

Brown University

By Mason Guarino and Robert Guarino

Brown University, a prominent Ivy League university located in Providence, RI, decided to add a new aquatics center with an Olympic-qualifying 164 ft (50 m) pool. Shawmut Design and Construction was awarded the general contracting contract and South Shore Gunitite Pools & Spas, Inc., was awarded the swimming pool contract. World-renowned swimming

pool consultant Counsilman ■ Hunsaker was the swimming pool designer of record.

This competition swimming pool was required to be built to NCAA and Olympic standards and was to be certified by the governing bodies for its competitive aspects. Certification means that the critical lengths of the swimming lanes fall within very tight tolerances—down to 1/16 (0.0625) of 1 in. (1.6 mm)—as required by the swimming sport organizations. The overall final dimensions of the pool were 183 ft (55.8 m) long x 75.1 ft (22.9 m) wide, ranging from 4 to 12.5 ft (1.22 to 3.84 m) deep and holding just less than 1,000,000 gal. (3,800,000 L) of water. The water is filtered at a staggering 3000 gal./minute (11,356.2 L/minute) through two state-of-the-art regenerative media filters powered by two 40 horsepower (30,000 watt) pumps.

The reason for the increase in size was to accommodate two movable bulkheads (Fig. 1). The movable bulkheads are 4 and 6 ft (1.22 and 1.82 m) fiberglass platforms that can move to change the desired length of the pool. On a positive note, after construction was complete, the pool was successfully fully certified.

The intended design of this pool was cast-in-place concrete. We were successful in converting the cast walls to shotcrete. This saved time and money on an already-taxing budget and schedule because we all know whether it is cast, shot with dry-mix, or shot with wet-mix, at the end of the



Fig. 1: Installed one of the two bulkheads that go in the pool



Fig. 2: Pool floor after the floor was cast but before shotcrete placement



Fig. 3: Completed cast floor and shotcrete walls

day, 4000 psi (28 MPa) concrete is still 4000 psi (28 MPa) concrete.

In reviewing methods of construction of the pool due to the sheer size of the pool and the fact that it was designed to adhere to the ACI 350 Code for liquid-containing concrete structures, it required approximately 900 yd³ (690 m³) of concrete and 52 tons (47 metric tons) of reinforcing bar. The final decision on the construction method was to cast the floor and shotcrete the walls (Fig. 2 and 3). This combined the best of both techniques. Casting the floor is far more cost-effective than shooting the floor. Then, using either wet- or dry-mix shotcrete and single-sided formwork was a real money-saver.

In addition to the use of single-sided forms, we had several other money- and time-savings aspects. We decided to thin-set the tile interior rather than use a 0.75 in. (19 mm) mud base. We also had a very elaborate surface-skimming system that, if cast, would have required extensive formwork, cold joints, and a lot of waterstops. Using shotcrete, we needed only one waterstop between the walls and the floor. The 400 yd³ (305 m³) floor casting took 15 men about 10 hours to place and finish. We then wet-cured the floor for 7 days before starting to shoot the walls (Fig. 4). Another great thing about casting the floor is that it allowed us to erect our OSHA-compliant staging on the floor, making movement much easier.

The walls provided some challenges. We had planned on taking about 8 days to shoot the walls because when we build large pools, we usually use two shotcreting crews. Due to site constraints, we could only use one crew and had to shoot from 250 to 350 ft (76 to 106 m) away from the actual placement location. This cut our production down to about 50 yd³ (38 m³) per day.

The equipment used was an Ingersoll Rand 825 compressor, an Airplaco model C-10 gun, a Cemen Tech batching plant (trailer-mounted), a John Deere 555 loader (to load sand), and a Right Way portable silo. We used the Cemen Tech batching plant that mixes materials for both wet- and dry-mix shotcrete on larger commercial jobs. Because the Cemen Tech unit is self-contained, small, and portable, we can set it up and shoot all day without stopping. This saves a lot of money because you use less fuel and it allows you to shoot 12 to 15 yd³ (9.2 to 11.5 m³) more per day by not having to back concrete trucks in and out. The Cemen Tech is more affordable for these types of jobs because you don't need a \$100,000 concrete truck idling on site while you shoot. We find that one man can run the Cemen Tech unit, load sand and cement, and keep the gun running properly all day long (Fig. 5).



Fig. 4: Shotcrete in progress. This pool required significant formwork, as 85% of the pool was 9 ft (3 m) deep or deeper



Fig. 5: The shotcrete mixture was made on site using a portable cement silo and a volumetric batch plant. This saved on material costs, allowed us to control our mixture and material delivery, and eliminated concerns regarding possible breakdowns with a concrete truck. Also shown is the truck-mounted 825 CFM air compressor

Our crew consisted of two ACI Certified Nozzlemen—one shooting and one operating the blowpipe—three finishers, one skid steer operator, and three laborers. Our silent crew member was Chris Zynda, whom we met through ASA (yes, membership does have its privileges). Chris helped us determine the best method to marry the poured floor to the shot walls. The decision was made to depress the exterior of the pool perimeter 3 in. (76 mm) deep within 6 ft (1.8 m) of the



Fig. 6: Pool completed and in use for a water polo competition. South Shore Gunite also installed the 11 x 24 ft (3.4 x 7.3 m) video screen

exterior edge. This allowed for an area for the shotcrete to be finished into so that it did not need to be finished to a feathered edge. No bonding agent was used when shooting onto the previously cast concrete. However, we did power-wash the surface very thoroughly to remove any laitance and made sure the surface was saturated surface-dry prior to the application of the shotcrete. The concrete floor surface where shotcrete would be placed was left very rough in the finishing process to help increase the bond. A waterstop was also used in the floor/wall joint as inexpensive backup to properly bonded shotcrete.

The Brown University pool was opened as scheduled with the pool events starting immediately (Fig. 6). One of the toughest parts about the commercial pool industry is keeping the general contractor on schedule throughout the entirety of the job. The pool contractor is often on site from the beginning of the project to the end. This allows the general contractor to easily push off pool items that are not as important at the beginning of the project. If we allowed that to happen, we would end up being the ones scrambling at the end of the project to get our work done on time. Often, with paying customers, swimming pool activity schedules are created months before the pool is actually complete. If the pool is not done on schedule, the facility could potentially lose thousands of dollars per week and may trigger substantial liquidated

damage charges to the contractor. Through planning and project management, projects can be finished on time and even weeks early.



Mason Guarino started in the pool industry when he was 14, learning how to install reinforcing bar. Since then, he has worked on all phases of the swimming pool industry. Guarino has been with South Shore Gunite Pools & Spas, Inc., full-time since graduating from the Wentworth Institute of Technology with his BS in construction management in 2009. Guarino is an active member of ASA and an ACI Certified Nozzlemaster.



Robert Guarino has been in the pool industry for over 30 years, more than 20 of which he has served as the President/Owner of South Shore Gunite Pool & Spa, Inc., with strongholds in both the residential and commercial sectors. He is an ACI Certified Nozzlemaster and a member of the National Plasterers Council, the Better Business Bureau, and ASA.

Author's note: This article is dedicated to longtime employee—and even longer-time shotcreter—Tony Zeleneski. Tony and I were the first ACI Certified Nozzlemasters in Streetsboro, OH.
—Robert Guarino