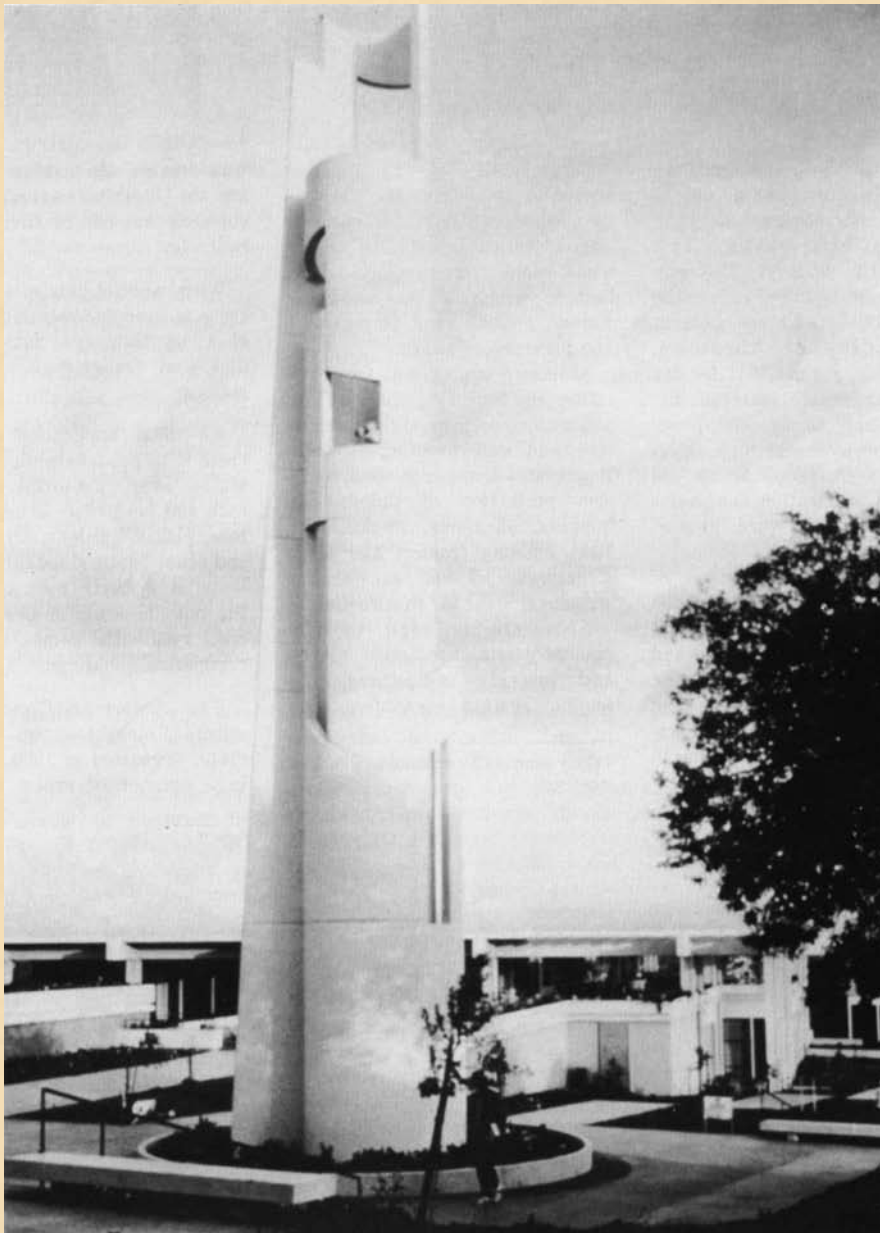


Introduction: Application and Use of Shotcrete

by Theodore R. Crom

The following article was reproduced from the January 1981 issue of Concrete International with permission from the American Concrete Institute. The author, Theodore R. Crom, was Chair of ACI Committee 506, Shotcreting, at that time. Crom was a contractor specializing in the construction of prestressed concrete water storage tanks. Crom is recognized as one of the "Shotcrete Greats" (see the President's Message) and was well-known for his definitive writing on dry-mix shotcrete nozzling techniques, still used as the basis for training today.



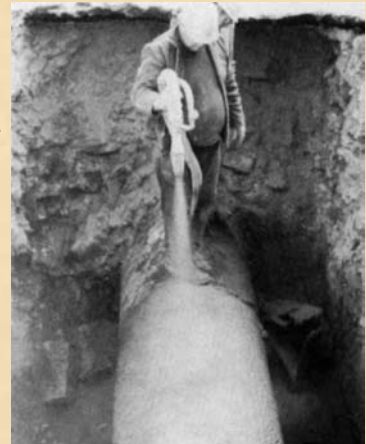
This memorial tower is an outstanding example of the use of shotcrete as a structural and architectural material

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A skatepark constructed by using shotcrete

Another wide-spread use of shotcrete is for the protection of pipe from corrosion. It is also often used to coat the interior joints of mortar-lined pipe



SHOTCRETE, by the American Concrete Institute definition, is mortar or concrete pneumatically projected at high velocity onto a surface (ACI 506.2-77). The still common term “gunite” is a trade name established by the Cement Gun Company of Allentown, Pennsylvania, around 1911 for dry mix fine aggregate material, hydrated at the nozzle, and pneumatically projected at high velocity onto a surface. Many old established application companies still incorporate the word “gunite” in their names.

In recent years, a number of manufacturers have developed widely different types of equipment for spraying both wet and dry mix shotcrete. Some of the equipment is capable of handling a mix incorporating coarse aggregate up to about $\frac{3}{4}$ in. (19 mm) in size.

Today both wet and dry mix shotcrete are extensively used in new construction for curved or folded section roofs, shell roofs, walls, canal, reservoir, and tunnel linings, swimming pools and other water containment structures, and prestressed tanks.

Shotcrete is excellent for restoration and repair of concrete, repairing fire damage and deterioration, and waterproofing of walls. It provides long-term steel corrosion protection of piling, coal bunkers, oil tanks, smokestacks, steel building frames, and other structures, as well as encasing structural steel for fireproofing.

Shotcrete is used to permanently stabilize rock slopes, and provide temporary protection against excavation side-wall erosion, air slaking or raveling of freshly excavated rock

surfaces that will be covered with concrete.

With special materials, shotcrete is used for refractory lining of kilns, chimneys, furnaces, ladles, and similar high-heat applications.

An ideal application of shotcrete is to produce sculptures and statues over wire forms, imitation rock and landscape formations for zoos, plazas, gardens, arboretums, and other “natural looking” formations. It is being used in coating the outside walls of precast concrete residential homes as well as commercial buildings.

The American Concrete Institute Committee 506 on Shotcrete, organized in 1960, is active in a number of areas. The first publication of the committee was a “Recommended Practice for Shotcreting” (ACI 506-66), which



Shotcreting fascia beam; area to right is overshot



Because of the high compaction density achieved by air placement, finishing operations can start immediately

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is still current. An expanded and updated version of the Recommended Practice is now being drafted.

"Specifications for Materials Proportioning and Application by Shotcrete" (ACI 506.2-77) was prepared by the committee for the use by architects and engineers as a reference in their work.

Committee 506 is also developing a program for certification of nozzlemen. The preliminary draft suggests that any firm can establish their own certification program for in-house use. For more credibility or recognition, a local testing laboratory or independent agency could conduct the examinations recommended and issue the certification. Such nozzleman certification, once the procedure is established, might be required by the job specifications. It is conceivable that eventually there may be a national certification by an independent agency such as the ACI.

Another activity of Committee 506 is preparing a State-of-the-Art paper on underground shotcrete. Preliminary drafts are completed.

ACI Committee 506 is also preparing a bibliography of shotcrete publications.

Other ACI publications currently available on shotcrete include: SP-14, *Shotcreting*, a collection of papers prepared from an ACI Symposium in 1955 and much of the information contained in SP-14 is still current, SP-14A, *Engineering Properties of Shotcrete*; SP-45, *Use of Shotcrete for Underground Structural Support*, a collection of 39 papers presented at an Engineering Foundation Conference in 1973; SP-54, *Shotcrete for Ground Support*, containing 43 papers presented at a similar conference in 1976; and SP-65, *Performance of Concrete in Marine Environment*, containing 2 papers, "Shotcrete Repairs of Concrete Structures in Marine Environment," and "Deterioration and Repairs of Navigation Lock



Shotcrete is often placed from a boom bucket as well as from grade level

Concrete." (The synopses of these two papers are published in this issue.)

The following articles in this Special Issue of *Concrete International* are intended to supplement the above publications by describing recent shotcrete developments in the areas of: shotcrete durability; environmental considerations; refractory shotcrete state-of-the-art; evaluation and state-of-the-art of steel fibrous shotcrete; accelerated shotcrete; current tunnel lining experiences; proper nozzling; and a comparison of the German shotcrete standard.

Materials for these articles were presented at a Symposium on the Application and Use of Shotcrete, ACI Fall Convention, November 1979, Washington, D.C.

In that ACI Committee 506 has now been a committee for almost 20 years and shotcrete is still developing, improving, and changing, it might be reasonable to assume that the committee will be serving the industry for years to

come. I hope the following articles will be informative and useful to our readers.



Shotcrete being applied over existing wood piling that had considerable erosion damage. By use of mesh-reinforced shotcrete, the pier was salvaged and is back in use

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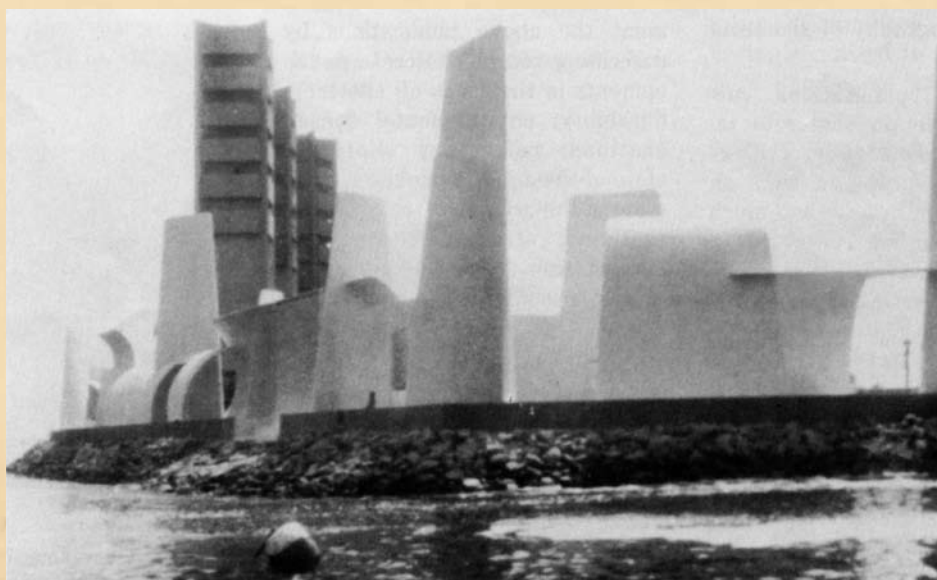
Wetting down an area prior to shotcreting



Shotcrete expansion dam became loose, had to be rewelded



Water-jetting equipment from a fountain is being encased in air-placed concrete. The nozzleman is directing the stream around this equipment to ensure proper imbedment



Another unusual use of shotcrete as a material. This photo shows free-form shapes that hide gas and oil drilling platforms constructed on man-made islands in Long Beach, CA, harbor. Some of these structures are over 120 ft high