LEARNING OUTCOMES

• Describe vortices producing local scour at an abutment

• List and define the variables used to analyze abutment scour

• Describe two equations for abutment scour

• Estimate scour at a vertical wall abutment (A only)
ABUTMENT SHAPE

• Spill-through abutments

• Vertical wall abutments

• Vertical wall abutments with flared wing walls
ABUTMENT LOCATION

• Alignment of embankment with respect to flow direction

• Projection into the main channel or floodplain
FLOW CONDITIONS

- Returning flow increases the strength of vortices
- Returning flow is typically sediment free
Flow Distribution for Laboratory

Flow Distribution at Typical Bridges
THE FROEHLICH EQUATION

\[ \frac{y_s}{y_a} = 2.27 K_1 K_2 \left( \frac{L'}{y_a} \right)^{0.43} Fr^{0.61} + 1 \]
<table>
<thead>
<tr>
<th>Description</th>
<th>( K_1 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical-wall abutment</td>
<td>1.00</td>
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<tr>
<td>Vertical-wall with wing walls</td>
<td>0.82</td>
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<tr>
<td>Spill-through abutment</td>
<td>0.55</td>
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</tbody>
</table>
Right Embankment

Equal Conveyance Tubes

Velocity

L

L'
THE HIRE EQUATION

\[
\frac{y_s}{y_1} = 4 Fr^{0.33} \frac{K_1}{0.55} K_2
\]
STURM ABUTMENT SCOUR EQUATIONS

- HEC-18, Appendix E
- Flume data with compound channel
- Live-bed and clear-water equations
- Discharge distribution factor rather than abutment length
MARYLAND ABUTMENT SCOUR EVALUATION METHOD

• HEC-18, Appendix F
• Research and development by Chang
• Laursen’s long contraction scour theory for live-bed and clear-water
• Velocity adjustment factor
• Spiral flow adjustment factor
DESIGN CONSIDERATIONS (ABUTMENTS)

• Equations over predict scour
• Design for contraction and long term degradation and provide protection
• Minimize adverse flow conditions
• Use spill-through abutments and protect slope
• Protect downstream side of abutment
LEARNING OUTCOMES

• Describe vortices producing local scour at an abutment
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ABUTMENT SCOUR