

Checks and Balances

By Bill Drakeley

As the educational efforts of organizations such as the American Concrete Institute (ACI) and the American Shotcrete Association (ASA) expand, there is great emphasis on the procedural techniques employed during shotcrete application that will produce good quality concrete. I applaud and encourage these efforts but venture the following questions: Are there non-concrete placement items that must be reviewed? What variables must be accounted for to allow a nozzleman to confidently spray that first yard of concrete? I propose that there is a checklist of issues that must be addressed prior to shooting which, if permitted to go undetected, can affect the finished product long after you've completed the shotcrete process. No doubt there are more issues to take into consideration, but I have identified nine factors that, in my experience, play key roles in ensuring quality shotcrete, a happy customer, and the receipt of that elusive final payment.

1. Plans and Specifications

Have all measurements been verified? For reference, a responsible pool contractor must have in his/her possession a complete set of detailed, engineer-approved plans and specifications that serve as a guide for every surface receiving concrete. All lengths, widths, depths, custom curves, radii, benches, steps—all information pertinent to the structure must be accounted for and checked against a complete set of plans and specifications prior to shooting. In fact, entering into a contract with a homeowner without detailed specifications is asking for trouble. Liability lies with the pool contractor in the absence of proper documentation.

2. Permits

We must ask: Has the town or municipality approved the project? It is crucial that the pool builder know that all necessary permission from the applicable building, zoning, health, and engineering departments has been acquired. Not only can these individuals catch and foresee potential problems with your project but also their approval can protect the pool contractor should any questions be raised regarding the choice of location, installations, codes, and electrical.

3. Soil Composition

Can this ground support the pool? Calling in a soil scientist for a geological investigation during the planning phase of the pool will quickly determine if the soil is capable of supporting both a concrete pool shell and the added weight of the water. I have inspected dozens of pools that have literally twisted under their own weight due to the inability of the soil to support them. Some blame falls on the pool contractor who should have done his/her research.

4. Water Conditions

Has this site been consistently dewatered during construction to compensate for a high water table? Is there a system in place to ensure adequate drainage after completion of the project? Groundwater cannot be allowed to sit in the excavation. I inspected a pool in Virginia that had floated due to hydrostatic pressure, surprising the contractor as the pool sat on a strong stone layer with multiple relief valves. After asking some questions, we quickly discovered the cause. Prior to shotcrete application, the pool dig had become saturated by heavy rains. Rather than draining the water from an outside well point, the contractor merely dropped a pump into the excavated area, which drew silt and fine particulates through the stone layer, clogging it and rendering it useless before the pool was even shot.

5. Plumbing

Four questions must be asked concerning plumbing. First, has the plumbing been pressure-tested? This step is absolutely essential to ensuring smooth operations of the mechanical system. Secondly, is the plumbing rigid and nonvibrating? A vibrating piece of pipe during a shoot will leave a void behind it, potentially inducing a crack in the pool wall. Thirdly, are there clearances allotted to ensure that every piece of plumbing is adequately covered during the shotcrete process? A little math can help the contractor determine proper placement of pipes. Lastly, has the plumbing system been consolidated to one spot, preferably under the pool? Perimeter piping and multiple random sleeves in the pool wall for plumbing, in addition to being (in my

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A watertight containment tank for off-road diesel tanks to be installed inside

opinion) low quality installation, will invariably be interfered with and/or broken by other contractors, masons, and electricians working around the pool. A neat and compact plumbing system strategically placed beneath the pool will protect piping and prevent future problems. These four plumbing issues eliminate unnecessary repairs after placing concrete.

6. Forming

Do the forms and their elevations correspond with the plans and specifications? Forms and their measurements, as the initial support of the concrete, must be accurate. Are the forms rigid and nonvibrating? Using rubber or Styrofoam forms is, in my experience, not solid technique. A pool contractor cannot afford forms that bounce back. Many guidelines set forth by ACI manuals and Committee 506 point to rigidity of forming during shotcrete regardless of the application.

7. Steel Placement

Is the steel being used of good quality and is it sturdy and nonvibrating? As a rule, our company uses Grade 60, 1/2 in. (12.7 mm) steel to provide a good solid structure. Is the steel placed according to the specifications to ensure good encapsulation? A good pool contractor will verify that concrete can be shot around every corner and cross section of the reinforcing bar. Common sense dictates that the steel be properly and evenly placed to guarantee that encapsulation process. Have guidewires been placed to help the finishers produce clean lines as they shape the concrete? The less “browning out” or building up of mortar a mason has to do (the application of mortar over concrete to produce a suitable surface for tile or coping), the better. Plaster and tile delamination and bond failure can all be avoided if tight tolerances are kept with the shooting process, requiring less hand-applied mortar.

Tom Norman, ASA member and Chair of ASA's Pool & Recreational Shotcrete Committee, wants your input. Your comments, suggestions, and the topics you'd like to see covered are welcome. Perhaps you'd like to become a contributing author to Pool & Recreational Shotcrete Corner. Norman and the ASA staff encourage you to contact ASA with your questions and comments at: info@shotcrete.org.

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This is a straight, solid formwork and steel application of concrete being placed and is one of the items on the check list for proper placement



A residential pool prior to the shotcrete process. Pipes are capped and pressurized to ensure the system has no leaks

8. Equipment

Is the pump, compressor, and/or dry-mix feeder operating correctly? Who serviced the unit last and are all connections clean and working properly? Based on applications, compressors will need a certain cubic feet (meters) per minute of air velocity to properly compact the material. So much integrity is lost due to inadequate velocity and improper compaction. Additionally, feeder or pump malfunctions, which delay applications, will pose bond ability issues after a restart if the crew is not familiar with the saturated surface dry (SSD) condition, for example.

9. The Material Itself

Shotcrete is a process, not a product. The product is concrete, and a contractor must be sure that the mixture is what is properly proportioned to what is necessary to achieve the required strength and performance for the pool structure. Simply asking questions and checking the ticket upon delivery and verifying the cement ratios will help catch any mistakes. Know what is being delivered and be able to verify it.

Also, with regard to concrete trucks, the following questions must be asked. When were they batched? How long have they been in transit? What are the concrete temperatures, both inside and outside the mixture? Has water been added to compensate for heat? How long have the trucks been sitting, waiting to unload? Any and all of these variables play major roles in the chemistry of the concrete mixture. In my experience, it is more cost effective to send the truck back to the plant for a fresh load than to use a mixture that has been watered down—the pool contractor will avoid a plethora of issues, including failed structural performance.

Finally, if shooting dry mix, what is the moisture level of the sand/aggregate? Is it necessary to predampen? A smart contractor will have loading, site delivery, and mixing preplanned to eliminate any last minute changes.

One may notice that I did not mention shotcrete application techniques. This is because attention to the nine factors mentioned previously must precede the shotcrete process, if the application is to be successful. Careful attention to this mental checklist can serve a pool contractor well, allowing him or her to produce a quality installation, minimizing potential issues.



Bill Drakeley is a third generation watershaper and President of Drakeley Industries and Drakeley Swimming Pool Company in Connecticut. He is a Genesis 3 Platinum Member, an American Concrete Institute Certified Nozzleman, an ASA-Approved Shotcrete Educator, an ACI-Approved Shotcrete Examiner, and his company is a corporate member of ASA. Drakeley is an instructor for the Genesis 3 Construction School, with a focus on the shotcrete process. He has been a contributing writer for Shotcrete magazine's "Pool & Recreational Shotcrete Corner" and has had projects featured in *Luxury Pools* magazine, *Better Homes & Gardens*, and *Aqua* magazine. Drakeley Pools was the recipient of ASA's "Outstanding Pool & Spa Project" for 2005 through 2008.