

# Improving Shotcrete Inspections

By Mark Bradford

**S**hotcrete is a placement method for concrete. Even though the shotcrete process is over 100 years old, it constantly evolves and today, it is a modern, cost-effective, and more sustainable method of concrete placement. Those of us who regularly shotcrete a variety of work will at times have inspections and therefore have to work with inspectors. Understanding the inspector's role as a safeguard or agent for the owner is important.

However, we often find dealing with inspectors can be a cumbersome part of our job. Knowing how to do something properly and being able to fully explain the means and methods of a specialized process (shotcrete) to someone who has little to no firsthand experience are two completely different animals.

## ASA SHOTCRETE INSPECTOR EDUCATION AND ACI CERTIFICATION

ASA has been making great strides in developing resources for inspector education and also working with ACI on the creation of its inspector certification. ASA's education program is only a couple of years old and the ACI certification was recently launched in Fall 2019. It will take time for these resources to reach the majority of inspectors that may be involved with shotcrete projects. Thus, we contractors will often still have inspectors on our projects who are either ill-informed or uneducated about the shotcrete process.

## AVOIDING POTENTIAL JOBSITE ISSUES

Outdated specifications are often cut and pasted into project plans and specifications. At times, boilerplate or typical/standard items will be integrated without any validity or relevance to the actual job or process. Disputes on jobsites may arise when an outdated or incorrect specification is coupled with an inspector with little to no experience with the shotcrete process who must enforce that specification. Though an experienced shotcrete contractor knows what is needed for quality, durable shotcrete placement, the inspector may try to enforce provisions that are not appropriate and can decrease the quality of the shotcreted concrete.

The best way to avoid potential jobsite issues is to plan ahead. Review all of the project plans and specifications prior to the job. When there are issues that may affect proper or efficient shotcrete placement, make them known to the specifier or owner as soon as possible. Hopefully, proper solutions to the issues can be developed prior to the contract phase.

## SHOTCRETE RESOURCES

There are a multitude of resources and information available through ASA and ACI that can help specifiers create current and applicable specifications and details. This includes ASA 1-hour on-site seminars for specifiers, full-day seminars for shotcrete inspectors, answers to technical inquiries, the resources page on [www.shotcrete.org](http://www.shotcrete.org), position statements, and technical sessions at ASA conventions. ACI Committee 506, Shotcreting, has many documents covering shotcrete including ACI 506.2, "Specification for Shotcrete," providing the specifier an up-to-date mandatory specification that can be directly included in project documents by reference. ACI 506R-16, "Guide to Shotcrete," also has a wealth of information about shotcrete materials, equipment, crew responsibilities, placement techniques, curing, testing, and protection.

## CONTRACTORS MUST BE KNOWLEDGEABLE AND PREPARED

I recently reviewed a contract document for a wet-mix shotcrete job that included only dry-mix-specific details, and no wet-mix-specific details. In this instance, because the job was still several months away, we had the time and ability to send RFI's to correct the situation before we arrived on the jobsite. But imagine if we had not reviewed the contract documents and showed up where the inspector was enforcing dry-mix provisions on our wet-mix placement. That would have been problematic from the first day on the job.

If for some reason, a project specification gets handed to you while the concrete truck is backing up to the pump, you must be ready to educate the inspector on the fly. Not only about proper procedures and the methodology behind them, but also about the concrete mixture design. This is where it is critically important that you as the contractor are knowledgeable, and able to relay the correct information quickly.

As a knowledgeable and experienced shotcrete contractor, you should have enough familiarity of mixture design to read and understand batch weights from the delivery ticket and compare them to the specified mixture design. Make sure that you are aware of the mixture design details to know how the concrete will behave and how the specifier is expecting the final concrete in-place to perform.

It is a necessity that the batch plant sends you batch weights for every truck. Batch weight tickets are the only way to know what materials are in the truck, as well as

what you will be placing. Quality, ease of placement, and safety are key reasons for knowing the exact details of the concrete mixture being delivered to the jobsite.

An inspector may question the mixture design and the properties of the concrete. Most often, the first question will be about the slump and the second will be about the water-cementitious materials ratio ( $w/cm$ ) of the mixture.

There are often specifications (or even building codes) that regulate slump even though it has limited, if any, true bearing on the in-place strength, quality, or durability of the concrete. You must be able to communicate that slump is only an indicator of workability and has little to no bearing on in-place strength as long as the specified  $w/cm$  is adhered to, and that if a mixture is too stiff, it will not properly encapsulate the reinforcing steel and can lead to safety issues due to plugged delivery lines. You must also be able to communicate that the slump at the truck and the slump at the nozzle can be quite different, especially when you are pumping long distances through a small-diameter delivery line. Slump loss can be a real issue.

One of the things that has made my life easier is to not show a value for the slump or a slump range when submitting mixture designs for approval. The lack of a specified value for slump that an inexperienced inspector may try to enforce allows the certified nozzleman to adjust the workability of the mixture as needed for proper placement without exceeding the desired  $w/cm$ . This is a key concept that all ACI certified nozzleman learn in the ASA nozzleman education.

Properly placed shotcrete needs to be viscous enough to “flow” around and encapsulate the reinforcing steel. Impact velocity, angle of impact, and higher paste content are a few of the things that allow for shotcreted concrete to flow while also stacking up well.

Another issue with slump revolves around the batch plant and the concrete truck driver. Sometimes the concrete is ordered at a specified slump and it will arrive very dry (low slump). The typical reason a driver may provide is “I saw the

ticket said shotcrete, so I made sure that it was really dry.” Getting concrete to arrive at a specified slump often can be a challenge that needs to be discussed with your concrete supplier prior to the concrete being transported.

Not too long ago, on a job in southern California, I had the opportunity to educate an inspector who really wanted to learn more about the shotcrete process. The experience of being able to walk him through the shotcrete process step by step from concrete mixture design, through placement, and curing was very rewarding for me, and hopefully him, too. The inspector was able to stand next to me during shooting while I verbalized what I was doing, and the reasoning behind it. He was very thankful for the time and the education.

Taking a few minutes to talk through the aspects of proper shotcrete placement and the reasons behind doing them with the inspector usually will go a long way towards a successful outcome for your job. Hopefully, we all (contractor, inspector, and owner) have the same goal of a high-quality, durable concrete in-place creating a long-lasting project for the owner.

## CONCLUSIONS

I am very excited about the future of the ASA Inspector Education Program, and what it means for the future of shotcrete. The more people who are properly educated about the shotcrete process helps with not only the specifying, but the placement and inspection processes as well. The future of shotcrete is bright, and I’m excited to see all the amazing ways that shotcrete can be used.



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