

SECTION 414—RIPRAP

414.01—Description

This work shall consist of placing the specified type of riprap in accordance with the plans, Standard Drawings where applicable, and these specifications.

414.02—Materials

- (a) **Riprap** shall conform to the requirements of Section 204.
- (b) **Sand** shall conform to the requirements of Section 202. Grading A, B, or C sand may be used in mortared or grouted riprap.
- (c) **Mortar and grout** shall conform to the requirements of Section 218.
- (d) **Geotextile bedding** shall conform to the requirements of Section 245.
- (e) **Welded wire fabric** shall conform to the requirements of Section 223.

414.03—Procedures

- (a) **Dry Riprap:** The classes of dry riprap shall be as follows:
 - 1 **Class I:** Stones shall weigh between 50 and 150 pounds each. At least 60 percent shall weigh more than 100 pounds, and approximately 10 percent may weigh 50 pounds or less.
 - 2 **Class II:** Stones shall weigh between 150 pounds to 500 pounds each. At least 50 percent shall weigh more than 300 pounds, and approximately 10 percent may weigh 150 pounds or less.
 - 3 **Class III:** Stones shall weigh from 500 pounds to 1,500 pounds each. At least 50 percent shall weigh more than 900 pounds, and approximately 10 percent may weigh less than 500 pounds.
 - 4 **Class AI:** Stones shall weigh between 25 and 75 pounds each, except that approximately 10 percent may weigh 25 pounds or less and 10 percent may weigh 75 to 100 pounds.

Dry riprap shall be placed as follows:

Grading: Slopes shall be finished to a reasonably smooth and compact surface within a tolerance of 6 inches from the surface lines shown on the plans.

Immediately prior to placement of riprap bedding, the prepared base will be inspected. Riprap or bedding shall not be placed until the prepared base has been approved.

Bedding: Riprap bedding shall be placed on the embankment to form a backing for riprap. Riprap bedding shall be spread uniformly on the prepared base. Compaction of the bedding material will not be required, but material shall be finished to a reasonably even surface, free from mounds or depressions.

When geotextile bedding material is required, the entire perimeter of the material shall be turned down and buried at least 9 inches for anchorage. Adjacent strips of material shall run only up and down the slope and shall overlap at least 18 inches. Geotextile bedding material shall not be used on slopes greater than 1:1. If sewed, strips shall overlap at least 4 inches and shall be double stitched with a prayer seam, Type SSa 1. Damaged material shall be replaced or repaired with a patch of the same material overlapping the damaged area by at least 18 inches on all sides. Displaced material shall be repositioned, including, if necessary, removing and replacing riprap stone, at the Contractor's expense. Material shall be placed loosely so that positioning riprap will not stretch or tear it.

Placing stones: Riprap shall be placed on the embankment as soon as practicable after bedding has been finished but no later than 15 days in a manner that will produce a reasonably well-graded mass of rock with the minimum practicable percentage of voids. Riprap shall be placed to its full course thickness in one operation and in a manner to avoid displacing underlying material. Riprap stone shall not be dropped onto fabric from a height greater than 1 foot. Smaller-sized material shall not be dropped onto fabric from a height greater than 3 feet. Larger stones shall be reasonably well distributed.

Finished riprap shall be free from objectionable pockets of small stones and clusters of larger stones. Hand placing may be required to the extent necessary to secure the results specified and form uniform slopes.

A tolerance of $\pm 1/4$ of the thickness of the maximum-size stone from the lines and grades shown on the plans will be allowed in the finished surface. However, the extremes of such tolerance

shall be not continuous over an area of more than 200 square feet. Riprap shall be keyed into the natural ground in an approved manner and to a depth equal to the bed thickness or to solid rock.

The desired distribution of various sizes of stones throughout the mass may be obtained by selective loading at the source, controlled dumping of successive loads during final placement, or a combination of these methods. Placing riprap by dumping into chutes or similar methods likely to cause segregation of the various sizes will not be permitted.

Riprap protection shall be maintained until the riprap is accepted by the Engineer. Displaced material shall be replaced to the lines and grades shown on the plans at the Contractor's expense.

- (b) **Dumped Riprap:** The types of dumped riprap shall be as follows:
- 1 **Type I:** Core riprap shall be composed of compact angular pieces of derrick stone weighing from 3/4 ton to 2 tons each with an average weight of approximately 1 ton. Approximately 10 percent by weight may weigh less than 3/4 ton.
 - 2 **Type II:** Heavy riprap shall be composed of compact angular pieces of derrick stone weighing from 3 to 10 tons each with an average weight of approximately 4 tons. Approximately 10 percent by weight may weigh less than 3 tons.
- Dumped riprap shall be placed in the same manner described for dry riprap in (a) herein. Dumped riprap shall not be placed in layers.
- (c) **Mortared Riprap for Slopes:** Stone shall be the same size as specified for dry riprap, Class II, and shall be selected to secure fairly large, flat-surfaced stones that will produce a true and even surface with a minimum of voids. Stone shall be placed on a slope not steeper than the natural angle of repose of the fill material. Fifty percent of the mass shall be broad flat stones placed with the flat surface uppermost and parallel to the slope. Stones shall be placed first and roughly arranged in close contact, with the larger stones placed near the base of the slope. Spaces between larger stones shall be filled with stones of suitable size, leaving the surface reasonably smooth and tight and conforming to the contour required. Stones shall be placed in a manner so as to ensure for plane surfaces a maximum variation from a true plane of not more than 1/4 inches in 4 feet. Warped and curved surfaces shall have the same accuracy as specified for plane surfaces.
- As each larger stone is placed, it shall be surrounded by fresh mortar, and adjacent stones shall be shoved into contact. After larger stones are in place, spaces or openings between them shall be filled with mortar, and smaller stones shall then be placed by shoving them into position, forcing excess mortar to the surface, ensuring that each stone is carefully and firmly bedded laterally.
- After the work is complete, excess mortar forced up shall be spread uniformly to fill surface voids completely. Surface joints shall then be pointed roughly with flush or shallow smooth-raked joints.
- (d) **Grouted Riprap for Slopes:** Grout shall consist of 1 part hydraulic cement and 3 parts sand, thoroughly mixed with water to produce grout having a thick, creamy consistency.
- Stones shall be of the same sizes and placed in the same manner as specified for dry riprap, Class I. Care shall be taken during placing to keep earth or sand from filling spaces between stones. After stones are in place, spaces between them shall be filled with grout from bottom to top and the surface swept with a stiff broom. Riprap shall not be grouted in freezing weather. In hot, dry weather, the work shall be protected from sunlight and kept moist for at least 3 days after grouting by the use of saturated burlap.
- (e) **Erosion Control Stone for Culvert Outlet Protection:** Erosion Control Stone for Class AI, I, & II culvert outlet protection shall conform to the requirements for Dry Rip Rap Class AI, I, & II respectively of (a) herein for weight and shall be placed in a manner to present an irregular or rough surface.
- (f) **Erosion Control Riprap:** Riprap shall consist of sound, nonerodible shot rock or rock excavation, which may be obtained from within the excavation for the typical sections on the project. Erosion control riprap rock shall be not more than 15 inches in its greatest dimension and shall contain a sufficient percentage of smaller rocks to provide a reasonably dense mass with a thickness of at least 8 inches. Riprap shall be placed where shown on the plans or as directed by the Engineer in accordance with the requirements of Section 303.04(h).
- (g) **Concrete Riprap in Bags:**
- 1 **Wet mixture:** Riprap shall consist of Class C1 concrete in suitable burlap bags except in brackish or tidal water, where concrete shall be Class A3. Bags shall weigh approximately 100 pounds

when 2/3 filled with concrete. Each bag shall be securely tied and immediately placed in the work. When used for foundation protection, bags shall be placed in accordance with the provisions governing placement of stone riprap for foundation protection as specified. When used for slope protection, riprap shall be placed in conformance with the provisions governing placement of dry riprap.

- 2 **Dry mixture:** Riprap shall conform generally to the requirements for wet mixtures except that the mixture shall consist of the dry ingredients and the requirements for water, consistency, and air will be waived.

Burlap or paper bags will be permitted. Riprap shall be a rectangular solid approximately 3 inches in thickness and shall weigh approximately 80 pounds per bag. Paper bags shall be perforated throughout on approximate 1-inch centers and shall be of adequate seal, thickness, and strength to maintain the integrity of the riprap until setting of the concrete mixture. Bag compositions shall be such that bags will disintegrate without presenting environmental problems.

- (h) **Stone Riprap for Foundation Protection:** Riprap for pier, abutment, and bridge spill slope protection shall conform to the requirements of the applicable specifications.

- (i) **Concrete Slab Riprap for Stream Crossings:**

- 1 **Materials:** Riprap shall consist of Class A3 concrete, cast-in-place, 6 inches in thickness. Concrete shall have a consistency that will permit placement without the use of top forms.

Welded wire fabric shall be No. 6 gage wire, spaced 6 inches center to center.

- 2 **Excavation and fine grading:** The finished embankment slope shall be reasonably smooth and dense. A trench shall be dug at the toe of the slope to accommodate the toe of the slab. Slab riprap shall not be placed until the slope has been approved by the Engineer.
- 3 **Construction methods:** Riprap shall be constructed in accordance with the applicable requirements of Section 404 except as modified herein and shall be cured in accordance with the requirements of Section 316.04(j). Welded wire fabric shall be positioned at the center of the slab, shall run continuously throughout the slab, and shall lap approximately 6 inches at the edges of each sheet of fabric.

The berm portion of the slab shall be placed on a slope of approximately 12:1, draining away from the abutment. Where the edge of the slab is placed against the abutment, the joint shall be sealed to a depth of at least 1/2 inch with hot-poured joint sealer conforming to the requirements of Section 212.

The toe of the slab shall extend to an elevation at least 3 feet below the elevation of the toe of fill, and the lower edge of the slab shall be increased approximately 6 inches in thickness, tapering to its nominal thickness 3 feet up the slope from the lower edge of the slab. The tapering shall be on the underside of the slab. The slab shall be placed using one of the following methods:

- a. **Block method:** The slab shall be placed in alternate blocks approximately 4 feet by 4 feet.
- b. **Strip method:** The slab may be placed in alternate, continuous strips having scored or formed joints perpendicular to construction joints. Strips shall be placed in alternating widths of 4 feet and 5 feet, or 4 feet 6 inches each. Joints shall be at least 1 inch in depth and spaced approximately 4 feet 6 inches apart. The width of the joint shall be as small as possible.

Successive courses or strips shall not have joints that line up with the joints in the preceding courses or strips. Horizontal joints shall be normal to the slope. Joints shall be closed without filler.

After concrete is placed, it shall be consolidated and the surface struck off by means of a strike board. Concrete shall be float finished with a wooden or cork float. The surface shall not vary more than 1/2 inch under a 10-foot straightedge.

414.04—Measurement and Payment

Dry riprap will be measured in square yards of surface area or tons as specified.

Mortared riprap will be measured in square yards of surface area.

Grouted riprap will be measured in square yards of surface area or tons as specified.

Stone riprap for foundation protection will be measured in square yards of surface area or tons as specified.

Dumped riprap will be measured in square yards of surface area or tons as specified.

Concrete riprap in bags will be measured in cubic yards.

Concrete slab riprap will be measured in square yards. When an optional riprap is used in lieu of concrete slab riprap, bedding material will not be measured for payment and the riprap will be paid for at the contract unit price for concrete slab riprap.

Erosion control riprap will be measured in square yards of surface area or tons as specified.

Riprap will be paid for at the contract unit price. This price shall include furnishing and placing riprap, including welded wire fabric, mortar, or grout; excavation; and riprap bedding.

These prices shall include geotextile bedding material when required and when not a separate pay item for these purposes. The price bid shall include preparing the surface, furnishing and installing geotextile bedding material, overlaps, repair work, and excavating and backfilling toe-ins.

Erosion Control Stone used for Culvert Outlet Protection will be measured in square yards of surface area or tons for the class specified and will be paid for at the contract unit price per square yard or ton. This price shall include excavating, backfilling, preparing the surface, furnishing and installing geotextile bedding material including overlaps, repair work, excavating and backfilling toe-ins, and placing the required materials.

Payment will be made under:

Pay Item	Pay Unit
Dry riprap (Class and depth)	Square yard or ton
Mortared riprap (Depth)	Square yard
Grouted riprap (Depth)	Square yard or ton
Stone riprap (Depth)	Square yard or ton
Dumped riprap (Type and depth)	Square yard or ton
Concrete riprap in bags	Cubic yard
Concrete slab riprap	Square yard
Erosion control riprap (Depth)	Square yard or ton
Erosion control stone (Class, st'd)	Square yard or ton