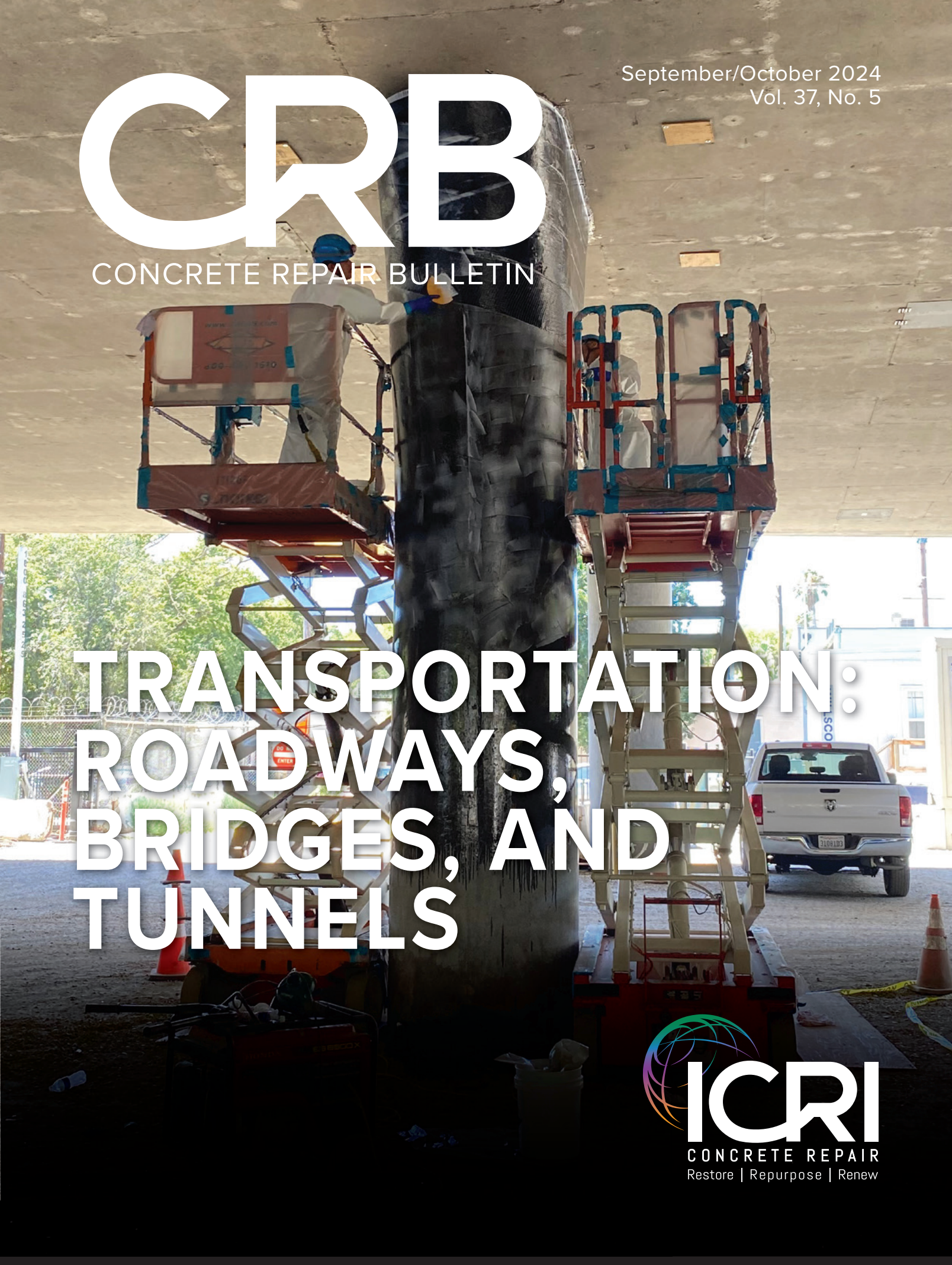
September/October 2024
Vol. 37, No. 5

CRB

CONCRETE REPAIR BULLETIN



TRANSPORTATION: ROADWAYS, BRIDGES, AND TUNNELS

ICRI
CONCRETE REPAIR
Restore | Repurpose | Renew

DOWSIL™ ALLGUARD™ SILICONE ELASTOMERIC COATING

DOWSIL™ ALLGUARD™ provides a durable, high-performance exterior protective coating designed to waterproof above-grade exterior masonry substrates for new and existing construction.

Contact Beacon Waterproofing to learn more about DOWSIL™ products.

DOWSIL™ ALLGUARD™ Silicone Elastomeric Coating information provided by Dow.com.

BEACON
Waterproofing Products

855.347.0866
Authorized Distributor

Concrete Repair Bulletin
is published bimonthly by the:
International Concrete Repair Institute, Inc.
1601 Utica Avenue South, Suite 213
Minneapolis, MN 55416
www.icri.org

For information about this publication or about membership in ICRI, write to the above address, phone (651) 366-6095, fax (651) 290-2266, or email info@icri.org. The opinions expressed in *Concrete Repair Bulletin* articles are those of the authors and do not necessarily represent the position of the editors or of the International Concrete Repair Institute, Inc.

ISSN: 1055-2936

ICRI CONCRETE REPAIR
Restore | Repurpose | Renew

ON THE COVER: Learn about seismic strengthening of bridge columns in our featured article on page 6.

CRB
CONCRETE REPAIR BULLETIN

September/October 2024
Vol. 37, No. 5

FEATURE ARTICLES

DEPARTMENTS

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'SMESSAGE


BRIAN MACNEIL

TRANSPORTATION: ROADWAYS, BRIDGES, AND TUNNELS

Today, as I am writing this "president's message," I find myself on the downhill slide of my presidency. Over 6 months down and less than 6 months to go (less than 5 by the time you fine people read this message). Still a lot of work to do, people to inspire, and contributions to make.

Any industry activities I have partaken in over the past six months of my presidency have just affirmed what I already knew. Our members, volunteers, and staff are of the highest caliber of experts and achievers and the moral compasses of these passionate people are what keeps our organization the most amazing, welcoming, and giving association in existence today. If you want to test that theory out, come to one of our conventions or start participating in your local ICRI chapter.

We recently had our annual ICRI Executive Retreat graciously hosted by our Executive Director, Eric Hauth, in the Twin Cities of Minnesota. ICRI leadership from across Canada and the United States got together to fortify the strategic direction of ICRI. There were many great discussions and comments, but one comment stood out above the rest and resonated with me. Dan Wald, who currently holds the position of ICRI Secretary took a moment to say (paraphrased), "Let's all remember. Our organization is amazing to start with. There are a lot of great contributions and value that ICRI brings to the industry."

Dan is right — from webinars to guidelines, certifications to applicator training sessions and tools; from publications to the most welcoming conventions for members to network, learn, and share ideas on how to continue making the concrete-built world stronger, safer, and last longer — ICRI is truly amazing!

In the State of the Institute penned by Eric Hauth (in this same issue), you'll get a flavor for where we are now and the incredible places we are headed. Everything we are planning to do is to help us increase our services and offerings to our members and stay relevant in an ever-changing industry association landscape. The valuable resources we currently have and keep updating are just one important element to successful member engagement. Another important element of engagement is the "how", and a big part of the "how" is the technology we use as an association. The structural beams that house our resources, the concrete roads and paths that the resources travel along, and the doorways our members use to interact with those resources.

A great example of the importance of keeping technology up to date is the recent upgrade to our AMS (association management system). To the computer technologically challenged like me, this is the backbone, database, online registration, member interaction, and website that shapes how ICRI and its members interact and engage. The previous AMS that was being used by ICRI was at max capacity and limited the quality of member engagement we could achieve. Changing such a pivotal part of our organization is not a small task. It would have been easier to keep coasting on the old system. But doing so would not have reflected the attitudes, innovation, and commitment of our members. A special thanks to our ICRI full-time crew for recognizing the need, sourcing the upgrade, putting in countless hours of work, and leading the way on this needed upgrade! Activites such as registration, submissions, nominations, data processing, and virtually all our digital interactions have vastly improved. One of the best parts is that we are still unlocking different levels of what is capable with the upgrade so the interactions will continue to get better and better.

Technology is not an item we can fall behind on — not in our field — and not in how we provide service to our members. This is especially important to the "up-and-coming" younger crowd that has never had the honor of using a fax machine. (raise your hand if you still have a fax number on your business card...yep... you're old).

One big focus of the upcoming year will be resource alignment. An individual can be strong and produce, but nothing is stronger and can achieve better outcomes than a team of extraordinary people working towards a common goal. From our executive and board to our staff leadership and committee chairs and members, ICRI is not short on extraordinary people, so this industry needs to fasten its seat belts!

We're not going to stop growing. We're not going to stop getting better and increasing our value to our members and industry. ICRI is stronger than ever and poised to hit new heights in the upcoming years.

Be safe!

Brian MacNeil
Brian MacNeil
President, International Concrete Repair Institute

2024 ICRI State of the Institute

by Eric Hauth, ICRI Executive Director

INTRODUCTION AND OVERVIEW

The first half of the fiscal year which began on July 1, 2023, and ended on June 30, 2024, was a time to celebrate ICRI's 35th anniversary. Throughout the year, we took stock of ICRI's many contributions to the concrete repair industry, culminating in a truly inspiring Fall Convention at St. Pete's Beach in Florida.

On the beach celebrating ICRI's 35th Anniversary!

That convention also saw a record number of first-time convention attendees – no doubt including some future ICRI leaders!

We thank all the countless volunteers throughout the years for their many contributions and incredible commitment to ICRI!

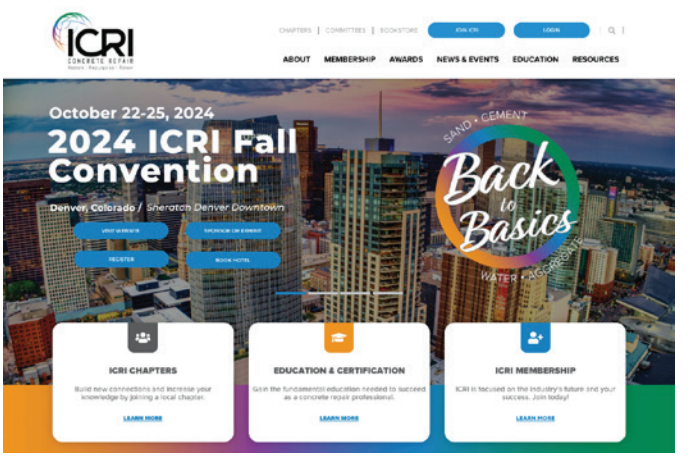
The work of ICRI is grounded in its four organizational pillars – **Industry Leadership. Professional Development. Organizational Strength. Organizational Credibility**. Like many structures on the jobsite, pillars sometimes require shoring, strengthening, and repair to ensure they remain strong and sustainable.

ICRI Strategic Pillars

In addition to the many regular activities under each of these pillars, ICRI leadership and staff put a special focus over the past year on strengthening our organizational foundation for the future.

By far the single biggest initiative – both in terms of financial investment and staff time – entailed a wholescale upgrade of ICRI's core membership database and a simultaneous build-out of a new, more flexible WordPress-based website.

We committed to this initiative at the start of the fiscal year, with a goal to launch the system in time for World of Concrete (WOC) 2024. And despite inevitable bumps along the way, we did it! I compare this accomplishment to running a popular restaurant and replacing the entire kitchen without shutting the restaurant down. Some toast may have gotten a little burned, but the restaurant stayed open, meals were served, and the guests left happy!



ICRI's new and improved website!

What we saw at WOC was a glimpse into what's possible with a more flexible and advanced technology platform. For the first time, the ICRI team could sign up new members onsite, in real-time.

ICRI Booth at WOC 2024

More recently, we've utilized the system to significantly improve the submission of projects under consideration for ICRI's Project Awards, submissions of abstracts for convention presentations, and promotion of sponsorship opportunities. That's the kind of user experience members and prospective members deserve. There's still work to be done to roll out all the available features on our new system, but it's a huge step forward for the organization.

FY 23/24 KEY PERFORMANCE MEASURES

Even with the significant investments in our new technology platforms, ICRI mostly held its own throughout the year, in terms of overall budget performance and membership. We fell slightly short on net income, driven primarily by significant inflation, especially convention-related costs (e.g., A/V, food and beverage).

The following summarizes key performance measures for the past fiscal year.

Net Income

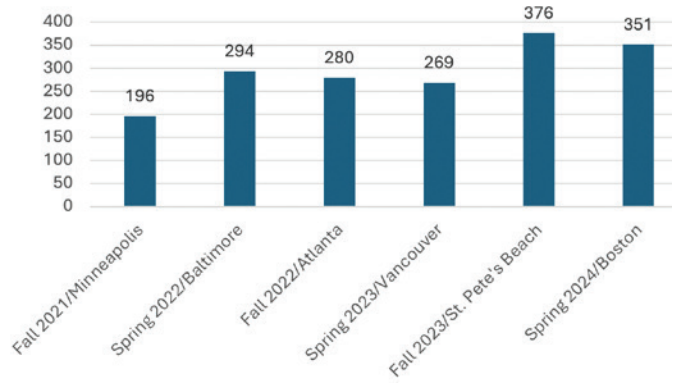
	Budget	FY 23/24 Actual	Variance
Revenue	$2,342,575	$2,148,818	-$193,757
Expenses	$2,346,480	$2,193,678	-$152,802
Net Income	-$3,905	-$44,860	-$40,955

Investment Reserves	June 30, 2023	$659,032
	June 30, 2024	$575,155

ICRI leadership leveraged reserves in FY 23/24 to partly fund the investment in the new database system and website, drawing $100,000 from the fund. Positive market performance allowed the fund to regain a portion of this draw, as noted.

	Jun-23	Jun-24
Total ICRI Membership	2,186	2,188
Membership Retention	87%	89%

Free Download	Sold	Total	Title
95	482	577	310.2R -Selecting and Specifying Concrete Surface Preparation GUIDE ONLY
83	107	190	310.1R - Surface Preparation: Repair of Deteriorated Concrete
102	59	161	110.1 - Guide Specifications for Structural Concrete Repair
56	33	89	210.1R - Verifying Field Performance of Epoxy Injection of Concrete Cracks
24	26	50	320.6 - Evaluation and Repair of Unbonded Post-Tensioned Concrete Structures
0	25	25	710.2 - Horizontal Waterproofing of Traffic Surfaces
54	24	78	210.3R - Using In-Situ Tensile Pulloff Tests to Evaluate Bond of Concrete
57	24	81	210.4 - Nondestructive Evaluation Methods for Concrete Structures
54	23	77	320.2R - Selecting and Specifying Materials for Repair of Concrete Surfaces
45	20	65	130.1R - Guide for Methods of Measurement and Contract Types



ICRI Convention Registrations

Membership

Overall membership ended the year basically where we started, with slight growth over the past two years. ICRI continues to see a high overall retention rate, growing slightly from an already high 87% to 89%.

Technical Publications

The following chart presents the top 10 technical publications by download and purchase from ICRI's bookstore over the course of the last fiscal year, representing approximately 74% of all document purchases/downloads.

Field Applicator Classroom Instruction

Training on Mock-Up Slabs – Raleigh, NC

ICRI Convention Performance

This past fiscal year saw some of our largest attendance ever at conventions. ICRI knocked it out of the park for our 35th Anniversary convention in St. Pete's Beach last fall, both in attendance and net income of $131,731. Our Spring Convention in Boston nearly matched Fall Convention registrations, but fell short financially, with net income of $39,530 – a reflection of significant, historic inflation in hotel costs, especially food and beverage.

TECHNICAL HIGHLIGHTS

Field Applicator Training Program

Over the past year, ICRI was busy as always on the technical side, developing, updating, and scoping new technical documents to enhance concrete repair across the industry. In addition, staff and volunteers launched an exciting new pilot program specifically designed for field applicators – the *Field Applicator Training Program*.

With extensive support from our North Texas and Carolinas chapters, two pilot programs took place in Dallas, TX and Raleigh, NC. The goal from these two programs was simple: test the idea that contractors/applicators would benefit from ICRI's fundamental knowledge on concrete surface repair techniques and apply those fundamentals through hands-on training.

Based on the feedback received from participants, these pilot programs more than met that expectation! ICRI is planning to leverage this experience to grow the program in partnership with ICRI chapters and member companies starting this fiscal year.

New Rebar Cleanliness App

After extensive work by Committee 210 and ICRI staff over the past several years, we've just launched ICRI's first technical app for the jobsite – a process finalized in the last fiscal year.

Incorporating ICRI's industry-leading guideline 210.5 "*Guide for Selecting and Specifying Reinforcing Bar Cleaning Levels*," this innovative tool empowers contractors, design professionals, and manufacturers with new language and resources needed to accurately assess the required level of rebar cleaning using mechanical or abrasive methods. Available on both Google Play and Apple app stores, this new app is truly an innovation "first" for ICRI.

Technical Collaborations

ICRI is expanding and reaffirming commitments across the industry including the Association for Materials Protection and Performance (AMPP), Post-Tensioning Institute (PTI), National Concrete Bridge Council (NCBC), and the Japan Surface Treatment Association (JSTA). The relationships with AMPP and PTI are resulting in new revisions of the 710.1/ SSPC-TR 5 and ICRI 320.6/ DC80.3 coming to publication respectively. As the newest member of the NCBC, ICRI has joined the preeminent concrete bridge construction and stewardship organization and is participating in the creation of the NCBC Concrete Bridge Stewardship Resource Guide. Finally, as a showcase to the reach and importance of the work ICRI's committees produce, ICRI and JSTA are working to formalize an agreement that brings a translated version of the 310.2 guide to the Japanese market.

LOOKING AHEAD

Now that we're in the new fiscal year, it's time to look forward. So, while we updated the kitchen, none of that shiny new equipment matters without a great menu that keeps guests coming back for more. ICRI has a lot of great items on the menu today – from its many chapters to its industry-leading technical guidelines to its national conventions. But we know there are some areas that need a refresh if the organization is going to meet the changing needs of the industry, attract more members, and generate the income to thrive.

To tackle this challenge, ICRI's Executive Committee (EC) kicked off the new fiscal year with an in-depth planning retreat held in Minneapolis, Minnesota. For two days, the EC gathered to take a hard look at ICRI's menu of services and programs – guided by pre-reading an excellent book entitled *Road to Relevance: 5 Strategies for Competitive Associations*.

From those discussions and with the help of a great tool called the Vision/Traction Organizer™ (VTO) developed by Entrepreneurial Operating System (EOS) Worldwide, we are building a detailed roadmap for ICRI's future. When fully implemented, these objectives will strengthen our organizational pillars through a more disciplined and focused approach that leverages ICRI's core strengths. Under ICRI President Brian MacNeil's leadership, this vision has been endorsed by the EC and has been shared with the Board of Directors and every ICRI committee. Staff are already utilizing the VTO as the touchstone for our weekly meetings.

This tool will help us all stay aligned and focused, ensuring that we provide members and prospective members with the menu items that they want and need! For us to succeed, we need each of you to play your part. First and foremost, we need you as members and your help spreading the word about ICRI. We also need you as volunteers at your chapter and/or on a national ICRI committee. There's some exciting work ahead and we can't wait for you to be a part of it.

ICRI is, first and foremost, your organization. So don't hesitate to share your ideas to make it even better. Thank you for your continued commitment and passion for this great organization. Together, we will make an even bigger splash when we celebrate ICRI's 40th anniversary!

SUPPORTING MEMBERS

ICRI would like to thank its Supporting Members, whose dedication to ICRI is greatly appreciated, and...

AMERICAN ENGINEERING TESTING

AQUAFIN

BAKER RESTORATION & WATERPROOFING

BALCO
A CSW Industrials Company

BENGOA

C.A. LINDMAN INCORPORATED

CPR saving the life of concrete®

CONTECH
CONTECH SERVICES, INC.

CSI
CONTRACTING SPECIALISTS INCORPORATED

CORTEC CORPORATION
Environmentally Safe VpCI™/ MCI® Technologies

CROM

CTS | Rapid Set

EUCLID CHEMICAL

EVONIK
Leading Beyond Chemistry

FREYSSINET
SUSTAINABLE TECHNOLOGY

HAMMER CONSTRUCTION

Husqvarna

IMER GROUP
TOGETHER WE BUILD

IMR
INNOVATIVE MASONRY RESTORATION, LLC

LOCAL 528

LymTal International, Inc.
Lake Orion, Michigan
www.lymtal.com

MAPEI

SUPPORTING MEMBERS

...your continued support greatly enhances programs both within ICRI and the concrete repair industry as a whole.

ICRI CONCRETE REPAIR
Restore | Repurpose | Renew

MIRACOTE

NCFI GEOTECHNICAL
www.ncfigeo.com

NELSON TESTING LABORATORIES
EXPERIENCED | INNOVATIVE | AUTHENTIC

NEOGARD
A part of HEMPEL

PROSOCO

PROSPEC

PULLMAN

COMMERCIAL GRADE QUIKRETE
CEMENT & CONCRETE PRODUCTS™

RHINO
CARBON FIBER REINFORCEMENT PRODUCTS

SAKRETE

SCHÖNOX
HPS NORTH AMERICA

SHERWIN-WILLIAMS

Sika
BUILDING TRUST

SSI
Silicone Specialties, Inc.

SIMPSON
Strong-Tie

STONE MOUNTAIN
ACCESS SYSTEMS, INC.

structural

USCP
US CONCRETE PRODUCTS

VECTOR CORROSION

QUALITY | SERVICE | INTEGRITY
W. R. MEADOWS
A Family Company Since 1926

WESTERN SPECIALTY CONTRACTORS
CONFIDENCE THROUGH PERFORMANCE

WHITE CAP
BUILDING TRUST ON EVERY JOB

Seismic Strengthening of Bridge Columns with FRP Value Engineered to Replace Steel Jackets

by Sarah Outzen, PE

Aging transportation infrastructure in the US highlights the increasing need for critical repairs and improvements. Among this aging infrastructure is a segment of US-50 in Sacramento, California, a major east-west route stretching 3,019 miles (4858 km) from West Sacramento, California, to Ocean City, Maryland. Originally constructed in the 1960s, this section needed extensive improvements to meet the current code.

The project included the widening of 11 bridges, the addition of seven miles (11.3 km) of High Occupancy Vehicle (HOV) lanes, replacement of all lanes with 100-year pavements and asphalts, and seismic repair and strengthening of over seventy flared bridge columns with round bases. A common technique for improving the seismic behavior of columns when retrofitting is steel jacketing. In this article, I will share how we value-engineered the originally specified steel jackets with fiber-reinforced polymer (FRP).

STEEL VERSUS FRP JACKET

The original US-50 column retrofit design showed steel jackets to strengthen the columns, a standard and popular choice for many years. Although there are many structural advantages to steel jacketing, there are also disadvantages. For example, the fabrication of special steel shapes to match existing column geometry, the use of multiple steel pieces to create the jacket, full-depth Complete Joint Penetration (CJP) groove welding, jacket modification to accommodate existing conditions, and grouting of the annular space between the steel jacket and the column.

FRP is an externally bonded reinforcement system made of a high-strength, fabric sheet saturated in epoxy resin and surface-applied to a structural element. FRP composites provide a variety of advantages over the traditional steel jacketing method. It is lightweight and corrosion-resistant, offering a lengthier duty life than steel. Installation is performed by hand, eliminating the use of cranes, providing cost savings, and simplifying site logistics. Moreover, unlike steel jacketing, FRP can be cut and shaped on-site, and the design can be easily modified for the varying demands of different regions of the columns.

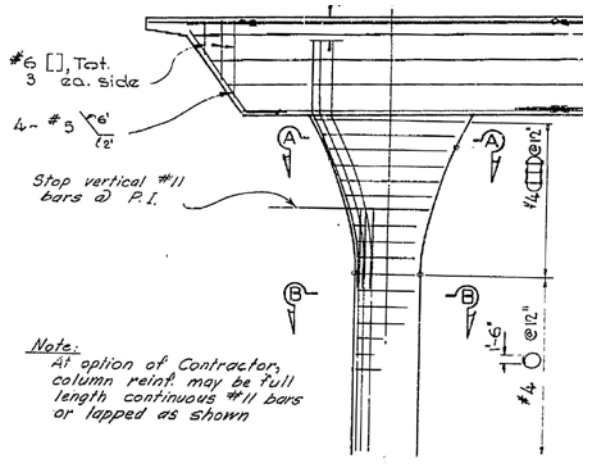


Fig. 1: Original column detailing

FRP JACKET DESIGN

The columns at US-50 have a hyperbolic flare at the upper portion and a circular section at the bottom portion. FRP provided an ideal solution for seismic retrofitting of the existing columns considering their non-uniform geometries. A performance-based approach was used for the design. The project Engineer of Record provided our design team with the target drift demands in longitudinal and transverse directions. Adding another area of structural concern, as you can see in the original detail in Figure 1, the geometric plastic hinge occurs at the same place as the vertical reinforcing bar splice region.

Our engineering team developed analytical models to identify the location and length of plastic hinges to calculate the required plastic rotation capacity to withstand target drifts. The location of the plastic hinge did not correspond to the location of the maximum moment, see Figure 2.

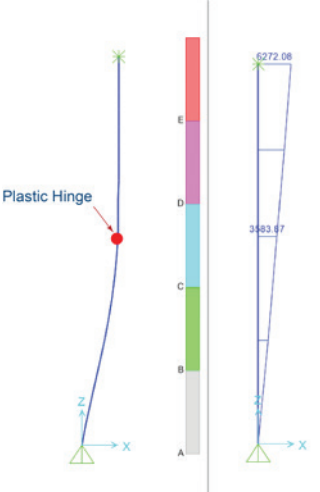


Fig. 2: Non-linear analysis model

What this means for the FRP jacket design is that by using a nuanced, performance-based approach, the engineering team could optimize layering

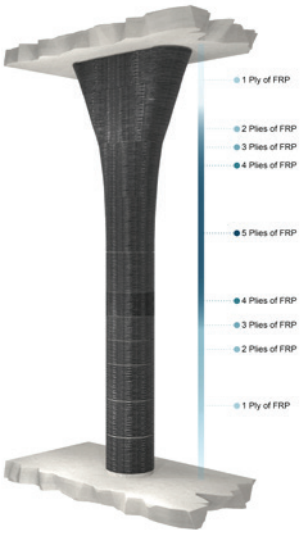


Fig. 3: Optimized FRP jacket along the column height

over the height of the column. A greater number of layers of FRP is applied at the plastic hinge region, compared to the top and bottom. This provides added strength and ductility where needed. However, the number of FRP layers is reduced outside the plastic hinge zone, meeting project design criteria while lessening the overall material and labor costs, see Figure 3.

The FRP jacket solution was presented to the project design team's staff and ownership. After addressing technical comments related to FRP detailing, the proposed FRP jacket solution was approved to improve the seismic performance of the concrete bridge columns.

FRP JACKET INSTALLATION

The existing columns extend 4-feet (1.2m) below grade; therefore, excavation was required to access the below grade portion of the columns and the FRP installation process ended up being broken into two phases. In Phase 1, the FRP jacket was installed on the upper portion of columns ahead of the excavation, and in Phase 2, the FRP jacket was installed on the column segment below grade; see the former in Figure 4.

The following steps were used by the FRP contractor to install the FRP jacket:

1. Concrete surface preparation was achieved using mechanical grinding to open up the concrete pores and grind down existing concrete form lines. The target surface profile is CSP-3 per ICRI Guideline 310.2R-2013.[1]
2. Applying epoxy primer coat to the prepared substrate and then using epoxy putty to smooth the surface and fill bug holes.
3. Impregnating dry FRP sheets with epoxy using mechanical saturators to control the amount of epoxy applied to the fiber sheets and avoid under or over-saturation of the sheets which can lead to dry fiber or sagging.
4. Installation of FRP sheets.
5. Using rib rollers to remove air bubbles after the installation of each FRP layer.
6. After cure of the FRP jacket, apply a topcoat for long-term protection of the jacket.

Fig. 4: Applied FRP jacket on the site

INNOVATIVE IMPROVEMENTS

The use of conventional construction materials or procedures does not always produce the most technically viable or cost-effective solutions. The US-50 project illustrates how advanced FRP composites can improve the seismic performance of concrete structures and provided a cost-effective alternative to conventional solutions. Material and labor costs were reduced over the traditional method. The elimination of welding reduced the overall quality assurance costs, as verification testing of the welds was no longer needed. The non-corrosive nature of the FRP also eliminates the ongoing need for periodic maintenance, as repairs should only be required in case of actual damage to the column itself. Overall project timelines with the FRP method can be reduced significantly compared to the steel jacketing method, as fabrication lead times can be four times as long. Figure 5 shows a comparison of steel jackets versus FRP, highlighting the benefits of using FRP jacketing.

Performance Factors	Steel Jacket	FRP Wrapping
Installed Cost (includes labor)	Base Price	Saved over $3,000 / col x 72 columns
Quality Assurance	Verify Welds ($$)	Direct Tension Tests ($)
Durability	Periodic Maintenance	Corrosion Resistant
Flexibility for Odd Shapes	Moderate	High
Materials Lead Time	12-16 Weeks	2-3 Weeks

Fig. 5: Comparison between steel jackets and FRP jackets

REFERENCES

1. ICRI 310.2R, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair, International Concrete Repair Institute, Minneapolis, MN, 2013

Sarah Outzen, P.E., has been a Composite Strengthening Systems™ (CSS) field engineer at Simpson Strong-Tie since 2020. Before joining Simpson, she worked as a consulting engineer for nearly a decade, focusing on both new construction and retrofit of existing structures, primarily in concrete and steel. Sarah received her undergraduate degree from Cornell University, and a Master of Science from San Francisco State University, with a research concentration on recycled aggregate in concrete.

Data-Driven Approaches for Optimizing Concrete Bridge Deck Preservation

by Stephen Garrett, Marwa Abdelrahman, and Mohamed ElBatanouny

Fig. 1: Bridge Engineers performing in-depth assessment of a reinforced concrete bridge deck (photograph by WJE)

INTRODUCTION

Service disruptions associated with maintaining and upgrading aging infrastructure systems are costly to transportation agencies and burdensome to the public. Engineers and asset managers responsible for maintaining bridge performance are tasked with determining inspection needs and selecting strategies to provide optimal value to the end users of these critical systems. To this end, implementing data-driven inspections and condition assessment practices can increase the knowledge base for decision-making, reducing decision risks and life-cycle costs (Figure 1).

Recent trends in advanced assessment techniques have endeavored to minimize traffic disruptions by performing inspections using rolling lane closures with rapid assessment tools. Certainly, there is value added by performing routine assessments without significant operational disturbances; however, a more accurate understanding of the structure's condition gained through hands-on, advanced assessment techniques can then inform service life modeling, which combined with engineering judgment can offer insight into alternative repair strategies and ultimately the optimal course of action for a given structure (Figure 2).

CURRENT STATE OF PRACTICE FOR REQUIRED INSPECTIONS

In the United States, highway bridge inspections have been standardized with the National Bridge Inspection Standards (NBIS) framework. The NBIS framework guides inspectors and agencies in performing and interpreting bridge conditions from a holistic and elemental level (Figure 3).

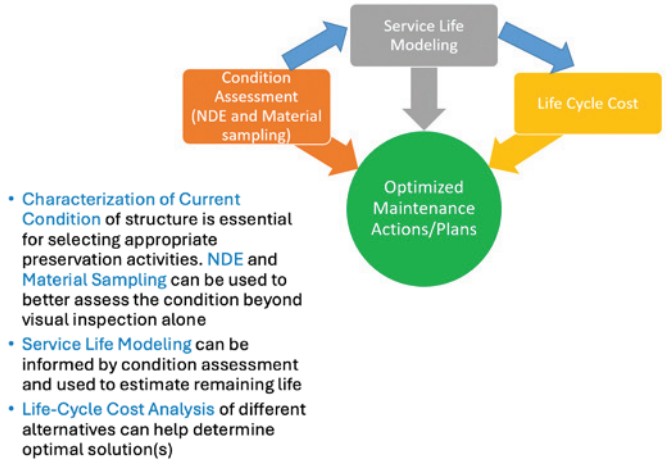


Fig. 2: Conceptual framework for use of condition assessment data, combined with service life and life cycle cost analyses to select optimized maintenance actions or plans

Through the routine NBIS inspection framework, bridge deck assessment techniques typically include visual assessments to identify cracking, delaminations, spalls, and other deterioration mechanisms. Quantification of these conditions factors into the overall condition rating for a structure. Inspections also provide a normalized basis for asset-level decision-making. The Federal Highway Administration (FHWA) states that the NBIS inspection data *"is necessary for bridge owners to make informed investment decisions as part of an asset management program."*[1] The inspection results include both the general condition ratings of the component and the element-level inspection data.

Fig. 3: Bridge Inspection Engineer performing routine inspection of a bridge deck

Beyond the conventional NBIS framework, there are a variety of advanced assessment techniques and data analysis tools available. This article introduces some of these methods.

ADVANCED NDE AND MATERIAL TESTING

Concrete bridge decks are susceptible to several deterioration mechanisms including cracking, corrosion of reinforcing steel, overlay debonding, and abrasion. The goal of advanced bridge deck assessments is to gather pertinent information to formulate a service life model and predict the future performance of the structure with and without maintenance or rehabilitation intervention. Beyond visual inspection, various non-destructive evaluation (NDE) inspection methods can yield useful condition data. These NDE methods are not explicitly mandated by the federal government as implementation and interpretation of data can be a burden to owners. Nonetheless, many agencies elect to collect data beyond visual inspections, utilizing techniques like sounding (Figure 4), cover surveys, and material testing.

Fig. 4: Example of a bridge deck with previous repairs, cracks, and delaminations identified from visual inspection and conventional chain-drag sounding techniques

Emerging NDE technologies are being adopted to assess bridge deck conditions and include rapid, cart- or vehicle-mounted scanning systems equipped with high-resolution cameras, infrared cameras, radar equipment, and even acoustic-sounding technologies. Rapid scanning techniques reduce traffic disruptions, but their accuracy can be limited without calibration through destructive or semi-destructive means. Ultimately, some level of hands-on inspection utilizing lane closures is prudent for an accurate in-depth assessment.

Chloride-induced corrosion is a common deterioration mechanism and the service life of concrete bridge decks located where deicing salts are used or in marine or brackish environments is typically controlled by chloride-induced corrosion, resulting in cracking and delamination of the concrete cover in bridge decks. A variety of corrosion evaluation techniques can be utilized including half-cell potential testing (Figure 5), electrical surface resistivity (Figure 6), and corrosion rate measurements. Corrosion surveys are especially effective when a baseline condition assessment has been performed through conventional assessment techniques, followed by an evaluation of corrosion risk which adds further context to these findings. The nature of the corrosion reaction is such that active corrosion can occur in regions that have not yet propagated damage, and thus corrosion potential maps offer a future view of damage progression. Half-cell potential maps of a bridge deck, for example, can indicate areas of corrosion risk beyond what can be identified through sounding (Figure 7).

Fig. 5: Half-cell potential survey of a bridge deck

Fig. 6: Surface resistivity survey of a bridge deck

Another important aspect of advanced bridge deck surveys is combining material sampling and laboratory testing with field findings. Core drilling not only offers a means of creating inspection openings to calibrate and verify NDE findings, but the core samples can be evaluated for chloride concentration and material degradation using laboratory techniques. As discussed below, chloride concentration profiles can be used to determine the concrete's resistance to chloride ingress as well as assess the risk for corrosion-related damage progression.

SERVICE LIFE MODELING AND LIFE CYCLE COST

Service life modeling is an essential tool for optimizing preservation and rehabilitation plans for existing reinforced concrete bridge decks. Modeling of future performance can

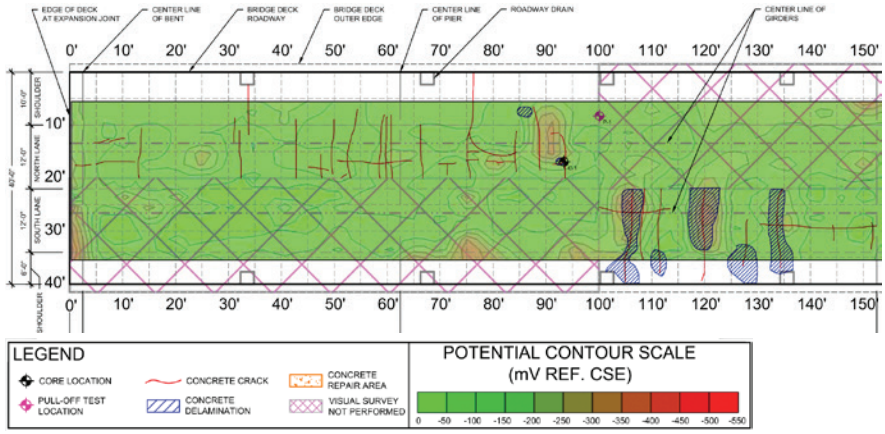


Fig. 7: Results from sounding and corrosion surveys showing observed damage and measured corrosion potentials

effectively evaluate the remaining service life, guide repair decisions, and most importantly inform the timing of those repairs.

Modeling corrosion-related damage is needed to predict the behavior of bridges exposed to deicer salts or in marine environments. This process involves predicting the development and progression of corrosion-related damage based on various influencing factors such as the exposure conditions, concrete properties, type of reinforcing steel, as-built cover, width, and frequency of cracks, and the presence and effectiveness of existing protective measures. The accuracy of predictions is significantly improved by careful evaluation of past performance data (if available) and current conditions, achieved through comprehensive field investigations with in-depth field assessment and laboratory testing of material samples to inform the service life model parameters.

Several modeling approaches are available for predicting corrosion in reinforced concrete, including deterministic and probabilistic approaches. The deterministic approach is defined by ACI Code-365-24 *Service Life Evaluation—Design Specification* as design based on characteristic input parameter values to provide a single output value, while the probabilistic modeling approach is designed based on consideration of input parameter values described by statistical distributions which is typically interpreted by evaluating the output at a certain level of reliability. Probabilistic modeling provides the advantage of incorporating the inherent variability of concrete properties and construction, by defining the input parameters with statistical distributions that best characterize the collected field data.[2] This approach is used to predict the amount of concrete surface area affected by corrosion-related damage with time and recognizes that corrosion is a local process that can develop at multiple locations on the structure. A reliable model is calibrated to accurately reflect the actual circumstances and exposure conditions of the modeled structure. Additionally, model predictions should be verified by evaluating the predicted damage at the current age relative to the currently observed distress quantified during the field investigation. NDE is a valuable tool to accurately quantify areas affected by corrosion activity and areas of delamination (especially with deep concrete covers), which in return enables accurate calibration of model inputs affecting the corrosion initiation and propagation times, respectively. An example of this process from a bridge investigation in Iowa is shown in Figure 8, where model predictions of the percentage of surface area affected by corrosion initiation and corrosion damage at the current age were verified against findings of half-cell potential and sounding surveys, respectively.

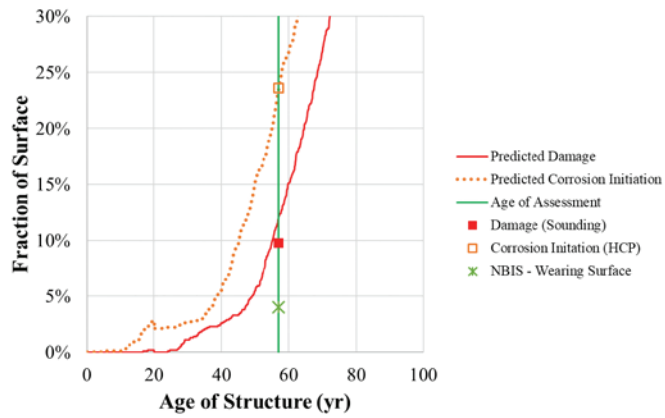


Fig. 8: Data fusion of field and service life modeling data to verify model predictions of corrosion initiation and damage propagation rates

Once the future performance has been estimated, different preservation or rehabilitation options and their respective impact on future performance can be explored (Figure 9). For example, the impact of surface and crack sealing can be compared to overlay installation/replacement. Modeling of the impacts of these options provides insight into the respective service life extensions and whether they achieve owner objectives. The cost associated with each of the preservation/rehabilitation options versus the service life extension benefits can be evaluated through a life cycle cost analysis to select the cost-optimal approach that achieves the project objectives.[3] Rehabilitation plan alternatives, each consisting of a series of preservation activities over the bridge's life span, can also be explored for long-term planning and efficient allocation of resources (Figure 10). This process of informed repair decision-making facilitates proactive and cost-effective management strategies.

APPROACHES FOR BRIDGE DECK PRESERVATION, MAINTENANCE, AND REHABILITATION

The NBIS framework is intended to ensure inspectors remain focused on the safety of traveling public on highway bridges. However, these limited data are often used by state Departments of Transportation (DOTs) and other agencies to determine required preservation activities to keep a bridge

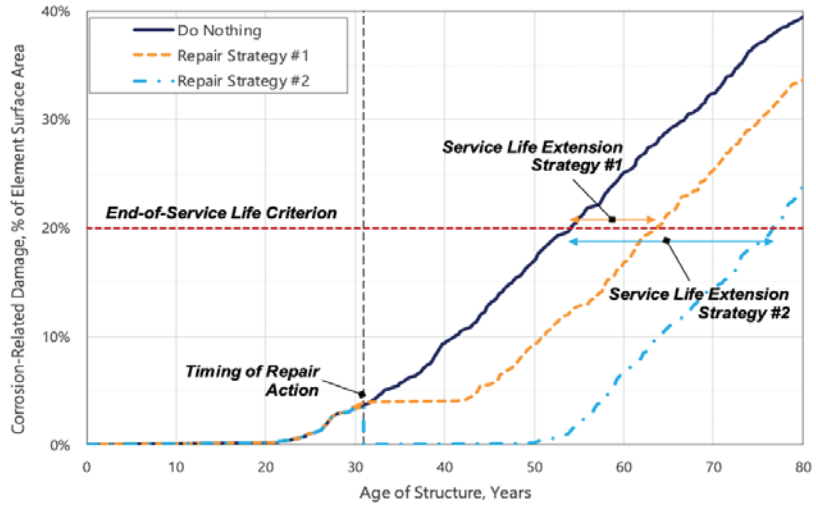


Fig. 9: Example of service life modeling projections considering different repair strategies

deck in good or fair condition. Preservation, as defined by the Federal Highway Administration (FHWA), involves actions that prevent, delay, or reduce deterioration, restore existing bridges' function, and extend their service life.

Guidance for selecting preservation activities is available. Many state DOTs implement preservation policies or preventive maintenance programs and have associated manuals, guides, or decision matrices for local engineers and bridge owners. Federal and national-level organizations have also developed several resources to help bridge owners make informed maintenance decisions, including the Guide to Bridge Preservation Actions and the Guide to Preservation of Highway Bridge Decks.[4,5] More recently, state DOTs and FHWA are funding research to develop an interactive decision-making aide that can be tailored to bridge-specific scenarios for practitioners.[6]

While the available resources aid in the selection of appropriate preservation and maintenance activities for common bridges in our transportation systems, more complete data will better inform these decisions. This is especially true for critical and signature bridges, which represent a fraction of our bridge inventory but can have a significant impact on the functionality of the transportation network. For such bridges, the risk of making less-than-optimal repair decisions based on limited data significantly outweighs the cost of obtaining additional NDE data and completing structure-specific service life modeling and life cycle cost analyses.

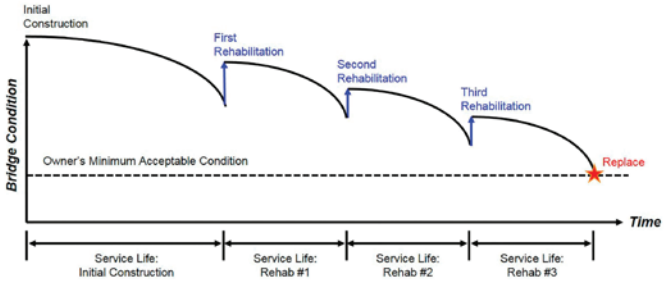


Fig. 10: The life cycle of a long-term bridge rehabilitation program[7]

CLOSING

Given the extensive transportation networks and constrained resources for preservation and maintenance efforts, transportation agencies face the challenge of finding cost-effective asset management strategies. Commonly, a "worst first" approach prioritized addressing bridge decks in the worst condition, but this sometimes allowed newer bridges to deteriorate prematurely. More effective strategies, now focus on preserving bridges in good condition, thereby extending their service life and reducing total life cycle costs. To enhance decision-making, many states developed their policies or utilize bridge management software, which stores detailed inspection reports and condition assessments.

The use of advanced NDE techniques and material sampling can provide more detailed and accurate information to assess the condition of bridge decks. Service life modeling further provides insight into the future performance of a given bridge deck. These methods can then be used to provide structure-specific data-driven comparisons between different preservation and maintenance strategies allowing bridge owners to make better informed decisions. Investing in a more complete understanding of the structure can significantly reduce the repair-selection risks and associated life-cycle costs of maintaining the bridge, especially for critical and signature bridges.

REFERENCES

1. National Bridge Inspection Standards, Final Rule (2022), Federal Highway Administration (FHWA), U.S. Department of Transportation (DOT)

2. Lawler, J.S., Kurth, J.C., Garrett, S.M., & Krauss, P.D. (2021). Statistical Distributions for Chloride Thresholds of Reinforcing Bars. *ACI Materials Journal*, 118(2).

3. ElBatanouny, M.K., Hawkins, K.A., Abdelrahman, M.A., Lawler, J.S., Nelson, T.D., & Krauss, P.D. (2022). Guide to Remediate Bridge Deck Cracking. Report No. TR-782. Ames, IA: Iowa Department of Transportation.

4. AASHTO Committee on Bridges and Structures. (2021). Guide to Bridge Preservation Actions, 1st Edition. American Association of State Highway and Transportation Officials.

5. AASHTO Committee on Bridges and Structures. (2023). Guide to Preservation of Highway Bridge Decks. American Association of State Highway and Transportation Officials.

6. ElBatanouny, M.K., Hawkins, K.A., Abdelrahman, M.A., Lawler, J.S., & Krauss, P.D. (2020). Bridge Deck Preservation Portal - Phase I. Ames, IA: Iowa Department of Transportation.

7. Johnson, A.P., Klein, G.J., & Lawler, J.S. (2019). Extending the Life of Historic Concrete Arch Bridges: State of the Art. *Structural Engineering International*, 29(1), 60-73.

Stephen Garrett is a Senior Associate and Professional Engineer at Wiss, Janney, Elstner Associates in Northbrook, IL. He has over 10 years of experience in condition assessment and nondestructive evaluation, corrosion evaluation and mitigation, field and laboratory testing, service life and durability evaluations, and repair/rehabilitation design, particularly for reinforced concrete structures and bridges. In addition to his professional practice, Mr. Garrett is an active voting member in ICRI 210 and 510, and currently serves as the Chair of ICRI 160. He received his BS and MS in Civil Engineer at University of Illinois at Urbana-Champaign, is a licensed Professional Engineer in multiple states, and holds a NACE CP-3 Cathodic Protection Technologist (CP3) certification.

Marwa Abdelrahman is a Senior Associate at Wiss, Janney, Elstner Associates with ten years of experience in concrete durability. She worked on various projects involving condition assessment of in-service structures, concrete durability, and service life modeling of existing and new construction. These projects included a variety of existing bridges, industrial ports, and other infrastructure. Dr. Abdelrahman contributed to several research projects involving remediations for bridge deck cracking, preservation and maintenance planning, and concrete durability for many notable organizations, such as Federal Highway Administration (FHWA) and several Departments of Transportation. She received her MS and PhD in civil engineering at the University of South Carolina. She currently serves as the secretary of ACI 365 Service Life Prediction and an active voting member of ACI 222 Corrosion of Metals in Concrete and holds a NACE Cathodic Protection Technician (CP2) certification.

Mohamed ElBatanouny is a Senior Associate and Unit Manager at Wiss, Janney, Elstner Associates with over 15 years of experience in evaluation of in-service structures, repair and rehabilitation design, nondestructive evaluation and instrumentation, and bridge engineering. He is the Committee Research Coordinator (CRC) for TRB Committee AKT60 "Standing Committee on Bridge Preservation" and holds leadership roles in several ACI committees related to structural evaluation, repair, and load testing. Dr. ElBatanouny has managed and served on numerous sponsored research projects funded by the Iowa Highway Research Board (IHRB) and FHWA funded research. He has authored over 60 publications including four book chapters and has presented numerous lectures on bridge preservation/maintenance and asset management, concrete material degradation, structural evaluation, load testing and nondestructive evaluation. Dr. ElBatanouny received his MS and PhD in civil engineering at the University of South Carolina and is a licensed Structural/Professional Engineer in multiple states.

Latex-Modified Concrete Preserves Bridge Deck in One Weekend

by Chris Davis

According to the American Society of Civil Engineers' most recent Infrastructure Report Card, almost half –42%– of the nation's 617,000 bridges are at least 50 years old.[1] Over the years, two stressors have taken their toll:

- Concrete expansion and contraction during seasonal temperature fluctuations cause cracking despite the strengthening presence of steel reinforcement.
- Salt and other deicers that public agencies apply to the surface to keep roads and bridges from icing over melts, penetrates the surface via cracks, and work through the concrete until they reach the rebar, which then rusts. The rebar expands as it rusts, pressing outward until the concrete around it cracks.

The phenomenon of corrosion is the number one reason reinforced concrete bridge decks deteriorate.[2] Cities and states spend almost $15 billion every year to repair, rehabilitate, or replace bridges. According to the Federal Highway Administration's National Bridge Index, 3% of that investment goes toward deck rehabilitation or replacement.[3]

LATEX-MODIFIED CONCRETE (LMC) OVERLAYS

State and local transportation departments can keep patching damage until the deck is so deteriorated that it must be completely replaced. This is extremely expensive. A cost-effective way to prevent this is to cover the deck with a topping 1.5 to 3 inches (38 to 76 mm) thick that acts as the wearing course.

Because corrosion begins at the surface, the overlay material should be as impermeable as possible.

One option introduced in the late 1960s is latex-modified concrete (LMC): an admixture of styrene-butadiene latex polymer suspended in water that replaces some of the water in a concrete mix. The latex essentially bridges and seals microscopic pores in the concrete matrix. This minimizes cracking during curing and increases resistance to water, chemicals, and freeze-thaw cycles. The result is a very low-permeability material.

In the United States, the latex is made by chemical admixture manufacturers, and supplied in 55-gallon (208 L) drums or 5,000-gallon (18,927 L) tanker trucks. The contractor or concrete supplier transports containers of latex to the job site, where it's mixed with sand, aggregate (usually 3/8-inch [10 mm]), and cement in a mobile volumetric mixer. One cubic yard of concrete can require 24.5 gallons (93 L) of latex.

ENSURING LMC OVERLAY DURABILITY

More than 10,000 reinforced concrete bridge decks have been preserved with LMC overlays.[4] That's because properly installed, the overlay should last at least 25 years.[5]

The contractor first removes any existing overlay to expose the reinforced concrete underneath (Fig. 1).

Fig. 1: The first step in placing any latex-modified concrete (LMC) overlay is removing the top layer of existing concrete. A cold-milling machine removed about ½ inch from the Thornburg Bridge deck in Pennsylvania via scarification

A preferred method for removing weak and damaged concrete from the deck is robotically driven hydrodemolition: an extremely high-pressure stream of water that blasts away concrete without damaging rebar (Fig. 2). Faster than manual concrete removal with jackhammers, hydrodemolition is also much more precise. Water velocity and cut depth and pattern are programmed into the hydrodemolition machine.[6]

After the damaged concrete is removed, the surface should be hosed down to remove dust, dirt, and other particles that compromise the bond between the substrate and the overlay (Fig. 3). The slurry should be vacuumed up and the clean surface covered with polyethylene reflective sheeting.

Improper or inadequate surface preparation is the primary reason any overlay, not just LMC, fails. I've overseen projects where an LMC overlay was removed after 30 years, and the underlying deck was in perfect condition. *That's* the goal.

Fig. 2: Hydrodemolition of the Thornburg Bridge. This hydrodemolition robot was calibrated to remove at least an additional ¾ inch (19 mm) after initial scarification

Fig. 3: After removal, the surface was hosed down to remove dust, dirt, and other particles that would compromise the bond. The slurry was vacuumed up and the clean surface covered with polyethylene reflective sheeting to protect it from dripping oil and other contaminants

The transportation department can then place a "second-generation" LMC overlay for minimal cost.

Once the substrate is prepared, the overlay is mixed, poured, compacted, and leveled with a screed (Fig. 4 A & B), followed by curing operations that typically include placing burlap on the surface, hosing it down, and covering it with polyethylene sheeting. Once cured, the overlay is often textured with a grinding machine to increase friction and decrease noise (Fig. 5).

LMC OVERLAY OPTIONS: FAST, FASTER, FASTEST

ACI 548.4 "Specification for Latex-Modified Concrete Overlays" guides two types of cement: ASTM C150 portland cement and, in Section 3.3, calcium sulfoaluminate (CSA) cement.[7]

Per the LMC Working Group, an overlay made with Types I and II Portland cement takes 96 hours (48-hour wet cure followed by 48-hour dry cure) to provide a 4000 psi (28 MPa) wearing surface. An overlay made with Type III portland cement, usually referred to as a high-early-strength (HESLMC) overlay, requires 48 hours to cure (24 hours wet and 24 hours dry).[8]

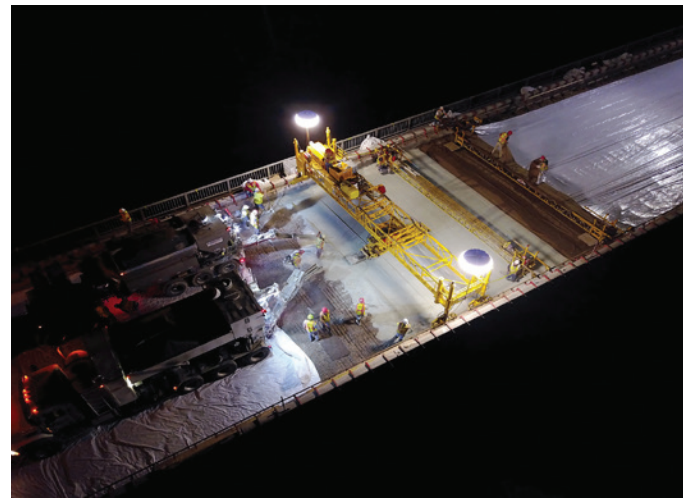


Fig. 4 A & B: The Thornburg Bridge's reinforced concrete bridge deck was restored and preserved with a very early strength LMC (VESLMC) overlay. The smoothed surface was covered with burlap, hosed down, and covered with polyethylene plastic sheeting to cure for at least three hours

Both timelines are too long for cities and states seeking to preserve bridge decks in highly congested, high-traffic locations. ACI 548.4, 3.3 provides a faster option: very-early-strength LMC, which must achieve a minimum compressive strength of 2500 psi (17 MPa) at three hours and 3500 (24 MPa) psi in 24 hours.[7] Although the specification uses the acronym LMC-VE, most public agencies, contractors, and concrete suppliers use VESLMC.

The only known way to achieve these strengths is by using calcium sulfoaluminate (CSA) cement instead of portland cement in the concrete mix.

In addition to speed, CSA cement provides benefits not available with portland cement. CSA cement shrinks less than portland cement, minimizing the cracking that creates entry points for water and chlorides.[9] CSA cement doesn't contain tricalcium aluminate (C_3A), the mineral phase that makes portland cement concrete susceptible to sulfate attack. It's also much less prone to alkali-silica reaction (ASR), expanding the range of aggregates that can be used in a concrete mix.

Fig. 5: After cure, the next step was texturing the very-early-strength latex-modified concrete VESLMC) overlay to increase friction and decrease noise. Like many state and local transportation departments, Pennsylvania DOT had the surface grooved longitudinally

For these reasons, the Pennsylvania DOT (PennDOT) has used CSA cement-based concrete to fast-track road and bridge repair and restoration for almost three decades. The agency chose VESLMC to restore a reinforced concrete deck on the outskirts of the state's second-largest city.

WEEKEND PROJECT DEMONSTRATES VESLMC'S ADVANTAGES

Built in 1980, the three-lane Thornburg Bridge carries Pennsylvania Route 60 over Chartiers Creek at the intersection of three Pittsburgh boroughs (Fig. 6). On average, 18,064 vehicles cross the bridge daily.

Fig. 6: Pennsylvania Route 60 over Chartiers Creek on the outskirts of Pittsburgh is called the Thornburg Bridge

The overlay consumed 235 cubic yards (180 m^3) of material and cost $643,121: $198,252 for surface preparation and $444,869 for materials and installation. The deck's restoration was part of a $3.15 million bridge preservation project that included replacing traffic signals and upgrading federally required Americans with Disabilities Act (ADA) curb ramps. Before restoration, PennDOT rated the deck as in "fair" condition; after, as "very good" (Fig. 7 A & B).

Fig. 7 A & B: The finished product: A very-early-strength latex-modified concrete (VESLMC) overlay that can be reopened to traffic after three hours

Of the 19 months the entire project took to complete, placing the overlay took one weekend in May 2023. The bridge was originally scheduled to close at 9 p.m. Friday and reopen at 6 a.m. on Monday. Instead, it closed at 9 p.m. Friday and reopened at 6 p.m. Sunday.

The process for placing a VESLMC overlay is the same as placing an LMC. The photos show the process step by step.

REFERENCES

1. American Society of Civil Engineers, 2021 Report Card for America's Infrastructure, Overview of Bridges, https://infrastructurereportcard.org/cat-item/bridges-infrastructure/

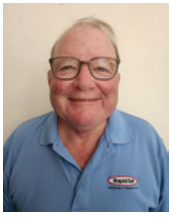
2. Clear, K.C., Chollar, B.H. "Styrene-butadiene latex modifiers for bridge deck overlay concrete," Federal Highway Administration (FHWA) interim report (FHWA-RD-78-35), April 1978.

3. American Road & Transportation Builders Association, Annual Bridge Report (2023), https://artbabridgereport.org/

4. Azari, Hoda, and Shams, Sadegh, "Nondestructive Evaluation of Concrete Bridge Deck with Overlays," *Public Roads*, Federal Highway Administration (FHWA), Autumn 2022 (Vol. 86, No. 3, FHWA-HRT-23-001), pp. 24-30.

5. Sprinkel, M.M. "Latex-Modified Concrete Overlays for Bridge Deck Repair and Preservation," Ministry of Transportation and Sustainable Mobility of Quebec, Quebec City, April 26, 2011.

6. ICRI 320.3R, *Guide for the Preparation of Concrete Surfaces for Repair Using Hydrodemolition Methods*, International Concrete Repair Institute, Minneapolis, MN, 2014
7. ACI SPEC-548.4-11, "Specification for Latex-Modified Concrete Overlays," American Concrete Institute, Farmington Hills, MI, 2012, 8 pp.
8. Latex Modified Concrete (LMC) Working Group. *HPLMC Mix Designs*. (n.d.). https://www.lmcworkinggroup.com/hplmc
9. Hicks, J.K., Caldarone, M.A., and Bescher, E. "Opportunities from Alternative Cementitious Materials," *Concrete International*, American Concrete Institute, April 2015 No. 4, pp. 47 - 51.



Chris Davis, CTS Cement Manufacturing Corp. Eastern Regional Manager, earned a bachelor's degree in civil engineering from Villanova University in Pennsylvania. He was VP of Operations for Frapaul Construction Co., a concrete contractor that placed latex-modified concrete (LMC) overlays on the East Coast. He now helps transportation departments, contractors, and materials suppliers use Rapid Set® calcium sulfoaluminate (CSA) cement products to optimize maintenance budgets and speed project delivery. He's been a member of the American Concrete Institute's ACI Committee 548 for more than 10 years.

NCBC

A council of allied industry organizations dedicated to quality concrete bridge construction and stewardship

Promoting Concrete Bridges & Making Things Happen for the Bridge Industry

by Gregg Freeby, American Segmental Bridge Institute and National Concrete Bridge Council

Adapted from: "National Concrete Bridge Council—Promoting Concrete Bridges for the Industry", ASPIRE, Fall 2022 & "National Concrete Bridge Council—Making Things Happen for the Concrete Bridge Industry", ASPIRE, Winter 2024. Reprinted with the permission of ASPIRE.

The National Concrete Bridge Council (NCBC) is a council of allied concrete industry organizations dedicated to expanding the concrete bridge market through promotion of the benefits of concrete bridges. But NCBC's mission goes beyond expanding the market. The organization also promotes quality in concrete bridge construction and preservation by gathering and disseminating information on design, construction, and condition assessment of concrete bridges; establishing and maintaining communication with federal and state departments of transportation, city and county public works departments, consulting engineers, contractors, and material suppliers; and providing information on behalf of the concrete industries to codes and standards groups. NCBC membership is limited to trade associations serving the concrete bridge industry and was founded in 1987. NCBC's first meeting with the Federal Highway Administration (FHWA) was on September 15, 1988. This meeting has continued as an annual tradition that enables the concrete bridge industry to collaborate with FHWA on various national initiatives and trends. Since that first meeting, NCBC membership has grown. The ten current NCBC members and their representatives are as follows:

- American Segmental Bridge Institute, Gregg Freeby (chair)
- Concrete Reinforcing Steel Institute, Danielle Kleinhans
- Epoxy Interest Group of CRSI, Brent Toller
- Expanded Shale, Clay and Slate Institute, Ken Harmon
- International Concrete Repair Institute, Eric Hauth (recording secretary)
- National Ready Mixed Concrete Association, Brian Killingsworth (vice chair)
- Precast/Prestressed Concrete Institute, William Nickas (past chair)
- Post-Tensioning Institute, Tim Christle, P.E.
- Silica Fume Association, Jim Wolsiefer
- Wire Reinforcement Institute, Paul Aubee

NCBC provides a unified voice for promoting concrete as the material of choice for all bridges in the United States. Council members work together on common projects to improve the quality, durability, and efficiency of concrete bridges to benefit the industry, taxpayers, and the traveling public. Through its member organizations, NCBC works closely with not only FHWA but also industry groups such as the American Association of State Highway and Transportation Officials (AASHTO), the American Concrete Institute (ACI), ASTM International, and International Federation for Structural Concrete (fib).

PRIMARY ACTIVITIES OF NCBC

The primary activities of the council are intended to address issues at the national level as we collaborate with FHWA, AASHTO, and other organizations to:

- Resolve technical issues.
- Provide training, sponsor research, sponsor conferences, and seminars.
- Maintain and update the library of *Concrete Bridge Views* and other newsletters.
- Advocate for infrastructure funding and legislation that benefit concrete bridges.

NCBC also maintains a website (nationalconcretebridge.org), where information about upcoming NCBC events as well as links to resources available from member organizations can be found.

2021: A TURNING POINT

In November 2021, NCBC member representatives met in Washington, D.C., as they had for the past 34 years. But this meeting was different: there was mutually agreed-upon interest in expanding the mission of NCBC to become a more structured and purposeful organization. As a result, NCBC's Articles of Organization were revised for the first time in many years, a new slate of officers was approved, and the following four primary strategic objectives were adopted:

- Collaboration with AASHTO
- Collaboration with FHWA
- Collaboration with the Concrete Bridge Engineering Institute (CBEI)
- A focus on sustainability and resiliency

COLLABORATION WITH AASHTO

In July 2022, with the assistance of PCI, NCBC entered into a collaboration agreement with AASHTO. The objective of this agreement is for NCBC to work closely with the various AASHTO bridge technical committees to develop technical documents related to concrete bridges, including specifications, standards, policies, and other materials. Collectively, these materials will be cobranded by AASHTO and NCBC and made available through the AASHTO bookstore and the NCBC website. Initially, the following documents are envisioned: *Resources for Concrete Bridge Design and Construction, Guide to Post-Tensioning for Transportation Structures,* and *Stewardship Guide for Concrete Structures*. In addition to document development, NCBC is committed to supporting the technical committees of the AASHTO Committee on Bridges and Structures by providing technical support and guidance as needed. This includes supporting the T-4 Construction, T-5 Loads and Load Distribution, T-9 Bridge Preservation, and T-10 Concrete Design committees, as well as the Committee on Materials and Pavements.

COLLABORATION WITH FHWA

NCBC is committed to continuing its collaboration with FHWA, which began more than 30 years ago. NCBC will assist FHWA by hosting webinars, communicating the latest industry resources and research studies, and promoting "Every Day Counts" initiatives such as the deployment of ultra-high-performance concrete for bridge preservation and repair.

NCBC is working to complete a new publication called *Guide to Post-Tensioned Transportation Structures*. In this document, NCBC will be updating FHWA's very popular Post-Tensioning Tendon Installation and Grouting Manual, and supplementing it with new content.[1] The new guide, which is on track to be balloted by the AASHTO COBS in 2024, will include details for spliced girders and troubleshooting guidance, as well as other new resources for bridge practitioners regarding all types of post-tensioned transportation structures.

The forthcoming *Guide to Post-Tensioned Transportation Structures* is just one example where a need was identified, and the two groups worked together to come up with an innovative solution in which NCBC becomes the steward for an existing FHWA publication. As such, FHWA has also committed to updating the e-learning modules that were created for the previous manual so that they reflect the new guide. In addition, NCBC has committed to keeping the new guide current through regular updates, making this a win-win situation for the industry.

COLLABORATION WITH CBEI

NCBC continues to support the Concrete Bridge Engineering Institute (CBEI) through both financial contributions and information sharing as various programs come to fruition. The collaboration between CBEI and NCBC means neither group is working alone, but rather in tandem with a common objective: to build better concrete bridges.

SUSTAINABILITY AND RESILIENCY

Sustainability and resiliency requirements are still emerging for the bridge industry. While both the vertical construction industry and the pavements branch of the transportation industry have already made great strides in this area, the bridge community is very much in need of industry leadership. To that end, NCBC has embarked on a collaboration with the National Steel Bridge Alliance. While a collaboration between these otherwise competing industry groups may sound shocking, it has happened before. In 2009, the concrete and steel industries teamed up to craft a white paper on the 12 essential elements of a comprehensive quality system.[2] This latest collaboration is intended to develop fair and technically robust life-cycle assessment (LCA) requirements for the

Fig. 1: Attendees listen to William N. Nickas, past chair of the National Concrete Bridge Council, during the Prestressed Concrete Bridge Seminar: Concepts for Extending Spans workshop in Hudson, Wis. All Photos: Gregg Freeby

bridge market. The Federal Highway Administration (FHWA) publication *Pavement Life Cycle Assessment Framework*[3] provides a framework for performing LCA for pavements, but no similar guidance currently exists for bridges. It's time for the concrete and steel industries to work together to fill this gap.

WORKFORCE DEVELOPMENT

Through deliberative collaboration with the American Association of State Highway and Transportation Officials (AASHTO) and FHWA, NCBC is making progress on the workforce development front. NCBC has two recent "wins" to report. The first win was the adoption by AASHTO of the AASHTO/NCBC "Resources for Concrete Bridge Design and Construction." This document was balloted for publication in May 2023 at the AASHTO Committee on Bridges and Structures (COBS) annual meeting in Kansas City, MIssouri, and now available on the AASHTO bookstore for no charge.

The second win for NCBC was a pilot workshop titled "Prestressed Concrete Bridge Seminar: Concepts for Extending Spans." This first-of-its-kind workshop was hosted in Hudson, Wisconsin, for the Minnesota and Wisconsin Departments of Transportation (Fig. 1). Two representatives from each of their prequalified engineering firms were also invited to attend. More than 100 attendees participated during two full days of instruction. Topics included an introduction to prestressed concrete, spliced girders, concrete segmental bridges, strain compatibility, design limit states, post-tensioning, fabrication, and many other subjects. Presentations on ethical issues were also included. The second was delivered in Atlanta, Georgia, and the third and fourth will be delivered in Portland, Oregon, and Spokane, Washington, in in November of 2024. See NCBC website for more details.

Fig. 2: The National Concrete Bridge Council (NCBC) has begun exhibiting at various bridge conferences to help increase the visibility and awareness of NCBC and its mission

VISIBILITY

If you attended the International Bridge Conference or the Western Bridge Engineers' Seminar in 2023 and visited the exhibit hall, I hope you stopped by the NCBC booth. That's right, NCBC has started exhibiting at bridge conferences (Fig. 2). This effort is led by NCBC member volunteers to help increase the visibility and awareness of NCBC. While NCBC continues to increase our support for the industry, it is important for the industry to know about the resources available not only from NCBC but also from our individual members. The next time you're at a bridge conference, look for us. We're likely to be there.

NCBC CONTINUES TO GROW

This is an exciting time for NCBC, and I am personally honored to serve as the current chair. The numerous opportunities that have been presented to NCBC and the outstanding response and cooperation among members have already taken us places that our founders could only have dreamed of. More to come.

Note: Visit the National Concrete Bridge Council website at nationalconcretebridge.org for more information about upcoming events, including the next Prestressed Concrete Bridge Seminar, as well as webinar recordings and registration links.

REFERENCES

1. Corven, J., and A. Moreton. 2013. Post-Tensioning Tendon Installation and Grouting Manual. FHWA-NHI-13-026. Washington, DC: Federal Highway Administration. https://www.fhwa.dot.gov/bridge/construction/pubs/hif13026.pdf.

2. American Institute of Steel Construction (AISC) and Precast/ Prestressed Concrete Institute (PCI). "AISC/PCI White Paper on Quality Systems in the Construction Industry." Accessed October 6, 2023. https://www.pci.org/PCI_Docs /Certification/AISC_PCI_Quality_Systems_White_Paper.pdf.

3. Harvey, J.T., Meijer, J., Ozer, H., Al-Qadi, I.L., Saboori, A., and Kendall, A. 2016. Pavement Life Cycle Assessment Framework. FHWA HIF-16-014. Washington, DC: Federal Highway Administration. https://www.fhwa.dot.gov/pavement/sustainability/hif16014.pdf.

Gregg Freeby is the executive director of the American Segmental Bridge Institute and chair of the National Concrete Bridge Council.

QUIKRETE Form and Pour MS is a highly flowable, shrinkage compensated high quality concrete mix designed for use in cast in place concrete applications. It is micro silica enhanced for reduced permeability, air entrained for superior freeze thaw durability, extended with coarse aggregate and contains an integral corrosion inhibitor. **QUIKRETE Form and Pour MS** is packaged in 80 lb bags and 3000-pound bulk bags.

quikrete.com

Live Traffic Repairs at the Monitor Merrimac Tunnel Using Low Dust Shotcrete

by Thomas Brennan and John Becker

Flexibility, efficiency, and cost-effectiveness drive dry mix shotcrete as a popular application method for concrete repair, especially in tunnel and bridge applications. In short turnaround, high-pressure situations, shotcrete applicators can deploy with minimal equipment and complete structural repairs, both vertical and overhead, rapidly. Historically, the dust associated with dry-mix shotcrete caused hesitation in projects in urban and/or live traffic environments, but recent innovations in low-dust materials have significantly changed planning considerations. The Monitor Merrimac Tunnel project combined careful construction planning with new material technology to execute emergency repairs using shotcrete, without closing the tunnel for more than a few minutes at a time.

WHAT CAUSES DUST IN SHOTCRETE?

Because of the nature of cementitious materials, dust prevention can be extremely difficult. The small particles associated with cement, sand, and other powders are key contributors to dusty environments, especially in confined installation areas common with shotcrete. In the case of dry-mix shotcrete, there are two clear avenues for dust to occur: at the dry mix hopper and at the nozzle. Between material being dumped into the hopper and the agitation of the dry material once inside, the dry mix hopper area traditionally emits quite a bit of dust.

The second and more commonly identifiable generator of dust in the shotcrete process is the placement process itself. The dust created at the nozzle and point of placement generally occurs in high concentrations relative to safety standards and therefore requires additional oversight and protective equipment.

When significant dust and high rebound occur, a lower amount of material is applied to the repair area. So in addition to creating dust exposure, the material is not used as efficiently as possible. As ACI 506R-16 details, aggregate selection in a shotcrete mix design plays a significant role in the rebound.[1] Aggregate gradation is key when discussing shotcrete performance, as approved gradations have been designed to ensure proper compaction and account for the rebound of larger particles.

STRIDES IN DUST REDUCTION TECHNOLOGY

The additional equipment and time often associated with wet mix shotcrete can lead to the demand for a lower dust dry mix material. The American Shotcrete Association has published articles showing significant research attempting to reduce dust in dry-mix shotcrete. Historical tests indicated that success in dust reduction has been consistently met with some combination of durability challenges, lower later-age strengths, or reduced early strengths.[2]

Over the last few years, there have been breakthroughs in the technology associated with dry-mix shotcrete additives that do not present challenges to other material properties. For example, proprietary admixtures have recently become available that have been shown to significantly reduce dust as compared to traditional dry-mix shotcrete. When combined with properly graded aggregate per ACI 506, these admixtures function as a dust and rebound suppressant. In comparing measured dust concentration to historical data, the maximum dust exposure between two on-site experiments, utilizing the same dry-mix shotcrete material averaged 2.45 mg/m^3, compared to published historical data points of 25.6 mg/m^3 for dry-mix and 15.8 mg/m^3 for wet (Fig. 1).[3,4]

The admixture has been included in the single component mix, which can be installed like any other dry-mix shotcrete, but the resulting process includes significantly less dust and consequently rebound. As expected, less material lost to rebound indicates that more material ends up installed, reducing waste. By reducing dust without impacting other material properties, the resulting product is not only safer but a more effective material for completing a dry-mix shotcrete repair.

SUCCESS AT THE MONITOR MERRIMAC TUNNEL

Emergency repair needs were identified at the Monitor Merrimac Tunnel when delamination was discovered during an inspection in July 2022. As inspections were completed, worry grew that the delaminated concrete, which was located on the ceiling of the tunnel, would present danger for motorists driving through the tunnel. As a result, emergency priority was quickly given to close lanes of traffic at night to be able to complete the repairs and remove the threat to traffic.

Position	Test 1 Dry Mix Dust Exposure (mg/m^3)	Test 2 Dry Mix Dust Exposure (mg/m3)	Historical Dry Mix Shotcrete Data (mg/m3)	Historical Wet Mix Shotcrete Data (mg/m3)
Mixer	**2.90**	0.95		
Nozzleman	0.98	**2.00**		
Finisher 1	0.31	0.18	25.6[3]	15.8[4]
Finisher 2	0.26	0.20		
Helper	0.25	N/A		

Fig. 1: Field Dust Exposure Monitoring Results vs Historical

The selected contractor's recent track record of completing similar work with the Virginia Department of Transportation (VDOT) on a nearby tunnel presented them as a preferred candidate to complete the job. Once the project characteristics were presented, shotcrete using the novel dustless admixture technology was identified as a perfect fit. Closing only one lane to complete demolition and preparation activities combined with the shotcrete process limited traffic stoppages to only 15-20 minutes instead of extending the total closure.

Fig. 2: Compact setup of installation equipment

To ensure the safe removal and installation of concrete next to traffic, a scissor lift was boxed in with plywood. A demolition hammer was used to remove all the loose and delaminated concrete, then embedded corroded utilities were replaced, and deteriorated steel was repaired or replaced. After the repair locations were cleaned and the surfaces were properly prepared, low dust dry-mix shotcrete was placed using a rotary-style piccola gun, as shown in Figure 4. From an emergency preparedness standpoint, sudden tunnel evacuation ability was required. Because of the compact nature of the shotcrete process, all equipment and materials were able to be loaded on a truck, which was able to evacuate quickly (Fig. 2 & 3).

The use of low-dust shotcrete material provided several benefits to the team for the duration of the project. Given the short windows when traffic was paused, material had to be applied as quickly as possible, with minimal cleanup of rebound and minimal visibility impact for the shotcrete process. The use of a low dust shotcrete ensured that all three of these key execution items were possible. The increase in productivity and decrease in cleanup ensured the repairs were completed when the outage time had expired. Similarly, motorists were never impacted by unsafe road conditions associated with lowered visibility. The use of low dust, dry mix shotcrete technology ensured the Monitor Merrimac project was an efficient and effective repair that minimized regional traffic impacts.

Fig. 3: Placement of Shotcrete in Tunnel

CONCLUSION

Understanding what causes dust on any concrete repair site allows for the proper mitigation measures to be put in place to minimize field exposure. In the case of dry-mix shotcrete, understanding the relationship between manufacturer mix design and rebound can make a large difference in terms of dust exposure, allowing for optimal material selection. Every project is different, but less dust in confined spaces, like the Monitor Merrimac Tunnel, offers an advantage from a safety and construction planning perspective. On projects of elevated complexity, collaboration between manufacturers and contractors can make a difference, especially when materials technologies can be deployed with success.

Fig. 4: Prepared Substrate Prior to Shotcrete Installation

REFERENCES

1. ACI Committee 506R-16. "Guide to Shotcrete". American Concrete Institute, Farmington Hills, MI, 2016.
2. Clements, W., & Fournier, C. (2020). Developing Dust Reduced and Low Cracking Potential Dry-Mix Shotcrete Mixes. American Shotcrete Association.
3. Kessel, R., Redl, M., Mauermayer, R., & Praml, G. J. (1989). Changes in lung function after working with the shotcrete lining method under compressed air conditions. *British Journal of Industrial Medicine*.
4. Li, P., Zhou, Z., Chen, L., Liu, G., & and Xiao, W. (2019). Research on Dust Suppression Technology of Shotcrete Based on New Spray Equipment and Process Optimization. *Advances in Civil Engineering*.

Project: Monitor Merrimac Bridge Tunnel Repairs Suffolk to Newport News, VA

OWNER
Virginia DOT

ENGINEER
Jacobs Engineering Group
Virginia Beach, Virginia

CONTRACTOR
Coastal Gunite Construction
Cambridge, Maryland

MATERIAL SUPPLIER
US Concrete Products
Baltimore, Maryland

Thomas Brennan, USCP Sales Engineer, holds a Bachelor of Science in Mechanical Engineering from the University of Massachusetts, Amherst, and has spent his entire career in Construction-related roles. After over four years of capital project construction as a Project Engineer with ExxonMobil in Houston, Mr. Brennan joined USCP to further his career in cementitious materials. Over his three years with USCP, Thomas has worked in many capacities, and currently oversees the QC program, assists with Sales and Operations, and leads development of new products for USCP. From an industry perspective, Mr. Brennan is on the board of the Baltimore/Washington Chapter of ICRI, a committee member of ACI 562, ACI Field Technician I certified, and an ICRI 40 Under 40 recipient.

John Becker is an ASA Certified Nozzleman and Project Manager, who for the last 17 years has worked in many capacities for Coastal Gunite Construction Company, based in Cambridge, Maryland. He has been involved with many shotcrete and infrastructure repair projects, large and small, including the Bonner Bridge Rehabilitation Project in Nags Head NC, the Old Mill Creek Sewer Rehabilitation Project in St. Louis MO, Ft. McHenry Tunnel Rehabilitation in Baltimore, Maryland, and most recently the Hampton Roads Bridge Tunnel Expansion in Hampton Roads VA.

Verify your project design with full-scale, application-specific testing.

In concrete and masonry, the only true strength is tested strength. That's why the Simpson Strong-Tie and Structural Technologies alliance is committed to full-scale product testing of Composite Strengthening Systems™ in a variety of applications. Our laboratories and facilities ensure products are rigorously tested and load rated for real-world, as-built conditions. It's all part of a complete solution with innovative products, engineering services, and technical and field support. So whether you're planning to strengthen, repair or design with concrete or masonry, you can move ahead with confidence.

Set a solid foundation for success. To learn more about our testing capabilities and concrete and masonry solutions, visit **go.strongtie.com/alliance** or call (800) 999-5099.

SIMPSON
Strong-Tie®

Composite Strengthening Systems | Products and Service for Smarter Building

We are focused on the industry's future and **your success.**

ICRI
CONCRETE REPAIR
Restore | Repurpose | Renew

ICRI is the center for concrete repair and restoration leadership, supporting a profession built on science and craftsmanship—making the built world safer and longer lasting.

1. Developing an industry of professionals through networking and best practices
2. Expanding certification programs and services to educate and build skills
3. Building strategic partnerships to strengthen the relevance of ICRI and the concrete restoration industry
4. Serving the needs of members and customers with staff, volunteers, and our chapter network

NETWORKING · EDUCATION · INFORMATION · CERTIFICATION
CONVENTIONS · COMMITTEES · INDUSTRY GUIDELINES

Join Today @ www.icri.org

Repairing Individual Mental Health in the Concrete Repair Industry

by John Gaal and Scott Greenhaus

The construction industry is high-stress, physically challenging, and mentally draining. Although these factors affect us all, the energy, pride in accomplishment, and teamwork environment of the job site are intoxicating and keep us in the game.

When the stress and potential isolation become too great, our mental health suffers. Living and working through the COVID-19 pandemic has only heightened the awareness and the adverse effects on the mental health of those who work in all positions in our industry.

Unfortunately, the construction industry is known to have a higher suicide rate compared to nearly all other industries, and it is helpful to understand and explore the many factors that contribute to this issue: [1,2]

- **High-Stress Environment**: Construction work often involves high-pressure situations, tight deadlines, and physically demanding tasks, which can lead to high-stress situations and a negative effect on our mental health.
- **Job Insecurity**: in a dynamic industry that is often project-focused, construction workers may experience periods of unemployment or uncertainty about future job prospects, which can contribute to feelings of hopelessness or despair.
- **Isolation**: Construction sites can be isolated, extensive travel may be required, and therefore workers may spend long hours alone or away from their friends and families, leading to feelings of loneliness and isolation.
- **Culture and Stigma**: There has historically been a culture within the construction industry that discourages seeking help for mental health issues, leading to underreporting and a lack of support for those in need. This tough-it-out mentality has only recently been challenged, as the understanding and implementation of behaviorally-based safety programs has created a greater focus on the whole person. This approach is often referred to as Total Worker Health® Approach.[3]
- **Physical Health Issues**: The physical demands of construction work can lead to chronic pain or injuries, which can lead to dependencies on opioids and other means of relieving the constant physical pain, which can further the downward mental health cycle of the individual.[4] Workers may fear being judged or ostracized if they admit to struggling with mental health issues... which may limit one's opportunity for promotion.[5]

WHY DON'T CONSTRUCTION WORKERS DISCUSS MENTAL HEALTH?

There are several reasons why construction workers may be hesitant to discuss mental health:

- **Culture of Toughness**: Construction is still about 90% male-dominated field and, as such, has a culture that values toughness and resilience, which can discourage workers from showing vulnerability or seeking help for mental health issues.[6]
- **Lack of Awareness**: Some workers may not be aware of the signs and symptoms of mental health issues or may not realize that what they are experiencing is a mental health concern.
- **Fear of Repercussions**: Workers may fear that discussing mental health issues could lead to negative consequences, such as being seen as unfit for work or losing their jobs.
- **Perception of Weakness**: There may be a perception among construction workers that admitting to mental health issues is a sign of weakness, which can prevent them from seeking help.
- **Lack of Access to Resources**: Some workers may not know where to turn for help or may not have access to mental health resources, making it difficult for them to discuss their mental health. Not to mention, most Employee Assistance Programs (EAPs) are underutilized.[7]

To address these barriers, it's important to promote mental health awareness to reduce the stigma associated with mental health challenges and create a supportive work environment where workers feel comfortable discussing mental health issues. Providing access to mental health resources and training can also help empower workers to seek help when needed.

HOW CAN WE ADDRESS MENTAL HEALTH CHALLENGES AND HIGH SUICIDE RATES IN THE CONSTRUCTION INDUSTRY?

Addressing the high suicide rates in the construction industry requires a multi-faceted approach that involves employers, workers, industry organizations, consumers/customers, and mental health professionals. Here are some strategies that can be implemented:

> It is important to note that too many of us conflate mental health with mental illness. While it is estimated that over 60 million people in the US currently experience some form of mental illness (i.e., depression, bipolar disorder, etc.), each and every one of us experiences mental health on a daily basis. How did you feel mentally (and physically) when you woke up this morning vs lunchtime vs bedtime? There is a good chance that your responses would ebb and flow throughout the day based on a variety of factors.

- **Mental Health Awareness and Training**: Provide mental health education and training for both employers and workers to recognize the signs of mental health issues and how to seek help. Getting comfortable discussing these issues is the first step in daylighting these critical issues. Training will help the individual better understand the issues and must be done in a way that develops trust and is non-judgmental. Free online courses focused on the construction industry are a greatplace to begin your journey.[8]
- **Access to Mental Health Resources**: Ensure that construction workers have access to mental health resources, such as counseling services, helplines (Figure 1), and support groups. Information regarding help services and educational opportunities is increasing rapidly, and resources are becoming much more accessible.[9]
- P**romote a Supportive Work Environment**: Create a work culture that prioritizes mental health and supports workers who may be struggling. This can include promoting work-life balance, encouraging open communication, and providing resources for managing stress.
- **Reduce Stigma**: Challenge the stigma surrounding mental health in the construction industry and encourage workers to seek help when needed. Creating a culture where the mental and physical safety of the individual are valued and balanced with the needs of the project and the customer, is essential.
- **Address Job Insecurity**: Implement policies and programs that help reduce job insecurity and provide support for workers during periods of unemployment or uncertainty.[10]

Fig. 1: Suicide and Crisis Lifeline 988lifeline.org

- **Suicide Prevention Programs**: Develop and implement suicide prevention programs that include training, resources, and support for those at risk. Awareness training for co-workers and supervisors can help with identifying early warning signs and ensuring the individual gets the proper care they need.[11]
- **Access to Health Care**: Ensure that construction workers have access to affordable healthcare, including mental health services.
- **Peer Support Programs**: Peer support programs pair trained peers who can provide support and guidance to colleagues who are experiencing mental health issues. [12]
- **Support for Substance Abuse**: Address substance misuse issues, which can be a risk factor for suicide, through education, prevention, and treatment programs. This is especially true in the construction industry where chronic pain from tough, physically demanding work can lead to substance misuse.[13]
- **Promote Work-Life Balance**: Encourage a healthy work-life balance by offering flexible work arrangements, paid time off, and other benefits that support overall well-being.
- **Monitor and Evaluate**: Regularly monitor and evaluate the effectiveness of suicide prevention initiatives to ensure they are meeting the needs of workers and making a positive impact.

While progress is being made, there is still much work to be done to address the high rate of suicide in the construction industry. Continued efforts to raise awareness, reduce stigma, and provide support to workers in need are essential to improving the mental health and well-being of construction workers. These efforts should include “safe spaces” to discuss these “taboo” topics![14]

A SIGNIFICANT FACTOR IN THE MENTAL HEALTH CRISIS IS THE USE AND ABUSE OF OPIOIDS. WHY IS OPIOID USE SO HIGH IN THE CONSTRUCTION INDUSTRY?

The construction industry has been disproportionately affected by opioid use for several reasons:

- **High-Risk Work Environment**: Construction work often involves physically demanding tasks and the potential for workplace injuries. Injured workers may be prescribed opioids to manage pain, leading to a higher likelihood of opioid misuse or dependence—also known as opioid use disorder (OUD). If you are the breadwinner in your family, you find ways to show up (hurt) on the job site since most workers only get paid for the time they work![15]
- **Lack of Access to Healthcare**: Many construction workers do not have access to adequate healthcare, including pain management alternatives to opioids. This can result in workers turning to opioids for pain relief.
- **Job Insecurity and Stress**: The cyclical nature of construction work can lead to job insecurity and financial stress, which can increase the risk of substance abuse, including opioids.
- **Culture of Self-Reliance**: There may be a culture within the construction industry that values self-reliance and toughness, which can discourage workers from seeking help for pain or mental health issues, leading them to self-medicate with opioids.
- **Easy Access to Opioids**: Opioids are often readily available on construction sites or through informal networks, making them easily accessible to workers who may be seeking pain relief or a way to cope with stress.

In the construction industry, the most abused opioids are prescription opioids. These are medications that are prescribed by healthcare providers to treat pain but are often misused or abused. Some of the most common prescription opioids abused in the construction industry include:

- **Oxycodone**: This is a powerful opioid pain medication that is often prescribed for moderate to severe pain. It is commonly sold under brand names like OxyContin and Percocet.
- **Hydrocodone**: Another commonly abused opioid, hydrocodone is often prescribed for pain relief. It is found in medications like Vicodin and Lortab.
- **Morphine**: Morphine is a strong opioid pain medication that is used to treat severe pain. It is often used in hospital settings and is also available in pill form.

On more than one occasion, one author has asked the group he is presenting to these three questions:

1. How many of you have a First Kit on your job site?
2. How many of you have an AED device on your job site?
3. How many of you have Narcan on your job site?

The responses typically go like this: 100%, 80%, <1%, respectively.

- **Fentanyl**: Fentanyl is a synthetic opioid that is much more potent than other opioids. It is often prescribed for severe pain, such as pain from cancer. Illicitly manufactured fentanyl is also a significant contributor to the opioid crisis.
- **Codeine**: Codeine is a less potent opioid that is often used in combination with other medications to treat mild to moderate pain. It is also found in some cough syrups.
- **Heroin**: Greater than 70% of the people who were on prescription opioids turned to heroin when their doctors stopped writing Rx for oxy, etc.[16]

It's important to note that while prescription opioids are commonly abused in the construction industry, illicit opioids like heroin and fentanyl are also a significant concern. These are highly addictive and can have serious health consequences, including death.

Photo by Mikael Blomkvist via Pexels

WHAT CAN WE DO ABOUT OPIOID ABUSE IN THE CONSTRUCTION INDUSTRY?

Photo by Matthew Rakola via flickr

Addressing opioid abuse in the construction industry requires a comprehensive approach that includes prevention, education, intervention, treatment, and support. Here are some strategies that can be implemented:

- **Education and Awareness**: Provide education and training to construction workers about the risks of opioid use and alternative pain management strategies. Raise awareness about the signs of opioid abuse and how to seek help.
- **Implement Drug-Free Workplace Policies**: Establish and enforce drug-free workplace policies that include testing and consequences for drug use. Provide resources for employees who need help with substance abuse.
- **Access to Alternative Pain Management**: Ensure that construction workers have access to alternative pain management strategies, such as physical therapy, acupuncture, and non-opioid medications.
- **Healthcare Access**: Improve access to healthcare for construction workers, including mental health services and substance abuse treatment programs.
- **Peer Support Programs**: Implement peer support programs that provide workers with a supportive environment to discuss substance abuse and mental health issues.
- **Training for Healthcare Providers**: Provide training for healthcare providers who work with construction workers on appropriate prescribing practices for opioids and alternative pain management strategies.
- **Community Partnerships**: Partner with community organizations and treatment providers to improve access to substance abuse treatment programs and support services.
- **Monitor and Evaluate**: Regularly monitor and evaluate the effectiveness of opioid misuse prevention and treatment programs to ensure they are meeting the needs of construction workers and making a positive impact.

WHAT ABOUT NALOXONE, AND THE USE OF "NARCAN" IN THE CONSTRUCTION INDUSTRY?

Naloxone, commonly known by the brand name Narcan, is a nasal spray medication used to rapidly reverse opioid overdose. Using Narcan in the construction industry can be an important safety measure, especially given the high rates of opioid use and overdose in this field. Here are some key points about Narcan use in construction:

- **Training and Access**: Providing training on how to recognize the signs of opioid overdose and administer Narcan can be crucial. Construction companies can ensure that Narcan kits are readily available on job sites and that workers know how to use them effectively.[17,18]
- **Emergency Response**: In the event of an opioid overdose on a construction site, having Narcan available can help save lives by quickly reversing the effects of the overdose until emergency medical help arrives.
- **Legal Considerations**: It's important for construction companies to understand the legal considerations around administering Narcan. Good Samaritan laws in many states provide legal protection to individuals who administer Narcan in good faith to someone experiencing an overdose.[19]
- **Community Collaboration**: Collaborating with local health departments, first responders, and community organizations can help ensure that construction companies have access to Narcan training and resources.

Overall, Narcan can be a lifesaving tool in the construction industry, but it should be part of a broader strategy that includes prevention, education, and support for workers struggling with opioid use. This is an example of an intervention strategy.

Addressing the opioid epidemic in the construction industry requires a multifaceted approach that includes providing access to alternative pain management strategies, improving access to healthcare, addressing job insecurity and stress, and reducing stigma around seeking help for substance abuse and mental health issues.

Stakeholders must take a serious look at how to consider addressing mental health, SUD/OUD awareness, and suicide prevention. Experience suggests that a top-down/bottom-up approach works well in the construction industry. First and foremost, leaders must endorse any efforts to send a clear message that their culture embraces a given strategy. Meanwhile, training new and incumbent workers must occur in such a manner that change encompasses all corners of a company and, thus, has a lasting impact: think OSHA ten to twenty years ago!

REFERENCES

1. Sussell, A., Peterson, C., Li, J., Miniño, A., Scott, K.A., & Stone, D.M. (2023). *Suicide Rates by Industry and Occupation - National Vital Statistics System*, United States, 2021. Morbidity And Mortality Weekly Report, 72(50), 1346–1350. https://doi.org/10.15585/mmwr.mm7250a2

2. Parker, Doug. (2023, August 23). *Suicide Prevention Stand Down* [Video]. Construction Suicide Prevention. YouTube. https://www.youtube.com/watch?v=OE8IcBmfCpI&t=215s

3. *About the Total Worker Health® Approach*. (2024, May 31). CDC, NIOSH. https://www.cdc.gov/niosh/twh/about/?CDC_AAref_Val=https://www.cdc.gov/niosh/twh/totalhealth.html

4. Dong, X. S., Brooks, R. D., Rodman, C., Rinehart, R., & Brown, S. (2022). "Pain and Prescription Opioid Use Among US Construction Workers: Findings From the 2011-2018 Medical Expenditure Panel Survey". *American Journal of Public Health*, 112(S1), S77–S87. https://doi.org/10.2105/AJPH.2021.306510

5. "Breaking Ground on Mental Health In Construction". (2024, May 13). *Construction Dive*. https://www.constructiondive.com/spons/breaking-ground-on-mental-health-in-construction/715822/

6. Morton, B. Andrea, D. (2022, August 8). "Work to Solve the Mental-Health Crisis in Construction". *Construction Executive*. https://www.constructionexec.com/article/work-to-solve-the-mental-health-crisis-in-construction

7. "EAPs in Construction Industry Can Help Foster Work-Life Balance". (2023, April 3). *HUB International*. https://www.hubinternational.com/blog/2019/09/eaps-in-construction/

8. *Preventing Suicide in The Construction Industry*. (2023, November 22). Forefront Suicide Prevention - University of Washington. https://intheforefront.org/preventing-suicide-in-the-construction-industry/

9. *Mental Health in The Construction Industry.* (n.d.). The Center for Construction Research and Training. https://www.cpwr.com/research/research-to-practice-r2p/r2p-library/other-resources-for-stakeholders/mental-health-addiction/

10. Schneider, S. (n.d.) *Addressing the Root of The Stress Problem in Construction. Laborers' Health & Safety Fund of North America*. https://lhsfna.org/addressing-the-root-of-the-stress-problem-in-construction/

11. *Training*. (n.d.). Construction Industry Alliance for Suicide Prevention. https://www.preventconstructionsuicide.com/training

12. Woodbury, W. (2023, June 15). *How LEAN-STL helps St. Louis laborers fight addiction*. St. Louis Public Radio. https://www.stlpr.org/show/st-louis-on-the-air/2023-06-15/how-lean-stl-helps-st-louis-laborers-fight-addiction

13. *Workplace Guidelines to Prevent Opioid and Substance Abuse for the Construction Trades*. (n.d.) Healthier Workforce Center of the Midwest. https://hwc.public-health.uiowa.edu/wp-content/uploads/Workplace-Opioid-Prevention-Program-Guidelines-for-Construction_v3.0.pdf

14. *2021 Pulse Survey Results and Report*. (n.d.) Center for Workplace Mental Health. https://workplacementalhealth.org/employer-resources/guides-and-toolkits/mental-health-and-well-being-in-the-construction-i

15. Moreno, E. (2024, Feb. 8). "Construction Industry Grapples with Its Top Killer: Drug Overdose". *The New York Times*. https://www.nytimes.com/2024/02/08/business/construction-drug-overdose-deaths.html

16. *Dose of Reality: Get the Facts on Opioids*. (2024, May 21). Wisconsin Department of Health Services. https://www.dhs.wisconsin.gov/opioids/facts.htm

17. "What is Naloxone?" [Video]. (2020, January 7). *Psych Hub*. YouTube. https://www.youtube.com/watch?v=QmrPgantvn8&t=89s

18. "Naloxone: How can I reverse opioid overdoses and save lives?" [Video]. (2022, Aug. 8). *Science Animated*. YouTube. https://www.youtube.com/watch?v=7klB8Vza9ac&t=3s

19. *Naloxone Frequently Asked Questions*. (n.d.). The Alliance for Naloxone Safety in the Workplace. https://www.answ.org/faqs

Dr. John S. Gaal, CWP, CPS, CHW-C, LAP-C, is the MO AFL-CIO's Missouri Works Initiative's Worker Wellness Program director. (At the end of January 2019, after 40 years of service, John retired as the Director of Training and Workforce Development for the St. Louis-Kansas City Carpenters Regional Council.) As a labor representative, he currently serves on the International Foundation of Employee Benefit Plan's Mental Health Expert Panel. Since 2018, John completed the Missouri Certified Peer Specialist certification, NWI's Certified Wellness Practitioner certification, QPR Train-the-Trainer certification course, Missouri Community Health Worker credential course, ASIST training course, CALM Train-the-Trainer course, and AFSP's Bereavement Support Group Facilitator course. In addition, he recently earned LAP certification.

Scott Greenhaus is affiliated with Structural Technologies, a construction technology and service provider specializing in concrete repair, strengthening, protection and new construction products, systems and services throughout the United States and the Middle East. Scott graduated with degrees in Civil Engineering and an MBA from the University of Maryland and has served as the Executive Vice President and Chief Risk Officer of Structural Technologies, headquartered in Columbia, Maryland. Mr. Greenhaus is Vice Chairman of the University of Maryland Engineering Board Of Visitors and has been on the Board of Directors of the Post-tensioning Institute (PTI), International Concrete Repair Institute (ICRI) and American Society of Concrete Contractors (ASCC) and served as the Chairman of the ASCC Safety and Risk Management Council. He is also a member of ASCE, ACI, ANS, and ASSE. Mr. Greenhaus was also the past president of PTI and has chaired many committees in these trade and technical associations.

PEDESTRIAN DECK COATING SYSTEMS

MiraFlex XL is a cementitious, fabric- reinforced, waterproofing membrane system engineered for exterior pedestrian traffic applications.

MIRAFLEX XL

Where to use:

- Over interior/exterior concrete surfaces
- Mixed-use, residential and commercial
- Waterproofing of existing topping slabs over sandwich membranes
- Vented and unvented metal pan deck slabs

Advantages:

- Vapor permeable - allows substrate to breath without blistering
- Wide array of slip resistant textures, colors and finishes
- Lower maintenance and life cycle costs vs. other flooring types
- VOC and LEED-compliant, low odor and fast cure time

MiraFlex II is a multi-layered pedestrian deck coating system consisting of a lath-reinforced cementitious underlayment, fluid-applied waterproofing membrane, and decorative finished deck surface. It can also serve as an under tile waterproofing membrane system.

MIRAFLEX II

Where to use:

- Interior/Exterior over occupied space
- Mixed-use, residential and commercial
- Over plywood and concrete substrates

Advantages:

- Monolithic, seamless protection – waterproofing membrane
- One-hour fire rated over plywood (ICC ESR 1714 listing)
- VOC and LEED-compliant, low odor and fast cure time
- Wide array of slip resistant textures, colors and finishes

Learn more at miracote.com

Headquarters: 800.692.3502
West Coast: 310.631.6594
Central: 210-888-0449
East Coast: 908.245.2808
miracote@cpcmail.net
miracote.com

MIRACOTE

Concrete Surface Repair Technician (CSRT) Program

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)

Concrete Slab Moisture Testing (CSMT) Program

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

ICRI CONCRETE REPAIR CERTIFICATION

Learn more at **www.icri.org**

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

REGISTRATION OPEN!

SAND • CEMENT

Back to Basics

WATER • AGGREGATE

2024 ICRI FALL CONVENTION

SHERATON DENVER DOWNTOWN, DENVER, COLORADO

OCTOBER 22-25, 2024

PHOTO BY ACTON CRAWFORD VIA UNSPLASH

WOMENINICRI

SPOTLIGHT— Marthe Brock

by Michelle Nobel, Women in ICRI Committee Member

MARTHE BROCK

Marthe Brock has been with Sika, formerly Master Builders Solutions/BASF, for 29 years and is currently a Buildings and Restoration Specialist for Minnesota and North Dakota. She has been a dedicated member of the local construction industry since 1988. She served as the President of the Minneapolis/St. Paul Chapter of CSI and has been a CSI Certified Construction Product Representative for over 20 years. She is an active member of several local and national organizations, including ICRI, MCC, MCMCA, and the BEC. She was awarded her ICRI fellowship in April 2024 and holds a BA from the University of Minnesota.

Marthe is married to Dean Johnson, who is a financial planner. They dated in college, broke up for 27 years, and reunited 12 years ago. Marthe has two adult children. Jack is 25 years old and recently graduated from UW-River Falls with a degree in Music Business. He teaches guitar in a local cover band that plays music from the '70s and '80s. Andrew is 22 years old and is studying Genetic Biology at the University of MN. He is currently doing an internship focused on developing a new Malaria vaccine because the current one is not very effective. I entered the construction industry because my father owned a distribution business in Minneapolis. He holds the US Patent for concrete curing blankets and helped develop the first membrane-forming curing compound.

I had the pleasure of meeting Marthe at an ICRI Convention a few years ago. It's been a pleasure getting to know her and having her be a part of this great organization. She is a member of the Women in ICRI Committee and, like many of the women in this great organization, she is an inspiration to women and young girls everywhere. I see her leaving her mark, making many friends at ICRI, and solidifying her status within ICRI.

ICRICHAPTERNEWS

CHAPTERS COMMITTEE CHAIR'S LETTER

DAVID GRANDBOIS
Chapters Chair

Wow, is it Fall already? School starts soon and with the change of the seasons comes a busy time for ICRI, both locally and nationally. After taking a break during the busy summer months to concentrate on the repair work, many local Chapters will get back into the swing of things, scheduling membership meetings, technical presentations, and social gatherings to close out the year. Please post your upcoming events to the ICRI website (in addition to your Chapter's website). Many ICRI members travel in the fall, and if anyone happens to be in your area and an event is planned and posted, they just might plan to attend! Be sure you plan and post your events with plenty of lead time. That is weeks, not just days!

On a national level, the 2024 Fall Convention is just around the corner! On October 22-25, ICRI's Fall Convention descends upon the Mile High city of Denver, Colorado! The theme "Back to Basics" is set to get you practical strategies and tools to help you in your career. Great technical sessions are planned, in addition to an abundance of networking opportunities. The annual Project Awards will be announced on Thursday afternoon and you don't want to miss that!

Your friends at the Rocky Mountain Chapter have planned a fun-filled afternoon of friendly competition at the Denver Puttshack for Wednesday, and a Thursday evening Chapter experience at the Wings Over the Rockies Air and Space Museum that will get you soaring with all your favorite people.

Has your Chapter designated a Delegate for the Fall Convention? The Chapter Delegate program allows each Chapter to send a representative to the Convention without having to pay the registration fee, provided the Delegate fulfills the following requirements:

- Pre-register for the Convention using the Chapter Delegate code
- Attend a minimum of one Technical Session, and at least one Technical and one Administrative Committee Meeting
- Attend Friday's Inter-Chapter Luncheon (12:00 PM to 1:30 PM) and Chapters Committee meeting
- After the Convention, provide a written report to the Delegate's Chapter

Each Chapter Delegate is responsible for travel and hotel expenses; however, many Chapters budget monies to reimburse Delegates for these expenses. We encourage ALL CHAPTERS to take advantage of this beneficial program!

Here's hoping we see you this Fall! As always, if I can be of assistance to you, please do not hesitate to contact me.

Best Regards,

David Grandbois, ICRI Chapters Committee Chair
Western Specialty Contractors – Minneapolis, MN

CHAPTER NEWS

GEORGIA HOSTS ANNUAL GOLF TOURNAMENT

The Georgia Chapter of ICRI held its Annual Spring Scholarship Golf Tournament on May 13, 2024, at Heritage Golf Links in Tucker, Georgia. With 100+ golfers and 100% participation of hole sponsors, this year's event saw tremendous participation and support from local contractors, engineers, consultants, and manufacturers representatives within the concrete repair and restoration industry. Even with a bit of rain on the day! This is the chapter's largest annual outing and the funds raised directly impact the success of the Georgia Chapter Scholarship Program.

In 2023, the chapter received a record-breaking number of scholarship applications and was truly honored to award funds to three outstanding students from local Georgia universities. Scholarship winners were recognized during our 2023 Holiday Party and better yet, all of the 2023 winners showed themselves to be outstanding students with bright futures ahead in the concrete repair industry!

No outing is complete without the generous sponsorship of local partners. The Georgia Chapter collected an impressive amount of swag for their May event

The chapter is grateful to have such strong support from dedicated corporate chapter sponsors and industry partners! With another incredible golf outing behind the group, The Georgia Chapter of ICRI looks to break records yet again in 2025 by increasing local university outreach, gaining even more scholarship program participation, and providing larger scholarship awards.

Every successful golf outing needs a great course to support it—members of the Georgia Chapter gathered in May 2024 at the Heritage Golf Links in Tucker, GA

And what is an outing without an impressive show of support from registered members and guests of the chapter?

PITTSBURGH GOLF OUTING HITS RECORD

The ICRI Pittsburgh Chapter celebrated its 25th annual golf outing on June 21, 2024, at Birdsfoot Golf Club in Freeport, Pennsylvania. Even with near-record temperatures that day, it couldn't stop the fun and enjoyment of a record attendance for this chapter's long-standing annual event. The chapter welcomed more than 60 golfers for this annual event. Congrats to the top foursome from Herc Rental, with a -10, as well as all of the individual skills competition and prize winners. The Chapter wishes to thank all their sponsors and everyone who could attend. They will be looking forward to the next big chapter event!

Friends gathered at Birdsfoot Golf Club for the Pittsburgh Chapter's annual outing, starting the day with a great lunch

Chapter leaders are grateful for the support of the many local sponsors for this event

ICRI**CHAPTER**NEWS

CHAPTER CALENDAR

ICRI Chapters are hosting events in 2024. 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 about added events.

BALTIMORE-WASHINGTON
September 12, 2024
3RD QUARTER DINNER MEETING
Maggiano's Little Italy
Tyson's Corner, VA

October 3, 2024
FALL GOLF OUTING
Blue Mash Golf Course
Laytonsville, MD

CAROLINAS
October 9 & 10, 2024
MEGA DEMO
Raleigh, NC

DELAWARE VALLEY
September 16, 2024
CHAPTER GOLF OUTING
Radley Run Country Club
West Chester, PA

FLORIDA FIRST COAST
September 12, 2024
LUNCH & LEARN
Topic: Building Envelope Water Intrusion
Speaker: Scott Weiland, Innovative Engineering
Herbert University Center
Jacksonville, FL

November 11, 2024
CLAY SHOOT TOURNAMENT
Jacksonville Clay Target Sports
Jacksonville, FL

FLORIDA WEST COAST
October 2, 2024
TECHNICAL MEETING
Location: TBD

October 18, 2024
SPORTING CLAY EVENT
Tampa Bay Sporting Clays
Land O' Lakes, FL

INDIANA
September 19, 2024
CHAPTER GOLF OUTING
Plum Creek Golf Club
Carmel, IN

METRO NEW YORK
September 19, 2024
CHAPTER GOLF OUTING
Livingston Country Club
Livingston, NJ

MINNESOTA
October 8, 2024
FALL TECHNICAL SESSION
Location: TBD

NEW ENGLAND
September 10, 2024
DINNER MEETING & PRESENTATION
Topic: Strengthening: Design & Challenges
Offices of Simpson, Gumpertz & Heger
Waltham, MA

October 15, 2024
ANNUAL GOLF TOURNAMENT
Tedesco Country Club
Marblehead, MA

NORTH TEXAS
October 4, 2024
JESSE POINTS MEMORIAL GOLF CLASSIC
Waterchase Golf Club
Fort Worth, TX

PITTSBURGH
September 10, 2024
CHAPTER ROUNDTABLE PRESENTATION
Topic: Concrete Mix Design and Placement
11 Stanwix Conference Center
Pittsburgh, PA

October 11, 2024
ANNUAL TECHNICAL DEMO DAY
BA Local 9 Training Center
Monroeville, PA

VIRGINIA
October 24, 2024
FALL DEMO DAY
Topics include Helical Ties, Expansion Joints, and Hydrophilic Grout
Richmond Primoid Shop
Richmond, VA

PRODUCTINNOVATION

HOW TO OVERCOME DEFICIENCIES OF EPOXY-COATED REBAR

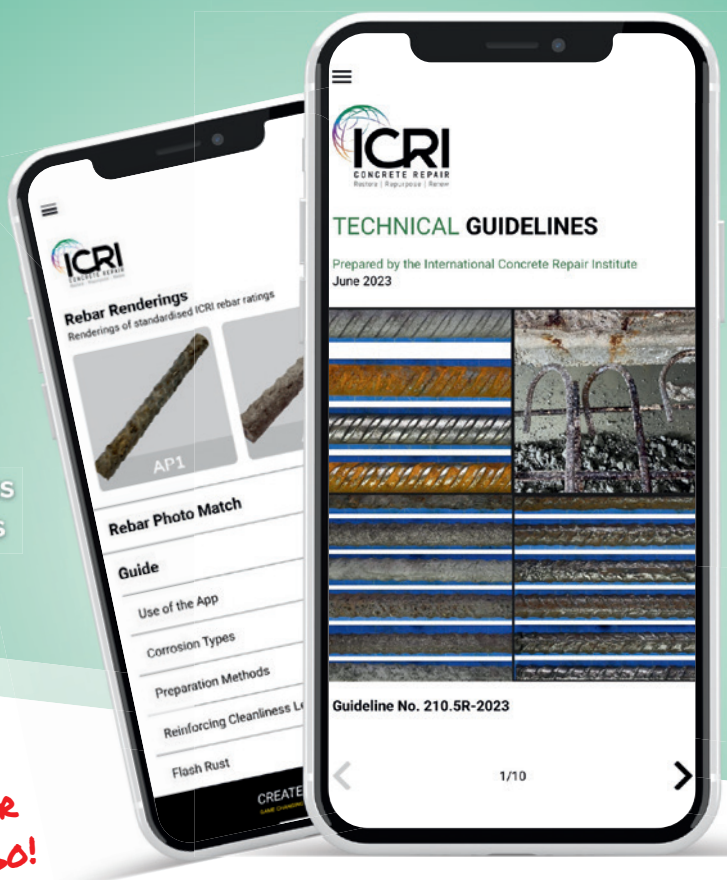
Concrete is the world's most widely used construction material. Although extremely durable, its chief vulnerability is corrosion. This occurs more readily on aging structures but can also attack new concrete located in hot, humid seaside climates or regions that rely heavily on deicing salts. Accordingly, rows upon rows of green epoxy-coated rebar are often seen staged at construction sites for enhanced protection. However, it is important that engineers and contractors understand this may not be an end-all to their corrosion worries and they need to be aware of alternative methods for overcoming the deficiencies of epoxy-coated rebar.

Raising the REBAR

The International Concrete Repair Institute (ICRI) is revolutionizing your approach to rebar in concrete repair. Our new mobile app streamlines cleanliness assessment and puts our industry-leading technical guideline at your fingertips.

Easy to use in the field or the office

Digital version of ICRI 210.5 "Guide for Selecting and Specifying Reinforcing Bar Cleaning Levels" included



Project reporting connects contractors and specifiers

Access to rebar renderings and photo match tool

ICRI CONCRETE REPAIR REBAR Cleanliness

LOOK FOR THIS LOGO!

GET IT ON Google Play

Download on the App Store

Grab your FREE download!
Available on Google Play and the App Store.

Unlock it all! Subscribe for just $2.99/year and get 16 ICRI rebar renderings, photo matching and reporting tools.

www.icri.org/rebar-cleanliness-app

COMMITTEE 160: LIFE CYCLE AND SUSTAINABILITY

MISSION STATEMENT

Increasing the longevity, resiliency, durability, and sustainability of concrete structures by providing tools to repurpose, protect, upgrade, extend the life, and maintain concrete structures.

BENEFITS OF COMMITTEE MEMBERSHIP:

Have an positive influence on the longevity, resiliency, durability, and sustainability of concrete structures by promoting the best and most adapted preservation/ maintenance program.

WHAT WE DO:

- Promote the best practice in sustainability by bringing the spotlight to the best projects at the yearly awards program.
- Promote the best practice to extend the service life and preserve existing structures.

GOALS/DELIVERABLES

1. Provide tools and prediction models to the industry to extend structure service life economically.
2. Promote the concept of sustainability through extending the structure service life by concrete repair.

www.icri.org/icri-committees

matthewc@icri.org

+1 651.366.6095

www.icri.org/volunteer-job-board

International Concrete Repair Institute

Restore | Repurpose | Renew

NEWMEMBERS

COMPANY MEMBERS

AK Industrial Services, LLC
Everett, Massachusetts
United States
Mark McLellan

Bulley & Andrews Concrete Restoration
Chicago, Illinois
United States
James Masterfield

Clean Sweep Hydroblasting
West Palm Beach, Florida
United States
Tracy Arnold

Crevalle Consulting LLC
North Fort Myers, Florida
United States
Joshua Michalski

Dry Works, LLC
Bristol, CT
United States
Monica Rourke

Edison Properties
Winnipeg, Manitoba
Canada
Robert Cornelius

Jablonski Building Conservation, Inc.
New York, New York
United States
Mary Jablonski

Martin Restoration LLC
Schaumburg, Illinois
United States
Martin Bazula

Mellow Construction, LLC
Mesa, Arizona
United States
Don Mellow

Paramount Painting & Services, Inc.
Tampa, Florida
United States
Karl Schmidt

Plan B Engineering
Huntingdon Valley, Pennsylvania
United States
Branden Ellenberger

Renaissance Stone Care and Waterproofing
Castro Valley, California
United States
Chevan Goonetilleke

Renovia
Tampa, Florida
United States
James Schulz

RestoreWorks Masonry Restoration
Griffith, Indiana
United States
Don Zuidema

Smart Finishes FL CORP
Winter Garden, Florida
United States
Javier Pineda

V-Rod
Rockford, Illinois
United States
Chuck Toth

WSP Canada
Toronto, Ontario
Canada
Nicholas Kwan

Yates Exterior Restoration Services
Long Island, New York
United States
Michael Yates

Zirconia Inc.
Tukwila, Washington
United States
Benjamin Cook

ADDITIONAL INDIVIDUALS FROM COMPANY MEMBERS

Abraham Jivanjee
The Quikrete Companies
Atlanta, Georgia
United States

Ahmed Alsalam
Sika Corporation
Edmonton, Alberta
Canada

Alex Ball
Vector Corrosion Technologies
Tampa, Florida
United States

Annie Hougland
Sherwin Williams Protective & Marine
Seattle, Washington
United States

Billy Marsden
White Cap Construction
Sarasota, Florida
United States

Brian Blesener
Sika Corporation
Lyndhurst, New Jersey
United States

Case Pikor
Vector Corrosion Technologies
Tampa, Florida
United States

Chaz Sztroin
KTA-Tator, Inc.
Pittsburgh, Pennsylvania
United States

Dalton Brodigan
Vector Construction
Winthrop, Iowa
United States

Daniel Kuhn
Hard Surface Finishers, Inc
Wood Dale, Illinois
United States

Daniel Nisivoccia
Walker Consultants
Houston, Texas
United States

Danny Odenthal
SpecChem
Rice, Minnesota
United States

Dave Fuller
Coastal Construction Products
Jacksonville, Florida
United States

David Jarrett
Sherwin Williams Protective & Marine
Garnett, Kansas
United States

David Parisian
CRX Inc.
Houston, Texas
United States

NEWMEMBERS

Dean Whitcomb
Spire Building Solutions
Boca Raton, Florida
United States

Dominick Akins
Gutknecht Construction
Columbus, Ohio
United States

Dylan Day
Vector Construction
Cedar Rapids, Iowa
United States

Elise Parisian
CRX, Inc. - Structural Restoration and Waterproofing
Houston, Texas
United States

Hunter Davis
Vector Construction
Cedar Rapids, Iowa
United States

Jacob Green
Gutknecht Construction
Columbus, Ohio
United States

Jamil Bhatti
Simpson Gumpertz & Heger Inc.
Waltham, Massachusetts
United States

Jason LaBonte
Pullman SST Inc.
Marlborough, Massachusetts
United States

Jason Oakley
Simpson Strong-Tie Company, Inc.
West Chicago, Illinois
United States

Jeffrey Elliott
Western Specialty Contractors
Kent, Washington
United States

Jeffrey Kindschuh
CRX, Inc. - Structural Restoration and Waterproofing
Houston, Texas
United States

John Best
The Quikrete Companies
Atlanta, Georgia
United States

John Neal
Gutknecht Construction
Columbus, Ohio
United States

Jon Wallace
Sherwin Williams Company
Naples, Florida
United States

Jorge Magallon
Nova Engineering and Environmental, LLC
Buford, Georgia
United States

Joseph Kutkoski
Hard Surface Finishers, Inc
Wood Dale, Illinois
United States

Jotsana Sunder
Simpson Strong-Tie Company, Inc.
West Chicago, Illinois
United States

Justin Roberts
Alpha Insulation and Waterproofing, Inc.
Lewisville, Texas
United States

Kent Sasaki
Wiss, Janney, Elstner Associates, Inc.
Emeryville, California
United States

Kimberly Lombardozzi
W.R. Meadows, Inc.
Hampshire, Illinois
United States

Kyle L. Schusler
Simpson Gumpertz & Heger
Waltham, Massachusetts
United States

Levi Duree
Neogard - Hempel (U.S.A - Inc.)
Conroe, Texas
United States

Mary Vancura
American Engineering Testing, Inc.
Saint Paul, Minnesota
United States

Mike Hazlett
Sherwin Williams Company
Naples, Florida
United States

Nicolai Sokulski
CRX, Inc - Structural Restoration and Waterproofing
Houston, Texas
United States

Pedro E. "Pete" Fernandez
Tremco Commercial Sealants & Waterproofing
West Warwick, Rhode Island
United States

Phil Thuys
CRX, Inc. - Structural Restoration and Waterproofing
Houston, Texas
United States

Sam Girgenti
Soprema, Inc.
Wadsworth, Ohio
United States

Sergio Farias
Vector Construction
Cedar Rapids, Iowa
United States

Shane Whiting
LRT Restoration Technologies
Indianapolis, Indiana
United States

Spencer Mahagan
White Cap Construction
Norcross, Georgia
United States

Steve Kotler
Sherwin Williams Protective & Marine
Cincinnati, Ohio
United States

Steven Negahbani
Sika Corporation
Lyndhurst, New Jersey
United States

Tim Kavka-Coogan
ESCA Blast
Hatfield, Pennsylvania
United States

NEWMEMBERS

Toby Butler
Sherwin Williams Protective & Marine
Moon Township, Pennsylvania
United States

Todd Cooklin
Ecobeton-USAGST Int
Sparks, Nevada
United States

Tom Behr
Concrete Strategies Inc
Saint Louis, Missouri
United States

Tom Kuhn
Sherwin Williams Company
King of Prussia, Pennsylvania
United States

ADDITIONAL INDIVIDUALS FROM SUPPORTING MEMBER COMPANIES

Andrew Tucker
NCFI Polyurethanes
Mount Airy, North Carolina
United States

Andy Castillo
Balco, Inc.
Wichita, Kansas
United States

Chris Gibby
NCFI Polyurethanes
Clemmons, North Carolina
United States

Dan Wald
Beacon Waterproofing
Stillwater, Minnesota
United States

Dirk Tharpe
Sakrete
Charlotte, North Carolina
United States

Jeremy Begley
MAPEI Corporation
Castle Rock, Colorado
United States

Jim Spencer
Euclid Chemical
Cleveland, Ohio
United States

Josh Burcaw
NCFI Polyurethanes
Mount Airy, North Carolina
United States

Kevin Irwin
NCFI Polyurethanes
Mount Airy, North Carolina
United States

Luis Pelayo
STRUCTURAL
Geneva, Illinois
United States

Patrick Slaughter
STRUCTURAL
Towson, Maryland
United States

Rick Smith
Structural Services Inc.
Richardson, Texas
United States

Roxanne Zamacona
Miracote Division of Crossfield Products Corp.
Washington, UT
United States

Tim Panek
MAPEI Corporation
Fuquay Varina, North Carolina
United States

INDIVIDUAL MEMBERS

Adam Zuber
Seattle, Washington
United States

Ally Hodges
Tampa, Florida
United States

Anthony J. "Tony" Cennamo, P.E.
New York, New York
United States

Asher Rudyan
Auburn, Washington
United States

Austin Darrimon
Turlock, California
United States

Billy Campbell
Novato, California
United States

Bob Wiley
Orlando, Florida
United States

Brandon Silar
Fort Collins, Colorado
United States

Caleb Dyck
Birmingham, Alabama
United States

Charles Ohrnberger
Sterling, Virginia
United States

Charles Pham
Kent, Washington
United States

Clemente Zamarripa
Houston, Texas
United States

Connor Koch
Spring Lake Park, Minnesota
United States

Craig Greenfield
Santa Ana, California
United States

Dan Freeman
Lyndhurst, New Jersey
United States

Darren Ashford
Golden, Colorado
United States

David Scott
Statesboro, Georgia
United States

Diego Oliveira
Deerfield, Florida
United States

DJ Devine
New Lenox, Illinois
United States

Emilio M. Takagi, MSc.
East Setauket, New York
United States

Emmanuel Allen
Lebanon, Tennessee
United States

NEWMEMBERS

Eric Morris
Marietta, Georgia
United States

Erric Jackson
Powder Springs, Georgia
United States

Fernando Dona
West Park, Florida
United States

Fernando Guzman
Hollywood, Florida
United States

Freddy J. Jara
North Myrtle Beach, South Carolina
United States

Gerald Delaune
Dallas, Texas
United States

Greg Lason
Gilbert, Arizona
United States

Harry M. Burbank
Edison, New Jersey
United States

Heath Pederson
Phoenix, Arizona
United States

Henry Dearing
St. Petersburg, Florida
United States

HJ Royston
Denver, Colorado
United States

Irfan Ahmed
Portage, Michigan
United States

Ivan Arroyo
Fort Myers, Florida
United States

Jack S. "Sandy" Crump Jr, P.E., S.I.
St. Petersburg, Florida
United States

Jacob Vernon Furr, C-MESH
Salisbury, North Carolina
United States

Jaime Castillo
Doral, Florida
United States

Jake Brown
Portland, Oregon
United States

Jake Lang
McKees Rocks, Pennsylvania
United States

James Reed
Winter Haven, Florida
United States

Jamieson Matthews
Birmingham, Alabama
United States

Jason Borden
Hollywood, Florida
United States

Jason Johnston
Abita Springs, Louisiana
United States

Javier Garcia
Fort Myers, Florida
United States

Jeremy Guinn
Aston, Pennsylvania
United States

Jhon Chavez
Washington, DC
United States

Jimmy Boswell
Orange Beach, Alabama
United States

John Bennett
Charleston, South Carolina
United States

John Lackey
Laure, Maryland
United States

John McGill
Gainesville, Georgia
United States

Jorge Hernandez Carranza, PE, SE
Austin, Texas
United States

Jose Vazquez
Hollywood, Florida
United States

Juan Velasquez
Houston, Texas
United States

Julio Rivas
Greenacres, Florida
United States

Kerry Pierce
Tulsa, Oklahoma
United States

Kevin Keohane
Edmonton, Alberta
Canada

Kevin Marks
Chicago, Illinois
United States

Kevin O'Sullivan
Orange Beach, Alabama
United States

Khaalid Lockett
Vallejo, California
United States

Liam Holloway
Perth
Australia

Marc Barter
Mobile, Alabama
United States

Marc Shen
Palmetto, Florida
United States

Mark Doughty
Wintersville, Ohio
United States

Matt Garrett
Houston, Texas
United States

Max Dashine
Oreland, Pennsylvania
United States

Michael Badeaux
Thibodaux, Louisiana
United States

NEWMEMBERS

Michael Carfagno
West Chester, Ohio
United States

Michael Dieu
Phoenix, Arizona
United States

Michael Solimine
Chicago, Illinois
United States

Miguel Rodriguez
Tampa, Florida
United States

Mike Hyland
Trenton, Michigan
United States

Mike Morris
Bountiful, Utah
United States

Mina Savaroliya
Houston, Texas
United States

Neil Denham
Darlington, England
United Kingdom

Norge Arnaiz, Jr.
Miramar, Florida
United States

Orestes L. "Ore" Lopez Recio, BA
Miami, Florida
United States

Patrick Kenealy
Evanston, Illinois
United States

Patrick Runkewich
Pompano Beach, Florida
United States

Paul Greenhalgh
Phrapradaeng, Samutprakarn
Thailand

Paul Noyce
Poughkeepsie, New York
United States

Pratik Murkute
Tampa, Florida
United States

Robert F. "Rob" Brown
Tampa, Florida
United States

Ronald Woods
Jacksonville, Florida
United States

Ross Babcock
Little Canada, Minnesota
United States

Ryan Irving
Hockessin, Delaware
United States

Ryan Little
Brandon, Mississippi
United States

Ryan McCreery
Indianapolis, Indiana
United States

Sawyer Wilson
Dunedin, Florida
United States

Scott Meredith
Safford, Arizona
United States

Sheri Marzano
Dade City, Florida
United States

Stefano Leonardi
Hampton, Virginia
United States

Stephen Hughes
Levittown, Pennsylvania
United States

Stephen Tennant
Richmond, British Columbia
Canada

Thomas Hutchins
Moraine, Ohio
United States

Traci Powell
Pittsburgh, Pennsylvania
United States

Tucker White
Blacksburg, Virginia
United States

William "Brent" Haynes
Lynchburg, Virginia
United States

Yang Li
Akron, Ohio
United States

Yolani Negron-Rivera
Cidra, Puerto Rico
United States

Yong Yue
Tampa, Florida
United States

Zachary von Stein
Littleton, Colorado
United States

Zack Ballard
Denver, Colorado
United States

Zeyad Sattar Surrey
British Columbia
Canada

GOVERNMENT MEMBER

Eric Morin
Ministry of Transportation Ontario
North Bay, Ontario
Canada

STUDENT MEMBERS

Ahmad Afzali
New Jersey Institute of Technology
Newark, New Jersey
United States

Alexis Smith
Vector Construction
Decatur, Illinois
United States

Ali Jarekji
Oklahoma State University
Stillwater, Oklahoma
United States

Ambar Lennon Baron Bello
University of Alberta
Edmonton, Alberta
Canada

Anthony Gosner
State College of Florida
Bradenton, Florida
United States

NEWMEMBERS

Belinga "Worrick" Jean-Charles Ludovic, MENG
National Advanced School of Public Works
Yaoundé
Yaoundé
Cameroon

Brandon Gonzalez
New Jersey Institute of Technology
Newark, New Jersey
United States

Brayan A. Baca Cruz
Universidad Andina Nestor Caceres Velasquez
Puno
Peru

Brett Graham
Vector Construction
West Fargo, North Dakota
United States

Charles McCue
Vector Construction
Omaha, Nebraska
United States

Chris Wintergalen
Pullman SST Inc.
Kansas City, Missouri
United States

Christopher Cruz
Nova Engineering and Environmental, LLC
Buford, Georgia
United States

Dallessandro J. "Dell" Castellanos
New Jersey Institute of Technology
Morristown, New Jersey
United States

Damaris Martinez Zeas
New Jersey Institute of Technology
Newark, New Jersey
United States

Daniel E. Vargas Sanchez, BA
Queen's University
Kingston, Ontario
Canada

Dylan Zappata
New Jersey Institute of Technology
Newark, New Jersey
United States

Elijah Bauer
Indiana University
Noblesville, Indiana
United States

Hesam Eshraghi
K. N. Toosi University of Technology
Tehran
Iran

Iyanna Lloyd
New Jersey Institute of Technology
Newark, New Jersey
United States

Jayden Correia
Vector Construction
Decatur, Illinois
United States

Jeffrey Borquist
Emerald Epoxy
Eugene, Oregon
United States

Jhosua Rodriguez
New Jersey Institute of Technology
Newark, New Jersey
United States

John Price
Texas State University
San Marcos, Texas
United States

Jomar Rivera
University of Puerto Rico at Mayaguez
Mayaguez, Puerto Rico
United States

Katherine Connor
Vector Construction
Winfred, South Dakota
United States

Luca Montanari
University of Texas at Austin
Austin, Texas
United States

Luke MacMillan
Dalhousie University
Halifax, Nova Scotia
Canada

Madeleine Murphree
University of Florida
Athens, Georgia
United States

Mohamed Ramadan Mahfouz
Alexandria University
Abu Dhabi, Ash Shariqah
United Arab Emirates

Nikolaos Figueroa
New Jersey Institute of Technology
Newark, New Jersey
United States

Parham Mohajerani
CCSR Consulting Engineers Pty Ltd
Kingswood, New South Wales
Australia

Sai Kishore "Sai" Medarametla, MSc
Fosroc International Limited
Tower Hamlets, England
United Kingdom

Shirly Zeas-Barrera
New Jersey Institute of Technology
Newark, New Jersey
United States

Stanley Mejia
New Jersey Institute of Technology
Newark, New Jersey
United States

Volodymyr Dutchyn
Illinois Institute of Technology
Niles, Illinois
United States

Willy A. Giron Matute
University of Alabama
Pembroke Pines, Florida
United States

Volunteer

Why Volunteer?

The success of the International Concrete Repair Institute and its work in the industry depends on a strong, active volunteer force. As a member of ICRI, you are invited to participate in the meetings and projects of any ICRI administrative or technical committee. All are volunteer-led and depend on your expert contributions.

ICRI's volunteer program strives to create an environment that is friendly and welcoming. As an ICRI volunteer, you work closely with volunteer leaders and ICRI staff—active parts of each committee—and available to assist you to answer questions about how ICRI operates, and to help you be the most effective volunteer possible.

Follow Your Interests

Check out the administrative and technical committees of ICRI, attend their meetings and learn what each is working on. Then decide where your area(s) of interest fit best. The ICRI staff is here to answer your questions and help align you with your interests. You are welcome to attend any meeting of any committee on the administrative or technical committee list. You attend—you can decide if you want to join.

Length of Commitment

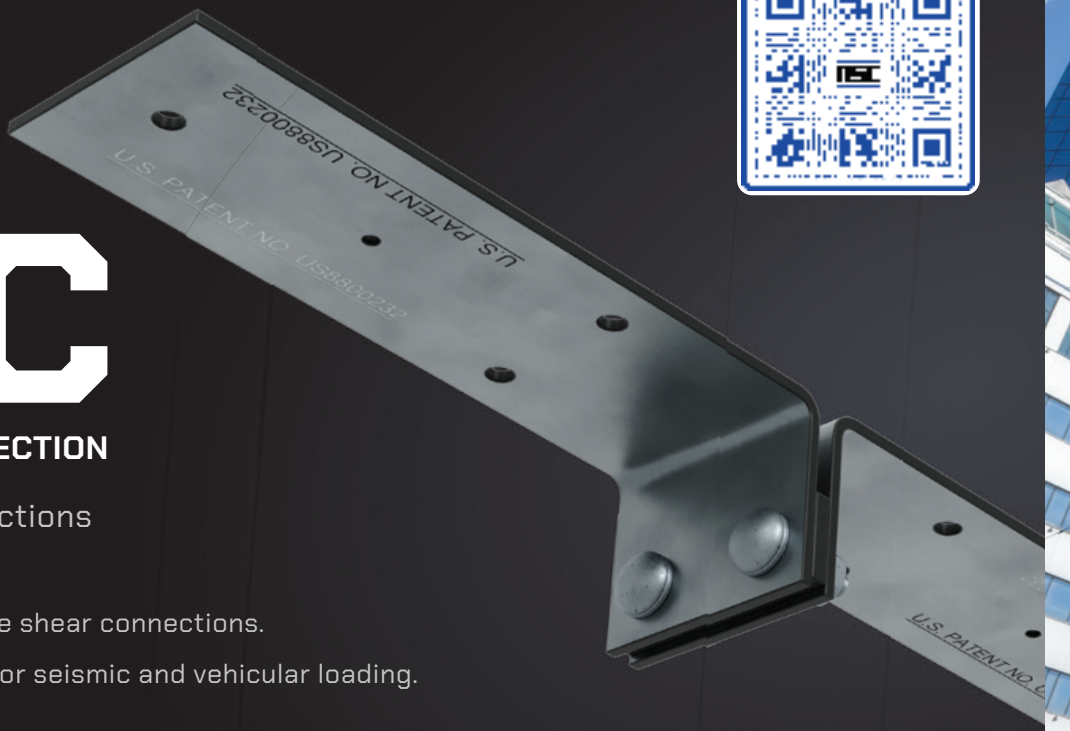
Most volunteer commitments are ongoing; leadership positions are a 3-year commitment. Committees usually meet monthly for 1-1.5 hours. In addition, committees often require tasks to be completed outside of the meetings on the volunteer's own time. **Visit www.icri.org for more information**.

INDEX OF ADVERTISERS

ICRI
CONCRETE REPAIR
Restore | Repurpose | Renew

INTERNATIONAL CONCRETE REPAIR INSTITUTE
1601 Utica Avenue South, Suite 213, Minneapolis, Minnesota 55416
P: 651-366-6095 | E: info@icri.org | W: www.icri.org

NORTHFORD STRUCTURAL CONNECTIONS



Introducing the

DTFC

DOUBLE-TEE FLEXIBLE CONNECTION

By Northford Structural Connections
(U.S. PATENT NO. US8800232)

Finally, a solution to failed double-tee shear connections.

A post-installed flexible connection for seismic and vehicular loading.

TESTED | PROVEN RESULTS | FATIGUE RESISTANT | CORROSION RESISTANT

TYPICAL FAILURES

Traditional double-tee connections can fail for many reasons, including corrosion of attached reinforcement, restrained tension in colder months, and fatigue from vehicular loading. The immediate and tangible result is in moving and leaking joints. More importantly, it also leaves the cantilevered double-tee flange unsupported and diminishes the seismic resistance of the deck diaphragm.

OLD METHODS FALL SHORT

Spall repairs at connections fail because the concrete patch is adhered to a stressed connection; it is a fight the patch cannot win. And weld repairs at fatigue fractures do not change the underlying problem; they just restart the clock.

OUR SOLUTION

Our DTFC is designed to both repair and avoid the common pitfalls of the traditional connection. It is corrosion resistant, allows movement across the joint to dissipate tensile loads, and is not affected by vehicular fatigue loading.

A GAME CHANGER

The DTFC was designed by industry experts seeking to provide a simple and resilient solution to the familiar precast double-tee garage connection weaknesses and failures. It succeeds where tradition has failed.

The DTFC is a product of Northford Structural Connections, a privately held company.

(203) 777-0751 • nsccclips.com • admin@nsccclips.com

Your **single-source provider** for construction projects, restoration, strengthening and corrosion protection

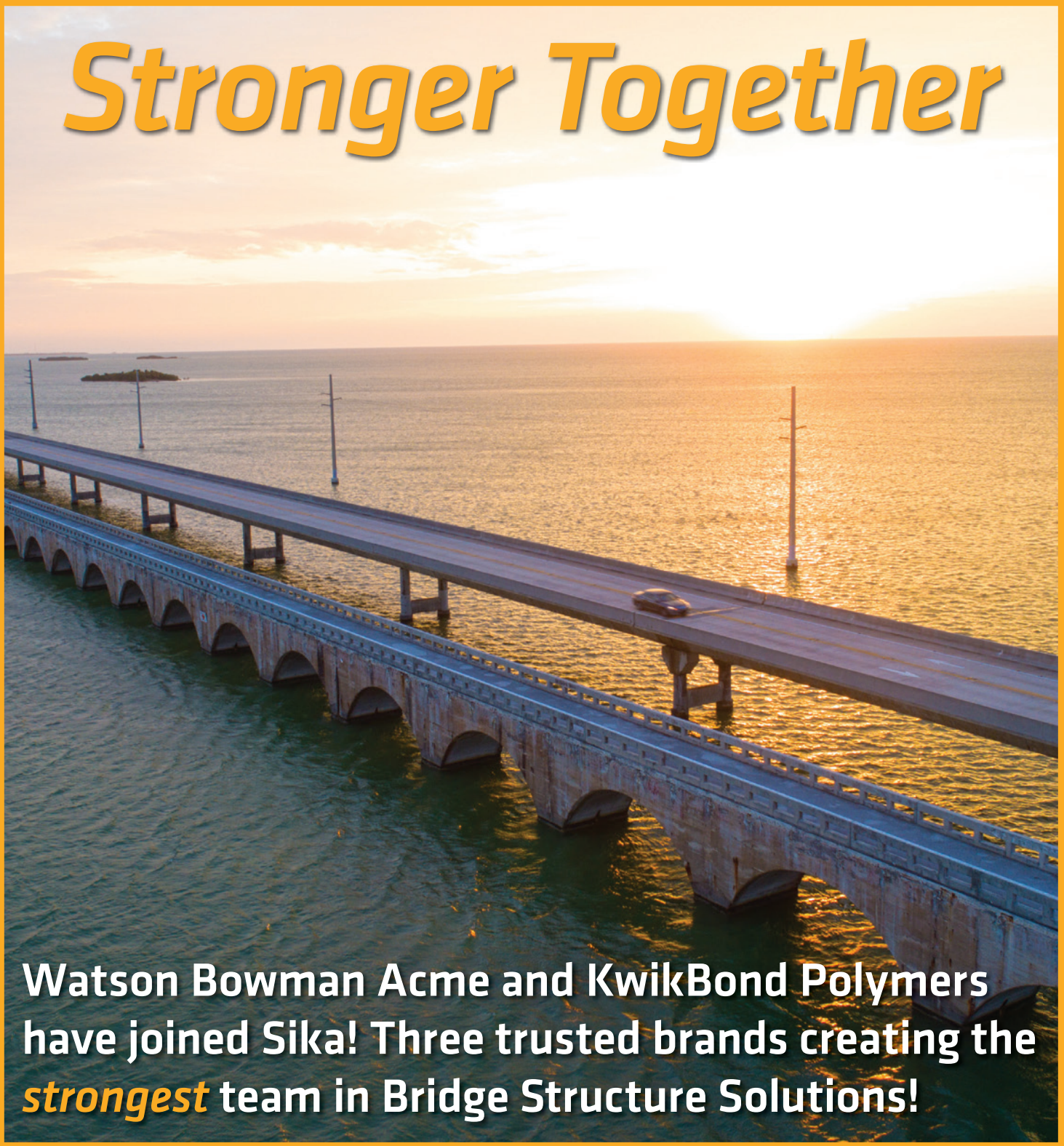
MAPEI offers a full range of products for concrete restoration, waterproofing and structural strengthening. Globally, MAPEI's system solutions have been utilized for such structures as bridges, dams, tunnels, highways, parking garages, stadiums and high-rises.

Visit www.mapei.com/us for details on all MAPEI products.

MAPEI USA

MAPEI®

Stronger Together



Watson Bowman Acme and KwikBond Polymers have joined Sika! Three trusted brands creating the *strongest* team in Bridge Structure Solutions!

Watson Bowman Acme

KWIKBOND POLYMERS

BUILDING TRUST

Sika®

SIKA CORPORATION
201 Polito Avenue | Lyndhurst, NJ 07071 | 800.933.SIKA | usa.sika.com