

OHIO STREAM MANAGEMENT GUIDE

Riprap Revetments

Guide No. 16

Streambank erosion is a natural process that occurs in streams. Depending on the soil type and land use, streambank erosion can account for 40 percent or more of total soil loss in some watersheds (Farm Journal, 1992). The major factor accounting for streambank erosion is the velocity of the flowing water. Velocity is affected by the stream cross section, stream bed gradient, bank cover, depth of flow and degree of meander. Water flowing at the rate of two feet per second can move a cobblestone weighing half a pound, but an increase in velocity to ten feet per second can move a stone that weighs one hundred and fifty pounds.

There are numerous methods of controlling streambank erosion. When a streambank requires protection from high velocity flows, structural methods should be considered. Two structural methods commonly used are riprap revetments and gabion revetments. Structural methods are also used when infrastructure, such as utility lines, roads or buildings, are endangered by the eroding stream. When installing streambank erosion protection, the ve-

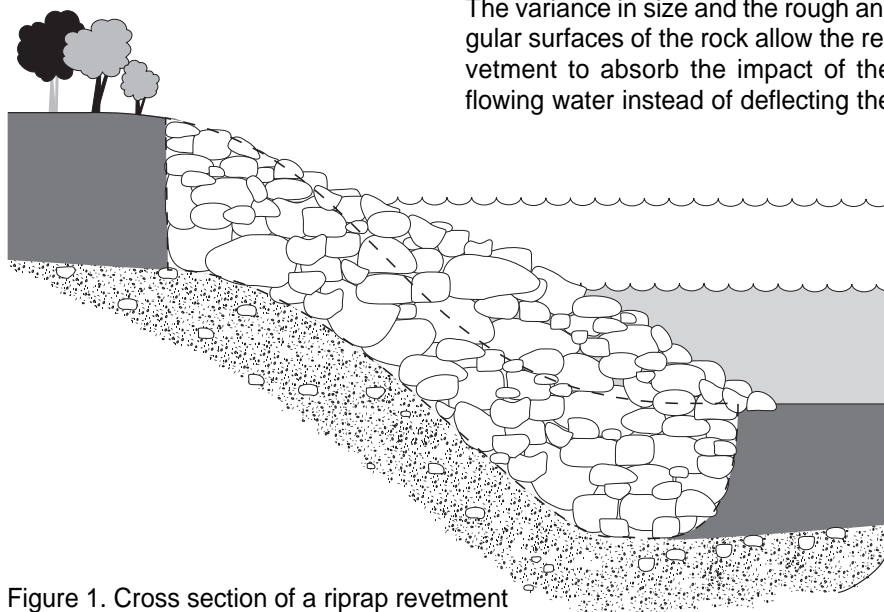


Figure 1. Cross section of a riprap revetment

Table 1. (From Ohio Department of Transportation, *Construction & Material Specifications*, 1997)

Velocity of Stream During High Flows	Size Range Largest Diameter of Rock	
2 - 6 feet/second	4" - 12"; average 6"	(ODOT Type D)
6 - 8 feet/second	6" - 18"; average 12"	(ODOT Type C)
8 - 10 feet/second	12" - 24"; average 18"	(ODOT Type B)
10 - 12 feet/second	18" - 30"; average 24"	(ODOT Type A)

locities during everyday flows as well as the velocities during large storm events should be considered in the design process.

RIPRAP REVETMENTS

Riprap revetments are a very effective and popular method of controlling streambank erosion. A revetment is a facing of stone or other armoring material to protect a streambank or shoreline. A riprap revetment consists of layered, various-sized rocks placed on a sloping bank (Figure 1). The most commonly used material for riprap in Ohio is broken limestone, dolomite or quartzite. The type of stone used is usually determined by what is locally available. The variance in size and the rough angular surfaces of the rock allow the revetment to absorb the impact of the flowing water instead of deflecting the

flow which could cause erosion to an adjacent streambank area. The rough angular surfaces of the broken rocks also allows them to fit together to form a dense layer of protection over the eroding bank.

STONE SIZE

The size of riprap to use for a given stream depends on the velocity of the water when the stream is at a bank full stage. Table 1 provides minimum size ranges for given stream flow velocities.

INSTALLATION PROCEDURE

1. Reshape the streambank to a maximum slope of two feet of horizontal distance for one foot of vertical rise.
2. Place a highly permeable and appropriately sized geotextile filter fabric on the prepared slope following the manufacturer's recommendations. Take care not to tear the filter fabric during installation.
3. Place a layer (six inch minimum) of gravel or small rock on the geotextile filter fabric. The underlayer stone needs to be sized appropriately so it will not wash through any gaps between the riprap stones.
4. Place the layer of riprap, 1.5 times the thickness of the largest stone, on top of the gravel. The heaviest rocks should be placed along the

bottom of the bank. Riprap should be placed into position, not dumped over the streambank edge.

5. Extend the rock layer out into the channel four to six feet or entrench the bottom row of stone into the stream bed to prevent undercutting.
6. Extend the revetment beyond the area of active erosion to prevent further erosion behind the ends of the structure.

MAINTENANCE REQUIREMENTS

A riprap revetment is susceptible to displacement and deterioration of the rock. When displacement and deterioration occur the effectiveness of the structure is greatly reduced. A riprap revetment needs to be inspected periodically and after high flow events. Any displaced or deteriorated rock should be replaced as needed.

MATERIALS TO AVOID

Stones that appear to have a smooth and rounded surface should be avoided if possible. The surface of these stones does not allow the rocks to interlock which decreases resistance to movement. Broken asphalt should not be used because it has a low density and contains toxic chemicals which can leach out into the water. Items such as refrigerators, mattresses, wood and plastics should never be used because they can increase the rate of erosion and degrade the water quality of the stream. Slab concrete should only be used as an underlayer material and then only if it is broken and free of rebar.

USE OF DORMANT CUTTINGS IN RIPRAP REVETMENTS

Dormant stakes of willow (or other rapidly-rooting species) may be installed between the placed rock. The stakes must be installed perpendicular to the bank, and be long enough for the base ends to reach back-filled or undisturbed soil. Over time, dormant cuttings create a living root mat in the base soil underlying the revetment. The roots reinforce the soil particles and prevent wash out of fine materials between and

under the rocks. The roots also improve drainage by removing soil moisture. The willow branches and leaves will dissipate additional energy along the streambank and may produce a more aesthetically pleasing view of the bank, as opposed to riprap alone.

As willows grow and mature, they lose their vigor and become subject to insect and disease problems. They also become brittle with age, causing them to break, fall into the stream and contribute to channel obstructions. These problems can be avoided by periodic pruning of the willows to a convenient height or down to a stump. They will re-sprout and maintain the function of the dormant cuttings.



ADVANTAGES OF RIPRAP AS AN EROSION TREATMENT

- Designed for high velocities
- Provides high degree of protection
- Relative ease of installation
- Low maintenance
- Provides immediate long-term protection

DISADVANTAGES OF RIPRAP AS AN EROSION TREATMENT

- Limited access to the site can make construction difficult
- Heavy machinery may be required to position rock
- Material costs (including transportation) may be expensive
- Often used to hold stream in an unstable configuration
- May pass erosion problems downstream

REFERENCES:

Iowa Department of Water, Air and Waste Management, 1984. *How To Control Streambank Erosion*

Smith, Darrell, May, 1992. "Raging Waters." *Farm Journal*.

State of Ohio, Department of Transportation, 1997. *Construction and Material Specifications*

U.S. Army Corps of Engineers, North Central Division, 1978. *Help Yourself*.

~

This Guide is one of a series of Ohio Stream Management Guides covering a variety of watershed and stream management issues and methods of addressing stream related problems. All Guides, including an **Index of Titles** in print, are available from the Ohio Department of Natural Resources. To obtain copies contact the ODNR Public Information Center at 1952 Belcher Drive Building, C-1, Columbus, Ohio 43224-1386 or 614/265-6791 or "infomail@dnr.state.oh.us". For more information about the project call the ODNR, Division of Water at 614/265-6757. Each Guide is designed to be easily and clearly reproduced and can be bound in a notebook. *Single copies are available free of charge. When distributing guides at meetings or in mailings, please use the printed editions as a master for reproducing the number of copies you need.*

Prepared by the Ohio Department of Natural Resources, Tara Lee, Division of Engineering, principal author. Input from staff of several ODNR divisions, and local, state and federal agencies are used in the development of the Ohio Stream Management Guides. Funding for the production of the Ohio Stream Management Guides is provided in part through a grant under Section 319 of the federal Clean Water Act.

Fact sheet are available on-line at: <http://www.dnr.state.oh.us/odnr/water/pubs/onlpubs.html>



An equal opportunity employer--M/F/H.
Printed on recycled paper