



Designation: D6825 – 21

Standard Guide for Placement of Riprap Revetments¹

This standard is issued under the fixed designation D6825; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This guide covers methods to place riprap with associated filters for erosion control purposes. This guide does not recommend a specific course of action because of the diverse methods and procedures that are capable of producing a functional product. This guide identifies favorable riprap qualities and recommends practices best suited to obtain those qualities. The production of rock, use of recycled materials, rock with cut dimensions, and engineering and revetment design are beyond the scope of this guide. Special forms of riprap, including hand placed riprap, grouted riprap, or keyed (plated) riprap that is tamped into place to smooth the surface, are also beyond the scope of this guide.

1.2 This guide offers an organized collection of information or a series of options and does not recommend a specific course of action. This document cannot replace education or experience and should be used in conjunction with professional judgment. Not all aspects of this guide may be applicable in all circumstances. This ASTM standard is not intended to represent or replace the standard of care by which the adequacy of a given professional service must be judged, nor should this document be applied without consideration of a project's many unique aspects. The word “Standard” in the title of this document means only that the document has been developed and approved through the ASTM consensus process

1.3 *Units*—The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are provided for information only and are not considered standard.

1.4 *This standard may involve hazardous operations and equipment. This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standard-*

ization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

2. Referenced Documents

2.1 ASTM Standards:²

C33/C33M Specification for Concrete Aggregates

C136/C136M Test Method for Sieve Analysis of Fine and Coarse Aggregates

D75/D75M Practice for Sampling Aggregates

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D4992 Practice for Evaluation of Rock to be Used for Erosion Control

D5519 Test Methods for Particle Size Analysis of Natural and Man-Made Riprap Materials

D6092 Practice for Specifying Standard Sizes of Stone for Erosion Control

2.2 AASHTO Standard:³

M 288 Geotextile Specification for Highway Applications

3. Terminology

3.1 *Definitions*—For definitions of common technical terms used in this standard, refer to Terminology D653.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *bedding, n*—an aggregate mixture placed below the riprap.

3.2.1.1 *Discussion*—Bedding material is usually sand and gravel sized, but may include cobble sized material. If placed without a geotextile, the bedding material may be used as a filter. If placed in conjunction with a geotextile, the bedding may provide a cushion for protection of the geotextile during riprap placement and provide confinement of the geotextile. It is possible to have more than one bedding layer.

¹ This guide is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.17 on Rock for Erosion Control.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, <http://www.transportation.org>.

*A Summary of Changes section appears at the end of this standard

3.2.2 *chinking*, *n*—the practice of filling riprap surface voids with smaller sized rock or aggregate.

3.2.3 *clam shell*, *n*—a bucket tool that is operated from a dragline or crane; the bucket is hinged at the top and opens like a clam so that rock can be placed without dropping it.

3.2.4 D_x , *n*—the particle diameter at which $x\%$ by weight (dry) of the particles of a particular sample are finer.

3.2.5 *filter*, *n*—any substance, as geotextile or layer of sand/aggregate, placed to provide separation and retention of materials, while allowing water to pass.

3.2.6 *floaters*, *n*—a individual rock within the riprap layer that is not interlocked with the surrounding rocks.

3.2.7 *maximum aspect ratio*, *n*—the ratio of the greatest to the least dimension, measured across mutually perpendicular axes, for any piece of rock; synonym, *slabiness*.

3.2.8 *orange peel*, *n*—a bucket tool that is operated from a dragline or crane and resembles the shape of an orange peeling; the sides lift up and out so that rock can be placed without dropping it.

3.2.9 *pit run material*, *n*—rock that has been blasted but not processed to remove undersize pieces; synonym, *shot rock* or *quarry run*.

3.2.10 *revetment*, *n*—bank protection by armor, that is, by facing of a bank or embankment with erosion-resistant material.

3.2.11 *riprap*, *n*—material generally less than 2 tonnes (2.2 tons) in mass, specially selected and graded.

3.2.11.1 *Discussion*—When properly placed, riprap prevents erosion through minor wave action, or strong currents and thereby preserves the shape of a surface, slope, or underlying structure. Riprap may be specifically produced for the intended purpose, or it may be a by-product from a mining operation, structure demolition, or industrial process.

3.2.12 *rock*, *n*—any naturally formed aggregate of mineral matter occurring in large masses or fragments.

3.2.12.1 *Discussion*—Rock may be either insitu or excavated material.

4. Significance and Use

4.1 Riprap is a commonly used form of scour protection and general slope protection. Riprap provides a long term solution when properly sized and installed. Riprap has structural flexibility so it will conform to irregular surfaces and adapt to minor subgrade settlement. It is often appropriate for use in conjunction with soil bioengineering (vegetation establishment) alternatives. In some environments, riprap may provide habitat for benthic organisms and fish.

4.2 Revetments provide a facing or lining to armor a surface; and the layer thickness is typically minimized while providing the necessary resistance to scour. In this case, standardized practices to obtain consistent coverage having acceptable thickness tolerances and voids become important.

4.3 This guide may be used by owners, installation contractors, regulatory agencies, inspection organizations, and designers and specifiers who are involved in the construction of

riprap revetments. Modifications may be required for specific job conditions. This guide is not intended for construction specifications on large projects, but may be referenced where preparation of job specific construction specifications are not justified. If this practice is included by reference in contract documents, the specifier should provide a list of supplemental requirements.

5. Planning for Riprap Placement

5.1 Site conditions, level of protection required, construction methods, and equipment may affect the sizing, thickness, and lateral extent of a riprap revetment. For some small projects, riprap may be dumped with minimal analysis or quality control, and still fulfill the intended purpose. For larger projects and critical structures, engineering, careful placement, and quality control become increasingly justified to minimize material costs and reduce the chance of failure. The degree of control appropriate should be appropriate for each project. The methods for placement and quality control should be compatible with the level of site investigation and other considerations included in Table 1, which includes factors that should be considered for each project, but are beyond the scope of this guide. Some recommended publications (1-9)⁴ from the Army Corps of Engineers, the Federal Highway Administration, and the National Cooperative Highway Research Program for additional information on these factors and engineering criteria are given in the References section.

NOTE 1—Slope stability should always be considered. If it is not investigated analytically by a qualified professional, then it should at least be considered subjectively in light of the site conditions and surrounding conditions (riverbanks, shorelines, or landforms). Many agencies have generalized maximum allowable slopes (usually in the range of 1.5H:1V to 3H:1V); however, these must be recognized as site specific. Limitations of the foundation, bank, material interfaces, seepage conditions, or toe scour may lead to instability.

NOTE 2—All of the references in this standard are from the United States. There are international standards such as EN 13383-1 “Armour-stone” from the European Committee for Standardization (9) that should also be considered.

6. Riprap Materials

6.1 *Stone Sources and Evaluation*—Rock must be durable material. In some cases, a source may be established based on rock classification, geologic evaluation, and observations of existing installations showing that the rock is durable. If a history of rock durability is not established, sampling and testing the rock may be required. Acceptable material properties for rock are dependent on the conditions (such as abrasion and saturation frequency due to wave run-up) and climate in the vicinity of where it will be used. Source selection should also consider the material properties available from local sources. Riprap is most commonly produced at a quarry, but it may also be screened from a gravel pit operation, processed from rock collected from some other source, or manufactured from crushed hydraulic-cement (recycled) concrete.

NOTE 3—Borrowing stone, cobbles or gravel from stream or lake beds that do not otherwise need to be disturbed may have environmental

⁴ The boldface numbers in parentheses refer to a list of references at the end of this standard.