

Pool & Recreational Shotcrete Corner

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Shotcrete Rising (Part III of a III Part Series)

By Lily Samuels and Bill Drakeley

The American Shotcrete Association’s 2015 Pool of the Year is simply amazing: Designed by Aquatic Consultants (Miami, FL) and engineered by Watershape Consulting (Solana Beach, CA), the ultra-modern custom pool sits on a difficult site and boasts an all-tile interior among a number of other deluxe features.

Truth be told, however, this prize-worthy watershape experienced an unsettling twist on its way to completion: It seems that the original contractor failed to follow established protocols for shotcrete placement, so the resulting shell wasn’t of the caliber specified by the engineer to support the pool’s interior finish.

The original shotcrete contractor was summarily dismissed from the project. The substandard shell was ripped out, and a replacement was shot by a new contractor, Revolution Gunite (Burlington, NC), which knew how to follow the protocols the first contractor had ignored. With this huge issue resolved, the project stepped back onto its award-winning path.

As we see it, this tale defines two major issues facing the watershaping industry today: first, the need to challenge bad practices and demand excellence; and second, the need to disseminate good information about proper practices to the entire design/build community. In this article, which is the third and last in our series on the developmental history of the shotcrete process, we address this key pair of issues while looking ahead to shotcrete’s future.

Out with the Bad

As has been discussed in previous articles, the installation of high-quality shotcrete is not a low-budget endeavor: a qualified, experienced crew must employ the right equipment to place the material, using a good mixture design on a properly prepared substrate. Unfortunately, and all too often, at least one of these three criteria is not respected.

Perhaps this is why so many contractors rely on the waterproofing systems that they consider basic insurance policies. With this added material, they believe they are compensating for any possible flaws having to do with poor or inconsistent application techniques, inadequate mixture formulations, or substandard forming.

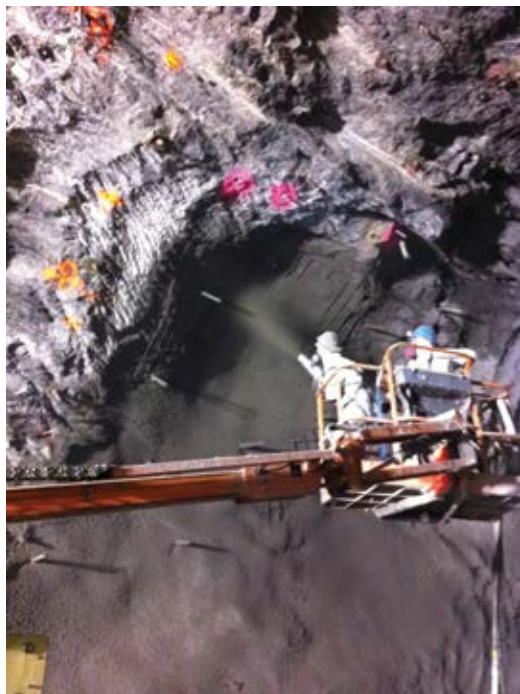
Some even market their reliance on waterproofing as an essential “final step”—that is, as an integral part of the shotcrete process. But nothing could be farther from the truth. In fact, the addition of layers atop the concrete material only increases the risk of bond failure.

Through years of experience in critical concrete applications (including the construction of roadway and railway tunnels), we at Drakeley Pool Co. (Bethlehem, CT) know that properly placed shotcrete structures designed to hold water—including swimming pools and spas—are watertight after a 28-day curing period and require no waterproofing before application of the finishing surface.

We also know that waterproofing isn’t necessarily an adequate mask for improper shotcrete application. And this is particularly true for projects of the greater level of complexity that are increasingly becoming the norm in high-end watershape design and construction. With swimming pools often being seen as artistic compositions with vanishing edges, perimeter overflows, glass-panel walls, and all-tile finishes, the construction processes involved are much more intricate (and expensive) and therefore raise expectations for flawless execution.

To us, flawlessness involves the use of high-performing concrete as a structural foundation that makes it possible to pull all of the specified finishing touches together. In this context, shotcrete failure spells disaster and underscores the need for meeting the concrete industry’s mandated performance criteria.

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We've used enough shotcrete in critical situations (including this huge tunnel) to know the material's capabilities and the value and importance of good application techniques



Shotcrete forms the subterranean base supporting this rill, made of reclaimed foundation stones, that graces an elegant English-style garden in Connecticut



With careful forming, properly executed shotcrete can create tight tolerances for free form stairs that are comparable to those that can be achieved by cast-in-place concrete. In this case, that execution was a key component of this nature-inspired slot-overflow pool



Shotcrete makes up the body of this radiant, glass-like Lautner-edge project. In addition, it was used to create the full-perimeter surge trough into which the pool's water flows

The Right Stuff

So what's the problem? If the value of proper shotcrete application is so obvious, why is there such a huge disconnect between the expectations of code-observant designers and engineers and the methods of contractors who seem willing to compromise on quality?

Our suspicion is that it's all about the scientific principle of inertia. Without something to make it move, an object at rest will remain that way. The watershaping industry has suffered with a bad case of inertia for a long time now, and it's up to those who know better to do what

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it takes to change mindsets and introduce more professionals to the need for excellence in shotcrete application.

Fortunately, the industry has significantly increased the strength and credibility of educational programs related to shotcrete in recent years—indeed, there's now a wealth of resources dedicated to bringing watershapers up to speed with good and accurate information and the best of the available courses and collateral materials for both wet and dry shotcrete are based on guidelines established by the American Concrete Institute (ACI) and the American Shotcrete Association (ASA).

What this means is that, with fair consistency, programs now offered by groups as diverse as the National Swimming Pool Foundation (NSPF), the Genesis Group, the Northeast Spa & Pool Association (NESPA) and the National Plasterers Council (NPC) are in large part aligned with the principles governing ACI's Nozzleman Certification program and ASA's technical review courses.

This is a good situation that will only get better with time. In fact, these programs are already starting to pay noticeable dividends. Many specifiers and engineers are already looking to ACI and ASA as standard-setters for key performance indicators including compressive strength and water-cement ratios. More important, these watershapers are incorporating the ACI/ASA indicators into their bid specifications, effectively binding contractors to follow protocols per contract terms.

Have all aquatic designers rejected the notion that concrete watershapes require waterproofing? Not universally by any means, but more and more of these professionals are calling these days for watertight shotcrete installation before any surface finish may be applied.

At the Nozzle

The importance of expanding participation in ACI Nozzleman Certification within the contractor community cannot be overstressed. In fact, its value is so widely appreciated already that more and more large shotcrete subcontractors are seeking ACI certification for their workforces. It's even reaching a point where such credentials are a basic indicator of proficiency recognized by design professionals, general and specialty contractors, and clients.

This certification isn't a guarantee of quality, but those with the certification are expected to understand the process, know what to expect as application moves forward, and are on a deter-

mined path to greater proficiency. Of course, it also takes extensive experience on top of basic certification to achieve excellence with complex, high-end watershapes—yet, even basic certification is helpful when watershapers compare the credentials of different shotcrete companies.

Another indicator of this new, more rigorous attitude in evaluating shotcrete companies is the fact that more and more plastering companies are taking a harder look at shotcrete and the effects it can have on their finishes. The NPC, for instance, has incorporated relevant information in its educational courses, helping its membership know how to size up a shotcrete job and make smart decisions in the field about whether to move forward with their own work.

Finally, shotcrete contractors themselves are taking ownership of their mixture designs and their expectations about the material being supplied to them by ready-mix suppliers. There is, for instance, a growing awareness of the detrimental effects that low quantities of cement binder material in the mixture has on the final product.

So considerable progress has been and is being made, which is the good news. The bad news is that there are still persistent pockets of old-school thinking—even in the education scene—that threaten to undermine the gains we've all made.

The Association of Pool & Spa Professionals' Builders Manual is a case in point: it includes a variety of quality information on overall pool requirements which we at Drakeley Pool Co. use regularly. But it also offers blatantly incorrect and/or outdated information on some of the structural aspects of shotcrete construction.

It's time to break away from the old-school suppositions and from instruction based on anecdotes and personal preference that is too often given equal time alongside scientific, fact-based criteria established by ASA and ACI.

It's also time for professionals on the periphery of watershaping to shrug off their reliance on dubious opinions and old-school approaches. Many engineers, for instance, do not encounter robust education on shotcrete, which is why so many of them are, to this day, wedded to a belief that casting in place is superior to pneumatic application—and have difficulty focusing on alternatives as a result. Making things even more difficult is the fact that many of these traditionalist engineers had negative experiences with shotcrete that occurred years ago—long before attitudes and approaches to the shotcrete process began to recover and improve.

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In addition, it's important to recognize that a growing percentage of the workforce in the construction industries does not have English as its first language. This highlights the need to extend training and education programs with presentations in other languages. That's not a simple task by any means, but it's another source of concern that needs to be addressed—the sooner, the better.

Down the Road

Despite the existence of these challenges to the ascendancy of the shotcrete process and of stubborn pockets of resistance that make universal acceptance of its merits an elusive goal, there are many reasons for optimism.

First, ASA's numerous position papers on shotcrete are already serving as educational tools and will eventually cover all functions related to watershape-related shotcrete application. Opinions are being replaced by facts, in other words, and personal preferences are giving way to standard operating procedures and an unprecedented level of conceptual unity within the affected trades. ACI and ASA are indeed taking command as definitive, binding standard-setters for shotcrete application—and it's all science-based and reproducible instead of opinion-based or self-promoting.

George Yogy, the father of modern-day shotcrete in the United States, has long proclaimed the shotcrete process as the ideal method for placing concrete and steadily testifies to the fact that a scientifically advanced concrete mixture design, when delivered and consolidated at high velocity, will capably stand the test of time.

He's not a lone wolf: among others, Dr. Lihe Zhang of Zhang Consulting & Testing Ltd. has convincingly documented the successes of shot material compared to cast-in-place material. These results should lead watershapers and engineers to take note and accept only the best. Inadequate compressive strength, automatic waterproofing, and shortcuts in mixture design—all insults to our trade—should become things of the past.

Those who move forward based on proper information and practice will become as accustomed to receiving accolades for the quality of their projects as were the pioneering applicators who worked for the Cement Gun Company in the 1920s and '30s and created structures that, ever since, have stood the test of time.

This is an elevated status toward which all of us should strive.



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Bill Drakeley is Principal and Owner of Drakeley Industries and Drakeley Pool Company. Drakeley holds the distinction of being the first and only member of American Concrete Institute (ACI) Committee 506, Shotcrete, from the pool industry. He is also an approved Examiner for the ACI Certified Nozzlemen program on behalf of the American Shotcrete Association (ASA), 2016 President of ASA, an ASA Technical Adviser, a Genesis 3 Platinum member, and a member of the Society of Watershape Designers as well as Chairman of its Advisory Board. Drakeley teaches courses on shotcrete applications at the Genesis 3 Construction School, World of Concrete, and numerous other trade shows. He is a contributor to Shotcrete magazine and other industry publications.

Catching Up

Here are references to the first two parts of this series on the history and development of the shotcrete process:

Part I: "Beginnings," *Shotcrete* magazine, V. 17, No. 3, Summer 2015, pp. 22-24.

Part II: "Shotcrete Reborn," *Shotcrete* magazine, V. 18, No. 2, Spring 2016, pp. 42-45.
