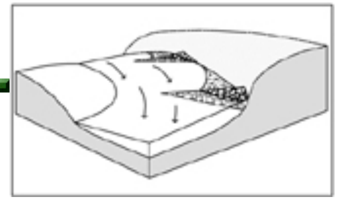
VANES



1. CATEGORY

1.0 – River Training

2. DESIGN STATUS

Level I

3. ALSO KNOWN AS

Rock vanes, Upstream angled spurs.

4. DESCRIPTION

Vanes are redirective, discontinuous, transverse structures angled into the flow in order to reduce local bank erosion by redirecting flow from the near bank to the center of the channel. The instream tips of the structures are typically low enough to be overtopped by all flows and crests slope upward to reach bankfull stage elevation at the bank.

5. PURPOSE

Structures angled upstream redirect overtopping flows away from the protected bank (Biedenharn et al., 1997). Vanes are installed to provide toe protection and rectify lateral instability by redirecting flow away from eroding banks, while providing greater environmental benefits than stone blanket or revetment (Shields et al., 1995). Vanes can increase scour at the tips, backwater area, edge or shoreline length, and the diversity of depth, velocity and substrate (D. Derrick, personal communication, 2002).

When properly positioned, a vane deflects flow away from the bank and induces deposition upstream and downstream of the structure. This redirection of flow reduces velocity and shear stress along the bank while creating a secondary circulation cell that transfers the energy toward the middle of the channel (Fischenich, 2001). Rock vanes, protruding 1/3 bankfull width into the channel and oriented at an upstream angle between 20° and 30°, move the thalweg an average of 20% bankfull width away from the eroding bank (Johnson et al., 2001).

Therefore, vanes, whether made of rock and/or logs, redirect water away from streambanks into the center of the channel. This serves to decrease shear stress on banks, as well as creating aquatic habitat in the scour pools formed by the redirected flow. By increasing shear stress in the center of the channel, the vanes create a stable width/depth ratio, maintain channel capacity and maintain sediment transport capacity and competence (Rosgen, 2001). J-hook vanes can also be paired and positioned in a channel reach to initiate meander development or migration (Genesee/Finger Lakes RPC, 2001).

6. PLANNING

Useful for Erosion Processes:

- ✓ Toe erosion with upper bank failure
- ✓ Scour of middle and upper banks by currents
- ✓ Local scour
- Erosion of local lenses or layers of noncohesive sediment
- Erosion by overbank runoff
- General bed degradation
- Headcutting
- Piping
- Erosion by navigation waves
- Erosion by wind waves
- Erosion by ice and debris gouging
- General bank instability or susceptibility to mass slope failure

Spatial Application:

- ✓ Instream
- ✓ Toe
- Midbank
- Top of Bank

Hydrologic / Geomorphic Setting

- Resistive
- ✓ Redirective
- Continuous
- ✓ Discontinuous
- ✓ Outer Bend
- Inner Bend
- Incision
- ✓ Lateral Migration
- ✓ Aggradation

Conditions Where Practice Applies:

Vanes are installed on the outside of stream bends where high velocity and shear stress is causing accelerated bank erosion. Vanes can often be used at sites where riprap revetments are traditionally applied but greater environmental benefits are desired. However, vanes and other redirective, discontinuous practices should be applied with caution to project sites where infrastructure is immediately adjacent to the protected bank. Vanes can be combined with longitudinal stone toe or toe or vegetated riprap if continuous resistive protection is also necessary (see Technique: **Longitudinal Stone Toe with Spurs** and **Vegetated Riprap**). Vanes have been successfully installed in rivers and streams with bankfull widths ranging from 9 m to150 m (30 ft to 492 ft), with gradients between 0.05 to 0.0003, and in a variety of bed materials (Rosgen, 2001); it is suggested that they only be used in streams with a width/depth ratio of 12 or greater (Maryland, 2000). The ability of vanes to redirect flows and shift local scour and stream power to the center of the channel makes the technique particularly effective where bridge infrastructure is threatened by scour or flanking. Vanes can be used where it is necessary to preserve as much of the existing bank vegetation as possible, and where aquatic habitat and substrate complexity is an important consideration. Unlike riprap revetment, which requires reshaping of the bank for installation, vanes require bank disturbance only where keys are placed. This provides opportunities for using vanes in combination with soil bioengineering techniques.