## ITEM P-185 ARMOR STONE

DESCRIPTION

185-1.1 Furnish all plant, labor, equipment and materials and perform the work necessary to manufacture and place stone protection on both ends of the runway as shown on the plans or as directed by the Engineer.

MATERIAL

185-2.1 GENERAL.Conform to the following quality and gradation requirements. Submit a quarrying, blasting and processing plan to the Engineer for required materials. Do not place materials prior to acceptance.

Provide primary armor and filter or underlayer stone; stone shall not be elongated or tabular. The minimum dimension of each individual stone shall be at least one-third of the stone's maximum dimension. Provide stone that conforms to the specified size requirements after processing. Conduct loading, placement or stockpiling operations in a manner that eliminates breakage. Comply with the following requirements for armor stone

1. **Primary Armor and Filter Stone.** Provide uniformly graded stone that falls within the limits shown in the following gradations, based on class:

|  |  |  |
| --- | --- | --- |
| **Primary Armor Stone - Class \_\_\_\_** | | |
| Stone Weight | Approximate  Diameter | Allowable % Smaller **by Stone Count** |
| \_\_\_ lb | \_\_ inch | 100% |
| \_\_\_ lb | \_\_ inch | 0-50% |
| \_\_\_ lb | \_\_ inch | 0% |
|  |  |  |
| **Filter Stone** | | |
| Stone Weight | Approximate  Diameter | Allowable % Smaller **by Stone Count** |
| \_\_\_ lb | \_\_\_ inch | 100% |
| \_\_\_ lb | \_\_\_ inch | 0-50% |
| \_\_\_ lb | \_\_\_ inch | 0% |

1. **Underlayer Stone.** Provide uniformly graded underlayer stone that falls within the limits shown in the following gradations, based on class:

|  |  |  |
| --- | --- | --- |
|  |  |  |
| **Underlayer Stone - Class \_\_\_ lb** | | |
| Stone Weight | Approximate  Diameter | Allowable % Smaller **by Stone Count** |
| \_\_\_ lb | \_\_ inch | 100% |
| \_\_\_ lb | \_\_ inch | 0-50% |
| \_\_\_ lb | \_\_ inch | 0% |

CONSTRUCTION METHODS

185-3.1 General.Provide a level, compact area large enough to dump and sort at approved locations(s). Dump the loads specified in this area and assist the Engineer as needed to sort and measure the stones in the load to determine it the riprap is within specifications. Provide the equipment needed to assist in this sorting.

Place primary armor and filter or underlayer stones on prepared slopes within the limits shown on the plans. Construct a uniform and regular surface with slopes no steeper than those shown on the plans. Maintain the armor stone until final acceptance, and replace any displaced material to the design slopes, lines, and grades at the Contractor’s expense.

Place materials in a manner that produces a well-keyed mass of stone, with each individual stone having three points of contact. Ensure that finished surfaces of all layers are free from pockets of single sized stone. Placement of small stone in primary armor and filter or underlayer stone layers to choke the spaces between large stones or for leveling the surface is not permitted. Breaking of individual pieces in place by blasting or mechanical methods is not permitted. Place filter or underlayer stone to the full course thickness in one operation and in a manner that avoids displacing underlying materials. Placement by methods likely to cause segregation, such as end dumping, side dumping or pushing into position with earth-moving equipment, are not permitted. Obtain the desired distribution of various sizes of armor stones throughout the mass by selective loading and by controlled placement of successive loads during placement. Materials that do not meet the specified requirements for size, quality or distribution of sizes will not be allowed for use.

Orient each stone individually so that the long axis of the stone is perpendicular to the structure's sloped surface. Rearrange individual stones as required to the extent necessary to correct deficiencies and to provide a uniform, well-keyed slope.

Place each class of stone to the full thickness and depth shown on the drawings. No minus tolerance is permitted. A greater thickness is permitted provided the outside slopes present a uniform appearance with a minimum of pieces projecting outside the plane of the finished slope surface. A greater depth is permitted in the toe apron provided uniform appearance and finished depths are maintained.

Stone of a certain weight classification that is rejected because of cracks or seam defects, as described in the Quality Control subsection of this specification, may be used for a lower weight classification if other quality and shape requirements are met.

185-3.2 CONSTRUCTION SEQUENCING. Schedule construction activities in general conformance with the following sequencing plan.

1. Clearly delineate the limits of use of each type of stone, both in the field and on as-built drawings.
2. Construct the embankment and slope protection in conformance with the plans and specifications.

185-3.3 QUALITY CONTROL. Establish and maintain quality control for stone to assure compliance with contract requirements and to maintain records of its quality control for all operations, including but not limited to the following

1. Produce stone of the size specified, verifying sizes by selected samples when requested by the Engineer.

Acceptability of stone quality is determined by visual inspection. The Engineer may reject materials not found to meet the specified requirements at any time during the performance of the contract, at the source or project site.

1. Test stone material for weight, gradation, and shape to assure compliance with the specifications. Conduct tests at the production site before transporting materials to the project site. Place materials that do not meet the specified requirements in a separate area to assure they do not get mixed in with acceptable materials. Perform tests at uniform intervals throughout the project to meet testing frequency requirements.
2. Before delivery of materials to the project site, meet with the Engineer at the production site and select stones that meet the required weight and shape. Set aside stones at the production site as reference samples. Select reference samples representing each size in the stone gradation and clearly mark and retain until completion of the project.
3. Testing frequency for this project is shown below

**STONE TYPE OF TEST NO. OF TESTS**

Primary Armor Visual Inspection/Measurement 10% of Stones

Weight 10% of Stones

Filter or Underlayer Measurement 1% of Material Produced

Weight 1% of Stones

Tests, other than weight, are on individual stones. Failing tests do not count toward the number of tests required. Increase testing frequency as necessary to maintain quality control during production.

1. **Visual Inspections** Make a visual check of the stones at the production site for elongation, cracks, deterioration, and other defects visible to the naked eye, on at least 2/3 of the surface area of the stone. Wet five percent of the stones checked for cracks and re-inspected for minute cracks to determine if they are detrimental to the stone quality and if additional inspections are necessary on all stone. Do not transport stones with cracks that are detrimental to stone longevity to the placement site.
2. **Measurement** Measure stones on three mutually perpendicular axes and compute weight using the appropriate specific gravity. Record computed weights and measurements daily and provide signed copies to the Engineer before the start of the next work shift. Select stones for measurement that represent all sizes specified in order to verify conformance with specified shape and grading limits.
3. **Weight** In addition to weighing for payment purposes, weigh primary armor in order to verify conformance with the gradation limits specified. Accomplish by placing stones of similar size into a truck or loader, weighing the stones, and calculating an average individual stone weight (e.g., 20 stones placed in a truck weigh 20,000 pounds; this is equivalent to 20 stones with an average weight of 20,000/20 = 1,000 pounds). Use other methods of weighing stones for grading purposes only if approved by the Engineer.

Provide quality test results meeting the following requirements as performed by a certified lab

|  |  |  |
| --- | --- | --- |
| **PROPERTY** | **TEST METHOD** | **LIMITS** |
| Specific gravity (SSD) | AASHTO T 85 | 2.65 min. |
| Absorption | ASTM C97 | 2% max. |
| Soundness (Sodium Sulfate) | ASTM C88 | 5% max. loss |
| Solubility & Durability (Ethylene Glycol) | COE CRD-C-148 | 2% max. loss after 15 days |
| LA Abrasion | ASTM C535 | 10% max. loss after 200 revs. and 50% max. loss after 1000 revs. |

185-3.4 Placement. Before placing armor materials, establish clear and understandable construction control for the workers. Establish minimum control to delineate the horizontal limits of all stone classes, both toe and shoulder lines. Unless specified in writing, follow the slope lines and grades indicated on the drawings for the limits of the in-place stone.

Survey each layer to document material placement. Make periodic checks as the work progresses to verify line and grade of the armor placement. Provide a copy of the check surveys to the Engineer and obtain approval before placing the next layer of material. Approval of cross-sections does not constitute final acceptance. Take cross-sections at 25-foot intervals and at the ends of each typical section range. Take horizontal cross-section at 5-foot intervals and at grade breaks along the survey grades.

Submit a plan detailing how the check surveys will be completed, including the methodology and equipment proposed. Do not place stones until the Engineer approves the method for performing check surveys.

METHOD OF MEASUREMENT

185-4.1 Primary armor stone and filter or underlayer stone will be measured by the tons of material placed, based on project weight records, and in accordance with the dimensions shown on the plans, or as directed by the Engineer. No payment will be made for material placed in excess of these dimensions.

BASIS OF PAYMENT

185-5.1 Payment for primary armor and filter or underlayer stone will be made at the contract unit price and includes all labor, materials, tools, equipment, testing, and incidentals required to construct shore protection.

Payment will be made under:

Item P185.\_\_\_.\_\_\_\_ Primary Armor Stone, Class \_\_\_\_ – per ton

Item P185.\_\_\_.\_\_\_\_ Underlayer Stone, Class \_\_\_\_ – per ton

Item P185.170.0000 Filter Stone – per ton

REFERENCES

AASHTO T 85 Specific Gravity and Absorption of Coarse Aggregate

ASTM C88 Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

ASTM C97 Absorption and Bulk Specific Gravity of Dimension Stone

ASTM C535 Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

COE CRD-C-148 Method of Testing Stone for Expansive Breakdown on Soaking in Ethylene Glycol