CITY OF MEMPHIS – STANDARD CONSTRUCTION SPECIFICATION
SECTION 02370 RIP-RAP

PART 1 – SCOPE

1.01 Rip-rap shall consist of furnishing and setting or placing, stones or sacked sand cement. The rip-rap shall be constructed in conformity to the lines, grades, and cross-sections, and at the locations indicated on the Plans or as directed by the Owner and in accordance with the requirements and provisions of these Specifications.

PART 2 – MATERIALS AND EQUIPMENT

2.01 MATERIAL

A. Stone.

1. Stone shall be sound, dense and durable, free from cracks, pyrite intrusions and other structural defects and have a density of not less than 150 pounds per solid cubic foot. When tested by the Los Angeles method, the percent of wear shall not exceed 60.

2. When the stone is subjected to five alternations of the sodium sulfate soundness test, the weighted percentage of loss shall be not more than 15.

3. Stone shall conform to one of the following gradations and shall be approximately rectangular in shape:

RIP-RAP GRADATIONS

Grade B
1,200 pound maximum weight

Weight	Percent
750 lbs. to 1,200 lbs.	27%
400 lbs. to 749 lbs.	25%
200 lbs. to 399 lbs.	25%
50 lbs. to 199 lbs.	15%
10 lbs. to 49 lbs.	5%
Less than 10 lbs.	3%

Grade C
400 pound maximum weight

Weight	Percent
250 lbs. to 400 lbs.	30%
50 lbs. to 249 lbs.	20%
30 lbs. to 49 lbs.	25%
10 lbs. to 29 lbs	20%
Less than 10 lbs.	5%

Grade D
125 pound maximum weight

Weight	Percent
90 lbs. to 125 lbs.	25%
25 lbs. to 89 lbs.	50%
10 lbs. to 24 lbs.	15%
Under 10 lbs.	10%

Grade E (upper bank)	
Weight	Percent
75 lbs. to 125 lbs.	10%
25 lbs. to 74 lbs.	40-60%
5 lbs. to 24 lbs.	20-40%
Under 5 lbs.	15%

B. Sacked Sand Cement.

1. Sand for sacked sand cement rip-rap shall be manufactured or natural sand and shall meet the quality requirements of Specification Section 03050. Cement for sacked sand cement rip-rap shall meet the requirements of Specification Section 03050.

2. Sacks shall be of either cotton or jute, standard grade of cloth, which will hold the sand cement mixture without leakage during handling and tamping. They shall be strong and shall be sized to hold approximately one cubic foot.

C. Filter Cloth and Fasteners.

1. The filter cloth material used as a base for rip-rap shall be pervious sheets of strong, rot-proof plastic fabric meeting the following Specifications:

Physical Property	Test Method	Acceptable Test Results
Tensile Strength, wet, lbs	ASTM D-1682	200 (min)
Elongation, wet, %	ASTM D-1682	40 (min)
Coefficient of Water Permeability, cm/scc	Constant Head	.03 (min)
Puncture Strength, lbs.	ASTM D-751	100 (min)
Pore Size – EOS U.S. Standard Sieve	Corps of Engineers CW-02215	40 (max)

2. The Contractor shall furnish a certified laboratory test report from an approved testing laboratory with each shipment of materials. Laboratory test reports shall include actual numerical test data obtained on this product.

3. Pins may be any commercially available pin 6 inches in length capable of retaining a washer.

4. Washers may be any commercially available washer 2 inches in diameter and compatible with the pin.

5. The pins and washers shall be manufactured from corrosion resistant metal material.

2.02 EQUIPMENT

A. All equipment necessary for the satisfactory performance of the work shall be on hand and approved by the Owner before construction will be permitted to begin.

B. The equipment shall include wooden or metal tamps of sufficient weight and number to properly compact the slopes on which the rip-rap is to be placed.

C. Wooden hand tamps, having a tamping face not greater than one square foot, and of sufficient weight and number to properly tamp the rip-rap, shall be furnished when sacked sand cement is used.

PART 3 – CONSTRUCTION REQUIREMENTS

3.01 SUBGRADE PREPARATION.

A. The area to be occupied by the rip-rap stabilization shall be cleared of all trees, roots, vegetation, and similar material. Immediately prior to the placement of rip-rap, the slopes or ground surface shall be trimmed in conformity to the lines and grades indicated on the Plans or as directed by the Owner and shall be thoroughly compacted by the use of hand or mechanical tamps. Unless otherwise specified herein make all fill with suitable materials excavated from site. All fills in dry areas shall be compacted to a maximum density of 90 percent as determined by ASTM D 698 (Standard Proctor). On slopes, the bottom of the rip-rap shall be placed at least 2 feet below the natural ground surface, unless otherwise directed.

B. Surplus excavated material shall be removed from the site and disposed of as shown on the Plans or as directed by the Owner. Spoil material shall not be disposed of in a watercourse or on the banks of a watercourse.

3.02 PLACING FILTER FABRIC.

A. Unless otherwise specified, filter fabric shall be placed on the prepared and compacted subgrade within the limits shown on the Plans for stone and sacked sand cement rip-rap. The filter fabric shall be laid loosely without wrinkles or creases. When more than one width or length of filter fabric is necessary, the joints shall be overlapped a minimum of 24 inches. Securing pins with washers shall be inserted through both strips of overlapped material and into the material beneath, until the washer bears against the fabric and secures it firmly to the base material. These securing pins shall be inserted through the overlapped fabric at no greater than 2 foot intervals along a line through the midpoint of the overlap. If the fabric is torn or damaged, a patch overlapping the edges of the damaged area by 2 feet shall be sewn securely to the fabric with a continuous, monofilament, rot-proof material.

3.03 PLACEMENT OF RIP-RAP

A. Stone Rip-Rap.

1. Stone rip-rap shall be constructed upon the prepared foundation by hand placing, so that the stones shall be as close together as is practicable in order to reduce the voids to a minimum.

2. When rip-rap is constructed in more than one layer, it shall be so placed that it will be thoroughly tied together with the larger stones protruding from one layer into the other.

3. Each stone shall be placed so that the depth will be perpendicular to the surface upon which it is set. The length shall be placed as directed by the Owner and each main stone shall be placed so that it will be against the adjoining stones. The stones shall be placed in such a manner as to stagger all joints as far as it is possible and practicable.

4. The main stones shall be thoroughly “chinked” and filled with the smaller stones by throwing them over the surface in any manner that is practicable for the smaller stones to fill the voids. This work shall continue with the progress of the construction. Tamping of the stones will not be required if the stones have been placed in a reasonable and satisfactory manner.

5. Knapping of the stones will not be required, except stones protruding more than 4 inches above the specified grade, in which case, these stones shall be broken down to come within 4 inches of the specified grade.

B. Sacked Sand Cement Rip-Rap.

1. Sacked sand cement rip-rap shall be constructed by placing sacks, filled approximately ¾ full with a mixture of san and cement, on the prepared foundation. Sand and cement shall be mixed dry, with a mechanical mixer, in the proportion of one bag (94 pounds) of cement to five cubic feet of dry sand, until the mixture is uniform in color. After the mixing has been completed, the sand cement mixture shall be poured into sacks of approximately one cubic foot capacity until they are approximately three-fourths filled. The sacks shall then be securely fastened with hog rings, by sewing or other suitable methods that prohibit leakage of the mixture from the bags.

2. The sacks of san cement shall be bedded, by hand, on the prepared grade with all the fastened ends on the grade and with the joints broken.

3. The sacks shall be rammed and packed against each other and tamped on the surface in such a manner as to form close contact and secure a uniform surface. Immediately after placing and tamping the sacks of san cement, they shall be thoroughly soaked by sprinkling with water. Water shall not be applied under high pressure.

4. Sacks of sand cement ripped or broken in placing shall be removed and replaced before being soaked with water.

3.04 DEPTH OF RIP-RAP.

A. The standard depth of stone rip-rap shall be 18 inches unless otherwise indicated or directed. The average depth for each 25 square feet of surface shall be not less than the depth indicated on the Plans or directed by the Owner, or the standard depth required in these Specifications.

B. The completed sacked sand cement rip-rap shall have a minimum thickness of 10 inches, measured perpendicular to the slope.

C. In no case shall any part of the finished depth of stone or sacked sand cement rip-rap vary more than 3 inches above or below the specified depth.

PART 4 – MEASUREMENT

4.01 RIP-RAP.

A. Stone rip-rap of various gradations will be measured for payment by the ton. Sacked sand cement rip-rap will be measured for payment by the square yard, complete in place. No measurement for payment will be made for excavation embankment construction or grading work required to prepare the foundation or for filter fabric.

4.02 COMPACTION TEST.

A. Soil test as required by the Owner will be paid for by the test as performed by a testing agency which meets the approval of the Owner.

PART 5 – PAYMENT

5.01 PNEUMATICALLY PLACED CONCRETE.

A. The accepted quantities of stone rip-rap, or sacked sand cement rip-rap will be paid for at the contract unit price per ton or square yard respectively for the depth and grade specified which price will be full compensation for preparing the foundation, furnishing and placing filter cloth

fabric and rip-rap, and furnishing all labor, materials, equipment and incidentals necessary to complete the work.

5.02 COMPACTION TESTING.

A. Accepted quantities of soil compaction tests as required by the Owner will be paid for at the contract unit price per test.

5.03 PAYMENT WILL BE MADE UNDER:

Item No.	Pay Item	Pay Unit
02370-01	RIP-RAP	Square Yard
02370-01.01.__.__	__" Thickness Stone Rip-Rap, Grade __	Ton
02370-01.02	Sacked Sand Cement Rip-Rap	Square Yard
02370-02	SOIL COMPACTION TEST	Each

END OF SECTION 02370