Section 8

Culvert End Treatments & Structural Design of Culverts & Pipe Materials
Culvert End Treatments

CONVENTIONAL INLETS

• Thin Edge Projecting
• Vertical Headwall
• Square Edge
• Beveled Edge
• Mitered to Conform to Slope
Thin Edge Projecting
Culvert End Treatments

CONVENTIONAL INLETS

• Thin Edge Projecting
• **Vertical Headwall**
• Square Edge
• Beveled Edge
• Mitered to Conform to Slope
Culvert End Treatments

CONVENTIONAL INLETS

• Thin Edge Projecting
• Vertical Headwall
• **Square Edge**
• Beveled Edge
• Mitered to Conform to Slope
Square Edge

Contraction of Flow Reduces
Effective Barrel Size

Square Edge

Section 8
Culvert End Treatments

CONVENTIONAL INLETS

• Thin Edge Projecting
• Vertical Headwall
• Square Edge
• **Beveled Edge**
• Mitered to Conform to Slope
Beveled Edge

Minimal Flow Contraction

Beveled Edge
Culvert End Treatments

CONVENTIONAL INLETS

• Thin Edge Projecting
• Vertical Headwall
• Square Edge
• Beveled Edge
• **Mitered to Conform to Slope**
Mitered to Conform to Slope
Culvert End Treatments

TAPERED INLETS

• **Inlet Depression**
• Side-tapered Inlet
• Slope-tapered Inlet
Inlet Depression
Culvert End Treatments

TAPERED INLETS

- Inlet Depression
- **Side-tapered Inlet**
- Slope-tapered Inlet
Side-Tapered Inlet
Culvert End Treatments

TAPERED INLETS

• Inlet Depression
• Side-tapered Inlet
• **Slope-tapered Inlet**
Slope-tapered Inlet

ELEVATION

Wingwalls
Taper
B

PLAN

Slope-Tapered Inlet
### TABLE A

**COMPARISON OF INLET PERFORMANCE AT CONSTANT HEADWATER FOR 6 FT. x 6 FT. RCB**

<table>
<thead>
<tr>
<th>Inlet Type</th>
<th>Headwater</th>
<th>Discharge</th>
<th>% Improvement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square-edge</td>
<td>8.0'</td>
<td>336 cfs</td>
<td>0</td>
</tr>
<tr>
<td>Bevel-edge</td>
<td>8.0'</td>
<td>392 cfs</td>
<td>16.7</td>
</tr>
<tr>
<td>Side-tapered</td>
<td>8.0'</td>
<td>438 cfs</td>
<td>30.4</td>
</tr>
<tr>
<td>*Slope-tapered</td>
<td>8.0'</td>
<td>523 cfs</td>
<td>55.6</td>
</tr>
</tbody>
</table>

*Minimum FALL in inlet = D/4 = 1.5 ft.*

Table B depicts the reduction in headwater that is possible for a discharge of 500 cfs. The headwater varies from 12.5 ft. for the square-edged inlet to 7.6 ft. for the slope-tapered inlet. This is a 39.2 percent reduction in required headwater.

### TABLE B

**COMPARISON OF INLET PERFORMANCE AT CONSTANT DISCHARGE FOR 6 FT. x 6 FT. RCB**

<table>
<thead>
<tr>
<th>Inlet Type</th>
<th>Discharge</th>
<th>Headwater</th>
<th>% Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Square-edge</td>
<td>500 cfs</td>
<td>12.5'</td>
<td>0</td>
</tr>
<tr>
<td>Bevel-edge</td>
<td>500 cfs</td>
<td>10.1'</td>
<td>19.2</td>
</tr>
<tr>
<td>Side-tapered</td>
<td>500 cfs</td>
<td>8.8'</td>
<td>29.6</td>
</tr>
<tr>
<td>*Slope-tapered</td>
<td>500 cfs</td>
<td>7.6'</td>
<td>39.2</td>
</tr>
</tbody>
</table>

*Minimum FALL in inlet = D/4 = 1.5 ft.*
## Outlet Protection

<table>
<thead>
<tr>
<th>Outlet Velocity</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-10 ft/sec</td>
<td>Quarry Spalls</td>
</tr>
<tr>
<td>10-15 ft/sec</td>
<td>Light Loose Riprap</td>
</tr>
<tr>
<td>&gt;15 ft/sec</td>
<td>Heavy Loose Riprap</td>
</tr>
</tbody>
</table>