

### **Section 53 Shotcrete**

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### Section 53 Shotcrete

#### 4-5301 General

This section provides guidelines for inspection of shotcrete placement under Section 53, "Shotcrete," of the *Standard Specifications*. Shotcrete is concrete that is pneumatically projected onto a surface. Shotcrete is used for facing of soil nail walls. Shotcrete may be used for lining ditches and channels, paving slopes, constructing warped sections, and structural elements. Shotcrete may also be used for structural repairs.

#### 4-5302 Before Work Begins

Before work begins, do the following:

- Review the contract to determine the areas and conditions in which shotcrete could be used. Determine whether the contractor intends to use shotcrete for structural elements and that it is provided for in the special provisions or Section 51-1.03B, "Methods and Equipment" of the *Standard Specifications*.
- Review and become familiar with Sections 46-3, "Soil Nails"; 53, "Shotcrete"; 72-5, "Concrete Slope Protection, Gutter Lining, Ditch Lining, and Channel Lining"; and 72-11, "Slope Paving," of the *Standard Specifications*.
- Authorize the contractor's quality control plan, witness the construction and demolition of preconstruction test panels, and obtain compressive strength results for sampled cores.
- Verify that Form CEM-3101, "Notice of Materials to Be Used," includes cement and aggregate. Refer to Section 6-202, "Responsibilities for Acceptance of Manufactured or Fabricated Materials and Products," of this manual for additional information.

#### 4-5303 During the Course of Work

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

- Examine the foundation that will receive the shotcrete and 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 cementitious material and aggregate, and test them for all specified attributes. Ship the samples to the

district Materials Unit for testing at the frequency shown in Section 6-1, "Sample Types and Frequencies," of this 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 cementitious material and aggregate.
- Take measurements and keep records to support payment for the work.
- Limit the placing of shotcrete to the specified lifts or layers.
- Periodically check the working pressures of the equipment to ensure they meet specifications.
- 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 cementitious material 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.

Follow these additional instructions for structural shotcrete applications:

- For locations where shotcrete can be used, refer to the special provisions and plans.
- Ensure the proper mix is delivered by checking the mix design number and the concrete mix design proportions on the concrete batch delivery ticket from the first truck and by verifying the concrete batch delivery tickets periodically throughout the day.
- Ensure that the nozzle person and the blowpipe operator work together and that the nozzle person does not get ahead of the blowpipe operator.
- Ensure the finishers rake away any loose material the blowpipe could not remove.
- Watch vertical surfaces and ensure no slough-off occurs because of mix that is too wet. Reference any areas that do slough off so they can be carefully inspected to ensure the integrity and soundness of the concrete after it has hardened. Any wet mix that does slough off should be removed and then reshot.
- Ensure that the nozzle person provides complete encasement of the reinforcement. Where there are double mats of reinforcement, the nozzle person

needs to place the nozzle through the front mat of the reinforcement and shoot both sides of large bars.

- On occasion, rake out areas of congested reinforcement to verify that shotcrete fully encases the 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 Structure Construction.
- Verify that the surface finish matches the one demonstrated in the preconstruction test 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 Quality Control**

Guidance for quality control activities included in this section is summarized as follows:

- Review and authorize structural concrete quality control plans.
- Ensure the nozzle person's experience conforms to the requirements for applying shotcrete in the intended location.
- Witness the construction and demolition of test panels. After demolition, inspect test panels for laminations and sand pockets, and verify the bar reinforcement and other obstructions are completely encased. For unreinforced test panels, confirm coring for compressive strength testing.
- Review concrete compressive strength results and inspect concrete cores.
- During field quality control ensure that the contractor obtains cores at four locations for every 50 cubic yards of production shotcrete. Select additional locations when the cores contain bar reinforcing.
- Inspect the cores to see that the concrete is dense and free of laminations and sand pockets, and confirm compressive strength is acceptable.
- Verify that the cored holes are patched with mortar.

#### **4-5305 Payment**

Measure shotcrete by the cubic yard, 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. Payment for bar reinforcing steel is not included in the payment for structural concrete.

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.