Live Stream

By Dennis L. Richards

Considerations when designing streambank stabilization measures

Streambank stabilization can be complex, and there are a number of elements that must be considered when designing bank stabilization measures.

For streams with erodible bed material, one essential element is providing adequate toe protection, or toe-down depth, as undermining of the toe has been identified as a primary mechanism of bank failure. The toe-down depth is determined by estimating the total depth of scour that may occur for the specified design event. This could be a 10-year, 25-year, 100-year or some other frequency event, depending on the criteria established for the project. There are several types or components of scour that must be considered when determining the total scour depth. The components are classified as general scour, long-term degradation, local scour, bend scour, bed form scour and low-flow channel incisement.

Long-term degradation is the lowering of the bed over a long period of time for a long reach of channel, which may be due to natural or man-made causes. It is typically determined based on the channel-forming discharge. General or contraction scour is the lowering of the channel bed over a relatively short time period—for example, the scour in a given reach during the passage of the design flow event. The lowering may be uniform across the bed or non-uniform (i.e., the depth of scour may be deeper in some parts of the cross-section). General or contraction scour occurs when the flow area of a river or wash is reduced by a natural contraction in the channel—a bridge or other structure that restricts the flow. Local scour occurs when flow-induced vortices remove soil from a localized region around an object that is in the flow path and thereby obstructs flow. Obstructions that induce local scour include bridge piers and abutments, spurs, utility poles and drop structures.

Bend scour is the result of bends or changes in the direction of flow that induce transverse or secondary currents, which scour soil from the outside of the bend and cause it to be deposited along the inside of the bend. Another scour component is bed form scour, which commonly occurs in sand bed channels. The bed forms result from the interaction of flowing water and the bed material, with antidunes forming in transitional or upper regime flow and dunes forming in lower regime flow. Finally, low-flow incisement is a form of scour that can occur in streams with width-depth ratios of greater than 10. There are no equations or rigorous methodologies for predicting low-flow incisement. The depth generally is based on field observation of existing conditions or engineering experience with similar conditions.

The toe-down depth is established by first determining the scour depth for each type of scour that occurs at the site and then adding the computed depths to obtain the total scour depth. This assumes each component occurs independently of the others and provides some conservatism in the design. Procedures for determining the scour depth for each component generally are provided in local or state agency drainage manuals. In addition, guidelines for computing scour are included in various publications of the U.S. Army Corps of Engineers, Federal Highway Administration, U.S. Bureau of Reclamation and the National Resources Conservation Service. SWS

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