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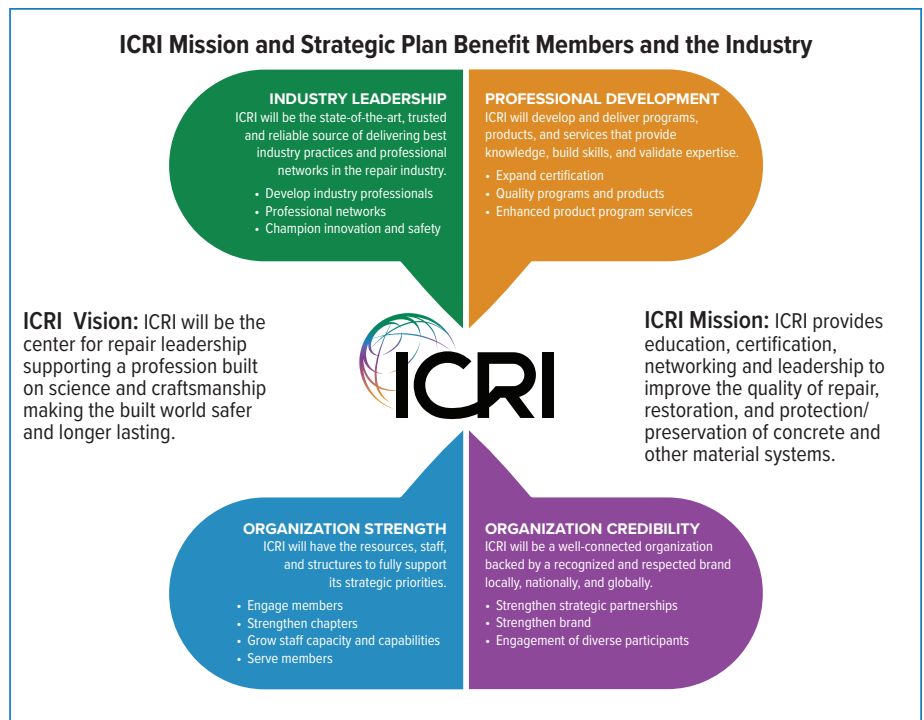
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The International Concrete Repair Institute is the leading resource for education and information to improve the quality of repair, restoration, and protection of concrete. Visit www.icri.org.

PRESIDENT'S MESSAGE

What's in It for Me?



PIERRE HÉBERT

In January, ICRI formally kicked off its 35th Anniversary Year in style at World of Concrete (WOC) in Las Vegas. It was another great ICRI networking event demonstrating the amazing personal connections that make ICRI such a special organization.

Now that WOC is back in full swing, we experienced great interest in ICRI at our booth with visits from industry professionals throughout North America and the world. Internationally, we spoke with representatives from Nigeria, Australia, and New Zealand as well as concrete repair professionals from Latin American countries including Mexico, Guatemala, Chile, Costa Rica, and Honduras. There's a clear need for the technical guidelines and education provided by ICRI—and that word is spreading!

Virtual meetings through technology kept us going during the pandemic. In this age of virtual communications, we're fortunate to have tools that make remote work possible. But what our experience in Las Vegas once again demonstrated is that they are no substitutes for face-to-face activities that help establish strong relationships, build trust, and connect with people on a deeper level. Businesses are built on relationships!

Whether it's our kick-off party and booth presence at WOC, a local ICRI chapter event, or an ICRI Convention, we are committed to offering the best possible opportunities to help you connect with colleagues in the industry. Think about it, we might just bring you your best business relationship opportunity at one of our in-person events! That's my message for you as we gear up for ICRI's Spring Convention, April 17-19, in beautiful Vancouver, BC, hosted by our British Columbia Chapter. If you haven't already, take the next step, register at www.icri.org and join us for what promises to be a highlight experience of the year!

In addition to great networking, ICRI is very focused on our mission to advance the quality of concrete repair and restoration through education, training, and practical tools. New offerings coming soon include:

- Applicator-focused training based on ICRI's Concrete Surface Repair Technician (CSRT) program. This program (planned to pilot in Q3 this year) will leverage the knowledge contained in the CSRT program to provide hands-on training on best practices in concrete surface repair.
- New online educational modules of ICRI's very successful Concrete Slab Moisture Testing (CSMT) program. We anticipate launching this online offering in Q2 of this year.
- New fiber-reinforced polymer (FRP) learning modules. After extensive volunteer work on this important initiative, ICRI anticipates launching these new online modules by Q4 of this year.

We are also pleased to launch ICRI's first digital mobile app to assist members and non-members on the job site! This app—designed to help assess rebar cleanliness—will be launched on



the Apple Store and Google Play in early 2023 and shows that ICRI is continually looking for innovative ways to advance the quality of concrete repair and restoration.

Speaking of technology, behind the scenes, the single biggest goal for ICRI's 35th Anniversary Year is to put in place next-generation technology that will power our association for the next 10-15 years. We've heard our members loud and clear that we need a website, association database, and learning management system that provide a seamless user experience. The ICRI staff team have spent extensive time and effort over the past year determining the future needs of the organization. I'm excited to report that, as of this writing, ICRI has finalized its plans to build and launch a new platform that will give our members a first-class online experience, enabling better access to tools, resources, and online education.

As we move into this, our 35th Anniversary Year, I have nothing but gratitude for all the volunteers and staff who have helped to build ICRI into what it is today and for the path they have laid out for an even more impactful future. So, when you wonder, "what's in it for me?" find your local ICRI chapter (www.icri.org/page/chapters), participate in one of the local events, or find a way to get involved with ICRI international. I guarantee that from these experiences, you'll understand why ICRI has reached this incredible milestone and why the future looks even brighter.

Don't hesitate to reach out to me directly with your thoughts or suggestions about how we can continue to make ICRI an even stronger organization for you, our members. Feel free to contact me at info@icri.org (your input will be forwarded). Thank you for your continued support of ICRI.

Your President,

Pierre Hébert

Pierre (Pete) Hébert



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TACTALK



MATT SHERMAN

Our job as TAC is to support our technical committees and we look forward to working with them. For more information on what our committees are doing, you can find descriptions of each committee online at www.icri.org/page/Committees and you will also see committee summaries in this and upcoming CRB issues.

As described in the prior TACTalk, our four TAC objectives for this year are centered on helping our committees, with the first objective for the year to improve our internal processes. We have started that with a new, easier method for the TAC liaisons and committee chairs to keep up to date with their “to-do” lists while cutting out some of the longer-form paperwork that we used to use. We are also developing the next installment of our committee chair training, focusing on our consensus process and the associated balloting. Rather than starting with the nuance and the mechanisms of balloting, we will begin with the underlying “why” of our consensus process, and then the “how” will fall into place.

The consensus process is fundamental to our work; it allows ICRI to be viewed as an impartial supporter of the industry as a whole and not as an advocate for a particular process, material, or product. It can seem slow and ponderous, but it is foundational to the value and applicability of our brand. The key components of this process include:

- **Accuracy and Applicability:** The technical accuracy that results from our ability to tap into the knowledge of suppliers, contractors, designers, and others is a key differentiator. Through it, we ensure that we are bringing the best knowledge and perspectives of our industry to bear.

- **Hearing all voices:** The balloting process ensures that everyone on the committee is heard. Everyone on the committee can submit comments—it's not just the loudest voice in the room.
- **Fairness:** All the comments submitted in response to a ballot must be fairly considered through a defined process that includes the person submitting the comment. The comment may lead to a change or modification, or it may not be accepted, but it will receive a fair consideration by the entirety of the committee.
- **Documentation:** The process for addressing ballot comments can seem robust, but it ensures that a documented record of the valuable work is retained. This enhances trust in the process and in the final work product itself.
- **Quality:** The review of the work product by the committee and check by TAC ensures that our quality is maintained. The industry relies on us for this, and we must maintain our standards.

In the context of these underlying principles, our balloting process becomes clearer because it is simply the tool to meet these objectives. As an example, our process of resolving a negative by committee ballot starts with a member with applicable knowledge, hears from that member during the process, fairly considers their suggestion in open forum, agrees on a resolution in a documented manner, and maintains the quality of our document.

Matt Sherman is chair of the ICRI Technical Activities Committee (TAC).

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ICRI TECHNICAL COMMITTEES

- 110 – Guide Specifications
- 120 – Environmental Health & Safety
- 130 – Contracts, Warranties and Agreements
- 160 – Life Cycle and Sustainability
- 210 – Evaluation
- 310 – Surface Preparation
- 320 – Concrete Repair Materials & Methods
- 330 – Strengthening and Stabilization
- 410 – Masonry
- 510 – Corrosion
- 710 – Coatings and Waterproofing

YOUR COMMITMENT:

Travel—Committee meetings are hybrid during ICRI Conventions. Attend in person and increase your networking opportunities, or attend virtually from your office or home. Between conventions, all committee meetings are held virtually.

Time—Active participation is encouraged and a time commitment is necessary.

If you become a voting committee member, you are required to VOTE at approximately 2-3 ballots per year. If you elect to be a consulting member, voting will not be required.

Easy to Join—Sign up through the ICRI website or contact ICRI Technical Director Dave Fuller.



www.icri.org/page/committees



davef@icri.org



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SAFETY SOLUTIONS

Stopping the “Invincible Minute”



BRIAN MacNEIL

How often in our construction industry have we heard something like one of these statements:

“I knew the excavation wasn’t stabilized yet. But I was just going in for a minute.”

“I left my helmet in the truck, but I was only getting out for a minute.”

“Don’t worry about your safety glasses, we’ll just be a minute.”

“It’s only a tiger. I’ll just be in its cage for a minute.”

“It takes less than a minute to back into place. No spotter needed.”

“I’m just going up for a minute to have a look. Don’t worry about the harness.”

“Forget the hearing protection. We’ll only be a minute.”

A lot can happen in “a minute.” So why do so many people believe that they have at least one invincible minute when they need it?

A cave-in. A wrench falling from a five-foot height. Debris getting stuck in an eye. A truck hitting a piece of equipment. A personal fall from scaffolding. A noise loud enough to burst an ear drum. All of these and more take only a second to make a devastating impact. Let alone a minute. In truth, it only takes a fraction of a second for an accident to happen. So why is “a minute” so often used as an excuse?

It’s important for us to emphasize with our project teams and partners that “a minute” provides hundreds of opportunities

for injuries to happen and lives to change for the worse. There is no minimum or maximum amount of time attached to the PPE we are required to wear or the safety procedures we follow in the workplace. There is no such thing as an “Invincible Minute.” We need to engrain that into our teams’ heads to get them to not only believe it but to preach it and teach it to others.

ICRI encourages each of us to promote this message in the workplace and through our social networks. The hashtag **#whywearesafe** is a reminder of the collateral damage that happens when there is an injury in the workplace. A broken arm, a hurt back, eye injury, or burn are all examples of the initial damage that can happen during a job site incident. The shrapnel from the initial damage hits the mental health of our fellow workers and trades as they worry and second-guess the causes of what happened. The inability to interact, support, and participate with our families in our day-to-day lives due to injury/incident can have long-lasting ripples well past the healing of a physical injury.

So how can we ensure that we can all high five our best friends? Take our dogs for a walk? Hug and carry our children? Live a healthy and happy life unhindered by workplace incidents? Let’s always send our teams home in a better condition than when they showed up for work. The best way to achieve this for us and our colleagues is to promote, enforce, and demonstrate proper safety procedures for **every minute** spent on every job. No exceptions.

Spread the word and share your story about **#whywearesafe**.

Brian MacNeil is ICRI President-Elect.

UPCOMING WEBINAR

April 11

Corrosion in Concrete Structures

by Jorge Costa | President of Durability, Inc.





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WOMEN IN ICRI

SPOTLIGHT— Eri Vokshi

by Michelle Nobel



ERI VOKSHI

Eri Vokshi is a senior product engineer for CFRP and Corrosion Products at Sika Corporation and a 2022 ICRI 40 Under 40 Award Winner. Eri has been in ICRI for over three years and is a member of ICRI Committee 330-Strengthening and Stabilization and the Women in ICRI Committee. She is also a voting member of ACI 440 and the chair of the ACI 440E Committee.

Eri loves learning about innovative building materials, such as FRPs, and their behavior in various applications. She likes presenting and sharing her knowledge with engineers and contractors. She is passionate about supporting women in the construction industry and is so grateful for the Women in ICRI and their embrace of females in our organization!

The career achievements that Eri is most proud of are the ICRI's 40 Under 40 award, being involved firsthand in developing a new product and taking it to market successfully, and receiving her Professional Engineering license.

Eri is married and lives in West Palm Beach, Florida, with her husband and five-year-old daughter. They love being on the water fishing—both offshore and freshwater—and their movie nights at home. Eri has learned that she can build mental strength through exercising so she's trained herself to love working out and recently completed her first obstacle course challenge.

All in all, Eri enjoys sharing her knowledge and growing through learning. She values the importance of working for a good company and is so thankful for the great people at Sika and organizations such as ICRI that help support us to become the next generation of female leaders in the construction industry!

It's been a pleasure to get to know Eri and have her be a part of this great organization and a member of the Women in ICRI Committee. I'm excited and encouraged to see ICRI attract such a dynamic young woman who will help lead ICRI for the next generation. Like so many of the people who came before, I see Eri making many friends and contributions to ICRI and the Women in ICRI.



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CERTIFICATION UPDATE

CSMT PROGRAM OUT WEST

The ICRI Concrete Slab Moisture Testing (CSMT) Program was held twice in Las Vegas during January/February 2023—World of Concrete, January 17–19; and TISE Surfaces Event, January 31–February 2.

ICRI hosted 27 individuals during World of Concrete at the Las Vegas Convention Center. Nineteen individuals participated in the entire CSMT Program—Education Course and Certification Course—including a demonstration and workshop, and performance exams in the South Hall. Five individuals participated in the Education Course only and three individuals were re-certified in the CSMT program.

ICRI congratulates winners of the drilling contest that accompanied the testing of ASTM F2170 during the CSMT program at World of Concrete: Chris Tull, Jon Dalton, and Larry Huff—all did an excellent job of hitting closest to the 2-inch mark.

Two weeks after World of Concrete, ICRI was back in Las Vegas hosting 14 more individuals in the CSMT program during TISE Surfaces at the Mandalay Bay Convention Center. Four individuals participated in the Education Course, there was one re-certification, and nine individuals were newly certified in the CSMT Program. During the drilling contest ICRI presented gift cards to Ko Kelii, Kevin Osbourne, and Blaze Bajet.

If your company or chapter wishes to schedule and host the CSMT Program, please contact ICRI Program Director Dale Regnier, daler@icri.org, and provide him with the contact information for the point person who will be in charge of coordinating the event, the proposed exam location, and potential date(s).



Pictured are the winners of the World of Concrete drilling contest: (left to right) Chris Tull (3rd place), Jon Dalton (1st place), and Larry Huff (2nd place)



Pictured are the winners of the TISE Surfaces drilling contest: (left to right) Ko Kelli (3rd place), Kevin Osbourne (1st place), and Blaze Bajet (2nd place)



ICRI CSMT instructors Adam Bakeman and Roland Vierra are pictured with the entire CSMT class from Surfaces 2023 in Las Vegas. Everyone who took the class passed! Congratulations!

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If you are involved with the measuring or assessment of moisture in concrete floor slabs, ICRI's CSMT program is for you!

Comprehensive Education and Certification Courses will give you the knowledge and skills to:

- ✓ Improve the performance of concrete slab moisture testing
- ✓ Report more consistent, accurate, and reliable test results
- ✓ Make better decisions on when a concrete slab is ready for a floor covering installation
- ✓ Reduce risks for your clients and your team



Concrete Surface Repair Technician (CSRT)

Education Course—Gain essential knowledge and training from your office or home

- ✓ Build a foundation for concrete surface repair, inspections, and testing
- ✓ Full online training that includes five competency-based modules
- ✓ Take this course by itself or get certified through the certification course

Certification Course—Demonstrate knowledge and competency to stand out from the crowd

- ✓ Qualifies you to perform pre- and post-placement inspections and testing
- ✓ Includes the five online training modules in the education course, an online knowledge exam, and performance exam on ASTM test methods (video recorded or live)

Learn more at www.icri.org

Questions? Contact ICRI Program Director Dale Regnier at daler@icri.org

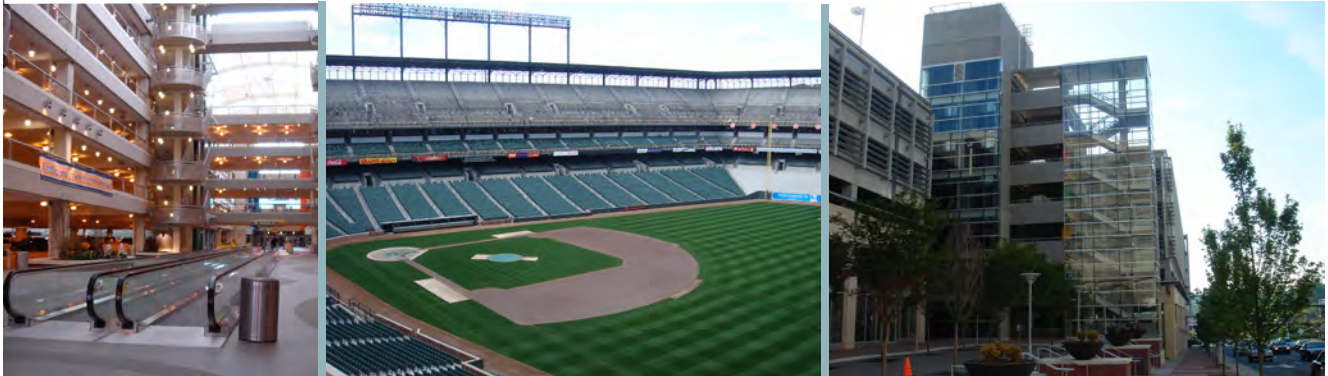


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Reusable Form of Infinite Shape and Size—A Sustainable Product for the Repair Industry

by Mo Ehsani

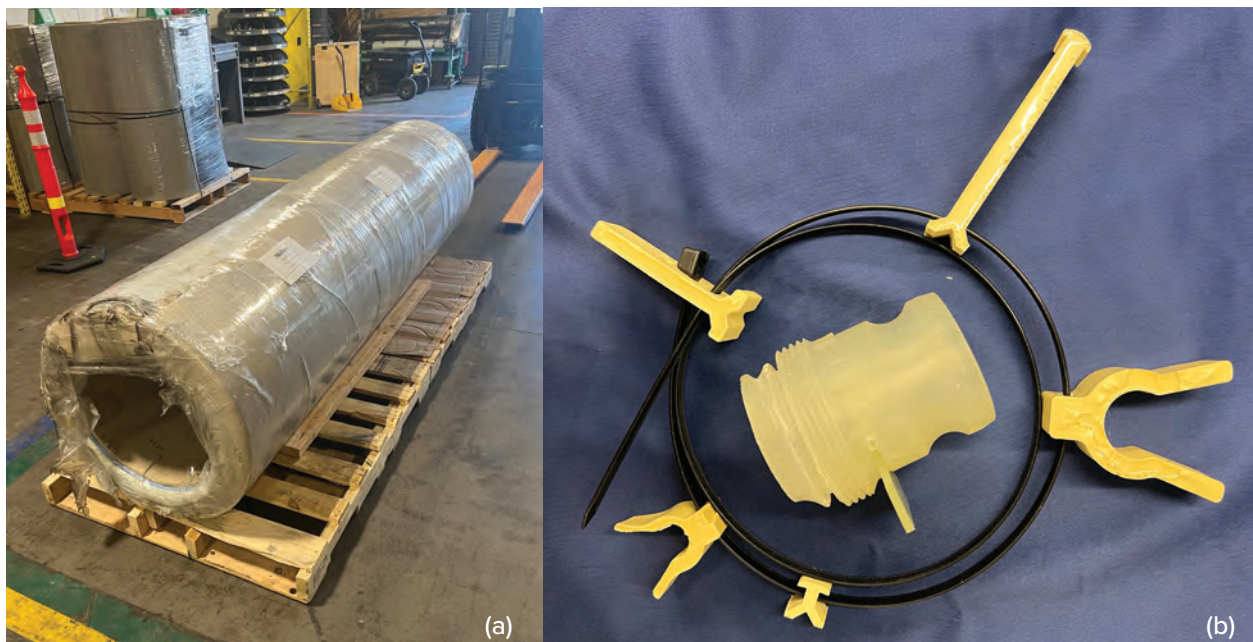


Fig. 1: A roll of FLF (a) and samples of spacers, rebar holders and grout injection port (b)

INTRODUCTION

Repair of columns in existing buildings and bridges is a challenging task. In many structures—such as bridges, parking garages, ports and piers, mines—columns (structural steel or concrete with embedded steel reinforcement) corrode and require repair. In other cases, column jacketing is used as a technique to strengthen existing columns by adding a shell of reinforced concrete around the column. The latter is gaining popularity in seismic upgrade of structures and the ACI Committee 369 on Seismic Repair and Rehabilitation is currently developing guidelines for such applications.

The forming of existing columns is a difficult task. The existing floor and beams above prevent the use of conventional disposable cardboard tubes because they cannot be slipped over the column. The contractor is faced with assembling a form consisting of many segments around the host column. Because these forms offer virtually no resistance to the lateral pressure of the freshly cast concrete, the segments must be tied externally with bolts, clamps and the like. These forms can become very heavy and add significant time and expense to the project. The

problem is especially arduous when the columns are not easily accessible.

This paper describes a recently developed application process that can overcome many of the above shortcomings.

FRP LAMINATE FORM

The new application process includes jacketing made of Fiber Reinforced Polymer (FRP). Using specialty equipment, glass fibers are impregnated with vinyl ester resin and subjected to heat and pressure to make very thin laminates. For brevity, the new jacketing system will be referred to as FRP Laminated Form (FLF) in this paper. The laminates have a uniform thickness that varies from 0.045 to 0.075 in. (1.1-1.9 mm) depending on the product style.

FLF is manufactured in rolls up to 102 in. (2,590 mm) wide. A typical roll includes approximately 500 lineal feet (152 m) of FLF (Fig. 1a). The laminates weigh between 0.31 to 0.51 lb/ft² (1.5–2.5 kg/m²). This light weight allows for easy handling. The mechanical properties of the laminates and the applicable ASTM Standards are listed in Table 1. The

unique design of the laminate provides a perfect balance between a smooth finish surface and enough friction to prevent sliding/slippage of the surfaces.

HOW TO INSTALL FLF

The behavior of FLF is based on principles of belt friction. Various shape and size spacers are available from the manufacturer, as shown in Fig. 1b. To repair a column, these spacers can be threaded through via a zip-tie and secured tightly around the column. They serve to hold the reinforcing bars in place, and to provide the desired stand-off distance, i.e., the annular space, between the FLF and the existing exterior face of the column (Fig. 2a, 2b).

The process begins with cutting a piece of the laminate long enough to wrap 2–3 times around the column. The laminate is tightly wrapped around the structure. Duct tape or double-sided tape can be used to secure the interior edge of the laminate to itself so as to minimize cement paste getting between the layers. The free exterior end of the laminate can be secured with a few pieces of duct tape. Alternatively, rope can be tied around the tube (Fig.

3a) to maintain the size of the tube. Note, the duct tape or rope is not required to resist any loads from the internal pressure of the freshly placed concrete.

Once the FLF is in place, the concrete can be placed using a hose and tremie method or by pumping it using the grout ports shown in Fig. 1. The latter will create a hole in the laminate that must be patched later and will ultimately limit the number of times the laminate can be reused.

Table 1: Typical Physical Properties of FLF

Property	US Customary
Flexural strength (ASTM-D790)	1.91x10 ⁴ psi
Flexural modulus (ASTM-D790)	6.0x10 ⁶ psi
Tensile strength (ASTM-D638)	1.0x10 ⁴ psi
Tensile modulus (ASTM-D638)	5.2x10 ⁵ psi
Izod impact (ASTM-D256)	4.5 ft-lb/in. notched
Coeff. of Linear Thermal Expansion (ASTM-D696)	1.7x10 ⁻⁵ in./in./°F
Water absorption / 24 hours (ASTM-D570)	0.3% @77°F
Coefficient of Static Friction	0.18



Fig 2: Spacers being installed (a) and the FLF laminate being wrapped around a deteriorated column (b)



Fig. 3. Field application: (a) FLF placed and filled with concrete, (b) removing the laminate after concrete hardens, (c) cleaning and saving the laminate for future use, and (d) smooth concrete finish with no spiral marks

After the concrete hardens, the rope is untied, and the laminate is removed (Fig. 3b). The laminate can be cleaned, washed, and dried (Fig. 3c) before it is coiled and stored away for future use to build a form of the same or different shape and size. Note, the finished surface of the cast concrete that is very smooth (Fig. 3d) and free from unsightly spiral marks that are commonly left behind when cardboard tubes are used for forming. Thus, eliminating the need for grinding of the new exterior surface.

As stated earlier, the behavior of this laminate is unique in that instead of using external clamps to hold the form together, the layers get pressed against one another due to the internal pressure of the concrete. Referring to Fig. 4a, if a tube of height H is filled with concrete and has a density γ , an internal hydrostatic pressure $p = \gamma H$ is developed at the base of the form. This internal pressure, shown with red arrows in Fig. 4b, results in a friction force between all layers of the laminate that is shown with smaller blue arrows in that figure. The higher the pressure of the concrete, the larger the friction force between the layers of the laminate. If the laminate is wrapped 3 times around itself, the external ties carry zero load. Alternatively, it is possible to use 2 layers of laminate. However, in that case stronger external ties such as ratchet straps must be used to resist some of the hydrostatic pressure of the freshly placed concrete.

The laminates themselves are very strong and for most applications, a layer can resist the hoop stresses generated in the form. In such cases, a minimum overlap length of 8 inches (200 mm) is recommended. For example, as-

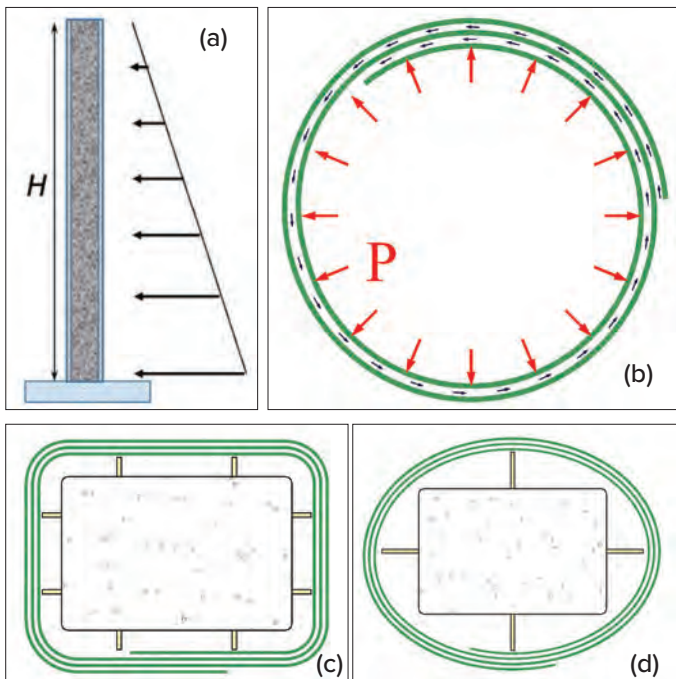


Fig. 4: Hydrostatic pressure of concrete generating internal friction between layers FLF; Spacer sizes allow making different FLF sizes around the same rectangular column

suming an 8-ft (2.4 m) high concrete placement with a unit weight of 145 lb/ft³ (23 kN/m³), the hydrostatic pressure at the base of the form will be 1160 psf (55.5 kPa). Assuming the diameter of the form is $D=36$ in. (914 mm), the tension force in a single layer of laminate will be $T=145$ lb (645 N). The 0.060 in. (1.5 mm) thick laminate shown in Fig. 3 has a breaking strength of 600 lb/in. (105 N/mm) width of laminate that is significantly larger than the force T calculated above. The safety factor in this case is 4.1—considerably larger than that required for live loads. This demonstrates that the construction of FLF with 2 or 3 layers of laminate is primarily to enhance the rigidity and stiffness of the tube. Again, the tensile strength of a single layer of laminate is greater than what is needed to confine the hydrostatic pressure of the freshly placed concrete.

In this example, a circular column was formed around a damaged circular column. A major advantage of FLF is that by changing the size of the spacers, the flexible laminates allow construction of nearly any shape and size form in the field. Fig. 4c shows a rectangular column cross section that can be enlarged to a larger rectangular column or an oval shape column, for example. The only limitation is that the radius of bend at the corners of a rectangular form must be larger than the allowable limit for the laminate. This radius is a function of the thickness of the laminate and is approximately 1 in. (25 mm).

PRESSURE TEST

To determine the adequacy of this system in resisting internal pressures, the following test was conducted. A 9.5-ft (2880 mm) long piece of a 0.06 in. (1.5 mm) thick laminate was cut from the roll. This laminate was coiled to create a 3-ply tube with a diameter of 12 in. (305 mm) and a length of 102 in. (2590 mm). The free end of the laminate was secured to itself with a few short pieces of duct tape to maintain the tube diameter.

An elongated balloon that is frequently used in internal repair of pipes was inserted inside the FLF. The balloon was connected to an air hose and gradually inflated to a pres-

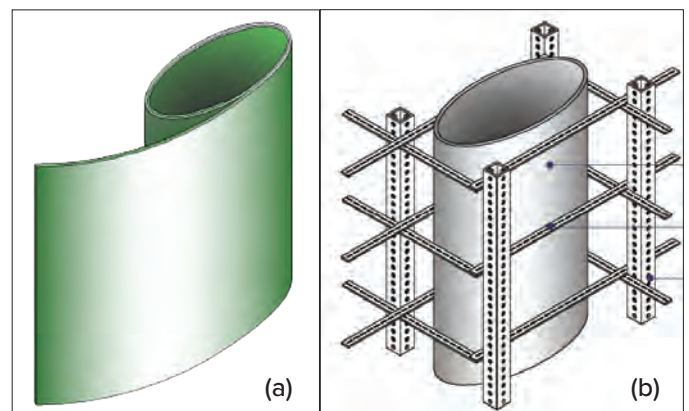


Fig 5: FLF can also be used to produce non-circular forms in a wide range of shapes and sizes for construction of new columns

sure of 3,300 psf (158 kPa). This is nearly 3 times higher than the pressure calculated in the above example. It is also significantly higher than any anticipated pressure that would be encountered in the field. The test was stopped at 3,300 psf due to the limitations of the balloon. There were no signs of any damage to the FLF at the conclusion of this test.


SUSTAINABILITY

The FLF presented here has several unique features making it an environmentally friendly alternative to a project's forming needs.

- The size of a single roll of laminate allows for virtually any size form to be built on site.
- The laminate can easily conform to the shape required. As demonstrated in Fig. 4d, the form can be shaped in rectangular, circular, and an endless range of geometries in between.
- The light weight of FLF eliminates the need for heavy lifting equipment on site that may be required for bulkier steel or timber forms.
- FLF is fully water resistant, making its storage easier and allowing for challenging forming of submerged columns and piles.
- The FLF can be used numerous times, thus reducing landfill waste.

These versatilities can help reduce forming costs on numerous projects.

SUMMARY

A new material, FRP Laminate Form (FLF) has been presented. The material can be used to form repair of existing columns or to form new columns (Fig. 5a, 5b). The advantages of this material are its ability to be used multiple times and to create forms of nearly any shape and size. FLF reduces storage space, transportation cost, and landfill costs significantly. It is fully water and rain resistant. The result in an environmentally friendly, sustainable solution. 

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- ASTM D696 *Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics between -30°C And 30°C with a Vitreous Silica Dilatometer*, ASTM International, West Conshohocken, PA, 2018
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Mo Ehsani, PhD, PE, SE, is President, QuakeWrap, Inc. and Centennial Emeritus Professor of Civil Engineering at the University of Arizona. He is a pioneer in the field of repair of structures with carbon FRP products and holds twenty patents in those technologies. He is also a registered general contractor in AZ and CA. Mo@QuakeWrap.com (520)250-7020.



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A Burning Ring of Fire: Techniques for Restoring Concrete Tunnels after Catastrophic Fires

by Stephen Sistrunk and Kent Sasaki



Fig. 1: The fire started on the evening of 12 October 2007 in a southbound Truck Bypass Tunnel that crossed under all lanes of I-5. Photo source: Wiss, Janney, Elstner Associates, Inc.

On the night of October 12, 2007, a tractor-trailer driving on the Truck Bypass Tunnel that crosses under all lanes of the Interstate 5 (I-5) freeway just north of Los Angeles attempted to make a late exit. Tragically, the attempt failed and the driver jackknifed, creating a massive pileup involving thirty semi-trucks, one passenger vehicle, three fatalities, and ten persons injured (Fig. 1).

Because large amounts of fuel were present in the semi-trucks, a severe fire erupted immediately and burned intensely over a four-hour period. The fire was not completely extinguished until 24 hours after the accident occurred. The fire spanned the tunnel's entire 550 ft (168 m) length and reached temperatures as high as 1,400°F (760°C) in some areas (Fig. 1). The temperatures and duration of the fire varied widely across different sections of the tunnel.

The fire caused an uncertain amount of structural damage, requiring closure of both the tunnel and the I-5 passenger

vehicle lanes sitting above it while the structure was evaluated for damage. Speed of evaluation and repair were critical because this stretch of freeway carried approximately 225,000 vehicles per day at the time (Fig. 3).

The California Department of Transportation (Caltrans) hired the engineering firm Wiss, Janney, Elstner Associates, Inc. (WJE) to investigate the severity and extent of damage to the concrete so that Caltrans could design repairs. WJE quickly mobilized an onsite team of engineers to perform a wide range of field evaluation methods including visual observation, acoustic impact (sounding), impact echo, concrete core sampling, and rebar sampling. Laboratory testing included petrographic examination of concrete cores, compressive strength testing of concrete cores, and tensile strength testing of steel reinforcement (Figs. 4-6).

FIRE'S IMPACT ON CONCRETE

Fire exposure may cause both physical and chemical changes that result in damage to the concrete. Physical effects include crazing, spalling, and deep cracking. Crazing is a surface level cracking that occurs around 550°F (300°C) and widens and deepens as the temperature increases. Spalling occurs when water inside the concrete quickly evaporates and expands, causing expulsion of larger concrete sections. Deep cracking is subsurface cracking or delamination that may be caused by rapid temperature change, aggregate expansion, or cement paste contraction due to dehydration.

Other fire impacts include rebar weakening, aggregate changes, and discoloration. Rebar weakening can occur at high temperatures, resulting in reduced tensile strength and ductility. Aggregate made of quartz may expand,



Fig. 4: Sounding is sometimes useful in identifying concrete damage, e.g. incipient spalling or weakened concrete. Photo source: Wiss, Janney, Elstner Associates, Inc.



Fig. 2: It took approximately 24 hours to completely extinguish the fire. Photo source: Wiss, Janney, Elstner Associates, Inc.



Fig. 5: 103 concrete samples were extracted from the undercrossing and examined in WJE laboratories in Illinois, Texas, and Ohio. Photo source: Wiss, Janney, Elstner Associates, Inc.

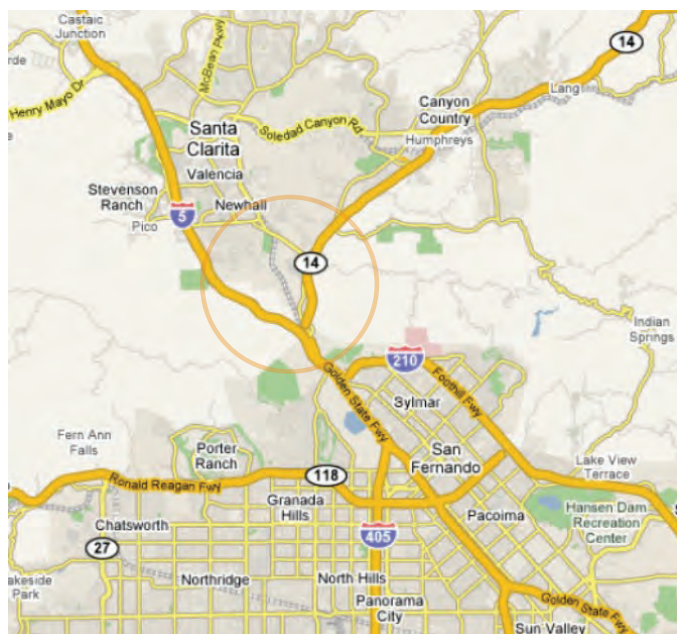


Fig. 3: The undercrossing (Tunnel) location is 35 miles north-northwest of downtown Los Angeles. Photo source: Wiss, Janney, Elstner Associates, Inc.



Fig. 6: 103 concrete samples were extracted from the undercrossing and examined in WJE laboratories in Illinois, Texas and Ohio. Photo source: Wiss, Janney, Elstner Associates, Inc.

while limestone aggregate degrades when exposed to high temperatures. Concrete may also experience discoloration, changing from normal to pink or red at about 550°F (300°C) and then to yellowish to buff above 1,100° F (600°C) (Fig. 7).

INVESTIGATION FINDS VARYING LEVELS OF DAMAGE IN THE TUNNEL

The evaluation performed by WJE produced a broad variety of findings depending on which area of the tunnel was being examined. In some areas, only mild soot staining was observed with minimal damage to the concrete (Fig. 8). In other areas, deep spalling and cracking were found. Of the thirty-four steel reinforcement samples tested, only four were found to be below the ASTM’s minimum strength requirements.

The varying levels of damage across different tunnel areas provides an important lesson about fire’s impact on concrete—time matters! Concrete is an excellent insulator, with low conductivity of heat. It takes a significant amount

Concrete Color	Temperature	Other Possible Physical Effects
Buff	950 C, 1,740 F	—
	1,850 F, 900 C	Powdered, light colored, dehydrated paste
Black Through Gray to Buff	1,450 F, 800 C	Spalling, exposing not more than 25 percent of reinforcing bar surface
	600 C, 1,100 F	Popouts over schert or quartz aggregate particles Deep cracking
Pink to Red	550 F, 300 C	Surface crazing
	100 F, 40 C	None

Fig. 7: Chemical and physical impacts on concrete increase in severity as the temperature rises. Photo source: Wiss, Janney, Elstner Associates, Inc.



Fig. 8: Soot blackening was present on the South exit of the Tunnel where the accident occurred. Photo source: Wiss, Janney, Elstner Associates, Inc.

of time for high temperatures to migrate through a concrete structure (Fig. 9). Therefore, the speed of fire suppression is extremely important for mitigating fire damage to concrete structures.

In this case, the firefighters were able to get on the scene almost immediately and contain the intense burning to a limited area and time frame of approximately four hours. Only certain areas sustained severe, deep damage. In these areas, most of the bad concrete had already been expelled via large spalls because it was extremely hot and was then doused with cold water by the firefighters—i.e., rapid expansion and contraction (Fig. 10). However, sub-surface cracking or delaminations that were likely caused by the fire were also found by core sampling and impact echo testing (Fig. 11).

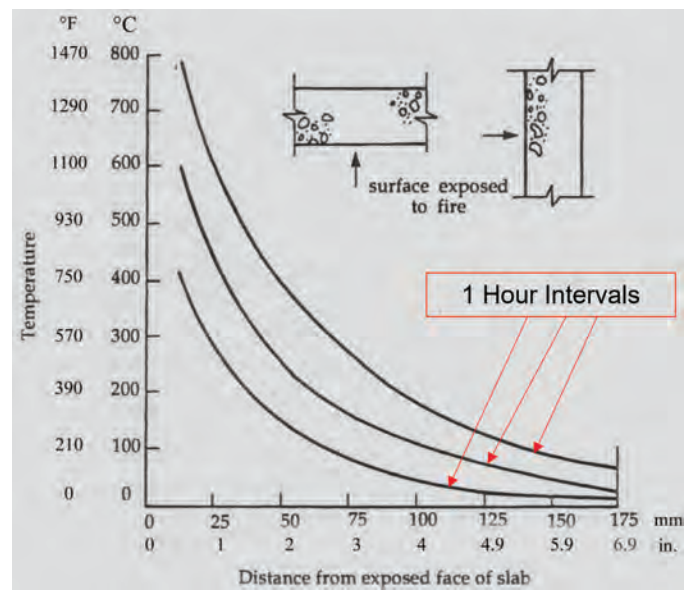


Fig. 9: Concrete temperature tends to fall off very rapidly, relative to the surface temperature, at increasing distances from the surface, i.e. there is a distinct time lag for the heat to migrate to the interior of the member, resulting in a distinct damage gradient at increasing distances from the fire-exposed surface of the concrete. Image source: ICRI Concrete Repair Manual



Fig. 10: Concrete spalling was extensive in areas with severe exposure to the fire. Photo source: Wiss, Janney, Elstner Associates, Inc.

HYDRODEMOLITION TECHNOLOGY IS DEPLOYED FOR SPEED AND PRECISION

WJE submitted its damage assessment and Caltrans began designing the repair plan. Speed of repair was crucial so that the critical I-5 traffic artery could get back up and running as quickly as possible. However, the quality of repair was also a major factor as the tunnel would carry heavy traffic loads both above and below. Caltrans needed a solution that would maximize the speed of concrete removal while ensuring that all bad concrete, but only the bad concrete, was selectively removed and replaced. In collaboration with the team of contractors, Caltrans decided to use hydrodemolition technology for the selective concrete removal scope of work.

Ray Wolfe, Supervising Bridge Engineer for Caltrans, stated, “We came up with the idea that if we could somehow start removing, in a controlled fashion, the surface concrete to see how far back in it easily came off that would give us an idea as to what structural concrete we had remaining. Certainly, using water demolition as a diagnostic tool proved to be a highly successful mechanism and really helped us make the decisions we needed to make in order to meet the schedule.”

Hydrodemolition is a proven technology for selective demolition, or removal, of concrete when repairing concrete structures. With hydrodemolition, a robotic device passes a high-pressure water jet of 15,000 to 40,000 psi across the concrete surface. The water penetrates into the pores and cracks in the concrete, creating an uplift pressure that overcomes the tensile strength of the concrete. The waterjet’s pressure and speed of travel across the concrete surface can be precisely controlled via user-friendly operating software, resulting in the selective removal of concrete below a certain strength threshold while keeping the good concrete intact. Observed removal rates for the hydrodemolition equipment used on the tunnel job were in the range of 25x to 100x faster than jackhammers. In addition, hydrodemolition yields a higher quality of repair compared to chipping because it does not leave microcracks in the remaining concrete substrate. Studies show that, when compared to percussive methods of concrete removal, hydrodemolition results in a 2.5x stronger bond between the residual substrate and new concrete application (Fig. 12). Hydrodemolition robots also improve jobsite safety by drastically reducing silica dust and noise and eliminating vibrations to equipment operators.

For this job, a hydrodemolition subcontractor was chosen that had robots equipped with a unique “Multipurpose Arm” or “MPA.” The MPA allowed the subcontractor to quickly reach the tall vertical walls and ceiling of the tunnel with the high-pressure waterjet (Fig. 13). The walls on average were 20 ft (6 m) high, with some areas as high as 27 ft (8.2 m). The contractor ran its robots around the clock for six days, removing a total of approximately 26,000 ft² (2,415 m²) of damaged concrete from the soffit and walls.



Fig. 11: Large scale, blind deep delaminations were found in some panels tested. Photo source: Hydropressure Cleaning, Inc.

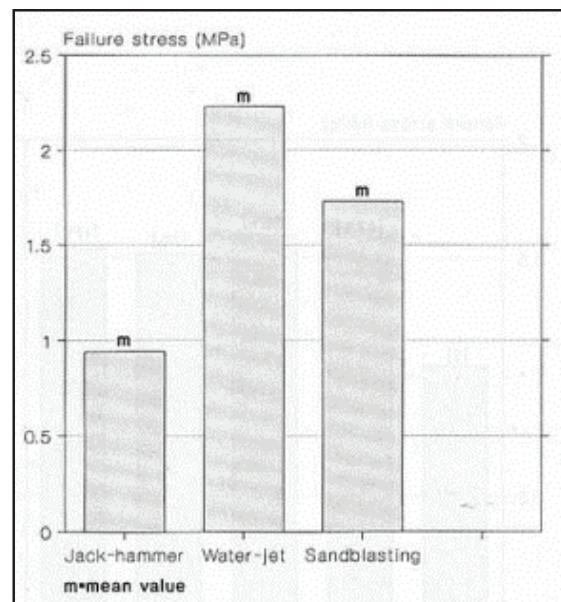



Fig. 12: Due to increased bonding area and the absence of microcracks, hydrodemolition-prepared surfaces result in repair strengths that are typically 2.5x greater than surfaces prepared with jackhammers. Photo source: Hydropressure Cleaning, Inc.



Fig. 13: The unique Multipurpose Arm (MPA) allows hydrodemolition contractors to easily attack horizontal, vertical, overhead and below-track surfaces, all at the push of a button. Photo source: Hydropressure Cleaning, Inc.

This equated to an average removal rate of 180.5 ft² (16.7 m²) per hour.

Following the removal of damaged concrete, the gunite subcontractor applied a fresh layer of new concrete to the structurally sound and microcrack-free surface that had been left in place after hydrodemolition. The entire construction phase took a total of 16 days—less than half of the 33 days estimated by Caltrans for the work! The tunnel resumed normal operations only 34 days after the accident occurred.

The I-5 Truck Bypass Tunnel fire is a great example of how fire damage to concrete structures can be minimized and quickly repaired with prompt action for fire suppression, advanced evaluation techniques, and contractors utilizing state-of-the-art hydrodemolition equipment. 

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Stephen Sistrunk runs the North American division of Conjet AB. Conjet, headquartered in Sweden, has been designing and manufacturing hydrodemolition equipment for the past 37 years. Stephen focuses on supporting and growing the North American hydrodemolition market by providing resources for customers to be successful on the jobsite and educating the market on the technology's many advantages for restoring and maintaining concrete infrastructure.



Kent Sasaki is a principle with Wiss, Janney, Elstner, Associates, Inc., and has performed engineering investigations on hundreds of structures including high-rise buildings, warehouses, apartment buildings, bridges, and tunnels. He investigates damage from earthquakes, fire, earth movement, landslides, flooding, vibration, blast, and construction defects. He holds a Bachelor of Science in Engineering as well as a Master of Engineering, Structural Engineering from the University of California, Berkeley.



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If you are interested in submitting an article for publication in the *Concrete Repair Bulletin*, please contact ICRI Technical Director Dave Fuller, davef@icri.org, for more details.

Surface Restoration for Concrete Structures

by Wayne Lawrence



Fig. 1: Cleaning smoke residue with baking soda blasting

Surface restoration for concrete structures often means applying coatings to rebuild and protect the deteriorated surface. These coatings range from sealants to overlays. There are some marvelous products on the market that perform a variety of restoration roles, including sealing, rebuilding, and resurfacing. The ultimate performance of these coatings, however, is greatly influenced by proper surface preparation.

In many cases, such as simple smoke damage from a fire, surface cleaning is all that's required for restoration. Many sealants can be applied directly onto the newly cleaned surface without regard to the actual surface profile. Fire restoration methods including pressure washing, soda blasting, and hand cleaning leave the surface roughness in a like-new condition with little change, if any, to the surface profile (Fig. 1).

Many of the more advanced materials for concrete restoration (such as epoxies, polymer overlays, various

mortars, and specialty coatings) require more vigorous profiling of the concrete to properly prepare the surface to accept the product. The "profile" of the surface refers directly to the roughness. This attribute is generally measured from the deepest "valley" on the surface to the highest "peak". This roughness is expressed by a scale called the Concrete Surface Profile (CSP) as described and illustrated in ICRI 310.2R. This is a standardized measure of surface roughness that assigns a number—CSP 1 through CSP 10—for roughness as low as 0-3 mils to over ¼" (6.4mm) (Fig. 2).

This roughness can be measured with numerous devices—some complicated and technical (such as lasers, pull-off adhesion tests), some more easily applied (such as replica tape and putty). One of the most common and simple methods is the use of rubber comparator chips provided by ICRI (Fig. 3). These rubber chips have a molded surface that replicates the surfaces of concrete of various profiles from CSP 1 to CSP 10. On restoration

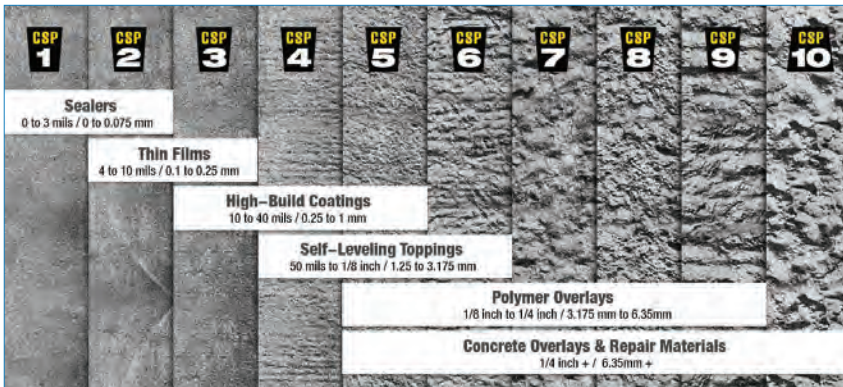


Fig. 2: Concrete Surface Profile (CSP) chart and visual examples



Fig. 3: ICRI CSP comparator chips

jobs the chips can be compared to the actual concrete surface to confirm that the required surface roughness has been achieved.

As mentioned, some degree of surface roughness is required for most of the quality products for restoring concrete surfaces. Imparting this roughness can be accomplished in several ways including acid etching, grinding, needle scaling, abrasive blasting, and water jetting—to name a few. Of these, the most adaptable and effective method is abrasive blasting. This is what many refer to as “sand” blasting. Due to the health issues associated with silica sand, however, actual “sand” blasting is nearly extinct. Abrasive media blasting, on the other hand, is very much alive and extremely adaptable.

Blasting media are available for many different applications. Soft abrasives like baking soda, dry ice, and walnut shells are capable of cleaning applications and coatings that don’t require more than a CSP 1 (Figs. 4 and 5). Soft abrasives have little impact on the surface, imparting little surface roughness. Harder abrasives like calcium carbonate, crushed glass, garnet, and others can remove surface material leaving a profile, or roughness. Different results can also be achieved by varying the grit size of the blast abrasive. Beyond media, abrasive blasting can also adapt to provide different profiles by increasing (or decreasing) blast pressure, or even applying different nozzle technologies (Fig. 6). It is generally true that blasting can provide CSP measurements from CSP 1 to CSP 9, depending on the combination of these—and a few other—important variables.

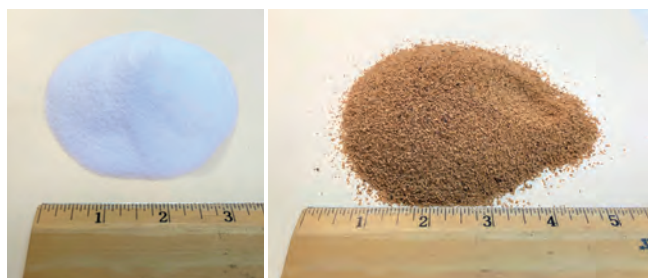


Fig. 4: Baking soda blast media Fig. 5: Walnut shell blast media



Fig. 6: Various blast nozzles

One of these important variables is the use of water in a wet abrasive blasting application. Commonly referred to as vapor blasting, wet abrasive blasting has multiple benefits including the descriptor—dustless (Fig. 7). While no blasting process is truly dust-free, this new development allows contractors to perform “open” blasting (not using containment) with little to no dust migrating beyond the worksite. Outdoor applications can obviously benefit from this lower dust level. Consider that a low dust application might even allow the blasting to move into areas previously inaccessible to more dusty dry blasting techniques. Newer rigs are less troublesome than in the past, more portable, and very effective (Fig. 8).

One of the best ways to look at this is through a brief case study. A large pharmaceutical company in southwest Michigan was concerned with premature aging and deterioration in one of its concrete equalizer tanks in their private wastewater system. The large concrete tank, approximately 8,000 ft² (743 m²) of concrete surface inside, was coated with 40–50 mils (1–1.3 mm) of an outdated and failing coal tar coating. There was also little evidence of proper surface preparation under this coating, another possible reason for the problems. This proved to be inadequate protection, in particular in the “headspace” of the tank where accumulations of corrosive hydrogen sulfide gas were significantly corroding the walls (Fig. 9).

Concerned with the high cost of replacing the tank, the owner investigated having the current concrete tank restored. Adding to this decision was a very real concern over a loss of production due to downtime during a pos-

sible replacement. They wisely reached out to an experienced restoration contractor, Blastek, LLC in Shelbyville, Michigan. It was clear to Eric Waddell, Partner and co-owner of Blastek, that properly restoring the tank would ultimately provide the customer with a significant cost savings over replacement. He added that the increased asset longevity (longer tank life) would further justify the cost of restoration. Other options such as steel and fiberglass had significant drawbacks, such as cost, availability, and downtime during the replacement process, when compared to the restoration project. Waddell explained that that the process of restoration would take about two

weeks to complete, one week for surface preparation, and one week for application of the protective layers.

The process of restoring the tank would be a multi-step method employing a series of products including a mortar compound, cementitious epoxy, and 100% solid epoxy from a well-known manufacturer of concrete restoration compounds. The manufacturer recommended that Blastek profile the concrete in the tank to a CSP 5 level in accordance with ICRI 310.2R. They chose to use abrasive media blasting with a hard abrasive, 80 Grit Garnet, at a high blast pressure to achieve the nearly 50 mils of



Fig. 7: Wet abrasive blasting with reduced dust emissions

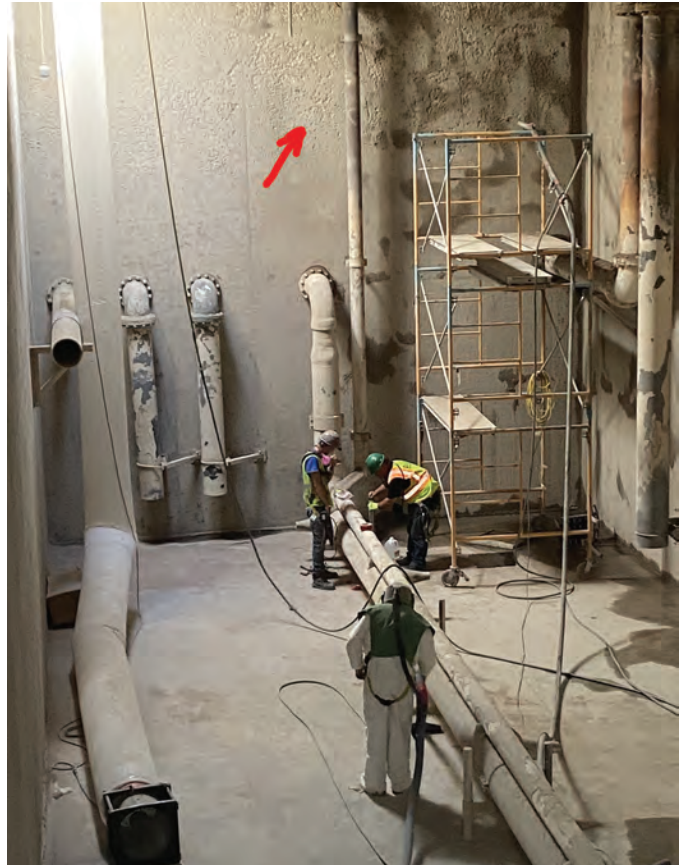


Fig. 9: Deteriorated concrete surface in equalizer tank



Fig. 8: Portable wet abrasive blast rig

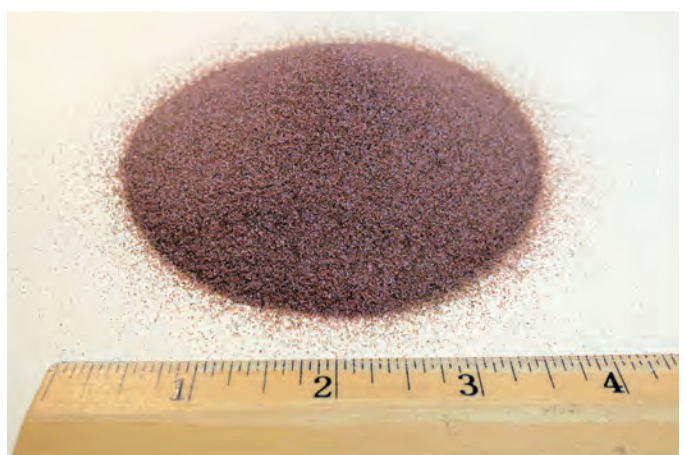


Fig. 10: Garnet blast media



Fig. 11: Preparing to blast in tank

profile required for proper surface preparation (Fig. 10). This was a confined space application and you can note the proper PPE and gas monitors clearly seen in the area when the blasting and coating processes took place (Fig. 11). The CSP 5 finish could easily be confirmed when compared to the comparator chips on the job site. After blasting, the contractor repaired any cracks or pits greater than ¼" (6.4 mm) with a polyurethane material. This was followed by a mortar compound, sprayed on and then hand troweled, primarily to resurface, filling any remaining holes and deterioration of the surface. The next step was to apply, via hand troweling, a cementitious epoxy to a thickness of about 125 mils (½", 3 mm) (Fig. 12). The final step in the restoration was to apply a glaze, or 100% solid epoxy coating via an airless spray system.

The pharmaceutical manufacturer was thrilled with the results, and the promise of an equalizer tank that would offer many more years of service with very little downtime at a fraction of the cost of replacement (Fig. 13).

When considering any concrete restoration job, always be mindful of the surface preparation requirements of the coating to be applied, and the recommended Concrete Surface Profile (CSP 1–CSP 10). Also keep in mind how



Fig. 12: Partially completed coatings in tank



Fig. 13: Finished equalizer tank with all coatings applied

surface preparation can influence material performance and how it relates to restoration success. Then think about blasting as a means to a very profitable end. 🗨️

REFERENCE

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Wayne Lawrence is a current ICRI member with his company, ESCA Blast Great Lakes in Grand Rapids, MI. In addition to his bachelor's degree from Central Michigan University, he has over 28 years of experience in the abrasive blasting field. As a current partner at ESCA Blast, he sells, rents, and services a variety of abrasive blasting equipment for concrete restoration and many other applications. Wayne can

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ICRI CHAPTER NEWS

CHAPTER CALENDAR

ICRI Chapters are hosting events in 2023. Be sure to check with individual chapters by visiting their chapter pages to determine if they have made any plans after this publication went to print. You can also contact a Chapter Leader from any chapter to ask if they have added events.

BALTIMORE-WASHINGTON

May 10, 2023
SECOND QUARTER DINNER MEETING
Martin's West
Baltimore, MD

CAROLINAS

May 4-5, 2023
SPRING CONFERENCE & NIGHT
AT THE BALLPARK
Hotel Indigo
Mt. Pleasant, SC

CHICAGO

April 20, 2023
CHAPTER DINNER MEETING
Erie Café
Chicago, IL

CINCINNATI

March 15, 2023
2ND ANNUAL CLAY SHOOT
Middletown Sportsmen's Club
Middletown, OH

April 19, 2023
CHAPTER TECHNICAL SESSION
TPC River's Bend
Mainville, OH

FLORIDA WEST COAST

April 7, 2023
CHAPTER DEMO DAY
Tom White Offices
St. Petersburg, FL

GEORGIA

March 24, 2023
CHAPTER LUNCHEON
Topic: Utilization of Drones
Maggiano's Perimeter
Atlanta, GA

May 16, 2023
ANNUAL GOLF TOURNAMENT
Heritage Golf Links
Tucker, GA

GULF SOUTH

March 9, 2023
SPRING MEETING
Topic: Concrete Repair in Transportation & Infrastructure
IP Casino Resort and Spa
Biloxi, MS

METRO NEW YORK

March 16, 2023
TECHNICAL PRESENTATION
Topic: Concrete Durability
Speaker: Professor Norman Weiss
Club 101
Manhattan, NY

MICHIGAN

March 3, 2023
CHAPTER DEMO DAY
Elcometer Facilities
Warren, MI

May 9, 2023
JOINT ACI MEETING
Topic: Surfside Condo Collapse
Location: TBD

MINNESOTA

March 3, 2023
10th ANNUAL FUNSPIEL (CURLING)
Chaska Curling Center
Chaska, MN

NEW ENGLAND

March 14, 2023
DINNER & TECHNICAL PRESENTATION
Topic: From Field to Laboratory & Back Again
SGH Offices
Waltham, MA

ROCKY MOUNTAIN

March 3, 2023
ANNUAL SKI DAY
Loveland Ski Area
Dillon, CO

ICRI CHAPTER NEWS

CHAPTER ACTIVITIES

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INDIANA HOSTS HOLIDAY GATHERING

The Indiana Chapter closed out 2022 by hosting its Holiday Social Event at the Indiana War Memorial in downtown Indianapolis in December. After an amazing tour of the Memorial, attendees were treated to a festive holiday food buffet. Included in the festivities was a chance to honor the chapter's most recent past president as well as an opportunity to hear from an organization called Operation: Job Ready Veterans. This organization was the recipient of the Indiana Chapter's annual giving campaign and a check was presented at the end of the talk.



◀ Stephen Manner (left) of FRP Inc. presents Tyler Gilpin (right) of Glenrock Company the Indiana Chapter Presidents award for serving as Chapter President from 2021-2022



▲ Tyler Gilpin (left) presents a check to Operation: Job Ready Veterans

◀ The dinnertime presentation by Operation: Job Ready Veterans was informative and inspiring

ICRI CHAPTER NEWS

CHAPTER ACTIVITIES

OKLAHOMA SOCIAL OUTING IS IN THE BAG

The Oklahoma Chapter took time to host a December social meeting in Tulsa, Oklahoma! Everyone had a great time and a big thank-you goes out to Whitecap for sponsoring the appetizers and to Maxwell Supply for sponsoring the drinks for this event. During the social outing, the chapter hosted a fun and exciting Cornhole Tournament. The big winners of the evening were Jim Chappell with Impact who won first place in Singles and Jim Chappell with Impact who teamed up with Shannon Hudson from Maxwell Supply to win first place in the doubles event. The chapter hopes everyone had a great time and they plan to make this an annual chapter event!



Left Photo: Jim Chappell with Impact won 1st place in Singles ▶

Right Photo: Jim Chappell with Impact and Shannon Hudson with Maxwell Supply won 1st place in Doubles ▶

ICRI CHAPTER NEWS

CHAPTERS COMMITTEE CHAIR'S LETTER



JON CONNEALY
Chapters Chair

Well, I'm not sure if I'm ready for this, and to be honest there are probably a few of you who aren't ready for it either...Guess who is the new Chapters Committee Chair?! THIS GUY!

If you've been to a Chapters Committee meeting at one of the ICRI conventions in the last few years, you've gotten to see me in action as I served as the Vice Chair.

Thank goodness, we've had the magnificent Michelle Nobel at the helm for the past five years, as her leadership was invaluable. And she was able to keep me tempered. Now, I'm told that I'm experienced enough to drive this ship. I hope you all like bumpy rides!

Joking aside, Chapters Committee has had my heart since I joined the Board of Directors in 2017. I am one of many people in this organization who truly and firmly believe that **chapters are the lifeblood of ICRI**. My passion for ICRI came from my involvement with the Great Plains Chapter, and my passion for my home chapter has driven me to be so active and vocal at the National level of leadership.

This year, I am not just stepping into the role of Chapters Committee Chair, but also back into a leadership role in my local chapter. I'm hopeful that each will give me insight into how I can better serve my role in the other.

I have believed for many years that the two most important things that ICRI provides its members are technical/educational content and industry networking opportunities. I plan to focus on how we at the Chapters Committee can assist chapter leaders in planning and executing these two functions. I look forward to meeting with and hearing from chapter leaders and delegates at this year's conventions, where we will get to share our successes, best practices, and even our failures in the hopes of helping other leaders through sharing our experiences.

If you are attending the Spring Convention in Vancouver this April, make sure to attend the Chapters Committee Meeting! I look forward to seeing you there!!

Jon Connealy, ICRI Chapters Committee Chair
BASF Master Builders Solutions USA



ICRI has 39 chapters, including two student chapters, in metropolitan areas around the world. Chapters hold technical presentations, educational meetings, symposia, and local conventions on repair-related topics.

Chapters also provide an outstanding opportunity to meet and build relationships with repair specialists in your area. In addition to the technical meetings, chapters also host golf outings, social evenings, dinner cruises, and other networking events.

CONCRETE REPAIR CALENDAR

APRIL 2-6, 2023

ACI Concrete Convention
San Francisco, CA
Website: www.concrete.org

APRIL 17-19, 2023

2022 ICRI Spring Convention
Vancouver, BC, Canada
Website: www.icri.org

INTERESTED IN SEEING YOUR CONCRETE INDUSTRY EVENT LISTED HERE?

Events can be emailed to editor@icri.org.
Content for the May/June 2023 issue is due by April 1, 2023, and content for the July/August 2023 issue is due by June 1, 2023.

APRIL 11, 2023

ICRI Webinar
Corrosion in Concrete Structures
Website: www.icri.org

ASSOCIATION NEWS

THE INTERNATIONAL GROOVING & GRINDING ASSOCIATION ANNOUNCES 2022 ANNUAL AWARD WINNERS

The International Grooving Grinding Association (IGGA)—a non-profit trade association founded in 1972 that is recognized as the industry's lead technical resource in the development and marketing of optimized pavement surfaces and pavement preservation around the world—has announced the winners of their annual awards program.

Presented at the association's annual meeting held in Nashville, Tenn. on Nov. 29, 2022, the purpose of the program is to honor individuals and companies/organizations for lasting contributions made to the grooving, grinding and concrete pavement preservation/restoration industry.

2022 Operator of the Year (Iron Man)—Tony Brink, Corrective Grinding Crew Manager, Diamond Surface Inc. (DSI), Rogers, Minn.

2022 Government Official of the Year—Joe Echelle, Assistant Executive Director, Maintenance, Engineering & Construction, Oklahoma Turnpike Authority (OTA).

2022 Lester F. Kuzmick Award—Scott Eilken, owner of Quality Saw & Seal, located, Bridgeview, IL; and Terrence Kraemer, CEO, Diamond Surface Inc., Rogers, Minn.

2022 Honorary Life Membership Award—Steve Garrison, retired Sales and Marketing Manager of the former Diamond B, Santa Fe Springs, Calif.

Visit www.igga.net for more information.



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AMERICAN CONCRETE PAVEMENT ASSOCIATION ANNOUNCES NEW BOARD OF DIRECTORS CHAIR AND VICE CHAIR

The American Concrete Pavement Association (ACPA) is pleased to announce Steve Friess of Milestone Contractors, LP, as the Chairman of the Board of Directors in 2023. Ernie Peterson of Ash Grove Cement will be the Board's Vice Chair and will serve as Chair in 2024. Both men are leaders in the concrete pavement industry as well as their respective companies.

ACPA also recently elected a new slate of board members: John Leckie, Indiana Chapter of ACPA; Bryan Beck, GOMACO; Jay Van Hove, Koss Construction Company, Jake Steinberg of American Highway—a Simplex Company; Greg Pelkey of Shafer Contracting Co, Tim Nash of Wirtgen America, David Loomes of Continental Cement and Joe Finnegan of GCC America.

For more information visit <https://www.acpa.org/>.

CONCRETE INDUSTRY MANAGEMENT PROGRAM SHATTERS PREVIOUS RECORDS BY RAISING \$2.1 MILLION AT 2023 AUCTION

The National Steering Committee (NSC) for the Concrete Industry Management (CIM) program—a business intensive program that awards students with a four-year Bachelor of Science degree in Concrete Industry Management—is thrilled to announce it raised more than \$2.1 million in gross revenue at its annual auction, held in conjunction with World of Concrete, on Wednesday, Jan. 18.

“Once again, we thank the concrete industry for their tremendous support for this record-breaking auction,” commented CIM Auction Committee Chairman Ben Robuck. “The auction results are indicative of the high value this industry places on the CIM program and the need for talented leaders in the industry. This year’s auction was an incredible success, both in terms of the value of donated items and the auction participants. In addition to a concrete mixer truck donated by Mack® Trucks, Inc. and McNeilus®, a truck-mounted concrete pump donated by Alliance Concrete Pumps and Papé Kenworth, a concrete mixer truck donated by Peterbilt Motors Company and Con-Tech Manufacturing

and an S-485 Laser Screed® donated by Somero Enterprises, we had a multitude of items targeted specifically for the concrete industry.”



In addition to the live auction, a silent auction was also held. This year CIM had record proceeds from the silent auction. Live and silent auction items included cement, fly ash, aggregate, concrete saws, drills, safety equipment, training sessions, reference books and software subscriptions, laptop computers, sports travel packages and golf and vacation travel packages and much more.

For more information visit www.concretedegree.com.

ACI FOUNDATION SEEKS FUNDING FOR KENNETH C. HOVER HONORARY FELLOWSHIP

The ACI Foundation has created a new Fellowship in honor of Kenneth C. Hover. His past and present teaching, communication, research, and consulting activities have positively influenced several thousands of individuals in the concrete industry community and enhanced our knowledge about concrete.



The ACI Foundation recently received \$50,000 in seed money from generous donors in honor of Hover’s lifelong contributions to the concrete industry.

The ACI Foundation is looking to raise additional funds towards the new fellowship to extend the award indefinitely to deserving students.

Hover is a professor of civil and environmental engineering at Cornell University, Ithaca, NY, USA, where his teaching and research focus on concrete materials,

design, and construction. He also acts as a consultant to many industry organizations, helping with the technical aspects of concrete construction projects. He is among the highest-rated speakers at World of Concrete, and his seminars often sell out. At World of Concrete in 2006, he was named “one of the 10 most influential people in the U.S. concrete industry.”

The new fellowship, once fully funded, will be available for student applicants who are graduate or undergraduate students studying in any concrete-related field. The award funding will be distributed in increments of \$15,000 to benefit one student annually. A \$10,000 educational stipend will go to the student to cover tuition, books, supplies, and \$5000 to cover expenses to attend three ACI Concrete Conventions, one of which will include an in-person interview with the Scholarship Council.

For more information, visit www.acifoundation.org/giving

AMERICAN CONCRETE INSTITUTE ESTABLISHES NEW CENTER OF EXCELLENCE FOR CONCRETE INDUSTRY PRODUCTIVITY

PRO: An ACI Center of Excellence for Advancing Concrete Industry Productivity has been launched by the American Concrete Institute (ACI). As a catalyst for solving the barriers of constructability to advance concrete construction productivity, PRO will collaborate with designers, materials suppliers, and contractors to identify and resolve issues that negatively impact productivity in concrete construction.



Located at ACI Headquarters in Farmington Hills, MI, USA, the Center aims to optimize labor and time against materials by improving structural design and construction processes through a collaborative approach with designers, material suppliers, builders, and industry stakeholders. Initial areas of focus for PRO include industry collaboration efforts, identification of productivity obstacles and solutions, constructable design resources, automation, technology validation, interaction with ACI committees, and more. Managed by ACI, the Center will draw from the Institute’s technical and administrative

support services, with funding provided by Sponsors.

“The concrete contractor’s input on design details, specifications, and material criteria that embraces the construction process is long overdue,” said Phil Diekemper, Executive Director, PRO. “Improving construction productivity through concrete design is the key to unlocking project value. I’m very excited to participate as the industry collaborates with a single focus to improve concrete construction productivity.”

Initial staffing for the Center comprises an Executive Director supported by ACI technical experts.

PRO and its future sponsors aim to advance new technologies and processes that improve productivity beyond historic levels. To learn more visit concreteproductivity.org.

AMERICAN CONCRETE PAVEMENT ASSOCIATION ANNOUNCES NEW WHITE PAPER TO SUPPORT SUSTAINABILITY IN THE CONSTRUCTION, MAINTENANCE, REHABILITATION, AND EXPANSION OF INFRASTRUCTURE

The American Concrete Pavement Association (ACPA) announced the release of a white paper, “Concrete Pavement’s Role in a Sustainable, Resilient Future,” that synthesizes research on concrete pavement’s contributions to economic, environmental, and social sustainability.

As part of the organization’s role educating decision-makers who are involved in the placement and rehabilitation of roadway, highway, and airfield pavements, the ACPA is providing the white paper to assist those decision-makers as they are challenged to meet ever-increasing levels of sustainability.

The report summarizes concrete pavement’s role in sustainability, including:

1. The long life span of concrete pavement, providing the greatest economic value over the long term for taxpayers and end users. .
2. Research supporting concrete pavement’s many use-phase environmental and societal benefits.
3. Examination of how the concrete pavement industry and others across the concrete value chain are working

together to implement the PCA’s Roadmap to Carbon Neutrality, with a goal of achieving net zero carbon emissions by 2050.

4. The importance of life-cycle thinking in addressing social sustainability, particularly concrete pavement’s long life; its ability to withstand, respond to, and recover rapidly after a disruptive event; and good performance with minimal traffic disruption due to maintenance.

Because millions of miles of pavements across the globe are placed or rehabilitated every year, the role of concrete pavement in sustainability cannot be understated.

For more information visit <https://www.acpa.org/>.

AMERICAN CONCRETE PUMPING ASSOCIATION (ACPA) UNVEILS JOB SITE SAFETY CAMPAIGN

The American Concrete Pumping Association (ACPA) launched a major safety campaign to bring heightened awareness of ASME B30.27, the Safety Standard for Material Placement Systems.

The campaign highlights the responsibilities of each trade working with or around a concrete pump under the standard. The ultimate goal of the campaign is to keep every person on a job site safe.

The cornerstone of the campaign is a new microsite—WeAreSaferTogether.org—which provides and promotes valuable information to all who work with or around concrete pump equipment. The microsite serves as an educational resource to familiarize all parties with the standard and provides videos, downloadable flyers,

job site responsibilities by trade, FAQs and much more.

What is ASME B30.27?

The B30.27 standard is intended to prevent or minimize injury to workers and otherwise provide for the protection of life, limb and property by prescribing safety requirements. It provides direction to manufacturers, owners, employers, users and others concerned with or responsible for its application, and guide governments and other regulatory bodies in the development, promulgation and enforcement of appropriate safety directives.

2023 and Beyond

Today is just the beginning for this campaign. Throughout 2023 and beyond, the ACPA will continue to expand the campaign’s impact by inviting associations and organizations across all trades to join in and support this important effort.

To learn more about the campaign visit WeAreSaferTogether.org.



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SERENITY HARDSCAPES LLC ACHIEVED ASA QUALIFIED SHOTCRETE CONTRACTOR— WET-MIX, LEVEL I

The American Shotcrete Association (ASA) is proud to announce that Serenity Hardscapes LLC has been named an ASA Qualified Shotcrete Contractor – Wet-Mix, Level I.

ASA's program recognizes shotcrete contractors who have shown by their company resources and past performance, a proven commitment to quality shotcrete placement. Quality, durable shotcrete placement on a consistent basis is key to extending the adoption of shotcrete in the wide variety of concrete structures where shotcrete is the most efficient, sustainable and cost-effective method of concrete placement.

The ASA Contractor Qualification program requires a significant time commitment to attend the ASA Contractor Education seminar as well as fully documenting shotcrete-related business. ASA has shotcrete experts (contractors, engineers, suppliers, and educators) who review and verify applicant submittals of past successful work and aspects of shotcrete critical to quality placement. The Contractor Qualification committee reviews the shotcrete team, including contractor management, ACI-certified nozzleman, crew experience, proper equipment, and knowledge and ability to consistently place quality shotcrete.

ASA qualification is active for five years. ASA Qualified Shotcrete Contractors must heed ASA's Code of Conduct in their shotcrete work:

For more information visit www.shotcrete.org.

AMERICAN CONCRETE PUMPING ASSOCIATION RELEASES ELECTROCUTION SAFETY VIDEO

The ACPA recently updated and re-released an important safety awareness video for the concrete pumping industry: *The Ray Ainsworth Story (Electrocution)*.

Operating the boom of a concrete pump requires focus and staying alert at all times—especially when working in and around high-voltage areas. Electrocution is one of the Occupational Safety and Health Administration's "Fatal Four"

leading causes of workplace deaths in the construction industry.

This video is a case study about the high-voltage accident that nearly took Ainsworth's life. While lucky to be alive, he suffered severe burns on his limbs, torso, back and head. He lost a finger and the use of his right hand.

The ACPA's re-release of the video preserves Ainsworth's story while also providing updated guidance on power line safety. Measures that have changed since the video's inception more than a decade ago include the ACPA's extension of the 17-foot rule to a minimum clearance of 20 feet from power lines carrying up to 350,000 volts (and 50 feet for 350,000+ volts). Other updates include the requirement of a spotter when power lines are in the boom movement area of a pour and responsibilities outlined in ASME B30.27, Material Placement Systems.

Ainsworth was not a novice. He had been working in the concrete pumping industry for nearly a decade and owned a concrete pumping business in Mesa, Arizona. Prior to that, he drove a concrete ready-mix truck for nine years. But accidents happen to even the most experienced construction professionals, and this video reminds viewers to be vigilant about locating power lines and following safety procedures.

Add the video to your company's safety training program by visiting www.concretepumpers.com/catalog.

For more information about the ACPA, visit www.concretepumpers.com.

REGISTRATION IS NOW OPEN FOR ACI CONCRETE CONVENTION IN SAN FRANCISCO, CALIFORNIA, USA

The American Concrete Institute is pleased to host the ACI Concrete Convention in San Francisco, CA, USA, on April 2-6, 2023. The in-person event showcases companies, projects, research, and more, plus numerous networking events where you can expect to meet with many of the concrete industry's leading professionals. Attendees may also visit the exhibit hall to learn more about the many products and services offered by exhibitors.

The convention will have a robust schedule that includes over 300 committee meetings, 45+ technical sessions, an industry trade exhibition, networking events, and

much more. The committee meetings are open to all attendees. Select programming will also be available on-demand to attendees who choose to participate remotely.

Technical and educational sessions will be presented live with on-demand viewing available afterwards, providing substantial opportunity to advance concrete knowledge.

To learn more visit aciconvention.org.

NEX ANNOUNCES PARTNERSHIP WITH DEXTRA GROUP

NEX: An ACI Center of Excellence for Non-metallic Building Materials is pleased to welcome Dextra Group, including Partner Industrial Control Solutions Company (ICSC), as the latest Bronze Supporting Member. Dextra Group will work alongside a growing list of other members to support NEX's mission to collaborate globally on the use of nonmetallic building materials driving research, education, awareness, and adoption.

Dextra Group is known for its ability to provide comprehensive solutions to its customers, with expertise in the design and reinforcement of concrete structures using glass fiber-reinforced polymer (GFRP) rebars, and closely collaborates with ICSC, an FRP manufacturer with a new facility in Damman, KSA. Founded in 1983 by French expatriate entrepreneurs, Dextra Group has established itself as a world-renowned manufacturer of engineered steel and fiber-reinforced polymer construction products. For the past 25 years, Dextra Group has been a leading figure in the composite industry, producing high-quality fiber-reinforced polymer solutions for major infrastructure projects. Beyond GFRP rebars, Dextra Group manufactures other non-metallic solutions like ground anchors & rock-bolts for geotechnical applications, and electrical insulators for overhead power lines. To learn more visit nonmetallic.org.

INTERESTED IN SEEING YOUR NEWS IN THIS COLUMN?

Email your 150-200 word association news to editor@icri.org. Content for the May/June 2023 issue is due by April 1, 2023, and content for the July/August 2023 issue is due by June 1, 2023. ICRI reserves the right to edit all submissions.

PRODUCT INNOVATION

10 HOUSES 3D PRINTED IN 10 WEEKS ON THE LARGEST 3D PRINTING PROJECT SITE TO DATE

Holcim's 14Trees beats other 3D printing companies in the race to create affordable housing.



From Oct. 2022 to Jan. 2023, 14Trees 3D printed 10 houses in Kilifi, Kenya, averaging one house per week:

- 6 three-bedrooms (76 m² / 836 ft²) and 4 two-bedrooms (56 m² / 616 ft²) houses have been 3D printed so far, making Mvule Gardens in Kilifi the largest 3D printed project to date.
- No other completed 3D construction printing project is currently larger than that, in the US or elsewhere.
- The fastest time to print one house in the Mvule Gardens project was 18 hours.
- No other 3D construction printing project has matched 14Trees productivity, in the US or elsewhere.

For a long time, 3D construction printing has been seen as a possible solution to the escalating affordable housing crisis. Proponents of the technology claim, that when 3D printing projects in construction are carried out at scale, the advantages of the technology become clear. Evidence of that claim has been lacking, but recent developments actually provide credibility to the statement.

14Trees is a joint venture company between the cement and concrete giant Holcim and British International Investment dedicated to accelerating the provision of affordable housing in Africa. The joint venture is behind the first 3D printed houses in Africa and the first 3D printed schools in the world. 14Trees announced some of the initial results of their efforts to 3D print up to 52 houses in Kilifi, Kenya, using a single BOD2 printer from COBOD. The BOD2 is the world's best-selling construction 3D printer. Following the start in October 2022, 14Trees completed the

3D printing of the walls of 10 houses in January 2023 after just 10 weeks using only one printer.

In addition, the project's sustainability profile also attained an EDGE Advanced sustainable design certification by IFC, the World Bank's development finance institution, which recognizes resource-efficient buildings with the potential to be zero-carbon. It is the first time a 3D printed housing project has attained this certification.

14Trees intends to get the full benefit of the large-scale project by experimenting and innovating as the project progresses. During the next phases which consist of 10-15 houses each, several innovations will be included that will allow future tenants to design their homes and move away from the standardized 3D printed approach to one which fully leverages the technology's customization possibilities.

The cost of construction is also an area of focus. With each phase, 14Trees is aiming at lowering construction costs further such that the build cost is 20% lower than standard houses. Using Holcim's proprietary 3D printing materials, TectorPrint, made at a local plant, has already meant a significant reduction in costs.

Visit COBOD.com for more information.

ALUMOGRIT® CAST ALUMINUM NOSINGS PROVIDE LONG LASTING ANTI-SLIP PROTECTION EVEN IN CORROSIVE ENVIRONMENTS

Wooster Products features AlumoGrit® cast aluminum nosings with abrasive grit integrally cast into the surface for long lasting anti-slip protection. These durable nosings are well suited for rough use, in indoor or outdoor installations, in new construction or existing structures. They are highly resistant to corrosive environments, making them ideal for



facilities where harsh chemicals are often used.

Available in 3-inch, 4-inch, and 6-inch widths, and lengths to 8 ½ feet, with cross-hatching and fluting that is clean and well defined. Each section is shot blasted prior to shipment with concealed anchors. AlumoGrit® abrasive cast aluminum nosings provide years of slip-resistant service life and are ideal for use in parking garages, exterior stairs, in wastewater treatment plants, chemical processing facilities, and other locations where harsh chemicals are often used.

Wooster Products is the industry leader in anti-slip stair treads and walkway products. Long respected for quality and innovation, their products include cast aluminum (Alumogrit®) cast iron (Ferrogrit®), extruded aluminum (Spectra, Supergrit®, Stairmaster®, and Flexmaster®), pressure sensitive adhesive tape/deck covering (Flex-Tred®), and coatings (WP-70, Walk-A-Sured®, and Safe-Stride®), as well as photoluminescent (glow-in-the-dark) nosings and treads (NITEGLOW®). For additional information visit www.WoosterProducts.com

HOW TO MITIGATE CORROSION IN PRECAST CONCRETE

Precast concrete is a high-quality building material with countless uses: for bridges, parking ramps, light poles, culverts, prefab houses, tanks, and much more. Because precast concrete is made and cured in a controlled environment, it has a low risk of corrosion vs. cast-in-place concrete. That is . . . until cracking occurs, as can often happen during transportation. Once cracks form, corrosives can enter and additional freeze-thaw cracking can occur, leading to long-term corrosion damage. Fortunately, Cortec® MCI® is an easy way to arrest corrosion and extend service life at any stage in the precast concrete lifespan.



PRODUCT INNOVATION

MCI® for Precast Concrete Repair

Sometimes, corrosion has already gone so far that precast concrete elements must be repaired. MCI® Technical Sales and Product Manager, Ash Hasania, found this to be the case when he encountered a client with deteriorating concrete light poles that were more vulnerable to corrosion because of old, poor quality concrete cast in a slender design. MCI®-2023 was used to re-passivate rusted rebars. MCI® Mini Grenades were added to the ready-mix for the new concrete patches. Once the concrete cured, surfaces were treated with MCI®-2020 and MCI®-2018 for additional corrosion protection. Going forward, the customer began adding MCI®-2005 to the light poles during casting.

To learn more visit <https://www.cortecmci.com/>

MCI® PRODUCTS FOR HISTORICAL RESTORATION

Two priorities exist when restoring historical structures that have deteriorated from corrosion: (1) Mitigate corrosion to extend service life and minimize future repairs. (2) Do so without changing the appearance of the structure. This is especially difficult with historical concrete structures, as the addition of new materials could alter the color or texture of the concrete. Fortunately, Cortec® MCI® products have proven to be excellent resources for both maintaining and repairing heritage structures.



One of the most difficult parts of a historical concrete repair can be matching new repair mortars or concrete mixes to the old surface where patching is needed. Sometimes this requires highly specialized historical or decorative concrete mixes. MCI® Mini Grenades can be added directly to these specialty mixes to introduce Migrating Corrosion Inhibitors to the repair. These concrete corrosion inhibitors have been successfully used in historical preservation jobs to extend service life without changing the color or look of the final

repairs. They may also discourage the progression of the ring anode effect in areas adjacent to the repair by migrating and evening out the corrosion potential between existing concrete and repaired areas.

Rebar and Concrete Surface Prep

Rebar rust is typically the leading cause of concrete deterioration, and good surface prep is therefore integral to a successful repair. Traditionally this involves labor-intensive sandblasting and cleaning of the rusted rebar to white metal. CorrVerter® MCI® Rust Primer offers a convenient alternative to treat and passivate rusted rebars.



A single component, fast drying water based primer, CorrVerter® MCI® can be applied to layers of tight rust, converting it into a hydrophobic passive layer. This method reduces labor and makes re-rusting less likely in the near future.

Another important aspect of surface prep is making sure the concrete is clean. For example, concrete contaminated with oils or greases can be cleaned with MCI®-2061 or MCI®-2062. These cleaners contain microorganisms for extended cleaning power. Left overnight, the microorganisms degrade and digest greasy substances within the concrete. They also continue to provide residual cleaning even after the surface has been rinsed off.

For more information visit <https://www.cortecmci.com>.

MCI® SURFACE APPLIED CORROSION INHIBITORS: A RECOGNIZED INDUSTRY STANDARD

ICRI Guideline No. 510.2-2019: *Guide for Use of Penetrating Surface Applied Corrosion Inhibitors for Corrosion Mitigation of Reinforced Concrete Structures* is the culmination of years of expert collaboration among members[†] of the International Concrete Repair Institute (ICRI). This groundbreaking standard was published in 2019 and defines SACIs as corrosion inhibitors that penetrate through concrete and directly inhibit corrosion on

the surface of the metal reinforcement, thus excluding chemistries that act as pore blockers only. It covers known technologies on the market at the time of publication and offers tips on surface prep, application, and detection/assessment.

Cortec® MCIs and the ICRI Standard

Cortec's MCI® SACI chemistries fall under the ICRI descriptions of ambiodic (mixed) inhibitors. They include MCI®-2018, MCI®-2019, MCI®-2020, and MCI®-2021, to name a few. The best SACI to use for a particular product varies from application to application. Factors such as environmental conditions, budget parameters, and the application of water protection products all figure into the decision-making. For example, those in search of the MCI® SACI with the highest concentration of corrosion inhibitors may opt for MCI®-2020. Those looking for convenient two-in-one corrosion protection and water repellency may select MCI®-2018, which combines Migrating Corrosion Inhibitors with a 100% silane water repellent. MCI®-2019, containing Migrating Corrosion Inhibitors and a 40% silane water repellent, may be preferred by those seeking to stay within a more limited budget. When tested according to the U.S. Bureau of Reclamation M-82 Protocol (one of the few existing test methods for SACIs), these three surface treatments* showed a significant reduction of corrosion and cracking in the presence of high chloride exposure.

For more information visit <https://www.cortecmci.com>.

INTERESTED IN SEEING YOUR NEW PRODUCT IN THIS COLUMN?

Email your 150-200 word news to editor@icri.org. Content for the May/June 2023 issue is due by April 1, 2023, and content for the July/August 2023 issue is due by June 1, 2023. One (1) high resolution product photo may be included. ICRI reserves the right to edit all submissions.



For the best in product manufacturers and industry professionals, visit www.icri.org.

NEWMEMBERS

SUPPORTING MEMBERS

Balco, Inc.

Wichita, Kansas
United States
Natalie Faber

Contech Services

Seattle, Washington
United States
Daryl Heppner

COMPANY MEMBERS

Advanced Caulking Systems, Inc.

Willoughby, Ohio
United States
TJ Dowhan

All Sorts Concrete Inc.

Oceanside, California
United States
Jody Cisewski

Anderson Poured Walls

Morristown, Tennessee
United States
Jeff Brewer

Baystate Shotcrete LLC

Groton, Massachusetts
United States
Justin Shook

Black Rhino Surfaces, Inc.

Gaithersburg, Maryland
United States
Daniel Abebe

Calvert Masonry, Inc.

Manassas, Virginia
United States
John Young

Cardinal Waterproofing, Inc.

Colleyville, Texas
United States
David Gladney

CH CO, INC.

Astoria, New York
United States
Mukarram Ahmed

GC Contractor Services, LLC

Holly Hill, Florida
United States
Glenn Canfield

Hard Surface Finishers, Inc

Wood Dale, Illinois
United States
James Lewis

Horsley Construction Group, Inc.

Panama City, Florida
United States
Mike Horsley

Hucks Enterprises

Myrtle Beach, South Carolina
United States
Lucas Hucks

JOBS Waterproofing and Restoration Services

Houston, Texas
United States
Tony Wightman

Kairos Construction Services

Parker, Colorado
United States
Turner Mann

MDH Foundation Repair

Daphne, Alabama
United States
Shannon Reichart

Millsap Waterproofing, Inc.

Houston, Texas
United States
Jack Moore

Nickelson Painting, Inc.

Rochester, Minnesota
United States
Bob Nickelson

Paveman Coatings

Rochester, Minnesota
United States
Justin Cady

RDQ Engineering, Inc.

Mississauga, Ontario
Canada
Rudin Qordja

Reynolds Painting Group FL

Tampa, Florida
United States
Kyle Rhamstine

SIMCO Technologies

Quebec, Quebec
Canada
Julie Arsenault

TCC General Contracting, Inc.

Quartz Hill, California
United States
Tom Conroy

Technical Representatives of TN

Lebanon, Tennessee
United States
Jim McConnell

Wells Concrete

Brighton, Colorado
United States
John King

ADDITIONAL INDIVIDUALS FROM SUPPORTING MEMBER COMPANIES

Zachary Blume

Pullman SST, Inc.
Natrona Heights, Pennsylvania
United States

Steve Cooper

Balco, Inc.
Wichita, Kansas
United States

Robert Costenaro

Sika Canada, Inc.
Quebec City, Quebec
Canada

Noah Doukas

Walter P Moore & Associates
Orlando, Florida
United States

Leslie Gayan

Sika Corp.
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