pipe to the concrete pavement subdrain pipe. The elbows or bends shall be of the same material as the outlet pipe but compatible with the pipe.

When directed by the Engineer, outlet pipes shall be stubbed into existing inlets or into existing ditch pavements at an elevation 6" above the inlet flowline or ditch bottom. Concrete apron and bordering sod are not required for stubbed outlets but replacement sodding will be required at trenches for pipes stubbed into paved ditches.

In sag vertical curves separate outlet pipes for concrete pavement subdrains from opposite directions shall use a single apron unless otherwise shown in the plans or otherwise directed by the Engineer.

Backfill around outlet pipes shall be of cohesive soils, draincrete will not be permitted.

8. Existing paved shoulder that is removed for the construction of outlet pipes shall be replaced with Type SP asphaltic concrete at the rate of 500 LBS per SY.

9. The contract unit price for Edgedrain Outlet Pipe (4") LF, shall be full compensation for removal of existing shoulder pavement, trench excavation, pipe and fitting, concrete apron, hardware cloth, sod, stubbing into existing inlets and paved ditches, restoration of ditch pavement, backfill in place, and disposal of excess materials.
NEW CONSTRUCTION

NOTES FOR DRAINCRETE PAVEMENT SUBDRAINAGE

1. The edgedrain sections for DRAINCRETE SUBDRAINAGE are applicable to pavement construction identified as RIGID PAVEMENT on Index No. 505, Sheet 2 and 4.

2. The contractor shall confine the construction of draincrete edgedrain to an area in which the entire operation can be carried out in five (5) work days, unless another construction period is called for in the plans, with sufficient time allowed for the draincrete to set before placement of pavement.

METHOD OF PAYMENT

NEW CONSTRUCTION:

1. The contract unit price for Edgedrain (Draincrete) LF shall be full compensation for trench excavation, disposal of excess materials, filter fabric, draincrete edgedrain pipe and fittings, and draincrete.

Payment for outlet pipe shall be in accordance with General Note 9, Sheet 1 of 4.

FOR REHABILITATION:

1. The contract unit price for Edgedrain (Draincrete) LF shall be full compensation for removal of existing shoulder pavement, trench excavation, disposal of excess materials, filter fabric, draincrete edgedrain pipe and fittings, and draincrete, necessary for edgedrain construction.

Payment for outlet pipe shall be in accordance with General Note 9, Sheet 1 of 4.

Shoulder joint seal shall be paid for under the contract unit price for Type SP, Asphaltic Concrete.

Shoulder pavement shall be paid for under the contract unit price for Pavement Joint, LF.
NOTES FOR DRAINCRETE PAVEMENT SUBDRAINAGE

1. The edgdrain sections for DRAINCRETE SUBDRAINAGE are applicable to pavement construction identified as RIGID PAVEMENT on Index No. 505, Sheet 2 and 3.

2. The contractor shall confine the construction of draincrete edgdrain to an area in which the entire operation can be carried out in five (5) work days, unless another construction period is called for in the plans, with sufficient time allowed for the draincrete to set before placement of pavement.

NEW CONSTRUCTION:

1. The contract unit price for edgdrain (Draincrete) LF shall be full compensation for trench excavation, disposal of excess material, filter fabric, draincrete edgdrain pipe and fittings and draincrete.

Payment for outlet pipe shall be in accordance with General Note 9, Sheet 1 of 4.

2. Type B-12.5 shall be paid for under the contract unit price for Optional Base.

3. Shoulder pavement shall be paid for under the contract unit price for Type SP, Asphaltic Concrete.

METHOD OF PAYMENT
CONCRETE TRAVEL LANE, SHOULDERS, AND AUXILIARY PAVEMENT

ASPHALT SHOULDERS

TREATED PERMEABLE BASE SUBDRAINAGE

GENERAL NOTES FOR TREATED PERMEABLE BASE EDGEDRAIN

NEW CONSTRUCTION

1. The contractor shall confine the construction of edgedrain to an area in which the entire operation can be carried out in (5) work days, unless another construction period is called for in the plans.

METHOD OF PAYMENT

NEW CONSTRUCTION

1. Payment shall be full compensation for trench excavation, disposal of excess materials, filter fabric, pipe and fittings, necessary for concrete pavement subdrainage construction. Payment shall be included in the cost for Asphalt Treated Permeable Base, CY or Cement Treated Permeable Base, CY.

Payment for outlet pipe shall be in accordance with General Note 9, Sheet 1 of 4.

2. Shoulder pavement and separation layer shall be paid for under the contract unit price for Type SP, Asphaltic Concrete.
24" STEEL WELL GRATE

Heavy duty "bee hive" grate

Openings: 1-½" maximum

For 24" well, outer diameter = 29'

Steel well grate to be installed over 24" deep well.

Steel grate to be hot dipped galvanized after fabrication, see Specification Section 962.

SECTION A-A

STRUCTURE WITH NO OUTFLOW

DESIGN NOTES

1. Depth of Casing Varies, 60' min.
2. Depth of Open Hole, 19'-20'.
3. Actual Size of the Inflow and Outflow Chambers Will Be Determined By The Size of The Pipes. (Refer To Table 3 Of Index 200.) The Width Of The Box Shall Be Constant Based On The Largest Pipe. The Length Is To Be Adjusted Based On Size and Orientation Of The Pipes.
TABLE 1 - MINIMUM BAR SPLICE LENGTHS FOR LONGITUDINAL REINFORCING

<table>
<thead>
<tr>
<th>BAR SIZE</th>
<th>CLASS II (3400 psi)</th>
<th>CLASS IV (5500 psi)</th>
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</thead>
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<tr>
<td>#5</td>
<td>1'-0&quot;</td>
<td>1'-0&quot;</td>
</tr>
<tr>
<td>#6</td>
<td>1'-4&quot;</td>
<td>1'-4&quot;</td>
</tr>
<tr>
<td>#8</td>
<td>2'-0&quot;</td>
<td>2'-0&quot;</td>
</tr>
</tbody>
</table>

SKEWED CONSTRUCTION JOINTS: Construction joints in barrels of 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.

CULVERT EXTENSIONS: For cut backs and ties into existing concrete box culverts see Sheet 6 of 7.

REINFORCING STEEL: See the "Box Culvert Data Tables" in the Contract Plans for grade and bar spacing. See the Reinforcing Bar List in the Contract Plans for bar sizes and bar bending details.

PART PLAN SHOWING PARALLEL WINGWALLS AND LOCATION OF CONSTRUCTION JOINTS

For non-skewed wingwalls they are located adjacent to the exterior face of the exterior barrel wall, when the $\gamma$ of wingwall and $\chi$ of exterior barrel wall results in an acute angle see Left End Wingwall above, and when the angle is obtuse see Left Begin Wingwall above and Detail C (Sheet 5).

CONSTRUCTION JOINTS IN WINGWALLS AND FOOTINGS ARE LOCATED AS FOLLOWS:

- Construction joint in footing permitted.
- Construction joint in exterior barrel wall.
- Construction joint in wingwall required.

END ELEVATION OF CULVERT

- Half Elevation showing Parallel Wingwalls
- Half Elevation showing Tapered Wingwalls

NOTE: All headwall and culvert skew angles are measured in degrees from a line perpendicular to the centerline of culvert (counter-clockwise positive), see Schematic "B".

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.
CULVERT BARREL NOTES:
1. Space Bars 110 and 112 with a bar in each corner, and at the ⅔ of interior walls (for multiple barrel culverts only), and the remaining bars placed at equal spacing shown in the Contract Plans. Adjust last bar spacing when required.
2. Place Bars 113 and 114 at spacing shown in the Contract Plans evenly between Bars 109 and 111.
3. Locate the first transverse bar from the ends of the culvert at one half the bar spacing, but provide the minimum reinforcement cover and not greater than 4" clear.

TYPICAL SECTION THRU SINGLE BARREL CULVERT

TYPICAL SECTION THRU MULTIPLE BARREL CULVERT

WINGWALL BARREL NOTES:
1. Align construction joint perpendicular to wingwall.
2. In the vicinity of the construction joint, field bond 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 NOTES:
1. Align construction joint perpendicular to wingwall.
2. In the vicinity of the construction joint, field bond 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.
NOTES:
2. WP = Working Point, used for wingwall layout and location of construction joint. See Detail "C" (Sheet 5).

PARTIAL PLAN TOP SLAB
(Left Side, Left Skew)

SINGLE BARREL BOX CULVERT
(Skewed Culvert With Parallel Wingwalls Shown)

PARTIAL PLAN BOTTOM SLAB
(Right Side, Right Skew)

Center of Traffic Lanes

Depth of fill (do not use upper or lower points in normal or super-elevated roadway sections unless so directed by the Structures Design Office.)

LONGITUDINAL SECTION THRU CULVERT
(Transverse Top & Bottom Slab Reinforcing Not Shown For Clarity)
MULTIPLE BARREL BOX CULVERT
(Skewed Culvert With Skewed Wingwalls Shown)

NOTES:
2. WP = Working Point, used for wingwall layout and location of construction joint. See Detail C (Sheet 5).
NOTES:
1. For small angles, the Contractor may elect to fill the area between the box and the wingwall footing with unreinforced concrete. For wingwall skew angles less than 90 degrees, field bend wingwall reinforcement as necessary while maintaining cover. No additional payment will be made for this work.
2. Location of Construction Joint determined by WP at theoretical intersection of:
   - Soil side face of Headwall and outside face of Box Exterior Wall, for SW=90°;
   - Outside face of Wingwall and outside face of Box Exterior Wall, for SW<90°.
3. Provide 6" chamfer when angle 'A' is greater than 45°. Maintain minimum wall thickness. Field adjust reinforcing to maintain cover.
4. Wingwall Skew Angles (SW) are measured from the adjacent box exterior wall to the wingwall.
5. Turn or extend Wingwall Cutoff Wall as necessary to meet Box Cutoff Wall.
6. Provide additional reinforcement in the top of the top slab below traffic railings to ensure a minimum area of 0.80 sq. ft./transverse reinforcing.
OUTSIDE WALLS OF BOXES

SECTION A-A

FLARED WINGWALL

SECTION C-C

INTERIOR SINGLE WALLS OF BOXES

PLAN VIEWS

DETAIL "L" - TRANSITION FOR EXTERIOR WALL/SLAB EXTENSION
(Interior Single Walls Similar)

DETAIL "M" - TRANSITION FOR INTERIOR DOUBLE WALLS OF BOX CULVERTS

TYPE I CONNECTION DETAILS FOR CONCRETE BOX CULVERT EXTENSIONS
(CUT BACK EXISTING CONCRETE)
Concrete Box Culvert

Filter Fabric (both sides)

2'-0" 1'-0"

Coarse Aggregate

Bottom of Base

Use Extra Base When This Dimension is Less Than 12"

10'-0"

Use Extra Base When This Dimension is Less Than 12"

2'-0" 1'-0"

Friable Base Material

Concrete Box Culvert

FRIABLE BASE

Place coarse aggregate in 6 inch lifts and compact sufficiently as to be firm and unyielding. Provide coarse aggregate gravel or stone meeting the requirements of Specification Section 901-2 or 901-3 respectively. Meet the gradation requirements of Specification Section 901-6, Grades 4, 467, 5, 56 or 57 unless restricted in the plans. Provide Type D-3 filter fabric (see Specification Section 985). The cost of furnishing and installing the coarse aggregate and filter fabric shall be included in the cost of the Box Culvert.

ASPHALTIC CONCRETE BASE

NOTE: Extra base is required when cross box culverts are located on facilities subject to high speed traffic (>45 mph) or high traffic volumes (>1600 ADT) and the cover is within the range specified in the notation above.

EXTRA BASE FOR BOX CULVERTS CROSSING UNDER FLEXIBLE PAVEMENT

BRIDGE CULVERT NUMBER LOCATION

SECTION THRU RECESSED V-GROOVE TO FORM INSCRIBED FIGURES

Black Plastic Figures 3" in height as approved by the Engineer may be used in lieu of numbers formed by 3/8" V-Grooves. V-Grooves shall be formed by preformed figures.

INLET IN TOP OF BOX CULVERT

The number is to be placed in the center of the top surface of all bridge culvert headwalls.

TOP VIEW OF HEADWALL

NOTE:
1. Cost of Steel Grating to be included in cost of Box Culvert.
2. All reinforcing shall be 2" clear for Slightly and Moderately Aggressive Environments, and 3" clear for Extremely Aggressive Environments.

LOCATION OF NUMBER

20' or more

(Bridge Culverts)

BLACK PLASTIC NUMBERS

Paint Recessed Surfaces Black

INLET TYPE A GRATE

See Index No. 230 for Grate detail

INLET TYPE B GRATE

See Index No. 231 for Grate detail

SECTION A-A

SECTION B-B

PLAN

PLAN

0000000

4'-8" 1'-0"

4'-4"

4'-3" (Grate)

2'-0" 1'-0" (Grate)

2'-6" 3" 1'-4"

2'-5 1'-4" (Grate)

1'-4"

6" Unless Otherwise Shown in Plans

45° 45°
ALTERNATE BOTTOM SLAB TRANSVERSE JOINT TYPICAL SECTION  
(DOUBLE-SIDED TONGUE & GROOVE JOINT)  
(All reinforcing not shown for clarity)

SECTION A-A  
(2" Cover - Thick Wall Detail)

NOTE:
Bottom Slab Joints in Type B Boxes may be single tongue & groove joints as shown in Section A-A when the Top Slab Joints are oriented as shown in Schematic "A".

* At the Contractor’s option when the box culvert reinforcing utilizes WWR, extend wall and slab reinforcing into the joint and bend to maintain cover in lieu of 4" x 4" ~ W4.0 x W4.0 WWR at joint. Transverse wire in tongue may be cut at corners of box to allow bending of the WWR.

PRECAST SEGMENT TO SEGMENT TONGUE & GROOVE TRANSVERSE JOINTS

SUPPLEMENTAL DETAILS FOR PRECAST CONCRETE BOX CULVERTS
NEW PRECAST BOX CULVERT  
FILTER FABRIC WRAPPED AROUND CONSTRUCTION JOINT 
OUTSIDE FACE OF WALL/SLAB 
LONGITUDINAL REINFORCING 
MECHANICAL COUPLERS OR 2'-0" EXTENSION OF PRECAST BOX REINFORCING 
EQUIVALENT REINFORCING TO C-I-P DESIGN SHOWN IN PLANS 

CAST-IN-PLACE (C-I-P) TRANSITION 
4'-0" (Typ.) 
SPlice 
EXISTING BOX CULVERT TO REMAIN 

CUTOFF WALL REINFORCING (Typ.) 
(SEE C-I-P DESIGN IN PLANS) 
Bend bottom reinforcing as required to maintain cover at joint 
** Provide adequate width to satisfy shear strength requirements at joint 

SECTION B-B 
TOP SLAB TO WALL JOINT 
(KEYED JOINT) 

SECTION E-E 
EXTERIOR WALL/SLAB TRANSITION DETAIL FOR PRECAST EXTENSION 
(TYPE I Connection shown, Type II Connection similar) 

Section of Existing Box Culvert to be removed and replaced, for Type I Connection. 

SUPPLEMENTAL DETAILS FOR PRECAST CONCRETE BOX CULVERTS 
01/01/12 

INDEX NO. 291 
3 of 5
**DIFFERENTIAL SETTLEMENT COUNTERMEASURES FOR PRECAST BOX CULVERTS**

**REVISION NO. 01/01/09**

**DESCRIPTION:**

**2016 DESIGN STANDARDS**

**SUPPLEMENTAL DETAILS FOR PRECAST CONCRETE BOX CULVERTS**

**INDEX NO. 2B91**

**SHEET NO. 5 of 5**

---

**DIFFERENTIAL SETTLEMENT COUNTERMEASURES FOR PRECAST BOX CULVERTS**

**BILL OF REINFORCING STEEL**

<table>
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<th>LENGTH</th>
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<td>2 per Barrel/Ft.</td>
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<tr>
<td>N</td>
<td>4</td>
<td>As Req'd</td>
<td>As Req'd</td>
</tr>
</tbody>
</table>

**REINFORCING STEEL BENDING DIAGRAMS**

**NOTES:**

1. All bar dimensions are out to out.
2. Lap splice length for Bars 4M is 1'-4" minimum.

**LONG-TERM DIFFERENTIAL SETTLEMENT WITH POSITIVE CURVATURE**

\[ \Delta Y = \frac{1}{760} \times R \times W \]

**WHERE:**

- \( \Delta Y \) = Maximum Long-Term Differential Settlement (ft.)
- \( R \) = Exterior height of Box Culvert (ft.)
- \( W \) = Length of Box Culvert Segments (ft.)
- \( L \) = Effective length for single curvature deflection (ft.)

2. Extend Link Slab to back face of headwalls and to limits of existing box culverts for extensions.

**ESTIMATED LINK SLAB QUANTITIES**

<table>
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<tr>
<th>ITEM</th>
<th>UNIT</th>
<th>QUANTITY</th>
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<tr>
<td>Class II or IV Concrete (Culvert)</td>
<td>CY/SF</td>
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<tr>
<td>Reinforcing Steel (Roadway)</td>
<td>LB/SF</td>
<td>1.52</td>
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</table>

**NOTE:** Estimated quantities are based on the plan area of precast box slabs, and are provided for information only. No additional payment will be made for Link Slabs where these are required for the precast box culverts.

**DESIGN NOTE:**

1. Link Slab required when joint openings from differential settlement exceed \( \frac{1}{2} " \) as determined in Link Slab Note 1.

**NOTE TO CONTRACTOR:**

- Install dowels with an Adhesive Bonding Material System in accordance with Specification Section 416. The Contractor may substitute mechanical couplers in lieu of adhesive bonded dowels. Shift dowels to clear box culvert reinforcing.

**LONG-TERM DIFFERENTIAL SETTLEMENT WITH NEGATIVE CURVATURE**

**SCHEMATIC LONGITUDINAL SECTION (NEW CONSTRUCTION)**

**SCHEMATIC LONGITUDINAL SECTION (WIDENING)**

---

**LINK SLAB NOTES:**

1. Provide a Cast-In-Place Link Slab to ensure uniform joint opening of precast box culverts when the differential settlement shown in the plans exceeds the following limits, except that a Link Slab is not required for differential settlements less than \( \frac{1}{2} " \).

\[ \Delta Y = \frac{1}{760} \times R \times W \]

**WHERE:**

- \( \Delta Y \) = Maximum Long-Term Differential Settlement (ft.)
- \( R \) = Exterior height of Box Culvert (ft.)
- \( W \) = Length of Box Culvert Segments (ft.)
- \( L \) = Effective length for single curvature deflection (ft.)

2. Extend Link Slab to back face of headwalls and to limits of existing box culverts for extensions.
TYPICAL BOX SECTION (TYPE 2)
DESIGN EARTH COVER 2' OR GREATER
(Option 1 Reinforcing Configuration Shown)

TYPICAL BOX SECTION (TYPE 1)
DESIGN EARTH COVER LESS THAN 2'
(Option 1 Reinforcing Configuration Shown)

STANDARD PRECAST BOX CULVERT WITH 2" CONCRETE COVER
### TABLE 1A - STANDARD PRECAST BOX CULVERT DESIGNS (2" COVER) - 3' & 4' SPANS

<table>
<thead>
<tr>
<th>SPAN x RISE (S/FT)</th>
<th>SLAB / WALL THICKNESS</th>
<th>DESIGN EARTH COVER ABOVE TOP SLAB</th>
<th>REINFORCEMENT AREAS (sq.in./ft)</th>
<th>AS1 EXT LENGTH (IN)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(FL)</td>
<td>(T) (T)</td>
<td>(M)</td>
<td>(A1)</td>
<td>(A2)</td>
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<tr>
<td>7' x 10'</td>
<td>7' x 7'</td>
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<td>0.33 - &lt;2</td>
<td>0.17 0.29 0.31 0.17 0.17 0.17 0.17</td>
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<tr>
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<td>2' x 2'</td>
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### TABLE 1B - STANDARD PRECAST BOX CULVERT DESIGNS (2" COVER) - 3' & 4' SPANS

<table>
<thead>
<tr>
<th>SPAN x RISE (S/FT)</th>
<th>SLAB / WALL THICKNESS</th>
<th>DESIGN EARTH COVER ABOVE TOP SLAB</th>
<th>REINFORCEMENT AREAS (sq.in./ft)</th>
<th>AS1 EXT LENGTH (IN)</th>
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<td>8' x 8'</td>
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</tbody>
</table>

### SCHEMATIC OF LAP SPlice LOCATIONS

- **S/2**
  - ξ Lap Splice (Outer Cage)
  - S/2
  - ξ Lap Splice (Inside Cage)

### GENERAL NOTES:
1. These precast designs may be substituted for cast-in-place box culverts designed to AASHTO LRFD Bridge Design Specifications, 4th Edition. Designs are based on the design criteria shown in FDOT Structures Design Guidelines.
2. Loading: HL-93 & any fill heights between the minimum & maximum shown.
3. Only one design of precast box culvert is to be used for any installation.
4. Reinforcing steel must consist of smooth or deformed welded wire reinforcement (WWR) meeting the requirements of Specification Section 931. Longitudinal reinforcing may consist of reinforcing bars meeting the requirements of Specification Section 931. Minimum cover must be 2" for slightly or moderately aggressive environments or 3" for extremely aggressive environments, unless otherwise shown. The spacing of circumferential wires must not be less than 2", nor more than 4". The spacing of longitudinal wires or bars must not be more than 8".
5. As9 longitudinal wires must have a minimum cross-sectional area of 40% of the required areas of reinforcement and slab or wall thickness. Interpolated areas may vary between the minimum and maximum shown in the Design Tables but only one haunch dimension must be used within the full length of the box culvert installation.
6. Welding of reinforcement must be limited to the locations shown in ASTM C1577 and in accordance with ANSI/AWS D1.4 “Structural Welding Code - Reinforcing Steel”.
7. For alternate reinforcing configuration Options 2 and 3 shown in Detail "A" and "B" (Sheet 1), As1 may be extended to the middle of either slab and lap spliced with As7 and As8. As4 may be lap spliced at any location or connected to As2 or As3 at corners by welding.
8. Haunch dimensions may vary between the minimum and maximum dimensions shown in the Design Tables but only one haunch dimension must be used within the full length of the box culvert installation.
9. Submittal of redesign calculations are not required for any increase to the slab and/or wall thickness when the minimum reinforcement areas shown in the Design Tables are provided.
10. For Design Earth Cover greater than 10 feet, the Contractor may interpolate the required areas of reinforcement and slab or wall thickness. Interpolated areas of reinforcement, slab or wall thickness must be approved by the Engineer.
11. Minimum length of precast box segments is 4 feet and maximum length is 16 feet.
12. See Index No. 291 for connections to wingwalls, headwalls and other general details.

### NOTES:
1. See Sheet 1 for Reinforcing Details and dimension locations.
2. See Sheet 14 for WWR Bending Diagram.
### TABLE 2A - STANDARD PRECAST BOX CULVERT DESIGNS (2" COVER) - 5' & 6' SPANS

<table>
<thead>
<tr>
<th>SPAN x RISE (S)</th>
<th>SLAB / WALL THICKNESS</th>
<th>DESIGN EARTH COVER (sq. in./ft.)</th>
<th>REINFORCEMENT AREAS</th>
<th>AS1 EXT. LENGTH ABOVE TOP SLAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Ft.)</td>
<td>(in.)</td>
<td>TOP (Tt.)</td>
<td>(in.)</td>
<td>(in.)</td>
</tr>
<tr>
<td>5' x 3</td>
<td>7 7 7</td>
<td>7 7 7</td>
<td>As1</td>
<td>As17</td>
</tr>
<tr>
<td>5' x 4</td>
<td>7 7 7</td>
<td>7 7 7</td>
<td>As1</td>
<td>As17</td>
</tr>
<tr>
<td>6' x 5</td>
<td>6' x 5</td>
<td>6' x 5</td>
<td>As1</td>
<td>As17</td>
</tr>
<tr>
<td>6' x 6</td>
<td>6' x 6</td>
<td>6' x 6</td>
<td>As1</td>
<td>As17</td>
</tr>
</tbody>
</table>

### TABLE 2B - STANDARD PRECAST BOX CULVERT DESIGNS (2" COVER) - 5' & 6' SPANS

<table>
<thead>
<tr>
<th>SPAN x RISE (S)</th>
<th>SLAB / WALL THICKNESS</th>
<th>DESIGN EARTH COVER (sq. in./ft.)</th>
<th>REINFORCEMENT AREAS</th>
<th>AS1 EXT. LENGTH ABOVE TOP SLAB</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Ft.)</td>
<td>(in.)</td>
<td>TOP (Tt.)</td>
<td>(in.)</td>
<td>(in.)</td>
</tr>
<tr>
<td>5' x 3</td>
<td>8 8 8</td>
<td>8 8 8</td>
<td>As1</td>
<td>As17</td>
</tr>
<tr>
<td>5' x 4</td>
<td>8 8 8</td>
<td>8 8 8</td>
<td>As1</td>
<td>As17</td>
</tr>
<tr>
<td>6' x 5</td>
<td>6' x 5</td>
<td>6' x 5</td>
<td>As1</td>
<td>As17</td>
</tr>
<tr>
<td>6' x 6</td>
<td>6' x 6</td>
<td>6' x 6</td>
<td>As1</td>
<td>As17</td>
</tr>
</tbody>
</table>
### TABLE 3 - STANDARD PRECAST BOX CULVERT DESIGNS (2" COVER) - 7' SPANS

<table>
<thead>
<tr>
<th>SPAN \ RISE (S/L)</th>
<th>SLAB/WALL THICKNESS</th>
<th>DESIGN EARTH COVER</th>
<th>REINFORCEMENT AREAS (sq. in./ft²)</th>
<th>AS1 EXT LENGTH (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOP (Tt) (in.)</td>
<td>BOT (Tb) (in.)</td>
<td>SIDE (Tw) (in.)</td>
<td>MAUNCH (Ht) (in.)</td>
<td>AS1</td>
</tr>
<tr>
<td>7 x 4</td>
<td>8 8 8</td>
<td>10</td>
<td>0.33 - &lt;2</td>
<td>0.37</td>
</tr>
<tr>
<td>8 8 8</td>
<td>10</td>
<td>2</td>
<td>&lt;2</td>
<td>0.37</td>
</tr>
<tr>
<td>12</td>
<td>5 - 10</td>
<td>0.26</td>
<td>0.30</td>
<td>0.33</td>
</tr>
<tr>
<td>20</td>
<td>0.49</td>
<td>0.53</td>
<td>0.53</td>
<td>0.10</td>
</tr>
<tr>
<td>8.5 x 8</td>
<td>8 8 7</td>
<td>10</td>
<td>25</td>
<td>0.60</td>
</tr>
<tr>
<td>8.5</td>
<td>8 8 12</td>
<td>30</td>
<td>0.68</td>
<td>0.79</td>
</tr>
</tbody>
</table>

### TABLE 4 - STANDARD PRECAST BOX CULVERT DESIGNS (2" COVER) - 8' SPANS

<table>
<thead>
<tr>
<th>SPAN \ RISE (S/L)</th>
<th>SLAB/WALL THICKNESS</th>
<th>DESIGN EARTH COVER</th>
<th>REINFORCEMENT AREAS (sq. in./ft²)</th>
<th>AS1 EXT LENGTH (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOP (Tt) (in.)</td>
<td>BOT (Tb) (in.)</td>
<td>SIDE (Tw) (in.)</td>
<td>MAUNCH (Ht) (in.)</td>
<td>AS1</td>
</tr>
<tr>
<td>8 x 4</td>
<td>8 8 8</td>
<td>10</td>
<td>0.33 - &lt;2</td>
<td>0.37</td>
</tr>
<tr>
<td>8</td>
<td>8 8 8</td>
<td>10</td>
<td>2</td>
<td>&lt;2</td>
</tr>
<tr>
<td>12</td>
<td>5 - 10</td>
<td>0.26</td>
<td>0.30</td>
<td>0.33</td>
</tr>
<tr>
<td>20</td>
<td>0.49</td>
<td>0.53</td>
<td>0.53</td>
<td>0.10</td>
</tr>
<tr>
<td>8.5 x 8</td>
<td>8 8 7</td>
<td>10</td>
<td>25</td>
<td>0.60</td>
</tr>
<tr>
<td>8.5</td>
<td>8 8 12</td>
<td>30</td>
<td>0.68</td>
<td>0.79</td>
</tr>
</tbody>
</table>

### NOTES:
1. See Sheet 1 for Reinforcing Details and dimension locations.
2. See Sheet 2 for General Notes.
### TABLE 5 - STANDARD PRECAST BOX CULVERT DESIGNS (2" COVER) - 9' SPANS

<table>
<thead>
<tr>
<th>Span (S) (Ft.)</th>
<th>Top Slab Thickness (in.)</th>
<th>Bottom Slab Thickness (in.)</th>
<th>Side Wall Thickness (in.)</th>
<th>Reinforcement Areas (sq. in./Ft.)</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>As9</th>
</tr>
</thead>
<tbody>
<tr>
<td>9 x 5</td>
<td>2 - &lt;2</td>
<td>0.33 - &lt;2</td>
<td>0.41 - 0.62</td>
<td>0.53 - 0.75</td>
<td>31</td>
<td>56</td>
<td>49</td>
<td>49</td>
<td>49</td>
<td>49</td>
<td>49</td>
<td>49</td>
<td>49</td>
</tr>
<tr>
<td>9 x 6</td>
<td>2 - &lt;2</td>
<td>0.43 - 0.67</td>
<td>0.57 - 0.81</td>
<td>0.69 - 0.94</td>
<td>54</td>
<td>54</td>
<td>49</td>
<td>49</td>
<td>49</td>
<td>49</td>
<td>49</td>
<td>49</td>
<td>49</td>
</tr>
<tr>
<td>9 x 7</td>
<td>2 - &lt;2</td>
<td>0.53 - 0.86</td>
<td>0.91 - 1.00</td>
<td>1.27 - 1.43</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
<td>79</td>
</tr>
<tr>
<td>9 x 8</td>
<td>2 - &lt;2</td>
<td>0.63 - 1.10</td>
<td>1.60 - 1.80</td>
<td>2.11 - 2.32</td>
<td>84</td>
<td>84</td>
<td>84</td>
<td>84</td>
<td>84</td>
<td>84</td>
<td>84</td>
<td>84</td>
<td>84</td>
</tr>
</tbody>
</table>

### TABLE 6 - STANDARD PRECAST BOX CULVERT DESIGNS (2" COVER) - 10' SPANS

| Span (S) (Ft.) | Top Slab Thickness (in.) | Bottom Slab Thickness (in.) | Side Wall Thickness (in.) | Reinforcement Areas (sq. in./Ft.) | As1 | As2 | As3 | As4 | As5 | As6 | As7 | As8 | As9 |
|---------------|--------------------------|-----------------------------|---------------------------|-----------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| 10 x 5        | 2 - <2                   | 0.33 - <2                   | 0.46 - 0.62               | 0.53 - 0.75                      | 38  | 38  | 38  | 38  | 38  | 38  | 38  | 38  |
| 10 x 6        | 2 - <2                   | 0.44 - 0.64                 | 0.64 - 0.94               | 0.94 - 1.24                      | 68  | 68  | 68  | 68  | 68  | 68  | 68  | 68  |
| 10 x 7        | 2 - <2                   | 0.55 - 0.81                 | 1.01 - 1.27               | 1.52 - 1.83                      | 96  | 96  | 96  | 96  | 96  | 96  | 96  | 96  |
| 10 x 8        | 2 - <2                   | 0.66 - 1.10                 | 1.60 - 1.80               | 2.11 - 2.32                      | 115 | 115 | 115 | 115 | 115 | 115 | 115 | 115 |

**NOTES:**
1. See Sheet 1 for Reinforcing Details and dimension locations.
2. See Sheet 2 for General Notes.
3. See Sheet 14 for WRB Bending Diagram.
### TABLE 7 - STANDARD PRECAST BOX CULVERT DESIGNS (2" COVER) - 11' SPANS

<table>
<thead>
<tr>
<th>SPAN</th>
<th>TOP RISE (Ft.)</th>
<th>WALL THICKNESS (in.)</th>
<th>DESIGN EARTH COVER ABOVE TOP SLAB (in.)</th>
<th>REINFORCEMENT AREAS (sq. in./ft.)</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>
</tr>
</thead>
<tbody>
<tr>
<td>11' x 4</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>10</td>
<td>3.72</td>
<td>0.51</td>
<td>0.57</td>
<td>0.47</td>
<td>0.27</td>
<td>0.27</td>
<td>0.45</td>
<td>0.48</td>
</tr>
<tr>
<td>11' x 6</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>10</td>
<td>3.72</td>
<td>0.45</td>
<td>0.62</td>
<td>0.52</td>
<td>0.27</td>
<td>0.27</td>
<td>0.41</td>
<td>0.45</td>
</tr>
<tr>
<td>11' x 8</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>10</td>
<td>3.72</td>
<td>0.4</td>
<td>0.65</td>
<td>0.54</td>
<td>0.23</td>
<td>0.23</td>
<td>0.42</td>
<td>0.46</td>
</tr>
<tr>
<td>11' x 10</td>
<td>11</td>
<td>11</td>
<td>11</td>
<td>10</td>
<td>3.72</td>
<td>0.39</td>
<td>0.83</td>
<td>0.69</td>
<td>0.18</td>
<td>0.18</td>
<td>0.38</td>
<td>0.44</td>
</tr>
<tr>
<td>12' x 4</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>10</td>
<td>3.72</td>
<td>0.39</td>
<td>0.83</td>
<td>0.69</td>
<td>0.18</td>
<td>0.18</td>
<td>0.38</td>
<td>0.44</td>
</tr>
<tr>
<td>12' x 6</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>10</td>
<td>3.72</td>
<td>0.39</td>
<td>0.83</td>
<td>0.69</td>
<td>0.18</td>
<td>0.18</td>
<td>0.38</td>
<td>0.44</td>
</tr>
<tr>
<td>12' x 8</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>10</td>
<td>3.72</td>
<td>0.39</td>
<td>0.83</td>
<td>0.69</td>
<td>0.18</td>
<td>0.18</td>
<td>0.38</td>
<td>0.44</td>
</tr>
<tr>
<td>12' x 10</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>10</td>
<td>3.72</td>
<td>0.39</td>
<td>0.83</td>
<td>0.69</td>
<td>0.18</td>
<td>0.18</td>
<td>0.38</td>
<td>0.44</td>
</tr>
</tbody>
</table>

### TABLE 8 - STANDARD PRECAST BOX CULVERT DESIGNS (2" COVER) - 12' SPANS

<table>
<thead>
<tr>
<th>SPAN</th>
<th>TOP RISE (Ft.)</th>
<th>WALL THICKNESS (in.)</th>
<th>DESIGN EARTH COVER ABOVE TOP SLAB (in.)</th>
<th>REINFORCEMENT AREAS (sq. in./ft.)</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>
</tr>
</thead>
<tbody>
<tr>
<td>12' x 4</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>10</td>
<td>3.72</td>
<td>0.39</td>
<td>0.83</td>
<td>0.69</td>
<td>0.18</td>
<td>0.18</td>
<td>0.38</td>
<td>0.44</td>
</tr>
<tr>
<td>12' x 6</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>10</td>
<td>3.72</td>
<td>0.39</td>
<td>0.83</td>
<td>0.69</td>
<td>0.18</td>
<td>0.18</td>
<td>0.38</td>
<td>0.44</td>
</tr>
<tr>
<td>12' x 8</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>10</td>
<td>3.72</td>
<td>0.39</td>
<td>0.83</td>
<td>0.69</td>
<td>0.18</td>
<td>0.18</td>
<td>0.38</td>
<td>0.44</td>
</tr>
<tr>
<td>12' x 10</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>10</td>
<td>3.72</td>
<td>0.39</td>
<td>0.83</td>
<td>0.69</td>
<td>0.18</td>
<td>0.18</td>
<td>0.38</td>
<td>0.44</td>
</tr>
</tbody>
</table>

**NOTES:**
1. See Sheet 1 for Reinforcing Details and dimension locations.
2. See Sheet 2 for General Notes.
### Table 9B - Standard Precast Box Culvert Designs (3" Cover) - 3' & 4' Spans

<table>
<thead>
<tr>
<th>Length</th>
<th>Top Side Reinforcement Areas</th>
<th>HAUNCH (in.)</th>
<th>Bot. Side Reinforcement Areas</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.13</td>
<td>0.13</td>
<td>0.13</td>
<td>0.13</td>
<td></td>
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<tr>
<td>0.22</td>
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<td>0.22</td>
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<td>0.28</td>
<td>0.28</td>
<td>0.28</td>
<td>0.28</td>
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</tr>
<tr>
<td>0.34</td>
<td>0.34</td>
<td>0.34</td>
<td>0.34</td>
<td></td>
</tr>
<tr>
<td>0.43</td>
<td>0.43</td>
<td>0.43</td>
<td>0.43</td>
<td></td>
</tr>
</tbody>
</table>

See General Note 5
### TABLE 10A - STANDARD PRECAST BOX CULVERT DESIGNS (3" COVER) - 5' & 6' SPANS

<table>
<thead>
<tr>
<th>SPAN (Ft)</th>
<th>NO.</th>
<th>DESIGN [in.]</th>
<th>REINFORCEMENT AREAS (sq. in./Ft.)</th>
<th>AS1 EST. LENGTH [in.]</th>
</tr>
</thead>
<tbody>
<tr>
<td>5' x 3</td>
<td>10</td>
<td>9 9 9 9</td>
<td>AS1 A2 A3 A4 A5 A6 A7 A8 A9</td>
<td></td>
</tr>
<tr>
<td>6' x 4</td>
<td>10</td>
<td>9 9 9 9</td>
<td>AS1 A2 A3 A4 A5 A6 A7 A8 A9</td>
<td></td>
</tr>
<tr>
<td>6' x 5</td>
<td>10</td>
<td>9 9 9 9</td>
<td>AS1 A2 A3 A4 A5 A6 A7 A8 A9</td>
<td></td>
</tr>
</tbody>
</table>

#### DESIGN STANDARDS
- 2' - <3'
- 3' - <5'
- 5' - 10'

#### SIDE
- 8
- 8
- 8

#### TOP SLAB
- 0.33' - <2'
- 0.33' - <2'
- 0.33' - <2'

#### TOP
- 10
- 10
- 10

#### EARTH COVER
- 15
- 15
- 15

#### MAUNSH (in.)
- 20
- 20
- 20

#### SLAB / WALL THICKNESS
- 9
- 9
- 9

#### TOP (in.)
- 43
- 43
- 43

#### BUT (in.)
- 36
- 36
- 36

#### SIZE (in.)
- 39
- 39
- 39

#### SPAN (Ft)
- 5
- 5
- 5

#### NO.
- 10
- 10
- 10

#### DESCRIPTION:
- 9
- 9
- 9

#### (Tb) [in.]
- 9
- 9
- 9

#### (Tt) [in.]
- 9
- 9
- 9

#### (Tw) [in.]
- 8
- 8
- 8

#### TABLE 10B - STANDARD PRECAST BOX CULVERT DESIGNS (3" COVER) - 5' & 6' SPANS

<table>
<thead>
<tr>
<th>SPAN (Ft)</th>
<th>NO.</th>
<th>DESIGN [in.]</th>
<th>REINFORCEMENT AREAS (sq. in./Ft.)</th>
<th>AS1 EST. LENGTH [in.]</th>
</tr>
</thead>
<tbody>
<tr>
<td>5' x 3</td>
<td>10</td>
<td>9 9 9 9</td>
<td>AS1 A2 A3 A4 A5 A6 A7 A8 A9</td>
<td></td>
</tr>
<tr>
<td>6' x 4</td>
<td>10</td>
<td>9 9 9 9</td>
<td>AS1 A2 A3 A4 A5 A6 A7 A8 A9</td>
<td></td>
</tr>
<tr>
<td>6' x 5</td>
<td>10</td>
<td>9 9 9 9</td>
<td>AS1 A2 A3 A4 A5 A6 A7 A8 A9</td>
<td></td>
</tr>
</tbody>
</table>

#### DESIGN STANDARDS
- 2' - <3'
- 3' - <5'
- 5' - 10'

#### SIDE
- 8
- 8
- 8

#### TOP SLAB
- 0.33' - <2'
- 0.33' - <2'
- 0.33' - <2'

#### TOP
- 10
- 10
- 10

#### EARTH COVER
- 15
- 15
- 15

#### MAUNSH (in.)
- 20
- 20
- 20

#### SLAB / WALL THICKNESS
- 9
- 9
- 9

#### TOP (in.)
- 43
- 43
- 43

#### BUT (in.)
- 36
- 36
- 36

#### SIZE (in.)
- 39
- 39
- 39

#### SPAN (Ft)
- 5
- 5
- 5

#### NO.
- 10
- 10
- 10

#### DESCRIPTION:
- 9
- 9
- 9

#### (Tb) [in.]
- 9
- 9
- 9

#### (Tt) [in.]
- 9
- 9
- 9

#### (Tw) [in.]
- 8
- 8
- 8

#### (H) [in.]
- 10
- 10
- 10

#### EXT.
- 8
- 8
- 8
### TABLE IIA - STANDARD PRECAST BOX CULVERT DESIGNS (3" COVER) - 7' SPANS

<table>
<thead>
<tr>
<th>SPAN x RISE (s)</th>
<th>SLAB / WALL THICKNESS</th>
<th>DESIGN EARTH COVER ABOVE TOP SLAB</th>
<th>REINFORCEMENT AREAS (sq. in./ft)</th>
<th>A61 EXT. LENGTH (in.</th>
<th>(in.)</th>
<th>(H)</th>
<th>to</th>
<th>(in.)</th>
<th>(in.)</th>
<th>(in.)</th>
<th>3' - 5'</th>
<th>5' - 10'</th>
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<td>3' - 5' 0.29 0.35 0.38 0.12</td>
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<td>3' - 5' 0.29 0.35 0.38 0.12</td>
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<td>3' - 5' 0.29 0.35 0.38 0.12</td>
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### TABLE IIB - STANDARD PRECAST BOX CULVERT DESIGNS (3" COVER) - 7' SPANS

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<th>SPAN x RISE (s)</th>
<th>SLAB / WALL THICKNESS</th>
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<th>REINFORCEMENT AREAS (sq. in./ft)</th>
<th>A61 EXT. LENGTH (in.</th>
<th>(in.)</th>
<th>(H)</th>
<th>to</th>
<th>(in.)</th>
<th>(in.)</th>
<th>(in.)</th>
<th>3' - 5'</th>
<th>5' - 10'</th>
<th>10' - 25'</th>
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NOTES:
1. See Sheet 2 for General Notes.
2. See Sheet 7 for Reinforcing Details and dimension locations.
3. See Sheet 14 for WWB Bending Diagrams.

LAST REVISION: 07/01/13
DESCRIPTION: 2016 DESIGN STANDARDS
INDEX NO. 292
SHEET NO. 10 of 14

STANDARD PRECAST CONCRETE BOX CULVERTS
<table>
<thead>
<tr>
<th>SPAN x RISE (ft)</th>
<th>LENGTH (m)</th>
<th>AS1 EST.</th>
<th>As2</th>
<th>As3</th>
<th>As4</th>
<th>As5</th>
<th>As6</th>
<th>As7</th>
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<td>0.42</td>
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<td>0.66</td>
<td>0.57</td>
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<td>0.24</td>
<td>0.42</td>
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<tr>
<td>8' x 6 10 10 10</td>
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<td>0.52</td>
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<tr>
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NOTES:
1. See Sheet 2 for General Notes.
2. See Sheet 7 for Reinforcing Details and dimension locations.
### TABLE 13A - STANDARD PRECAST BOX CULVERT DESIGNS (3" COVER) - 9' SPANS

<table>
<thead>
<tr>
<th>SPAN x RISE (Ft)</th>
<th>SLAB / WALL THICKNESS (Tin)</th>
<th>DESIGN OF EARTH COVER ABOVE TOP SLAB</th>
<th>REINFORCEMENT AREAS (Sq. in./Ft)</th>
<th>AS1 EXT LENGTH (In.)</th>
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<tr>
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<td>0.65 0.63 0.64 0.71</td>
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### TABLE 13B - STANDARD PRECAST BOX CULVERT DESIGNS (3" COVER) - 9' SPANS

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<th>SPAN x RISE (Ft)</th>
<th>SLAB / WALL THICKNESS (Tin)</th>
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<th>REINFORCEMENT AREAS (Sq. in./Ft)</th>
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**NOTES:**
1. See Sheet 2 for General Notes.
2. See Sheet 7 for Reinforcing Details and dimension locations.
3. See Sheet 14 for WWR Bonding diagrams.
### TABLE 14 - STANDARD PRECAST BOX CULVERT DESIGNS (3" COVER) - 10' SPANS

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<th>MAUNCHED WALL THICKNESS (In)</th>
<th>DESIGN EARTH COVER ABOVE TOP SLAB (In)</th>
<th>REINFORCEMENT AREAS (sq. In./Ft)</th>
<th>AS1 EXT LENGTH (in.)</th>
<th>AS1</th>
<th>AS2</th>
<th>AS3</th>
<th>AS4</th>
<th>AS5</th>
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</table>

### TABLE 15 - STANDARD PRECAST BOX CULVERT DESIGNS (3" COVER) - 11' SPANS

<table>
<thead>
<tr>
<th>SPAN (Ft)</th>
<th>TOP SLAB (Rt)</th>
<th>BGT (In)</th>
<th>SIDE WALL THICKNESS (In)</th>
<th>MAUNCHED WALL THICKNESS (In)</th>
<th>DESIGN EARTH COVER ABOVE TOP SLAB (In)</th>
<th>REINFORCEMENT AREAS (sq. In./Ft)</th>
<th>AS1 EXT LENGTH (in.)</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>AS9</th>
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</table>

**NOTES:**
1. See Sheet 2 for General Notes.
2. See Sheet 7 for Reinforcing Details and dimension locations.
TABLE 16 - STANDARD PRECAST BOX CULVERT DESIGNS (3" COVER) - 12' SPANS

<table>
<thead>
<tr>
<th>SPAN x RISE (S) x (T)</th>
<th>WALL THICKNESS</th>
<th>DESIGN MATERIAL</th>
<th>REINFORCEMENT AREAS (sq. in./ft.)</th>
<th>A1 EXT LENGTH (M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>12' x 4'</td>
<td>2</td>
<td>4</td>
<td>0.33 - 0'</td>
<td>0.59</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>3</td>
<td>0.33 - 0'</td>
<td>0.56</td>
</tr>
<tr>
<td></td>
<td>5 - 10</td>
<td>12</td>
<td>0.33 - 0'</td>
<td>0.59</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>12</td>
<td>0.33 - 0'</td>
<td>0.59</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>12</td>
<td>0.33 - 0'</td>
<td>0.59</td>
</tr>
</tbody>
</table>

NOTES:
1. See Sheet 2 of 14 for General Notes.
2. See Sheet 7 of 14 for Reinforcing Details and dimension locations.

REINFORCEMENT NOTES:
1. Reinforcement bending dimensions are out-to-out.
2. See General Notes 4, 5 and 6 on Sheet 2.
SAFETY MODIFICATION FOR INLETS IN BOX CULVERTS

LONGITUDINAL SECTION

SECTION AA

SECTION BB

SAFETY MODIFICATIONS FOR INLET IN BOX CULVERTS
DIMENSIONS AND QUANTITIES PER GRADE

<table>
<thead>
<tr>
<th>Slope</th>
<th>Pipe Size</th>
<th>Bars F (5 Required)</th>
<th>Bars V (U-Bends)</th>
<th>Anchor Bolt (6 Required)</th>
<th>(2) Total</th>
<th>Weight Lbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1:6</td>
<td>7-8&quot;</td>
<td>2&quot; x 1/2</td>
<td>6&quot; x 2</td>
<td>2&quot; x 1/2</td>
<td>6 x 1</td>
<td>444</td>
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<tr>
<td>1:4</td>
<td>7-8&quot;</td>
<td>2&quot; x 1/2</td>
<td>6&quot; x 2</td>
<td>2&quot; x 1/2</td>
<td>6 x 1</td>
<td>444</td>
</tr>
</tbody>
</table>

GENERAL NOTES

1. For use criteria see "Steel Grating Use Criteria" Index No. 261.
2. Grates shall be ASTM A242, A572 or A588, Grade 50 steel, and galvanized in accordance with Section 975 and 425-3.3 of the Standard Specifications.
3. Channel section C3 x 6.0 may be substituted for the C4 x 5.4 channel.
4. All reinforcing No. 4 bars with 2" clearance except as noted. Spacings shown are center-to-center. Laps to be 12" minimum. Welded wire fabric (two cages max.) having an equivalent cross section area (0.20 sq. in.) may be substituted for bar reinforcement.
5. Drill 1/2" holes 8" deep with a rotary drill in existing endwall for dowel bars. Holes shall be thoroughly cleaned prior to installing Adhesive-Bonded Dowels.
6. Endwall to be paid for under the contract unit price for Class I Concrete (Endwalls), C1 and Reinforcing Steel (Roadway), LB. Cost of Adhesive-Bonded Dowels to be included in the contract unit price for reinforcing steel. Cost of grates to be paid for under the contract unit price for Endwall Grate, LB, plan quantity. Cost of galvanized bolts and nuts to be included in the contract unit price for the grate.
7. Sod slopes 5' each side and above endwall. Sodding to be paid for under the contract unit price for Performance Turf, SY.

DIMENSIONS AND QUANTITIES PER U-ENDWALL

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>G</th>
<th>M</th>
<th>D</th>
<th>R</th>
<th>Class</th>
<th>Concrete-CY</th>
<th>Reinforcing Steel</th>
<th>Sod</th>
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</thead>
<tbody>
<tr>
<td>15&quot;</td>
<td>7-8&quot;</td>
<td>3-10&quot;</td>
<td>2-5&quot;</td>
<td>8-6&quot;</td>
<td>2-5&quot;</td>
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<td>167</td>
<td>23</td>
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<tr>
<td>18&quot;</td>
<td>7-8&quot;</td>
<td>3-10&quot;</td>
<td>2-5&quot;</td>
<td>8-6&quot;</td>
<td>2-5&quot;</td>
<td>2.32</td>
<td>167</td>
<td>23</td>
</tr>
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<td>20&quot;</td>
<td>7-8&quot;</td>
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<td>2-5&quot;</td>
<td>2.32</td>
<td>167</td>
<td>23</td>
</tr>
</tbody>
</table>

SCALE

1" = 10'"