

## Section 53 Shotcrete

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### 4-5301 General

Shotcrete is concrete pneumatically projected onto a surface. Shotcrete may be used for lining ditches and channels, paving slopes, and constructing warped sections. If allowed by the special provisions, shotcrete may also be used for structural applications.

### 4-5301 General

### 4-5302 Before Work Begins

Take the following actions:

- Review the contract to determine the areas and conditions in which shotcrete is to be used. Determine whether the contractor intends to use shotcrete as allowed by the special provisions or by Section 51-1.11, “Construction Methods,” Section 72-4.01, “Description,” or Section 72-6.01 “Description,” of the *Standard Specifications*.
- Verify the receipt and proper distribution of Form CEM-3101, “Notice of Materials to Be Used,” which lists shotcrete cement and aggregate.

### 4-5302 Before Work Begins

### 4-5303 During the Course of Work

The following instructions are for nonstructural and structural applications of shotcrete:

- Examine the foundation that will receive the shotcrete to ensure the foundation is evenly graded and free of high areas that would cause a thinner layer of shotcrete than required. Also, at the time the shotcrete is placed, ensure the foundation is firm and moist as specified. Note such observations in the daily report.
- Ensure the reinforcement is placed and firmly held in position as specified. Check joints, side forms, shooting strips, and where used, the position of ground or gauging wires.
- Obtain certificates of compliance and samples of portland cement and aggregate, and test them for all specified attributes. Ship the cement samples to the district materials unit for testing at the frequency shown in Section 6-1, “Sample Types and Frequencies,” of the *Construction Manual*. For testing aggregate, the district establishes the frequency, which can vary depending on the particular operation. Sufficient tests are to be run to ensure substantial compliance.
- Ensure the contractor proportions the specified amount of cement and aggregate.
- To support payment for the work, take measurements and keep records.
- Limit the placing of shotcrete to the specified lifts.
- Periodically check the working pressures of the equipment to ensure they meet specifications.

### 4-5303 During the Course of Work

- Ensure the contractor uses clean reused rebound material in the specified amount.
- For placing dry-mix shotcrete, ensure the materials are used within 45 minutes of mixing the cement with the aggregate.
- For placing wet-mix shotcrete, ensure the materials are used within 90 minutes of mixing.
- Through observation, ensure a reasonably smooth and uniform finished surface for the type of work involved. Require low spots or depressions to be brought up to proper grade.
- Ensure the shotcrete is cured by one of the specified methods. When curing compound is used, ensure the specified application rate.
- Ensure the shotcrete is protected as specified.
- For structural applications the following are some of the more important duties of field personnel. For detailed procedures for using shotcrete, refer to the Office of Structure Construction's manual, *Shotcrete, a Field Guide for OSC Employees*.
- For locations where shotcrete can be used, refer to the contract's special provisions and plans.
- Only allow the use of a wet-mixed process if the specifications allow such use. For the "finish coat," the contractor may use a dry-mix process.
- Ensure the contractor abides by all the elements of the following prequalification process:
  1. Ensure the nozzleperson's experience conforms to the requirements for applying shotcrete in the intended location.
  2. Ensure the contractor sets up and shoots a preconstruction test panel that contains rebar and any other obstructions that are identical to the most heavily reinforced section to be shot.
  3. Ensure the contractor takes and tests the cores as necessary or required.
  4. After the time specified in the special provisions, demolish the preconstruction panel, and verify that a dense homogeneous mass completely encases the reinforcement.
- Ensure the proper mix is delivered by checking the delivery ticket of the first truck and by also checking the delivery tickets periodically throughout the day.
- Ensure that the nozzleperson and the blowpipe operator work together and that the nozzleperson does not get ahead of the blowpipe operator.
- Ensure the finishers rake away any loose material the blowpipe could not remove and they keep the surface at approximately a 45° angle.
- Watch vertical surfaces to ensure no slough off occurs because of mix that is too wet. Reference any areas that do slough off so they can be carefully sounded later. Any wet mix that does slough off should be removed and then reshot.
- The nozzleperson should make the extra effort to ensure complete encasement of the reinforcement. On double mats of reinforcement, this extra effort will require placing the nozzle through the front mat of the reinforcement and shooting from the sides of large bars to properly place the concrete behind the bars.

- To verify that shotcrete fully encases the reinforcement, occasionally rake out areas of congested reinforcement. Look for rock or sand pockets.
- Verify the shotcrete is homogeneous and the compressive strength adequate by taking random production cores from the completed work, as specified in the contract. To lay the cores out, follow the latest policies of the Office of Structure Construction.
- Verify that the surface finish matches the one demonstrated in the preconstruction panel.
- During the shotcrete application, ensure the contractor meets all the applicable safety standards and uses the proper safety equipment.
- Discuss with the structure representative or the area construction manager any proposal to use shotcrete at a location not indicated in the contract plans and special provisions.

#### **4-5304 Measurement and Payment**

Measure shotcrete by the cubic meter, computed from the actual area placed and the theoretical thickness shown in the plans. The special provisions may allow you to modify the measurement method.

Keep records of rejected shotcrete loads, and provide the reasons (preferably including test data) for such actions. Also, keep records of any significant amounts of concrete placed outside of pay limits.

#### **4-5304**

#### **Measurement and Payment**