1. Use end sections on 1V:4H to 1V:6H slopes DNL Y. Use toe plate (see sec. A-A) longitudinal slope extension where shown on the plans.

2. Fabricate safety and longitudinal bars from steel pipe conforming to ASTM A53 Schedule 40 Specifications. Galvanize bars after fabrication.

3. A longitudinal bar is required for cross drainage end sections when the span is greater than 30 inches. Use additional longitudinal bars if spacing exceeds 30 inches on larger end sections.

4. Longitudinal bars are not required on 30 inches thickness as end section and small cross drainage end sections.

5. Safety bars are not required on 18 inches and smaller parallel drainage end sections.

6. When required, toe plate extensions shall be the same gage as end sections. Dimensions shall be overall width less 6 inches.

METAL END SECTIONS FOR ROUND PIPE CULVERT

<table>
<thead>
<tr>
<th>Pipe Size (inches)</th>
<th>Metal Thickness (inches)</th>
<th>Dimensions (inches)</th>
<th>Overall Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
<td>0.064/16</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>24</td>
<td>0.064/16</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>30</td>
<td>0.092/12</td>
<td>12</td>
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<tr>
<td>36</td>
<td>0.092/12</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>42</td>
<td>0.092/12</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>48</td>
<td>0.092/12</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>54</td>
<td>0.092/12</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>60</td>
<td>0.092/12</td>
<td>16</td>
<td>12</td>
</tr>
</tbody>
</table>

METAL END SECTIONS FOR PIPE ARCH CULVERT

<table>
<thead>
<tr>
<th>Pipe Size (inches)</th>
<th>Metal Thickness (inches)</th>
<th>Dimensions (inches)</th>
<th>Overall Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>18</td>
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</tr>
<tr>
<td>60</td>
<td>0.092/12</td>
<td>16</td>
<td>12</td>
</tr>
</tbody>
</table>

SAFETY BAR DETAILS

General notes:
1. Use end sections on 1V:4H to 1V:6H slopes DNL Y. Use toe plate (see sec. A-A) longitudinal slope extension where shown on the plans.
2. Fabricate safety and longitudinal bars from steel pipe conforming to ASTM A53 Schedule 40 Specifications. Galvanize bars after fabrication.
3. A longitudinal bar is required for cross drainage end sections when the span is greater than 30 inches. Use additional longitudinal bars if spacing exceeds 30 inches on larger end sections.
4. Safety and longitudinal bars are not required on 30 inches thickness as end section and small cross drainage end sections.
5. Safety bars are not required on 18 inches and smaller parallel drainage end sections.
6. When required, the plate extensions shall be the same gage as end sections. Dimensions shall be overall width less 6 inches.

Project Development Branch: July 31, 2019

Traversable End Sections and Safety Grates

Standard Plan No. M-603-12

Sheet No. 1 of 3

Colorado Department of Transportation

CDOT No., 3rd Floor
Boulder, CO 80304
Phone: 303-757-9021 FAX: 303-757-9868
TYPE 1
STRAIGHT CULVERT

EDGE OF ROADWAY PAVEMENT

TYPE 2
SKEWED CULVERT

TYPE 3
FLARED CULVERT

TYPE 4
FLARED-SKEWED CULVERT

INSTALLATION TYPES
Grate bars shall be perpendicular to direction of traffic flow.

INSTALLATION PLAN
(Type 4 - Flared-Skewed Culvert Shown)

SKEW ANGLE DETERMINATION

SHIM DETAIL

SECTION A-A

SECTION B-B

SECTION C-C

NOTES
1. Shop drawings shall be submitted per 105.02.
2. Hardware such as bolts, washers, and lock nuts shall be hot-dipped galvanized per ASTM A572.
3. Designed for use on terrain XX slopes with a clear radius for errant vehicles. Diamond is the preferred option on steep terrain or with higher traffic volumes.
4. Minimum schedule # pipe shall be hot-dip galvanized all tiers, fittings, and hardware after all cutting, bending, and fabrication.
5. Both ends of culvert shall be treated to prevent debris from entering.
6. Equally spaced 24 inches min. to 30 inches max. from inside of sidewall to center of bracket, or from center to center of bracket.
7. The cross bar diameter shall be equal to or greater than the grate bar diameter.
8. If more than 20 feet than a midspan support shall be required. See sheets 3 and 4.
9. Grate bars shall be perpendicular to roadway edge.
10. Drill holes using equipment designed to cut through concrete and reinforcing steel.
11. A 1/4 inch hole, lock nut and washer, all holes are to be 3/8 inch diameter.
12. Bend plates or strips without cracking material.
13. Shim thickness equals the difference in diameters of the grate bar and cross bar.