

## Rock Riprap

### 1. SCOPE

The work shall consist of the construction of loose rock riprap revetments and blankets, including filter layers or bedding where specified.

### 2. MATERIALS

#### Rock

Rock for rock riprap shall be obtained from the designated sources or, if the source is not specified, shall conform to the following specifications:

Individual rock fragments shall be dense, sound and free from cracks, seams and other defects conducive to accelerated weathering. The rock fragments shall be angular to sub-rounded in shape. The least dimension of an individual rock fragment shall be not less than one-third the greatest dimension of the fragment.

Unless otherwise specified and except as provided below, the rock shall have the following properties:

- a. Bulk specific gravity (saturated surface-dry basis) not less than 2.5.
- b. Absorption not more than 2 percent.
- c. Soundness: Weight loss in 5 cycles not more than 10 percent when sodium sulfate is used or 15 percent when magnesium sulfate is used.

The bulk specific gravity and absorption shall be determined by ASTM Method C 127. The test for soundness shall be performed by ASTM Method C 88 for coarse aggregate modified as follows:

The test sample shall not be separated into fractions. It shall consist of 5000 + 300 grams of rock fragments, reasonably

uniform in size and shape and weighing approximately 100 grams each, obtained by breaking the rock and selecting fragments of the required size.

After the sample has been dried, following completion of the final test cycle and washing to remove the sodium sulfate or magnesium sulfate, the loss of weight shall be determined by subtracting from the original weight of the sample the final weight of all fragments which have not broken into three or more pieces.

The report shall show the percentage loss of weight and the results of the qualitative examination.

Rock that fails to meet the requirements stated in a, b, and c above, may be accepted only if similar rock from the same source has been demonstrated to be sound after five years or more of service under conditions of weather, wetting and drying, and erosive forces similar to those anticipated for the rock to be installed under this specification.

#### Filter and bedding materials

When required, filter and bedding materials shall, unless otherwise specified, conform to Montana Construction Specification MT-117, Drainfill and Filters.

### 3. GRADING

The rock shall conform to the specified grading limits after it has been placed in the riprap.

The rock shall be free from dirt, clay, sand, rock fines and other materials not meeting the required gradation limits.

At least 30 days prior to delivery of rock from other than designated sources, the Contractor shall designate in writing the source from which they intend to obtain the

rock. The Contractor will also provide satisfactory documentation to the Technician that the material meets the requirements of the specifications. The Contractor shall provide the Technician free access to the source for the purpose of obtaining samples for testing. The size and grading of the rock shall be as specified in the special provisions.

Rock from designated sources shall be excavated, selected and processed as necessary to meet the quality and grading requirements in the special provisions. The rock shall conform to the specified grading limits when installed in the riprap.

#### **4. SUBGRADE PREPARATION**

The subgrade surfaces on which the riprap or bedding course is to be placed shall be cut or filled and graded to the lines and grades shown on the drawings. When fill to subgrade lines is required, it shall consist of approved materials and shall conform to the requirements of the specified class of fill.

Riprap shall not be placed until the foundation preparation is completed and the subgrade surfaces have been inspected and approved by the Technician.

#### **5. EQUIPMENT-PLACED ROCK RIPRAP**

The rock shall be placed by equipment on the surfaces and to the depths specified. The riprap shall be constructed to the full course thickness in one operation and in such a manner as to avoid serious displacement of the underlying materials. The rock shall be delivered and placed in a manner that will insure that the riprap in place shall be reasonably homogeneous with the larger rocks uniformly distributed and firmly in contact one to another with the smaller rocks and spalls filling the voids between the larger rocks.

Riprap shall be placed in a manner to prevent damage to structures. Hand placing will be required to the extent necessary to prevent damage to the permanent works.

#### **6. HAND-PLACED RIPRAP**

The rock shall be placed by hand on the surfaces and to the depths specified. It shall be securely bedded with the larger rocks firmly in contact one to another. Spaces between the larger rocks shall be filled with smaller rocks and spalls. Smaller rocks shall not be grouped as a substitute for larger rock. Flat slab rock shall be laid on edge.

#### **7. FILTER LAYERS OR BEDDING**

When filter layers or bedding beneath riprap is specified, the filter or bedding material shall be spread uniformly on the prepared subgrade surfaces to the depth specified. Compaction of filter layers or bedding will not be required, but the surface of such layers shall be finished reasonably free of mounds, dips or windrows.

When a geotextile filter is specified, the material used shall be non-woven and meet the requirements as outlined in Table 1. Geotextile shall be joined by over-lapping a minimum distance of 18 inches. Anchoring of the fabric is not required but care shall be taken to minimize displacement.

Rock riprap shall not be dropped from a height greater than three feet on geotextile. Sufficient hand work shall be done to produce a dense section with a neat and uniform surface.

#### **8. MEASUREMENT AND PAYMENT** (Used only if applicable)

Items of work for which specific unit prices are established, will be measured to the nearest unit applicable. Payment for each item will be made at the agreed-to unit price

for that item. Items of work for which specific lump sum prices are established; payment will be made at the lump sum price.

Such payment will constitute full compensation for all materials, labor, equipment, tools, and all other items

necessary and incidental to the completion of the work.

Compensation for any item of work shown on the drawings or described in the special provisions but not listed on the bid schedule will be considered incidental to and included in the pay items listed on the bid schedule.

**TABLE 1. REQUIREMENTS FOR NONWOVEN GEOTEXTILES**

PROPERTY	TEST METHOD	Class I	Class II
Weight - Typical	ASTM D-5261	8.0 oz/sy	10 oz/sy
Tensile Strength	ASTM D-4632	205 lbs	230 lbs
Elongation @ Break	ASTM D-4632	50%	50%
Mullen Burst*	ASTM D-3786*	350 psi	500 psi
Puncture Strength*	ASTM D-4833*	110 lbs	120 lbs
CBR Puncture	ASTM D-6241	500 lbs	700 lbs
Trapezoidal Tear	ASTM D-4533	80 lbs	95 lbs
Apparent Opening Size	ASTM D-4751	80 US Sieve	100 US Sieve
Permittivity	ASTM D-4491	1.35 Sec-1	1.2 Sec-1
Water Flow Rate	ASTM D-4491	90 g/min/sf	80 g/min/sf
UV Resistance @ 500 Hours	ASTM D-4355	70%	70%

\* Historical averages (current values not available): Mullen Burst Strength ASTM D-3786 is no longer recognized by ASTM D-35 on Geo-synthetics as an acceptable test method. Puncture Strength ASTM D-4833 is not recognized by AASHTO M288 and has been replaced with CBR Puncture ASTM D-6241.

Use Class I for  $d_{50} \leq 15''$   
 Use Class II for  $d_{50} \geq 16''$