2017 Outstanding Pool & Recreational Project

Recreating a Masterpiece: A Successful Marriage of Cast-in-Place and Shotcrete

By Bill Drakeley and Kerri Allmer

DRAWING INSPIRATION

Frank Lloyd Wright continues to leave his mark on the world of architecture, design, and construction. This project, located in Bridgewater, CT, drew its inspiration directly from Wright's architectural masterpiece, Fallingwater, a house designed to rise above the waterfall over which it is built.

Wright's philosophy of organic architecture places strong emphasis on harmony between art and nature. Simply put, the architecture must seamlessly blend into the environment and use site-appropriate shapes and materials. This design principle does not mean that all structures must be freeform, per se; they can be linear and still be considered an organic fit if it complements its natural surroundings.

The client's home, a modernist approach to a multi-tiered, open-air glass and concrete installation, exemplified organic architecture and already bore striking similarities to Fallingwater (Fig. 1). Using this as the starting point, the design of the pool became a direct reflection of the existing straight-lined house and the surrounding landscape. The result was an upper two-sided vanishing edge swimming pool with vertical spillway drops into varying catch pools that meander along the hillside slope to the bottom of the structure 20 ft (6 m) below, reminiscent of the Fallingwater house perched atop its cascading waterfall.

Fig. 1: Home inspired by Frank Lloyd Wright's "Fallingwater" design

OVERCOMING DIFFICULT TOPOGRAPHY

The house was built into a ledge pocket, and the surrounding area was a very steep vertical slope comprised of boulders, rock, and organic peat. This mixture of materials coupled with sloped conditions would not support a pool structure, so we began with rock and ledge removal down to a workable substrate. Once excavation was complete, we brought in a soil scientist and engineer to ensure the pool structure would not need to contend with differential settlement.

Due to the topography and geological conditions of the site, it was necessary to use cast-in-place concrete for supporting walls and footings. However, the restricted work area and its elevated accessibility could not have been completed economically by any other means besides the proven shotcrete methodology. Therefore, we needed to apply concrete via the shotcrete process into and on top of a cast-in-place formed wall and foundation. Two different applications of concrete were successfully combined because the high-velocity impact of shotcrete on a hardened, existing concrete surface creates excellent bond and results in a monolithic structure, free of any cold joints (refer to ASA Pool Position Statement #5, "Monolithic Shotcrete for Swimming Pools (No Cold Joints)").

Our first step was to cast the supporting concrete foundational walls, footings, and locking mechanisms. We then installed additional connecting reinforcing bars from the concrete foundation that would penetrate up and into our shotcrete pool structures.

Once the connecting reinforcing bar was completed, we proceeded with forming and the remaining reinforcing bar installation. Unlike the cast concrete substructure, our forms were one-sided, rough-sawed lumber and 3/4 in. (19 mm) sheets of plywood. The entire pool installation was out of ground and required some intricate formwork. The steel reinforcement was Grade 60, No. 4 and No. 5 (No. 13M and No. 16M) bars, including 12 in. (300 mm) and 6 in.

Fig. 2: Although intricate forming was required for this out-of-ground pool construction, the use of sustainable shotcrete resulted in a material savings of 50% due to needing only one-sided forming

Fig. 3: Reinforcing bars, non-vibrating rigid forming, and a roughened SSD bond plane were installed to connect the cast concrete foundation and the shotcreted portions of the pool structures

(150 mm) spacings, all double cage. All reinforcing steel was rigidly installed and free of oil and contaminants that could affect performance.

The shotcrete method was also attractive to the client because of the sustainable attributes the process provides. Using shotcrete on this project, we provided a labor and material savings of approximately 50% over conventional formwork, as it did not need to be designed for internal liquid concrete pressures, and only required one-sided forming (Fig. 2). Additionally, the work was performed nearly 50% faster overall due to the reduced formwork. The cost savings with materials and man power is evident when compared with the formed foundation on this same job.

A SUCCESSFUL MARRIAGE

Two months after the cast-in-place foundational walls and footings were installed, we began the process of marrying the existing cast concrete with sprayed concrete. As explained in ASA Pool Position Statement #5, "the construction of a monolithic shotcrete pool shell is not constrained by time limits as long as proper techniques are observed from surface preparation to mixture design, to the shooting velocity of the concrete itself." This means that concrete can be applied via the shotcrete process to an existing concrete surface (cast or shot) at any point in the future, so long as the surface is prepared properly prior to installation (Fig. 3).

Over the course of 5 days, we completed the wet-mix shotcrete placement onto the pre-existing formed concrete and reinforcement of the four interconnecting swimming pools. The first few days were spent shooting the bulk of the main pool and some of the thicker wall-to-floor junctions. The final days were focused on the detail of the vanishing edge and all the spillway lower pools. Although the pool is not that large dimensionally, the attention to detail to meet the required tolerances was critical.

Using the shotcrete process for this project allowed us to achieve a successful structural installation and watertight

Fig. 4: Wet-mix shotcrete placement against an existing cast-in-place structure created a monolithic, watertight concrete vessel. The marriage of these two placement techniques was completed without bonding agents or expansion joints

connection between two different concrete placement methods, without bonding agents or expansion joints. Bondability and water-tightness were easily accomplished using the methods outlined in ASA Pool Position Statement #5. All next-day shooting and connecting joints were prepped to a saturated surface-dry (SSD) condition with a roughened bond plane. The high-velocity impact of the fresh cement paste of the shooting process penetrated and comingled with the prepared receiving substrate, which forms an excellent bond. This is why swimming pools built with properly prepared surfaces and proper placement techniques create a monolithic structural vessel with no cold joints.

Although the shotcrete took nearly a week to complete, there are no cold joints and all interconnecting pools are monolithic and watertight (Fig. 4). After the concrete installation, the pool was water-cured to ensure strength gain and water-tightness. Compressive strength tests after a 28-day wet cure were between 6000 and 7500 psi (41 and 52 MPa).

FINISHING TOUCHES

We continued following Wright's concept of organic architecture by selecting finish materials based on their harmony with the surrounding environment. Native stone veneer for the vertical spillway walls were chosen to match the existing house foundational stone colors. Roxbury Granite used for cladding on the pool's entrance steps and perimeter benches were sourced from local quarries. The colors found in the Pennsylvania Select Bluestone treads and Vermont slate tile are reminiscent of stone found throughout the area, while the IPE decking surrounding the pool reflects the wooded border of the property. A medium grey plaster finish creates a clear blue surface, mirroring the floor to ceiling windows of the house above. On an overcast day, the clouds are reflected in the pool, further interweaving the structure with its surrounding environment (Fig. 5).

This project's success is especially important to the pool industry, as it refutes the outdated conception that cast-in-place water-holding structures must have expansion joints and bonding agents to be watertight. It is also an effective

Fig. 5: Beautiful reflection of clouds

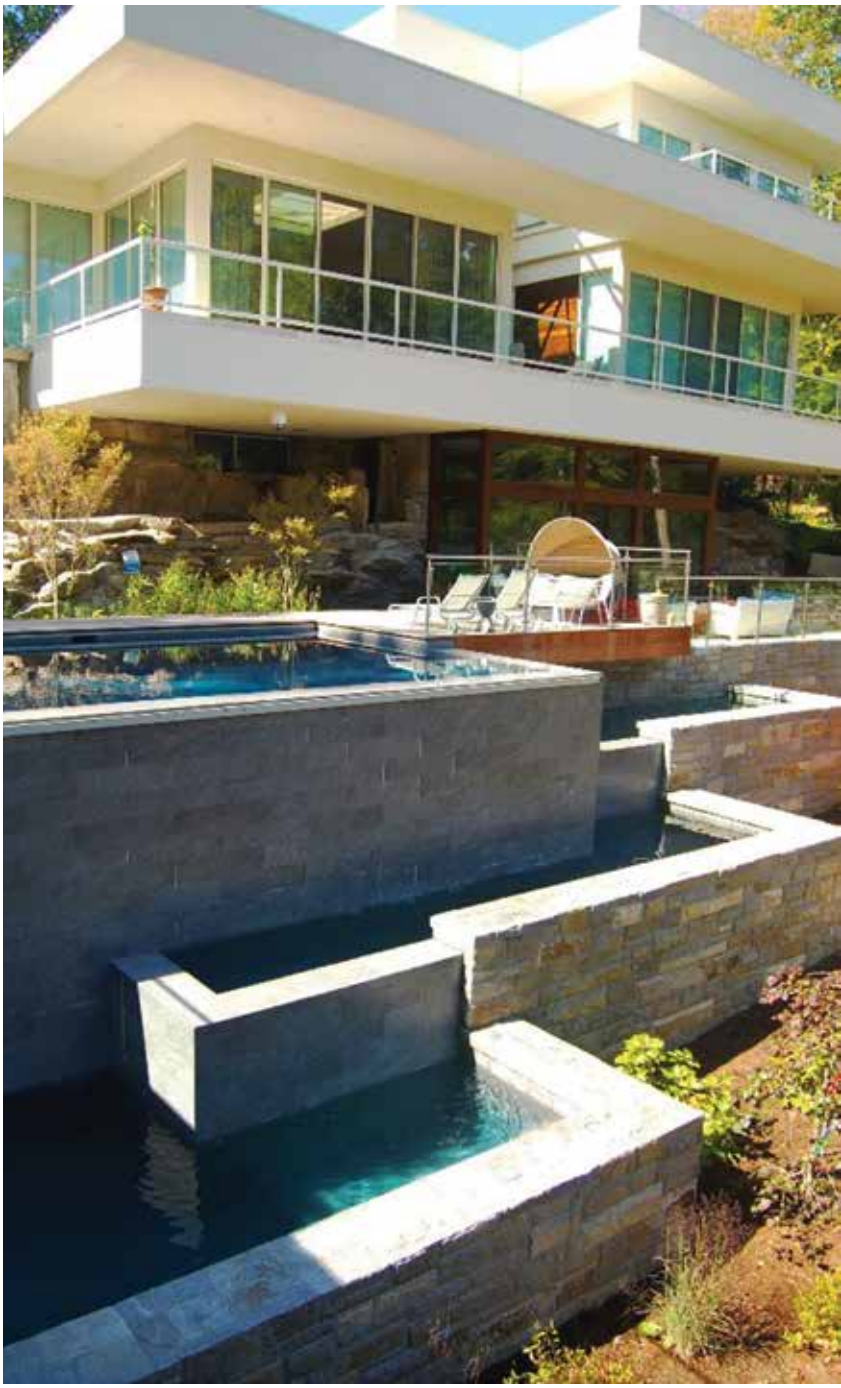

Fig. 6: The final product is a tip of the hat to Frank Lloyd Wright's "Fallingwater" and his philosophy of organic architecture: blending a structure into its surrounding environment

case study of ASA Pool Position Statement #5 by creating a monolithic concrete structure using two different concrete applications. This water feature is confirmation that the shotcrete process not only creates a watertight bond to other concrete surfaces, but can be used in conjunction with leading architecture and design that satisfies and recreates world-renowned architectural works (Fig. 6).

Editor's note: ASA Pool Position Statement #5, along with ASA's other freely available position statements, can be found at ***www.shotcrete.org/pages/products-services/shotcrete-resources.htm****.*

2017 OUTSTANDING POOL & RECREATIONAL PROJECT

Project Name
The Scheinberg Residence

Project Location
Bridgewater, CT

Shotcrete Contractor
Drakeley Pool Company

General Contractor
Tara Construction and Development

Architect/Engineer
Drakeley Industries,* Watershape Consulting

Material Supplier/Manufacturer
O&G Industries

Equipment Manufacturer
Putzmeister*

*Corporate Member of the American Shotcrete Association

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 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.*

Kerri Allmer *is the Office Manager of Drakeley Industries, a design and structural shotcrete consulting firm specializing in swimming pools, water tanks, tunneling, and other infrastructural shotcrete applications. She also serves as Office Manager of Drakeley Pool Company, a specialty watershape design, construction, and service firm in Bethlehem, CT. Allmer has developed and produced educational materials on pool shotcrete construction for multiple pool trade associations including NSPF/Genesis and NESPA. She has also partnered with Bill Drakeley on technical presentations given to the architectural and landscape architectural industries. Allmer received her bachelor's degree from Quinnipiac University, Hamden, CT, and her master's degree from West Virginia University, Morgantown, WV. She is currently a student of Genesis 3 University, pursuing membership in the Society of Watershape Designers.*