MAGAZINE

shotcrete

VOLUME 27, NUMBER 4 • 4TH QUARTER 2025 • A PUBLICATION OF THE AMERICAN SHOTCRETE ASSOCIATION • SHOTCRETE.ORG

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shotcrete MAGAZINE

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FEATURES

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Editor's Note: Shotcrete is a placement method for concrete. However, for the sake of readability, the word "shotcrete" is often used either to identify the shotcrete process (method of placement) or the shotcrete mixture (product materials).

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COVER PHOTO: *Maria Chastka onsite and ready to get the job done. See her full story on Pg. 20.*

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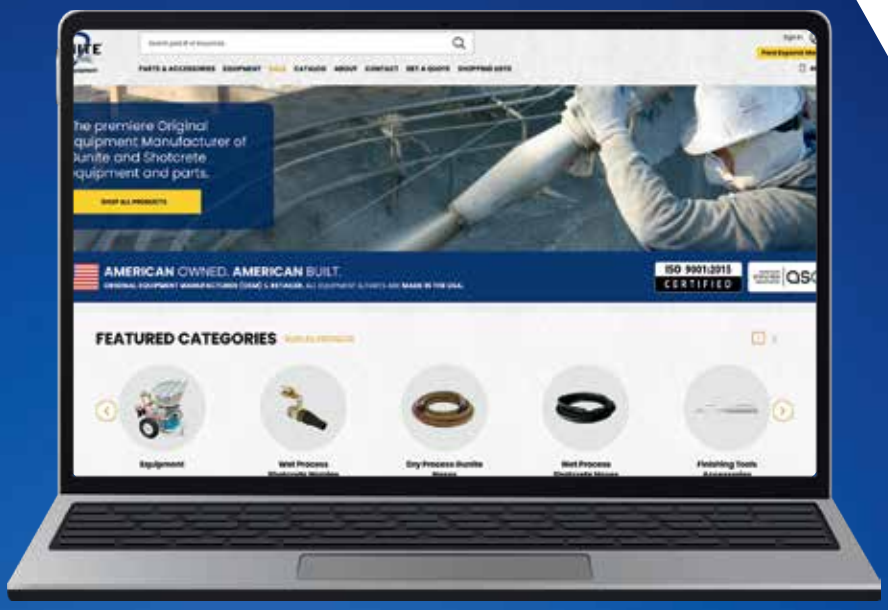

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Recognizing Women's Contributions to Shotcrete

By Bill Geers

Welcome to the Quarter 4, 2025 issue of Shotcrete Magazine, an edition devoted to highlighting "Women in Shotcrete". Over the years of my involvement with the American Shotcrete Association (ASA) and the shotcrete industry, I have seen the considerable impact women have made on the growth of the ASA and the broader shotcrete sector. Many accomplished women have undertaken essential responsibilities both within ASA and across the shotcrete industry.

KEY LEADERS AND ACCOMPLISHMENTS

This edition presents profiles of prominent women whose leadership and achievements have a substantial influence on the field. Throughout ASA's history, numerous women have provided significant contributions to both the Association and the wider shotcrete industry. Examples of such leaders I personally have seen include:

- Randle Emmrich, President of Coastal Gunite, whose leadership continues to inspire
- Ezgi Wilson, current Director of Engineering for Transport in New South Wales, Australia, whose expertise and vision drive progress on a global basis
- Cathy Burkert, former ASA President, who made history in March 2009 by becoming the first female ACI-certified shotcreter

KEY CONTRIBUTOR TO ASA

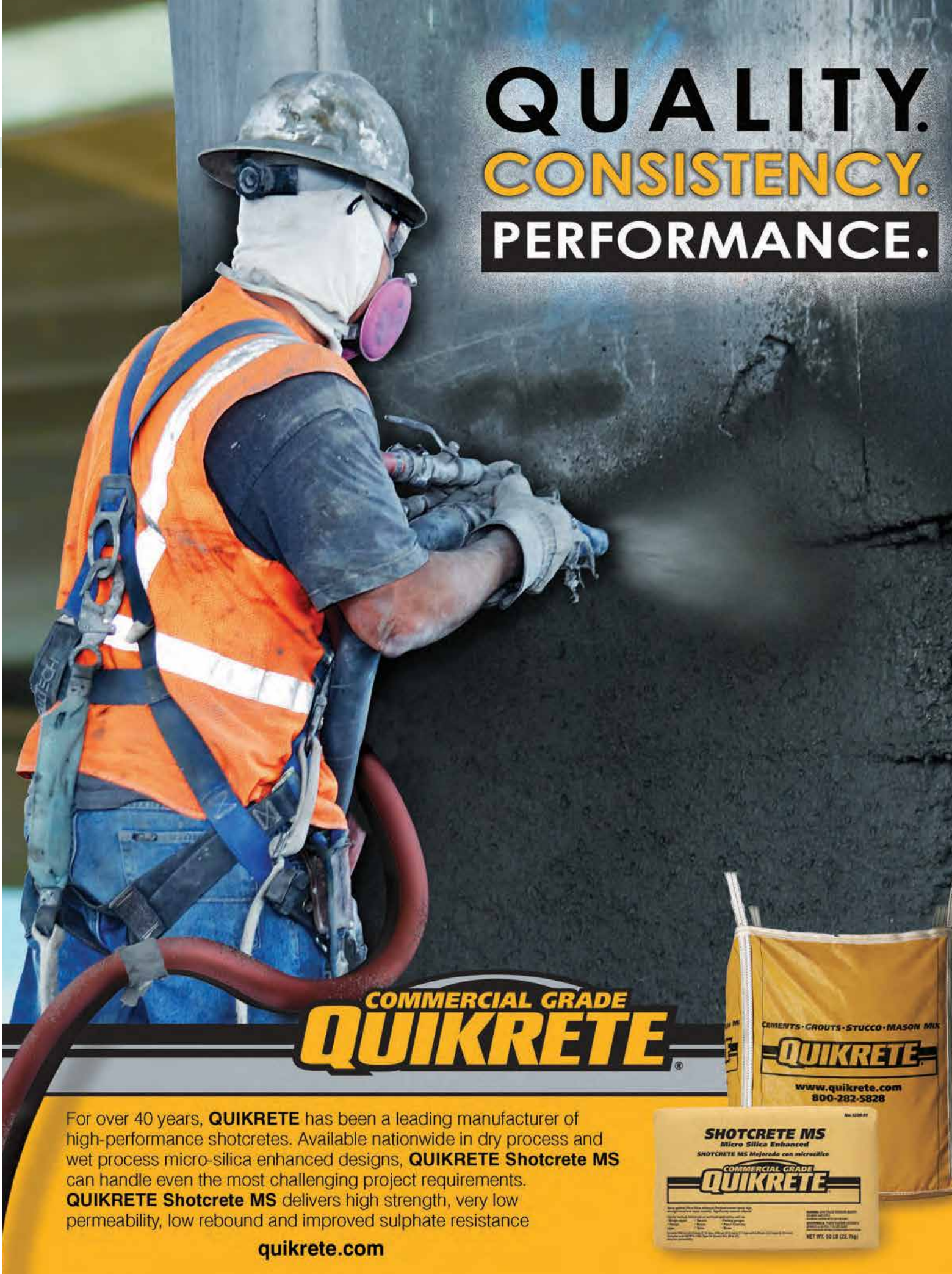
In addition to the contributions of esteemed professionals in the field, the ASA has greatly benefited from the commitment of individuals such as Alice McComas, ASA's Assistant Director. Her significant contributions have played a vital role in advancing ASA's ongoing success.

In recognition of her exemplary service, Alice was presented with the 2022 ASA President's Award, acknowledging her, at that time, of 11 years of outstanding dedication to ASA. In her now over 14 years of service, she has effectively managed and grown complex programs, including the ACI Shotcrete Certification for both shotcreters and inspectors, as well as the new ASA qualified contractor programs for structural and pool shotcrete contractors. Alice's professionalism and steadfast dedication have been central to ASA's growth and to the advancement of quality standards throughout the shotcrete industry. I also want to recognize and personally thank her for all the help and support that she has provided to me as the current President of ASA. I am thankful for having such a qualified and dedicated individual on our staff — makes my job much easier!

> "...women have made important contributions as project managers, engineers, educators, and innovators within the shotcrete community. Their dedication and ability have advanced industry best practices and fostered greater inclusivity in a field that has traditionally been male dominated."
>
> **– Bill Geers**

CONCLUSION

In addition to these leaders, many other women have made important contributions as project managers, engineers, shotcreters, educators, and innovators within the shotcrete community. Their dedication and ability have advanced industry best practices and fostered greater inclusivity in a field that has traditionally been male-dominated. By highlighting their experiences and acknowledging their achievements, we look to encourage and empower more women to pursue careers and leadership positions in shotcrete placement in a wealth of applications, and to become members of our Association. The industry continues to grow, offering significant opportunities for women now and even more in the future.



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Winter 2025 Follow up on Early Strength Testing

By Christoph Goss, PhD, PE, PMP, F.ASCE

In my last column, I discussed the need for early strength testing in underground shotcrete, particularly to determine whether it was safe to enter a recently shotcreted heading. In the winter 2024 issue of *Shotcrete* magazine, my co-authors (Norbert Fuegenschuh, Lauro Lacerda, Kevin Robertson, and Shaun Radomski) and I published the paper "**Early Age Strength Testing for Shotcrete: 2024**". Our intent was to use that article as a starting point for an ASA position paper on early strength testing. We devoted the underground committee meeting at the ASA Shotcrete Convention in March 2025 to a discussion of the paper's conclusions.

There was a consensus that early strength testing was a good idea, but that it was not typically done in the North American market. This was blamed on the relatively high cost, time, and effort required for the beam-end test, as well as a lack of confidence in the other methods. Basically, if the specifications do not require it, early strength testing is not carried out. Regarding the testing methods: Beam-end testing was considered good for pre-construction testing but not production; Hilti BX 3 stud driver had neutral reviews; the needle penetrometer was quick, cheap, and generally okay; no experience with Hilti DX 450; soil penetrometer was acceptable only to check for setting; and the Schmidt Hammer was only adequate in looking for defects.

The discussion continued with what compressive strength was acceptable for entry, noting that requirements around the world varied from 75 – 435 psi with 145 psi (0.5 – 3 MPa with 1 MPa) becoming more common in the US and 290 psi (2 MPa) in Canadian mines. Underground committee members noted that minimum strength requirements were highly project-specific, based on ground conditions, shotcrete thickness, and the next operation in the area. Worse ground conditions (thicker shotcrete) would require a higher strength. If personnel were at the heading, that would require higher strength than just equipment. Given the variables, the strength for entry should be determined by the mine or the contractor's geotechnical engineer in charge of that project — not by a blanket rule.

The committee decided that there would be no ASA position paper on early strength testing, but that we should provide resources to tunnel contractors and underground mines to develop their own guidance and policies. Here are some thoughts:

- Read the various papers on the topic (see our **2024 paper** for a handy list of references).

- Include beam-end testing in the pre-construction phase to develop typical early strength curves for all mixtures and accelerator dosages you plan to use.
- Include some testing during construction to confirm the preconstruction results.
- Work with the geotechnical or mining engineer in charge of ground control to determine the minimum strength for temporary support for a specific project, location, or reach.
- Adjust the work plan/mine cycle to keep personnel away from the fresh shotcrete as long as possible.
- Make your underground crew aware of the dangers and limitations of fresh shotcrete.

I sincerely appreciated the community feedback on this. If you would like to get involved in the ASA Underground Committee, please contact me or Tosha at ASA. We would love to have you join us and lend your experience to advancing ASA and the underground community.

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Guidance for a Successful Certification Session

Alice McComas, Assistant Director

Shotcreter (formerly nozzleman) certification sessions have changed and evolved over the last decade. After a program reorganization in 2011, ASA has worked very closely with our examiners to maintain consistent quality and bring stronger oversight to the program. Anyone who has hosted a session knows that there is a lot involved.

Normally, much of the focus is on paperwork: Without the correct, fully documented hours, participants will not be allowed to test for the certifications they wish to pursue. Education requirements have also changed for recertifying shotcreters; they must now participate in the 8-hour ASA-sponsored shotcreter education for their recertification. Both time and cost constraints have many companies looking to reduce the number of days required for certification sessions.

While we try to work with companies to minimize the days needed for a session, we wanted to highlight some factors that could easily add a day to your session for completion — and how to avoid them.

RECERTIFICATION OPTIONS

Recertifying shotcreters (recerts) have the option of showing 500 hours on the nozzle **within the last two years** to take a comprehensive oral interview in lieu of taking the written exam. This is only available to recerts who are currently certified or have been expired for less than one year. This is a nice option if candidates struggle with taking written exams, but it requires more time for the session host to compile and fully document the minimum 500 hours of work experience. It also adds time at the session for the examiner to confirm the experience with each recert and then conduct the oral exam. If taking the written exam is not a problem for the shotcreter (after all, they did take and pass the exam for their original certification), we suggest your recerts retake their written exam. This saves time before and during the session, as no work experience needs to be submitted beforehand. Also, both new candidates and recerts can take the 90-minute written exam at the same time, rather than each recert taking about 30 minutes per oral interview.

TIMELY SUBMISSION OF WORK EXPERIENCE FORMS (WEF)

If your examiner doesn't have enough lead time before your session to review the WEFs and prepare, your examiner must take time away at your session to conduct lengthy interviews with each participant to verify and possibly re-calculate hours required for the certification pursued.

CRAFTSMAN WORKBOOKS

The printed study material for the written exams is shipped when full payment is made. We recommend you make full payment as soon as your numbers are confirmed (but no later than 2 weeks prior to your session start date) so you can get the workbooks to your shotcreters as soon as possible. Don't keep them until the session! Distribute them to your shotcreters, have them study, and remind them to bring them to the session. Reviewing the questions at the end of each chapter and bringing any questions from their studies to the session to ask your examiner can be particularly helpful in reinforcing the written information. If you think any of your participants would benefit from studying with others, we highly recommend setting up study sessions or a review partner to help your shotcreters prepare.

SCHEDULE

We have a standard template for the certification session schedule, but adjustments can be made. If concrete supply or storm forecasts may impact your session, speak with your examiner. He will work with you to schedule the best time to shoot and core the panels at your session.

PANELS

It's not a bad idea to build a couple extra panels to have on hand just in case a shotcreter needs to reshoot a panel. If a panel fails at coring, you often have the option to ask your examiner to stay an extra day so the shotcreter can reshoot their panel and then core the next day. Having your examiner stay one extra day could save you from scheduling an additional session which would require two days at a minimum to shoot and core. Equipment and material availability may affect whether this is an option or not.

SHOOTING SET-UP

Make sure all your panels are secure. If you are shooting overhead panels, it is highly recommended to place only ONE panel on a single scaffold setup. Though two panels may fit, vibration from shooting the second panel will make the first panel drop out. In cold weather shooting, plan to protect the panels from freezing overnight, as slower strength gain in cold temperatures can preclude coring the panels the next day. Protecting overhead panels is more challenging than the vertical panels, feel free to discuss options with your examiner beforehand.

EQUIPMENT

Make sure you discuss the equipment you will be using with your examiner and ensure that you will have the proper power and water supply required. If all your best equipment is in the field and you plan to use some of your old backup equipment for the session, make sure it is properly maintained and ready for service. Do not pull them out of storage the day of the session: This includes compressors!

CONCRETE MATERIAL

A certification session is not the time to try something new. Use the wet or dry-mix materials you typically use, so your shotcreters are most familiar with achieving the proper consistency. Discuss the concrete mixture with your examiner beforehand, as he cannot help you make adjustments during the performance exam.

CORING

This can often take up the most time at a session. Be prepared, and consider what would work best for your company. GFRP rebar is highly recommended for larger sessions as it can substantially reduce the coring time. ASA provides contact information for a supplier who sells pre-cut kits which include the required rebar sizes, cut to length, per panel. New and spare coring bits, a backup core drill, or hiring a coring contractor are also options that can facilitate the time required for coring.

CURING

Be prepared to protect your panels accordingly to account for climate conditions (high/low temperatures, rain/snow, etc.). If you have any questions, please ask your examiner!

CONCLUSION

Certification is an investment. Taking these considerations into account will go a long way toward a smooth session. Anything can happen, but the more prepared you are, the more able you will be to respond. We want to partner with you for smooth, successful certification sessions!

Becoming the First Female ACI Certified Nozzleman

(AND WHAT IT TOOK TO GET THERE)

By Cathy Burkert

I must have recognized early on that I had an aptitude for leadership and management, because when my kindergarten teacher asked us what we wanted to be when we grew up, I quickly proclaimed "Taco Bell manager." I seemed to intuitively know that my straight-forward nature and organizational skills were going to be my greatest assets in achieving future goals. These traits naturally led me toward acquiring a degree in business administration and propelling me toward owning my own company.

GETTING STARTED

My story began in April of 2005, when I started working at a heavy-highway concrete construction company that specialized in the use of wet-mix shotcrete placement for structural bridge repairs. I didn't realize at the time how consequential this choice would be in my professional journey, or that one day I would manage, purchase, grow, and eventually sell this company. However, the story of my rise to success in the shotcrete industry would be incomplete without an honest recognition of the barriers I had to break down in its pursuit.

I had to start at the bottom as a union labor apprentice and work my way up, like everyone else. The laborer apprenticeship program was comprised almost entirely of male laborers — I can only recall one other women apprentice during the time I attended, and unsurprisingly no female instructors.

So, I had to forge my path among a sea of male instructors who often made no secret about their disdain for women working in the construction field. I can recall one instructor who seemed to make it his mission to insult and embarrass me in front of the male apprentices. I hesitated to report his behavior, unfortunately, due to the power structures that existed within the union. While this was, and is, a common scenario that women face in all professions dominated by men, it was especially challenging in the construction industry.

2008 Outstanding Shotcrete Project Award Winner for Infrastructure Project, the Abraham Lincoln Memorial Bridge in LaSalle, IL

MOVING UP

After 2 years in the apprenticeship program, I graduated to the next level, a union journeyman, and began training to be a nozzleman (recently renamed 'shotcreter'). At the same time, I was moving up in the ranks at the concrete company and started running my own crews. Soon after that I earned the title of Field Office Coordinator and was managing projects from start to finish, building relationships, and cementing my own reputation in the concrete construction field.

Transitioning from being in the trenches with other laborers to overseeing projects and crews came with an additional set of challenges and obstacles. In this managerial role, I had to communicate with people from all aspects of the job, including laborers, project managers,

2010 Outstanding Shotcrete Project Award Winner for Infrastructure Project, the Dan Ryan Expressway in Chicago, IL

2014 Outstanding Shotcrete Project Award Winner for Repair & Rehabilitation Project, the 606-Bloomingdale Trail viaduct repairs

inspectors and engineers. As a woman in this role, I often had to wear a mask and imitate the behaviors of my male colleagues to garner acceptance and respect. Walking into a room full of male colleagues was both intimidating and exhilarating — I knew that I was opening doors for myself, as well as future women in this profession.

While working my way through the apprenticeship program and gaining experience in the field, I had the opportunity to attend the 2006 World of Concrete convention in Las Vegas. It was here that I met many active members of the American Shotcrete Association (ASA) while attending their committee meetings and their annual banquet to celebrate outstanding shotcrete projects and award winners.

I felt supported among members of the ASA, and I was excited to meet and network with other businesswomen who were also fighting the silent uphill battle to make a name for themselves in the shotcrete industry. Their stories and passion inspired me, and I finally felt a sense of ease about my career path. Following this event, I quickly immersed myself in ASA activities by volunteering on numerous committees and writing articles for their quarterly magazine.

By March 2009, I became the first female ACI-Certified Nozzleman for the wet-mix, vertical, and overhead processes after training with the company's nozzleman for many years. One of my mentors used to say, "The shotcrete industry is not for everyone; it takes a certain kind of crazy to do this job." He was speaking of the challenging and creative nature of the work, but I also faced the added pressures of navigating this terrain as a woman among many men who did not want to see me succeed, viewing me as a quota to fulfill rather than an experienced and reputable colleague. Despite this tumultuous environment, I persisted.

CONTINUED GROWTH

For the next few years, I managed several types of projects including bridges, tunnels, buildings, and repairs. During this time, I also learned the administrative side of the business, including estimating, job costing, and

2016 Outstanding Shotcrete Project Award Winner for Repair & Rehabilitation Project, a shotcrete segment of O'Hare and Midway reconstruction project

forecasting. Since the company was often a subcontractor to the same general contractors, I also worked with many of the same project managers.

Due to the company's long-standing reputation and the personal relationships I had cultivated, it expanded in size and scope under my leadership. In addition, I participated in a group (with other reputable ASA members) that helped the State of Illinois accept shotcrete as an acceptable alternative to traditional concrete methods and assisted in rewriting their shotcrete specification.

While I noticed in various meetings that men seemed to think differently than women, we were generally able to collaborate and create blended perspectives. Most of these networking events were round-table and inclusive — but some of them immediately felt like a 'boys club'. A lot of important conversations in this industry are held outside of round table meetings (occurring on golf courses or at dinner), and I had one unfortunate experience in Las Vegas when an all-male group planned to visit a strip club to continue conversations. With events such as this, I sometimes felt it necessary to substitute my presence with one of my male employees.

As the company expanded into additional markets, we began networking in non-traditional groups to expand the market for our product. Finally, in 2013, the opportunity to purchase the company presented itself. I felt prepared to

take over the business that I had helped grow over the last eight years, but the decade that followed really altered my perspective on how internalized gender bias has shaped the industry.

Ownership Meets Awareness

My time as a small business owner came with unique challenges. While it had its perks, it also involved significant risk and tremendous amounts of stress. Being in charge of the entire company showed me a level of burden that is unfelt by lower-level employees, and the decisions I made every day affected everyone in the company. My body was constantly in fight or flight mode, with the demand of this role slowly damaging my nervous system. In addition, I began to experience imposter syndrome as a female in the industry, often feeling inadequate despite all of my hard work and contributions to the shotcrete industry.

As my perspective began to shift, I began to really take notice of the barriers I faced in this industry. For instance, a couple of our previous customers decided to use their own internal crews for shotcrete repairs. This kind of inexperienced competition incentivized me to be part of the team that created the ASA Contractor Qualification Program (CQP). I also faced a project manager who, much like my former laborer apprentice instructor, made his views on women in construction very clear. His unprofessional and illegal comments were so offensive, they caused me to file a complaint to his company president.

I began to realize that without the existing DEI programs, I would not have reached my level of success. I also struggled with other businesses being incorrectly certified under those same programs, which led me to become more involved with the certifying agencies and their personnel to help strengthen their policies.

A New Direction and a New Perspective

In 2022, I accepted an opportunity to sell the company I had grown. I remained active while the new ownership transitioned but soon found myself drifting away from the shotcrete industry. It felt like I was grieving a loss — I had worked in the shotcrete industry for almost half my life — working my way through all the emotions and bearing all its weight for nearly two decades.

I've done a ton of reflection in the years since leaving my ownership role. I faced many challenges, and received a lot of support and mentoring yet the feeling of a room made up of a majority of men is still much different than a room made up of women. When I'm in a room full of women, we are engaging in conversation that feels genuine and emotional. We listen to each other and feel eager to collaborate. It feels more inclusive, supportive, and safe. Given the political climate we are currently facing, I feel it is necessary for all to remember that uniting as a team and making a safe place for all to grow is how we will all be successful.

For me, it is now time to embrace the unexpected and be open to the infinite possibilities that lie ahead. I was thrilled to learn that *Shotcrete* magazine had followed through on my suggestion and planned a 'Women in Shotcrete' issue to highlight the impact women have on the shotcrete industry. I was also excited to learn that the term 'nozzleman' was replaced with 'shotcreter' — a more acceptable, gender-neutral title.

My Time in the ASA

Throughout my career I was an active member of ASA. I sat on all the committees and served as chair for the marketing and membership committees. I was involved with four award-winning ASA infrastructure projects:

- The Abraham Lincoln Memorial Bridge in 2008
- The Dan Ryan Expressway in 2009
- The 606-Bloomingdale Trail Viaduct Repairs in 2014
- Shotcrete Segment of the O'Hare and Midway Reconstruction Project in 2016

I served on the team that created the ASA Contractor Qualification (CQ) Program, which establishes a shotcrete contractor's qualifications through peer review of the contractor's work, participating on review task groups for CQ applicants. I was elected onto ASA's Board of Directors, then again onto the Executive Committee in 2013, before being elected as ASA's President in 2019.

I am so thankful to my mentor and the ASA for creating a safe space where others in the shotcrete industry could openly share ideas, advice, and memories. I encourage anyone looking to be part of a shotcrete family to get involved with ASA.

Cathy Burkert *earned a degree in business management and started her career as a union laborer apprenticed to learn the intricate details of the concrete industry. Having trained along the field crew and nozzlemen for many years, she became the first female ACI certified shotcreter and, soon after, led the company as project manager on numerous ASA outstanding projects of the year. Cathy became owner of the same company in 2013. In 2022, she sold the company and is now fully focused on her family, while mentoring other female entrepreneurs. Throughout her career, Cathy has spent a great deal of time helping ASA grow, educate, and promote the use of the shotcrete process for concrete placement. She was committee chair for marketing and membership committees, member of the Board of Directors, and on the Executive Committee before finally serving as ASA President in 2019.*

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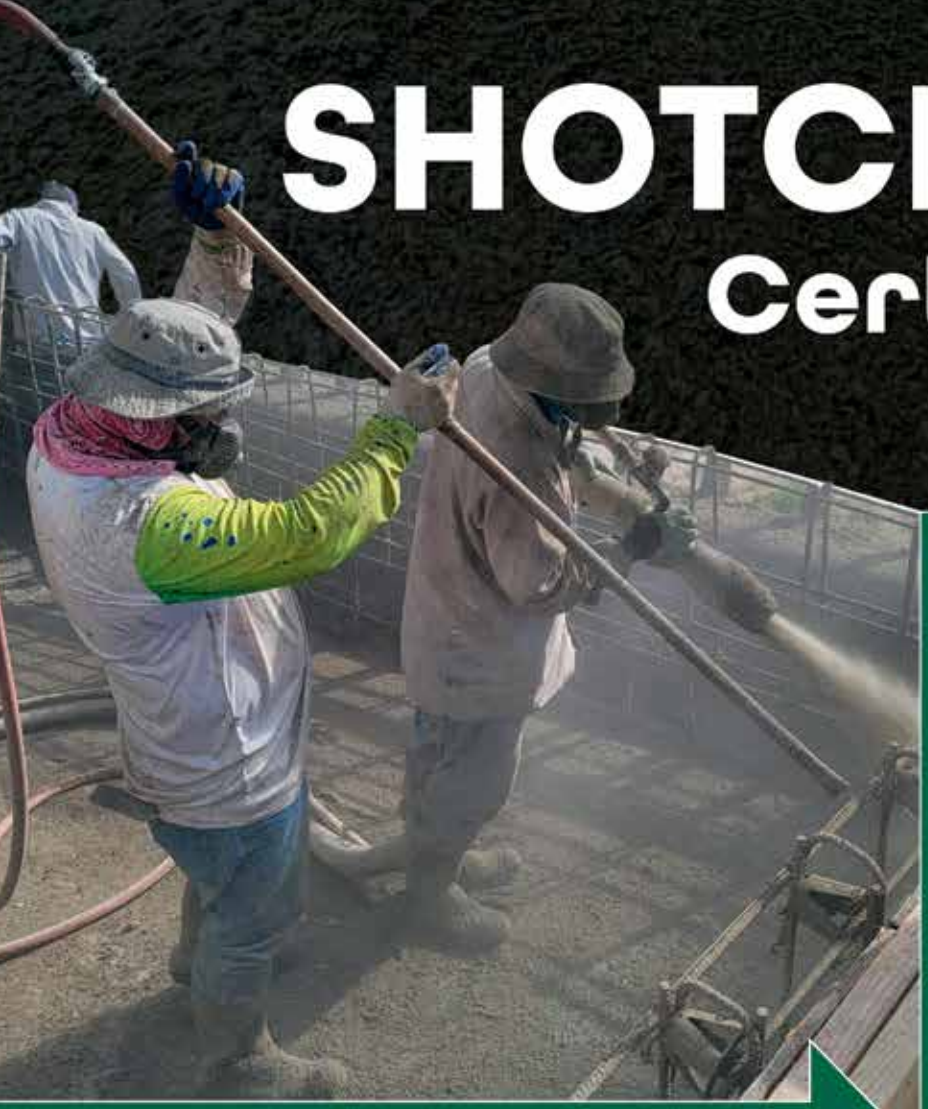

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My First Experience with an Inspector

By Randle Emmrich

***ABOVE** - Fig. 1: Pre-inspection walk of aqueduct*
***BELOW** - Fig. 2: Initial 2 in. (50 mm) shotcrete lining*

In the Fall of 1997, I relocated to Washington, DC, to be the on-site Safety Supervisor for Coastal Gunite on the US Army Corps of Engineers aqueduct rehabilitation project. I was 23 years old and eager to make a good impression on my fellow colleagues, my employer, the owner of the project, and the inspection staff.

Waking up before the sun was refreshing. I enjoyed putting on my steel toe boots and hard hat and welcoming our employees every morning with a brief safety meeting from the steps of our office trailer. I felt important and valuable. Most of my days were spent checking inventory, ensuring we ordered enough materials in advance, taking daily notes of job site activities, performing routine safety checks, and looking at the completed work with our supervisors and the Corps of Engineers' inspection staff. Months went by and all was going smoothly for my first job-site experience until the day a new inspector graced our project.

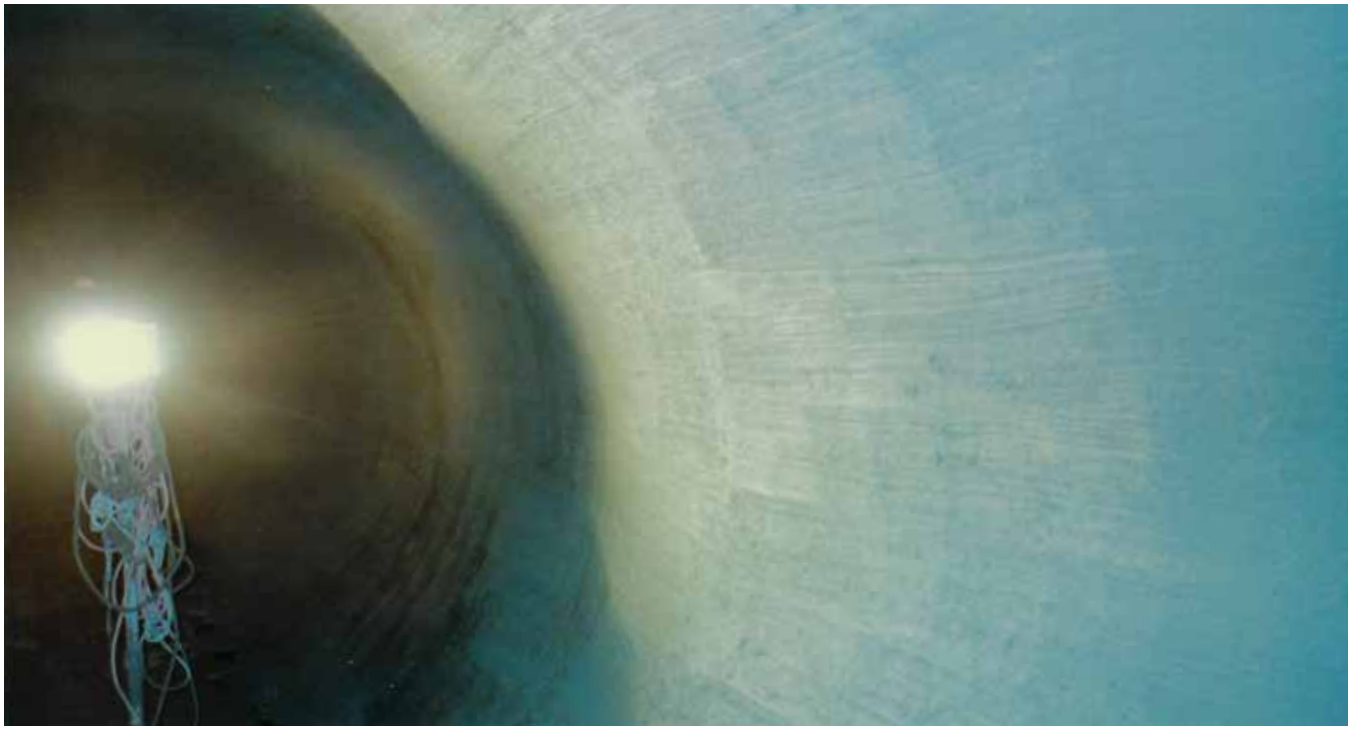
He looked a bit like Santa Claus but had a completely opposite personality. He showed up to my office trailer doorstep proclaiming that he was the authority on all things related to the project, he would be watching us at all times (so we should be on our best behavior) AND that he could get me fired if I didn't cooperate with him. WOW. Nice introduction.

I knew I was young and didn't have much experience — and was both female and blonde — but really?!? I have always respected authority and am a very cooperative person, but this was going to be a challenge.

That night I decided I was not going to cower or show weakness. I was hired for this project, and I was confident both in what I knew and in the team we had in place to get the job done correctly. I was not going to let him run me off this project.

The next morning, I showed up with a smile on my face and a positive attitude, walking the length of the job with our new inspector. He must have thought he was going to walk all over me. He tried to find things that were not perfect and made multiple attempts to trip me up, but I had nothing to hide. As the oldest of 4 children, I have dealt with my fair share of conflict. I remained calm and listened to all that he had to say. He asked, "Where is your notebook? Shouldn't you be writing this down?" I pointed to my head and replied, "I've got it all in here, don't worry." I doubt that he appreciated the comment, but he stopped challenging me every step of the way.

By the end, I had made it clear that I wasn't afraid to stand up for myself. We both had a job to do, and we were



Figs. 3 & 4: Finished shotcrete lining

going to have to work together whether either one of us liked the other or not. We made our way back to the trailer, I told him we would address his concerns, and that was that. He backed off.

That inspector stayed with us for another month or two. He threw a curve ball every once in a while, but he never threatened to have me fired again, and he didn't spend as much time on our project as he initially said he would. In the end, he was either reassigned or he retired. I, on the other hand, remained on that project for another year, through to its completion.

As a woman, especially a young and inexperienced one, being bullied by a man can be a scary experience. Thankfully, I had a wonderful support system in my co-workers, employer, and friends. They believed in me and helped me believe in myself. So, instead of giving up, I persevered, and it paid off — 30 years later, I am still heavily involved and successful in the shotcrete contracting business.

Randle Emmrich *graduated cum laude with BS in Civil Engineering from Bucknell University, Lewisburg, PA. She is a former Chair of ACI C660, Shotcreter Certification, helped develop ACI C661, Shotcrete Inspector Certification, and is a current board member of ASA. Randle lives in Bradenton, FL with her husband, 16-year-old son, and dog. She loves visiting her daughters at Florida State University, going on long walks, and watching sunsets on the beach.*

Natural Fibers with Improved Dispersion for Sustainability and Durability in Shotcrete

By Jisha Hechel

In recent years, the construction industry has increasingly turned to sustainable and eco-friendly materials to enhance performance while reducing environmental impact. Sustainability in shotcrete involves reducing its environmental footprint through innovative measures. As the most widely used construction material in the world, cement production is responsible for a significant portion of global carbon emissions. One way to reduce the impact of shotcrete on our environment is to incorporate renewable resources, while also ensuring that the quality structures are durable and long-lasting.

Azelis, a global distributor of specialty chemicals and additives, has a large network of application labs that provide innovative solutions to producers looking to enhance their formulas using our specialty additives portfolio. Our Building & Construction lab has worked extensively to give customers valuable insight on the benefits of using natural fibers in shotcrete, as well as the best way to implement the material for optimal performance.

MiniFIBERS natural fibers, derived from sustainable plant sources, have been shown to perform as well as synthetic fibers composed of polypropylene and fiberglass. This reduces the environmental impact of the raw materials, as well as creating a high-performing, robust shotcrete formulation that is resistant to microcracking and tensile stress.

BACKGROUND

In an article published in 2023, we presented a study comparing various sources of natural fibers against traditional shotcrete formulations containing synthetic fibers. These studies demonstrated that in all hardened concrete tests, the natural fibers performed comparably to the synthetic fibers. These performance properties included compressive strength, tensile strength, dimensional stability (dry shrinkage), and flexural strength.

In this updated article, we present our latest work, exploring the practical aspects of natural fibers in shotcrete. The crucial element of dispersing natural fibers was carefully considered. Due to the length and nature of plant-based fibers, the entangling and bundling of fibers in the shotcreted concrete mixture was a challenge to overcome. Having well-dispersed fibers is essential to the integrity of the structure, as well as the consistency of the shotcreted sections performance.

Out of the natural fiber offerings in the MiniFIBERS portfolio, jute fibers were the most abundantly available. Jute is the second-most-produced natural fiber in the world, after cotton. Therefore, the recent round of testing used these as our preferred source of natural fibers. In addition to jute, MiniFIBERS carries an extensive variety of synthetic fibers, specializing in Short Stuff fibrillated high-density polyethylene fibers that are significantly shorter than traditional fibers, and offer a variety of unique properties for many industrial applications, including cementitious mortars and concrete. We leveraged our experience to help with dispersion of the jute fibers and found tremendous synergies when combining the benefits of the Short Stuff fibers with jute fibers.

TESTING

The Azelis Building & Construction lab spent years investigating the use of natural fibers in shotcrete. Previous findings indicated that the replacement of synthetic fibers with natural fibers had an overall beneficial effect on properties, but there was an inconsistent distribution of the natural fibers due to their inherent bundling behavior. We conducted a series of trials to improve the dispersion and distribution of the natural fibers in the concrete network.

The objective was to conduct dispersion evaluation trials using a variety of potential dispersing agents. Once an ideal dispersion solution was identified, we incorporated it into a shotcrete formulation and evaluated some key performance properties, such as density, air content, compressive strength, and flexural strength.

TEST DESIGN – IMPROVED DISPERSION OF NATURAL FIBERS

In an effort to efficiently evaluate the natural fibers dispersion, the Azelis lab created a simple slurry with a constant amount of water and fiber. The mixture was placed in a benchtop stand mixer and mixed on medium speed for 2 minutes.

Various dispersion additives were added to the

	Control - Jute Alone	Jute + Short Stuff	Jute + Superplasticizer	Jute + Wetting Agent	Jute + Microsilica	Jute + Cement Dry Blend
Ingredients	**Grams**	**Grams**	**Grams**	**Grams**	**Grams**	**Grams**
Lab Type IL Cement						118.35
Microsilica					118.35	
Superplasticizer			3.55			
Wetting Agent				2.35		
Jute - 6mm	2.95	2.95	2.95	2.95	2.95	2.95
Short Stuff Fibers		2.95				
Water	500	500	500	500	500	0

Table 1: Slurry Designs

Fig. 1: Slurry Results

water-fiber slurry system to improve the dispersion (Table 1). These included powered cement superplasticizer, powdered wetting agent, microsilica, and Short Stuff. Another trial was conducted using a dry-blending technique with jute fibers in cement.

RESULTS – IMPROVED DISPERSION OF NATURAL FIBERS

A sample of the slurry was placed in a clear petri dish to assess the fiber dispersion (Fig. 1). It was very apparent, based on visual evaluation, that the best natural fiber distribution came from combining the jute fibers with Short Stuff fibers in the mixing water. This combination resulted in a much more uniformly dispersed slurry and allowed all the stubborn bundles of natural fibers to unwind and form a homogenous network.

TEST DESIGN – FULL SHOTCRETE FORMULA WITH IMPROVED DISPERSION

Once the optimal dispersion system was identified — in this case, a slurry containing half jute fibers and half Short Stuff fibers in water — we evaluated the performance in a full-scale shotcrete formulation.

We conducted our tests using a basic concrete formulation containing 28% Type IL cement, 5% microsilica, graded sand, and a small dose of performance additives out of the Azelis Building & Construction portfolio, including BASF Melflux 4930 (a superplasticizer based on polycarboxylate ether) and Vinapor AE 3914 (air entrainer). The water-cement ratio remained a constant 0.32 (Table 2).

The objective was to evaluate a shotcrete formula with the fiber slurry against a control with no fibers. The addition of fibers to the shotcrete mix initially created a less flowable mix due to the increased surface area and water demand from the fiber addition. To achieve similar flow properties

	Control - No Fibers	Jute-Short Stuff Slurry
Ingredients	**%**	**%**
Lab Type IL	28	28
Lab All Purpose Sand	66.9	66.8
Red 106 Microsilica	5	5
Melflux 4930	0.075	0.114
Vinapor AE 3914	0.003	0.003
Minifibers ESS 20		0.0625
Jute - 6mm		0.0625
Total	100	100
Water	10.56	10.56
Water/Cementitious Ratio	0.32	0.32
Mix Protocol		
Mix fibers in water for 2 minutes		
Pour dry mix into water - let sit for 30 sec		
Mix 30 sec speed 1 (~135RPM)		
Scrape 15 sec		
Mix 1.5 minutes speed 1		

Table 2: Shotcrete formulations and mix protocol

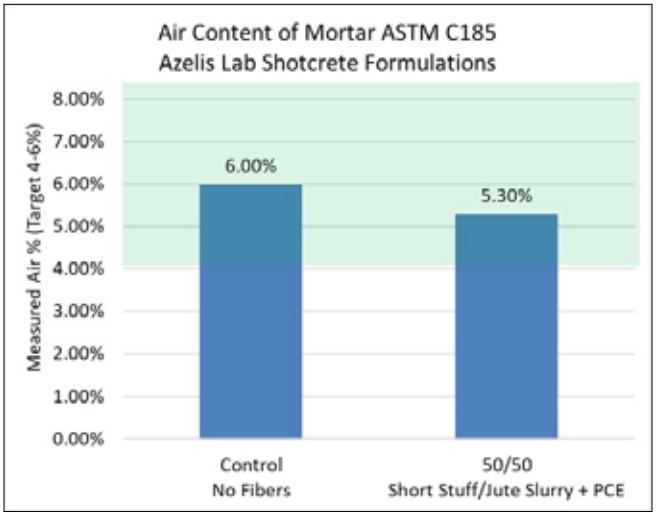


Fig. 2: Air Content

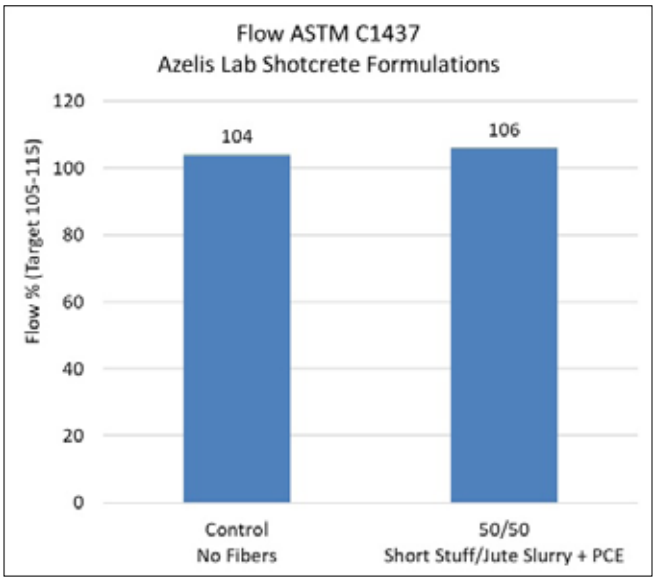


Fig. 3: Flow

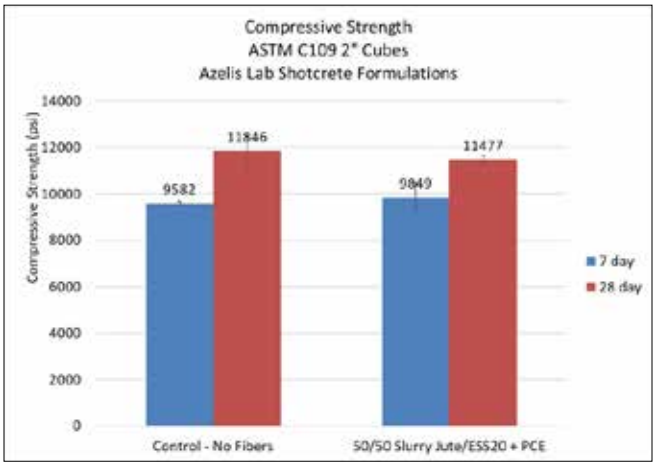


Fig. 4: Compressive Strength

to the control, we added additional superplasticizer, rather than increasing the water, which would have a detrimental effect on the properties.

TEST RESULTS – FULL SHOTCRETE FORMULA WITH IMPROVED DISPERSION

Azelis labs evaluated various properties of the shotcrete formulation containing MiniFIBERs natural fibers and Short Stuff in comparison to a formulation with no fibers. Air content, flow, compressive strength, and flexural strength are reported below.

Mortar density testing was performed following ASTM C185 (modified). The results correlated with air measurements. Air content was targeted at 6 +/-2%*. Air content was measured using a 0.026 ft^3 (0.75 l) mortar air meter employing the same method as a standard 0.25 ft^3 (7 l) air meter used in ASTM C231.

> *NOTE: A targeted 6% air was chosen to better understand "as shot" hardened state properties. It is understood that a higher air content of 12% before shotcrete is placed would typically be targeted assuming 50% of the air is removed in the application process. Since the material was unable to be pumped and shotcreted for the hardened state tests, a typical "as shot" air content was targeted to avoid high air contents impacting hardened state properties.*

The concrete mixture maintained air content within the targeted range when the natural fibers slurry was added (Fig. 2).

Flow and rheology are an essential attribute to shotcrete since it must be reliably sprayed. Typically, addition of fibers reduces the flowability in cementitious mortar. Actual spray testing was not conducted, so flow was used as an indicator of the rheology. To return the mortar to a comparable flow as the control, superplasticizer was added to the formulation. Flow was determined following ASTM C1437 using a shocking table (Fig. 3).

The mortar containing fiber slurry had the addition of superplasticizer to produce the same flowability as the control. The resulting formulation enhanced by fibers had excellent texture and creaminess, making it easy to smooth and finish.

The mortar was cured in a controlled lab environment with 50% relative humidity at 73°F (23°C) and the specimens were tested for compressive strength and flexural strength. Compressive strength was measured using 2-in. (50 mm) cubes following ASTM C109. Flexibility testing followed ASTMC580.

The formulation with natural fibers achieved compressive strength over 9000 psi (62 MPa) at 7 days, and over 11,000 psi (76 MPa) at 28 days (Fig. 4). The difference in compressive strength between the two sample sets was not statistically significant. It should be noted that the typical shotcrete performance requirement for compressive strength is around 6000 psi (41 MPa) at 28 days. This concrete mixture far exceeds this requirement,

demonstrating its robustness and performance, and enabling cost savings through binder or admixture reduction.

The mortar containing fiber slurry had statistically higher flexural strength than the control with no fibers (Fig. 5). This improvement in flexural strength over the control is consistent with previous findings, and the newly homogenous distribution of fibers in the mortar network allows for consistent and repeatable results.

CONCLUSION

Azelis labs used a basic sanded shotcrete formulation (no coarse aggregate) to test the impact of MiniFIBERS natural fibers. Development of a practical method of proper dispersion was essential to prevent bundling of the natural fibers in the shotcrete. The typical performance requirements referenced were for "as-shot" mortar containing a targeted 6% air. Our lab concluded that using natural fibers in the concrete mortar allowed the shotcrete formulation to achieve excellent performance targets, while allowing for a lower carbon footprint due to the use of sustainable materials. These results reinforce our previous conclusions that natural fiber addition contributes to the enhanced performance of shotcrete formulations.

Processing natural fibers can present challenges when it comes to precision cutting. There are a minimal number of fiber processing companies that are capable of producing a consistent natural fiber cut to less than 0.4 in. (10 mm) in length. MiniFIBERS was founded on, and excels in, state-of-the-art fiber cutting technology and is a world leader in fiber processing.

By harnessing the strengths of Short Stuff fibrillated HDPE fibers, we were able to utilize jute natural fibers to their full potential. The resulting final shotcrete formulation had excellent plastic and hardened state properties that matched or exceeded the non-fiber control mixture. By incorporating natural fibers, a standard shotcrete formula can be transformed into a more durable, more flexible, and more environmentally sustainable product.

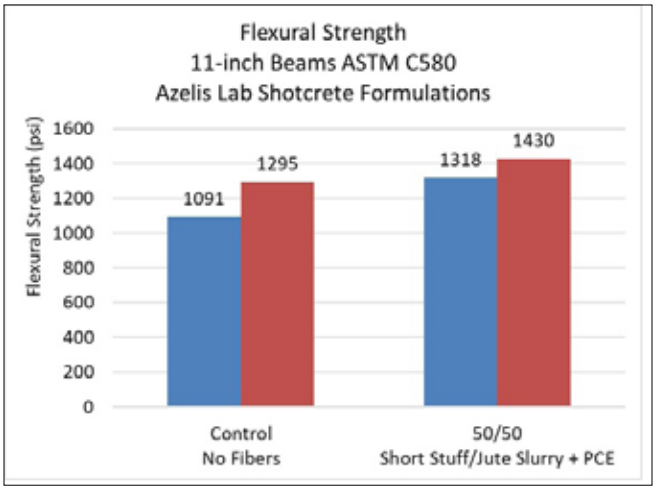


Fig. 5: Flexural Strength

Jisha Hechel *is the Laboratory Manager for Building & Construction at the Azelis Innovation Center in Oak Creek, WI, USA. She has 12 years of experience formulating concrete and cementitious mortar systems. Her background includes formulation research and development, manufacturing and field trial consulting, and specification testing. Her passions are in breakthrough technology and environmental sustainability.*

How Do You Recruit for an Invisible Job?

By Maria Chastka

Fig. 1: Shooting panels for nozzleman certification on Newell Project, Santa Cruz, CA

Tunneling projects are a unique construction segment to be a part of. You can be working on a large-scale, technically challenging, resource-consuming project — in some cases the most expensive investment a city or state has ever made to their infrastructure — and if it goes well, people will not even know you're there. Herein lies one of the struggles the tunneling industry faces: If people aren't aware the projects exist, they also don't know there are jobs available. So how do we recruit both for technical positions and craft labor for invisible opportunities? That is the 2.1-million-employees-needed question.

While the projections vary from hundreds of thousands to over several million workers, depending on the metrics used, the fact is that currently, over 20% of the existing underground construction/tunneling work force is over the age of 55. We needed to start rebuilding our base of employees a decade ago. That didn't happen, and now we need new solutions for a worsening problem. In my opinion, this needs to be a shotgun approach. Yes, we need people today — but we also need to be attracting younger generations to even consider this industry, so we don't have another large gap in employees.

From a higher education standpoint for potential engineers, project managers, and consultants, this seems like an easy goal: Just go to all of the engineering schools and speak with students studying complementary majors. But, with nearly 300 Civil Engineering programs in the US alone, this is neither quick nor easily achieved. Multiply that number by more than a dozen other majors and programs that can feed into the industry, and this feels impossible.

Now for the good news: There are incredibly dedicated people working on this very approach. Between the collaboration of the Society of Mining, Metallurgy, and Exploration (SME) and Underground Construction Association (UCA) with universities throughout the US, the *Teach the Professors* initiative is working to inform college professors of the career opportunities in our underground industry. The goal is to include coursework in their syllabus that introduces students to various aspects of underground construction. This also provides recruiting opportunities and contacts for students to reach out to when pursuing a job after graduation. This initiative needs more support from industry individuals to reach and increase the network of programs sooner. People can reach out to UCA directly to get involved.

In conjunction with the *Teach the Professors* initiative,

UCA also has a *Down for That* program, which reaches out directly to students from grade school through university to engage and educate them about tunneling. This program has the structure and tools necessary to support industry veterans who are available to share their time with schools in their area. There are presentations, books, and contact lists just waiting for more volunteers to join the effort. This is how we continue to build the base for not only the tunneling industry, but also for construction and the trades.

The opportunity to go into a grade-school classroom and talk about the equipment we use and the projects we build can spark an interest that may lead a student to pursue construction as a career. One bonus I have personally found has been in reigniting my own excitement for the work we do: Sharing photos and videos from different projects I've been on and then watching the students' eyes light up with delight reminds me why we are building these projects in the first place. The infrastructure projects we are building are for future generations to benefit from. Answering their questions — which always include, "But why?" — helps instill that needed sense of purpose, especially on the really challenging workdays.

Another aspect of this initiative that I feel strongly passionate about, is sharing this career opportunity with all the students — not just the boys that have previously been the target audience for construction career planning. When I walk into a classroom in full shotcreter PPE (rain gear, hard hat, full or half face respirator, thick gloves) and then remove the respirator so they can see me, I inevitably get a gasp

Fig. 2: At The Mighty Quinn's 1st hole through for the LOT Project

Fig. 3: Maria Chastka on site

and comments like, “But you’re a girl!” I hope that being able to explain all of the different opportunities I have had in my career, despite being ‘just a girl’, allows those students who didn’t consider themselves capable of something similar to reevaluate that notion.

As these initiatives with schools, professors, and students gain momentum, I believe we also need to promote and target the trades. Sharing the opportunities available to everyone, not just college graduates, is a key component to the tunneling industry’s success. While visiting elementary and high schools, we need to share information about trade schools and union training opportunities. The financial stability available for trade employees rivals and in many cases surpasses new college graduates, depending on their degree. Trade schools and unions offer training programs to provide a springboard into the workforce. There are also scholarship opportunities for trade schools, and some high schools now have co-op programs with local trades to learn while still in school.

Overall, the tunneling industry has a surplus of career opportunities, and projects will continue to need new generations of employees to succeed. The request I have for all of my colleagues is to find their replacement: Try to teach and mentor, but at the very least, hire prospective candidates to take your role at some point in the future. If we can all approach the workforce shortage with this mentality, I believe we have a chance of improving our odds of success.

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Maria Chastka *has worked in the Mining and/or Underground Construction industry since 2001. Projects include small heading drill and blast, roadheader, SEM, NATM, and large scale TBM infrastructure projects around the US. She is currently a Project Engineer for Granite Construction on the Lower Olentangy Tunnel (LOT) Project in Columbus, Ohio. Her first experience working with shotcrete was on the Dulles International Airport (IAD) East/West Automated People Mover (APM) project with Atkinson Construction in 2005. Since then, she has worked on various projects throughout the US, getting her shotcreter certification in 2020 on the Newell Creek Dam Inlet/Outlet Project with Obayashi. She is passionate about growing the tunneling industry and encourages hands-on learning opportunities whenever possible. She is the Tunnel Tour Lead for UCA’s Women In Tunneling (WIT) and Co-Chair for UCA’s Cutting Edge Conference, as well as a member of the US-ITA’s Working Group 12 - Sprayed Concrete Use.*

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A Few Words from Women in the Shotcrete Industry

HOW DID YOU GET STARTED IN THE CONSTRUCTION INDUSTRY?

I am part of a third-generation family-owned business that manufactures cement pumps and mixers as well as aggregate broadcasters. My grandfather started our business in 1954. My father learned at his knee and eventually took over the business, eventually leaving it to my brother and me. While growing up we would constantly be at the shop following dad or the employees (who were more like family) around. Each summer I would work at the shop in the office helping with secretarial work. Neither of us originally intended to take over the family business — we both actually went to college to become educators. After graduating with my Master's, I came back to the shop to work until I found a teaching position. However, I ended up never leaving, because I enjoyed the business and found myself totally immersed!. **~Barker**

Growing up in a family business with a father who was extremely supportive helped me make an early decision (at 8 years old) to become an engineer. Going from helping my mom do payroll at the kitchen table and cleaning pools during my summers in high school to running the service department, helping my father with construction, and taking over the business when he retired (and passed away a month later), I have been in every position in this business. **~Brown**

I started in 2005 as a union laborer apprentice. ***~Burkert***

You could say construction runs in my blood. My dad was shooting pools long before I was born and a few years following me, they started their business. I studied landscape architecture because I love design, construction, and people. Seven years ago, I said "Yes!" to the family business. My initiation came in 2019, mixing 1,600 yd^3 of concrete for the Park Avenue Tunnel. Since then, the challenges have only fueled my fire. **~Cruz**

I've been mechanically inclined and a problem solver since I was young. My dad worked on oil rigs as well as various other hands-on jobs, and there was always something to work on or fix around the house. That desire to understand how things work and fix them continued through engineering school. I studied mining engineering because it was a more hands-on degree and, as far as I knew at the time, had the coolest equipment that I wanted to work with (that is still the case). Transitioning from the mining industry to tunneling and underground construction was simply a decision on location; I no longer wanted to be on remote sites. I've been in tunneling for over 2 decades now, so I think I've found my niche. **~Chastka**

My journey into the construction industry began unexpectedly when I met Mike Klemp, the owner of Thorcon Shotcrete and Shoring LLC. Our engaging conversations about the industry and Thorcon's unique projects piqued my interest, and I found myself fascinated by the work they do. Recognizing the potential for growth and innovation, I decided to seize the opportunity. Shortly after, I accepted the role of Corporate Vice President for Thorcon, eager to contribute my skills and passion to the dynamic world of construction. This unexpected turn has been both rewarding and inspiring, as I've had the chance to be part of significant shotcrete projects and work alongside a talented team of industry leaders. **~Fox Nyarko**

During my studies in civil engineering, at Université Laval in Quebec City. **~Poulin**

At the age of 9, I visited jobsites with my father, founder of Coastal Gunite Construction Company. I never intended to work for/with him, but after obtaining my degree in Civil Engineering I wanted to gain experience for a couple of years before attending business school. After a year working as a safety engineer on a storm sewer job in Washington, DC, I became enamored with the shotcrete process. I loved how we could rehabilitate 100-year-old structures so they could continue to be used instead of demolished and rebuilt. Not only is it satisfying work, but it challenged me every day and continues to do so. **~Emmrich**

Leah Barker
Quikspray Inc.

Melissa Brown
BonaVista Pools

Cathy Burkert
Mentor

Maria Chastka
Granite Construction

Ashley Cruz
Cruz Concrete & Guniting Repair

Growing up in a family where the males were predominantly working in the construction field, it just felt natural. My dad was always making improvements at home with renovations, so I really got to see it first-hand at a very young age. **~Da Ponte**

After graduating from university, I saw there was a local masonry company looking for R&D staff, so I interviewed and was brought on board. I had amazing mentors and colleagues who taught me about the chemistry and formulation of cementitious materials, and I gained valuable insights on the construction industry and the manufacturing process — from there I was hooked. I loved working with building materials, getting my hands dirty, and designing and testing cementitious formulas to tame the beast that is concrete and mortars. **~Hechel**

My background was in facilities management, with a focus on strategic planning — it dabbled in everything, so it was an ideal choice when you couldn't decide what you wanted to do when you grew up. Balancing the variety of needs as a facility manager was a natural steppingstone to the variety of needs I face at ASA. **~McComas**

I never imagined I would find my place in construction, but life has a way of leading us to unexpected paths. After my husband's passing, I was focused on healing and supporting my sons. One day I met Evan, a superintendent at CROM, and our friendship grew through shared challenges — training for a Spartan race, rebuilding our lives, and eventually creating new memories together. When Evan's project was ending, he asked me to move with him. Leaving behind the past, my sons and I took a leap of faith. Evan, passionate about CROM, encouraged me to join as his timekeeper. I refused about ten times before finally giving in. My first project was an 18-million-gallon thermal energy storage tank in Bartow, Florida, featuring the largest diffuser system in America. From that moment, I was hooked. Over the past ten years, I've grown far beyond my initial role. I'm not just a timekeeper — I'm my brothers' keeper, fully immersed in all aspects of the project, ensuring safety, teamwork, and excellence. Shotcrete and construction have become more than a career; they've given me purpose, resilience, and a second chance at life. **~Thomas**

I was lucky enough to work side by side with my husband and grow a small construction business, which turned into a remodeling operation that I was heavily involved with. I joined CROM five years ago with a background in Business Management, but a passion for people and the quality of our work. **~Smith**

I grew up with a metallurgist father on his mining sites, and he showed that you can take what others may see as "plain dirt" and make something special out of it. This holds true for any aspect of the construction industry. Architects have this mindset in undeveloped properties, and landscapers see this in any outdoor space. We as shotcrete specialists help make that "plain dirt" an oasis for a homeowner, constructing their get-away pool or spa, or making an agricultural property become green and lush with canal/water retention management assistance. **~Spring**

My entry into the construction world was far from conventional; I was the quintessential girly girl growing up, more at home drawing pictures than playing in the dirt. My family owns and operates a construction company doing concrete formwork, flatwork, and shotcrete After earning my business degree and having no luck landing a degree-related job, I asked my dad for a job over the summer. Little did I know that summer gig would turn into a lifelong passion. I came in green as grass, having no prior experience in the industry (my dad had very high expectations and was very tough on me). I started as a laborer, but it wasn't long before I found myself captivated by shotcrete. Today, I can confidently say I've turned that summer job into a career I am very passionate about. I can't imagine doing anything else! **~Unruh**

My career began unexpectedly 15 years ago, stemming from a Thanksgiving dinner conversation with a family friend. I didn't know it at the time, but he was a recruiter specializing in hiring for technical and scientific roles. He set me up for the interview that started my career with calcium aluminates. I never imagined I would be working in the construction industry, and I am extremely grateful to our last-minute guest for introducing me to what turned out to be an exciting and fulfilling career in construction. **~Vawter**

Stephanie Da Ponte
Consolidated Shotcrete Inc.

Randle Emmrich
Coastal Gunite Construction Company

Katrina Fox Nyarko
Thorcon Shotcrete and Shoring LLC

Jisha Hechel
Azelis

Alice McComas
American Shotcrete Association

I was born into the concrete industry. My father started pumping concrete in the late 70s and my folks started their concrete pumping business in 1981. When the economy crashed in 2008, my father started Redwood Empire Hose Repair — that turned into a Schwing line pump dealership and is now the beast that it is today. We sell Schwing line pumps, Schwing parts, and shotcrete supplies, and run a concrete line pump repair facility in Northern California, which is easily one of the best (arguably the best in the nation). We eat, breath, and live everything line pump. **~Worden**

DESCRIBE YOUR ROLE IN YOUR COMPANY

Each day I wear a different hat or multiple hats at once. My main focus is sales and marketing for the business, but I am also HR, sometimes bookkeeper, purchasing agent, R&D project organizer, technical question responder, and material manufacturing demonstrator, which sometimes finds me with a shotcrete nozzle in my hands. It just depends on what that day needs. **~Barker**

I am the one who smooths the pot holes to ensure that we run as smoothly as we can. As President, my job is to make the best business decisions for the business — which means sometimes getting on site and running the concrete pump or holding the hose on a pool shoot. As I am currently trying to step away from the day-to-day, my main role now is to build my team of managers to take on the routine business. **~Brown**

I am currently a Project Engineer/Construction Manager for Granite Construction Tunnel Division, involved onsite in planning and executing daily construction activities. We have all manner of excavation; EPB TBM, roadheader, excavator, and drill and blast, as well as earth retention systems; secant piles, diaphragm walls, rock bolts, rib and lagging, segmentally lined, concrete, and shotcrete. I am in the field working with the crews to build our projects. **~Chastka**

My title says Director of Operations, but that's only part of the story. I handle bidding, ordering, mobilization checklists, project flow, and billing — and I'm still learning every day from Michele Cruz, the trailblazing Woman in Shotcrete. Wearing many hats is simply part of the job. **~Cruz**

My role as the Director of Deployment is to facilitate the needs of the corporation, the clients, and our field employees to make sure we are able to successfully execute our projects with the highest standards. **~Smith**

I do health and safety, which involves writing and implementing procedures, completing injury reports, and implementing corrective action to help prevent these injuries from occurring, as well as completing site inspections, reviewing these inspections with the foremen, etc. **~Da Ponte**

My current role is President of Coastal Gunite Construction Company, but I started out in sales 26 years ago and then went on to be a Safety Engineer, Project Engineer, Project Manager, Area Manager, and Vice President. It has been a fun ride! **~Emmrich**

As the Corporate Vice President at Thorcon, I play a pivotal role in driving the company's strategic direction and ensuring operational excellence. My responsibilities encompass overseeing ways for Thorcon to simplify internal office processes and systems, and leading a talented team of professionals. I am deeply involved in ensuring we stay focused on our business and what we deliver to our clients. Additionally, I collaborate closely with my leadership team to implement policies that enhance efficiency, safety, and quality across all projects. My role also includes mentoring and supporting team members, fostering a culture of collaboration and continuous improvement. Overall, my goal is to contribute to Thorcon's success and reputation as a leader in the construction industry. **~Fox Nyarko**

As the Assistant Director, I dabble in most everything! I administer most of ASA's programs: Shotcreter certification, inspector certification, contractor qualification, and convention and exhibitor programming. Since we are a small group, we are all involved in much of what you see happening in the Association. As such, I also contribute toward efforts

Christine Poulin
Sika Canda Inc.

Heather Smith
CROM
Corporation

Heather Spring
American
Shotcrete

Nina Thomas
CROM
Corporation

Jacquie Unruh
Unruh
Construction

on the magazine, membership, finance, website, and as camp mom. **~McComas**

I'm currently the Laboratory Manager for one of our construction applications laboratories at Azelis. My lab specializes in dry mortars containing cementitious binders. We offer to help customers optimize their concrete and mortar mix designs for better properties using our specialty chemical additives portfolio. We also represent a variety of raw material and additive suppliers and we support them by performing laboratory studies and benchmarking against market materials. **~Hechel**

Worked all the way from apprentice, to certified shotcreter, to business owner, to sale of shotcrete company. **~Burkert**

I manage the shotcrete division of our company, a role that brings unique challenges and rewards, especially as a woman in a physically demanding field. I manage and coordinate with other trades, and manage my prep and spray team, as well as nozzle. The work isn't just about directing operations; it requires strength, resilience, and a hands-on approach. Every day demands not only physical stamina but also the ability to problem-solve in a fast-paced environment. It's this blend of teamwork and grit that fuels my passion for what I do, proving that women can thrive in all aspects of construction. **~Unruh**

I am the General Manager of American Shotcrete, headquartered in Mesa, Arizona, providing high-quality shotcrete services throughout the Phoenix metropolitan area. With a focus and commitment to excellence and safety, I coordinate the day-to-day operations in the office as well as occasional on-site project oversight. My personal goal is ensuring every job meets the highest customer standards from delivery to completion.. ~Spring

I built all our websites. I also actively update and add new parts and equipment to our online shop. I started Line Pump Outlaws on Facebook which is at 20k members and growing. I sell shotcrete and line pump-specific supplies to folks all over the nation. I run dispatch for our operators out in the field. I designed a bunch of cheeky stickers and shirts that are related to the line pump industry. I'm not working the end of the hose, but I am in the background making the wheels turn, generating sales, and driving folks to our shop for repairs and line pump sales. I know this industry. And I love it. ~**Worden**

Technical support for shotcrete and tunneling technologies for my team in Sika Canada. **~Poulin**

As an Infrastructure Sales Manager I work closely with owners, engineers, and contractors to understand and identify their rehabilitation needs and challenges. I travel extensively throughout my region sharing technical product knowledge and solutions across the heavy industrial, wastewater, and aerospace sectors. I can be anywhere from giving a technical presentation to an active jobsite — sometimes on the same day! **~Vawter**

As an Administrative Craft Labor Coordinator and Health, Safety, and Environmental Representative at CROM, I am deeply committed to both the craft and the well-being of my team. My role is demanding, working long hours in all weather conditions, side-by-side with my brothers in construction. I take pride in the physically intense work, assisting in all areas needed from finishing shotcrete to working at heights, installing diaphragm, operating the Vertical Mobile Access Platform (VMAP), and so much more. Safety is at the heart of everything I do. Authorized by OSHA, I lead by example in conducting toolbox talks, training my team on hazard identification and prevention, and ensuring compliance with safety protocols. I cultivate a culture where safety is not just a requirement but a shared responsibility, recognizing and uplifting my team while providing guidance when needed. Beyond the field, I handle critical administrative tasks, including preparing activity hazard analyses, confined space permits, payroll, and equipment management. I ensure our tools and trailers are maintained, our environmental impact is minimized, and our team is educated on caring for their bodies and minds. As certified in CPR and first aid, I care for my brothers and sisters as needed. My role is more than a job — it's a purpose. Every day, I strive to protect, educate, and empower the hardworking men and women who make our projects possible. At CROM, I am not just a leader for my team: I am my brothers' and sisters' keeper. **~Thomas**

WHAT DO YOU LOVE MOST ABOUT WORKING IN THE SHOTCRETE INDUSTRY?

Meeting new people and learning what type of job they are completing. I love seeing customers' job photos and learning about their experiences on the jobsite. I would have never dreamed of some of the areas where our equipment is used and the projects our customers are completing — Our customers may need a custom-sized pump to fit into a small space in a mines, or just building cool projects like pools, skate parks, themed amusement parks, repair and rehabilitation projects on bridges, and tunnels, etc. **~Barker**

For me, it is not the shotcrete industry, but the pool industry. We only build shotcrete pools, and by narrowing our focus, we are lucky to be able to create beautiful pools for our clients. When I get to spend a day on a concrete shoot it is so much fun to be playing in the 'mud' instead of being behind a desk. **~Brown**

Educating others on quality shotcrete placement vs traditional form-and-pour. ***~Burkert***

The people in this industry are incredible. Everyone has been on a challenging job and needed to reach out to someone else in the industry to help solve an issue. It's a network of incredibly hardworking individuals who want to do their job well and will help each other whenever it is needed. The unique applications — stamped and dyed shotcrete on retaining walls to look like an exposed rock face rather than landslide prevention, for example — are also a compelling reason to enjoy this industry. But for me, it will always be the people. **~Chastka**

I really love seeing things be built and finished. Most of our work is repair and reconstruction based, and with that, knowing that the service we provide is benefiting so many people is very rewarding. **~Cruz**

I love the versatility of the trade; one day you're in a tunnel, the next you're doing a culvert, a pool, a parking garage, etc. **~Da Ponte**

The people. Most people that I have met in relation to the shotcrete industry are fun, or at least interesting. We are a small group in the very large construction industry, and everyone has amazing stories to tell about their projects, or an inspector, or a new approach to the method. It is never boring, and I am always learning something. **~Emmrich**

Remy Vawter
Imerys

Nichole Worden
Redwood Empire Concrete Pumping Equipment

Working with passionate people — because people in shotcrete are the craziest, nicest, most hard-working and passionate people I know. **~Poulin**

What I love most about working in the shotcrete industry is the unique blend of innovation and craftsmanship it offers. As I am new to the industry, I am learning every day. I am constantly inspired by the work my team delivers, pushing the boundaries of what's possible in construction through shotcrete techniques and a design-build approach. Additionally, I am passionate about the collaborative spirit within the industry, as it requires close coordination and teamwork to achieve the best results. Every day presents new challenges and opportunities to learn and grow, making my role both rewarding and fulfilling. **~Fox Nyarko**

The shotcrete process is very fun to watch and be a part of. The crew run like a well-oiled machine and everyone has an important part to play — the final result after a successful shotcrete project is amazing to see. I am humbled to play a small part in some shotcrete mixture designs, and I love to serve the industry by helping to make their concrete mixtures more robust, higher performing, and more enjoyable to work with. **~Hechel**

There is never a dull moment. I work and interact with a variety of people, from serving to soliciting service. There is always a unique problem or question that needs either my junior detective cap or a creative problem-solving solution. I get to work independently and on teams. I have co-workers and friends who will think through an issue with me and support me to make things happen. **~McComas**

The vastly different applications in which our products can help transform a person's dream and vision into reality. ***~Spring***

I have enjoyed watching the industry grow, using new technology to improve processes, and not staying stagnant in our processes, as well as helping to identify crew members who have potential to grow within the shotcrete industry. **~Smith**

Being on site remains my favorite part of the job, as it allows me to apply technical product knowledge to real-world challenges and offer solutions. Many of these visits are initiated by requests from our shotcrete contractors, and I value the relationships we've built. **~Vawter**

What I love the most about working in the shotcrete industry is the lasting impact of our work, knowing that our craftsmanship will endure. The tanks we build are lifelines for communities, providing essential resources for families and standing strong for generations. These tanks built with shotcrete have lasted 70 years and more. These tanks support life in ways many people never realize. Beyond the final product, I love the journey shotcrete has provided — the transformation that happens both in the structures we build and in the people who build them. Shotcrete is an art and a skill, and I take great pride is seeing my team members grow. We take individuals from all walks of life, teach them how to shoot, form, and finish shotcrete, and in the process they develop confidence, expertise, and a sense of purpose. Most importantly this industry provides opportunities: Shotcrete gives my team members the ability to provide for their families, build meaningful careers, and take pride in their work. I love being part of something bigger than myself — a team that creates, protects, and sustains. Every day, we shape lives thanks to shotcrete. **~Thomas**

My passion for the shotcrete industry runs deep. I thrive on the physical and mental challenges it presents; this field is truly not for the faint of heart. Every day brings new challenges, but we always find a way to win. When I leave the job site each day, I carry with me a profound sense of accomplishment and satisfaction that's hard to find elsewhere. What fills me with pride is not just the work I do — I'm honored to continue my family's legacy in this industry, and each project is a tribute to where I come from. **~Unruh**

I love the comradery of this industry. It is such a small bunch of us who are out here working in this industry. Everyone I have met or had the pleasure of working with are big-hearted, hard-working goof balls who love what they do. I love the freedom this industry allows me, and I am fascinated and in love with the machinery. Want to know the specs on any Schwing SP? I gotcha. I love supporting the folks who are boots on the ground making the magic happen. I love making sure they are getting the best equipment out there. I love that my position allows for me to travel and interview shotcreters and pumpers out in the field doing what they love, and producing content for the industry. My background is in film, photography, video, and media, and I've been able to apply my creative expertise to the concrete world. I'm pretty unique when it comes to this industry — there aren't many women who even know what a line pump is, let alone a shotcrete nozzle assembly. I feel like I am only just starting to catch my stride, and I can't wait to see what I will be making in the near future! **~Worden**

NAME A CHALLENGE IN YOUR CAREER AND HOW YOU OVERCAME IT.

A challenge in my career is working in a man's world. I have experienced being put into a box and stereotyped by my looks and gender. The only way to overcome this is to prove myself by demonstrating I am knowledgeable and strong enough to work alongside the men. Respect is earned and I do have to prove that a woman is good enough in this male-dominated industry. I continue to educate myself with seminars and completing hands-on demos with the material and our equipment. I try not to shy away from new experiences or jobs that I can help complete. But the best way I find to help stand out in the shotcrete world is to physically perform right next to the guys. I can still throw bags of cement on the mixer and manipulate a shotcrete nozzle. **~Barker**

After my father retired, I was wary that clients would not trust a 34-year-old to build them a stunning (and structurally sound) pool. We were working on a couple of large commercial pools at the time, and it was because of the faith that the project managers and site supers had in me that I knew we could carry on without a hitch. The next challenge was when we made the decision to get rid of a few of our seasoned guys from our shotcrete crew because of continued substance abuse. How could we do it without them? I decided that I would be the lead on the crew and run the pump and be there to make the decisions. Big decision, but it worked out well. **~Brown**

A challenge that I still strive to overcome is saying "Yes" to everything. ***~Cruz***

It was daunting to enter a male-dominated industry but I persevered despite the myriad challenges. I learned to know my audience and who I was able to trust. The diversity programs helped me succeed by allowing me a chance to get contracted work. From there, I was able to build my professional reputation by consistently cultivating skilled and certified personnel and delivering the highest quality work and to stay successful in a competitive market. **~Burkert**

Safety is an ongoing challenge. You have people who have been doing things a certain way for so long, and it can be difficult to make them understand why things aren't done this way anymore. I find using real life examples help people understand the dangers associated with shotcrete and the construction field in general. **~Da Ponte**

As the nature of our work requires us to move every few years to the next project, I am fortunate enough to be able to work with my husband on projects. While this has been a huge benefit personally (thank you Granite Construction), it hasn't always been possible with other companies, or the best option for my career. It was challenging to be seen as just someone's wife when we were newly married, rather than as an asset to a project. Some company's policies wouldn't allow us to work on the same site, and that often meant we'd need to work in different states. It was also easier to be overlooked by management for growth and learning opportunities. Consistently working hard, showing my commitment to the project being built, and leveraging my network in the industry helped me cement my position in our field. It took years of dogged determination to show that I'm here to stay. My goal now is to continue to help grow our industry as we bring in the next generations and support them in their careers. **~Chastka**

A long time ago, I had an inspector (grouchy old man) that tried to run me off a job site. He threatened to have me fired — I believe because he thought I was too young, too female, and too blonde. Confidence has never been much of an issue for me, but he made me doubt myself and my capabilities. In the end I stood my ground, persevered, and did not allow him to scare me away. Not only was this a challenge in my career, but also one of my proudest moments! ***~Emmrich***

One significant challenge I faced recently was (and still is) transitioning into the construction industry without prior construction experience. Stepping into the role of Corporate Vice President at Thorcon, I was determined to quickly get up to speed and make meaningful contributions. To overcome this challenge, I immersed myself in learning about the industry, attending ASA conferences, the World of Concrete conference, and the Bauma conference, seeking knowledge from my seasoned leadership team at Thorcon (as well as other professionals I have met), and leveraging my existing skills in leadership and business development. I prioritized building strong relationships with my team and actively listening to their insights and feedback. This collaborative approach allowed me to gain a deeper understanding of the process and skills it takes for us to deliver on a project from bid to closeout while fostering a supportive and innovative work environment. By embracing a continuous learning mindset, I am able to navigate the complexities of the industry and continue to drive Thorcon's success. **~Fox Nyarko**

Collaborating on a tunnelling rehabilitation project to develop a unique shotcrete solution, and in return getting resistance from the customer and owner. After more than a year's investment with my team, we were able to demonstrate that our solution was the best, most suitable for their project and the most economical. Success with shotcrete requires perseverance and, above all, education. **~Poulin**

We switched association management firms right before COVID hit. While I was able to set up our work-from-home office before everyone else was sent home, it was still a massive change. COVID shut down a lot of things, which gave us time to figure out how to regroup and learn new ways of working. The work continues to be significant, and working from home blurs the lines of working hours. Finding a balance is a very intentional goal that I am still working on. My family, friends, and faith have been huge assets in that process. **~McComas**

We were excited to try incorporating natural fibers into shotcrete formulations because we'd heard great things about the benefits they can impart, from environmental sustainability to better rheology and texture. One challenge we ran into was the even dispersion of the natural fibers in the mortar, because they had a tendency to tangle and form clumps in the mixture that would not evenly distribute. We discovered that by using a 50/50 slurry blend of natural fibers in combination with fibrillated HDPE fibers in water, we were able to create a pre-dispersion of the fibers that were free of tangles and bundles, resulting in a high-quality shotcrete formula with excellent performance properties. **~Hechel**

Upon joining CROM in October 2020, I quickly immersed myself in understanding the industry and the growing challenges CROM faced as it rapidly expanded. After carefully evaluating and collaborating with my teammates, I identified a critical gap: CROM's growth had outpaced its existing deployment strategy. Drawing on my experience and problem-solving skills, I developed a more efficient logistics strategy for CROM's field crews. With the support of CROM and their leadership, our solution not only streamlined operations and increased the company's field crew capacity, but also saved the company both time and money. **~Smith**

Challenges are a daily occurrence in this industry, and the key to overcoming them lies in maintaining a positive mental attitude. When a project doesn't go as planned, it's all about putting in the effort; doing everything possible to get the job done, no matter the obstacles. Once the dust settles, I reflect on the experience: What went wrong, and how can I prevent it in the future? I believe in the power of learning, so I dive deep, researching, asking questions, and seeking insights. It's a continuous journey of improvement, and each challenge only makes me stronger and more resilient. **~Unruh**

Working in a family business is really tough. There are a lot of strong characters, and it can feel like there are too many cooks in the kitchen. I'm proud of being able to serve my family by taking on a bunch of work myself while also being able to zone in on my niche within the family business and grow in my own way. I've always wanted to be creative, as an artist and musician. I had no idea how I was going to be able to combine my desire to be creative in the concrete industry. I mean, how do you do that? I'm finding it behind my camera lens and on my computer, creating content, graphics, websites, and visuals that are informational, fun, and a bit goofy, just like all us blue collar concrete folks. I'd love to create a version of "concrete pumping/shotcrete for dummies" type videos for folks who are starting out. I digress: I suppose I overcame the feeling of being worthless in a male-dominated industry by realizing that my take on things is original, interesting, and just as valuable. Keep your chin up — do your thing fearlessly. **~Worden**

One of the greatest challenges in my career has been proving myself as a woman in the construction industry. In a field traditionally dominated by men, I had to earn respect not just by my title, but through my actions. Early on I was met with skepticism and knew that words alone wouldn't be enough. I had to show that I could work just as hard even at the age of 57 years. I had to show I could endure the same tough conditions and contribute just as much to the success of our projects. I overcame this challenge by refusing to be discouraged. I immersed myself in the work, learning every aspect of shotcrete construction from physically demanding tasks to technical details that ensure our tanks stand strong for decades. I didn't just do my job, I went beyond — leading by example, educating my team on safety, and proving that leadership is about capability, not gender. Over time my persistence paid off. I gained not only the respect of my team but also their trust. Today I am an award-winning leader. I take pride in mentoring others, showing that women belong in this industry and can thrive in it. My journey has made me stronger, and I am opening doors for more women to follow. **~Thomas**

It was a challenge to move from a structured laboratory environment to the busy and ever-changing world of construction. I had to quickly adapt and use every opportunity to build my knowledge in the field. I knew it would be a steep learning curve and immediately began visiting project sites at various stages, before, during, and after completion. Directly engaging with owners, engineers, contractors, and even competitors accelerated my understanding of industry challenges and proved to be the most effective way to learn. **~Vawter**

DO YOU HAVE A WORD OF ENCOURAGEMENT OR ADVICE FOR WOMEN STARTING OUT IN THIS INDUSTRY?

Don't be afraid to jump in and help. We can do almost everything that men can do too. On multiple demos or jobsites, I will do anything that I can physically do — I will be the one picking up 50- to 80-pound bags and bringing them to the mixer. I have surprised and earned respect from men who would have never thought a woman could be industrious and capable of the job that was being performed. **~Barker**

Stick to your guns. Know that you can do it and don't listen to any of the people who say that you can't. My guidance counsellor in grade 11 told me that I couldn't become an engineer — I stood up and left her office after telling her I could and would. Find someone senior who supports you 100%; it is their confidence in you that will both give you internal power and give others confidence that you can do it. **~Brown**

I would say to these up and coming women to be passionate and confident. Always keep safety first and pay attention to details. ***~Burkert***

The best advice I have is to find your support network and be that network for others. Find a mentor or colleague that believes in you and will be a phone call away to console or encourage you when you have an awful day and want to quit (I promise you will have those days). And then pay it forward. Make sure other people know you are there for them as well when they have those days. Specifically for the shotcrete industry; vendors are an incredible resource. Most of them have been in the industry for years, so there isn't a question you have that they can't answer or at the very least find an answer to. There may be times you are in a bind on a project and need pump or material help. The vendors in our industry are amazingly resourceful and can solve most issues with a phone call. **~Chastka**

Get dirty, ask questions and be curious. Women can see things in the field with a different perspective. Use your voice and offer what you see. **~Cruz**

Working in a male-dominant field can be intimidating, but don't let this discourage you. Rising up to the challenge and succeeding is exceptionally rewarding. **~Da Ponte**

Women have different ways of looking at problems and handling situations, and are an asset to the industry! My advice: Don't be afraid to ask questions. We were all in the same shoes at one point. **~Emmrich**

Build a Strong Network: Connect with other professionals in the industry, both men and women. Attend conferences, join industry associations, and seek out mentors who can provide a wealth of knowledge and expertise as well as guidance and support. A strong network can open doors to new opportunities and provide a source of encouragement. **~Fox Nyarko**

Find the helpers (to quote Fred Rogers). It may be intimidating being in the minority, but there will almost always be a friend in the crowd to welcome you in and make you feel at ease. Lean into anyone who can help you, ask questions, and learn what you can, but also don't be afraid to speak up. Share your knowledge and experience with others, because you have much to share. **~Hechel**

Having a sense of humor and looking for the good in others will keep you sane. Own your mistakes, but don't let them own you. Give grace to others, but don't forget to give grace to yourself. We are all human and we move forward by taking one step at a time. These may sound pretty straightforward, but these are lessons that I am growing more into each day! **~McComas**

My most powerful piece of advice is to believe in yourself. In a field where men may have a physical advantage, focus on working smarter, not harder. Identify your unique skills and leverage them. Whether it's your creativity, problem-solving ability, or attention to detail, find ways to use those strengths to your advantage. Remember, it's not just about the physical aspect; it's about bringing your whole self to the table and proving that you can excel in this industry. Embrace your journey and never underestimate the impact you can make! **~Unruh**

Embrace learning, asking questions, reaching out, and finding mentorship within your organization and the industry. Women may be underrepresented, but those of us within the industry are proud of it, and we are happy to help encourage and grow anyone interested in learning. **~Smith**

Never be afraid to ask questions. It can be intimidating to admit that you "don't know", but seeking clarity demonstrates that you are engaged and truly care about understanding the topic or concern. **~Vawter**

Be fearless. There are plenty of resources out there to support you and help you grow in any direction that you choose to take your career! ***~Spring***

To any woman stepping into the construction and shotcrete industry, know that you belong here. This work is tough, demanding, and often underestimated, but so are you. Never let anyone tell you that you can't do something. Prove yourself through your work ethic, your knowledge, and your resilience. You don't have to be the strongest person in the room to be the most capable. Learn everything you can, ask questions, and never be afraid to get your hands dirty. Respect is earned through action, and the more you invest in yourself, the more you will gain. Most importantly, invest in yourself physically and mentally, and support and uplift other women in the field. We are breaking barriers, not just for ourselves but for the next generation. Stand tall, work smart, work hard, and remember you are not just building structures; you are building a legacy. Leave your life print everywhere you go. Enjoy life to the fullest. **~Thomas**

We belong in construction, and without meaning to, we're making a big difference. The guys are our biggest supporters and want to help us flourish in this industry. So let's go queens — the doors are wide open for us! **~Poulin**

It's crass; the boys probably have the inner monologue of a sixteen-year-old boy running between their ears most of the time. You will hear it all. But, one thing that that will get you to where you want to be is to just focus on yourself. Show up, work hard, play hard, and shoot it right back at them. There's nothing a woman with an indomitable spirit can't accomplish. **~Worden**

Shotcrete Resources

Shotcrete is used for new structural concrete construction and a variety of pool, repair, and repurposing applications. ACI offers numerous industry-leading shotcrete products and programs. Some highlights include the newly released, ACI PRC-506.8-24, “Shotcrete Use in Pool Construction - Guide”; On-Demand Course: “Shotcrete—Guide and Specification”; and more. For a complete list of all shotcrete products and programs, visit **www.concrete.org** or **www.shotcrete.org**.

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Growing With the Times

KEEPING UP WITH SAFETY & EQUALITY CHANGES

By Stephanie Da Ponte

Shotcrete is a century-old method used in the construction industry, and along with it came a century of men dominating the field. While the vast majority of 21st-century construction industry professionals are still men, we're beginning to see an influx of women entering the field, and I am incredibly proud to be a part of this transformation. Encountering women in the industry has been a morale boost. It encourages other women who may feel intimidated, that they are not alone. It serves as a reminder that women can excel in every part of the construction industry. Seeing organizations such as ACI change their terminology from "Nozzleman" to "Shotcreter" is showing not only me but women all over that we are taking exponential steps in the right direction.

Although I'm very involved in the trades, I'm technically not a tradesperson — I work in Health and Safety. Over the years, I've observed significant safety changes within the shotcrete industry. People are taking safety more seriously and taking the initiative to make their work environment safer for themselves and their co-workers. In this article, I'll discuss the importance of ensuring that material delivery lines, reducers, clamps, and air supply lines are used properly and maintained effectively, as well as the ways we can reduce injuries associated with them.

Figs. 1 & 2: Whip checks installed on material and airlines to restrain them in the event of a disconnection.

COMMON HAZARDS

AIR SUPPLY LINES AND MATERIAL LINES

One of the most common hazards associated with air supply hoses is when the Chicago fittings disconnect from the end of a live air line. This could cause the fitting to become a projectile: The escaping air will cause the air line to whip around violently, posing a hazard to anybody nearby. The same can be said about the material delivery lines — the bell ends can come off or ruptures can occur due to a blockage or rubbing against a protruding object, causing a tear. It is crucial to ensure that inspections are being completed every morning as the crew is unrolling and setting up the lines, as damaged sections will have less resistance to pressure

It's important to keep an eye on the condition of the lines (cracks, cuts, abrasions, flexibility, kinks, and/or exposed wire), inspect the fittings and connections for tightness, rust, and corrosion, and check to make sure the pressure of the air line and material line can withstand the pressure from the compressor and concrete pump. It's also crucial to ensure whip checks are installed properly: Too many times, I have come across an air line with a whip check installed incorrectly, with the loop section on the fitting instead of the air line. Whip checks play a critical role in shotcreter safety

Fig. 3: 'Down line' hoses, which are connected to the reducer at the pump, are wire-braided to handle higher pressure. This particular hose shows a clearly worn area, likely caused by repeated contact with a soldier pile.

Fig. 4: This material line suffered a rupture; upon inspection it's noticed that this section was showing clear indentations. These were likely caused by repeated rubbing against rebar. This caused a weakened section in the line and ruptured during a plug.

by preventing the lines from whipping around freely in the event of a disconnected fitting.

ELBOWS

Elbows undergo more wear than any other component in the material line system. Since the elbow is directly connected to the pump, it is the point where it endures the full force of discharge from the concrete pump. Concrete, being an abrasive material, will wear down the elbows, reducers, and material lines over time. A visual indication of this wear is when an opening that was once 4 in. (100 mm) may expand to 5 in. (125 mm) or more. Using worn elbows, reducers, and material lines creates a risk of hose or pipe failure. As concrete wears down the walls of the pipes, they become thinner and weaker, particularly in high-pressure areas such as a reducer transitioning from 3 in. (75 mm) to 2 in. (50 mm). Since elbows endure the most pressure, it is in the workers' best interest to install a concrete discharge-end pump cover. We currently use the 'Python' cover, which prevents concrete from suddenly spraying upward in the event of a rupture, protecting both the pump operator and the concrete truck driver. Using heat-treated pipes enhances strength, durability, and resistance to abrasion, making them suitable for the rigorous demands of shotcrete applications. They also tend to have greater longevity compared to non-heat-treated pipes.

Fig. 5: Installing a 'Python' cover will confine concrete within the cover in the event of a rupture.

Figs. 6 & 7: When comparing the new and used pipes side by side, there's a noticeable difference in diameter. Upon measuring, it's clear that the used pipe is slightly larger.

INSPECTIONS

There are numerous components to consider when determining if a hose or pipe is nearing the end of its lifespan. Several key signs can help ensure timely replacement and prevent failures. These include visible wear and tear such as:

- Surface damage
- Deformation
- Increased internal diameter
- Leakage
- Increased vibration

All pipes, clamps, and material lines should be inspected "frequently", which is defined as monthly according to concrete pumping equipment standards including ASME B30.27 (USA) and CSA Z151 (Canada). It's a good idea to include this item in your monthly Health and Safety inspection.

Using an ultrasonic thickness gauge can help detect thinning and corrosion in your steel pipes. Measuring the openings of elbows, reducers, and material lines can indicate the extent of wear incurred. Typically, when the opening has expanded by 15%, they should be replaced. We developed an inspection tool to help determine when a pipe should be taken out of service, since there are no existing standards to guide this process.

When inspecting clamps, check for corrosion, excessive wear on the clamp edges, inspect the bolts, check the gasket for gaps and brittleness, and ensure the clamp aligns correctly with the material lines. Faulty elbows, reducers, clamps, and material lines are the leading cause of

Fig. 8: Consolidated Shotcrete designed an inspection tool to evaluate pipe condition and determine end-of-life criteria."

Figs. 9 & 10: Here we can see that the pipe that has been in service is now at the red marking, indicating no longer safe for use.

accidents in a typical shotcrete setup. Regular inspections, proper installation, and timely replacement are critical in ensuring a safe and efficient work environment.

PROTECT YOUR PEOPLE

Safety, at its core, is about protecting everyone on the job site — from proper inspection of material lines, elbows, reducers, and clamps to ensuring the correct installation of whip checks. Every step we take reduces the likelihood of injury and equipment failure. Simple yet essential actions, such as daily inspections, using ultrasonic thickness gauges, and replacing components when wear becomes visible, can prevent accidents.

As the industry continues to evolve, the integration of advanced materials like heat-treated pipes and the adoption of better safety standards reinforce the need for a proactive approach. By fostering a culture of accountability, vigilance, and continuous improvement, we can ensure that the shotcrete industry remains not only productive, but also safe and inclusive for all. Let us all take these lessons forward, recognizing that safety is not just a checklist: It is a shared responsibility that protects the lives and livelihoods of every worker on-site.

WE CAN GROW TOGETHER

The shotcrete industry has evolved tremendously: From the increasing presence of women to inclusive language changes and the recognition of the importance of safety, these steps undoubtedly signify progressive forward movement. This change not only encourages diversity but also sets a precedent for the industry to adapt and grow in all aspects, including safety practices.

I am proud to be a woman in shotcrete, and I hope to show the next generation of women that this is a field where they, too, can thrive. We will continue to strengthen and shape the industry for all.

Stephanie Da Ponte *is an experienced Health and Safety Coordinator with a demonstrated history of working in the Construction industry. Skilled in Hazard Identification, incident investigations, and risk assessments, she is a strong operations professional with a certificate from University of Toronto focused on Occupational Health and Safety.*

Creciendo Con los Tiempos

MANTENERSE AL DÍA CON LOS CAMBIOS EN MATERIA DE SEGURIDAD E IGUALDAD

Por Stephanie Da Ponte

El hormigón proyectado es un método centenario utilizado en la industria de la construcción, y con él llegó un siglo de dominio masculino en el sector. Aunque la gran mayoría de los profesionales de la industria de la construcción del sigloXXIsiguen siendo hombres, estamos empezando a ver una afluencia de mujeres que se incorporan al sector, y me siento increíblemente orgullosa de formar parte de esta transformación. Encontrar mujeres en el sector ha sido un estímulo para la moral. Anima a otras mujeres que pueden sentirse intimidadas a saber que no están solas. Sirve para recordar que las mujeres pueden destacar en todos los ámbitos del sector de la construcción. Ver cómo organizaciones como ACI cambian su terminología de "Nozzleman" a "Shotcreter" nos demuestra, no solo a mí, sino a todas las mujeres, que estamos dando pasos exponenciales en la dirección correcta.

Aunque estoy muy involucrada en los oficios, técnicamente no soy una artesana, sino que trabajo en salud y seguridad. A lo largo de los años, he observado cambios significativos en materia de seguridad dentro de la industria del hormigón proyectado. La gente se toma la seguridad más en serio y toma la iniciativa de hacer que su entorno de trabajo sea más seguro para ellos y sus compañeros. En este artículo, hablaré de la importancia de garantizar que las líneas de suministro de material, los reductores, las abrazaderas y las líneas de suministro de aire se utilicen correctamente y se mantengan de forma eficaz, así como de las formas en que podemos reducir las lesiones asociadas a ellos.

Fig. 1 y 2: Comprobaciones de latigazos instaladas en el material y las líneas aéreas para sujetarlas en caso de desconexión.

RIESGOS COMUNES

LÍNEAS DE SUMINISTRO DE AIRE Y LÍNEAS DE MATERIAL

Uno de los riesgos más comunes asociados a las mangueras de suministro de aire es que los racores Chicago se desconecten del extremo de una línea de aire activa. Esto podría hacer que el racor se convirtiera en un proyectil: el aire que se escapa hará que la línea de aire se mueva violentamente, lo que supone un peligro para cualquier persona que se encuentre cerca. Lo mismo puede decirse de las líneas de suministro de material: los extremos acampanados pueden desprenderse o romperse debido a un bloqueo o al roce con un objeto saliente, lo que provocaría un desgarro. Es fundamental asegurarse de que se realicen inspecciones cada mañana, mientras el equipo desenrolla y instala las líneas, ya que las secciones dañadas tendrán menos resistencia a la presión.

Es importante vigilar el estado de las líneas (grietas,

Fig. 3: Las mangueras «Down line», que están conectadas al reductor de la bomba, están trenzadas con alambre para soportar una mayor presión. Esta manguera en particular muestra una zona claramente desgastada, probablemente causada por el contacto repetido con un pilón soldado.

Fig. 4: Esta línea de material sufrió una ruptura; tras inspeccionarla, se observó que esta sección presentaba claras hendiduras. Probablemente, estas fueron causadas por el roce repetido contra las barras de refuerzo. Esto provocó un debilitamiento de la sección de la línea, que se rompió durante un tapón.

cortes, abrasiones, flexibilidad, torceduras y/o cables expuestos), inspeccionar los accesorios y las conexiones para comprobar que estén bien ajustados y que no presenten óxido ni corrosión, y asegurarse de que la presión de la línea de aire y la línea de material puedan soportar la presión del compresor y la bomba de hormigón. También es fundamental asegurarse de que las válvulas antirretroceso estén instaladas correctamente: en demasiadas ocasiones me he encontrado con líneas de aire con válvulas antirretroceso instaladas incorrectamente, con la sección del bucle en el accesorio en lugar de en la línea de aire. Las válvulas antirretroceso desempeñan un papel fundamental en la seguridad de la hormigonera, ya que evitan que las líneas se muevan libremente en caso de que se desconecte un accesorio.

CODOS

Los codos sufren más desgaste que cualquier otro componente del sistema de líneas de material. Dado que el codo está conectado directamente a la bomba, es el punto donde soporta toda la fuerza de descarga de la bomba de hormigón. El hormigón, al ser un material abrasivo, desgasta los codos, los reductores y las líneas de material con el tiempo. Una indicación visual de este desgaste es cuando una abertura que antes era de 4 pulgadas (es) o (100 mm) puede expandirse a 5 pulgadas (125 mm) o

Fig. 5: La instalación de una cubierta «Python» confinará el hormigón dentro de la cubierta en caso de rotura.

Figs. 6 y 7: Al comparar las tuberías nuevas y usadas una al lado de la otra, se aprecia una diferencia notable en el diámetro. Tras medirlas, queda claro que la tubería usada es ligeramente más grande.

más. El uso de codos, reductores y líneas de material desgastados crea un riesgo de fallo de la manguera o la tubería. A medida que el hormigón desgasta las paredes de las tuberías, estas se vuelven más delgadas y débiles, especialmente en zonas de alta presión, como un reductor que pasa de 3 pulgadas (75 mm) a 2 pulgadas (50 mm). Dado que los codos soportan la mayor presión, lo más conveniente para los trabajadores es instalar una cubierta de hormigón en el extremo de descarga de la bomba. Actualmente utilizamos la cubierta 'Python', que evita que el hormigón salpique repentinamente hacia arriba en caso de rotura, protegiendo tanto al operador de la bomba como al conductor del camión hormigonera. El uso de tuberías tratadas térmicamente mejora la resistencia, la durabilidad y la resistencia a la abrasión, lo que las hace adecuadas para las rigurosas exigencias de las aplicaciones de hormigón proyectado. También tienden a tener una mayor longevidad en comparación con las tuberías no tratadas térmicamente.

INSPECCIONES

Hay numerosos componentes que hay que tener en cuenta a la hora de determinar si una manguera o un tubo se está acercando al final de su vida útil. Hay varios indicios clave que pueden ayudar a garantizar su sustitución oportuna y evitar fallos. Entre ellos se incluyen el desgaste visible, como por ejemplo:

- Daño superficial
- Deformación
- Aumento del diámetro interno
- Fuga
- Vibración aumentada

Fig. 8: Consolidated Shotcrete diseñó una herramienta de inspección para evaluar el estado de las tuberías y determinar los criterios de fin de vida útil.

Figs. 9 y 10: Aquí podemos ver que la tubería que ha estado en servicio se encuentra ahora en la marca roja, lo que indica que ya no es segura para su uso.

Todas las tuberías, abrazaderas y líneas de material deben inspeccionarse “con frecuencia”, lo que se define como mensualmente según las normas de equipos de bombeo de hormigón, incluidas ASME B30.27 (EE. UU.) y CSA Z151 (Canadá). Es una buena idea incluir este punto en su inspección mensual de salud y seguridad.

El uso de un medidor de espesor ultrasónico puede ayudar a detectar el adelgazamiento y la corrosión de las tuberías de acero. La medición de las aberturas de los codos, reductores y líneas de material puede indicar el grado de desgaste sufrido. Por lo general, cuando la abertura se ha expandido un 15%, deben sustituirse. Hemos desarrollado una herramienta de inspección para ayudar a determinar cuándo debe retirarse una tubería del servicio, ya que no existen normas que guíen este proceso.

Al inspeccionar las abrazaderas, compruebe si hay corrosión, desgaste excesivo en los bordes de las abrazaderas, inspeccione los pernos, compruebe si la junta presenta huecos y fragilidad, y asegúrese de que la abrazadera se alinea correctamente con las líneas de material. Los codos, reductores, abrazaderas y líneas de material defectuosos son la principal causa de accidentes en una instalación típica de hormigón proyectado. Las inspecciones periódicas, la instalación adecuada y la sustitución oportuna son fundamentales para garantizar un entorno de trabajo seguro y eficiente.

PROTEJA A SU PERSONAL

La seguridad, en esencia, consiste en proteger a todas las personas que se encuentran en la obra, desde la inspección adecuada de las líneas de material, los codos, los reductores y las abrazaderas hasta la instalación correcta de los dispositivos de control de latigazos. Cada medida que tomamos reduce la probabilidad de lesiones y fallos en los equipos. Acciones sencillas pero esenciales, como las inspecciones diarias, el uso de medidores de espesor ultrasónicos y la sustitución de componentes cuando el desgaste es visible, pueden prevenir accidentes.

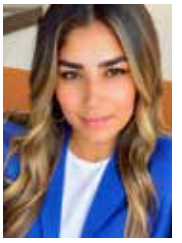
A medida que la industria sigue evolucionando, la integración de materiales avanzados, como las tuberías tratadas térmicamente, y la adopción de mejores normas de seguridad refuerzan la necesidad de adoptar un enfoque proactivo. Fomentando una cultura de responsabilidad, vigilancia y mejora continua, podemos garantizar que la industria del hormigón proyectado siga siendo no solo productiva, sino también segura e inclusiva para todos. Aprovechemos todos estas lecciones, reconociendo que la seguridad no es solo una lista de verificación: es una responsabilidad compartida que protege la vida y el sustento de todos los trabajadores en la obra.

PODEMOS CRECER JUNTOS

La industria del hormigón proyectado ha evolucionado enormemente: Desde la creciente presencia de mujeres hasta los cambios en el lenguaje inclusivo y

el reconocimiento de la importancia de la seguridad, estos pasos sin duda significan un avance progresivo. Este cambio no solo fomenta la diversidad, sino que también sienta un precedente para que la industria se adapte y crezca en todos los aspectos, incluidas las prácticas de seguridad.

Me enorgullece ser una mujer en el sector del hormigón proyectado y espero poder mostrar a la próxima generación de mujeres que este es un campo en el que ellas también pueden prosperar. Seguiremos fortaleciendo y dando forma a la industria para todos.



Stephanie Da Ponte *es una coordinadora de salud y seguridad con amplia experiencia y una trayectoria demostrada en el sector de la construcción. Especializada en la identificación de peligros, la investigación de incidentes y la evaluación de riesgos, es una sólida profesional de operaciones con un certificado de la Universidad de Toronto centrado en la salud y la seguridad en el trabajo.*

Sustaining Corporate Members

Thank you, Sustaining Corporate Members, for your investment in the industry! ASA Sustaining Corporate Members show true dedication to ASA's vision to see "structures built or repaired with the shotcrete process accepted as equal or superior to cast concrete." These industry leaders are recognized for their exemplary level of support for the Association in a variety of ways.

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www.cancrete.ca

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Breaking the Mold

ONE WOMAN'S PATH INTO CONCRETE INDUSTRY MANAGEMENT (CIM)

By Cara Baker

Rylie McKinney

When Rylie McKinney enrolled at Texas State University, she didn't expect concrete to shape her future. In fact, she didn't know much about the industry at all.

"I was set on business because I've always been entrepreneurial and math-oriented," she said. "But then I talked to the recruiter for the Concrete Industry Management (CIM) program, and she told me all these amazing things — how it's small, hands-on, and full of opportunities to travel and meet professionals." That conversation changed everything.

What began as a "why not?" decision turned into a thriving career path. Today, McKinney is a senior in the CIM program — one of the fastest-growing specialized degree tracks in construction and materials science.

FROM LONE WOMAN TO LEADING VOICE

"When I joined, I was the only girl in my class," McKinney recalled. "There were about 30 students total." Just a few years later, the program has nearly quadrupled in size, now enrolling more than 100 students and including around 30 women.

Ryan Penlerick, the program's director and Professor of Practice, says this growth is a point of pride. "The young ladies in the program always do very well," Penlerick said. "About 16 percent of our total enrollment is women now — well above the industry average. They bring a completely different perspective on a lot of things, and there's no reason they shouldn't consider this as a career."

For McKinney, being one of the first women in her class wasn't always easy — but it gave her an edge. "I feel like I'm actually at a huge advantage compared to the males," she said with a laugh. "If you walk into a room and you're the only woman, people are curious. I worked really hard to prove myself, and now people know I mean business."

Her advice to women considering the program? Confidence is key. "It's alright to be nervous, but confidence in yourself says more than anything they could ever say to you," she said. "Stand your ground and show that you know your stuff."

A DEGREE THAT BUILDS MORE THAN CONCRETE

The CIM program blends science, construction, and business — preparing students to lead in a multi-billion-dollar industry that touches nearly every part of modern infrastructure.

"It's a business-intensive degree," Penlerick explained. "We teach students the technical side — mixture design, testing, materials science — but also how to manage operations, run companies, and make decisions in the field."

For McKinney, that mix of technical and entrepreneurial training was the perfect fit. She's spent years in materials labs experimenting with concrete mixture designs, while also learning how to write business plans and lead projects.

As part of her senior capstone, McKinney is launching a business concept focused on shotcrete — particularly as used for pools. Her industry mentor, Juan Jose Armenta, has already connected her to the American Shotcrete Association (ASA) and is helping her refine her business model.

"Ultimately, I'd love to start my own company," McKinney said. "This capstone is giving me a real plan to do that. Even if I don't go straight into it after graduation, I know I'll have the tools."

HANDS-ON EXPERIENCE, REAL-WORLD OPPORTUNITIES

McKinney's favorite part of the program isn't just the coursework — it's the people.

"We're like a family," she said. "I came from a really small town, so walking into a close-knit program where professors and industry mentors actually know you — that's probably the main reason I stayed in the program."

Students regularly network with industry professionals through weekly guest lectures, field trips, and national conventions. They also travel across the U.S. and Canada for competitions and professional events, all funded by the program's patrons and sponsors.

"The opportunities that come out of this program are actually insane," McKinney said. "We have 100 percent job placement after graduation, tons of scholarships, and amazing travel experiences. You just don't get that in other degrees."

POURING A FOUNDATION FOR THE FUTURE

As McKinney nears graduation, her path reflects what CIM is all about — turning curiosity into confidence, and raw materials into careers.

For students who like working hands-on, problem-solving, and thinking big, McKinney says CIM is worth a closer look. “It’s definitely worth a try,” she said. “You get so many experiences, you meet incredible people, and the opportunities are endless. You might come in not knowing much about concrete — but by the time you leave, you realize you can build just about anything. One thousand percent recommend.”

Cara Baker *is a creative professional with a BA in Graphic Design and a background in journalism and communications. She served five years in the U.S. Navy as a print photojournalist and editor, documenting events such as the 60th Anniversary of the Battle of the Bulge and the maiden deployment of USS Ronald Reagan (CVN 76). After her service, she honed her writing and branding skills in both corporate and nonprofit settings before becoming Managing Editor at the American Shotcrete Association, where she oversees global author relations, editorial content, and design for the quarterly magazine. Skilled in copywriting, editing, layout, and graphic design, Cara blends creativity with precision in every project.*

CIM

CONCRETE INDUSTRY MANAGEMENT

The **Concrete Industry Management (CIM)** is a professional degree that combines business education, cutting-edge technology, and hands-on experience.

It produces leaders perfectly tailored for the numerous industry jobs available. Graduates aren’t just ready to enter the concrete and shotcrete worlds — they’re ready to redefine the future of our workforce.

This program is available at:

- **California State University, Chico**
- **Middle Tennessee State University**
- **New Jersey Institute of Technology**
- **South Dakota State University**
- **Texas State University**

Fig. 1: The earthy color of the concrete at Torguson Park in North Bend, WA, was inspired by nearby Mt. Si; photo courtesy of Grindline Skateparks, Inc.

Shotcrete Makes for Smoother, Safer Skateboarding

By Kristin Dispenza, AOE

Early skateparks may have been made out of wood, but as the sport grew in popularity, concrete became the recommended material, providing a smoother, safer, and more durable surface. Shotcrete, specifically, became the best placement option for concrete because of its flowability and high strength, allowing for complex curvatures with tight tolerances that would not be possible with other installation methods. The appeal of this particular market to the younger generation makes it a very effective space to target workforce needs. The Skate4Concrete program puts student interns to work on skatepark jobsites and helps them learn concrete construction skills, including how to handle shotcrete equipment.

SHOTCRETE: A SOLUTION FOR SKATEPARKS

Concrete skateparks are built using a familiar construction type: Non-structural slab on grade. Designers use earthwork to provide the shape and support of the concrete skating surface, and then edge and shape control formwork is installed.

"The formwork used for skateparks is unique compared

to other types of concrete construction," said Matt Fluegge, Chief Executive Officer of Grindline Skateparks, Inc. "We don't use panels, since every part of a skatepark is geometrically unique. We custom-fabricate radii out of plywood and board lumber."

After formwork is in place, 6 in. (300 mm) of concrete is shotcreted against the soil. Shotcrete placement is essential for achieving smooth-flowing transitions in features such as bowls, pools, and banks. Finishing methods are also important.

"We hand trowel an air-entrained mix, which is not standard," said James Klinedinst, Senior Project Manager at Grindline Skateparks, Inc. "Typically, air-entrained mixtures are broomed or textured. It requires a technique learned over years to hand-trowel in a way that releases the trapped air and prevents delamination."

Having consistency in the concrete mix is also critical. "We've used a tried and true, off-the-shelf shotcrete mixture from Heidelberg Materials for years. And while we have that single, preferred mixture design, because we build parks all over the country, we also have to take into consideration variations due to regionally available aggregates, cement and other local materials," said Klinedinst. "We address this by sending our suppliers a cut sheet that breaks down aggregates and other mixture contents."

SKATE4CONCRETE CONNECTS SKATERS WITH SHOTCRETE

Founded by Crystal Howard in 2014, the non-profit organization Project Cornerstone focuses on education and workforce development in the concrete and construction materials industry. That same organization launched Skate4Concrete in 2023.

There's ample evidence that a passion for skateboarding can lead to a lifelong career in the concrete industry. The team at Grindline, a Seattle-based skatepark construction company, comprises former professional skateboarders-turned-concrete craftsmen. (See the sidebar on the next page for project details on the Grindline project: Torguson Park.)

"For just about all of us at Grindline, it started with a passion for skateboarding and recognition that skate facilities could be improved and made into more skateable terrain if designed and constructed by skateboarders. Several of us have now been at the company for more than 20 years, building our careers by moving up in the ranks while also contributing to the sport we love," said Fluegge.

Project Cornerstone created Skate4Concrete with funding from, and in cooperation with, the Concrete Advancement Foundation. Initial efforts included a series of informational videos and a website with a **map-based interface** to help students easily find job openings with member companies of the National Ready-Mixed Concrete Association (NRMCA). Skate4Concrete also created the Concrete Certification for high school students, an online course that continues to expand its reach today. When the course was being beta tested, schools stressed

Fig. 2: Skatepark designers use earthwork to provide the shape and support of the concrete skating surface, then formwork is installed; photo courtesy of Grindline Skateparks, Inc.

Fig. 3: Formwork for skateparks is custom-fabricated; photo courtesy Grindline Skateparks, Inc.

Fig. 4: Shotcrete is essential for achieving the smooth-flowing transitions in features such as bowls, pools, and banks; photo courtesy Grindline Skateparks, Inc.

Torguson Park
North Bend, WA

Fig. 5: ACI award-winning Torguson Park; photo courtesy Grindline Skateparks, Inc.

Opened in 2021, this 13,000 ft² (1200 m²) facility features a one-of-a-kind flow bowl, pool-style bowl, and large street skate area. The skatepark was constructed using shotcrete placement, which helped achieve the smooth-flowing transitions and curves of the design. Ready-mixed concrete containing Heidelberg Materials' EcoCem®PLC portland limestone cement (which lowered the carbon footprint by about 10%) allowed the team to design and build any shapes desired, including a rock coping mini pool, a replica of a mountain, stairs, banks, ledges, and curbs. The earthy color palette of the concrete, achieved using integral color, was inspired by nearby Mt. Si, which can be seen from the facility. The project was a **first-place winner** in the American Concrete Institute's (ACI) 2023 Excellence in Concrete Construction Awards in the Decorative Concrete Category.

TEAM MEMBERS:

- Owner: Si View Metropolitan Park District
- Architectural Firm: Grindline Skateparks, Inc.
- Engineering Firm: Mackay Sposito
- General Contractor: Grindline Skateparks, Inc.
- Concrete Contractor: Grindline Skateparks, Inc.
- Concrete Supplier: Heidelberg Materials formerly Cadman, Inc.

that the certification would be more widely adopted if it was nationally recognized by the industry, so an endorsement soon followed from the NRMCA.

A current goal is to get the certification adopted in more states. To ensure the certification fulfills its intended function of connecting students to available jobs, some states require the certification to be on a state-approved list, and may require letters showing not only that the program is nationally recognized, but that it has local support, including proof that local companies consider the certification to be a differentiating factor when they are hiring.

Heidelberg Materials has provided such proof in the form of letters to states including Washington, Maryland, New York, and Illinois. The letters list Skate4Concrete Certification as an approved certification for Career and Technical Education (CTE).

"We have skaters in our work force at Heidelberg Materials, and we believe Skate4Concrete Certification provides valuable experience for students, which translates to greater interest and success in the workplace," said Larry Rowland, Sustainability Market Manager at Heidelberg Materials.

"Closing the loop with input from [the] industry is important, because states need to understand the relevance of the certification program," said Howard. "That is what drives school adoption of the program."

Corey Rosson, Senior Sales Representative of Pacific Northwest Heidelberg Materials, works in the building materials industry but has been a skateboarder since he was 10 years old. He became aware of Skate4Concrete when Heidelberg Materials North America mentioned the program on social media channels.

"It's exciting to see Skate4Concrete offering a different approach to career development," Rosson said. "Often, three main routes come to mind for young people coming out of high school: College, trade school, or the military. Having an additional pathway that connects people to work — work that's built around something they already love — is a real benefit."

Building on its success with the certification program, Skate4Concrete's next initiative was to create an internship program, which had its first intern in 2023. Students are currently recruited through the **Concrete Industry Management (CIM)** program, which is offered at five universities across the U.S.

Interns spend three months being part of a building team for a skatepark and, one day a week, gain exposure to various aspects of the concrete industry. For example, they tour concrete and cement plants and quarries, or spend time with city officials or other owner representatives who are managing the skatepark construction project. These excursions are organized by local concrete associations, with whom Skate4Concrete partners to increase awareness of concrete careers.

Partnerships with skatepark construction companies are a keystone of the program's success. While Skate4Concrete and Project Cornerstone rely on grants, an annual golf

tournament, and corporate contributions for funding to pay interns' wages, skatepark construction companies provide on-site instruction, mentoring, and even summer housing with the construction crew.

"In our first two years, we had one student each summer," said Howard. "For the summer of 2025, we have two. One student will work with New Line Skateparks in Idaho Springs, Colorado, and the other with Grindline Skateparks on their Las Cruces, New Mexico skatepark."

"The internship is a great opportunity for everyone involved," said Fluegge. "Years ago, when members of my team and I were entering the concrete/skatepark industries, we didn't have an opportunity like this, so supporting the effort is important to Grindline. It's a great opportunity for the applicant to learn and display their skillsets, as well as an opportunity for us to scope new talent, which ideally would develop into a long-term career opportunity."

Related to Skate4Concrete's certification and education efforts, the organization hosted its first Construction Summer Camp in 2024. The camp features interactive activities and educational sessions that provide 15- to 18-year-olds with insights into career pathways. The 2025 camp program launched an affiliation with the Associated General Contractors (AGC) Apprenticeship and Training Trust Program. On the second day, campers worked with the Miramar College Diesel Technology program, receiving hands-on training with heavy equipment including a ready-mix concrete delivery truck. The third day of camp was "concrete day", with students visiting a concrete supplier, Pedroza Ready-Mix. The camp concluded on its fourth day at Martin Marietta Materials, where the itinerary included a quarry tour. A new event for this year's camp included a team exercise designing and constructing mini-skateparks — complete with mock interviews and a mini-skatepark competition.

Like shotcrete placement, which efficiently solves many technical hurdles in concrete construction, Skate4Concrete's direct approach to addressing workforce shortages provides a unique solution to industry challenges.

Visit **www.skate4concrete.com** for a complete listing of resources, and follow, like, and share them on Instagram at **www.instagram.com/skate_4_concrete**. Find out more about the Concrete Advancement Foundation at **www.concreteadvancement.org**.

Kristin Dispenza *is a Senior Account Manager with Advancing Organizational Excellence, developing trends articles, case studies, and other PR materials. She received a Bachelor of Science degree from The Ohio State University College of Engineering/School of Architecture and has more than 30 years of writing and editorial experience. She can be reached at* ***kristin.dispenza@aoeteam.com****.*

A "Field Report" from Paul J. Nunez, Skateboarder and Skate4Concrete Intern

I was already a student in the Construction Industry Management (CIM) program at California State University, Chico when one of my professors approached me about a summer internship. The internship was offered through Skate4Concrete, an organization that provides information to skaters on entry-level careers in concrete.

I was the program's first intern, and I went to Lenexa, KS, to be part of the team building the city's new skatepark. My work there was hands-on from the very beginning. By my second day, I was helping place reinforcing bars. On only my third day, I learned how serious site inspections are: I had to redo some of my reinforcing to make sure the spacing was correct — down to a T! By the end of the summer, I had learned how to pump water off the site, handle shotcrete equipment, and do floating and troweling to finish the concrete skating surface.

As part of the internship, I got to do more than work on the construction site. Every Friday, I visited a place — or spent time with a person — where I could learn even more about how concrete is made and how it gets used. I spent time with the Lenexa city inspector and a Parks & Recreation official. I toured a cement plant and even saw a limestone mine, which was 1200 ft (370 m) below sea level and had all kinds of trucks and equipment working underground.

Elise Besse Skatepark Torrington, CT

Opened in October 2024, the Elise Besse skatepark has 11,000 ft^2 (1000 m^3) of concrete and is designated for beginner, intermediate, or expert levels. The shotcrete method was used to construct the park. The O&G Industries' concrete mixture contained Heidelberg Materials cement and a pozzolan, which is commonly available in the northeast region and is added to mixes to improve pumpability.

"This was a very smooth and workable mix. We appreciate working with the suppliers to get the pozzolan in the mix, which makes things a little easier on the jobsite," said Tony Misiano, project manager and shotcreter for New Line Skateparks.

TEAM MEMBERS:

- Owner: City of Torrington, CT
- Design-Build: New Line Skateparks
- Concrete Supplier: O&G Industries
- Cement Supplier: Heidelberg Materials

Contracts, Chemistry, and Communication

THE WOMEN BEHIND SPOHN RANCH'S SHOTCRETE PRECISION

By Mark Bradford

THE INVISIBLE ARCHITECTURE OF SHOTCRETE

Shotcrete looks effortless when it's done right — a smooth wall, a sculpted bowl, a perfect transition that seems to rise from the earth. In reality, each surface hides layers of planning, chemistry, and coordination.

At Spohn Ranch, a design-build-fabricate firm specializing in concrete skateparks and pump tracks, that invisible architecture extends well beyond the nozzle. From contracts and mixture design to field execution, success depends on leaders who turn precision into culture.

At the center are three women whose expertise anchors the company's work worldwide: Kirsten Dermer, Olivia Rich, and Holly Schwartz. Their influence runs through every phase of construction — from California to Saudi Arabia, Israel to Mexico, Peru to the Philippines, and Okinawa to Puerto Rico.

KIRSTEN DERMER — THE FRAMEWORK AND THE FIXER

For more than 30 years, Kirsten Dermer has been the backbone of Spohn Ranch. As CEO, CFO, and managing partner, she has stood beside founder Aaron Spohn since the backyard-ramp days. Under her direction, the company grew into a global design-build leader, blending creative vision with financial and operational discipline.

Kirsten built the infrastructure that maintains active contractor licenses in 19 states and reciprocal agreements allowing work in five others, with additional experience obtaining new licensure in support of emerging projects. She manages bonding, insurance, and certified payroll across all jurisdictions — an achievement few specialty contractors can match. Her oversight also extends to the firm's design studio in Los Angeles, CA, and fabrication facilities in Kennedale, TX, and Perris, CA, where each shipment of pre-bent rebar and prefabricated parts reaches the field ready to assemble: A system made possible by the same structure Kirsten brings to every financial decision.

"Quality starts long before the pump fires," she says. "It starts in the systems and in the people who care enough to get the details right."

That same precision guides how she manages risk.

THE CRACKS THAT APPEARED BEFORE THEIR EYES

On a large pump-track build, a Spohn Ranch crew had just finished shaping a freshly shot section when the ground began to vibrate beneath their boots. A separate contractor — working for the same city client — was compacting an adjacent parking lot with a heavy roller. Within seconds, fractures began to form across the still-green surface, visible as the crew stood and watched.

Hairline cracks are not unusual in large, jointless expansions, but these were different. The vibrations had caused full-depth fractures — structural damage, not shrinkage. The cause seemed clear, yet the proof wasn't. The client hesitated to assign responsibility, leaving Kirsten to make a difficult judgment: Dispute the liability and risk a drawn-out delay, or negotiate a solution that would preserve relationships and schedule alike.

"When you're operating in 19 licensed states, you can't look at one job in isolation," she says. "A delay here can ripple across the whole company."

The choice was clear. Though confident the vibration caused the damage, Spohn Ranch agreed to share replacement costs. The decision balanced ethics, efficiency, and long-term strategy — repairing both the concrete and the relationship.

"It wasn't compliance for convenience," Kirsten explains. "It was a strategic decision — to protect the work, the client, and our credibility."

With winter weather closing in on other projects, keeping crews on schedule across multiple states mattered as much as fixing the cracked section itself. For Kirsten, the calculation wasn't just financial: It was about momentum.

"Our reputation is built one pour at a time," she says. "Sometimes the fix is as important as the finish."

OLIVIA RICH — THE SCIENTIST IN THE MIX

If Kirsten provides the framework, Olivia Rich supplies the science. As Spohn Ranch's lead for quality control and mixture design, she manages the chemistry behind every park — roughly forty projects each year across climates and continents.

At the core is the company's proprietary 7.5-sack

concrete mixture, engineered for 4000 PSI (28 MPa) at 28 days. Because skateparks can't have expansion joints — trip hazards for wheels — the concrete must absorb movement and temperature change while holding tight surface tolerances within ± 0.25 in. (6.3 mm).

Because Spohn Ranch's parks are sculpted rather than poured flat, the concrete has to stay workable for extended trowel time yet hold its shape once placed. The ratio between cement, water, and admixtures is tuned to achieve that rare balance; fluid enough to finish, firm enough to stand.

Each batch uses 0.375 in. (9.5 mm) aggregate for pumpability through a 2 in. (50 mm) wet-mix hose, with low water-cement ratios to limit shrinkage. All admixtures are polycarboxylate-based, giving the concrete structure that 'stands up' on sculpted transitions.

Local plants often default to lignosulfonate water reducers and 6 percent air entrainment. Olivia's experience shows that 3 percent and below works best to prevent delaminations from troweled surfaces exposed to freezing and thawing cycles. When plants can't supply the right materials, Spohn Ranch ships its own admixtures for field dosing.

Convincing regional concrete producers isn't always easy. Many QC managers are accustomed to conventional admixture packages or higher entrained air targets, but Olivia's data-driven approach often changes minds. Once they see the smoothness, density, and lack of spalling in the finished skate surfaces, they become advocates for the tighter mix parameters Spohn Ranch demands.

Olivia reviews every ticket and test report, maintaining a national database that keeps mixtures consistent from the seismic activity of California to the heat of Saudi Arabia and the humidity of the Philippines. She continues refining and documenting the company's shotcreted concrete performance data to push consistency and durability even further.

"Quality control isn't about catching mistakes," she says. "It's about knowing the material so well that problems can't hide."

HOLLY SCHWARTZ — THE CONNECTOR IN THE FIELD

If Kirsten builds the structure and Olivia defines the chemistry, Holly Schwartz connects it all on site. As project manager, she links Spohn Ranch's design studio, fabrication shops, working foremen, and general contractors, keeping projects synchronized from first layout to final finish.

Because Spohn Ranch often serves as both designer and subcontractor, Holly's coordination spans multiple worlds, including technical drawings, logistics, and field execution.

"Most of our foremen are literally in the trenches," Holly says. "My job is to keep them supplied and supported so they can build."

A major part of her role involves prefabrication coordination. Every project begins as a digital model. From those files, CNC routers cut templates, screeds, and stop forms, while fabrication teams in Kennedale, TX, and Perris, CA, produce steel edging, grind rails, coping, and pre-bent rebar kits. Holly manages the scheduling and shipping of those parts, so each site receives a precise, plug-together kit that defines geometry before fine grading begins.

Once construction is underway, she becomes the communication hub between Spohn Ranch's crew leads and the general contractor, resolving inspection issues, juggling schedules, and adjusting for weather or delivery delays without compromising cure times or finish quality.

"Every pour is a choreography," she says. "You plan it all day, but you have to read the crew and the concrete in real time."

Her coordination keeps projects on spec and on schedule — the quiet force that turns design and mix into rideable form.

THE COMPLETE POUR

Shotcrete placement rewards precision and punishes shortcuts. At Spohn Ranch, that precision begins long before concrete meets air — in contracts, chemistry, and communication — and Kirsten Dermer, Olivia Rich, and Holly Schwartz embody that continuum of excellence. Their leadership, science, and coordination transform ideas into strong concrete environments that perform beautifully and endure for decades around the world.

"What people see is concrete," says Mark Bradford, Principal/VP of Skatepark Construction at Spohn Ranch. "What they don't see are the women whose leadership and collaboration hold it all together — one perfect pour at a time."

Mark Bradford *is the Principal/VP of Skatepark Construction at Spohn Ranch Skateparks and has spent his entire adult life eating and breathing wheeled sports. He is highly skilled in all facets of construction, from steel fab to mass grading, but is considered a concrete virtuoso with multiple certifications from the American Concrete Institute and expert analysis featured in industry publications. As the primary leader of Spohn Ranch's major builds, Mark is often on the road over 300 days per year – flying from critical shotcrete placement to Mountain Dew Tour arena set-up to supervising coping fabrication at Spohn Ranch's shop.*

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The Concrete Bookshop supplies a range of publications, digital downloads and webinars on concrete.

Technical Report 18:

A guide to the selection of admixtures for concrete

This is a non-technical guide to admixture selection for those who are not materials specialists. It recognises the many applications of admixtures and their effects on the properties of concrete. The guide is in two parts: The first provides a general overview of admixtures and usage trends. The second consists of a series of Information Sheets showing the main admixture types.

2002, 60 pages

Non-members: £50 **Members: £30**

Technical Report 70

Historical approaches to the design of concrete buildings and structures

Approaches to the design of concrete structures have changed considerably since the first national Code of Practice for reinforced concrete was published in 1934. This report summarises the contents of all the relevant Codes and Standards, from the earliest guidance up to about 1990.

2020, 56 pages Format: PDF

Non-members: £40 **Members: £24**

Technical Report 44

The relevance of cracking in concrete to corrosion of reinforcement

This report examines the relevance of cracking in concrete on the corrosion of reinforcement. The first edition in 1995 was a response to BRE publications, which suggested that cracks in concrete structures can give rise to reinforcement corrosion. In this new edition, the discussion has been reassessed to bring it in line with current thinking.

2015, 38 pages

Non-members: £33.75 **Members: £20.25**

Concrete Advice Sheet No 19

Historic reinforcing bars and steel fabric

In assessing an existing structure, there is often a need to determine the load capacity of reinforced concrete elements. Original drawings would have been prepared in accordance with the then current Standards. This sheet provides information on how Standards have changed.

2016, 3 pages Format: PDF

Non-members: £8.00 **Members: £4.80**

Concrete Advice Sheet No 23

Large area pours for suspended slabs

Large area pours for suspended slabs improve both productivity and quality. This document provides background information to help designers and contractors avoid unnecessary restrictions on pour size and gives sources of information on the provision of reinforcement to control cracking due to restrained early thermal movements.

2020, 3 pages Format: PDF

Non-members: £10 **Members: £6**

Concrete Advice Sheet No 33

Axial shortening of concrete columns in high-rise buildings

Reinforced concrete is the chosen material for many medium- and high-rise buildings of 8–20 storeys and beyond. For such structures, the prediction and control of axial shortening are becoming increasingly important.

2016, 4 pages Format: PDF

Non-members: £12 **Members: £7.20**

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IMERYS

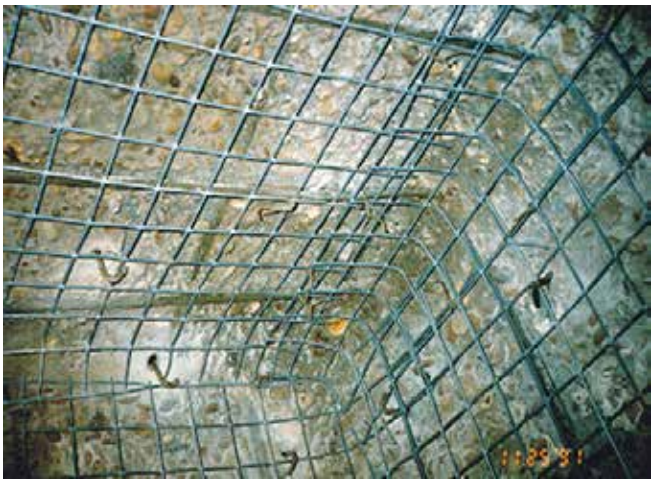

Fig. 1: HRSD James River WWTP damaged ordinary portland cement (OPC) concrete showing exposed aggregate, prepared with new rebar for initial SewperCoat® 2000 HS, 1991

Fig. 2: HRSD James River WWTP inspection in 2022, still performing after 31+ years without additional rehabilitation, SewperCoat® 2000 HS

Imerys is the world's leading supplier of mineral-based specialty solutions with $4.17 billion in revenue and 12,400 employees in 40 countries as of 2024. The group offers high value-added and functional solutions to a wide range of industries and fast-growing markets such as solutions for the energy transition and sustainable construction, as well as natural solutions for consumer goods. Imerys draws on its understanding of applications, technological knowledge, and expertise in material science to deliver solutions which contribute essential properties to customers' products and their performance. As part of its commitment to responsible development, Imerys promotes environmentally friendly products and processes in addition to supporting its customers in their decarbonization efforts.

We have dedicated teams of Sales and Technical Service Managers that provide on-the-job technical and product support throughout North and South America. We work with owners, engineers, municipalities, and contractors to show how 100% calcium aluminate solutions work in the most aggressive environments, and how to apply them.

WASTEWATER REHABILITATION – SUPERIOR H_2S PROTECTION

SewperCoat® PG and SewperCoat® 2000 HS are 100% calcium aluminate shotcrete solutions for wastewater applications and have been on the market for over 34 years, beginning with an installation in Virginia for the Hampton Roads Sanitation District's (HRSD) James River WWTP in 1991. This initial rehabilitation project remains in service today and continues to be a testament to the powerful protection properties provided by our 100% calcium aluminate protective liners.

SewperCoat® products work against biogenic sulfuric acid attack via the release of alumina ions that create a bacteriostatic effect. This process drastically reduces bacterial activity, which in turn reduces sulfuric acid (waste product of the bacteria) from depositing on the surfaces of the concrete structure. This cycle creates an environment where acidic concentration is reduced by a factor of 100 to 1000 times lower when compared to typical sewer surfaces, which often exhibit a pH as low as 1. This characteristic is a natural phenomenon that occurs due to the chemistry and

Fig. 3: Grit Chambers, Blue Plains Advanced WWTP, SewperCoat® 2000 HS, 2018

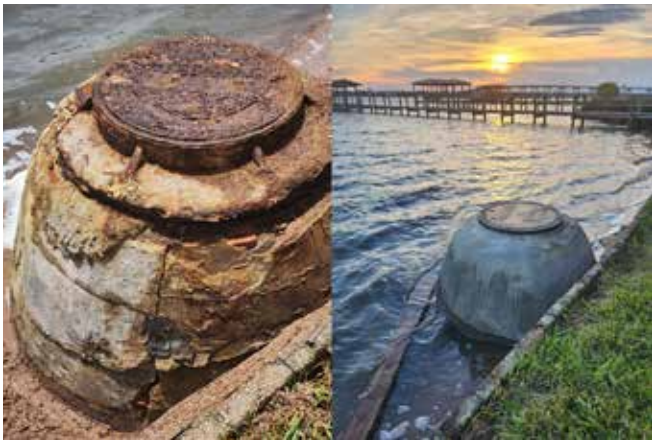

Fig. 4: Manhole rehabilitated inside and out with SewperCoat PG®, 2023

Fig. 5: Fondag® DG installed on all inner surfaces of fire academy burn buildings, still in service, 1999 and 2012

CONTACT INFORMATION:

IMERYS

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minerology of our 100% calcium aluminate products.

HEAVY INDUSTRIAL PROTECTION

FONDAG® is a 100% calcium aluminate industrial concrete product with low porosity and high density. The calcium aluminate aggregates provide abrasion resistance several times better than 5000 psi (35 MPa) portland cement concrete. Because the aggregate and the binder are mineralogically the same, there is an ideal chemical affinity resulting in a unique and stronger paste-aggregate bond. This bond gives Fondag® its exceptional thermal, mechanical, and chemical properties. Product features include:

- Thermal Cycling 2000 °F to -395 °F (1100 °C to -240 °C)
- Erosion/Heavy Abrasion Resistance
- Corrosion Resistance
- Mechanical Shock Resistance
- Constant Temperature Soak
- Cold Weather Applications – placeable at curing temperatures as low as 0 °F (-18 °C)
- High Early Strength – Early Return to Service, within 18-24 hours

AEROSPACE

FONDAG® AEROSPACE is an extremely high-performance version of Fondag® that was developed specifically for the aggressive environments of rocket launch pads and other areas relevant to the aerospace industry. The outstanding performance of FONDAG® AEROSPACE is due to an enhanced combination of a hard, dense, synthetic calcium aluminate aggregate and a calcium aluminate binder. This significantly improves refractory properties and resistance to chemical corrosion as well as making tasks like modeling easier and more efficient. Since the product is resistant to both high temperatures (up to 2012°F [1100 °C]) and low temperatures (down to -292°F [-180 °C]), there is no need to use multiple products within the complex.

The product features of SewperCoat®, FONDAG®, and FONDAG® AEROSPACE allow IMERYS to provide solutions to an array of industries, including wastewater, heavy industry, food/beverage processing, steel mills, foundries, road repair, dam repair, and aerospace. The products can be combined to provide owners with solutions for their most aggressive and oftentimes complicated needs.

BonaVista Pools

Good afternoon, everyone. It's a pleasure to be here and share my journey in the pool industry — mine is a story rooted in family, determination, and a deep passion for learning and innovation.

My story begins in childhood, where some of my fondest memories were working alongside my dad. Whether it was renovating the house, gardening, or cleaning his workshop, I loved being by his side. By the time I was eight years old, I knew what I wanted to do — become an engineer and work with my father. I still remember visiting job sites with him and sharing McDonald's french fries sitting in the front seat of his big blue Oldsmobile. As I got older, I jumped at the chance to work at BonaVista. It started at the kitchen table, helping my mom record the time and job costing codes from the payroll time cards. I then got my feet wet learning about cleaning pools with BonaVista's first maintenance technician, Doug McLean.

My parents played a huge role in shaping who I am today. My dad was always in "teaching mode," involving me in his projects and encouraging me to ask questions. He showed me the value of curiosity and the importance of hands-on learning. My mom, too, inspired me with the same curiosity and hands-on learning by letting me make messes in the kitchen while learning to cook, she also taught me how to sew and knit — all sparking the creativity to make something. For my 8th Grade graduation, she gave me a cross-stitched poem that still resonates with me:

> *"Somebody said that it couldn't be done,*
> *but she, with a chuckle, replied*
> *that "maybe it couldn't," but she would be one*
> *who wouldn't say so till she'd tried.*
> *So she buckled right in with the trace of a grin*
> *on her face. If she worried, she hid it.*
> *She started to sing as she tackled the thing*
> *that couldn't be done, and she did it!"*

That message of perseverance and optimism became a core part of my identity. Only later did I learn that this poem was originally written with masculine pronouns — how smart my mom was to change it for me.

The decision to pursue engineering felt natural, but I remember a pivotal moment in high school that solidified my determination. During a meeting with my guidance counselor at my all-girls catholic high school, I told her I planned to apply to engineering programs at a few Ontario universities. Her response shocked me: "You can't do that, it is not something that girls do." Stunned, I responded firmly, "Yes, I can — and I will." That conversation ignited a determination I'd never felt before, and it's been a guiding force ever since.

Like any career, mine hasn't been without challenges. Early on as a recent graduate attending site meetings, I often encountered older men who wouldn't speak to me directly, instead addressing my father. It stung, but my dad turned it into a teaching moment. He would ask me for information in front of them, giving me the confidence to speak up. The surprise on their faces when they realized I knew what I was talking about was always satisfying. I still see that a little bit today, but my knowledge and confidence easily squashes any prejudice that may appear in others.

One of my biggest challenges came when my father passed away. I was 32 years old and worried that clients might hesitate to trust me to lead BonaVista. At that time, we were working on a major project at Blue Mountain Village. The project manager's unwavering confidence in me was invaluable. That silent support gave me the strength to move forward and continue growing the business. Just last week I had the opportunity to meet the project manager and site superintendent from those projects once again, and I told them that they gave me the confidence to carry on — something that I am sure they did not realize at the time.

Although more fun than challenging, the birth and raising of my four kids has been a wonderful adventure and a bit challenging. Part of owning a business that is active in the summer ensured that I did not get much time off — I was back at work three days after Alexa was born, seven days after Bob, 10 days after Owen was born, and I got a whole three months after Isabelle was born — I knew she was going to be my last, it was October, and I felt that I could take some time to enjoy! And am I ever glad I did.

Shortly after I returned to work in 2012, my brother was rushed to surgery to have a tumor removed from the back of his head. Non-cancerous, which was great, but the slow recovery needed after brain surgery was not expected. As women, we do not realize how much we take on to get things done until it is too late. My brother was back at work almost full time by August, but it took me two years to get past my adrenal fatigue as a result of taking everything

on through the spring and early summer of 2012 with a 6-month-old. I can honestly say that my brother recovered from brain surgery faster than I did from the overload. This taught me that my own self-care is as important as the business. Although the work still gets a lot of me, I am working to change that.

Today, I'm proud of how far we've come. BonaVista has an incredible team, and I find joy in mentoring and guiding them. They all know that I will always question, push them to try new things, and figure out how to be better. My focus is shifting to developing processes, sharing knowledge, and creating tools to help the team measure success and set meaningful goals as I start to step back and help them grow.

Curiosity remains one of my most important guiding principles. It drives me to question the status quo, explore new methods, and stay innovative. That mindset has kept me learning and improving over the years. It's also why I'm so excited about the future, particularly about two thermal spa projects I'm currently working on. My goal is to create spaces where water takes center stage in wellness. Water can be calming, invigorating, social, and restorative — everything a wellness journey needs.

But beyond the projects, I'm thinking about my legacy in the industry. A long time ago, I took the Pool and Spa Servicer and the Installer Apprenticeship courses. At that time our industry held Trade status, and I believe it's time to bring it back. I want to help reinstate Apprenticeship Trade Status for swimming pool builders and technicians in Ontario. The work our builders and technicians do is skilled, essential, and deserving of recognition. I'd love to be part of teaching the curriculum that trains the next generation.

Looking back, I'm proud of what we've built — both in my family and at BonaVista. But I'm not done yet. There's always more to learn, teach, explore, and achieve. Thank you for letting me share my journey. I hope it inspires you to embrace curiosity, overcome challenges, dive into your own dreams with confidence and share what you can with those around you.

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A project featured in the Inspiration Gallery at bonavistapools.com

Stay Strong and Pump On

A TRAINING BLUEPRINT FOR LONGEVITY

By Jacquie Unruh | Photos by Alanna Pearson

Shotcreting is a physically demanding job! As a petite shotcreter standing 5 ft 5 in. (165 cm) at 122 lbs (55.3 kg), maintaining proper technique, peak physical fitness, and overall body balance are my top priorities. To keep my body functioning effectively, I prioritize mobility and strength training — I bend so I don't break.

Just as it's crucial to keep the moving parts of our equipment well-lubricated to prevent breakdowns, our bodies require similar care. A weak link in any system can fail under pressure, and our bodies are no exception. As a competitive bodybuilder with power yoga teaching credentials and experience working alongside top international coaches, I am excited to share my top exercise recommendations to help you stay pain- and injury-free throughout your career.

KEY INJURY RISKS FOR SHOTCRETERS

Shotcreters face significant injury risks due to the heavy weight and the thrust of the hose, as well as the potential for surges from hose plugs. Common injuries relate to musculoskeletal strain (back, arms, shoulders) and trauma from sudden hose movements.

- **Muscle Fatigue and Back Injury:** Improper handling techniques, such as holding the hose over the shoulder or fully extended, can lead to increased fatigue and a higher risk of back injury. Proper support is crucial to avoiding overexertion.
- **Injury from Hose Plugs and Surges:** Blockages can result in violent hose movements. If the hose is not properly secured, sudden motion can cause injuries.

SAFER SHOTCRETING TECHNIQUES

Improper hose handling technique puts excessive strain on the body and greatly increases the risk of injury. Here are recommendations for the safest placing techniques:

Straddle the Hose: Position the hose between your legs and trailing behind your body to act as a counterweight. This allows better control and reduces fatigue, preventing potential back injury while improving stability.

- **Maintain Perpendicular Position:** Keeping the hose perpendicular to your body while manipulating the nozzle with one hand allows for more efficient movement and reduces the chance of injury.
- **Training and Certification:** Participation in training and certification is essential for safe operation and injury prevention. Combine programs like the **American Shotcrete Association (ASA) Shotcreter** education and the American Concrete Institute (ACI) Shotcreter Certification (wet- or dry-mix), for full education and certification.

A COMPREHENSIVE STRENGTH AND MOBILITY PROGRAM

Because the body operates as a connected system, a comprehensive strength and mobility training program is recommended to achieve optimal physical performance. This article focuses specifically on exercises tailored to shotcreting.

If you're new to exercising, remember to start slowly and listen to your body. Aim for two training sessions per week to allow for adequate recovery time. As you grow more comfortable with the movements and increase your strength and mobility, you can gradually increase the frequency of your workouts.

The goal is to develop a body that is strong and balanced through all ranges of motion — a balance of both strength and mobility. While good mobility is essential, lacking sufficient strength can lead to injuries, just as having strength with limited range of motion can pose similar risks. In the event of a whipping hose or a sudden trip, for example, having good body mobility reduces the risk of injury by allowing for more fluid movement in unexpected situations. It's critical to address these weaknesses to help prevent injuries.

Wrist Active Stretch

MOBILITY TRAINING

Mobility training aims to increase your range of motion. It's crucial to build strength within that newly achieved range. Mobility exercises serve as excellent dynamic stretches before shotcreting, workouts, or in the morning to prepare your body for the day ahead. Here is a list of mobility exercises to try.

WRIST ACTIVE STRETCH

Begin by extending your arms out in front of you, parallel to the ground with palms facing up. Imagine pushing into a wall to engage your arms and wrists. Actively pull your fingers towards your face. (This will likely be a tight and weak position. It's advisable to linger and actively hold the stretch.) Turn your wrists and fingers down towards the ground. Move back and forth between these positions for 10 reps.

WRIST ROCKS

This exercise is done on a mat and on your hands and knees. In yoga, this is referred to as table top position. Place your palms on the mat with your fingers pointing toward 3 and 9 o'clock. While maintaining your palms on the mat, shift your body weight from left to right. Complete for 10 reps.

SHOULDER DISLOCATES

To complete this exercise, hold a stick or a light resistance band between your hands in front of your hips. (Your grip must be as wide as current mobility allows.) In one motion, lift the stick out in front of you, above your head and then behind your body. This is one repetition. Now complete the movement in the reverse order to bring it back in front. Complete for 10 reps.

THORACIC ROTATION

From table top position, shift the weight into your left hand, engage your core to maintain balance. Lift your right arm to the right side and then up towards the sky. Then sweep your right arm back down and underneath your left arm, reaching towards the left side of the room. Complete for 10 reps and then switch sides.

JEFFERSON CURLS

When first trying this exercise, use your bodyweight. Once you are familiar with the movement, you may add weights (to hands or wrists) to build strength throughout the spine. Start in an upright position. Begin the movement with the crown of your head. Pull your chin towards your chest and then lower your body down one vertebra at a time. Reverse this movement by rolling your spine up one vertebra at a time with your head coming up last. Complete for 10 reps.

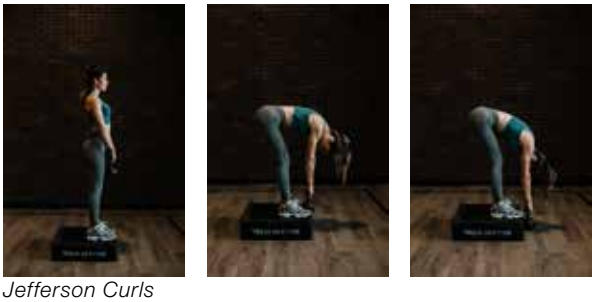
SCORPION TAIL

Lay on a mat, facedown, with your body in a T shape: your arms will be out to ether side and your legs straight along the ground. Try to keep your chest and shoulders on the ground while you take your left foot and reach it towards your right hand. Alternate the movement and complete 10 reps per side.

Wrist Rocks

Shoulder Dislocates

Thoracic Rotation



Jefferson Curls

Scorpion Tail

BALANCE AND STABILITY

Shifting strokes of the concrete pump challenges a shotcreter's balance. Site conditions may require navigating uneven terrain and/or working on scaffolding or slopes. These conditions can make maintaining balance more difficult. Having a strong core is more than just having chiseled abdominals — core strength is vital for preventing excessive pressure on the lower back and overall stability. Core activation and stability exercises include:

BIRD DOG CRUNCH

From a table top position, engage your core. Raise your right arm out in front of you parallel to the floor. Raise your left leg out behind you. Hold this position for a moment to challenge your core stability and then crunch the two limbs together. Complete for 10 reps and then switch sides.

Bird Dog Crunch

PLANK

Your body should be long and in a straight line from head to heel with your core engaged and toes touching the ground, shoulders, elbows, and wrists all in line. Hold this position for one minute to start and increase time to build deep core strength.

Plank

SHOULDER PROTOCOL

The goal of this exercise is to build strength in the small stabilizing muscles of the shoulders. There are three positions in this exercise completed back-to-back. Begin laying facedown on a mat with your palms facing up, close, alongside your body. Lift for 25 reps. Flip your grip so palms are facing down. Complete another 25 reps. Move your arms out to the 3 and 9 o'clock positions, palms down, and complete another 25 reps.

Shoulder Protocol

ONE LEG BALANCE (WITH EYES CLOSED)

From a standing position, shift the weight onto your left foot. Begin to lift your right foot off the ground. The higher you lift your leg, the more difficult it will be. Once you feel balanced, close your eyes for added challenge. You will feel the stabilizing muscles in your leg and foot keeping you upright. Switch sides.

One Leg Balance (with Eyes Closed)

Overhead Dumbbell Press

One Arm Dumbell Row

STRENGTH TRAINING

Concrete hoses are heavy! Ensuring equal strength between the left and right sides of the body is important, especially since certain muscles can become overworked while placing shotcrete. To correct any imbalances, consider doing an extra set of exercises for weaker muscle groups. If you notice a strength disparity between your dominant and non-dominant sides — perhaps due to consistently holding the hose with your dominant hand — try performing two repetitions with your non-dominant hand for every rep with your dominant hand. This can help bring both sides into balance. The exercises below focus on unilateral movements, helping to correct any imbalances:

PASSIVE HANG

The passive hang is excellent for shoulder health, decompressing the spine, and grip strength. From a chin up bar, grip the bar and hang for as long as you can. Work up to a cumulative hang time of 5 mins. Take 1-minute breaks in between sets.

OVERHEAD DUMBBELL PRESS

Hold a dumbbell in each hand with elbows bent at 90 degrees out to your side. Engage your core and press the dumbbells up over head. Lower the weights with control and complete for 8-10 reps.

ONE ARM DUMBBELL ROW

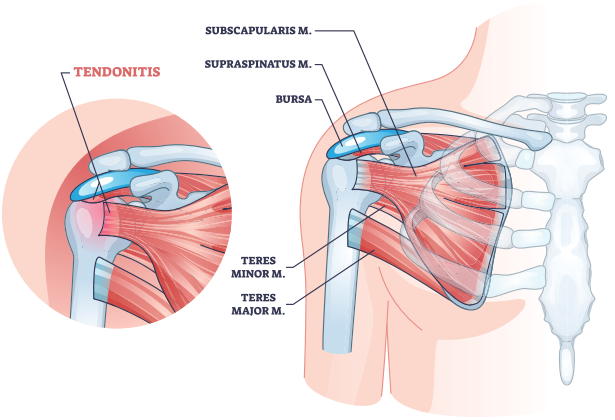
With your body bent over a bench or the weight rack, maintain a straight back and use your opposite arm to support you. Your other arm will be extended down holding the weight. Use a rowing motion, squeeze your back muscles and lift the dumbbell up towards your waist. Lower with control, and complete for 8-10 reps per side.

ONE ARM LAT PULLDOWN (CABLE)

Sit on the pulldown machine with the knee pad adjusted to prevent the body from being pulled out of position. Attach a single hand cable to the machine. Grab the cable and pull your elbow toward your hip. You should feel the exercise in your latissimus dorsi (back muscle).

One Arm Lat Pulldown (Cable)

COMMON REPETITIVE STRAIN INJURIES



Shotcreters often encounter repetitive strain injuries due to the demanding nature of the job. Common issues include:

1. Carpal Tunnel Syndrome: Caused by prolonged wrist flexion and repetitive gripping of the nozzle, leading to numbness and pain
2. Tendonitis: Inflammation of tendons in the wrist, shoulder, or elbow due to repetitive movements
3. Epicondylitis: Overuse of forearm muscles causing pain in the elbow
4. Shoulder Impingement Syndrome: Caused by repetitive overhead movements, leading to shoulder pain and reduced motion
5. De Quervain's Tenosynovitis: Pain and swelling affecting wrist tendons on the thumb side
6. Neck Strain: Resulting from holding fixed positions or tilting the head during operations
7. Lower Back Pain: Poor ergonomics while lifting equipment can lead to chronic strain

Implementing ergonomic practices and building a strong and mobile body can help reduce the risk of these injuries.

These exercises might sound like a lot, but when you consider the toil shotcrete placement takes on your body, it's worth investing some time in strengthening your body for the long haul. At the very least, I hope these exercises help you understand how your body is affected by your work and some measures you can proactively take to keep your body functioning well for your work.

POST-WORK STRETCHES

After a physically demanding day, you likely feel stiff. Here are a few effective stretches for shotcreters that can be done post-work or workout:

PALM PEELS

In a table top position, turn your palms so that your fingers are facing toward you. If this is too intense, shorten your stance so your knees are closer to your hands. Keep your fingers on the floor and pull your elbow towards the ground. You will feel a stretch in your hand, wrist and forearm.

FOREARM EXTENSION

Begin in a kneeling position. Make a fist with both hands and place them with knuckles facing together on the mat. With your knuckles touching, keep contact with the mat as you lift your body by straightening your arms. You will feel a deep stretch in your forearms.

SUPINE TWIST

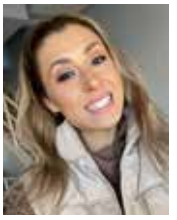
Lay face up on a mat, feet flat on the ground and knees towards the sky. You can put your hands out in a T shape. Take your knees over to the right and if it feels good in your body, take your gaze to the left. Breathe deeply and hold for 30-60 seconds per side.

Palm Peels

Forearm Extension

SEATED SIDE BODY STRETCH

From a seated position, raise both hands above your head. On an exhale, lean your body to the right. You can put your right hand or forearm to the ground to stabilize you. Breathe deeply and hold for 20-30 seconds per side.



Jacquie Unruh *was born and raised in Calgary, Alberta, where she grew into a multifaceted creative with a passion for art and fitness. From a young age, she thrived in drawing, sculpting, and painting, showcasing her artistic talents. She later completed a business degree online at DeVry University, blending creativity with a strong academic foundation. In her twenties, Jacquie discovered weightlifting, competing in fitness modeling competitions that highlighted her dedication and strength. Outside of her professional endeavors, she enjoys hot yoga, immersing herself in books, and exploring the great outdoors on nature walks.*

Supine Twist

Seated Side Body Stretch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ACHIEVE PEAK PERFORMANCE
VIEW GLOBAL EVENTS

Tiffany Williams
Revolution Gunite

Nominated by Ryan Oakes

Just over 3 years ago, Tiffany Williams started working for us as a volumetric concrete batch truck driver for dry-mix shotcrete placement applications. She was fresh out of driving school, having left a career as a robotic programmer. She wanted to do something different and found a home she liked with our company, Revolution Gunite.

Ryan: What led to your decision to try out driving for a shotcrete company?

Tiffany: I like to learn. This seemed interesting and it involved traveling without being a long-haul driver. It would allow me to travel but still be at home a lot with my daughter. Initially there was a lot to learn, but I'm mechanically inclined and it seemed like a good fit.

Ryan: Tell me about that, learning. What was the hardest thing to learn and what are some really interesting things you have learned?

Tiffany: Running the dry-mix shotcrete gun and hand signals. It was such a new concept to use numbers for actions, but I got them, and really it's easy, just different.

I think running the gun was hard at first, but it's easy now. It's interesting; I listen to it, and I know if the line needs more air just by the sound of the motor of the gun and the air compressor. It's so easy to prevent problems just by listening — I can prevent a plug just by paying attention to the sounds. It's like I can feel what's happening before it happens.

Ryan: Our goal is that the person at the end of the hose never feels anything but smooth flowing material, and I've heard numerous times that the team likes how smooth and predictable it is when you run a gun. They're happy when you pull up.

Tiffany: I think so. They smile, they seem ready to see me. I always try to clean up too. I know they don't want me to leave a mess, and neither does the next driver.

Ryan: Do you prefer running our hydraulic guns or the air-powered guns, and why?

Tiffany: Hydraulic! Less adjustments. I'm not balancing the air for the material line with the gun motor. It really is easier than running an air-driven gun.

Ryan: The guys tell me you always show up ready to roll. How do you do this? What would you tell other drivers?

Tiffany: I always check my material, my auger, and my power take off (PTO) before I leave. I can fix anything at the shop, or have it fixed, but if I wait 'til I get to the job, it's going to be a problem. I really don't want there to be a problem. It's hard being a woman — so I have to work hard to make sure I'm not making mistakes.

Ryan: Tell me about that! What is it like to be a woman in trucking, shotcrete, and construction in general?

Tiffany: Working with men can be difficult. Some don't believe it's a women's job, and they can be hardheaded.

Ryan: How do you deal with that?

Tiffany: I have to prove them wrong.

Ryan: How?

Tiffany: Attention to detail. Like I said, I make sure everything is working. I want be good at what I do. I keep my truck clean — I know that's a requirement, but I want to be in a clean truck, too. I love the work. I have family here. I communicate with my fellow drivers, male or female. I communicate with Blythe [female logistics coordinator], Dakota [male fleet manager], and the crew leaders.

It's funny, but males and females see simple things like port-a-johns differently, and I communicate with the other drivers about this: I can't use a tree. Maybe that's off topic, but it's real — and in construction, there should be facilities provided for everyone.

Ryan: I couldn't agree more. What aspect of the job do you like the most?

Tiffany: Driving in the mountains. Especially, backing up in steep mountain terrain! It's challenging and feels good when I do it.

Ryan: Would you encourage other women to do this work?

Tiffany: Absolutely, I love it! I said that already, but I really do. I have family here; I'm always learning something new, like wet-mix shotcrete now that we're doing that. It's not always easy, and that's ok — It pushes me to work through new situations and I enjoy that. Women shouldn't be afraid to do this work; I think we're better at it anyway!

Ryan: I agree with all of that. Shotcrete is for a special breed, regardless of gender, and I think for those of us who are entrenched in this industry, what matters is whether it speaks to you or not. Thank you for taking a moment to discuss this! You are definitely family and we love working with you, too.

SHOTCRETE SPOTLIGHT NOMINATIONS

Highlight the individuals or teams that make your company shine. Scan or click the QR code to learn more or nominate someone!

WORLD OF CONCRETE 2026

January 20 – 22, 2026
Las Vegas Convention Center | Las Vegas, NV

Registration is open! Be sure to use ASA's Source Code: A17 for the biggest discount and to support your Association! ASA will again host our *Annual General Membership Meeting* in the South Hall, Tuesday evening (Jan 20). Be sure to come by to network and hear the latest Association updates.

New this year, ASA will also have a 90-minute presentation under WOC's Advanced Concrete Repair track: *Shotcrete for Repair, Rehabilitation and Re-purposing*, Monday morning. Tuesday we will present the full-day *ASA Shotcreter Education seminar*, which supports the ACI Shotcreter Certification program. On Wednesday we will host the ASA *Quality Shotcrete – Know It When You See It* seminar, supporting the ACI Shotcrete Inspector Certification. As always, please stop by the ASA Booth in South Hall: S10919 to greet ASA staff and some of our members.

Check out **Shotcrete.org/WOC** for the latest updates!

2026 ASA SHOTCRETE CONVENTION AND TECHNOLOGY CONFERENCE

March 1 – 3, 2026
Eldorado Hotel & Spa | Santa Fe, NM

Registration is officially open for the ASA's 2026 Shotcrete Convention & Technology Conference!

Join us at Eldorado Hotel & Spa in Santa Fe, NM for a unique opportunity to connect with your peers and explore the latest advancements in shotcrete. We'll be diving into state-of-the-art materials, equipment, and applications, and looking ahead to what's next for the industry.

Beyond the conference sessions, you'll have a chance to network, enjoy local Santa Fe attractions, and celebrate the winners of the **21st Annual ASA Outstanding Shotcrete Projects Awards** at our awards banquet.

Be sure to **pre-register by February 26th at www.shotcret.org/convention**.

SPONSORSHIP OPPORTUNITY!

Lock in your sponsorship TODAY! Make sure your company is recognized among the leaders of the shotcrete industry by sponsoring the 2026 ASA Shotcrete Convention & Technology Conference! As a sponsor, you will receive a variety of exposure opportunities:

- Convention Venue – banners onsite, in the program, & the opportunity for a tabletop exhibit
- Awards Banquet (reception, dinner, & awards program)
- 1st Quarter 2026 Awards Issue of *Shotcrete* magazine
- ASA What's in The Mix (eNewsletter) & Social Media promotions
- ASA Website, Convention page – all year

SPONSORSHIP CATEGORIES:

BIG SHOOTER ($5000): Exposure with the most prominent placement of your company logo throughout all promotional materials; one complimentary tabletop exhibit (first come, first served — must confirm interest at time of application); and unlimited Half Price Awards Banquet Tickets.

GOLD ($2500): Exposure — prominently placed after Big Shooters — of your company logo throughout all promotional materials; one complimentary tabletop exhibit (first come, first served — must confirm interest at time of application); and one (1) Half Price Awards Banquet Ticket.

SILVER ($1000): Exposure — prominently placed after Gold Sponsors — of your company logo throughout all promotional materials.

ASA OUTSTANDING SHOTCRETE PROJECT AWARDS FEATURED IN CRB

ICRI Concrete Repair's Concrete Repair Bulletin (CRB) featured a 3-page spread of our ASA 2024 Outstanding Shotcrete Project Awards recipients in their July/August 2025 issue, including photos of the 6 category winning projects! Click here to see the spread: **https://tinyurl.com/ye5ese6x**

SPECIAL THANKS TO OUR EXECUTIVE DIRECTOR!

ICRI recognized Board Members, Technical Activities Committee Members and Technical Committee Chairs, and Administrative Committee Chairs whose terms ended December 31, 2024. Among those recognized was our very own Executive Director, Charles Hanskat, who was recognized for his term ending as Technical Committee Chair for *Committee 110: Guide Specifications*.

HAVE YOU SUBMITTED YOUR AD FOR 2026?

There's still time to secure your ad space in the 2026 issues of *Shotcrete* magazine! The 2026 Media Kit is now online and can be viewed at **shotcrete.org/mediakit**. Place your insertion orders now to ensure inclusion in all four 2026 issues of Shotcrete magazine!

Advertising in *Shotcrete* magazine will position your company at the forefront of the shotcrete industry. With an average savings of 25% or more compared to other leading concrete industry trade association magazines, you can reach the companies and people you need to grow your business at a competitive price. These rates certainly provide you with the most bang for your advertising dollars! Email **info@shotcrete.org** to submit your insertion order.

GSI INTRODUCES SCULPTED CONCRETE FINISHES FOR SLOPE STABILIZATION AND RETAINING WALLS

WESTMINSTER, CO / August 13, 2025 / GeoStabilization International, the leading geohazard mitigation firm in North America, expands its lineup of design-build services with sculpted shotcrete. The new offering provides clients with customizable finish options that enhance the appearance of shotcrete walls and slope stabilization systems while maintaining their structural integrity.

"Sculpted shotcrete allows us to deliver projects that are both functional and visually appealing," said Brian McNeal, Vice President of Operations, GeoStabilization International. "Many clients, including public agencies, are looking for solutions that blend into the landscape or meet community design regulations. We have the flexibility to meet these goals without compromising aesthetics."

The finishes are applied to structural shotcrete that is placed at high velocity through a hose and nozzle system, a method that provides durability and long-term performance. GeoStabilization crews handle installation, using carving, stamping, and staining techniques. Sculpted shotcrete can be integrated into slope stabilization, soil nail walls, retaining walls and other geohazard solutions.

The finish options include:

- **Staining:** Providing a clean, natural look without texture
- **Geologic Relief:** Replicating surrounding geology
- **Stamped Finishes:** Offering uniform, patterned designs
- **Hand-Carved Finishes:** Offering a more artistic, customizable appearance

GSI Shotcrete Wall

Each finish is tailored to project goals and site conditions. Sculpted concrete is well suited for transportation, infrastructure, municipal and private development projects where both performance and aesthetics are priorities.

More information and photos of each finish are available at **geostabilization.com/sculpted-shotcrete**.

DFI EDUCATIONAL TRUST AWARDS SCHOLARSHIPS AND GRANTS TO SUPPORT FUTURE INDUSTRY LEADERS

Hawthorne, N.J. (September 18, 2025) — The DFI Educational Trust has awarded scholarships and professional development grants to support the next generation of deep foundations professionals. This spring, 43 students pursuing degrees in civil engineering and construction received scholarship funding through the Trust's dedicated funds. Since 2006, the Trust has distributed more than $2.4 million to over 600 individuals, helping students enter and advance within the industry. View the full list of scholarship recipients at **https://tinyurl.com/bdh5wwzy**.

In addition, the Trust awarded 11 Women in Deep Foundations (WiDF) Professional Development Grants of $1,750 each to women working in the field. The recipients were invited to attend the DFI 50th Annual Conference on Deep Foundations in Nashville, Tennessee, October 20–23, 2025, with complimentary registration and travel support. See the full list of WiDF grant recipients at **trust.dfi.org/scholarships/widf-grants/**.

These initiatives are made possible by the generosity of donors, sponsors, and corporate partners including Bauer Foundation, Berkel & Company Contractors, Malcolm Drilling, Nucor Skyline, and others. Their contributions ensure that emerging engineers and researchers have access to vital educational and professional opportunities.

Through its scholarships and development programs, the DFI Educational Trust continues to strengthen the future of the deep foundations industry—empowering students and professionals alike to innovate, lead, and build a more resilient world.

Member Company Technical Resources

By LaTosha Meadows

Looking for valuable technical information about shotcrete? ASA's Member Company Technical Resources page provides direct access to industry expertise, practical solutions, and innovative approaches shared by ASA corporate member companies. This growing library connects you to information that supports quality and best practices in shotcrete application, equipment, and technology.

WE INVITE ALL ASA SUSTAINING & CORPORATE MEMBERS TO CONTRIBUTE!

If your company offers helpful technical documents, guides, or online resources that could benefit the shotcrete community, we encourage you to share them. Email your link to **info@shotcrete.org** for consideration. By contributing your online knowledge and experience, your company not only supports industry education and advancement, but also gains visibility among professionals seeking reliable technical information.

Current member-contributed resources are available on ASA's website at **shotcrete.org/resources/#member_resources**. Under the Member Company Technical Resources tab, you'll find contributions from the following organizations:

- GeoStabilization International
- Putzmeister
- South Shore Gunite Pools & Spas, Inc.
- Sprayforce Concrete
- Thorcon Shotcrete & Shoring

ASA is proud to showcase the expertise of our member companies and their commitment to advancing shotcrete knowledge across all sectors of the industry. Visit the page today to explore these valuable resources and consider adding your own to strengthen the shotcrete industry knowledge!

PUTZMEISTER PRESENTS WETKRET 2 NARROW VEIN, THE FIRST DUAL OPERATION MECHANIZED CONCRETE SPRAYING EQUIPMENT FOR NARROW VEIN MINES

Putzmeister Underground, the Putzmeister's division specialized in underground equipment, will present its latest innovation in mechanized concrete spraying equipment: Wetkret 2 Narrow Vein on September 3rd at a private event at the facilities of its Peruvian dealer Metal Técnica S.A.

Specifically designed to operate in reduced sections of up to 2.5 x 2.5 m (8.2 x 8.2 ft), this robotic equipment features Putzmeister's most advanced pumping technology and experience, offering a compact, safe, and highly efficient solution for one of the most demanding environments in the sector. Wetkret 2 Narrow Vein allows mechanizing the application of shotcrete in narrow veins, significantly improving operational safety and reducing personnel exposure to adverse conditions.

LATEST TECHNOLOGY FOR NARROW VEINS

Putzmeister is globally recognized as a leading manufacturer of concrete pumps; innovation and development in this field are the foundation of its business, being a benchmark in the sector. The heart of the Wetkret 2 Narrow Vein incorporates its latest pumping technology with OPS control which translates into lower pulsation, easy maintenance and common in other equipment of the Wetkret line.

The theoretical maximum concrete flow rate reaches 13 m³/h at 40 bar (17yd³ at 580 psi), making it an ideal solution for applications in galleries with reduced dimensions. The equipment can be connected directly to the mine's electrical network or spray with its powerful diesel engine (Dual Drive). Additionally, like other equipment in Putzmeister's Wetkret series, it comes equipped with a precise additive synchronization system with concrete flow controlled by software.

As for the remote-controlled telescopic spraying arm, with a vertical reach of up to 7.5 m (25 ft) and deployment once the front is reached, it allows mechanizing the application of shotcrete in narrow veins, significantly improving operational safety and reducing personnel exposure to adverse conditions.

Finally, the articulated design with reduced dimensions (7360 x 1409 x 2295 mm) (290 x 55 x 90 in.) allows for a high maneuverability, combined with the 106 kW (142 HP) diesel engine (or 55.4 kW [74 HP] with Stage V) and traction system with individual motors on each wheel. As an option, it can incorporate an anti-slip system to improve performance on uneven or low-adhesion terrain. The component distribution allows easy and safe access to elements that require more attention, such as the dual brake system power panel that separates high and low voltages, the FOPS/ROPS certified cabin with plug-in design, batteries and hydraulic oil filters. Additionally, the equipment has an integrated cleaning system that ensures durability.

OPTIONS BASED ON PUTZMEISTER UNDERGROUND'S EXPERIENCE

Putzmeister Underground offers a wide range of optional configurations to adapt the equipment to the specific needs of each operation. These include the use of biodegradable hydraulic oil, high-efficiency filtering systems with breather dryer, automatic greasing during translation, traming direction lights, transformers for discontinuous currents and various options for tires, operator seat and cleaning pump among others.

Putzmeister Wetkret 2 Narrow Vein

NEW ASA MEMBERS

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ACADEMIC

Rylie McKinney
Texas State University
San Marcos, Texas

SHOTCRETE CALENDAR

Please check with the meeting provider as some meetings may be postponed or cancelled after publication of this issue of Shotcrete.

DECEMBER 4-6, 2025	**Watershape University Education Vacation** Embassy Suites Phoenix-Biltmore | Phoenix, AZ
JANUARY 11-15, 2026	**Transportation Research Board - 105th Annual Meeting** Washington, DC
JANUARY 19, 2026	**Shotcrete for Repair, Rehabilitation and Re-purposing | WOC** Las Vegas Convention Center, Las Vegas, NV
JANUARY 20, 2026	**ASA Shotcreter Certification Education | WOC** Las Vegas Convention Center | Las Vegas, NV
JANUARY 20, 2026	**ASA General Membership Meeting & Shotcrete Reception | WOC** Las Vegas Convention Center | Las Vegas, NV
JANUARY 20-22, 2026	**2026 World of Concrete** Las Vegas Convention Center | Las Vegas, NV
JANUARY 21, 2026	**Quality Shotcrete – Know It When You See It | WOC** Las Vegas Convention Center | Las Vegas, NV
JANUARY 22-23, 2026	**ACI Shotcreter Certification (Wet- & Dry-Mix) | World of Shotcrete** World of Shotcrete | Henderson, NV
FEBRUARY 22-25, 2026	**MINEXCHANGE - 2026 SME Annual Conference & Expo** Salt Palace Convention Center | Salt Lake City, UT
MARCH 1-3, 2026	**2026 Shotcrete Convention & Technology Conference** Eldorado Hotel & Spa | Santa Fe, NM
MARCH 1, 2026	**ASA Contractor Qualification Education - Level I & II, Pool** Eldorado Hotel & Spa | Santa Fe, NM
MARCH 1, 2026	**Estimating Strategies & Calculations (NEW)** Eldorado Hotel & Spa | Santa Fe, NM
MARCH 2-3, 2026	**ASA Spring Committee Meetings - 2026** Eldorado Hotel & Spa | Santa Fe, NM
MARCH 3, 2026	**Outstanding Shotcrete Project Awards Banquet** Eldorado Hotel & Spa | Santa Fe, NM
MARCH 15-18, 2026	**2026 ICRI Spring Convention** JW Marriott Nashville | Nashville, Tennessee

SHOTCRETE CALENDAR

MARCH 27-29, 2026	**ACI Shotcreter Certification (Wet-Mix) | Skatepark Summit** Kaaterskill Kahncrete | Saugerties, NY
MARCH 29-APRIL 1, 2026	**ACI 2026 Spring Concrete Convention** Hyatt Regency O'Hare | Rosemont/Chicago, IL
APRIL 15-17, 2026	**ACI Shotcreter Certification (Wet- & Dry-Mix)** Minova | Millstadt, IL
APRIL 24-26, 2026	**ACI Shotcreter Certification (Wet- & Dry-Mix)** Applied Shotcrete | Sebastopol, CA
MAY 31-JUNE 3, 2026	**ASTM Committee Meetings | C09 Concrete & Concrete Aggregates** Hyatt Regency Dallas | 300 Reunion Blvd. E | Dallas, TX
OCTOBER 7-9, 2026	**ACI Shotcreter Certification (Wet- & Dry-Mix)** Minova | Millstadt, IL
MORE INFORMATION	To see a full list, current updates, and active links to each event, visit www.shotcrete.org/calendar.

2026 Open Shotcreter Certification Sessions

January 22-23, 2026
ACI Shotcreter Certification (Wet- & Dry-Mix)
World of Shotcrete | Henderson, NV

March 27-29, 2026
ACI Shotcreter Certification (Wet-Mix) | Skatepark Summit
Kaaterskill Kahncrete | Saugerties, NY

April 15-17, 2026
ACI Shotcreter Certification (Wet- & Dry-Mix)
Minova | Millstadt, IL

April 24-26, 2026
ACI Shotcreter Certification (Wet- & Dry-Mix)
Applied Shotcrete | Sebastopol, CA

October 7-9, 2026
ACI Shotcreter Certification (Wet- & Dry-Mix)
Minova | Millstadt, IL

October 23-25, 2026
ACI Shotcreter Certification (Wet- & Dry-Mix)
Applied Shotcrete | Sebastopol, CA

For details, visit shotcrete.org/calendar

SHOTCRETE FAQs

As a service to our readers, Shotcrete magazine includes selected questions and answers by the American Shotcrete Association (ASA). Questions can be submitted to info@shotcrete.org. Selected FAQs can also be found on the ASA website at www.shotcrete.org/FAQs.

Fig. 1

QUESTION:

I have a technical question that I can't seem to find an answer to. In the attached photo (Fig. 1), you can see the wall we shot back in July. My question is, what causes that rebar 'ghosting' effect? The only walls that have this were formed using MDF; the plywood-formed walls don't have it. It was an 18 in. (450 mm) wall, #6 (#19M) bar at 12 in. (300 mm) each way each face, 2 in. (50 mm) of clearance each way, placed at a 3 to 4 in. (75 to 100 mm) slump. The concrete was tested for air and slump with each truck per spec. The wall stripped perfectly, no bubbles, no pockets, no defects. The sacrificial cores came out perfect with no significant voids or bubbles. The only issue is the discoloration behind the bar causing this 'shadowing' or 'ghosting'. I've seen this a bunch over my career and I've never heard a good explanation as to what the cause may be.

ANSWER:

With the sacrificial cores showing excellent shotcrete placement, these dark areas are likely not evidence of voids or lower permeability areas behind the reinforcing bars. During shotcrete placement, the shadow area behind the reinforcing bars is filled in by the impact of the concrete at the form, and by the concrete paste 'flowing' around the back of the bar. This results in the area immediately behind the bar being somewhat more paste-rich, and that may contribute to a color difference.

Another factor is MDF is likely more porous than plywood. If the form was not thoroughly wetted before shooting, it is possible that the MDF absorbed some of the water from that paste-rich area behind the bar, resulting in a slightly different shade.

Over time, the concrete surface exposed to the weather may well give the surface a more uniform color.

Table 4.4.1—Compressor capacities and hose diameters based on experience

Material hose inside diameter, in. (mm)	Compressor capacity	
	ft^3/min at 100 psi	m^3/min at 7 bar
1 (25)	350	10
1-1/4 (32)	450	13
1-1/2 (38)	600	17
2 (50)	750	21
2-1/2 (64)	1000	28

QUESTION:

I work for a major compressor manufacturer and manage our diesel portable compressors. We're looking into what compressors to build next, and application focus is a big priority for me. I was wondering if you could help me to gain a better understanding of what customers are looking for in a compressor to pair with either dry-mix (formerly Gunite) or wet-mix shotcrete. Specifically, air flow ranges, pressure at the compressor, and any other beneficial features.

ANSWER:

Dry-mix shotcrete placement uses larger CFM compressors, as the airflow conveys dry concrete materials through the hose. *ACI PRC 505-22 Shotcrete – Guide* has this table (Table 4.4.1 above) for air flow based on delivery hose size. Most dry-mix shotcrete contractors use a 1.5 to 2 in. (38 to 50 mm) diameter hose.

If the dry-mix gun is driven by an air motor, a higher air flow will be needed.

Wet-mix shotcrete placement only needs to add airflow at the nozzle to increase velocity. *ACI PRC 506-22* recommends 200 to 400 CFM (5.7 to 11.3 m^3/min).

Both dry-mix and wet-mix normally use a typical 120 psi (8.3 bar) air pressure at the compressor. Higher pressure is not required. Longer hose lengths may require more airflow. Also, using a blow pipe to help control rebound can use an additional 100 to 200 CFM (2.8 to 5.7 m^3/min).

QUESTION:

Can shotcrete be used as an impervious liner to dam reservoir slopes? If so, what are the special design considerations that need to be considered? Is there any prior experience with shotcrete as a liner for dam reservoirs?

ANSWER:

Definitely! Shotcrete has been used on many canal linings, reservoirs, dams, tanks, and other liquid-containing structures. Shotcrete is a placement method for concrete, so designing for liquid-tightness requires crack control and proper concrete materials and placement. *ACI CODE 350-20: Code Requirements for Environmental Engineering Concrete Structures (ACI 350-20)* and *Commentary (ACI 350R-20)* provide design requirements and guidance for liquid-containing concrete structures. Shotcrete placement should meet the requirements of *ACI SPEC 506.2-13(18) Specification for Shotcrete*. Also, *ACI PRC 506-22 Shotcrete – Guide* provides excellent guidance on shotcrete placement. These ACI documents can all be found at ACI's website: **concrete.org**.

INDEX OF ADVERTISERS