

9.6—Placement techniques

One of the most important factors that should be considered in shotcrete installation is placement technique. If quality control is excellent in all other aspects of the shotcrete application but placement is questionable, an unsatisfactory product may result. The procedures and techniques described in other portions of this guide should be followed closely because they represent good shotcrete practice.

9.7—Inspection

A knowledgeable, thorough, and qualified inspector is a necessary requirement for implementing quality-assurance procedures. The inspector should be familiar with plans, specifications, and applicable standards. The inspector should understand all facets of the shotcrete process, especially the installation technique referred to in Chapter 8. The inspector should continuously inspect the work, paying attention to materials, forms, reinforcement, equipment, placement, finishing, curing, and protection of the finished product. The inspector also is responsible for the field-testing as outlined in the following section.

9.8—Testing procedures

An important aspect of quality assurance is the physical testing of the shotcrete before, during, and after placement. ACI 506.2 describes the procedures to be followed in preconstruction and construction testing. The agency providing the testing and/or inspection should meet the requirements of ASTM E 329.

Normal testing ages for compressive strength are 7 and 28 days; however, shorter periods may be required for particular applications or conditions. Testing is usually done once a day or every 50 yd³ (40 m³)—whichever is greater. Sampling and testing, however, should be varied according to the size and complexity of the project. Sampling should be done in accordance with ASTM C 1385. Making extra cylinders or panels is sometimes done if testing results vary.

Other testing may include tests for water absorption, drying shrinkage, and resistance to freezing-and-thawing cycles. Fiber-reinforced shotcrete may require fiber washout tests or flexural toughness testing according to ASTM C 1018.

Acceptance of shotcrete should be based on results obtained from drilled cores or sawed cubes (ASTM C 42). The use of data from nondestructive testing devices, such as impact hammers or probes (ASTM C 805, ASTM C 803), ultrasonic equipment (ASTM C 597), and pull-out devices (ASTM C 900) may be useful in determining the uniformity and quality of the in-place shotcrete. These tests, however, may not provide reliable values for compressive strength. Refer to ACI 228.2R for additional information on nondestructive testing.

Core grading is a method used to evaluate encasement of reinforcement. Core grading is only used for nozzle operator evaluation and is done in accordance with ACI CP-60. Core grading should not be used to evaluate structures.

these documents are revised frequently, the reader is advised to contact the proper sponsoring group if it is desired to refer to the latest version.

American Concrete Institute

121R	Quality Management System for Concrete Construction
211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
214R	Evaluation of Strength Test Results of Concrete
228.2R	Nondestructive Test Methods for Evaluation of Concrete in Structures
301	Specifications for Structural Concrete
304R	Guide for Measuring, Mixing, Transporting, and Placing Concrete
304.2R	Placing Concrete by Pumping Methods
304.6R	Guide for the Use of Volumetric-Measuring and Continuous-Mixing Concrete Equipment
305R	Hot Weather Concreting
306R	Cold Weather Concreting
308R	Guide to Curing Concrete
308.1	Standard Specification for Curing Concrete
311.4R	Guide for Concrete Inspection
318	Building Code Requirements for Structural Concrete
506.1R	Committee Report on Fiber Reinforced Shotcrete
506.2	Specification for Shotcrete
506.4R	Guide for the Evaluation of Shotcrete
546R	Concrete Repair Guide
547R	Refractory Concrete: State-of-the-Art Report
CP-60	Craftsman Workbook for ACI Certification of Shotcrete Nozzleman
SP-57	Refractory Concrete

ASTM International

A 185	Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete
A 497	Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
A 820	Specifications for Steel Fibers for Fiber-Reinforced Concrete
C 33	Standard Specification for Concrete Aggregates
C 42	Standard Test Method of Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
C 94	Standard Specification for Ready-Mixed Concrete
C 150	Standard Specification for Portland Cement
C 157	Standard Test Method for Length Change of Hardened Hydraulic-Cement, Mortar, and Concrete
C 171	Standard Specification for Sheet Materials for Curing Concrete
C 173	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method
C 231	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
C 260	Standard Specification for Air-Entraining Admixtures for Concrete

CHAPTER 10—REFERENCES

10.1—Referenced standards and reports

The standards and reports listed as follows were the latest editions at the time this document was prepared. Because