Subsection 4.11
Riprap

I. Scope: Furnish and place concrete or stone riprap.

II. Materials

A. Concrete: Concrete shall conform to the requirements of Subsection 4.07 "Concrete." Concrete shall be 3000 psi.

B. Stone Riprap: The Contractor shall supply durable stone with a bulk specific gravity of at least 2.50 as determined by Tex-403-A, unless otherwise shown on the plans. Provide stone that, when tested in accordance with Tex-411-A, has a weight loss of no more than 18% after 5 cycles of magnesium sulfate solution.

The contractor will perform a size verification test on the first 5,000 square yards of finished riprap stone for all types of stone riprap at a location determined by the Engineer or ODR.

Provide filter fabric in accordance with TxDOT's DMS-6200, "Filter Fabric." Provide Type 2 filter fabric unless otherwise shown on the plans.

Use stones between 50 and 250 pounds. Use stones that are at least 3 inches in their least dimension. Material may consist of broken concrete that meets the same requirements of virgin aggregate. Cut exposed steel reinforcement flush with all surfaces before placement.

III. Construction: Dress slopes to the lines and grades to the line and grade shown on the plans before placement of riprap. Place riprap and toe walls according to details and dimensions shown on the plans.

A. Concrete Riprap. Reinforce concrete riprap with 6 inch x 6 inch – W2.9 x W2.9 welded wire fabric or with No. 3 reinforcing bars meeting the requirements of Subsection 4.12 "Reinforcing Steel," spaced at a maximum of 18 inches in each direction unless otherwise shown. Provide a minimum splice of 6 inches. Bars can be no closer than 3 inches and no further than 6 inches to the forms and centered in the thickness of the riprap using chairs of other devices to hold bars in place. Weld wire fabric must be kept off the bottom during placement. When allowed fiber reinforcement can be used, the following fibers are acceptable:

a) Stainless, alloy, or carbon steel:

b) Alkali resistant glass: and

c) Synthetic fiber

Consolidate the subgrade and sprinkle surface before placement of concrete.

Compact and shape the concrete once it has been placed to conform to the dimensions shown on the plans. Finish the surface with a wood float after concrete has set sufficiently to avoid slumping to secure a smooth surface and broom finish.

B. Curing Materials: Cure riprap immediately after finishing with one of the following applications.

a) Burlap: Burlap shall be made from jute or hemp and, at the time of using shall be in good condition, free from holes, dirt, clay, or any other substance which interferes with its absorptive quality. It shall not contain any substance which would have a deleterious effect on the concrete. Burlap shall be of such quality that it will absorb water readily when dipped or sprayed and shall weigh not less than 7 ounces per square yard when clean and dry. Burlap made into mats may be used if care in handling is exercised to avoid marring the finished surface of the concrete.

b) Cotton Mats: Cotton mats for curing concrete shall conform to the requirements of AASHTO M 73 "Cotton Mats for Curing Concrete."

c) Waterproof Paper: Paper and impermeable sheets for curing concrete shall conform to the requirements of ASTM C 171 "Sheet Materials for Curing Concrete."

2. Liquid Membrane-Forming Compounds: Liquid membrane-forming compounds shall conform to the requirements of ASTM C 309 "Liquid Membrane-Forming Compounds for Curing Concrete."

3. Expansion Joint Material: Preformed fiber expansion joint material shall be of the dimensions shown on the plans. The material may be the following types unless specifically noted otherwise on the plans. Preformed bituminous fiber material shall conform to ASTM D 1751 "Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and resilient bituminous types)." Preformed non-bituminous fiber material shall conform to ASTM D 1752 "Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction."

IV. Equipment: The contractor will supply all equipment including those in Subsection 4.07 “Concrete.”

V. CONSTRUCTION METHODS: The Contractor shall design, produce, transport, and place the class of concrete in accordance with requirements of this Subsection. The Contractor will perform quality assurance (QA) testing at the scope and frequency outlined in Table 1. QA testing conducted by the Contractor will be submitted to the ODR for review to determine payment and make acceptance decisions. The Contractor may perform quality control (Q/C) testing. The Contractor is allowed to submit Q/C testing to the ODR. The ODR reserves the right to take additional Q/A tests.

Table 1
Concrete Testing Frequency

Test For	Test Number	Sampling Location	Frequency of Testing	Remarks
Compressive Strength	Tex-418-A	At point of placement	4 cylinders for each 100 CY or fraction thereof for 3000 psi concrete.	Sampling shall be in accordance with Tex-407-A. 2 cylinders shall be tested at 7 days and if the average is below the design strength as defined in Table 1 of Subsection 4.07 "Concrete", the remaining 2 cylinders shall be tested at 28 days. If the average value of the 2 cylinders broken at 7 days the 2 remaining cylinders are not required to be tested.
Slump	Tex-415-A	At point of placement	When cylinders are taken.	Maximum slump allowed is 4%.
Entrained Air	Tex-416-A or Tex-414-A	At point of placement	When cylinders are taken.	A minimum of 3% and a maximum of 7% entrained air is required.
Temperature	Tex-422-A	At point of placement	When cylinders are taken.	Check first load of all placements. Maximum of 90˚F at placement.

A. Forming: Forms shall be of wood or metal, of a satisfactory section, straight, free from warp, and of a depth equal to the thickness of the finished work. They shall be securely staked to line and grade and maintained in a true position during concrete placement. Inside forms for the curb shall be of approved material and shall be of such design as to provide the curb required and shall be rigidly attached to the outside forms**.**

Forms shall remain in place at least 12 hours after placement of concrete. Forms shall be treated with light oil before each use and forms which are to be re-used shall be cleaned immediately after use and maintained in good condition.

B. Shrinkage Crack Control: Concrete shall be below the allowable temperature as determined by the Contractor by using (ACI 305 chart (modified). The rate of evaporation of water from the concrete shall not exceed 0.15pounds per square foot per hour. The Contractor shall keep a log of air temperatures, relative humidity, wind velocity, and allowable concrete temperature for each day he places concrete. The log shall be readily available for review by the Project Representative. For air temperature, relative humidity and wind speeds other than what is listed, the next highest temperature shown, next lowest relative humidity, and next highest wind velocity interval shall be used to determine acceptable concrete temperature.

Contractor is to inform the concrete supplier of the temperature requirements prior to delivery to the project. The concrete temperature limit shall not be exceeded at least until fifteen minutes after surface finishing. Appropriate curing methods shall be used to prevent shrinkage cracks in conjunction with these concrete temperature requirements.

Concrete shall not be poured when wind or weather conditions are such that dirt, sand, or debris enters the concrete. No concrete will be placed when wind speeds exceed 25 miles per hour. The concrete shall be protected to maintain temperatures of not less than 50°F for 5 days after placement. If aggregate and water are heated, they shall not be heated

above 175°F. Concrete shall not be placed when ambient temperature is less than 40°F. It shall be the responsibility of the Contractor to anticipate as nearly as possible changes in weather conditions which would affect the placement and protection of the concrete and to be prepared to protect freshly placed concrete when sudden changes in the weather make such protection necessary.

C. Expansion Joints and Scoring: Expansion joints shall be placed at intervals not to exceed 30 feet and at such other locations as may be shown on the plans. Expansion joints shall be placed vertically Forethought shall be used in the spacing of expansion joints and also in the spacing of the scoring so as to have approximately equal spacings and so that no short or long spacings will exist.

Where a sidewalk or curb and gutter are being constructed adjacent to or abutting existing concrete construction, an expansion joint shall be placed between the new and the existing concrete. Expansion material shall also be placed around all obstructions protruding through sidewalks or driveways.

All expansion joints shall be premoulded expansion joint monolithic with the edge of the expansion joint will be approximately 1/4 inch below the face of finished surface

D. Protection: The Contractor must protect his work against weather, vandals, and any and all things that may mar the finish, surface, or the appearance of the concrete. Any damage to the surface is cause for rejection of all concrete between the expansion joints on either side of the damaged surface.

VI. Measurement: Riprap will be measured by the square yard, complete in place.

VII. PAYMENT

The work performed and materials furnished as prescribed by this item and measured as provided will be paid for at the unit price bid. The prices shall each be full compensation for preparing the subgrade; for furnishing, and placing all materials, including all reinforcement and expansion joint materials; for furnishing, placing, testing, shaping and tamping backfill; and for all manipulation, labor, tools, equipment, and incidentals necessary to complete the work.

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