2023 Shotcrete Awards: Honorable Mention

Water's Edge

By Bill Drakeley

Fig. 1: Vanishing edge slot perimeter overflow with multiple edge elevations.

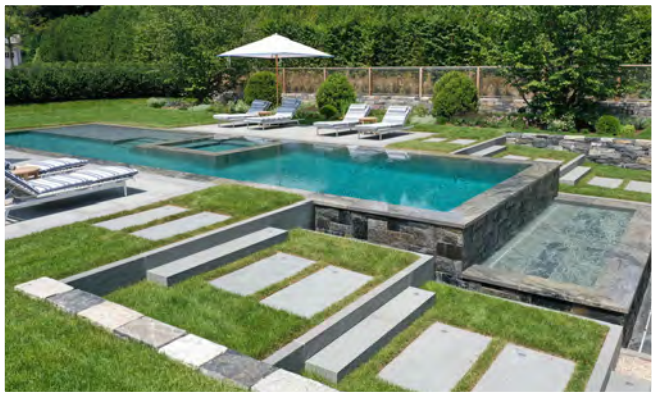

Fig. 2: Multiple edge/water-in-transit.

The Water's Edge pool project was a contracted water feature that drew its contemporary design from the architecture of the new house addition. The house is a modern version of the old coastal mansions once built and adorned by the Rockefellers, Morgans, and Vanderbilts. The house, with its surrounding architecture and landscape architecture, incorporates a contemporary, strict linear version of the old-world construction. The house and all its features, including the pool, blend into the modernist property connecting directly to the ocean. This pool is a reflection of the house. It's a 3-tiered pool, spa, and vanishing edge slot overflow with a Moses edge detail. All water spills over the edges into a shotcrete-constructed runnel system that leads to a lower shotcrete basin and surge tank.

CONSTRUCTION PHASING

Construction phasing started with forming and reinforcing bar installation. Unlike the cast concrete substructure, our forms were one-sided, rough-sawed lumber that was 2x4x1.5 in. (50x100x40 mm) thick as well as 3/4 in. (19 mm) sheets of plywood. The entire pool installation was out of ground, and some intricate forming was required. The steel reinforcement was Grade 60, #4 and #5 bars (Grade 420M, #13M and #16M), including 12 and 6 in. (300 and 150 mm) on centers, in double and triple cages. All reinforcing steel was installed with a high degree of rigidity and free of oil and contaminants that could affect performance. Total steel installed was 12 tons (11,000 kg).

SHOTCRETE PROCESS

The shotcrete process was completed over a three-day period. The first two days were for the bulk of the main pool shooting and some of the thicker wall to floor areas, which included full thickness bench shooting on seats, benches, and shelves. The last day was focused on the detail of the vanishing edge and all of the spillway lower pools.

Fig. 3: Rigid forming, plumbing, and reinforcing steel installation.

Fig. 4: Form removal—quality concrete example of the sprayed pneumatic wet shotcrete process.

Fig. 5: Water-in-transit changes in elevations and edge designs.

Fig. 6: Plan view of in-pool features and shapes within and on top of the pool structure.

The most challenging part of the shotcrete process was the installation of the Moses detail. The spa shotcrete common wall has a slot built into the shotcrete itself (see Figs. 1 and 6). With tight tolerances established by the shotcrete crews, the spa overflow stones are essentially equal with the stainless steel gutter system that surrounds the pool and is hidden on top of the shotcrete atmospheric perimeter gutter. This set up shows the water surface to be clean and without any part of the structure protruding up and above the clean glass looking pool surface. This architectural look was a high priority for the clients. Our shotcrete engineering had to devise a way to use this under-surface water spa independently from the pool, based on client's usage.

With surface elevations the same and automatic valving at the filter system, we installed a system where the client can hit a spa button and have the surface of the water evacuate through our Moses detailed shotcrete slot in the spa wall. This gives the visual effect of the water "parting" to allow for the spa and pool to "separate." Elapsed time to do this takes approximately 20 seconds. Having this feature flow through our watertight shotcrete channel allows the pool user to heat and circulate just the spa water, providing sustainable use of fuel for the pool heaters and sustainable power used by the pumps.

Even though the dimensions of the pool are not that large, the detail work of the tolerance was critical. After the concrete installation via wet-mix process, the concrete was water-cured to ensure not only strength gain but to also give a sense of watertightness. Compressive values after 28-day wet cure were between 6000 and 7500 psi (41 and 52 MPa).

Completion of the pool included the following finish materials:

- Native stone veneer matching existing house foundational colors
- Pennsylvania Select Bluestone treads and caps
- Italian marble stone
- Stainless (316L) steel slot perimeter overflow earth support
- Pool plaster, aggregate finish

SIGNIFICANCE OF SHOTCRETE

The significance of the shotcrete work, especially to the pool industry, is a successful installation and watertight connection of two connected water retaining structures. Using a hidden channel in the spa for the Moses effect—incorporating shotcrete's strengths for water retention, ability to connect, bond, and function as one monolithic structural vessel—pushes our existing norms to a new level. This water feature is proof positive that shotcrete placement not only creates a watertight bond to support vastly different surfaces, but it can be used in conjunction with leading architecture and design that satisfies and recreates world-renowned architectural works.

SHOTCRETE SEGMENT OF THE PROJECT

The shotcrete segment of this project was one week's worth of shotcrete on the pre-formed reinforcing steel caging for three interconnecting water-in-transit pools. Although the shotcrete took three days to complete, due to shotcrete placement's inherent properties, there were no cold joints, and all interconnecting pools were monolithic and watertight. There was no expansion joint or bonding agent used between concrete connections. All next day shooting and connecting joints were prepped to an SSD condition with a three-dimensional bond plane before shotcrete placement.

MIX DESIGN

- Cement (ASTM C150 Type I/II) – 750 lb (340 kg)
- Fly Ash (ASTM C618 Class C) – 50 lb (23 kg)
- Sand (ASTM C-33) SSD – 2020 lb (920 kg)
- ASTM No. 8 (3/8") – 600 lb (270 kg)
- Water – 358 lb (162 kg)
- Air Mix 250 (air entraining admixture) – 1.0 to 2.0 oz (28 to 57 g)
- Water reducing admixture – 2.0 oz
- Entrained air content before placement – 8%-10%
- Slump – 1 to 3 in. (25 to 75 mm)
- w/cm Ratio – 0.44

Total yardage: 165 yd^3 (126 m^3)

Equipment: Schwing BP500 Wet Mix Shotcrete Pump and Ingersoll Rand 375 Air Compressor

SUSTAINABLE BENEFITS REALIZED ON THE PROJECT RESULTING FROM SHOTCRETE

Sustainability benefits on this project were as follows:

- Approximately 50% labor and material savings over conventional form work.
- Our form work did not need to be designed for internal pressures and thus only needed one-sided forming.
- The speed of labor increased by almost 50% because of the reduced need for overall forms in relationship to reinforcement.
- The restricted work area and its elevated accessibility could not have been completed economically or timely by any other means besides the shotcrete process.
- The cost savings with materials and manpower is evident when placed in comparison with the formed foundation on this same job.

CONCLUSIONS

Building water features or swimming pools with multiple layers of water-in-transit edges and elevations requires quality shotcrete installations. Tight tolerances, material bond ability to a structure, and clean water flow at a minimum energy usage all rely on quality shotcrete. Durability and serviceability of a swimming pool is contingent on how well the structure was built. The top criteria of a well-built swimming pool is the quality of the shotcrete placement. Clearly, this water's edge placement of watertight concrete with wet-mix shotcrete is entirely reliant on not only the concrete materials but how that material was shot into place. This project was installed correctly.

2023 HONORABLE MENTION

Project
Water's Edge

Project Location
Greenwich, CT

Shotcrete Contractor
Drakeley Pool Company

Materials Supplier
O&G Industries

General Contractor
Drakeley Pool Company

Owner
Nordic Custom Builders

William "Bill" Drakeley *is an award-winning shotcrete technologist specializing in concrete science and construction, particularly shotcrete applications, techniques, and standards. He has thirty-plus years of experience in shotcrete installation, waterfeature and Geotech design, and construction. He is co-founder of Watershape University.*