

# Shotcrete

A quarterly publication of the  
American Shotcrete Association

## MAGAZINE

Volume 11, Number 4 ♦ Fall 2009

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# Shotcrete

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*On the cover:*

*A perspective view of the Cocoa Beach Skatepark in Florida.  
Photo courtesy of Team Pain Enterprises Inc.*



*Shotcrete—A Proven Process for the New Millennium*



## Structural Shotcrete Nozzleman— Assessing Qualification for a Project

By Chris Zynda



The use of shotcrete continues to grow in both the volume of the material and the variety of applications in which it is used. In addition to swimming pools, tunnels, and mines, shotcrete is being used with increasing frequency in structural walls, parking garages, environmental structures, retaining walls, refractory, and architectural projects. Critical to all applications of shotcrete is the knowledge and skill level of the nozzlemen placing the shotcrete. In assessing nozzleman competency, a two-step qualification process has evolved.

The first step is to ascertain a nozzleman's basic knowledge and ability. The ACI Shotcrete Nozzleman Certification has become the industry-recognized credential for identifying individuals who possess the basic knowledge and skill level needed to apply shotcrete.

ASA is the industry's primary administrator of the ACI Shotcrete Nozzleman Certification Program. ASA's exceptional team of approved educators and ACI examiners offers the shotcrete industry the premier program for training and certification testing. (More details on ASA's programs can be found at [www.shotcrete.org/ASAcertification.htm](http://www.shotcrete.org/ASAcertification.htm).)

Shotcrete is increasingly being used as the means and method of installing concrete in projects with complex reinforcement requirements such as parking garages, structural shear walls, large water tanks, and retaining walls. The reinforcement for

many of these projects is more complex than the current ACI Certification field test panels (refer to Fig. 1 and 2).

Figures 3 and 4 illustrate how congested reinforcement can become. Properly placing shotcrete in such heavily congested reinforcement (not recommended for the faint of heart or a nozzleman with minimal experience) requires a qualified nozzleman and an experienced shotcrete/concrete contractor.

Job specifications for these heavily congested projects should require shotcrete nozzlemen to possess current ACI certification. In addition, the specification should also require these nozzlemen to shoot test panels that simulate project conditions (Fig. 5). This second step can be used to determine if the nozzleman's skills



*Fig. 1: The ACI vertical test panel contains a single mat of reinforcing spaced with noncontact lap splices at 3.5 in. (89 mm) thickness*



*Fig. 2: The ACI overhead test panel is the same configuration. Both panels are designed with minor reinforcing bar and a minimum thickness*



*Fig. 3: Example of heavily congested reinforcement*



# ASA President's Message



Fig. 4: Example of heavily congested reinforcement

have reached a level appropriate for the specific project and becomes more critical as the complexity of the project increases.

As more and more segments of the concrete industry realize the benefits of shotcrete, the amount of shotcrete specified continues to grow along with placement complexity and difficulty. For this growth to continue, we must make sure that



Fig. 5: Example of a completed job-specific test panel. Drilled cores have been removed to evaluate encapsulation of reinforcing bar

one of the most important parts of the shotcrete equation, the nozzleman, is properly qualified for every job. Whether you are a contractor or project owner, it is critical that you embrace and employ this two-step process for assessing nozzleman qualifications before the shotcrete is applied.

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## The Green Wave It's Coming, Are You Ready?

By Chris Darnell, ASA Executive Director



Regardless of where you stand on environmental issues and whether or not current science supports or refutes many environmental claims and alarms, a potentially harsh wake-up call is coming.

The current political and social environment is resulting in significant changes that are and will significantly impact the shotcrete industry. The green/environmental or sustainability movement has grown to a point that it is now a leading force in shaping governmental policy. The U.S. government is embracing policies that will impact our industry's ability to conduct business.

These changing policies—and perhaps more importantly, public opinion—are coming about without a unified representation by the concrete industry of the facts regarding the most widely used building material in the world.

Much of our membership and industry could be blindsided by the changes that are taking place. These changes will impact items such as operating costs, safety requirements, and the ability to win or even submit a project bid.

### There Is Hope

With any big challenge also comes the opportunity not only to meet the challenge but also to leverage it for growth. This opportunity can only be realized if strong leadership is in place. Fortunately for all of us involved in the shotcrete world, ASA's Officers and Board members are individuals who are shotcrete experts, strong leaders with a vision, and people of action. The more I am involved with people in the shotcrete world, the more apparent it is that this is an industry of action. Shotcrete requires hard work so it should be no surprise that ASA's leaders have that same trait, as evidenced by their efforts to address unfair criticisms of concrete/shotcrete and promote the shotcrete process in the sustainability debate.

### ASA Action

In August, the ASA Board voted to become a full partner in the Joint Sustainability Initiative (JSI), the concrete industry's effort to present a unified industry approach and promote concrete and its sustainability benefits. This was accomplished after the Board's careful review led to signing a Memorandum of Understanding (MOU) with dozens of other concrete-related associations.

The MOU is titled "Joint Declaration of Industry Vision for a Sustainable Future." The memorandum is based on nine basic declarations. These are listed in the Sustainability section of this magazine. I encourage you to read through them. These statements will be the main principles behind this industry effort, which will focus on providing credible, technical information and using that information to address regulatory considerations and promote concrete to project decision makers.

ASA's participation in this effort strengthens the overall concrete industry and helps further the recognition of shotcrete as a key component of the concrete world. This will be further realized as this new effort produces education materials, including a concrete sustainability-focused best practices book. ASA will have the opportunity to contribute and help shape the chapter covering shotcrete in this new document.



Circle #12 on reader response form—page 60



## A New ASA Committee

The next step your ASA Board took was to form a new Sustainability Committee. This new committee's first meeting will be this November at the ASA fall meetings in New Orleans, LA. The main purpose of this committee will be to identify and quantify the numerous sustainability benefits of shotcrete.

The Board then plans to leverage the work of this committee into multiple new products designed to help ASA members (and the overall shotcrete industry) promote the benefits of its process. One of these new products would be a shotcrete sustainability brochure outlining the benefits of concrete and, specifically, shotcrete.

Many large project owners are requiring contractors to submit documentation regarding the sustainability benefits of their product to even bid a project. This trend will only continue as the size of projects requiring such documentation drops to smaller and smaller jobs. It is also a matter of time before state and federal agencies follow suit. A professional document that not only identifies and quantifies the sustainability benefits but also sells the process will be a critical tool.

Other actions in the works include a sustainability-themed issue of *Shotcrete* magazine in late 2010, sustainability education or training programs, and the creation of presentations explaining shotcrete sustainability benefits.

## Thanks to Our Leadership

As the lead staff member of ASA, it is very exciting to be a part of this important transformation of a challenge into an opportunity. From our Officers and Board Members through our dozens of committee members to our membership, I extend a huge "thank you" on behalf of the shotcrete industry. These folks are action-oriented problem solvers who unflinchingly tackle any issue that pops up. It is a blessing to get to work with them, and I would encourage our readers who are not currently ASA members to strongly consider getting involved.

The shotcrete industry is only beginning to recognize its potential growth, and I know the leadership of ASA is firmly committed to realizing

that potential. The only question is how many in our industry will become involved via membership and/or committee participation to help ensure that shotcrete's potential market share is realized. Together, we can increase the size of the concrete industry pie and the size of the slice that is shotcrete.

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**The bridge was named the 2008 ASA Outstanding Infrastructure Project and voted #7 on the 2008 Top 10 Bridges in *Roads & Bridges* magazine. Thank you to all those who participated in completing this job safely and successfully!**



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# Shotcrete Application in Skatepark Construction

By Charles Timothy Payne, James Hedrick, Lance Spiker, and Tony Walsh

**S**hotcrete is a crucial component in custom skatepark construction and is the most desirable and effective way to place concrete in the skatepark industry. The high velocity at which shotcrete is applied creates perfect placement and compaction for flawless radii and vertical surfaces of skate bowls and pools, as well as other skateable features contained in skateparks. Without shotcrete, it would be very hard to accomplish the smooth contours incorporated within skatepark designs. The urethane skateboard wheels on a shotcrete finish make for the best riding experience.

## Formwork, Excavation, and Reinforcing Bar

The formwork is the first of many steps taken before shotcrete is applied. These forms create the custom layout, grade, and shape for applying the shotcrete. The use of steel pipe is used for the skating edge and is traditionally referred to as the “coping.” The coping also becomes the form to which crews shoot and cut off from. After the forms are complete and the coping is set, excavation can begin. The main excavation is completed by machinery, while fine hand tuning is necessary to ensure the correct thickness of the shotcrete. Once excavation is complete, reinforcing bar is set according to the forms, which are typically placed on 12 in. (305 mm) centers. The

grid pattern is adjusted according to the vertical height and sometimes beyond vertical where the reinforcing bar may be placed as close as 6 in. (152 mm) on center.

## Mixture Designs and Placement

After many years of working with the shotcrete medium, a specialized mixture has been refined. The hand finishing process calls for the slump to be a bit more on the wet side. Fly ash is used in the mixture, which is air entrained with a water reducer. The use of additives is usually avoided because it produces a “lumpy” product. A large amount of portland cement is also used for a good pumpable mixture and a smooth finish surface optimal for skateboarding. Retarding admixture and accelerators are only used when the temperatures are conducive to do so. The refined mixture design is a 4000 psi (28 MPa) mixture, though it can be exceeded but breaks at 6000 psi (41 MPa). The placement of the shotcrete is the most exciting



Team Pain crew member Curt Baker front side grinds around the Colorado Springs “Combi Bowl”



Team Pain’s Construction Superintendent, James Hedrick, testing the freshly placed “capsule” at the Kortrijk, Belgium, skatepark



part of the job because it means the park will soon be skateable. To accomplish an efficient work flow and maintain constant communication with the pump operator and nozzleman, the line pump is placed as close as possible to the sections the crew is shooting. When shooting, the mixture is layered so the cut, float, and finish will be uniform and the amount of concrete placed is less than a typical swimming pool. Each placement is separated by a form at about 18 to 24 yd<sup>3</sup> (14 to 18 m<sup>3</sup>) so the quality of the final product can be controlled. All of the floating and finishing is accomplished with pool-style plaster trowels and specialty, custom-made tools. Immediately after placing and shooting the concrete, a cure/seal agent is applied to control evaporation and help retain the moisture, followed by a 7-day or longer moisture-induced curing period. After all these steps are complete and the concrete has been cured, it's time to skate!



*Overview of an 18,000 ft<sup>2</sup> (1672 m<sup>2</sup>) skatepark in Englewood, FL*

## Beyond Vertical

A few years ago, a skatepark in Kortrijk, Belgium, was built that features a “cradle” structure, which is basically a full pipe closed on one end and open on the other. It called for a special mixture design to speed up the shotcrete application because it was being shot overhead. This mixture design called for a special nozzle that had a third port with valve control to dispense an accelerator that makes the mixture flash. A total of 3 yd (3 m) was shot using the tunnel mixture, taking only 8 hours, compared to using a regular mixture which would have taken up to 14 hours.

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*Team Pain consists of a total of 25 staff members. The following individuals had input on this article:*



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# ASA ANNOUNCES AVAILABILITY OF NEW ONLINE BUYERS GUIDE

**New online tool offers the industry free access to products and services of the leading companies in the shotcrete industry**

The new American Shotcrete Association (ASA) Buyers Guide is now available free to the concrete industry at [www.shotcrete.org/BuyersGuide](http://www.shotcrete.org/BuyersGuide).

The ASA Buyers Guide provides a new and important tool to locate those companies that continually prove their commitment to the shotcrete process and its quality by supporting ASA through Corporate Membership.

This new service enables users to search for companies based on products and/or services related to shotcrete across seven main categories:

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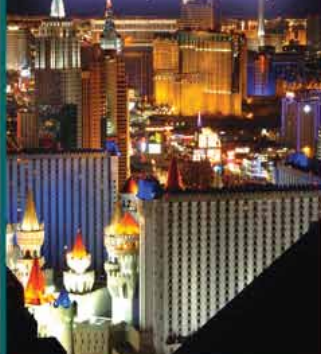


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# Monolithic Dome School Buildings

By David B. South

**J**ust about everyone in the construction industry has been feeling the effects of the worst economic downturn since the Great Depression, but there is one sector that has been largely undeterred from moving ahead with plans for new buildings—public school districts. Fueled by bond issues passed before the crisis hit and, in some cases, federal funding, construction is currently under way on two monolithic dome school buildings. Four other school districts are nearing final approval for building a steel-reinforced, shotcrete dome in the next several months.

One of the largest of the new projects is in the Woodsboro Independent School District located near the Gulf Coast in South Texas. Construction is set to begin in fall 2009 on a 20,000 ft<sup>2</sup> (1858 m<sup>2</sup>) multipurpose building that will serve as the district's gymnasium and auditorium. The dome, which will cost between \$2.1 and \$2.4 million, will host everything from band programs to graduation ceremonies. Because monolithic domes meet the Federal Emergency Management Agency's (FEMA's) standards for near-absolute protection from tornadoes and hurricanes, the building will double as a community disaster shelter when bad weather strikes.



*USD 225 in Fowler, KS, recently received voter approval for a \$1.94 million bond issue that will fund construction of this monolithic dome multipurpose facility that will house a computer/technology lab, a new band/vocal room, a new gymnasium, two locker rooms, and a commons/concession area. The project is currently out for bids and, when completed, will be the first monolithic dome school in the state*

Construction of the monolithic dome multipurpose facility is the final phase of the Woodsboro ISD's capital improvement program funded by a \$9.9 million school bond issue passed in 2005. But Superintendent Steve Self has also applied for grant money from FEMA to help fund the project, and he is expecting the federal dollars to come through as early as September 2009.

Self is following in the footsteps of the Niangua R-V School District in Missouri, which earlier this year completed construction on a much smaller monolithic dome building. This facility was funded by a FEMA grant. The 2700 ft<sup>2</sup> (251 m<sup>2</sup>) Niangua building was financed by a FEMA predisaster mitigation grant of \$313,000 designed to cover 90% of the construction costs for a new building. Completed in April 2009, the dome is serving as the district's preschool classroom and replaces a nearby double-wide trailer that school officials concede was a tornado magnet.

Another Missouri school district that recently completed three monolithic domes is starting construction on two more of the round buildings to accommodate students in kindergarten through second grade. Valley R-6 School District in Washington County is building the two new dome structures on the same site as three existing domes. One of the new 85 ft (26 m) diameter domes will house five classrooms, whereas the other will feature three classrooms and a large library and media center. The new domes will unite students from kindergarten through grade 12 on the same campus.

The district completed two academic domes in 2002 that house a total of 11 classrooms, and a third monolithic dome multipurpose facility in 2008, which can seat 800. Construction on the two new domes is taking place in phases and will be governed by available funds. The district already has enough money in its Capital Projects Fund to finance construction of the dome shells, which is expected to cost approximately \$500,000. The interior will be completed over the next 2 or 3 years using district employees and local contractors.

In nearby Kansas, USD 225 in Fowler recently received voter approval for a \$1.94 million bond issue that will fund construction of a monolithic dome multipurpose facility that will house a computer/technology lab, a new band/vocal room, a new gymnasium, two locker rooms, and a



commons/concession area. The project is currently out for bids and, when completed, will be the first monolithic dome school in the state. A second Kansas school district in Leoti, however, is working on a plan to build two large domes and one smaller one.

In Oklahoma, the state with more monolithic dome schools than any other, construction is nearing completion on a new middle school and high school in Geronimo. The project consists of five modular monolithic domes. Geronimo is among eight school districts in Oklahoma that have opted for the monolithic dome method of construction—others include Locust Grove, Buffalo, Hinton, Beggs, Okima, Texoma, and Dibble.

Although Niangua is the only monolithic dome school funded by FEMA to date, all of the monolithic dome school buildings are strong enough to serve as safe havens when severe weather strikes. Part of the monolithic domes' strength comes from the curvature of the building. While conventional walls are not strong enough to withstand the pressure of a tornado, which can push with 100 to 400 lb (45 to 181 kg) of pressure, the curved, steel-reinforced concrete walls of a monolithic dome can withstand pressure of up to 2000 lb/ft<sup>2</sup> (9765 kg/m<sup>2</sup>). But the shotcrete mixture, along with the technique used to spray the shotcrete over the structure's steel reinforcing bars, also play important roles in the buildings' virtual indestructibility.

Before beginning the shotcrete phase of the construction process, crews pour a slab inside a ring beam footing. In many cases, a stem wall is then erected to give the building straight walls and a more conventional look. Next, crews attach an airform, a tarp made of tough, single-ply roofing material, which is inflated using giant fans. Once the airform is inflated, work moves to the interior where steel frames are attached to frame the windows and doors. Three inches (76 mm) of polyurethane foam is then sprayed on the rest of the airform, and a grid of steel reinforcing is attached to the foam.

At this point, the shotcrete work begins. Crews start by spraying a thick, tapered layer of shotcrete around the entire circumference at the base of the dome, up to approximately 1 ft (0.3 m) high. This ensures the concrete on the footing is not "rebound shotcrete," or aggregate (particles that separate from the air stream). Rebound does not make good concrete. Rebound and overspray also inhibit proper encapsulation if they also keep good concrete from embedding the reinforcing bar.

Once the base has been sprayed, work proceeds from the ground level up, with the first layer of shotcrete gradually thinning as it nears the top of the dome. A second relatively thin layer of shotcrete is usually applied in the same manner

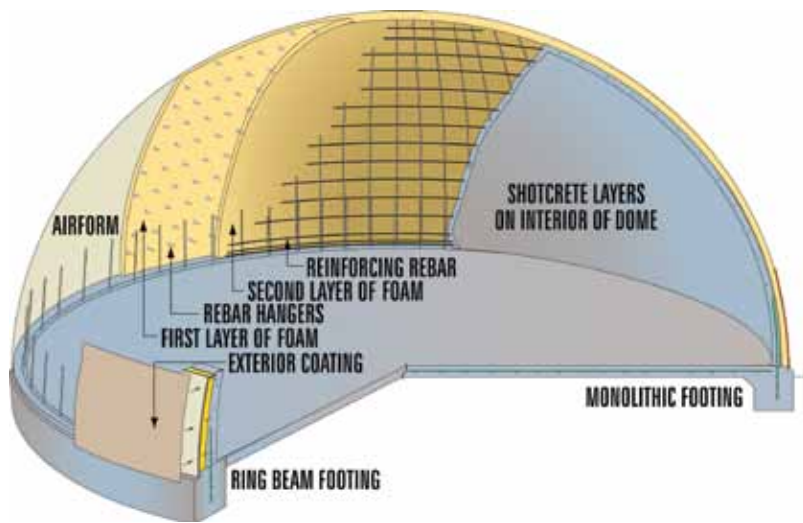
the next day. If the second layer is applied early in the day and the weather is warm enough to enable the concrete to set up fast, a third layer is applied in the afternoon of day two. By day three, the dome will support more weight and the layers can go on thicker. Before spraying the final layer, crews



*Valley R-6 School District in Caledonia, MO, already has three monolithic dome buildings—two classroom domes and a multipurpose facility (pictured here). It is now building two new 85 ft (26 m) diameter dome structures on the same site. One dome will house five classrooms, whereas the other will feature three classrooms and a large library and media center. The new domes will unite students from kindergarten through grade 12 on the same campus*



*This 2700 ft<sup>2</sup> (251 m<sup>2</sup>) monolithic dome preschool building in the Niangua R-V School District in Missouri was financed by a FEMA predisaster mitigation grant of \$313,000 designed to cover 90% of the construction costs for a new building. Completed in April 2009, the dome replaces a nearby double-wide trailer that school officials concede was a tornado magnet*



*This graphic shows the various layers of the monolithic dome. The shotcrete coats the interior of the building*



*This is an aerial view of the newest monolithic dome school in Oklahoma. Construction is nearing completion on a new middle school and high school in Geronimo, consisting of five modular monolithic domes*

check the depth to ensure that the shotcrete ranges from approximately 8 in. (203 mm) at the base to 4 in. (102 mm) at the top. A final thin layer is then applied to the dome, with crews working from top to bottom to make the shotcrete as smooth as possible.

While the application process is important, the shotcrete mixture also plays an important role in the buildings' strength. Over the years, we have asked everyone, from other shotcreters to the Portland Cement Association, how to make the maximum strength shotcrete with efficiency. We have discussed how much, and what kind of, cement, supplementary cementing material, water, rock, sand, and admixtures we should use. After trying every mixture we could think of, we came to the following conclusions for construction of monolithic domes. Because of their shape, monolithic domes only need a relatively small amount of concrete, so we

always use the best materials and the optimum amount of cement.

If fly ash is available—it usually is at most ready mix plants—we replace 100 lb (45 kg) of cement with 120 lb (54 kg) of fly ash per  $\text{yd}^3$  ( $\text{m}^3$ ). Fly ash makes the concrete pump easier and eventually makes the set concrete stronger, increasing the later age strengths. We also replace one bag of cement with admixtures that give us the same strength with other added benefits. These benefits include “air entrainment,” easier pumping, and water reduction.

Just as importantly, we have found only very small amounts of water are needed to properly set concrete for proper concrete strength gain in a monolithic dome. Too much water is concrete's worst enemy because it weakens it and makes it crack more. Typically, crews supply the concrete with too much water to make it easier to pour. It won't stick and the worker handling the nozzle ends up wearing it. We also have to watch our crews to keep them from applying shotcrete with too little water. Too little water makes fantastic concrete, but makes it difficult to properly encapsulate around the reinforcing bar as it should.

We prefer to use natural river rock and sand for shotcrete. The best concrete has the most even gradation of its aggregate—from small (0.375 in. [9.5 mm]) down to the very, very fine rocks (1/100 in. [0.25 mm]).

Like other companies in the construction industry, we are heartened by the signs we're seeing of an economic rebound. The phones are ringing more, and inquiries are coming in for everything from our large storage facilities to our miniature monolithic cabins. But until business returns to 2008 levels, we continue to focus on the burgeoning public school market, knowing we are also doing our part to make America's children safer.



**David B. South** is President of the Monolithic family of companies, based in Italy, Texas, and directs and oversees all corporate activities on a daily basis. He co-invented and patented the monolithic dome construction process and now trains builders at 5-day workshops held at the Monolithic Dome Institute, which he also founded. South served for 9 years as Chair of the American Concrete Institute Joint ACI-ASCE Committee 334, Concrete Shell Design and Construction, and has received numerous awards and patents. For more information, visit [www.monolithic.com](http://www.monolithic.com).

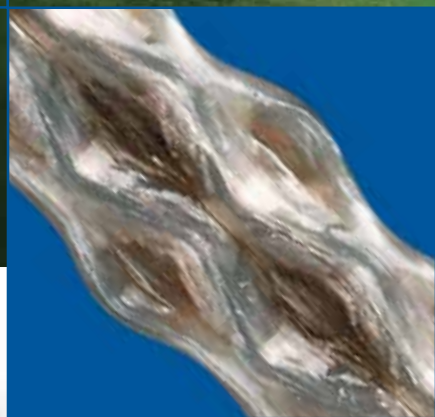
construction process and now trains builders at 5-day workshops held at the Monolithic Dome Institute, which he also founded. South served for 9 years as Chair of the American Concrete Institute Joint ACI-ASCE Committee 334, Concrete Shell Design and Construction, and has received numerous awards and patents. For more information, visit [www.monolithic.com](http://www.monolithic.com).



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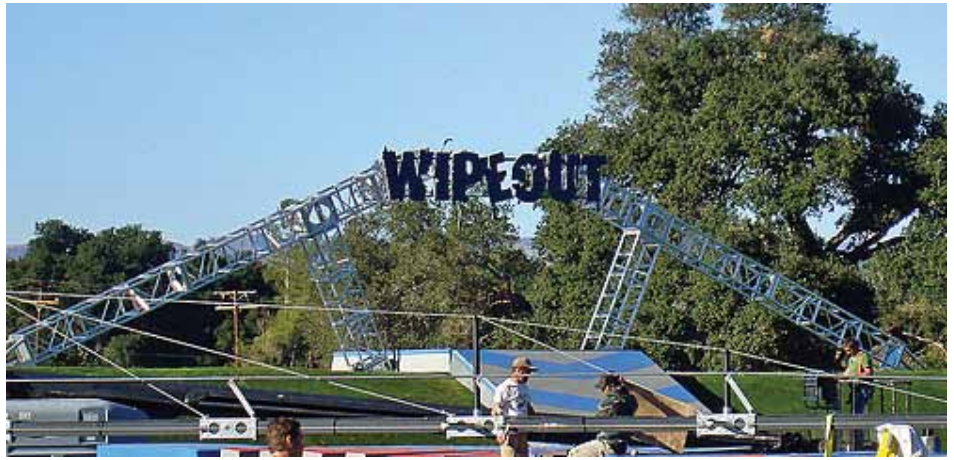
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Circle #3 on reader response form—page 60



# WIPEOUT!

By Jon Harpole



*Wipeout!*

**T**he American Broadcasting Company (ABC) contacted Nationwide Shotcrete, asking for the fastest and most efficient way to produce several pools and foundations for a new game show called “Wipeout.” It was determined that shotcrete would be the fastest and most efficient process. For three pools totaling 40,000 ft<sup>2</sup> (3716 m<sup>2</sup>), the producer of the show wanted us to excavate, install the needed reinforcement, and then use shotcrete to complete the project.

After negotiating the contract with ABC, work began immediately on excavation and preparation for the shotcrete process. ABC’s demanding schedule for the production of “Wipeout” left no room for error.

Excavation began with slope dozers and loaders. Due to the location of the site, water was not accessible. Instead, water trucks were there to maintain the dust control and keep the soil damp and compacted for the application of shotcrete



*Excavation of the first pool*



*Pool shotcreted with vertical walls using no forms*



*Preparing to apply shotcrete*



*Pool shotcreted and ready for production*



and to minimize shrinkage and the number of joints. Once excavation was completed, the show's obstacles were reinforced with foundation anchors. These anchors had to be very secure and correctly placed to prevent movement during the shotcrete process. No formwork was used on this site and control wires were used in each pool.

Nationwide Shotcrete decided to complete the 40,000 ft<sup>2</sup> (3716 m<sup>2</sup>) by 425 yd<sup>3</sup> (325 m<sup>3</sup>) project in 1 day. Shotcreting operations started at 5:00 a.m. with four shotcrete pumps and four shotcrete crews. Two crews worked in the largest pond (21,000 ft<sup>2</sup> [1951 m<sup>2</sup>]), the third crew worked in a second, 9000 ft<sup>2</sup> (836 m<sup>2</sup>) pool, and the fourth crew worked on the 11,000 ft<sup>2</sup> (1022 m<sup>2</sup>) pool. At 1:00 p.m., we had over 9180 ft<sup>3</sup> (260 m<sup>3</sup>) completed. Shotcreting operations finished at 3:30 p.m.



**Jon Harpole** started in the shotcrete industry 27 years ago. Beginning his career as a job foreman, he has since completed shotcrete projects all over the U.S. In 2006, Harpole opened Nationwide Shotcrete—a family owned and operated corporation—with the dream of someday working alongside his three sons. That dream began to take life when his son Jordan broke into the industry following the legacy of his father. Commanding the attention of job owners and contractors alike, the Harpoles made a name for themselves on numerous jobs. They continue to gain experience and knowledge through each new project, and aspire to one day own and operate California's largest shotcrete company.

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The presentation is provided on a 2 gigabyte USB flash drive that also includes the following ASA publications: *The History of Shotcrete* by George Yogy, *Shotcrete Versatility Plus*, the video of the World of Concrete Mega Demo, and the ASA brochure, *Shotcrete, A proven process for the new millennium*.



Future editions of the presentation will include information on mining and tunneling, pools and recreational shotcrete, and other sectors of the concrete construction industry.

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# 3<sup>RD</sup>

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This conference will focus on technical subjects related to the use of shotcrete, ranging from material properties, spraying technique, and structural design, to analysis of shotcrete interaction with supported ground. The scope of the conference will appeal to geotechnical engineers, research specialists, consultants, and mining and tunnelling contractors wishing to learn about the latest advances in shotcrete technology. A trade exhibition of shotcrete-related products will operate in parallel with the presentations. Delegates and potential presenters are welcome to visit the conference web site at [www.eds2010.com](http://www.eds2010.com) to find out more. If you are interested in shotcrete and travelling to New Zealand, now is the time to act!

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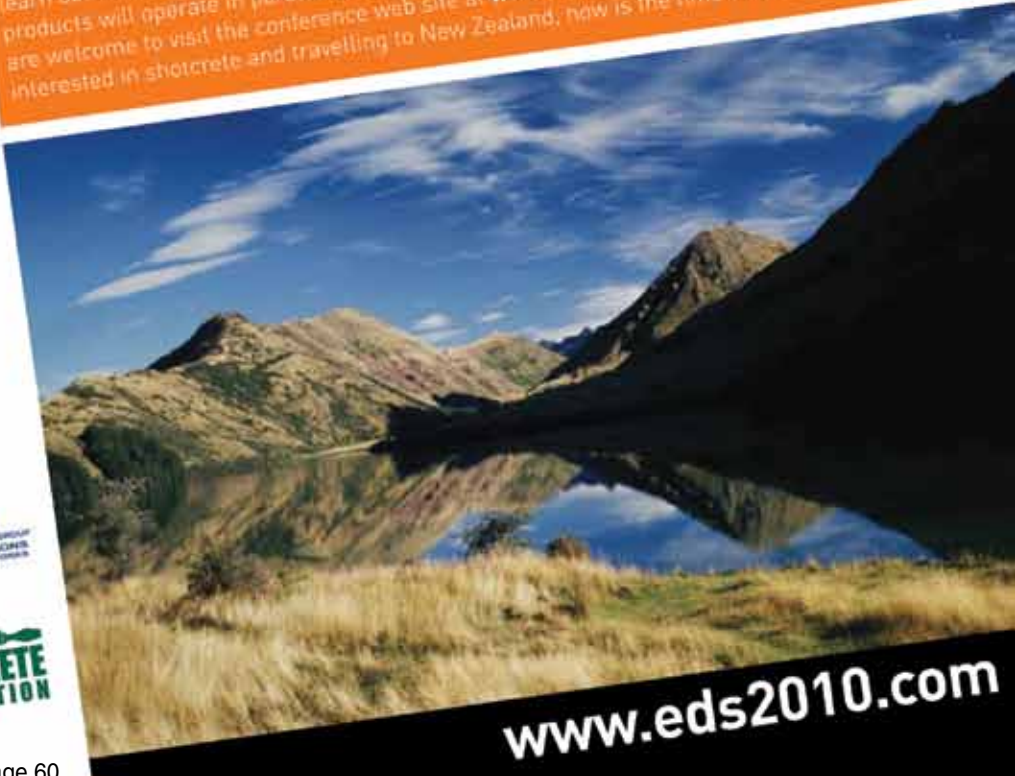


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## Checks and Balances

By Bill Drakeley

**A**s the educational efforts of organizations such as the American Concrete Institute (ACI) and the American Shotcrete Association (ASA) expand, there is great emphasis on the procedural techniques employed during shotcrete application that will produce good quality concrete. I applaud and encourage these efforts but venture the following questions: Are there non-concrete placement items that must be reviewed? What variables must be accounted for to allow a nozzleman to confidently spray that first yard of concrete? I propose that there is a checklist of issues that must be addressed prior to shooting which, if permitted to go undetected, can affect the finished product long after you've completed the shotcrete process. No doubt there are more issues to take into consideration, but I have identified nine factors that, in my experience, play key roles in ensuring quality shotcrete, a happy customer, and the receipt of that elusive final payment.

### 1. Plans and Specifications

Have all measurements been verified? For reference, a responsible pool contractor must have in his/her possession a complete set of detailed, engineer-approved plans and specifications that serve as a guide for every surface receiving concrete. All lengths, widths, depths, custom curves, radii, benches, steps—all information pertinent to the structure must be accounted for and checked against a complete set of plans and specifications prior to shooting. In fact, entering into a contract with a homeowner without detailed specifications is asking for trouble. Liability lies with the pool contractor in the absence of proper documentation.

### 2. Permits

We must ask: Has the town or municipality approved the project? It is crucial that the pool builder know that all necessary permission from the applicable building, zoning, health, and engineering departments has been acquired. Not only can these individuals catch and foresee potential problems with your project but also their approval can protect the pool contractor should any questions be raised regarding the choice of location, installations, codes, and electrical.

### 3. Soil Composition

Can this ground support the pool? Calling in a soil scientist for a geological investigation during the planning phase of the pool will quickly determine if the soil is capable of supporting both a concrete pool shell and the added weight of the water. I have inspected dozens of pools that have literally twisted under their own weight due to the inability of the soil to support them. Some blame falls on the pool contractor who should have done his/her research.

### 4. Water Conditions

Has this site been consistently dewatered during construction to compensate for a high water table? Is there a system in place to ensure adequate drainage after completion of the project? Groundwater cannot be allowed to sit in the excavation. I inspected a pool in Virginia that had floated due to hydrostatic pressure, surprising the contractor as the pool sat on a strong stone layer with multiple relief valves. After asking some questions, we quickly discovered the cause. Prior to shotcrete application, the pool dig had become saturated by heavy rains. Rather than draining the water from an outside well point, the contractor merely dropped a pump into the excavated area, which drew silt and fine particulates through the stone layer, clogging it and rendering it useless before the pool was even shot.

### 5. Plumbing

Four questions must be asked concerning plumbing. First, has the plumbing been pressure-tested? This step is absolutely essential to ensuring smooth operations of the mechanical system. Secondly, is the plumbing rigid and nonvibrating? A vibrating piece of pipe during a shoot will leave a void behind it, potentially inducing a crack in the pool wall. Thirdly, are there clearances allotted to ensure that every piece of plumbing is adequately covered during the shotcrete process? A little math can help the contractor determine proper placement of pipes. Lastly, has the plumbing system been consolidated to one spot, preferably under the pool? Perimeter piping and multiple random sleeves in the pool wall for plumbing, in addition to being (in my



# Pool & Recreational Shotcrete Corner



*A watertight containment tank for off-road diesel tanks to be installed inside*

opinion) low quality installation, will invariably be interfered with and/or broken by other contractors, masons, and electricians working around the pool. A neat and compact plumbing system strategically placed beneath the pool will protect piping and prevent future problems. These four plumbing issues eliminate unnecessary repairs after placing concrete.

## 6. Forming

Do the forms and their elevations correspond with the plans and specifications? Forms and their measurements, as the initial support of the concrete, must be accurate. Are the forms rigid and nonvibrating? Using rubber or Styrofoam forms is, in my experience, not solid technique. A pool contractor cannot afford forms that bounce back. Many guidelines set forth by ACI manuals and Committee 506 point to rigidity of forming during shotcrete regardless of the application.

## 7. Steel Placement

Is the steel being used of good quality and is it sturdy and nonvibrating? As a rule, our company uses Grade 60, 1/2 in. (12.7 mm) steel to provide a good solid structure. Is the steel placed according to the specifications to ensure good encapsulation? A good pool contractor will verify that concrete can be shot around every corner and cross section of the reinforcing bar. Common sense dictates that the steel be properly and evenly placed to guarantee that encapsulation process. Have guidewires been placed to help the finishers produce clean lines as they shape the concrete? The less “browning out” or building up of mortar a mason has to do (the application of mortar over concrete to produce a suitable surface for tile or coping), the better. Plaster and tile delamination and bond failure can all be avoided if tight tolerances are kept with the shooting process, requiring less hand-applied mortar.

***Tom Norman**, ASA member and Chair of ASA's Pool & Recreational Shotcrete Committee, wants your input. Your comments, suggestions, and the topics you'd like to see covered are welcome. Perhaps you'd like to become a contributing author to Pool & Recreational Shotcrete Corner. Norman and the ASA staff encourage you to contact ASA with your questions and comments at: [info@shotcrete.org](mailto:info@shotcrete.org).*

# Pool & Recreational Shotcrete Corner



*This is a straight, solid formwork and steel application of concrete being placed and is one of the items on the check list for proper placement*



*A residential pool prior to the shotcrete process. Pipes are capped and pressurized to ensure the system has no leaks*

## 8. Equipment

Is the pump, compressor, and/or dry-mix feeder operating correctly? Who serviced the unit last and are all connections clean and working properly? Based on applications, compressors will need a certain cubic feet (meters) per minute of air velocity to properly compact the material. So much integrity is lost due to inadequate velocity and improper compaction. Additionally, feeder or pump malfunctions, which delay applications, will pose bond ability issues after a restart if the crew is not familiar with the saturated surface dry (SSD) condition, for example.

## 9. The Material Itself

Shotcrete is a process, not a product. The product is concrete, and a contractor must be sure that the mixture is what is properly proportioned to what is necessary to achieve the required strength and performance for the pool structure. Simply asking questions and checking the ticket upon delivery and verifying the cement ratios will help catch any mistakes. Know what is being delivered and be able to verify it.

Also, with regard to concrete trucks, the following questions must be asked. When were they batched? How long have they been in transit? What are the concrete temperatures, both inside and outside the mixture? Has water been added to compensate for heat? How long have the trucks been sitting, waiting to unload? Any and all of these variables play major roles in the chemistry of the concrete mixture. In my experience, it is more cost effective to send the truck back to the plant for a fresh load than to use a mixture that has been watered down—the pool contractor will avoid a plethora of issues, including failed structural performance.

Finally, if shooting dry mix, what is the moisture level of the sand/aggregate? Is it necessary to predampen? A smart contractor will have loading, site delivery, and mixing preplanned to eliminate any last minute changes.

One may notice that I did not mention shotcrete application techniques. This is because attention to the nine factors mentioned previously must precede the shotcrete process, if the application is to be successful. Careful attention to this mental checklist can serve a pool contractor well, allowing him or her to produce a quality installation, minimizing potential issues.



**Bill Drakeley** is a third generation watershaper and President of Drakeley Industries and Drakeley Swimming Pool Company in Connecticut. He is a Genesis 3 Platinum Member, an American Concrete Institute Certified Nozzleman, an ASA-Approved Shotcrete Educator, an ACI-Approved Shotcrete Examiner, and his company is a corporate member of ASA. Drakeley is an instructor for the Genesis 3 Construction School, with a focus on the shotcrete process. He has been a contributing writer for Shotcrete magazine's "Pool & Recreational Shotcrete Corner" and has had projects featured in *Luxury Pools* magazine, *Better Homes & Gardens*, and *Aqua* magazine. Drakeley Pools was the recipient of ASA's "Outstanding Pool & Spa Project" for 2005 through 2008.



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Circle #47 on reader response form—page 60

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## Structural Shotcrete Reinforcing

By Marcus H. von der Hofen

### Complicated Questions with Complex Answers

**O**ne the biggest topics I run into while working on structural shotcrete is reinforcing steel. What size? What spacing? Contact splices or noncontact splices? What can we do? These are not simple questions and are certainly not questions with cut-and-dry answers. As a contractor who deals with these issues every day, here are a couple of ideas that might help you answer these questions as they apply to you. In any case, reinforcement should be sized, spaced, and arranged to facilitate the placement of shotcrete in meeting the structural design requirements by the American Concrete Institute's "Guide to Shotcrete (ACI 506R-05)."

### Size of Steel

For the most part, configuration seems to play a greater role than the size of steel. Large (No. 7 and larger) vertical reinforcing can consistently be encased when spacing and configuration allow the nozzlelemen good access. Large horizontal reinforcing is a different story and is more a difficult task for good encapsulation. In general, a

design with bigger, but fewer, vertical bars can give you more spacing between; and smaller, but more, horizontal bars limit sloughing or sagging.

### Contact Versus Noncontact Splices

The soundest shotcrete is usually obtained when the reinforcement is designed and positioned to cause the least amount of interference with the placement of shotcrete ("Guide to Shotcrete (ACI 506R-05)"). Commonly called "noncontact splices," the obstruction areas where bars overlap can be reduced by separating an approximately 2 in. (51 mm) space with reinforcing bar at the splice, which will allow flow around two smaller obstructions rather than just one larger one. This is typically the preferred method, but it's not always the case. In highly congested areas, this method may cause interference to the nozzlelemen.

### Talk to Your Shotcrete Contractor

These issues and their answers are subjective and the experts in the field can often disagree. It's important to allow the input of the shotcrete contractor to ensure that the final structural design will facilitate proper shotcrete placement in a way that is best suited to his or her vision and skill set. We don't all do or see things the same, so it is communication more than any set rule that I find to be the most productive.

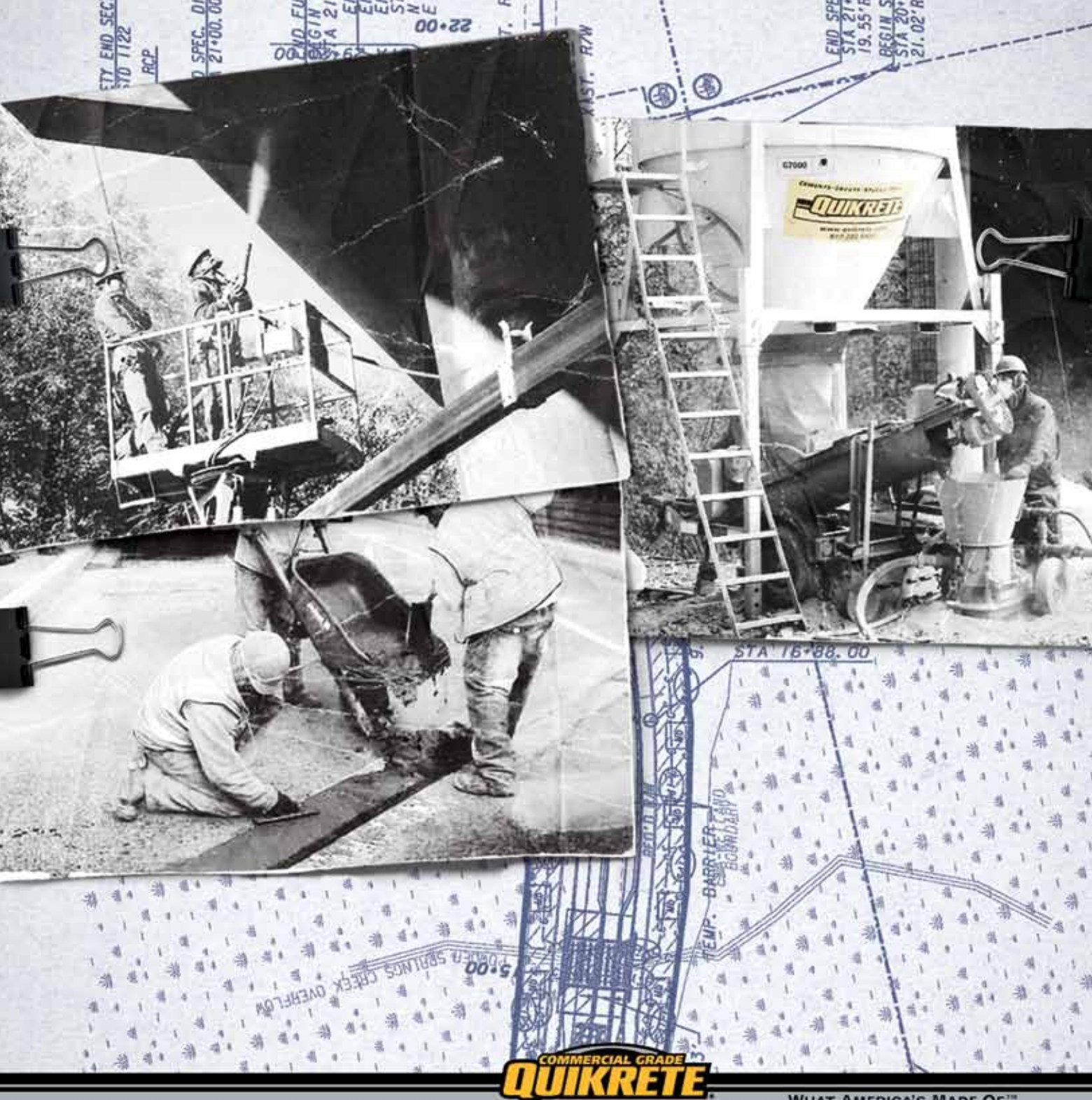


Noncontact splices used in open area boundary element done with contact splices for better access



**Marcus H. von der Hofen** is the Pacific Northwest Area Manager for Johnson Western Gunitite Company, San Leandro, CA. He has been in the commercial construction field since 1982 and is an active member of ACI Committees 506, Shotcreting, and C660, Shotcrete Nozzleman Certification. He is a charter member of ASA, joining in 1998, and is Co-Chair of the ASA Education Committee.





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# Outstanding Shotcrete Project Award Winner

## 2008 Outstanding Architectural Project

# ASANTE

**T**he ASANTE project consisted of six aqueduct structures, two sign walls, and a faux bridge that was actually two massive retaining walls. The structures were part of an elaborately designed lake-oriented main entry for a new housing community by Lennar Homes in Surprise, AZ. With the exception of the brick veneer and column caps, all components of each structure were constructed with shotcrete.

Shotcrete significantly reduced construction time. The sign walls and aqueducts were 6 ft (1.8 m) thick and up to 14 ft (4.3 m) high with various radii and arched block outs. The faux bridge walls were 22 ft (6.7 m) high with integral water fountain columns that were another 6 ft (1.8 m) higher. One challenging and unique feature was the exposed board formed areas—which the architect wanted to resemble concrete—placed prior to the concrete industry's use of plywood in forming systems. Another was the various colored shotcrete sills and wall caps. This project was a natural for shotcrete considering all of the variables involved with each structure.

### Outstanding Architectural Project

*Project Name:*  
ASANTE

*Project Location:*  
Surprise, AZ

*Shotcrete Contractor:*  
Fisher Shotcrete, Inc.\*

*General Contractor:*  
Pacific Aquascape, Inc.

*Architect/Engineer:*  
McGough Group

*Equipment Supplier:*  
Ready Mix, Inc. (RMI)

*Project Owner:*  
Lennar Homes

\*Member of the American Shotcrete Association



*Shotcrete being placed for one of the faux bridge retaining walls. A total of 180 yd<sup>3</sup> (138 m<sup>3</sup>) were placed in one shift for each of these massive footings*



*The two sign walls presented numerous forming challenges. This is a 6 ft (1.8 m) thick wall with an arched opening within a curved section*



# Outstanding Shotcrete Project Award Winner



*Access for forming the water column crowns was from scaffolding 20 ft (6 m) off the ground on both sides of the wall*



*The sign wall with veneer being applied. Note the detail at the top with the sill, cap, and the 10 ft (3 m) long x 6 ft (1.8 m) wide x 2 to 4 in. (51 to 102 mm) thick cantilevered sill, all done with integral colored shotcrete*



*Placing colored shotcrete for the arched sills on the bridge walls. Note the board-formed sections within the water columns*

*These shotcrete structures are part of the stunning entry feature for one of Lennar's master planned communities in Surprise, AZ*



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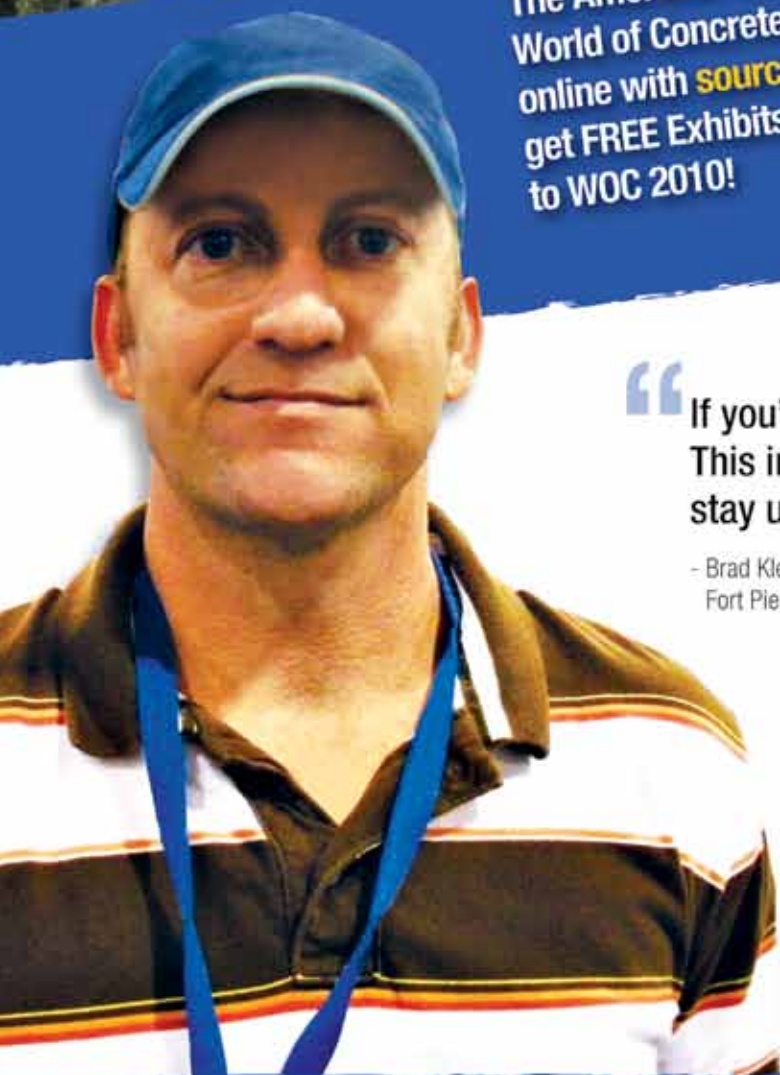
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Circle #43 on reader response form—page 60

# Outstanding Shotcrete Project Award Winner

## 2008 Outstanding Underground Project

# The Heartland Corridor Clearance Improvement

**W**ith sky-rocketing fuel costs for truck and air transport, moving freight over national railroads has become increasingly attractive to suppliers and manufacturers. With this increasing traffic demand, many railways have been challenged to find solutions to accommodate the increased volume. The solution, which has been under review and planning for a number of years, is clearance improvements to the railway system. This will allow for double-stacked containers to be moved seamlessly from state-to-state or coast-to-coast when all work has been completed.

Norfolk Southern Railway has embarked on the Heartland Corridor Clearance Improvement Project, which would allow for this seamless movement throughout its system. Tunnels with low clearance and other overhead obstructions would be altered or removed over 3 years to allow for double-stack train traffic. A design team worked tirelessly to design and implement an efficient and cost-effective clearance repair method.

The first of 28 tunnels on the Heartland Corridor Clearance Improvement Project stretches between Virginia and Kentucky. The Cowan Tunnel Project involved the removal of approximately 3304 lineal ft (1007 m) of existing concrete crown tunnel liner. This involved grinding the liner to meet required clearance, installing approximately 7800 rock bolts, as well as applying approximately 2300 yd<sup>3</sup> (1758 m<sup>3</sup>) of steel fiber-reinforced shotcrete. The necessity to complete the repair areas and return the railroad to service at the end of each 10-hour shift was a challenge, to say the least. This was a confined tunnel 3304 ft (1007 m) long on a single track, where 2300 yd<sup>3</sup> (1758 m<sup>3</sup>) of shotcrete was required.

Road headers were used to remove the tunnel liner, which later was removed to stockpile using railway-supplied air dumps and company-owned hy-rail car movers. Areas were thoroughly scaled of loose debris, rock bolts were installed in predrilled holes, and drain fabric was installed

prior to the application of shotcrete. A typical work train was outfitted with a volumetric batching machine, a gantry hoist system, and a custom shotcrete pump.

Crews were able to apply an average of 30 to 40 yd<sup>3</sup> (23 to 31 m<sup>3</sup>) of shotcrete on a daily basis with minimal rebound and fall out. This was made possible using a prebagged, silica fume, fibrous shotcrete mixture as well as the application of the product by ACI Certified Nozzlemen. Shotcrete operations were overseen by a tunnel superintendent and an ACI Certified Nozzleman. The tunnel nozzleman applied the shotcrete in multiple layers at site inspectors' direction with very minimal rebound. The finished product far exceeded expectations of the owner. The lead project inspector remarked, "The nozzleman was one of the best I had worked with during my career and appreciated my demand for perfection." The nozzleman not only applied the shotcrete during this project but also provided assistance and training for other nozzlemen within the company looking to achieve their ACI certification.

The project was completed in late September of 2008. Crews then mobilized to another four tunnel projects in West Virginia. Similar means and methods were planned for these tunnels with completion dates in mid-2009.

The Heartland Corridor Clearance Improvement Project proved to be a challenging but very rewarding experience. The first tunnel in the project, the Cowan Tunnel, comprised the work of grinding the liner to meet required clearance, installing approximately 7800 rock bolts, as well as applying approximately 2300 yd<sup>3</sup> (1758 m<sup>3</sup>) of steel fiber-reinforced shotcrete. With meticulous schedule planning, labor coordination, and equipment allocation, the team was able to achieve high shotcrete productivity without forgoing the efficiency of other tunnel work tasks. As the first of the 28 tunnels, this crew developed a standard of means and methods for future tunnel improvements in the project.



# Outstanding Shotcrete Project Award Winner



*Placing initial layers of fiber-reinforced shotcrete*



*Lattice girder tunnel supports within the layers of fiber-reinforced shotcrete (initial layer)*



*Shotcrete being applied near portal area. Spiling installed and shot in prior to the demolition of the adjacent panel*



*Lattice girder tunnel supports with final layers of fiber-reinforced shotcrete*



*Shotcrete being applied to tunnel walls by ACI certified nozzleman*

## Outstanding Underground Project

### *Project Name:*

The Heartland Corridor Clearance Improvement

### *Project Location:*

Radford, VA

### *Shotcrete Contractor:*

Johnson Western Guniting Company\*

### *General Contractor:*

Johnson Western Guniting Company\*

### *Architects/Engineers:*

STV Whitehead, Hatch Mott McDonald,  
and Rick Meredith

### *Material Supplier:*

The Quikcrete Companies

### *Project Owner:*

Norfolk Southern Railway

\*Member of the American Shotcrete Association



## Bekaert Corporation

**E**ver since Leo Bekaert founded Bekaert Corporation in 1880, the Bekaert company name has been synonymous with quality and innovation. Bekaert has been a leader in the steel fiber industry since its first steel fiber patent, filed 34 years ago. The mindset in the company is to create the best performing products and back them up with outstanding customer service and engineering. This strategy allows Bekaert to maintain the enviable position in the steel fiber industry of outselling its top two competitors combined.

Better together summarizes the way this company works: Bekaert builds win-win relationships with its customers through listening and understanding customer needs. Bekaert recognized a customer need in shotcrete, and its engineering division developed mechanical

equipment for fiber-reinforced shotcrete projects. This includes development of the first steel fiber dosing system and a wet shotcrete steel fiber counting system.

Bekaert understands that not all projects are the same; therefore, it offers the widest range of shotcrete fibers on the market. Many other fiber suppliers offer one or two fiber types and basically take a one-size-fits-all approach. Currently, Bekaert offers six types of steel shotcrete fibers (Dramix®), three types of fire protection fibers (Duomix®), and one macro-synthetic fiber (Synmix®). Due to extensive testing and research, Bekaert manufactures the highest performing fibers for any variety of application. The company learned years ago that high aspect ratio, hooked end, and drawn wire fibers with high tensile strengths provide the best cost/dosage/performance value.

Dramix® structural steel fibers are an easy alternative for reinforcing shotcrete. Dramix fully meets the requirements of “steel fiber-reinforced concrete” as defined in ACI 318-08. The high tensile strength steel wire fibers provide ductility to concrete, which can be sprayed directly on earth or rock to stabilize the surface. Its principle advantages are a reduction in material, greater speed, improved safety, technically superior solution, and lower costs. The use of steel fiber-reinforced shotcrete allows applications to follow contours of the ground, thereby providing a consistent thickness that saves concrete volume (Fig. 1), and the fibers give resistance to tensile stresses at any point in the shotcrete layer. Replacing steel with steel is a solution that really makes sense.

Synmix® macro-synthetic plastic fibers have been benchmarked against the highest performing macro-synthetic fibers available. Synmix is used to provide reinforcing for shotcrete that does not require structural properties or maintenance of long-term sustained loads. Synthetic fibers tend to rely on a large fiber network and bond with concrete rather than mechanical anchorage. As a result, over time, the bond with the concrete tends to loosen, the plastic stretches, and creep occurs. This is why Bekaert only recommends macro-synthetic plastic fibers for temporary structures or structures that can allow large crack widths.

Bekaert’s shotcrete fibers have been used in a wide variety of projects, including slope protection, civil tunnels, mining, wharf facing, and bridge repair. Slope stabilization, as shown in Fig. 2, provides a working surface for foundation excavations as well as for rock fall protection along roadways. A recently completed civil tunnel project that used steel fibers extensively is the south Boston Piers Transitway Tunnel for the Silver Bus line, which was part of the “Big Dig.” This project was the first in the U.S. to use ground freezing in combination with the New Autrain Tunneling Method (NATM). During excavation, a 12 in. (305 mm) thick Dramix fiber-reinforced shotcrete layer was used as initial support. Lattice girders were then erected at 3 to 5 ft (0.9 to 1.5 m) intervals. The final lining initially specified reinforcing bar but was changed during construction.



*Fig. 1: Shotcrete application following contours of the tunnel*



*Fig. 2: Slope stabilization*



# Corporate Member Profile

The redesigned final tunnel lining used 12 in. (305 mm) of Dramix fiber-reinforced shotcrete covered by a 2 in. (51 mm) thick smoothing layer containing plastic micro fibers. The result was a significant savings to the contractor.

To help improve tunnel construction safety, Bekaert worked together with its customer to develop the laser shell method of tunnel construction. Morgan Est. wanted to develop a safer way to construct a tunnel, as a result of a tunnel collapse in England. They came up with a method that employs an inclined full-face excavation for increased stability, improved safety for tunnel workers, minimized the number of construction joints, and improved productivity. Lattice girders and rock bolts are replaced with

high (8000 psi [55 MPa]) compressive strength steel fiber-reinforced shotcrete mixture that is shot in a complete ring all at once. Rapid closure of the ring provides an extremely safe work environment and minimizes convergence of the tunnel walls. Due to the high compressive strength concrete, however, conventional low carbon steel fibers could not achieve the toughness requirements needed. Bekaert suggested supplying high-strength steel fibers with tensile strengths of 330 ksi (2275 MPa). The result is a successful merger of technologies that fulfill the objective of a safe and practical way of improving tunnel excavation.

Bekaert prides itself on working together with its customers to provide the correct fiber-reinforced shotcrete system for the project.



Visit the Bekaert Corporations Building Products Division at [www.bekaert.com/BUILDING/](http://www.bekaert.com/BUILDING/)  
1395 S. Marietta Parkway  
Building 500, Suite 100  
Marietta, GA 30067  
Phone: (800) 555-1775  
Fax: (770) 426-8107

## The 2010 ASA Annual Membership Meeting and Fifth Annual Outstanding Shotcrete Project Awards Banquet

**Monte Carlo Hotel, Las Vegas, NV**  
**Tuesday, February 2, 2010**  
**6:00 p.m. Reception—7:00 p.m. Dinner**  
**See Registration Form on page 32!**

**AMERICAN**  
**SHOTCRETE**  
**ASSOCIATION**

# 2010 ASA Annual Membership Meeting and Fifth Annual Outstanding Project Awards Banquet

## Registration Form

Join us in celebrating another year of membership success and in recognizing our 2009 project award recipients. Submit one form per attendee by January 18, 2010. We look forward to seeing you in Las Vegas!

### Banquet Information:

Location: Monte Carlo Resort & Casino  
Grand Ballroom, 2nd Floor  
Las Vegas, NV  
Date: Tuesday, February 2, 2010  
6:00 – 7:00 p.m. Registration, networking, cocktails, and hors d'oeuvres  
7:00 – 10:00 p.m. Plated dinner with an open bar, the 2009 membership meeting and awards ceremony

### Attendee Information:

☐ Register me for the 2010 ASA Annual Membership Meeting and  
Fifth Annual Outstanding Project Awards Banquet.....\$80.00

Name \_\_\_\_\_ Company \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_ Country \_\_\_\_\_

Phone \_\_\_\_\_ Fax \_\_\_\_\_

E-mail \_\_\_\_\_

On-site registration is required after January 18, 2010, and increases to \$95.00 per attendee

### Payment Information:

☐ Check (U.S. \$)      ☐ MasterCard      ☐ Visa      ☐ Cash

Credit Card # \_\_\_\_\_ Exp. Date \_\_\_\_\_

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### Become an ASA Banquet Sponsor:

☐ Bronze—\$100.00      ☐ Silver—\$500.00      ☐ Gold—\$1,000.00  
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# Shotcrete

A quarterly publication of the  
American Shotcrete Association  
**MAGAZINE**

## Africa Live! at the San Antonio Zoo

By Ken Tucker

**A**frica Live! at the San Antonio Zoo, San Antonio, TX, immerses visitors in the wonders of Africa including its diverse plants, animals, and people. The central theme of the exhibit is water—both its scarcity and its abundance—with exhibits arranged seasonally from trickling streams to flash floods. Visitors are able to see how plants and animals have adapted to changing amounts of water.

Hippos are visible through underwater viewing windows so guests can see them in beautifully replicated natural habitats representative of the

environments in which they spend most of their lives. Africa Live! creates a wild trek where the animals appear to roam free and the visitors are on safari. The immersion-style exhibits empower guests to feel as though they have been transported into the wild.

The shotcrete design begins in the Hippo Viewing Building where, entering through a large rock wall beside a waterfall, the interior details give the impression of being on a river bottom looking into the hippo pool. As visitors walk through the building, they gradually rise to be closer to the river edge experience, passing crocodile, aquarium tanks, and snakes as they emerge into a large aviary filled with birds. A colobus monkey mesh enclosure is within the bird aviary and people can walk beside the shotcrete stream that flows from a waterfall at the far end of the aviary. Emerging from the aviary, the visitors pass the rocky cliff that conceals the Okapi holding, buried on top with a planter and viewing area high above.

The rockwork gradually changes from fractured rock to kopje that now begins the mound areas. Views from within the huge termite mound look out onto African dogs in a large exhibit space that is shared with the hippos. More kopje await as the visitors walk past hyraxes and elephants to climb the path up to a large terraced dining area shaded by a trellis. The visitors can sit and relax with food and beverages while looking at the African panorama of landscapes and rockwork.

The same team that fabricated the rockwork and replicated the natural environments throughout



*Africa Live! Phase 1—Hippo pool*



*Africa Live! Phase 1—Hippo pool and viewing area*



*Africa Live! Phase 1—Crocodile pool*



# Shotcrete Corner



*Africa Live! Phase 2—Waterfall in aviary*



*Africa Live! Phase 2—Colobus aviary and stream*

Africa Live! Phase 1 is currently on site completing Africa Live! Phase 2. Using 5000 psi (34.5 MPa) shotcrete, the rock is hand carved with trowels and rubber-coated paint rollers to achieve the look and texture of rock. When constructing earth banks, larger roots and rocks are first tied to the structure wall, and then integral color is added to the mixture. The texture is achieved by applying the shotcrete from different angles with the shotcrete nozzle to achieve the dirt look. Smaller rocks are placed on the wall after it is shot to achieve an authentic-looking environment.

Africa Live! Phase 2 construction continues on schedule and on budget and is scheduled to open in the spring of 2010. Africa Live! Phase 2 will feature an African primate exhibit, a walk-through aviary filled with trees and birds of every color and variety, a pack of African wild dogs, and a walk-through termite mound where visitors will see larger-than-life models of chambers, tunnels, a queen, and other types of these amazing social insects. With fluffy long tails, the colobus monkeys will perform acrobatic leaps from tree to tree. Further down the trail, guests will encounter the mysterious “forest giraffe”—the beautiful okapi. A giant “termite mound” will provide fun for kids to crawl through as they watch mongooses poke their heads through the mound’s ventilation shafts. Wild hunting dogs will be next along the path, where guests will come face to face with the pack. Rock formations will become the playground to rock hyraxes, as monitor lizards lie in the crevices. All the while, pygmy falcons fly overhead watching the excitement below. Up the hill, the Baraza Café will offer guests rest and delicious food from the outdoor grill with a grand view of the river valley and forest below.



*Africa Live! Phase 2—Colobus building path and stream*

## Acknowledgments

Ken Tucker received contributions for this article from Steve McCusker, Zoo Director at The San Antonio Zoo and Dave Matthews, Architect with Jones & Jones Architects and Landscape Architects.



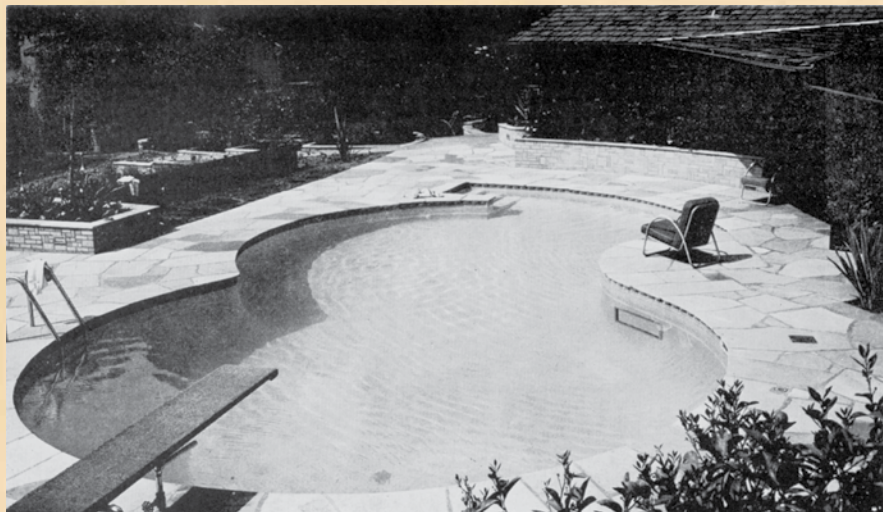
**Ken Tucker**, Rockwork Superintendent with The Nassal Company, has more than 30 years of experience in the Project Management and Superintendent roles involving the fabrication and installation of artificial rock formations, natural earth formations, clay banks, textured rockwork, artificial trees, water features, landscapes, sculptural elements, natural habitats, and immersive environments. As Superintendent, Tucker is the on-site supervisor and manages the project crew(s) as well as coordinates with other trades in the completion of the project. Tucker and The Nassal Company’s team deliver immersive and themed environments for entertainment, leisure, museum, zoo, and aquariums venues.



From the library of Chris Zynda

*Chris Zynda is President of ASA and Safety Committee Chair. He is a member of ACI Committees 506, Shotcreting, and C660, Shotcrete Nozzleman Certification; an ASTM International member; and a certified ACI Examiner.*

## Swimming Pool Construction in Southern California



*This custom-designed 42 ft pool in Arcadia features a subterranean observation room. One of the viewing windows can be seen in the picture*

Photographs courtesy of Baker Pools, Inc.

## Aquatic Pastime Booms Pool Construction

PRIVATE SWIMMING POOL CONSTRUCTION in Southern California has reached such proportions that it is worthy of analysis that will help explain its growth and trends, and how the industry is handling a branch activity that has attained such stature in a comparatively short length of time. Inasmuch as swimming pools have become a definite part of California living, Southwest Builder and Contractor recently made a compilation of pertinent information on the subject, which is submitted herewith for the benefit of its readers.

The statistical data included covers a period of 17 months—the year 1954 and 1955 through May. So far this year private pool construction, for which permits have been issued, has a valuation of \$4,734,772, or at an annual rate of more than \$11 million. According to companies specializing in pool construction, this figure could be conservatively increased by 10 percent to cover pools that are built by the owners without procuring permits, etc.

An important part of this report is an article written by Dennis L. Gibbs, general manager of Baker Pools and publicity chairman of the Associated Swimming Pool Contractors, organized two and one-half years ago to advance the industry. It describes steps that are being taken to standardize specifications, improve building codes, and clean up sales and advertising practices in the trade. Equipment manufacturers, too, are diligently working on improvements, especially as concerns water purification. It all points toward better standards, materials and methods for swimming pool construction.

Manufacturing and distribution of swimming pool equipment, by the way, has become an important activity in Southern California, where more of it is made than anywhere else in the country. Many companies are specializing in the manufacture of such equipment, which oftentimes will represent

fifteen to twenty percent of the total cost of a pool.

The importance attached to pool building by the State of California was seen in the recent establishment by the Contractors' State License Board of a new specialty classification of swimming pool contractors. Designated Class C-53 and effective June 2, 1955, it requires a special examination for licensees. The new section was published in the May 27, 1955 issue of Southwest Builder and Contractor.

Another section of this report is devoted to minimum requirements for swimming pools in the City of Los Angeles, where 1480 private pools were built last year and 860 the first five months of this year. Requirements of the unincorporated areas of Los Angeles County are also included, as are those of the Los Angeles City Health Department.

Written by Glenn L. Black, of Long Beach, and made a part of the report is a description of Anthony Homes 22-house tract in Downey, which has a swimming pool with every house. The pools are considered incomparable sales features for these homes, which are in the \$25,000 price class.

Concerning new developments in pool construction, mention should be made of the recent approval by the Los Angeles City Board of Building and Safety Commissioners of a petition to install steel swimming pools. The design is for a circular tank pool, 18 ft. in diameter, with a maximum depth of 5 ft., 6 in. Bottom of the tank is a 5-in. reinforced concrete slab; steel walls are 4 ft. high and are embedded in the concrete.

Other materials sometimes used for the "shell" of the pool are plastic, aluminum and fiberglass, but pneumatically-applied concrete (gunite) has become practically standard and is described in detail herein. It is reported to be the least expensive method of providing a sound structure in an irregular shape, a design favored by most buyers.



## Statistics Tell Spectacular Swimming Pool Story

CONSTRUCTION OF private swimming pools in Southern California has recorded a spectacular expansion in 1955 and has attained new all-time monthly high levels in each month since February, despite the fact that the peak season for this type of work will not be reached until July and August.

Statistics for the first five months of 1955 show building permits issued throughout the Southland for construction of 1804 private swimming pools with a total valuation of \$4,734,772. The number of pools represents a jump of 47.4% over the 1224 pools provided in permits issued during the first five months of last year, while the valuation in the five-month period this year is an increase of 38.6% over the total of \$3,417,136 in the corresponding months of 1954.

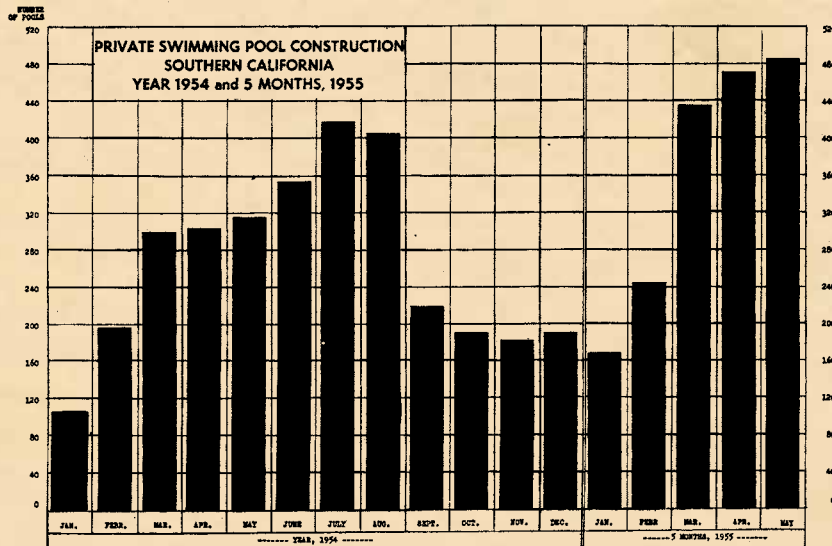
Record-breaking construction figures have been consistent throughout 1955, with the month of January recording an increase of 60.4% in the number of swimming pools as compared with the number provided in January last year, the year-to-year gain in February being 23.2%, in March 45.2%, April 55.1%, and May 52.4%.

With the peak season still ahead, construction of private swimming pools in Southern California for the year 1955 will break all records by a wide margin if current trends are maintained, and to date there has been no indication of slackening in demand.

The previous annual high in private swimming pool construction was last year, when building permits were issued for 3188 pools in the Southland with a total valuation of \$8,511,375. This type of construction has been largely centered

in Los Angeles County, where the year 1954 brought the building of 2868 pools valued at \$7,355,085, the number of pools representing 90% of the Southern California total and the county valuation representing 86.4% of the Southland valuation.

pools with a valuation of \$3,818,276, or 51.6% of all pools in the county and 51.9% of the county's total valuation. In the first five months this year, Los Angeles City showed construction of 860 pools with a valuation of \$2,124,408, or 53.3% of all pools in the county and



In the first five months of this year Los Angeles County accounted for 1614 new pools with a valuation of \$4,086,004, the number of pools being 89½% of the Southern California total and the valuation representing 86.3% of the Southland total.

While Los Angeles County accounts for the great proportion of all Southern California swimming pools, Los Angeles city accounts for more than half of all built in the county. In the year 1954, Los Angeles city showed 1480 new private

52% of the total valuation for pools in the county.

Average building permit valuation per private swimming pool in the year 1954 was \$2670 for all of Southern California, \$2565 for Los Angeles County, and \$2580 for Los Angeles city. In the first five months this year, the average building permit valuation per pool for all of Southern California was \$2625, while in Los Angeles County the average was \$2532 and in Los Angeles city the average was \$2470.

*Recessed surface skimmer, comparatively new device which automatically skims surface of pool, keeping it free of bugs, leaves, and other debris*



## The Swimming Pool Industry Grows Up

By DENNIS L. GIBBS, Vice-President  
BAKER POOLS, INC.  
for ASPC

SWIMMING, as a recreation and a sport, has been popular since the beginning of civilization. No one is so old whose childhood memories do not include the old swimming hole, or a holiday at the seashore. For many years municipal and public plunges also have been centers of recreation, where natural bathing spots were not available. But the golden era in Southern California, the Hollywood of the twenties and thirties, really gave birth to that fabulous baby, the commercial swimming pool industry.

Even then, a private residential swimming pool was something to be read about in movie magazines or social columns, but seldom to be seen or enjoyed

by even the more-prosperous-than-average citizen.

What has happened since that day is a typical story of American ingenuity and industry, and the ever spiraling American standard of living. The Wall Street Journal, in an informative article, reported that there were only 8000 pools of all types in the United States at the end of World War II. Another 10,000 were built, it states, in the next seven years. But in the 18 months closing 1953, another 10,000 were built.

### The boom is on

Estimates are not reliable, but one source states that at the beginning of 1954 there were more than 28,000 pools in the United States, with a breakdown something like this: 15,000 private pools; 5200 in Y.M.C.A.'s, schools, motels and



# Shotcrete Classics



*Excavation being done here with a Hough Payloader; which ramps out of shallow end of pool. Proper setting of forms and excavation are two crucial operations*

hotels; 4700 owned my states, cities, and counties; 2500 Country club pools, and about 900 commercial pools. Most local authorities agree that the 15,000 count on private pools is extremely conservative, and, of course, 1954 saw a doubling of volume for some established builders, with many new companies springing up over the nation.

It is only natural that Southern California, with its combination of ideal climate and tremendous industrial and population growth, should be far ahead of the rest of the country in swimming pool construction, both in techniques, merchandising, and in sheer volume; and with this growth have come the growing pains that have plagued so many of our construction and allied industries. Residential swimming pool construction is a breed all its own; it embraces nearly every trade and skill in the building industry, and at the same time it requires a vigorous, well-coordinated selling program to keep it alive.

With the increasing popularity of swimming pools have come an inevitable influx of ill-fitted and unscrupulous builders, accompanied by their ever-present complement of "suede shoe artists." Too many an innocent home owner in recent years has been left with a partially-completed pool in his back yard and a stack of liens against his property; or, next in line on the growing list of black marks against the pool industry, a piece of construction that was by far more of a headache and a problem than it was a pleasure.

## **The ASPC**

With an eye to the future of the industry and its imminent dangers, a small group of established pool builders sat down to dinner on November 17, 1952, in Hollywood, to discuss these problems. With M. W. Enbody as temporary chairman, they formed a group which was formally organized on March 9, 1953,

with David Brown of Brownie Construction Co., as president; Stanley Curlett of Paddock as vice president, and Dennis L. Gibbs of Baker Pools, Inc., as treasurer. The group named themselves the Associated Swimming Pool Contractors, and dedicated themselves to advance the swimming pool industry in every way possible.

Today, a little over two years later, the association is still striving to gain recognition as the only organized representative group of specialized pool builders in the country, and considerable progress is being made. Membership consists of 14 "regular" members, limited to those who actually make a business of swimming pool construction, and 13 "associate" members, including equipment manufacturers, pool service companies, and sub-contractors. ASPC is pioneering legislation and practice conducive to standardization of specifi-

cations, raising of minimum standards, improvement of building codes and a general cleanup of sales and advertising practices, among other things, within the industry.

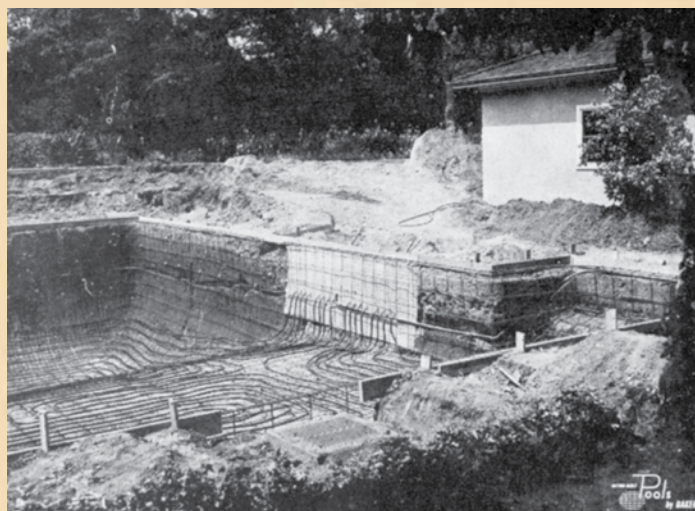
## **ASPC accomplishments**

So far a committee, headed up by Stan Curlett, now associated with Marlin Pool Equipment Co., and M. W. Enbody of Enbody and Sons Co., has succeeded in preparing and having adopted a swimming pool section to be added to the standard code of the Western Plumbing Officials Association. This same code has been adopted en toto by the City of Beverly Hills, and other cities are expected to follow.

Ozzie King, of King Blue-White Pools, chairmanned a committee which has just recently succeeded in persuading the State Contractors License Board to establish a new classification for Swimming Pool Contractors, Class C-53, which became effective June 2, 1955. Construction of appropriate qualifying examinations has already begun. Establishment of this classification should be a long step forward in removing the unqualified builder from the swimming pool industry.

Still another committee, headed by Bart Courtney of Landon Pool Equipment Co., has formulated and adopted a code governing the advertising and selling practices of the industry. Courtney has since become a member of the board of directors of the Better Business Bureau, and the entire association is working with the BBB to enforce the code.

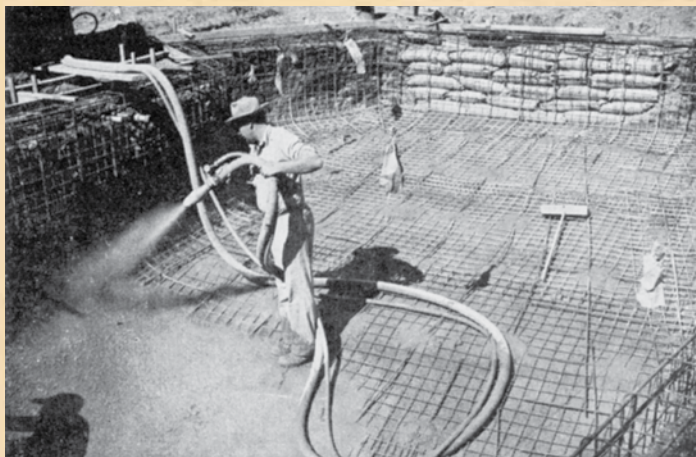
Associate members, as well as regular members, are taking an active interest in forwarding the cause of the association. As an example, W. O. Baker, of Swinequip, Inc., one of the larger equipment manufacturers, is leading a committee, composed exclusively of pool equipment dealers, toward standardiza-



*Radiant heat from tubing buried in the wall is becoming more popular as a means of heating water; also surrounding decks. This photograph of a private installation shows the tubing and reinforcing in place, ready for gunite*



# Shotcrete Classics



*In the gunite process, dry sand and cement are forced under air pressure through hose; water mixture takes place at nozzle. Type of sand used, ratio of sand, and cement to water method of applying can cause quality and strength to vary*

tion of trade practices and improvements of selling ethics.

Above all, the association is anxious to increase its effective membership and strength; and qualified applicants, both regular and associate, are welcome to attend the monthly meetings. There is a great confidence that the Associated Swimming Pool Contractors will grow in strength and size to become a force of great benefit both to the industry and the general public.

#### **Types of pool construction**

In the meantime, equipment manufacturers and pool builders alike are hard at the problem of meeting growing competition with changes and improvements in design and construction of everything from the under-water light, to the filtering system, to the pool structure itself. Types of materials tried with varying degrees of success for the structure, or "shell", include masonry, plastic, steel, aluminum and fiberglass, to name a few.

Of these, gunite, or pneumatically-applied concrete, has become practically standard, for a number of good reasons; for one thing, it is the least expensive of providing a sound structure in an irregular shape, and design is becoming an important factor in residential pools today. Method of application results in a concrete of extreme density without the expense of the forms required for poured concrete. Most pools are "shot" in one day as a monolithic structure and, when completed, present a smooth, unbroken surface with no corners or joints to catch dirt or develop maintenance problems.

#### **Equipment becoming big business**

The increased volume in pool construction has, along with its problems, resulted in some definite advantages to the buying public. For the first time in its history the industry itself has presented a big enough market to warrant the development of bona-fide manufac-

turers and distributors, with a resultant constant improvement in pool equipment, right down the line.

Biggest furor at this writing is over filtering systems, with various adaptations of the diatomaceous earth principle being offered as revolutionary improve-

ments, but most old-time builders are sticking to the time-proven sand pressure system until something that is really better comes along. Without question, the science of water purification is in the throes of producing something truly superior to anything available today, and that new product may not be too far off, now that the market is here to warrant its development.

Everything about pool design and construction is pointing toward improvement: improvement of industry standards; improvement of construction materials and methods, of equipment and accessories. The time is not too far off when a buyer any place in the country will be able to go to a franchised dealer for a nationally known swimming pool, and buy with confidence a standardized, proven product.

And each year millions are recognizing the benefits that can be had from a swimming pool in the home. It offers healthful recreation that keeps the family together in a world that is ever demanding more and more time and energy, and that is allowing less time for true relaxation and exercise. In fulfilling a definite need for modern living the swimming pool industry has an unlimited future.

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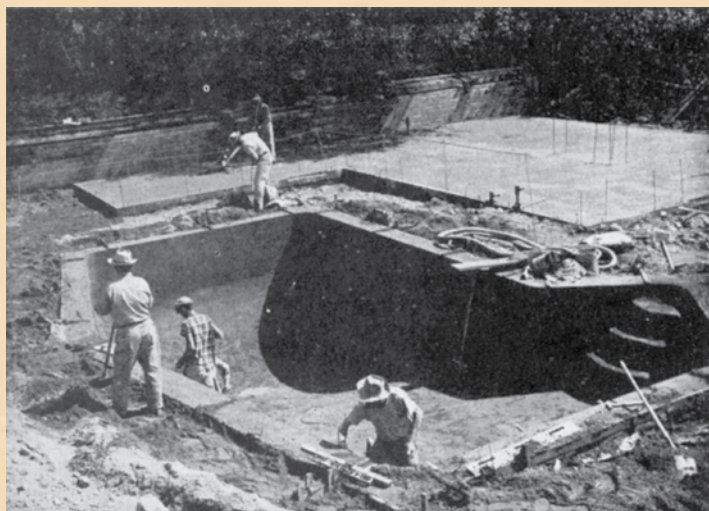
## Gunite in Pool Construction

**By STANLEY G. ZYNDA, Manager  
Gunite Contractors Association**

"GUNITE" is the backbone of the swimming pool industry. It is estimated that over 95 percent of the pools constructed in the Southwest are built by this method. It is preferred because no forms are required for the shell itself. A nominal bond beam form only is used; the remainder of the shell is "shot" directly against the earth, which is graded to the

desired contours.

In that "gunite" is readily adaptable to rounded corners and to curves, almost any imaginable shape is possible at little or no extra cost. This fact is of prime importance in that today, swimming pools are being installed in even the smallest back yard. It is quite often necessary to design the shape to avoid buildings, walks, gardens, etc. The result of this flexibility of gunite has been



*Guniting has been completed and workmen are finishing this private pool*



# Shotcrete Classics



*View of Anthony pool-patio from point just outside living room. Overhead fiber glass screening and surrounding fence create attractive outdoor living area*

the widest imaginable variation in pool shapes.

#### **Subgrade preparation important**

Of over-all importance to the owner and to the "gunite" contractor is the proper preparation of the subgrade. Inasmuch as the weight of the filled pool rests entirely upon excavated earth it is evident that failure of the subgrade will produce a failure in the pool. In some instances pools have been placed in improperly compacted filled ground with a resulting settlement and cracking. The most common error is a comparatively loose backfilling of an over-excavated site. Such cases usually occur where an attempt is made to improve the "looks" of the subgrade. Where torn spots occur in the excavation, it is far better to fill such areas with "gunite". However, if

this policy is carried to the extreme it is also evident that the contractor will be forced to charge for time and material which was not included in his estimate. Hence, it is repeated that proper excavation is of importance to both the owner and the subcontractor.

After the subgrade is prepared the reinforcement is placed. Here, again, is a step of major importance in that, as in concrete, the action of gunite under stress depends upon the "gunite-reinforcement" combination. All too often the steel mat is not chaired from the bottom. In many cases the "gunite" nozzleman, with a helper, should raise the mat to the proper position by placing "gunite" pads at convenient locations. Wall steel is often improperly spaced out and sometimes even rests against earth. Bond beam rein-

forcement is sometimes spaced too closely. There have been cases of heavy bond beams where it was impossible to "shoot" between the bars without incorporating a large amount of rebound in the work. The entire system of reinforcement should be rigidly fastened in place to prevent sloughing of the "gunite."

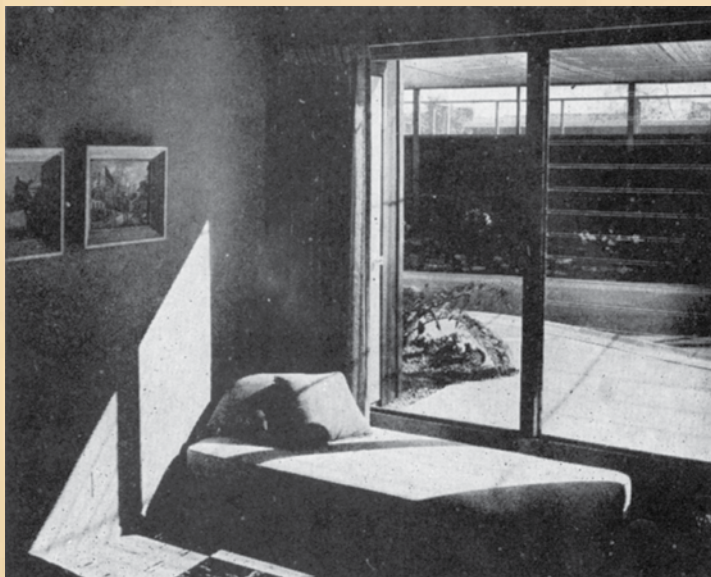
#### **Placing of "gunite"**

The next step is the placing of "gunite." This operation is the most important in the entire construction of the pool, yet sometimes even experienced engineers overlook some of the most common faults. First in importance is the mix, which is usually 1:4½. The owner should ascertain from his "gunite" contractor how many sacks of cement he plans on using in the pool. If necessary he can then check with the engineer who designed the pool as to whether the amount is correct. He should then assure himself by actual count of sacks brought on the job, by empty sacks at the end of the job, or by frequent checks during shooting operations that the proper amount of cement is incorporated into the work. The material should be properly mixed. If there is any doubt about this the owner should have his engineer check the work.

#### **Incorporation of rebound**

The most common fault and the most serious is the incorporation of rebound in the work. Rebound is that material which is rejected upon impingement of the nozzle stream. This is often allowed to fall into the bottom, where it is permitted to lay until covered over by a thin layer of "gunite." Rebound, sometimes allowed to accumulate in the bond beam and in other inaccessible places, is fairly easy to identify, even by the uninitiated, by its loose, gravelly composition. Owners and engineers should insist upon removal of this excess material, which is without structural strength.

Another indication that something is amiss is the number of men working on the pool. It has been found by experience that at least seven men are required to do a good job and to insure proper removal of rebound. Thickness of walls is established by ground wires and is easily checked by measuring from these wires to the earth surface. Bottom thickness can be checked by actual measurement of the "gunite" during placing. The best insurance in the long run is to deal with a reputable contractor experienced in the construction of pools. The Gunite Contractors Association is a non-profit organization whose purpose is to assist engineers, contractors, and owners. In any cases of doubt as to the proper placement of "gunite" it is suggested that this agency be called upon to inspect the work.



*Master bedroom in Anthony home has view of pool-patio through window walls*

A comparatively recent development in pools is the recessed surface skimmer. It automatically skims the surface of the pool, keeping it free of debris.



# Shotcrete Classics

## Minimum Requirements for Swimming Pools in the City of Los Angeles

TWO SETS OF PLANS are required with the permit application, which must include a plot plan showing all buildings on the site and location of the dry well.

A distance of at least 5 ft. must be maintained between a pool and the property line; also between a pool and structures. Dry wells must be at least 8 ft. from a property line, structures and the pool.

Where dry wells are not shown on the plan the following must be shown:

- a. replaceable type filters (\*);
- b. replaceable sand-type filters;
- c. 2000 sq. ft. of site suitable for irrigation, with approval from the city plumbing department, regardless of whether the site is on a hillside or not.

Pools in hillside areas require grading inspection and areas of critical soil require inspection by the city plumbing department.

A pool must be an accessory to a main building in residential zones.

Springboards are not permitted if the pool is less than 7 ft. deep.

Where permits are required the plans must be signed by a licensed engineer.

The use of chlorine gas (for purification) in over 35-lb. cylinders or bromine in any quantity, is controlled by the Los Angeles Fire Department.

Pools accessory to apartment houses are considered public for health and safety requirements, but private for zoning requirements.

Disposal of excavated material is important to the Building and Safety Department. Any question about disposal should be referred to the grading section: MI 5211, Sta. 2942.

Pools, where resting against natural ground, must be designed for earth pressures inward of 30 lbs. per sq. ft. on a 33 degree angle of repose.

If walls of the pool do not rest against natural soil the pool must be designed for water pressure outward.

The design of concrete pools is based on Division 26 of the Los Angeles City Building Code, an entire chapter covering the city's requirements for concrete construction. All pools must be designed for surcharge loads.

Minimum steel reinforcing in either direction must be 1/10 of 1% of the cross sectional area, with maximum spacing of 18 in.

The installation of gunite pools is governed by Sec. 91.2611 (Pneumatically Applied Mortar) of the Los Angeles City Building Code. Exceptions to Sec. 91.2611 are:

- a. gunite concrete (Grade B) swim-  
(\*) Replaceable type filters cannot be used for public pools.

ming pools do not require continuous inspection if designed for Grade "C" concrete stresses.

b. 2 in. of minimum protection will suffice in lieu of 3 in. where concrete is deposited directly against earth, as set forth in Sec. 91.2610 (d).

Permission to construct steel swimming pools requires special action by the Board of Building and Safety Commissioners.

There are no calculations on plastic-lined pools with concrete sides if they are built on natural ground, providing the retaining wall sides for such a pool are not over 4 ft. in height, measured from the bottom of the footing to the top of the wall, unless supporting a surcharge. A grading permit is required for such a pool in a hillside area.

The city's requirements for plumbing work in connection with swimming pools are covered in Sec. 94.20613 of the Los Angeles City Plumbing Code. However, it is anticipated that more rigid requirements for this type of work will soon be in effect, to be covered in a proposed entirely new section (Div. 3 of Part 6) of the city plumbing code. It will go to the board for consideration, probably within the next 30 days.

There is nothing in the Los Angeles City Electrical Code that specifically mentions swimming pools. However, all motors, materials, etc., used for the purpose must be approved under general codes.

### L. A. County Requirements

MINIMUM REQUIREMENTS for swimming pool construction in the unincorporated areas of Los Angeles County are essentially the same as those in the



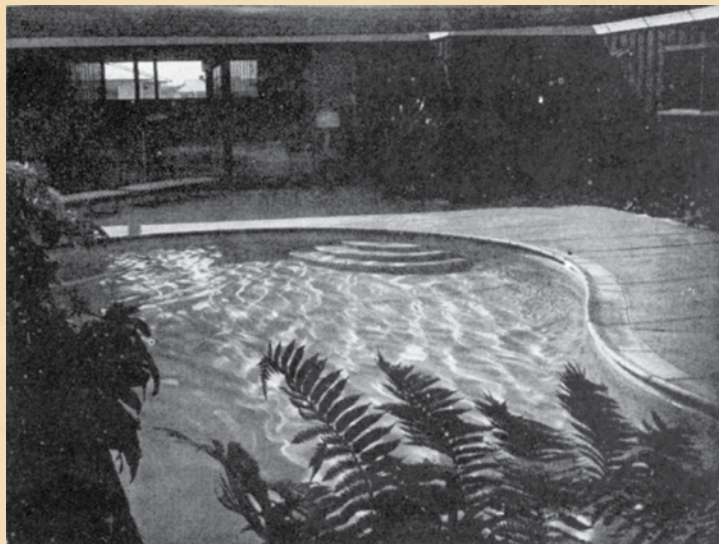
*Tile and coping set around pool's edge by skilled craftsmen serve to make maintenance easier as well as add decorative touch*

City of Los Angeles in respect to design. Designs are based on Chapters 23 and 26 of the Uniform Building Code, used by the county.

Los Angeles County requirements for plumbing used in connection with swimming pools follow the regulations listed under Appendix F of the Uniform Plumbing Code. These standards apply only to outdoor swimming pools. Plans and specifications for all indoor installations must be submitted to the administering authority for approval.

The Los Angeles County Electrical Code makes no specific mention of wiring and fixtures for swimming pools. However, the county follows the state regulations pertaining to approved electrical equipment and materials.

Most of the other municipalities in Southern California use the Uniform Building, Plumbing and Electrical Codes, or codes that are based thereon.



*Pool-patio at Anthony home looking toward the house. Living room is at left*



# SAFETY SHOOTER

## Scaffolding by the Pros?

By Chris Zynda, Director of Shotcrete Operations, Joseph J. Albanese, Inc.,  
ASA President and Safety Committee Chair



I just had a professional scaffolding contractor set up one of our shotcrete jobs. I thought that because I was hiring a firm specializing in scaffolding, I would have a clean and safe workplace for the shotcrete crew.

The job was a large basement at Fresno State University in California (refer to Fig. 1). The job required approximately 2000 lineal ft of 20 ft (6 m) high scaffolding. I ordered 4 ft (1.2 m) walk-through scaffolding set 5 ft (1.5 m) down from the top of the wall. I requested that the scaffolding be set 20 in. (508 mm) off the existing form already put in place by our carpenter crew. Reinforcing bar also had been placed by our reinforcing bar crew

prior to erection of the scaffolding. (*Tip: never erect scaffolding before reinforcing bar. It only gets in your way*). The finished wall thickness was to be 10 in. (254 mm). Setting the scaffolding at 20 in. (508 mm) off the existing form would leave 10 in. (254 mm) from the edge of the scaffolding to the newly placed shotcrete wall. At first glance the scaffolding looked good—fully planked, ladders, and guard rails installed. I started to walk the job and climbed the scaffolding to observe our wireman setting grade. He was standing between the newly erected scaffolding and the reinforcing bar for the shotcrete wall (refer to Fig. 2). This looked very dangerous, and I decided to investigate. We measured the scaffolding offset from the wall and found it was 29 in. (737 mm) instead of the 20 in. (508 mm) requested. Nine inches (229 mm)





may not seem like a lot, but remember, the shotcrete wall was not in place yet so the gap between the existing wall and scaffolding was more than 19 in. (483 mm) in some locations, creating a hazardous work place, especially without the use of a safety harness. The other concern on this job was the installation of solid-brace scaffolding at the base (refer to Fig. 3) instead of 4 ft (1.2 m) walk-through scaffolding, making it hard to properly place the shotcrete and impossible for continuous work. Without the specified scaffolding the shotcrete pump would have to be shut down while moving between scaffolding supports.



Fig. 2

We called the scaffolding contractor back to the site and had him move all the scaffolding to the requested 9 in. (229 mm) offset needed to make the job safe for the shotcrete crew (refer to Fig. 4). Figure 5 shows the ladder needed for the shotcrete crew to climb the scaffolding. Note the guard rail at top used for the material hose—all rails needs to be secured properly.

Hiring a scaffold specialty contractor is an important step in creating a safe, efficient work site. Never assume, however, that the scaffolding will be erected properly. As President Ronald Reagan said when discussing a disarmament treaty with the former Soviet Union, "Trust, but verify."



Fig. 4



Fig. 3



Fig. 5

## 6000 Economic Recovery Projects and Counting

In early August, Transportation Secretary **Ray LaHood** called it a “major milestone” when the 6000th highway construction project was approved under the American Recovery and Reinvestment Act (ARRA). The price tag: \$17.3 billion, which will soon be flowing into the nation’s economy to support hundreds of thousands of jobs and businesses both large and small.

Even before the recovery act was signed into law, state departments of transportation began the advance work necessary to gain speedy federal approval to obligate ARRA funds. And in the 6 months since ARRA was signed into law, state departments of transportation have obligated 65% of the \$27 billion targeted for highways and bridges.

Obligation is the first step required by law that allows states to initiate the bidding process. After advertising the projects to contractors, states then select the winning bid and award the contract. Bids have come in from between 5% to 30% lower than anticipated on many of the 2500 projects now under construction in all 50 states and the District of Columbia.

## U.S. Construction Spending Rises Unexpectedly

Construction spending rose for the second time in 3 months in June as residential building increased—evidence that the housing sector may be recovering.

The Commerce Department indicated that construction spending increased by a seasonally adjusted annual rate of 0.3% in June. Still, June’s \$965.7 billion in spending was 10.2% below the year-ago level.

New and existing home sales each rose in June, and new home construction also increased. Private residential construction rose 0.5% to a seasonally adjusted annual rate of \$246.1 billion. The improvement follows a 3.1% drop in May.

Public construction also helped drive the increase, jumping 1% to \$321.7 billion for the biggest rise since March. Federal

government construction spending increased 1.9%, the most since December 2008, after falling 0.3% in May and plummeting 6.1% in April. State and local construction rose 1% as spending on education and highway construction also grew.

## Calgary Structural Shotcrete Forum and Seminar

On June 24, 2009, the American Concrete Institute (ACI) Alberta Chapter, in conjunction with the Canadian Society for Civil Engineering (CSCE) Calgary Section, co-hosted a “Structural Shotcrete Forum and Seminar.” The 1-day forum and seminar was organized by the immediate Past President of the American Shotcrete Association (ASA), **Dr. D. R. (Rusty) Morgan**, PEng, in conjunction with **David Impey**, PEng, of Graham Construction Inc (representing ACI) and **Dan Danke** (representing the American Society of Civil Engineers [ASCE]) in response to the rapid growth of the use of structural shotcrete in Western Canada and the request from the concrete industry for such a forum to bring all the players together to facilitate dialogue and technology transfer. The event was successful with nearly 90 attendees and lively question/answer sessions.



*Rusty Morgan*



The Structural Shotcrete forum began with an introduction by Rusty Morgan, followed by his guidance on “Structural Shotcrete Specifications.” This was followed by a presentation by **Ken Lausten**, PEng, of Read Jones Christoffersen on “Structural Shotcrete: Structural Engineers Perspective.” **Bill Lenz**, PEng, of Lafarge Canada Inc., then spoke on “Ready Mix Shotcrete Design and Supply,” followed by a presentation by **Shaun Radomski**, PEng, of AMEC Earth & Environmental on “Shotcrete Quality Control Inspection and Testing.”



*Chris Zynda*

The contractors building structural shotcrete works then took over. **Ross King** of Conshot Systems Inc. gave a very interesting presentation on “Structural Shotcrete Construction in Western Canada.” The forum was privileged to have the current President of ASA, **Chris Zynda**, travel all the way from California to provide a most illuminating presentation on “Structural Shotcrete Construction: California Experience.” Forum attendees benefited greatly from the information disseminated by the collective knowledge and experience of the speakers and many compliments were received at the end of the day.

The afternoon seminar session started with a presentation by Rusty Morgan and Chris Zynda on “Shotcrete: A Versatile Construction Solution.” This presentation drew largely from the collective 60+ years of case history experience of the two speakers and showcased the many and various uses of the shotcrete process. This was followed by a presentation by **Justin Lessard** of ConCreate-USL on the ASA award-winning infrastructure project: “Shotcrete Construction of the 2010

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Circle #6 on reader response form—page 60



Winter Olympics Bobsleigh/Luge Track at Whistler.” **Shaun Radomski** of AMEC Earth & Environmental and **Matthew McCreakan** of ConCreate-USL then gave a joint presentation on “Shotcrete Repair of a Sulphur Pit.” The seminar concluded with a presentation by **Kevin Yuers** of Kryton International Inc. on the topic of “Waterproofing Structural Shotcrete.”

## A Concrete Industry Sector Still Growing in 2009—Hospitals and Health Care Facilities

Ed Sullivan, Chief Economist for the Portland Cement Association (PCA), predicted in PCA’s Spring 2009 “U.S. Cement and Construction Forecast” that hospital and institutional building construction will rise to \$18 billion in 2009, a 1.9% increase from last year.

## 4.4 Billion for Construction in War Funding Bill

The White House signed a \$106 billion supplemental spending bill for fiscal 2009 that funds the wars in Afghanistan and Iraq but also contains approximately \$4.4 billion for defense and nonmilitary construction. The measure’s construction allocations include \$2.7 billion for Department of Defense construction—\$847 million will go to the Army Corps of Engineers for work along the Gulf Coast, including rebuilding barrier islands and other ecosystem restoration.

## ACI Certification Exam Recognized By U.S. Department Of Veteran Affairs

The American Concrete Institute (ACI) announced the recent recognition of its ACI Concrete Field Testing Technician—Grade I certification exam by the U.S. Department of Veteran Affairs (VA).

By way of the G.I. Bill, veterans may now attend an ACI Concrete Field Testing Technician—Grade I exam session and submit a copy of their invoice to the VA for reimbursement up to \$500. Currently, the Concrete Field Testing Technician—Grade I certification exam is the only ACI exam recognized by the VA; however,

ACI plans to apply for additional approvals for other exams by the VA in the next year.

“The American Concrete Institute is dedicated to providing certification programs that result in a knowledgeable and efficient workforce in concrete construction,” said **John Nehasil**, Managing Director of Certification at ACI. “We are pleased to offer America’s veterans the opportunity to take the ACI

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Circle #8 on reader response form—page 60

# Industry News

Concrete Field Testing Technician—Grade I certification exam and be reimbursed by the U.S. Department of Veteran Affairs and will work hard to gain the same recognitions for other ACI exams in the future.”

ACI currently offers 17 certification programs, including the Shotcrete Nozzleman Certification, designed to form a minimum qualification for personnel employed within the concrete construction industry.

## Personnel News

### Lifetime Achievement Award to George Yoggy



The Underground Construction Association (UCA) of The Society of Mining, Metallurgy and Exploration (SME) presented its 2009 Lifetime Achievement Award to **George Yoggy**. This is the highest award by UCA of SME. George Yoggy is an ASA Founding and Honorary Member.

*George Yoggy* Yoggy has been involved in shotcrete and concrete applications for underground and heavy construction and repair of concrete structures for more than 50 years. He has international experience in shotcrete for ground support technology employing the New Austrian Tunneling Method and similar techniques developed in Switzerland and Austria, as well as shotcrete for repair and refractory applications.

His career started as a college job with a concrete contractor while attending Wheaton College and the University of Chicago, Chicago, IL. From 1967 to 1986, Yoggy was a partner in Concrete Equipment Corp. and Shotcrete Plus, a business engaged in the design, manufacture, and supply of shotcreting equipment and services for ground support and mass concrete placement. In 1986, the companies became part of Master Builders Technologies. There, he founded the Underground Construction Group for MET Americas.

Yoggy retired from Master Builders in 2000 and is a Consultant to the tunnel, mining, and shotcrete industries, specializing in ground support. He serves on technical committees including ACI and ASTM shotcrete, underground, and certification. He is a Past Director of Laborers-AGC Tunnel Advisory Board and is a Past President of the American Underground Construction Association.

Some of the projects Yoggy has worked on include the foundation for the World Trade Center; La Guardia Airport runway extensions; the foundations for the Delaware Memorial Bridge; the Newburgh Beacon Bridge and the Maryland Bay Bridge; the New York subway; the Nevada Test Site; the Arlberg Tunnel in Austria; and, most recently, the St. George Tunnel; the Bergen Tunnel; the Yucca Mountain project; and World Trade Center repairs.

### Meadow Valley Contractors, Inc., announces Robbins as VP of Business Development



*Howard Robbins*

Current ASA Director **Howard Robbins** has taken the position of Vice President of Business Development for Meadow Valley Contractor's Inc.

Meadow Valley Contractor's Inc. (MVCI) was founded in 1980 as a heavy construction contractor and has been providing construction services since its inception. The company's operations are concentrated in Utah and the Las Vegas, NV, and Phoenix, AZ, metropolitan areas. MVCI provides contracting services in the construction of roads and highways, bridges, overpasses, drainage channels, and the paving of highways and airport runways.

### Boral Makes Changes to Board



*Dr. Bob Every*

Boral Limited (Boral) has announced that **Dr. Bob Every** has been appointed as Deputy Chairman of the Board.

Dr. Every joined the Boral Board in September 2007. **Dr. Ken Moss**, Boral's Chairman, is seeking reelection at the 2009 Annual General Meeting (to be held on October 28, 2009). Assuming he is reelected, Dr. Moss intends to remain as Chairman until May 2010. This will provide continuity during the change of CEO at Boral (which is scheduled to occur at the end of this year) and enable Dr. Moss to provide assistance to the incoming CEO while that person gets established in the role.

In May 2010, Dr. Moss intends to retire as Chairman and from the Board, at which time Dr. Every will assume the Chairmanship of Boral. Dr. Moss said, "After 10 years as Chairman of Boral, the time will be right for me to stand down from the Board in May 2010 and for Bob to assume the role of Boral's Chairman at that time. This transition will provide for an orderly succession in respect of the Chairman's role

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while at the same time providing continuity during the change of CEO. Bob is a very capable and well respected Director, with significant operational experience in the building and construction materials industry, and will serve shareholders well as Chairman of Boral."

Another of Boral's long-standing Directors, **John Cloney**, has announced that he does not intend to seek reelection at the 2009 Annual General Meeting. Cloney has been a member of the Board since 1998.

Dr. Moss said, "Over the past 11 years, John has made a significant contribution to the governance and direction of the company. John has been a long-serving member of the Board's Remuneration Committee and has chaired the committee since December 2003. John will retire at the end of the Annual General Meeting on October 28. Along with my fellow Directors, I wish John all the very best and thank him for the valuable contribution he has made."

## Pires New APSP Director of Communications

**Kirstin Pires**, former Editor of *AQUA* magazine, joined the Association of Pool & Spa Professionals (APSP) staff in March as Director of Communications.

In addition to her journalism experience, Kirstin brings to the APSP team a strong public relations background and a wealth of knowledge of the industry. Among Kirstin's responsibilities are *AQUA* magazine and the APSP Smart-Brief e-newsletter.

## Rispin to Join NORMET Americas

Normet Americas Inc. and Normet International Ltd. announced the appointment of **Michael (Mike) Rispin** to the position of Managing Director—NAFTA, effective September 1, 2009. He will be based at the company's operations in Union Grove, WI.

A graduate of the McGill University Mining Engineering program in 1985 and a professional engineer since 1987, his career associated with the mining and construction industries spans 25 years: 12 in explosives (with a focus on underground blasting) and 13 in construction chemicals (with a focus on sprayed concrete). He joins the Normet team after 13 years with Master Builders/Degussa/BASF in Canada, the U.S., and Switzerland.

Rispin will head up Normet's NAFTA team which brings the company's well-

known suite of underground equipment (concrete spraying, concrete transportation, explosives charging, lifting and installation, scaling, and underground logistics), Life Time Care (LTC) parts and service platform, and process expertise to the mining and tunneling construction markets.



*Michael Rispin*

## Kryton International Hires Eastern U.S. Manager

Kryton International Inc. has hired **Paul Anderson** as the new territory manager for the Eastern U.S. He will serve the East Coast from his base in West Islip, NY.

Anderson brings 14 years of experience in the construction industry, having worked his way up in a variety of positions with Lafarge, the world's largest construction materials company. Most recently, he served as Lafarge's Territory Sales Manager for New York City, NY.

Through this new position, Anderson will be the main point of contact for all ready mix concrete suppliers, engineers, architects, and general contractors working with Kryton's crystalline concrete waterproofing products.



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## ASA Signs Memorandum of Understanding Regarding the Concrete Industry's Vision for a Sustainable Future

In August of 2009, the ASA Board of Direction exercised strong leadership and made ASA a full partner in the concrete industry's effort to present a unified industry-wide defense and promote concrete and its sustainability benefits. Details on this new endeavor by ASA can be found in the "Sustainability" section of this magazine.

## ASA Fall 2009 Committee Meetings in New Orleans November 7-9

The ASA Fall 2009 Committee Meetings in New Orleans, LA, will be held at the New Orleans Marriott, November 7-9, 2009. The following committees have scheduled working meetings: ASA Executive Committee, Publications Committee, Pool & Recreational Committee, Education Committee, Safety Committee, Marketing & Membership Committee, ASA Board of Direction, and the inaugural meeting of the new Sustainability Committee.

This event offers participants the opportunity to network with colleagues, provide input on shotcrete materials and publications, and become part of ASA's overall mission.

These meetings are held in conjunction with the ACI Fall 2009 Convention but do not require preregistration and are open and free to the general public and to anyone who has an interest in the shotcrete process.

Scheduled times for all meetings can be found at: [www.shotcrete.org/ASAcalendar.htm](http://www.shotcrete.org/ASAcalendar.htm).

## New ASA Committee on Sustainability Formed

This new committee will hold its first meeting at the ASA Fall 2009 Committee Meetings in New Orleans, LA, on November 7 at 2:30 p.m. The committee will focus on the identification and promotion of the sustainability benefits of shotcrete. Any ASA member interested in participating in this committee is welcome. If you wish to participate but are unable to attend the meeting in New Orleans, please contact the ASA staff.

## ASA Exhibits at the 2009 IBC Show in Pittsburgh

For the first time, ASA had a manned booth at the International Bridge Conference (IBC) in June. This was a rare opportunity to reach out to the infrastructure world and promote the unique advantages of the shotcrete process for repair and rehabilitation. The Pittsburgh, PA, show's 1200 registrants included approximately 120 federal, state, or local agency representatives and 45 university faculty members. ASA was able to contact these two very important groups either directly or by

mail and begin establishing a relationship with them. Numerous sources of information on shotcrete were provided along with the offer of on-site presentations covering the benefits of the shotcrete process.

## New ASA Member Benefit—Government Project Bid Postings

ASA is now posting links to government projects currently open for bid that involve or are related to shotcrete. These postings are sent in the member edition of our twice-a-month e-newsletter "What's In the Mix." If you are an ASA member but are not receiving these links, please forward your e-mail address to [info@shotcrete.org](mailto:info@shotcrete.org).

## ASA Releases New Compilation—"Infrastructure Repair & Rehabilitation Using Shotcrete"

ASA released a new compilation of papers focusing on shotcrete's use in the repair and rehabilitation of infrastructure. The 34-page black-and-white soft-cover book, *Infrastructure Repair & Rehabilitation Using Shotcrete*, is a compilation of eight papers previously published in ASA's *Shotcrete* magazine.

The document was originally created for distribution at the recent International Bridge Conference held in Pittsburgh, PA. Positive response to the compilation moved ASA to make the document available to the entire concrete industry.

Copies of the compilation are available for a special price of \$9.00 U.S. Pricing includes shipping. To place an order, visit [www.shotcrete.org/RepairBulletin](http://www.shotcrete.org/RepairBulletin) or call (248) 848-3780.

## ASA Annual Meeting and Awards Banquet Sponsorship Opportunities

Sponsorship of this event offers your organization exceptional exposure through many venues while supporting a critical event that allows ASA to display the versatility and value of the shotcrete process to the entire construction industry. In short, this event plays a critical role in our efforts to expand the use of shotcrete.


Sponsorship exposure will include the acknowledgment and display of sponsor logos at the Annual Meeting, in the ASA Booth during World of Concrete, on the ASA Web site, in an issue of ASA's e-newsletter, and in the upcoming awards issue of *Shotcrete* magazine. All Web site and e-mail displays will include hot links to each sponsor's Web site.

## Register Now!

The 2010 ASA Annual Membership Meeting and Fifth Annual Outstanding Projects Award Banquet is February 2, 2010. Turn to page 32 for more information.



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## CORPORATE MEMBERS

### Aircrete Systems LP Inc.

Calgary, AB, Canada  
Primary Contact: Jack Radu  
lamanagement@shaw.ca

### Boral Material Technologies Inc.

Roswell, GA  
Primary Contact: Kevin Foody  
kevin.foody@boral.com

### Deluxe Shotcrete & Concrete Construction

Santa Rosa, CA  
Primary Contact: Cindy Culley  
cindy@deluxeshotcrete.com  
www.deluxeshotcrete.com

### Donald J. Scheffler's Construction

City Of Industry, CA  
Primary Contact: Donald J. Scheffler  
mailbox@heidicorp.com

### Meadow Valley Contractors

Phoenix, AZ  
Primary Contact: Howard Robbins  
www.meadowvalley.com

### Pacific Alloy Casting Company Inc.

South Gate, CA  
Primary Contact: Mark Regus  
mregus@pacificalloy.com  
www.pacificalloy.com

### Prestige Concrete Products

Orlando, FL  
pampey@msn.com

### Serafina Industries Ltd.

South Hampton, NY  
Primary Contact: Joseph Tortorella  
info@serafinaconcrete.com  
www.serafinaconcrete.com

### Thiessen Team USA Inc.

Elko, NV  
Primary Contact: James Schumacher  
info@thiessenteam.com

## INDIVIDUAL MEMBERS

### C.J. Bakkes

Elite Gunit LLC  
Lakeland, FL

### David M. Henry

Johnson Concrete Pumping  
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Contact:

**Chris Zynda**

ASA President  
and Safety Committee Chair  
ACI Approved Examiner

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All ASA members and subscribers now have access to the NEW electronic version of *Shotcrete* magazine. A link to this e-magazine is sent as an item in the "What's in the Mix" e-newsletter. To ensure that you receive access to all future issues of the electronic version of the magazine, send your e-mail information to [info@shotcrete.org](mailto:info@shotcrete.org).

Circle #2 on reader response form—page 60



**William H. Hoy**  
Skyline Pool & Spa Inc  
Menlo Park, CA

**Jeff D. Malpass**  
Crom Engineering & Construction  
Services Inc.  
Gainesville, FL

**David Morowit**  
Acorn Concrete Pumping  
Martinez, CA

**Justin Scott**  
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**John Sherline**  
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Lynchburg, VA

**Shafi Ullah**  
Technical University of Vienna

**Yalmezewed Mulugeta Wube**

# **AMERICAN SHOTCRETE ASSOCIATION**

FIRST ANNOUNCEMENT  
AND CALL FOR PAPER

## **Sixth International Symposium on SPRAYED CONCRETE**

**- Modern Use of Wet Mix Sprayed  
Concrete for Underground Support**



**Tromsø, Norway, 12.- 15. September 2011**

[www.sprayedconcrete.no](http://www.sprayedconcrete.no)



**NB** norsk  
betongforening



Circle #49 on reader response form—page 60

## ASA Officially Signs Memorandum of Understanding Regarding the Concrete Industry's Vision for a Sustainable Future

The current political and social environment is resulting in significant changes that are and will impact the concrete industry. The green or environmental movements have grown to a point that they are now the leading forces in shaping governmental policy. The U.S. government is embracing policies that will significantly impact our industry's ability to conduct business.

These changing policies and, perhaps more importantly, public opinion have come about without a unified representation by the concrete industry of the facts regarding the most widely used building material in the world. Our historically fragmented industry is realizing the critical need for our industry to promote concrete and its sustainability benefits.

In August of 2009, the ASA Board of Direction exercised strong leadership and made ASA a full partner in the Joint Sustainability Initiative (JSI), the concrete industry's effort to present a unified industry approach and promote concrete and its sustainability benefits.

This new industry-wide effort, which includes dozens of other concrete-related associations, such as NRMCA, PCA, and ACI, has formed into three fronts: policy making, public relations, and education of architects and engineers (especially in light of green-build requirements). This effort is based on the following nine basic declarations stated in the JSI Memorandum of Understanding.

1. For many decades, our industry has thought and acted as fragmented segments. This approach can no longer lead us to a better future. **We therefore declare that Concrete Structures are the core of our industry identity, which include all vertical and horizontal applications and concrete products.**
2. Until now, this fragmentation has led us to overemphasize component thinking as opposed to integrated systems thinking. **We therefore declare that Concrete Structures are at the center of an integrated approach to addressing industry challenges.**
3. During our century-plus industry history, we have taken for granted that Society acknowledges the value of our endeavors. However, we can no longer rest on this assumption. **We therefore declare that we will proactively communicate and continuously enhance the Social Value of Concrete Structures.**
4. In the narrowness of component-based thinking, we (and Society) often neglect and understate the value provided by concrete structures. **We therefore declare that our integrated thinking will focus on the following Social Values provided by Concrete Structures:**

- **Resource Efficiency:** Concrete Structures, over their life cycle, are efficient users of energy, water, land, and other resources;

- **Safety/Protection:** Concrete Structures provide a superior level of user safety, protection, and peace of mind;
  - **Financial Responsibility:** Concrete Structures provide economic advantage from both a total cost of ownership perspective and from greater local content benefit to communities;
  - **Operational Continuity:** Concrete Structures offer greater disaster resistance, protecting essential community services and business continuity;
  - **Longevity/Durability:** Concrete Structures outlast the useful lives of other structures with minimal maintenance and repair;
  - **By-Products Reduction:** Concrete Structures, over their life cycle, produce a reduced level of by-products (including CO<sub>2</sub>), use the by-products of other activities, and can ultimately be recycled themselves.
  - **Aesthetics:** Concrete Structures can be designed to create aesthetic quality for both users and their surroundings; and
  - **Societal Connectivity:** Concrete Structures provide the essential links (roads, bridges, ports, utility infrastructure) that enable society to function safely and efficiently and prosper financially.
5. In the course of our fragmented history, we have not used our limited industry resources in the most effective way, with resulting duplication, cross-purpose, and sometimes gaps in our actions. **We therefore declare that we will review our priorities and activities, coordinate to align our respective programs and projects, and leverage on the particular strengths and expertise of each organization to pursue an integrated focus on Concrete Structures.**
  6. Our industry has consistently pursued a direction of continuous improvement even though this has been evolutionary and component-based. **We therefore declare that we will persistently drive continuous improvement at component and integrated levels to enhance the Social Value of Concrete Structures.**
  7. We recognize that in order to benefit from using Concrete Structures, all stakeholders must be informed. **We therefore declare that we will provide advocacy and technical and educational resources as appropriate to enhance the use and convey the benefits of Concrete Structures to others.**
  8. We realize that this thinking and corresponding action are overdue and that pressing challenges require we catch up quickly. **We therefore declare that time is of the essence and we will pursue mechanisms and approaches that may diverge from business as usual to aim for expedited results.**
  9. We acknowledge the need to engage and embrace input from all segments in adapting this thinking throughout our industry. **We therefore declare we will maintain open channels to welcome, involve, and engage all industry segments in becoming part of this direction.**

The ASA Board has initiated a wide range of plans to promote the sustainability benefits of concrete and, more specifically, shotcrete. You can read about these planned efforts in the Staff Editorial on page 4 of this issue.



# Shotcrete FAQs

As a service to our readers, each issue of *Shotcrete* will include selected questions and provide answers by the American Shotcrete Association (ASA). Questions can be submitted to: [info@shotcrete.org](mailto:info@shotcrete.org). Selected FAQs can also be found on the ASA Web site, at [www.shotcrete.org/ASAfaqs.htm](http://www.shotcrete.org/ASAfaqs.htm).

**Question:** *I am reconfiguring the interior of a spa and am wondering if drains and jets can be relocated without compromising the overall structure and getting cold cracks. Can the entire interior be re-shot to maintain the monolithic form and guarantee against failure? Is there an independent professional who could conduct an on-site inspection and recommend a next step?*

**Answer:** We are not able to advise you on the structural integrity of a remodel of a spa or any other structure and would suggest you consult with a local engineer who is familiar with pools and spas.

Shotcrete is often used to overlay or patch structures and the success of such overlays and patches is highly dependent upon the quality of the surface preparation prior to the application of the shotcrete.

With respect to referrals of independent professionals, we would suggest that you use the directory of Corporate Members on the ASA Buyers Guide at [www.shotcrete.org/BuyersGuide](http://www.shotcrete.org/BuyersGuide).

**Question:** *I am a civil engineer looking to use shotcrete in a culvert rehabilitation project. Due to flow constraints, we are forced to have a maximum wall thickness of 3 in. (76 mm). For the typical 96 in. (2438 mm) precast concrete culvert, the walls are approximately 9 in. (228 mm). What can I do to obtain a near similar product with only 3 in. (76 mm) of wall thickness? Can shotcrete be applied at higher compressive strengths, 10 psi (0.07 MPa), or is it better to use fiber-reinforced shotcrete? The intent of the retrofit is to at least obtain a 10-year service life to this temporary solution.*

**Answer:** This is an engineering question, not an application question. Precast pipe is sized for multiple uses and services. Depending on this service (depth of cover or loads), creative reinforcing bar placement and higher compressive strengths can

reduce the wall thickness significantly. For example, success has been realized using elliptical steel to reduce concrete section thickness. Fiber reinforcement is secondary reinforcing and is not a suitable replacement for reinforcing steel.

Given the short life required of the culvert, and assuming fairly equal loading on the circumference, a 3 to 4 in. (76 to 101 mm) section with judiciously placed reinforcing bar, and silica fume (8 to 10% of cement for higher strength [up to 10,000 psi (69 MPa)]) would be sufficient. The resulting culvert's life would probably be much longer than 10 years. In the end, an engineering call should be made, but the material will perform.

**Question:** *Is it feasible and economical to construct floodwalls approximately 5 ft (1.5 m) high with shotcrete?*

**Answer:** Yes, it is feasible and economical to construct structural walls such as a 5 ft (1.5 m) high floodwall. Shotcrete is a method of placing concrete and has similar, if not identical, properties after placement.

As you can imagine, shotcrete needs to be shot against something such as a one-sided form, gabion baskets, earth, expanded metal lath, or just about any structurally sound thing you can think of. The economy of the system is dependent upon the site conditions and the ingenuity of the contractor.

An example of a similar structure is on the east side of I-880, south of Dixon Landing Road in Milpitas, CA. This project, a flood control channel, involved trapezoidal channel sections, vertical wall sections, and a combination of sloped walls with a vertical extension.

If you have further interest, you should contact an organization with experience in this area. An excellent source is the directory of Corporate Members on the ASA Buyers Guide at [www.shotcrete.org/BuyersGuide](http://www.shotcrete.org/BuyersGuide).



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Circle #10 on reader response form—page 60

# New Products & Practice

## ACI Releases New 506.5R-09: “Guide for Specifying Underground Shotcrete”



This document provides a guide for owners; contractors; designers; and testing, specifying, and inspection organizations engaged in the application of shotcrete for underground support. The guide provides general information for the selection of constituent materials and methods to proportion shotcrete. Typical methods of batching, mixing, and handling of proportioned shotcrete

materials are detailed along with shotcrete placement methods and equipment.

For more information on this new 52-page report, go to [www.concrete.org](http://www.concrete.org).

## MacLean Engineering Partners with Allentown Shotcrete Technology, Inc.



MacLean Engineering (MacLean), manufacturer of carriers, drilling equipment, and haulers for the mining industry, announces the development of its new self-contained shotcrete spraying machine using Allentown Shotcrete Technology, Inc.'s (Allentown) expertise and spraying components.

MacLean recognized that the Canadian mining industry was in need of a better choice for fully self-contained spraying

machines. Given that the company already manufactures equipment for this industry, a shotcrete spraying machine was a natural addition to the product lineup.

The shotcrete spraying machine's development was fast tracked beginning in September 2008 at MinExpo when MacLean contacted Allentown about the possibility of using their components and expertise to develop this machine.

"After multiple meetings, MacLean recognized the strength behind Allentown, both in our equipment engineering and longevity in the shotcrete industry," says Bill Carbeau, Director of Special Applications Business for Allentown. "They decided Allentown components needed to be in the machine."

MacLean used the Allentown concrete pumping assembly because of its proven ability to supply material both surge- and trouble-free to the nozzle. Also incorporated is the chemical dosing system and robotic boom arm. To top it off, a nozzle is used to obtain optimal spray coverage and performance.

The new shotcrete spraying machine is now available to the mining industry throughout the world. For more information, contact Allentown at (800) 553-3414 or MacLean at (866) 856-3626.

## Putzmeister America, Inc., Launches Genuine Parts Online Webshop



Offering greater convenience for its distributors, Putzmeister America, Inc., is launching its Genuine Parts Online Webshop through its Web site, [www.putzmeister.com](http://www.putzmeister.com), located in the Parts & Service section.

"Our new online parts Webshop provides nationwide computerized coverage for distributors to access our inventory of over 20,000 parts totaling more than \$40 million through a quick and seamless process from home or work," says Ian Moore, Vice President of Customer Support for Putzmeister America. "The great thing about ordering your parts online is that there's no waiting on someone, waiting in line, or the need to get your order placed by 5 p.m.; all orders can be placed at your leisure at any time, 24/7. Of course, our personalized customer service is always accessible through our toll-free phone line and round-the-clock fax as well."

An advanced storage system at the Wisconsin headquarters makes retrieval quick and a spare parts stock order program includes recommended lists for all Putzmeister product lines.

The Genuine Parts Online Webshop features a secure online transaction process with your Putzmeister Advantage Plus card as well as your Visa, MasterCard, or Amex card.

## Lafarge Launches Product Guide for LEED Project Certification

Lafarge announces the launch of a new online tool for design professionals—primarily architects and engineers—designed to help them find Lafarge products that can be specified to help

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**AMERICAN**  
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**ASSOCIATION**



# New Products & Practice

meet green building requirements under the LEED rating system. This online version replaces the former print document and meets U.S. and Canadian LEED requirements.

"Each search result will display the product name, image, and description; list the credit categories it applies to; provide an explanation of how the product satisfies credit requirements; and list a Lafarge contact person," said Andrew Pinneke, LEED AP and Technical Marketing Coordinator for Lafarge. "This is a tool that will take the mystery out of determining what Lafarge product is available for use in a given project. Once the product has been identified, the specifier can contact the Lafarge representative to address any remaining product/project issues."

While the guide currently features Lafarge cement and gypsum products, Lafarge plans to soon add other Lafarge products and green building rating systems. The guide complies with the requirements of the new LEED 2009 rating system.

To learn more about the Lafarge Product Guide for LEED Project Certification, visit the Lafarge Web site at [www.lafarge-na.com](http://www.lafarge-na.com). A link to the guide is located on the right side of the home page.

## Kryton Launches Extended Warranty in North America to Guarantee Waterproofing for 10 Years

Vancouver-based Kryton International Inc. has launched an extended warranty and quality control program for concrete waterproofing construction—The Krystol® Assurance Program™.

The performance warranty guarantees that areas of a structure waterproofed by Kryton will remain watertight for 10 years. It also provides enhanced quality control and project support through consistent on-site supervision, mixture design consultation, jointing design review, and training for applicators by Kryton representatives.

The Krystol Assurance Program is distinct from Kryton's standard warranty. While Kryton's standard warranty guarantees that every product is free from manufacturer defects, the Krystol Assurance Program includes services such as on-site supervision, inspection, concrete mixture design consulting, and applicator training. These additional services enable Kryton to offer a performance-based warranty that covers all materials and labor required for repair or replacement should leaks occur within the warranty period.

Kryton International is a 36-year-old Canadian manufacturing company with global reach. The company developed the world's first crystalline waterproofing admixture and a patent-pending concrete jointing system using the same technology. The Krystol™ Concrete Waterproofing System replaces traditional external membrane systems by transforming porous concrete into an impermeable barrier. The technology works within the concrete through a chemical reaction that causes microscopic, needle-like crystals to grow and fill the naturally occurring pores and capillaries—permanently blocking pathways to water. Later, if water reenters the concrete through new cracks or changing water levels, the reaction starts again to block incoming water.

All North American projects can be considered for the Krystol Assurance Program. Acceptance into the program is dependent on a review of project specifications, mixture design consultation, and a mutual commitment to work together in following best practices for concrete waterproofing with crystalline technology. The warranty is subject to adhering to Kryton's Best Practices guide for crystalline waterproofing, which incorporates American Concrete Institute guidelines for concrete construction.

For more information, please visit [www.kryton.com](http://www.kryton.com).

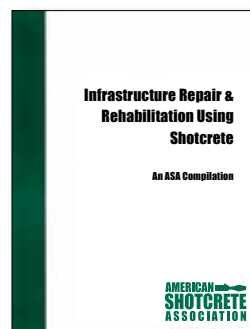
## New Downloadable Brochure from MEYCO Global Underground Construction, Part of BASF



### Construction Chemicals

The new brochure, "Solutions for Tunneling and Mining-Sprayed Concrete," is an in-depth review of the company's solutions-based approach. The document can be downloaded from the "Sprayed Concrete" section of the Web site ([www.meyco.basf.com](http://www.meyco.basf.com)).

## Infrastructure Repair & Rehabilitation Using Shotcrete—An ASA Compilation



The document was originally created for distribution at the last "International Bridge Conference" held in Pittsburgh, PA. Positive response to the compilation moved ASA to make the document available to the entire concrete industry.

This new compilation of papers focuses on shotcrete's use in the repair and rehabilitation of infrastructure. The 34-page black and white soft-cover book, "Infrastructure Repair & Rehabilitation Using Shotcrete," is a compilation of eight previously published papers in ASA's *Shotcrete* magazine.

Copies of the compilation are available for a special price of \$9.00 U.S. Pricing includes shipping. To place an order, visit [www.shotcrete.org/RepairBulletin](http://www.shotcrete.org/RepairBulletin) or call (248) 848-3780.

# Shotcrete Calendar

NOVEMBER 7, 2009

## **ASA Fall Committee Meetings**

Marriott New Orleans ([www.marriott.com](http://www.marriott.com))

New Orleans, LA

Web site: [www.shotcrete.org](http://www.shotcrete.org)

Executive Committee—CLOSED

7:00 a.m.-9:00 a.m.

Salon A

Publications Committee

9:00 a.m.-10:00 a.m.

Salon A

Pool & Recreational Committee

10:00 a.m.-11:00 a.m.

Salon A

Education Committee

11:00 a.m.-12:00 p.m.

Salon A

Safety Committee

12:00 p.m.-1:00 p.m.

Salon A

Sustainability Committee

1:00 p.m.-2:30 p.m.

Salon A

Marketing & Membership Committee

2:30 p.m.-4:00 p.m.

Salon A

Board of Direction

4:00 p.m.-6:00 p.m.

Salon A

NOVEMBER 8-12, 2009

## **ACI Fall 2009 Convention**

Theme: "Spice up your Concrete"

Marriott New Orleans

New Orleans, LA

Web site: [www.concrete.org](http://www.concrete.org)

NOVEMBER 9, 2009

## **ASA Fall Committee Meeting**

Marriott New Orleans

New Orleans, LA

Underground Committee

5:00 p.m.-7:00 p.m.

Balcony M

NOVEMBER 13-18, 2009

## **International Pool/Spa/Patio Show**

Conference: November 13-18

Exhibits: November 16-18

Mandalay Bay Convention Center

**Visit ASA at booth 310**

Las Vegas, NV

Web site: [www.poolspapatio.com](http://www.poolspapatio.com)

DECEMBER 7-9, 2009

## **ASTM International Committee C09,**

### **Concrete and Concrete Aggregates**

Hyatt Regency Atlanta

Atlanta, GA

Web site: [www.astm.org](http://www.astm.org)

FEBRUARY 1, 2010

## **ASA World of Concrete Annual Meetings**

Las Vegas Convention Center

Las Vegas, NV

Publications Committee

8:00 a.m.-9:00 a.m.

Pool & Recreational Committee

9:00 a.m.-10:00 a.m.

Education Committee

10:00 a.m.-11:00 a.m.

Safety Committee

11:00 a.m.-12:00 p.m.

Marketing & Membership Committee

12:00 p.m.-2:00 p.m.

Underground Committee

2:00 p.m.-3:00 p.m.

FEBRUARY 1-5, 2010

## **World of Concrete**

Seminars: February 1-5

Exhibits: February 2-5

**Register FREE with ASA's source code of A17**

Las Vegas Convention Center

**Visit ASA at booth S10749**

Las Vegas, NV

Web site: [www.worldofconcrete.com](http://www.worldofconcrete.com)

FEBRUARY 2, 2010

## **Using the Shotcrete Process to Rehabilitate**

### **North America's Infrastructure Seminar**

8:30 a.m.-10:00 a.m.

Las Vegas Convention Center

Las Vegas, NV

Web site: [www.worldofconcrete.com](http://www.worldofconcrete.com)

FEBRUARY 2, 2010

## **The 2010 ASA Annual Membership Meeting**

### **& Fifth Annual Outstanding Shotcrete Project Awards Banquet**

Reception: 6:00 p.m.-7:00 p.m.

Dinner: 7:00 p.m.-10:00 p.m.

Monte Carlo Resort & Casino

Las Vegas, NV

Web site: [www.shotcrete.org](http://www.shotcrete.org)



MARCH 15-17, 2010

**Australian Shotcrete Society's International  
Conference/Engineering Developments  
in Shotcrete**

Millennium Hotel

Queenstown, New Zealand

Web site: [www.eds2010.com](http://www.eds2010.com)

MARCH 20, 2010

**ASA Spring Committee Meetings**

Sheraton Chicago

Chicago, IL

Executive Committee

Publications Committee

Pool & Recreational Committee

Education Committee

Safety Committee

Sustainability Committee

Marketing & Membership Committee

Board of Direction

MARCH 21-25, 2010

**ACI Spring 2010 Convention**

Theme: "Xtreme Concrete"

Sheraton Chicago

Chicago, IL

Web site: [www.concrete.org](http://www.concrete.org)

MARCH 22, 2010

**ASA Spring Committee Meetings**

Sheraton Chicago

Chicago, IL

Underground Committee

APRIL 14-16, 2010

**ICRI 2010 Spring Convention**

Theme: "Transportation Structures"

Myrtle Beach Resort & Spa at Grande Dunes

Myrtle Beach, SC

Web site: [www.icri.org](http://www.icri.org)

OCTOBER 20-22, 2010

**ICRI 2010 Fall Convention**

Theme: "Aesthetics in Concrete Repair"

Omni William Penn Hotel

Pittsburgh, PA

Web site: [www.icri.org](http://www.icri.org)

OCTOBER 28-NOVEMBER 2, 2010

**2010 AASHTO Annual Meeting**

Beau Rivage Resort & Casino

Web site: [www.transportation.org](http://www.transportation.org)

DECEMBER 5-8, 2010

**ASTM International Committee C09,  
Concrete and Concrete Aggregates**

Sheraton New Orleans

New Orleans, LA

Web site: [www.astm.org](http://www.astm.org)



# Shotcrete

## *A Compilation of Papers*

This 424-page hardcover book, *Shotcrete: A Compilation of Papers*, is a collection of the most important papers concerning shotcrete by Dudley R. "Rusty" Morgan, PhD, PEng, FACI, FCAE.

Topics in the book include: Shotcrete Research and Development, Freeze-Thaw Durability of Shotcrete, Fiber-Reinforced Shotcrete, Shotcrete for Ground and Underground Support, Infrastructure Rehabilitation with Shotcrete, and Supplementary Shotcrete Publications.

Rusty Morgan has over 40 years of experience in materials engineering, specializing in concrete technology, and is recognized as an authority in shotcrete technology throughout the world. The listing of selected examples of projects he has worked on during his career is over 8 pages long, and his bibliography includes more than 140 peer-reviewed papers. He has also served as editor of several books.



ASA Members: \$50.00

Nonmembers: \$85.00

[www.shotcrete.org](http://www.shotcrete.org)

# AMERICAN SHOTCRETE ASSOCIATION



## ASA Membership Benefits

	Corporate	Corporate - Additional Individual	Individual	Employees of Public Authorities or Agencies	Nozzleman	Student
Annual Dues	\$750	\$100	\$250	\$50	\$50	Free
Subscription to quarterly <i>Shotcrete</i> magazine (Hard Copy)	X	X	X	X	X	
Electronic Subscription to quarterly <i>Shotcrete</i> magazine	X	X	X	X	X	X
Free advance general admittance registration to World of Concrete	X	X	X	X	X	X
Reduced advance registration fees to ASA annual meetings	X	X	X	X	?	X
Networking and participation opportunities at Annual Membership Meeting and committee meetings	X	X	X	X	X	X
Opportunity to become a shotcrete educator	X	X	X	X	X	
Discounted ASA Member prices on all ASA products	X	X	X	X	X	X
Complimentary ASA shotcrete brochure each year	25		1	1		
Complimentary ASA reflective hardhat sticker each year	10		1	1		
Permission to include ASA logo on corporate letterhead and business cards	X	X	X	X		
Permission to display ASA logo on company web site	X					
Discounted Member pricing on advertising in <i>Shotcrete</i> magazine	X	X	X	X		
Free logo and link advertising on ASA website homepage for duration of each issue you advertise in <i>Shotcrete</i>	X					
Opportunity to submit items for Industry News and New Products & Practice sections of <i>Shotcrete</i> magazine at no charge	X	X	X	X		
Voting privileges at meetings and director/officer elections	X		X			
All company employees have opportunity to receive discounted Corporate Additional ASA Memberships (\$150 off regular membership price for each employee)	X					
Company & specialty information listed in <i>Shotcrete</i> magazine's annual Buyers Guide	X					
Company & specialty information listed in ASA online Buyers Guide	X					
Opportunity to submit entries into the annual Outstanding Shotcrete Project Awards Program	X					
Discount on ACI Nozzleman Certification program and ACI Recertification program	X					
Discount on ASA Underground Shotcrete Education Program	X					
ASA Promotion of nozzleman certification on a national basis in conjunction with ACI						X
<b>Education &amp; promotion of your shotcrete industry to the overall concrete industry</b>	X	X	X	X	X	X



## MEMBERSHIP APPLICATION

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|---|--|
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| <input type="checkbox"/> Individual                                   | \$250  |
| <input type="checkbox"/> Additional Individual from Member Company    | \$100  |
| <input type="checkbox"/> Employees of Public Authorities and Agencies | \$50   |
| <input type="checkbox"/> Nozzleman                                    | \$50   |
| <input type="checkbox"/> Student                                      | Free (Requires copy of Student ID card or other proof of student status) |

*NOTE: Dues are not deductible as charitable contributions for tax purposes, but may be deductible as a business expense.*

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Name on card \_\_\_\_\_ Signature \_\_\_\_\_

### Company Specialties—Corporate Members Only

Company Specialties are searchable in the printed and online Buyers Guide.

#### Admixtures

- ☐ Accelerating
- ☐ Air Entraining
- ☐ Foaming
- ☐ Retarding
- ☐ Shrinkage Compensating
- ☐ Special Application
- ☐ Stabilizing
- ☐ Water Proofing
- ☐ Water Reducing-Accelerate
- ☐ Water Reducing-High Range
- ☐ Water Reducing-Mid Range
- ☐ Water Reducing-Normal
- ☐ Water Reducing-Retarding
- ☐ Water Repellent

#### Cement/Pozzolan Materials

- ☐ Cement-Blended
- ☐ Cement-Portland
- ☐ Cement-White
- ☐ Fly Ash
- ☐ Ground/Granulated Slag
- ☐ Metakaolin
- ☐ Pozzolan
- ☐ Silica Fume-Dry
- ☐ Silica Fume-Slurry

#### Consulting

- ☐ Design
- ☐ Engineering
- ☐ Forensic/Troubleshooting
- ☐ Project Management
- ☐ Quality Control Inspection/Testing
- ☐ Research/Development
- ☐ Shotcrete/Gunite
- ☐ Skateparks

#### Contractors

- ☐ Architectural
- ☐ Canal Lining
- ☐ Culvert/Pipe Lining
- ☐ Dams/Bridges
- ☐ Domes
- ☐ Flood Control/Drainage
- ☐ Foundations
- ☐ Grouting
- ☐ Lagoons
- ☐ Mining/Underground
- ☐ Parking Structures
- ☐ Pumping Services
- ☐ Refractory
- ☐ Repair/Rehabilitation
- ☐ Residential
- ☐ Rock Bolts

#### Contractors, contd.

- ☐ Rock Carving
- ☐ Seismic Retrofit
- ☐ Sewers
- ☐ Skateparks
- ☐ Slope Protection/Stabilization
- ☐ Soil Nailing
- ☐ Storage Tanks
- ☐ Structural
- ☐ Swimming Pools/Spas
- ☐ Tunnels
- ☐ Walls
- ☐ Water Features

#### Equipment

- ☐ Accessories
- ☐ Adaptors
- ☐ Air Vibrators
- ☐ Bowls
- ☐ Clamps
- ☐ Compressors
- ☐ Couplings
- ☐ Feeder/Dosing
- ☐ Finishing
- ☐ Grouting
- ☐ Guide Wires
- ☐ Gunning Machines

#### Equipment, contd.

- ☐ Hoses
- ☐ Mixers
- ☐ Nozzles
- ☐ Pipe/Elbows/Reducers
- ☐ Plastering
- ☐ Pre-Dampers
- ☐ Pumps
- ☐ Robotic
- ☐ Safety/Protection
- ☐ Silo Systems
- ☐ Valves
- ☐ Wear Plates

#### Fibers

- ☐ Carbon
- ☐ Glass
- ☐ Steel
- ☐ Synthetic

#### Shotcrete Materials/Mixtures

- ☐ Dry Mix
- ☐ Steel-Fiber Reinforced
- ☐ Synthetic-Fiber Reinforced
- ☐ Wet Mix

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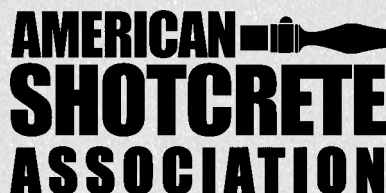
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SUMMER 2010  
Infrastructure Repairs

SPRING 2010  
Outstanding Shotcrete Project Winners

FALL 2010  
Sustainable/Green Shotcrete

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For more information, contact the ASA offices at:  
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Fall 2009

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