

SECTION 612

PNEUMATICALLY PLACED CONCRETE MORTAR (SHOTCRETE)

DESCRIPTION

612.01.01 GENERAL

- A. This work shall consist of lining ditches and channels, slope paving, and constructing warped sections and other similar features with mortar pneumatically placed in accordance with these specifications and the Special Provisions.
- B. Pneumatically placed mortar shall consist of either dry mixed fine aggregate and Portland cement applied by a suitable mechanism, to which mixture the water is added immediately previous to its expulsion from the nozzle, or mortar premixed by mechanical methods and pneumatically applied through a nozzle onto the prepared foundation.

MATERIALS

612.02.01 GENERAL

- A. The materials used shall be those prescribed for the several items which constitute the finished work and shall conform to all the requirements for the materials as set forth in this specification and in Division III, "Material Details."
- B. Cement shall conform to **Section 701, "Hydraulic Cement."**
- C. Sand shall conform to **Subsection 706.03.03, "Fine Aggregate."**
- D. The dry mixture shall consist of 1 part Portland Cement to 4 parts sand, thoroughly mixed in a dry state.
 - 1. Measurement may be either by volume or weight.
 - 2. Before placing the proportioned materials in the hopper of the application gun, all lumps 3/8 inch and over shall be removed by screening.
- E. The premixed mortar shall contain not less than 610 pounds (6.5 sacks) of Portland cement per cubic yard, fine aggregate and water, a maximum of 20% Fly Ash replacement (by mass), and a maximum of 0.45 water/cement ratio. A maximum of 30 percent size #8 or size #89 aggregate as defined in ASTM D448 or AASHTO M43 may be substituted for fine aggregate.
- F. Combined aggregate gradation shall comply with the following table:

| Sieve Size | Percent Passing by Weight |
|-----------------|------------------------------|
| 1/2 in (12.5mm) | 100 |
| 3/8 in (9.5mm) | 90-100 |
| No. 4 (4.75mm) | 70-85 |
| No. 8 (2.36mm) | 50-70 |
| No. 16 (1.18mm) | 35-65 |
| No. 30 (600µm) | 20-35 |
| No. 50 (300µm) | 8-20 |
| No. 100 (150µm) | 2-10 |

- G. All shotcrete shall have a 28-day strength requirement of 4500psi.
- H. For general acceptance of the mix, provide test samples from the mixer truck that meet 28-day strength requirements using 4x8 single use plastic molds.
- I. For job site production acceptance, provide test samples cored from test panels or wall face that meet 85% of 28-day strength requirement. No individual test specimen shall be less than 75% of the required strength.
- J. Mesh reinforcing for ditch lining and slope paving reinforcement shall be of the sizes shown on the plans, shall be fabricated of cold drawn steel wire, and need not be galvanized. Mesh reinforcing shall conform to ASTM A185.
- K. Header boards consisting of 2-inch by 4-inch redwood lumber furnished and placed in the concrete slope paving shall be as shown on the plans. Lumber used in the construction of header boards shall be commercial grade heart redwood, S4S.
- L. Nails used on construction of header boards shall be commercial quality galvanized nails.

CONSTRUCTION

612.03.01 PREPARATION OF SUBGRADE

- A. The subgrade for paved ditches and slope paving shall be formed by excavation to the required depth below the prepared finish surface grade in accordance with dimensions and design indicated on the plans or as directed by the Engineer.
- B. The subgrade shall be thoroughly compacted.
 - 1. Any soft, spongy, or other unsuitable material shall be removed to the depth directed by the Engineer, backfilled with suitable material, and thoroughly compacted.
 - 2. Water shall be sprinkled on the subgrade during compaction.
 - 3. The subgrade shall be sufficiently moist prior to placing concrete mortar to prevent absorption.

612.03.02 PLACING

- A. Prior to placing slope paving for use in the work, the Contractor shall construct sufficient test panels to assure the Engineer that the proper color has been obtained.
 - 1. The final panel shall be at least 4 feet by 6 feet in size.
 - 2. The panels shall be constructed at the construction site and shall be placed by a method to be used in placing slope pavement.
- B. The Engineer shall be the sole judge of compliance of the test panel construction with these specifications.
- C. Header boards shall be installed to conform to the grades of the slope paving and to the dimensions, spaces, and layout shown on the plans.
- D. Header boards shall be held in position with stakes of suitable size and length as shown on the plans.
- E. A constant pressure of not less than 45 psi shall be maintained in the placing machine where the hose length is 100 feet or less and the pressure shall be increased at least 5 psi for each additional 50 feet of hose or fraction thereof.

- F. Water used for hydration at the nozzle shall be maintained at a uniform pressure, which shall not be less than 15 psi greater than the air pressure at the machine.
- G. The nozzle shall be held at a distance and in a position so that the flowing stream of material will impinge, as nearly as possible, at right angles to the surface being covered.
 - 1. Any deposits of loose sand shall be cut out.
 - 2. All rebound materials shall be wasted.
- H. The Contractor shall do this work only with experienced personnel.
- I. Materials that have been mixed for more than 45 minutes and have not been incorporated in the work shall not be used, unless otherwise permitted by the Engineer.
- J. Mortar shall not be placed against frosted or frozen surface. If mortar is placed during the cold weather, it shall be heated and protected during placing and curing as set forth in **Section 501, "Portland Cement Concrete,"** except mortar shall be maintained at a temperature of not less than 50 degrees F for 72 hours after placing and at not less than 40 degrees F for an additional 4 days.
- K. The ditch lining and slope paving shall be constructed without expansion joints. Suitable forms shall be used where necessary to ensure full dimensions as shown on the plans at the perimeter of the lining.
- L. The mesh reinforcing shall be placed in the approximate center of the pneumatically placed concrete mortar. All joints shall be lapped 6 inches and run continuously throughout paving or between headers.
- M. After the work is completed, the Contractor shall remove all debris from the work.

612.03.03 FINISHING

- A. After the mortar has been placed to the required depth, the surface shall be checked with a straightedge, and any low spots or depressions shall be brought up to grade by placing additional mortar so that the finished surface will be smooth and uniform for the type of work involved.
- B. Loose areas of air-blown mortar shall be removed and replaced by the Contractor at no additional cost to the Contracting Agency. The surface finish of the exposed slope paving shall be the equivalent of a wood float finish, unless otherwise specified.
- C. Immediately after completion, the surface shall be covered with wet burlap or wet cotton mats and the mats kept wet for at least 72 hours. When approved by the Engineer, mortar may be cured by the use of a waterproof or liquid membrane conforming to **Section 702, "Concrete Curing Materials and Admixtures,"** and these specifications.

METHOD OF MEASUREMENT

612.04.01 MEASUREMENT

- A. Pneumatically placed concrete mortar will be measured in square yards of the actual surface covered to the depth shown on the plans.

BASIS OF PAYMENT

612.05.01 PAYMENT

- A. The quantity, measured as provided above, will be paid for at the contract unit price bid per square yard for Pneumatically Placed Concrete Mortar (___ inch, depth), which shall be full compensation for excavation, backfill, furnishing and installing redwood headers, and mortar; for all labor, tools, equipment, and incidentals; and for doing all the work involved in placing the pneumatically placed mortar, including subgrade preparation, forming, and curing, complete in place, as shown on the plans and as specified herein, and as directed by the Engineer.
- B. Mesh reinforcement may be measured and paid for as specified in **Section 505, "Reinforcing Steel,"** unless otherwise specified.
- C. Note: If the Contractor elects to place the slope paving by other methods approved by the Engineer, the method of measurement and basis of payment will not be changed.
- D. All payments will be made in accordance with **Subsection 109.02, "Scope of Payment."**
- E. Payment will be made under:

| PAY ITEM | PAY UNIT |
|---|-----------------|
| Pneumatically Placed Concrete Mortar (inch depth) | Square Yard |