ITEM 432

RIPRAP

432.1. Description. This Item shall govern for the furnishing and placing of riprap of the type and details shown on the plans and in accordance with this Item.

432.2. General. Riprap furnished under this Item shall be Concrete; Stone (Type R)(Dry or Grouted); Stone (Type F)(Dry, Grouted or Mortared); Stone (Common)(Dry or Grouted); Pneumatically Placed Concrete (Class II); or Cement Stabilized.

Dry Riprap is defined as Stone Riprap of the required type with voids filled only with spalls or small stones.

Grouted Riprap is defined as Stone Riprap (Type R, F or Common) of the required type with voids filled with grout after all the stones are in place.

Mortared Riprap is defined as Stone Riprap (Type F) laid and mortared as each individual stone is placed.

432.3. Materials. All materials shall conform to the pertinent requirements of the following items:

Item 420, "Concrete Structures"
Item 421, "Portland Cement Concrete"
Item 431, "Pneumatically Placed Concrete"
Item 440, "Reinforcing Steel"

(1) Concrete Riprap. Concrete shall be Class B unless otherwise shown on the plans. Wire reinforcement used in Concrete Riprap shall consist of welded wire fabric meeting the requirements of ASTM A185.

(2) Stone Riprap. Unless otherwise shown on the plans, stone for riprap shall meet the following requirements:

Riprap stone shall be a durable, natural stone and have a minimum bulk specific gravity of 2.40 when tested in accordance with Test Method Tex-403-A. The maximum loss of 18.0 percent with magnesium sulfate and 12.0 percent with sodium sulfate when subjected to 5 cycles in accordance with Test Method Tex-411-A. When testing riprap stones for soundness, crushing may be required. The soundness test will be performed on the particles passing the 2 1/2 inch sieve and retained on the No. 4 sieve.

A verification test for the size of finished riprap stone in place shall be performed by the Contractor at a location determined by the Engineer. The test area size shall be a square, each side of which will measure a minimum of three (3) times the specified thickness of riprap. Additional tests may be required by the Engineer for each 5000 square yards (SY) of surface area of riprap or fraction thereof. Placement of subsequent 5000 SY riprap areas shall not begin until previously placed stone has been approved by the Engineer.

Grout or mortar, when required, shall conform to Item 421, "Portland Cement Concrete". Grout shall have a consistency such that it will flow into and completely fill all voids.

Filter fabric shall meet the requirements of Departmental Material Specification D-9-6200, Type 2.

(a) Stone (Type R). Unless otherwise shown on the plans all stones except spalls shall weigh between 50 and 250 pounds each, and at least 50 percent of the stones shall weigh more than 100 pounds each.
(b) **Stone (Type F).** Stones shall have at least one broad flat surface. Unless otherwise shown on the plans all stones except spalls shall weigh between 50 and 250 pounds each, and at least 40 percent of the stones shall weigh more than 100 pounds each.

(c) **Stone (Common).** Stones shall not be less than 1/3 of a cubic foot in volume and not less than three (3) inches in their least dimension. The width of the stone shall not be less than twice its thickness. The material used for Stone Riprap (Common) may consist of broken up concrete removed under the contract or obtained from other approved sources.

(3) **Pneumatically Placed Concrete Riprap.** Pneumatically placed concrete for riprap shall be Class II in accordance with Item 431, "Pneumatically Placed Concrete", unless otherwise shown on the plans.

(4) **Cement Stabilized Riprap.** The aggregate for this riprap shall be material conforming to Item 247, "Flexible Base", except for measurement and payment, of the type and grade shown on the plans. Unless otherwise shown on the plans, Cement Stabilized Riprap shall contain three (3) sacks of portland cement per cubic yard of cement stabilized riprap.

(5) **Special Riprap.** Special Riprap shall be as shown on the plans.

432.4. **Construction Methods.** The slopes and other areas to be protected shall be dressed to the line and grade shown on the plans prior to the placing of riprap. Riprap and toe walls shall be placed in accordance with the details and to the dimensions shown on the plans, or as established by the Engineer, or as specified herein.

Mortar or Grouted Riprap shall not be placed on embankment slopes until the embankment has been compacted to the satisfaction of the Engineer.

No mortar or grout shall be placed when the air temperature is below 35 F. The work shall be protected from rapid drying for at least three (3) days after placement.

Spalls and small stones weighing less than 25 pounds shall be used to fill open joints and voids in stone riprap and shall be placed to a tight fit.

When filter fabric is required by the plans, the fabric strips shall be placed with the length running up and down the slope, and shall have a minimum overlap of two (2) feet. Fabric shall be secured to the slope with nails, 12 inch minimum length and washers or U-shaped pins with a nine (9) inch minimum length and a maximum spacing of 10 feet, five (5) feet on seams. Alternate anchorage devices and spacings may be used when approved by the Engineer.

(1) **Concrete Riprap.** Unless otherwise shown on the plans, concrete riprap shall be reinforced using wire or bar reinforcement.

When wire reinforcement is used, it shall be a 6 x 6 - W2.9 x W2.9 welded wire fabric or its equal. A minimum lap of six (6) inches shall be used at all splices. At the edge of the riprap, the wire fabric shall not be less than one (1) inch nor more than three (3) inches from the edge of the concrete and shall have no wires projecting beyond the last member parallel to the edge of the concrete. Wire reinforcement shall be adjusted during concrete placement to maintain its position approximately equidistant from the top and bottom surface of the slab.

When bar reinforcement is used, the sectional area of steel in each direction shall not be less than the sectional area of the wire fabric described above. The spacing of bar reinforcement shall not exceed 18 inches in each direction and the distance from the edge of concrete to the first parallel bar shall not exceed six (6) inches.

Bar reinforcement shall be supported properly throughout the placement to maintain its position approximately equidistant from the top and bottom surface of the slab.
If the slopes and bottom of the trench for toe walls are dry and not consolidated properly, the Engineer may require the entire area to be sprinkled, or sprinkled and consolidated before the concrete is placed. All surfaces shall be moist when concrete is placed.

After the concrete has been placed, compacted and shaped to conform to the dimensions shown on the plans, and after it has set sufficiently to avoid slumping, the surface shall be finished with a wooden float to secure a reasonably smooth surface or broom finished as approved by the Engineer.

Immediately following the finishing operation the riprap shall be cured in accordance with Item 420, "Concrete Structures".

(2) **Stone Riprap.** Stone riprap shall be constructed in accordance with the specified type as shown in Figure 1.
(a) **Stone Riprap (Type R).** The stones shall be placed in a single layer with close joints. The stones shall be placed so that the greater portion of their weight is carried by the earth and not by the adjacent stones. The upright axes of the stones shall make an angle of approximately 90 degrees with the embankment slope. The courses shall be placed from the bottom of the embankment upward, the larger stones being placed in the lower courses. Open joints shall be filled with spalls. Stones of greater dimension than the required riprap thickness shall be embedded in the embankment to present a uniform finished top surface such that the variation between tops of adjacent stones shall not exceed six (6) inches. Stones that project more than the allowable amount in the finished work shall be replaced, embedded deeper, or chipped.

When the plans require this riprap to be grouted, care shall be taken to prevent earth or sand from filling the spaces between the stones. After the stones are in place, the stones shall be wetted thoroughly and the spaces between the stones shall be completely filled with grout. The surface of the riprap shall be swept with a stiff broom after grouting.

(b) **Stone Riprap (Type F).** When the plans require this riprap to be placed dry, the flat surface shall be placed on a prepared horizontal earth bed and so placed as to overlap the underlying course, the intent being to secure a lapped or "shingled" surface. These stones shall be placed first and roughly arranged in close contact. The spaces between the large stones then shall be filled with stone of suitable size so placed as to leave the surface evenly stepped, conforming to the contour required, and capable of shedding water to the maximum degree practicable.

When the plans require Stone Riprap (Type F) to be mortared they shall be lapped or "shingled" as described for dry placement. Before placing mortar, the stones shall be wetted thoroughly, and as each of the larger stones is placed, it shall be bedded in fresh mortar and adjacent stones shall be shoved into contact. After the larger stones are in place, all of the spaces or openings between them shall be filled with mortar and the smaller stones then placed by shoving them into position, forcing excess mortar to the surface and insuring that each stone is carefully and firmly embedded. After the work has been completed as described above, all excess mortar forced out shall be spread uniformly to completely fill all surface voids. All joints then shall be pointed up roughly either with flush joints or with shallow, smooth raked joints.

When the plans require Stone Riprap (Type F) to be grouted, stone shall be selected as to size and shape in order to secure fairly large, flat-surfaces stone which may be laid with a true and even surface and a minimum of voids. Stones shall be placed with the flat surface uppermost and parallel to the slope. The largest stones shall be placed near the base of the slope. The spaces between the larger stones shall be filled with stone of suitable size, leaving the surface smooth, reasonably tight, and conforming to the contour required. In general, the stones shall be placed with a degree of care that will insure for plane surfaces a maximum variation from the true plane of not more than six (6) inches in 10 feet. Warped and curved surfaces shall have the same general degree of accuracy as specified for plane surfaces. Care shall be taken to prevent earth or sand from filling the spaces between the stones. After the stones are in place, the stones shall be wetted thoroughly and the spaces between the stones shall be completely filled with grout. The surface of the riprap shall be swept with a stiff broom after grouting.

(c) **Stone Riprap (Common).** Stones shall be placed on a suitable bed excavated for the base course or layer. The base course or layer of stone shall be bedded well into the ground with their edges in contact. Each succeeding course or layer shall be well bedded into and placed on even contact with the preceding course or layer. Spalls and small stones used to fill open joints and voids in the riprap shall be placed to a tight fit. The finished surface shall present an even, tight surface true to the line and grades of the typical sections.

When the plans require Stone Riprap (Common) to be grouted, care shall be taken to prevent earth or sand from filling the spaces between the stones. After the stones are in place, the stones shall be wetted thoroughly and the spaces between the stones shall be completely filled with grout. The surface of the riprap shall be swept with a stiff broom after grouting.
(3) **Pneumatically Placed Concrete Riprap, Class II.** Pneumatically placed concrete for riprap shall be placed in accordance with the details and to the dimensions shown on the plans or as established by the Engineer. Pneumatically placed concrete shall conform to the requirements of Item 431, "Pneumatically Placed Concrete". Reinforcement shall conform to the details on the plans and with Item 440, "Reinforcing Steel". Reinforcement shall be supported properly throughout placement of concrete. The subgrade surfaces shall be moist when concrete is placed.

The surface shall be given a wood float finish or a gun finish as directed by the Engineer.

Immediately following the finishing operation, the riprap shall be cured with membrane curing compound in accordance with Item 420, "Concrete Structures".

(4) **Cement Stabilized Riprap.** Cement Stabilized Riprap shall conform to the requirements of the plans and to the provisions for Concrete Riprap except reinforcement will not be required. Design and mixing of Cement Stabilized Riprap shall be as approved by the Engineer.

432.5. **Measurement.** This Item will be measured by the cubic yard of material complete in place. Cubic yards will be computed on the basis of the measured area and the thickness shown on the plans.

Concrete in toe walls will be measured as riprap of the type with which it is placed.

432.6. **Payment.** The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Riprap" of the various classifications specified. This price shall be full compensation for furnishing, including all royalty, hauling, and placing all materials including mortar, grout, reinforcement, filter fabric, premolded expansion joint material, and for all labor, tools, equipment, and incidentals necessary to complete the work.

Payment for excavation of toe wall trenches and for all necessary excavation below natural ground or bottom of excavated channel will be included in the unit price bid per cubic yard of riprap.

Payment for all necessary excavation for riprap below natural ground or bottom of excavated channel, and for shaping of slopes for riprap will be included in the unit price bid per cubic yard for riprap, except that when the header banks upon which riprap is to be placed were built by prior contract, the excavation or embankment required for shaping of slopes will be paid for in accordance with Item 400, "Excavation and Backfill for Structures" and Item 132, "Embankment".