

Section 02378

RIPRAP AND GRANULAR FILL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Section includes requirements for furnishing concrete or stone riprap and granular fill.

1.02 MEASUREMENT AND PAYMENT

- A. Payment for Riprap Gradation number 1 is on a square yard basis.
- B. Payment for Riprap Gradation number 2 is on a square yard basis.
- C. Where there is not a separate item listed for work of this Section, no separate measurement and payment is made. Include cost for work under this Section in related item listed on Unit Price Schedule.
- D. Measurement and payment is as noted on Unit Price Schedule.
- E. Refer to Section 01270 - Measurement and Payment for unit price procedures.

1.03 DELIVERY, STORAGE AND HANDLING

- A. Keep storage area clean, firm, smooth and well drained in order that product can be placed with a minimum of foreign matter.
- B. Stockpile and handle material so as to not cause undue segregation of particle sizes either in stockpile, or while loading, hauling and handling.

PART 2 PRODUCTS

2.01 RIPRAP

- A. Provide riprap consisting of broken concrete or stone. Provide riprap that is dense, durable and hard material free from cracks, seams and other defects, which would increase deterioration from handling and natural causes.
- B. Shape and Dimensions.
 - 1. Provide riprap in cubic form, rather than elongated (flat) shapes.

- 2. Provide riprap with a minimum thickness of 6 inches.
- 3. No more than 25 percent may have a length greater than 2-1/2 times width or thickness. No length shall exceed 3 times width or thickness.
- C. Do not provide spalls, fragments and chips exceeding 5 percent by weight. Dimension and shape limitations do not apply to this portion of riprap.
- D. Where broken concrete is used, cut exposed metal, including rebar and wire mesh, flush with surface prior to placing riprap.
- E. Provide riprap conforming to following tables:

**Table 1
Riprap Gradation No. 1**

Percent Lighter by Weight	Stone Weight Lbs.		Volume Cubic Ft. (2)		Cubical Shape Ft (Each Side)		Spherical Shape Ft (Dia.)	
	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
100	180	265	1.20	1.77	1.06	1.21	1.31	1.50
50	80	110	0.53	0.73	0.81	0.90	1.01	1.12
15	40	60	0.27	0.40	0.64	0.74	0.80	0.91

Notes:

- 1. Theoretical cube and sphere size is presented for guidance only. Paragraph 2.01 shall control riprap shape and dimensions.
- 2. Volume is based on 150 pcf, unit weight.
- 3. Riprap Gradation No. 1 is to be used where 18-inch-thick riprap mat is noted on Plans.

**Table 2
Riprap Gradation No. 2**

Percent Lighter by Weight	Stone Weight Lbs.		Volume Cubic Ft. (2)		Cubical Shape Ft (Each Side)		Spherical Shape Ft (Dia.)	
	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit	Lower Limit	Upper Limit
100	260	640	1.73	4.27	1.20	1.62	1.49	2.01
50	130	200	0.87	1.33	0.95	1.10	1.18	1.37
15	40	150	0.27	1.00	0.64	1.00	0.80	1.24

Notes:

- 1. Theoretical cube and sphere size is presented for guidance only. Paragraph 2.01 shall control riprap shape and dimensions.
- 2. Volume is based on 150 pcf, unit weight.
- 3. Provide a 24-inch-thick mat, minimum, for Riprap Gradation No. 2.

2.02 GRANULAR FILL

- A. Provide granular fill consisting of crushed concrete or stone. Provide granular fill that is dense, durable and hard material.
- B. Provide granular fill, as shown on Plans, to the following dimensions:
 - 1. Provide 3-inch to 5-inch granular fill with no material diameter less than 3 inches and no material diameter greater than 5 inches.
 - 2. Provide 4-inch to 8-inch granular fill with no material diameter less than 4 inches and no material diameter greater than 8 inches.
- C. Do not provide spalls, fragments and chips exceeding 5 percent by weight.
- D. Where crushed concrete is used, cut exposed metal, including rebar and wire mesh, flush with surface prior to placing granular fill.

2.03 GEOTEXTILE

- A. Refer to Section 02621 - Geotextile.

PART 3 EXECUTION

3.01 GRADE PREPARATION

- A. Refer to Section 01578 - Control of Ground Water and Surface Water.
- B. Trim and dress channel bottom and side slopes to proper lines and grade prior to placing riprap or granular fill. Where shown on Plans, place geotextile in accordance with Section 02621 - Geotextile.
- C. City Engineer to inspect prepared section prior to placing geotextile, where required, and riprap or granular fill.

3.02 EXCAVATION AND FILL

- A. Excavate channel. Refer to Section 02315 - Roadway Excavation.
- B. Excavate for structures. Refer to Section 02316 - Excavation and Backfill for Structures.

3.03 RIPRAP PLACEMENT

- A. Riprap shall meet gradation and quality requirements prior to placement.
- B. Place riprap to slopes, lines and grades as shown on Plans, to establish a well-graded mass of

riprap with minimal voids. Fill voids between larger riprap blocks with spalls and smaller blocks of largest feasible size to form a compact mass. Do not place spalls and small blocks in place of larger size riprap.

- C. Install riprap mat to thickness as shown on Plans, with a minimum mat thickness as shown on gradation tables.
- D. Place riprap to avoid displacement or damage to prepared surface or geotextile. Place riprap in a manner to avoid segregation of particle sizes.
- E. Distribute elongated riprap throughout mat.
- F. Avoid dropping riprap from a height to cause breakage or damage to geotextile (if used).
- G. Prevent mixture or incorporation of dirt or other materials with riprap during placement.

3.04 GRANULAR FILL PLACEMENT

- A. Place granular fill to slopes, lines and grades as shown on Plans or as directed by City Engineer.

END OF SECTION