ACI Committee 506, Shotcreting—Activities Update

By Marc Jolin

ACI Committee 506, Shotcreting, is one of the most active technical committees of the American Concrete Institute (ACI). Formed in 1960 to address some of the needs of the industry, the committee has evolved over the years to cover many aspects of the shotcrete process. Today, the ACI 506 library includes a guide, a specification document, and other documents pertaining to the evaluation of shotcrete, underground applications, and fibers (refer to Table 1).

As many readers may know, one of the biggest challenges for a technical committee covering a number of documents is to preserve coherence between those documents while keeping their content up to date and as valuable as possible to the industry. Needless to say, this can prove difficult to achieve across the entire document library. Very conscious of the rapid evolution of the industry over the last two decades (one simply has to look at the content of this magazine over the last 15 years to verify that statement!), and the increasing attention given to quality control and acceptance as a whole, all of the subcommittees started in a serious effort to address this challenge a few years ago. The strategy was to start with our core documents (Guide and Specification documents) and then follow with our equally important companion documents. This article therefore aims at presenting some of the advances made so far, as well as the strategy adopted for some of the documents currently being revised/rewritten.

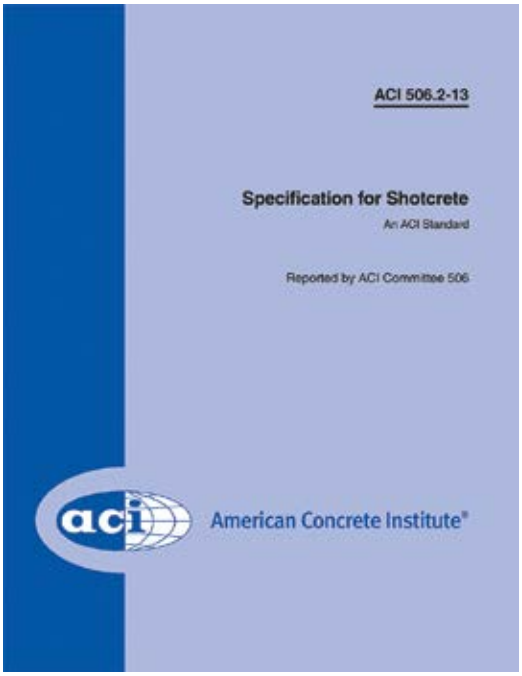
Table 1: ACI Committee 506 Library as of July 2016

Current Documents	Subcommittee Name	Subcommittee Chair
506R-16, Guide to Shotcrete	506-C, Guide	Lars Balck Jr.
506.1R-08, Guide to Fiber-Reinforced Shotcrete	506-B, Fiber-Reinforced	Jeffrey Novak
506.2-13, Specification for Shotcrete 506.2M-13, Specification for Shotcrete (Metric)	506-E, Specifications	James Ragland
506.4R-94, Guide for the Evaluation of Shotcrete	506-A, Evaluation	Simon Reny
506.5R-09, Guide for Specifying Underground Shotcrete	506-F, Underground	Lihe (John) Zhang

Guide and Specification

One of the first steps taken was to initiate a parallel revision of our aging 506.2-13, Specification for Shotcrete, document (previous version dated back to 1995) and our 506R-16, Guide to Shotcrete (previous version dated back to 2005). Indeed, years of feedback from the industry showed that these two documents were often confused or considered as one by many specifiers[1]; although this can be an advantage, because it puts the Guide in more hands (therefore disseminating more information on proper shotcreting technique), it had the potential to create complex situations—and even legal problems—if there were any discrepancies between the Specification and the Guide at any given point in time. This is where the first steps in our efforts to align our document

[1] It should be noted that the only document that can appear in contractual documents is the ACI 506.2, Specification for Shotcrete, because it is the only one written in enforceable mandatory language and offering defaults, values appropriate for specifications.



library were taken. Following the publication of a completely new version of our Specification in 2013, the Guide was revised both for content and format. The later was adapted to match the organizational structure of the specification document; although still a complete stand-alone document that merits reading on its own, it can also be considered to be a commentary to the Specification document. To illustrate this, Table 2 shows a simple example of the correlation between both documents about construction joints. In the left column, the specification tells us concisely how to do something, while in the right column, the guide provides further explanations. It is the intent of the committee to maintain the synchronization between these two documents in the future.

One important change that was made in the 2013 Specification, and later supported by the Guide in 2016, is the removal of the Core Grading system. This is noteworthy because it leaves an apparent gap in our documents, as they offer little guidance to the engineer on the acceptance of shotcrete. In fact, the subject of shotcrete acceptance was (and still is!) an important part of the consideration in rewriting the 506.4R-94, Guide for the Evaluation of Shotcrete, document. It was also felt that that aging document (1994!) needed a complete rewriting to better address the changes in QA/QC seen in recent years.

Evaluation of Shotcrete

The document currently being revised by the committee will cover all the usual aspects of QA/QC for shotcrete, from the tests to run on fresh material, all the way to durability-related tests, with emphasis on the frequency of testing, the interpretation of the results, and typical expected values. For example, special care is being given to the "Compressive Strength" section and especially panel handling or core extraction, as experience has shown it is often the source of erroneous noncompliant results.

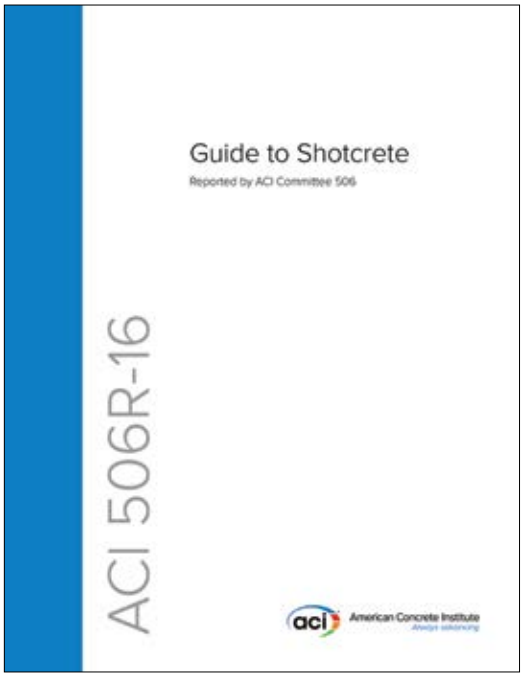
A novel addition, however, is the inclusion of a special section on the "acceptance of shotcrete." The openly stated objective of the acceptance of shotcrete section is to guide the engineer to evaluate what is and is not acceptable for the specific job at hand and realize that, similar to cast-in-place concrete, some limited defects may be present, especially as the complexity of the work increases.

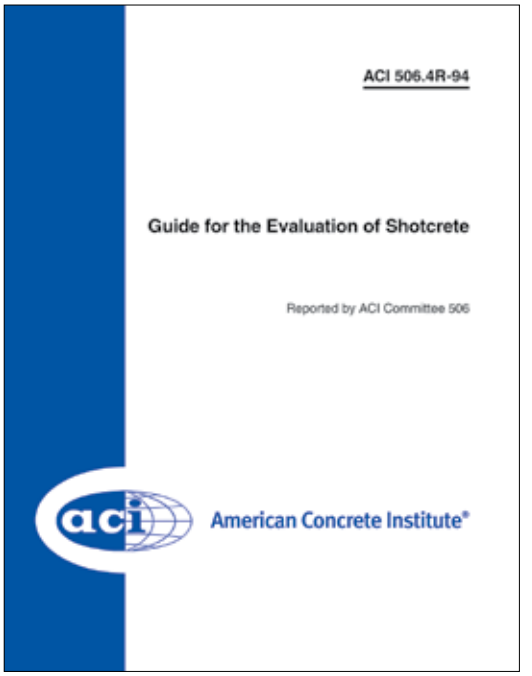
The task to define what "acceptable" shotcrete has turned out to be a complex one. It was decided by the committee to separate the exercise into two parts. The first part consisted of producing a methodology aimed at evaluating the quality of a set of shotcrete cores. These cores may come from pre-

Table 2: Excerpt from the Specification (left) and Guide (right) documents on the topic of construction joints

(underlined words to illustrate difference of language)

506.2-13, Specification for Shotcrete	506R-16, Guide to Shotcrete
*3.2.1 - Construction joints_* Taper construction joints at approximately 45 degrees from receiving surface. Form joints by cutting plastic shotcrete. Roughen shotcrete in the joint face while shotcrete is still plastic.	*3.2.1 - Construction joints_* Square construction joints are generally avoided in shotcrete construction because the corner is a trap for rebound and overspray. Construction joints are usually constructed at a 45-degree angle. Where the joint will be subjected to compressive stress, however, square joints are sometimes required, in which case, the crew should take the necessary steps to…





construction test panels (the ideal approach) or from the shotcreted structure itself (for particular cases where in-place quality is questionable). The outcome of this evaluation of core quality is a qualitative judgment such as "good" or "fair." The hope of the committee is to have this methodology published as a Technical Note (a short standalone ACI technical document) to facilitate its updating and revision. The second part is a dedicated section in the Evaluation document on the Acceptance Criteria that is based on a number of difficulty levels, which address many aspects of the jobs such as section thickness, reinforcement layout, orientation, and need for certified nozzleman. This section of the Evaluation document will therefore guide the engineer in identifying the Difficulty Level related to the work in progress (a jobsite may present several different difficulty levels) and in selecting the Quality Level the engineer is willing to work with. In effect, the engineer is creating project-specific acceptance criteria.

Although briefly hinted at previously, it is noteworthy to mention that the Evaluation document being developed will also include a complete section on mockup panels and preconstruction trials, an increasingly popular qualification method. The objective here is to illustrate what has been successfully done in the past on projects, and then point out what information can be gained from these tests.

Fibers and Underground

Our two remaining subcommittees are working on 506.5R-09, Guide for Specifying Underground Shotcrete, and 506.1R-08, Guide to Fiber-Reinforced Shotcrete. Although slightly less impacted by the ongoing effort, they are nonetheless both in the process of being reapproved and the committee members are hard at work revising them to make sure they reflect the most recent advances and good practices.

Conclusions

ACI Committee 506, Shotcreting, is busy and actively working on offering the most useful and complete document library for the entire shotcrete industry. With the rewriting and revision of our documents to reflect the most recent changes in the industry, the goal to make them coherent and synchronized across the whole library is well under way. As we look toward the future, we are also actively working on extending shotcrete acceptance into the concrete-specific Codes and standards that can benefit from incorporating shotcrete placement for many types of structural concrete construction.

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