

IN-LB

Inch-Pound Units

SI

International System of Units

Shotcrete Use in Pool Construction—Guide

Reported by ACI Committee 506

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Shotcrete Use in Pool Construction—Guide

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Shotcrete Use in Pool Construction—Guide

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This document is intended for use by owners and pool builders. It does not include specific design requirements. It does include recommendations for aspects of planning, design, and construction that are needed for quality shotcrete placement, with the goal of producing pools that have the long-term durability and serviceability owners should expect. With proper design, material selection, and construction, a shotcreted concrete pool should have a service life of 50 to 100 years or more.

Keywords: concrete pools; dry-mix; durability; service life; shotcrete; wet-mix.

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This document is intended for use by owners and pool builders. It does not include specific design requirements. It does include recommendations for aspects of planning, design, and construction that are needed for quality shotcrete placement, with the goal of producing pools that have the long-term durability and serviceability owners should expect. With proper design, material selection, and construction, a shotcreted concrete pool should have a service life of 50 to 100 years or more.

Although pool design is not directly addressed, **ACI PRC-506**, with guidance on shotcrete placement, and **ACI CODE-350**, with requirements for design of concrete liquid-containing structure, can be used in the design of watertight, durable concrete pool shells. ACI has also estab-

lished a committee, ACI Committee 322, to develop and maintain a code to address concrete pools and watershapes.

Both wet-mix and dry-mix shotcrete are methods of pneumatically placing concrete, generally including some type of steel reinforcement. Shotcrete placement is ideally suited for support and construction of concrete swimming pool installations. The pneumatic projection of shotcrete onto a surface at high velocity while fully encasing embedded reinforcement provides specific performance and durability to a swimming pool vessel. The characteristics of the shotcrete process provide specific quality enhancement to compressive strength, bondability, long-term durability, toughness, and serviceability.

Form-and-pour methodology does still play a role in swimming pool construction, though typically only on larger or commercial applications. Shotcrete placement in water vessel construction has key advantages over a formed-and-poured swimming pool. The shotcrete placement inherently produces monolithic concrete sections without the presence of cold joints. Forming, complex shapes, and time constraints for installation are aspects that prove why concrete pool construction is essentially limitless with the shotcrete process. Formed-and-poured vessels require more laborious forming and require careful attention to cold joints.

Shotcrete swimming pool construction is unique and very demanding. With infinite shapes, curves, and features above and below pool water elevation levels, an installation crew is tasked with fully encapsulating all the embedded reinforcement, polyvinyl chloride (PVC) piping, and fixture penetrations during shotcrete placement. Workers walk over and negotiate slope elevation changes on top of the installed steel reinforcing bars while carrying the material hose in the process. The degree of care and attention needed cannot be overstated during the shooting process.

Technology within the shotcrete pool industry has kept pace with other shotcrete applications. Tunneling, mining, soil support, and infrastructure all use the same basic shotcrete principles, materials, and equipment as the pool industry. Oversight, inspections, and quality control are, however, not often encountered with pool building in the residential market. Specifiers, engineers, and contractors have, for years, questioned the use of shotcrete due to poor workmanship by unknowledgeable shotcrete contractors, resulting in lower quality and durability.

Modern pools and watershapes have become very sophisticated concrete structures. For example, pools may have vanishing edges, water transiting over varying wall elevations, dam walls, connecting spas, and pool overflows (Fig. 1.1). These sophisticated watershapes require experienced design professionals to create designs that are practical to build, structurally sound, and provide long-term durability. Owners should take care to select a design and construction team that has proven experience in complicated pools and watershapes.

Currently, shotcrete education provided by shotcrete-oriented associations such as the American Shotcrete Association (ASA) and pool-specific groups dedicated to improving pool quality and durability using shotcrete



Fig. 1.1—Curved pool with close-tolerance high water level. No straight or flat sections.

has led to significant improvements to the swimming pool sprayed product. The pool industry's task ahead is to continuously improve and expand the education of shotcrete field personnel and contractors with the goal of improving the quality of shotcrete placement in the pool industry.

CHAPTER 2—DEFINITIONS

Please refer to the latest version of ACI Concrete Terminology for a comprehensive list of definitions. Definitions provided herein complement that resource.

delivery equipment—equipment that introduces shotcrete material into the delivery hose.

finisher—craftsperson who trims and finishes the surface of the shotcrete.

impact velocity—velocity of the material particles just before impact.

mockup—full-size structural or architectural model built to scale for evaluation.

nozzle body—device at the end of the delivery hose that has a regulating valve and contains a manifold (water or air ring) to introduce water or air into the shotcrete mixture; a nozzle tip is attached to the exit end of the nozzle body.

pneumatic feed—shotcrete delivery equipment in which material is conveyed by a pressurized air stream.

positive displacement—wet-mix shotcrete delivery equipment in which a pump or other nonpneumatic means pumps the material through the delivery hose in a solid mass.

predampening—in the dry-mix shotcrete process, the controlled addition of water to the aggregates or premixed shotcrete materials during batching to adjust the moisture content of the shotcrete mixture before introduction into the gun.

pump operator—wet-mix shotcreting crew member who operates delivery equipment.

rodman—shotcrete crew member who trims and finishes shotcrete using a rod or other tools.

rolling—result of applying shotcrete at angles less than 90 degrees to the receiving surface, resulting in an uneven, wavy, textured surface at the outer edge of the spray pattern.

sand lens—sand pocket shaped as a lens.

shadow—area behind an obstacle that is not directly impacted and compacted by the shotcrete stream; in hardened shotcrete, refers to any porous area behind an obstacle such as reinforcement.

wetting—in the dry-mix shotcrete process, the addition of mixing water to shotcrete materials just before the material exits the nozzle.

CHAPTER 3—CONTRACTS AND SUBMITTALS

The contract submittal process is an extremely important aspect of the contracting practice. Complete and comprehensive submittals are essential when it comes to demonstrating the contractor's understanding, commitment, and capability to meet project quality assurance (QA) and quality control (QC) requirements. Typically, submittals are required to confirm that specific shotcrete materials, equipment, methods, processes, practices, and personnel have the potential to meet specified project requirements. The nature and type of submittals should be commensurate with the size and complexity of the swimming pool project.

ACI SPEC-506.2 is a valuable reference document for the owner, general contractor, and shotcrete contractor on a shotcrete pool project. If the owner or the general contractor requires special exceptions to the ACI SPEC-506.2 specification, they should delineate these in the project contract.