

Riprap



Riprap can be used to stabilize drainageways and outlets to prevent erosion

Description

Riprap is a layer of large stones used to protect soil from erosion in areas of concentrated runoff. Riprap can also be used on slopes that are unstable because of seepage problems.

Applicability

Use riprap to stabilize cut-and-fill slopes; channel side slopes and bottoms; inlets and outlets for culverts, bridges, slope drains, grade stabilization structures, and storm drains; and streambanks and grades.

Siting and Design Considerations

Riprap can be unstable on very steep slopes, especially when rounded rock is used. For slopes steeper than 2:1, consider using materials other than riprap for erosion protection.

Consider the following design recommendations for riprap installation (Smolen et al., 1988):

Gradation. Use a well-graded mixture of rock sizes instead of one uniform size.

Quality of stone. Use riprap material that is durable so that freeze and thaw cycles do not decompose it in a short time; most igneous stones, such as granite, have suitable durability.

Riprap depth. Make the riprap layer at least two times as thick as the maximum stone diameter.

Filter material. Apply a filter material--usually a synthetic cloth or a layer of gravel--before applying the riprap. This prevents the underlying soil from moving through the riprap.

Riprap Limits. Place riprap so it extends to the maximum flow depth, or to a point where vegetation will be satisfactory to control erosion.

Curves. Ensure that riprap extends to five times the bottom width upstream and downstream of the beginning and ending of the curve and the entire curved section.

Riprap Size. The size of the riprap material depends on the shear stress of the flows the riprap will be subject to, but it ranges from an average size of 2 inches to 24 inches in diameter (Idaho Department of Environmental Quality, no date).

Wire Riprap Enclosures. Consider using chain link fencing or wire mesh to secure riprap installations, especially on steep slopes or in high flow areas.

Limitations

The steepness of the slope limits the applicability of riprap, because slopes greater than 2:1 can cause riprap loss due to erosion and sliding. If used improperly, riprap can actually increase erosion. In addition, riprap can be more expensive than other stabilization options.

Maintenance Considerations

Inspect riprap areas annually and after major storms. If riprap has been damaged, repair it promptly to prevent a progressive failure. If repairs are needed repeatedly at a location, evaluate the site to determine if the original design conditions have changed. Also, you might need to control weed and brush growth in some locations.

Effectiveness

When properly designed and installed, riprap can prevent erosion from the protected area.

Cost Considerations

The cost of riprap varies depending on location and the type of material selected. A cost of \$35 to \$50 per square yard of nongROUTed riprap has been reported, while grouted riprap ranges from \$45 to \$60 per square yard (1993 dollars; Mayo et al., 1993).

References

FHWA (Federal Highway Administration). 1995. *Best Management Practices for Erosion and Sediment Control*. FHWA-SLP-94-005. Federal Highway Administration, Sterling, VA.

Idaho Department of Environmental Quality. No date. *Catalog of Stormwater BMPs for Cities and Counties: BMP #20 - Riprap Slope and Outlet Protection*.

http://www.deq.state.id.us/water/data_reports/storm_water/stormwater_catalog_bmp20.pdf. Accessed May 10, 2006.

Mayo, L., D. Lehman, L. Olinger, B. Donavan, and P. Mangarella. 1993. *Urban BMP Cost and Effectiveness Summary Data for 6217(g) Guidance: Erosion and Sediment Control During Construction*. Woodward-Clyde Consultants.

MPCA (Minnesota Pollution Control Agency). 1998. *Protecting Water Quality in Urban Areas*. Minnesota Pollution Control Agency, Division of Water Quality, St. Paul, MN.

Smolen, M.D., D.W. Miller, L.C. Wyatt, J. Lichhardt, and A.L. Lanier. 1988. *Erosion and Sediment Control Planning and Design Manual*. North Carolina Sedimentation Control Commission; North Carolina Department of Environment, Health, and Natural Resources; and Division of Land Resources Land Quality Section, Raleigh, NC.

SWRPC (Southeast Wisconsin Regional Planning Commission). 1991. *Costs of Urban Nonpoint Source Water Pollution Control Measures*. Technical Report No. 31. Southeast Wisconsin Regional Planning Commission, Waukesha, WI.