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# Swimming Pool Renovation with Shotcrete

By Bill Drakeley

**T**he major renovation of a pool structure is never an easy undertaking. Determining the quality of the in-place concrete is an art in and of itself. Concrete quality, surface textures, finish coats, and polyvinyl chloride (PVC) and hydraulic considerations make renovating an existing pool quite challenging. The question of when and where to use proper concrete applications on the pool adds to the fact that pool renovation is not for the faint of heart. Now, admittedly, the pool industry propagates, breeds, and promotes self-proclaimed contractors who are experts without any expertise or quality experience for that matter. Countless times, we see concrete pool renovations where a “licensed” (I use this term lightly) contractor will place new concrete walls or sections to areas of an older pool where original concrete was removed. This replacement of material is set without proper substrate preparation, required bond characteristics, proper reinforcement placement, or an understanding of cold joints. A year or two later, the owner is left with a crack from debonding at the interface between the

existing and new material. This crack permeates through the pool plaster cementitious finish, often showing leaching or efflorescence, and the client becomes irate with the repair contractor after spending a good sum of money only to experience the same cracking issues they probably had before.

## UNDERSTANDING THE SHOTCRETE PROCESS

Understanding the use of shotcrete placement and its benefits will enhance the quality and durability of pool structural renovation. Even contractors who don't necessarily grasp the fine details of marrying two concrete installations together can benefit from using shotcrete placement and its inherent monolithic properties.

## THE CONNECTICUT PROJECT

Shotcrete was the only answer to a renovation proposition we received from a client in an affluent Connecticut neighborhood, bordering the State Capitol. The streets are



Fig. 1: Close-up of raised bond beam with supplemental reinforcing and roughened substrate

populated with historic homes featuring grand architecture and design that have stood the test of time. With a homestead steeped in history, our client's back yard featured a pool that was at one time considered a jewel in the neighborhood. The structure was an outdated kidney shape with a leaking tile line and structural cracking. The renovation approach with the homeowner was to review the condition of the pool; test the hydraulic lines; assess turnover and functionality of the water in transit to determine water, electrical, and fuel consumptions; and compare this to a new sustainable and energy-efficient watershape. We also proposed removal of all the finished masonry materials to examine the core concrete structure. The goal was to have the information and data necessary to make a recommendation to the owners regarding one simple question: "Is the pool concrete structure worth building and renovating or is it too deteriorated to put money into?" With the understanding that the renovation of an existing structure in aggregate can cost as much as six figures, the answer to this question was extremely important. Our company completed the analysis of the pool systems and found that the pool concrete was deteriorated, but almost 70% of the structure was intact. Our crews and staff determined that the hydraulics, filtration, lighting, and decking were not worth saving and were to be removed and replaced. With this information gathered, the conversation with the owner was straight forward and direct. In the end, it came down to two parts:

- Can this pool be revived to today's standards? and
- What is the cost difference between this total renovation and a new pool?

As an experienced pool contractor, one must anticipate these questions and have quality arguments for both.

## THE DECISION TO RENOVATE

As a conservationist myself, I was delighted to report that the freeform pool, originally constructed in the early 1960s with dry-mix shotcrete, could be renovated with wet-mix shotcrete. The owner agreed to this approach and we began the demolition and removal phase.

## DEMOLITION PHASE

The demolition phase started by pumping water out of the pool in preparation for sandblasting the entire shell. During the demolition, all materials were removed from the concrete walls, including the tile line. We core drilled the original main drains and removed all PVC and metal fittings, sumps, and suction lines. Subgrade soil was evaluated for suitability, and the concrete shell was hammer sounded to identify potential delaminations or near surface voids. We then chipped out and removed porous or deteriorated concrete, cleaned or replaced any significantly rusted reinforcing steel within the concrete shell, and removed the decking and substrate around the pool area.

## EXCAVATION PHASE

Once demolition was complete, we began the excavation phase. First, soils were removed from around the pool

shell for trenching and new piping. This also helped to expose areas with previously undetected deterioration on the exterior of the pool shell. The dewatering well for groundwater control that had been buried for some time was located. Drainage trenching was dug for the entire pool and deck area to help alleviate frost and soil movement. The clay/silty soils surrounding the pool were not conducive to drainage and posed an issue that would have put additional lateral pressure against the pool shell and walls during the winter.

The original project estimate included an average of 1 ft<sup>3</sup> (0.03 m<sup>3</sup>) of concrete removal in the pool bond beam. This was estimated due to the fact that the pool held water up to the bottom of the tile line. Interior concrete degradation followed this line around the perimeter. However, once exposed, the back of the pool walls (installed at an angle more than 11 degrees from vertical) was essentially deteriorating from the backside. The moist soils and more than 50 years of frost pressures had penetrated the back of the bond beam, exposed and corroded the No. 3 reinforcing steel, and deteriorated the concrete. This deterioration was shown to the owner and we explained that this was not expected based on our original findings. However, the majority of the shell was still a fit for renovation and we agreed to proceed with our current plan. We continued to chip and remove concrete on the backside of the pool shell, leaving a distance of 6 in. (150 mm) in thickness into the old bond beam and extending down to the walls between 2 and 4 ft (0.6 and 1.2 m).

For the pool hydraulic system, new fittings, skimmers, main drains, PVC piping, and an updated filter system were installed to improve hydraulic flow. We continued by leveling off the pool area, then setting grades and pitch. A new granite coping was installed directly to the new bond beam, and the surrounding area included matching granite decking sitting on the new sub-base and connected to the new pool coping. Drainage was installed for the decking, and new anchors for oversized shade umbrellas were set in the decking. Our tile installer then prepped the bond beam area,



Fig. 2: Kidney-shaped pool during restoration

steps, and bench; then installed a new 3/4 in. (19 mm) Italian glass tile in a custom blend.

Once existing concrete was exposed, we inserted steel pins and tied No. 4 bars to supplement reinforcing in the existing concrete. We also added new steps and deep end benches to help ease access for the client and their new grandchildren. Knowing the old pool elevations, we took advantage of the existing riser heights on the adjacent back porch steps and raised the depths and bond beam elevations of the pool which helped with concrete coverage and pool water depths. This added approximately 8 in. (200 mm) to the top of the pool walls.

The pool bond beam was roughened to create an excellent surface for the paste-rich, high-impact shotcrete materials to create an excellent bond. Once the reinforcing steel and substrate were prepped and the concrete in a saturated surface dry (SSD) condition, wet-mix shotcrete was placed. The concrete mixture design specification was 6000 psi (41 MPa) compressive strength at 28 days (refer to

ASA Position Statement #1 at [www.shotcrete.org/media/pdf/ASAPositionPaper\\_PoolRec\\_1.pdf](http://www.shotcrete.org/media/pdf/ASAPositionPaper_PoolRec_1.pdf)). The shotcrete delivery system used a 375 ft<sup>3</sup>/min (11 m<sup>3</sup>/min) compressor with 2 in. (50 mm) hoses and a 2 in. rubber nozzle tip. The distance to the receiving surface was 2 to 4 ft at most. The shooting process consisted of the pool's interior steps, step-out bench, bond beam, and the exterior walls, bringing the wall thickness to 12 to 14 in. (300 to 350 mm) as needed. Shotcrete placement facilitated a monolithic section, which was achieved with no bonding agents, expansion joints, and cold joints (refer to ASA Position Statement #5 at [www.shotcrete.org/media/pdf/ASAPositionPaper\\_PoolRec\\_5.pdf](http://www.shotcrete.org/media/pdf/ASAPositionPaper_PoolRec_5.pdf)). We took advantage of access to groundwater and wet cured the new concrete for 14 days by constantly pumping groundwater onto the new concrete surfaces.

## EXAMINING THE RESULTS

It was important for both us and the client to examine the results from the first winter freezing pressures against the pool shell. We removed the pool cover to inspect the connection and bond plane between the old pool concrete and the new shotcreted sections. The connection was intact and withstood all the pressures from the tough northeast winter weather. This was a key point not only of the pool shell's future durability, but also to highlight what we teach each year in industry classes and seminars. Watershape education needs to be precise and thorough, paying close attention to the details, and clients need to have confidence in their contractor. As a point person for our company, anything that I claim or promote to the client needs to be proven. This answers any questions and assures all parties involved that the investment was worth the time and money spent.

As our crews prep the concrete shell for future plaster and tile, we need to remain cognizant of the existing surfaces. Much like the existing concrete gets prepped for shotcrete placement, the existing concrete surface scheduled to receive plaster or tile needs to be significantly roughened for a good bond. Pressure washing, chemical cleaning,



Fig. 3: Interlocking three-dimensional bond plane between new shotcrete and existing shotcrete



Fig. 4: Installation of waterproofing coat



Fig. 5: Finished pool after renovation

and roughening of the existing substrate significantly increases the surface area and thus enhances the grab or bond of new hand-applied coatings. In this case, we will install a surface waterproofing agent to the entire shell as a redundant system. I am a huge proponent of not using these additives on top of high-quality concrete produced by the shotcrete process, particularly on new pools with surface texture consistency. Our current shell now has two different surface textures: the new wet-mix shotcrete with 3/8 in. (9 mm) aggregate, and the existing pool surface of dry-mix shotcrete with 1/4 in. (6 mm) aggregate. Applying a cementitious waterproofing membrane (like Basecrete) was done to bridge the textures and allow the final plaster coat to adhere and cure consistently over 100% of the pool interior. We are not using this technique for watertightness, but rather for aesthetics and plaster uniformity only.

## CONCLUSIONS

The pool will be plastered and started up in the coming weeks, and our clients will most likely be enjoying their new space at the time of publication. As it stands now, the pool lacks a seam between the two concrete installations and acts together monolithically, providing complete watertightness prior to any surface application (refer to ASA Position Statement #4 at [www.shotcrete.org/media/pdf/ASAPositionPaper\\_PoolRec\\_4.pdf](http://www.shotcrete.org/media/pdf/ASAPositionPaper_PoolRec_4.pdf)). Chronicling phases of implementation as they happen always seems to keep us on our feet, and hopefully does the same for those of you reading this. Stay tuned for the final result as we restore this pool's former title of neighborhood jewel.



**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, Shotcreting, from the pool industry. He is also an approved Examiner for the ACI Certified Nozzleman program on behalf of 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. Drakeley is a member of the ASA Pool & Recreational Shotcrete and Underground Committees.

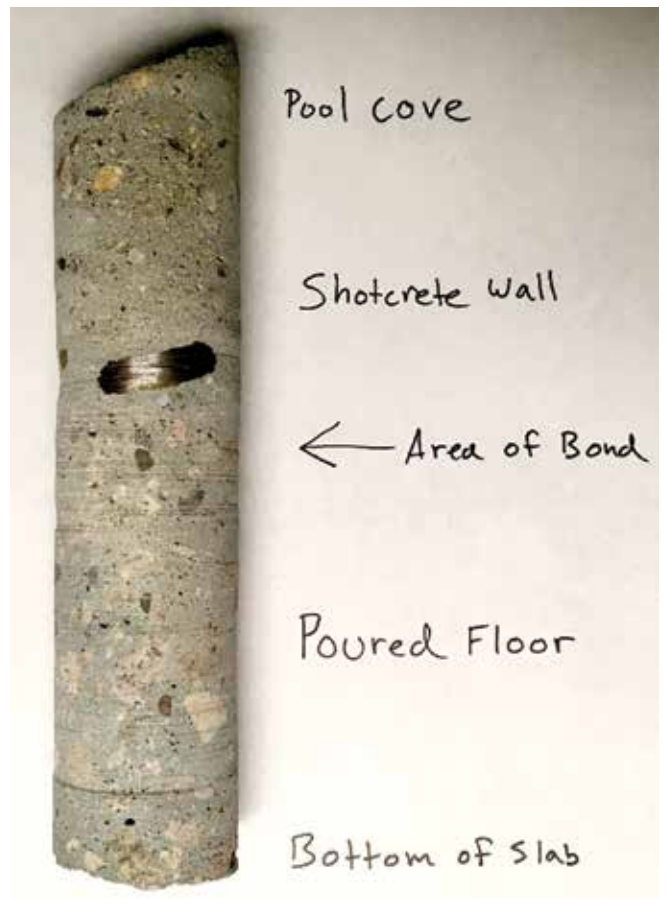


Fig. 6: Core demonstrating excellent bond of shotcrete to a poured floor