

Bridge Geotechnical Considerations and Designing for Scour

PART V

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Scour Countermeasures

- Bank-hardening
 - Riprap
 - Toskanes
 - Cable-tied blocks
 - Geobags
- Flow-altering
 - Submerged vanes
 - Delta wings
- River-training
 - Groynes, spur dikes
 - Submerged vanes
 - Guidebanks
 - Grade-control structures

Bank-Hardening: Riprap

- Use round stones; flat ones can be lifted and washed away.
- Use well-graded stones so small ones fill void spaces.
Largest size = $2D_{50}$; smallest size is gravel.
- Use geotextile filter fabric between bank material and riprap stones to prevent winnowing of fines. Place stones carefully. Seal sides of fabric to prevent undermining.
- Riprap blanket thickness should be at least 12 in. or $1.5D_{50}$.
- Difficult to place in flowing water. Can add additional thickness at toe to settle into place after initial settling.

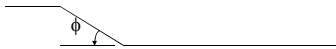
Sizing Riprap

$D_{50} = (\tau_c)_s / 4$; d_{50} in ft, τ_{cs} in psf

$$K = \frac{(\tau_c)_s}{(\tau_c)_b} = \sqrt{1 - \frac{\sin^2 \phi}{\sin^2 \theta}}$$

$(\tau_c)_b = 1.6\gamma RS$

θ =angle of repose; R =hydraulic radius; S =bed slope



Bank-Hardening: Toskanes

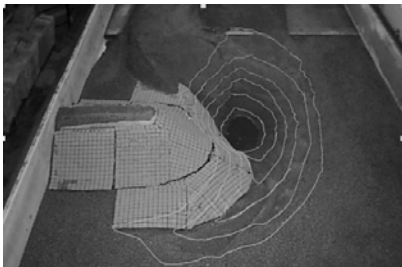
- Kind of jacks that interlock (Tetrapods)



- Won't wash away as easily as riprap
- Placement similar to riprap

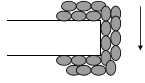
Bank Hardening: Cable-Tied Blocks

- Large concrete block tied together with cable. Acts as a mattress



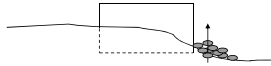
Bank-Hardening: Geobags- Pervious Bags Filled with Gravel

• PLAN



• SECTION

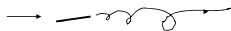
- Vertical water seepage
- No winnowing of fines



Flow Altering: Submerged Vanes

- Creates vortex to direct bed sediment

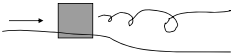
• Plan View



Downstream View

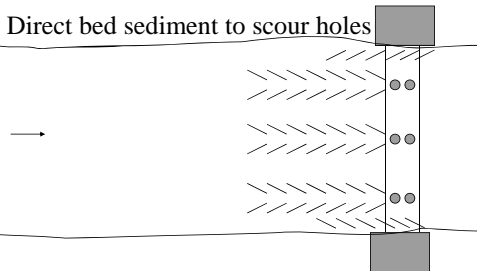


• Side View




Flow Altering: Submerged Vanes

- Direct bed sediment to scour holes



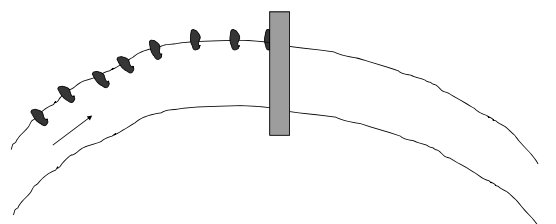
Flow Altering: Delta Wings

- Creates vortex to counter pier's horseshoe vortex



River-Training: Groynes/Spur Dikes

- Rock structures tied into bank
- Directs flow away from bank



River-Training: Groynes/Spur Dikes

