

Sustainability of Shotcrete in the Pool Industry

Quality pool construction allows no compromise on the quality of materials or installation procedures. Fortunately, quality pool design and construction can also enhance the sustainability of both the installation and the finished product. The American Shotcrete Association (ASA) is attentive to the global need to promote green practices in all areas of shotcrete application. The pool industry has a great opportunity to provide enhanced sustainability through use of shotcrete construction.

The United States Green Concrete Council (USGCC) highlighted the “Top Ten” sustainability benefits inherent with shotcrete in its publication *The Sustainable Concrete Guide—Applications*. The ASA Pool and Recreational Shotcrete Committee confirms that eight of the 10 sustainability benefits directly apply to the creation of quality pool structures with shotcrete. The applicable sustainability benefits are:

1. Formwork savings of 50 to 100% over conventional cast-in-place construction.
2. Formwork does not have to be designed for internal pressures.
3. Complex shapes require very little—if any—formwork.



Fig. 1: Lightweight, one-sided form is all that's needed when using shotcrete

4. Labor savings of at least 50% in repair applications.
5. New construction speed savings of 33 to 50%.
6. Better bonding to the substrate enhances durability.
7. Adaptability to repair surfaces that are not cost-effective with other processes.
8. Ability to access restricted space and difficult-to-reach areas, including overhead and underground.

Formwork savings of 50 to 100% over conventional cast-in-place construction

Pool shotcrete placement uses earth forms, wood, or any other immovable type of substrate to create the basic pool shape. Because shotcrete is placed at a 90-degree angle within 2 to 6 ft (0.6 to 1.8 m) of the receiving surface, it requires an open-faced or one-sided form system. Shotcrete is self-supporting in its plastic state and thus only requires one-sided forms to provide shape. This 50% reduction in materials, when compared to double-sided needed by cast concrete, provides substantial cost reduction in the overall pool construction (refer to Fig. 1 and 2).



Fig. 2: Pool shell is in place. Ready for the pool deck

Formwork does not have to be designed for internal pressures

As mentioned previously, fresh shotcrete is self-supporting and does not flow like cast-in-place concrete. Thus, the shotcrete process has little to no lateral pressure on the form from fluid pressure. This is true regardless of shooting a pool wall, spa, bench, or radius connection between the floor and vertical wall. The only pressure on the exterior form during the shooting process is the momentary impact pressure from the shotcrete placed at high velocity by air volume.

Complex shapes require very little—if any—formwork

The pool industry—particularly, when using the shotcrete process—epitomizes this statement. Free-form shapes, vanishing-edge perimeters, raised spa elevations, skateboard parks, and any monolithic nonplanar concrete structure envisioned by the designer eliminates the need for complex forming through using shotcrete (refer to Fig. 3 and 4).

Labor savings of at least 50% in repair applications

Typically, while repairing an older pool with deteriorated or spalled concrete, the poor material is removed to expose a reusable, hard, quality concrete surface where renovation materials can be placed (otherwise, the whole pool is removed).



Fig. 3: Overview of a pool with extensive curves typifying shotcrete's flexibility

In this type of renovation, the expediency and rapidity of placing the repair material through the shotcrete process is much more cost-effective than forming and pouring a cast-in-place repair. Using shotcrete, there are labor savings in eliminating form placement and stripping, the need for a bonding agent, and placing and consolidating cast concrete.

New construction speed savings of 33 to 50%

The overall time of installation and implicit costs associated with the speed of installing a concrete pool shell using the shotcrete process versus using cast-in-place methods is significant. Quite simply, it takes 33 to 50% less time to build the same size pool structure with shotcrete compared to cast-in-place methods. Excavation, forming, reinforcing steel work, and concrete placement need less time to complete because of the one-sided forming aspect and use of the surrounding earth as part of the support structure, as well as requiring less labor force to complete each phase.

Better bonding to the substrate enhances durability

Concrete placement through the shotcrete process is the ideal way to place concrete, and when done properly, will yield high concrete strengths. Not only is the high-strength shotcrete durable but it is also watertight with good impact resistance, which enables it to withstand accidental loadings that could



Fig. 4: Using shotcrete makes curved concrete pool surfaces easy

compromise the structure. Shotcrete inherently has superior bonding of the concrete to a properly prepared substrate. The high velocity at which the material is placed ensures that the open pores or crevices of the receiving substrate will have cement paste driven into and covering the surface area. Additionally, shotcrete's impact velocity on the receiving surface acts as a natural surface roughener that further enhances bond. Combined, these effects ensure proper bond and makes shotcrete the ideal method for ensuring long-lasting concrete that will require minimum repair and/or replacement.

Adaptability to repair surfaces that are not cost-effective with other processes

In pool repairs, the adaptability benefits of shotcrete are a result of the simple fact that one does not require significant forming. Shotcrete is bondable to every masonry material used in the pool industry and can be shaped in any free-form style used for water flow.

Ability to access restricted space and difficult-to-reach areas, including overhead and underground

Again, as mentioned previously, shotcrete can be placed more easily in a pool environment than can cast-in-place concrete. By using the shotcrete pumping system with its flexible hose connections in either the dry or wet process, one can get the nozzle at the right distance in any area of the project (for example, deep diving wells, raised waterfalls, and perimeter overflows). This reduces costs of conveying the material on-site, labor, and placement because of the flexibility of the shotcrete hose, leading to less waste and more efficient installation.

In conclusion, the shotcrete process, when implemented correctly for swimming pool or recreational construction, is inherently sustainable. In particular, the sustainability of the shotcrete process and the portion of the pool industry that uses it for pool installation is drawn from three main factors: 1) one-sided forming and the direct savings in material and labor costs; 2) the overall strength, enhanced durability, and superior bond of the final shotcrete pool sections that will require fewer, if any, repairs and have a longer life; and 3) the flexibility of shotcrete as the optimal process for repair and renovations of existing structures. Overall, shotcrete in the pool industry uses less energy, less money, and less material while providing placement of better-quality concrete.