September/October 2019
Vol. 32, No. 5

# CONCRETE REPAIR BULLETIN

A Bimonthly Publication of the International Concrete Repair Institute

# WATERPROOFING WITH AESTHETICS

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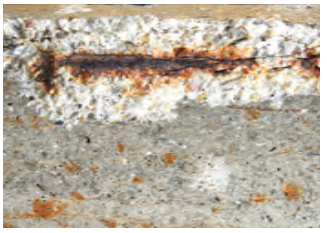


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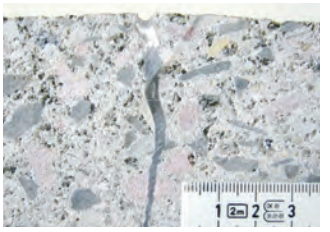
**MMA Crack Sealer HE**



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**ON THE COVER:** Stadium repairs including new landings, coatings, and minimally modified rails to maintain sightlines; see page 14 for article, "Waterproofing with Style: Nissan Stadium Upper Deck and Upper Concourse Waterproofing and Repair Case Study."

CONCRETE REPAIR
# BULLETIN

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## FEATURE ARTICLES



## DEPARTMENTS



## NOTE FROM THE EDITOR

Fall is here and things continue to be busy for many of our members. The 2019 ICRI Fall Convention in Philadelphia is rapidly approaching. The theme is "Historic Restoration: The Art and Science of Preserving Structures." Registration for the Convention is open. Make sure you reserve your hotel room by October 21, 2019, to take advantage of special pricing in the ICRI block of rooms.

The theme for this issue of the *Concrete Repair Bulletin* is Waterproofing with Aesthetics: Making It Dry and Appealing to the Eye featuring articles: "Spokane City Hall Building Restoration" by Rusty Boicourt (Veritas Material Consulting); Waterproofing with Aesthetics: Making it Dry and Appealing to the Eye—One Decorative Option" by Rich Cofoid (Euclid Chemical Company); "Waterproofing with Style: Nissan Stadium Upper Deck and Upper Concourse Waterproofing and Repair Case Study" by David Tepke (SKA Consulting Engineers, Inc.), Bryan Wood (University of Alabama), and Christopher Bathgate (SKA Consulting Engineers, Inc.); plus two more sections on the Evolution of the ACI 562 Code series.

*The Concrete Repair Bulletin* is always looking for new contributors. If you think you have an interesting project case study or topic, please feel free to reach out to us. We would love to have more member authors.

I hope you continue to have a successful and safe 2019 and look forward to seeing you in Philadelphia for this year's Fall Convention!

Jerry Phenney, Editor, CRB
MAPEI Corporation

# PRESIDENT'S MESSAGE

CHRIS LIPPMANN

As the Fall months are upon us we are now just a few weeks away from our convention in Philadelphia. This host city will serve as a perfect backdrop to our convention theme "Historic Restoration: The Art and Science of Preserving Structures." Our hosting Delaware Valley chapter has done an incredible job putting together some new social and networking events and we expect record breaking attendance. Whether you are a novice or seasoned professional, this is your best opportunity to expand your understanding of concrete repair through networking, technical sessions with PDH credits, and participating in ICRI committee meetings. So if you want to stand out and be recognized as an Industry leader, attendance at this convention is a must. I look forward to seeing you!.

Christopher R. Lippmann

Chris Lippmann
2019 ICRI President

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**ICRI Mission:** ICRI provides education, certification, networking and leadership to improve the quality of repair, restoration, and protection/preservation of concrete and other material systems.

**Our Vision:** ICRI will be the center for repair leadership supporting a profession built on science and craftsmanship making the built world safer and longer lasting.

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# TACTALK

## Megatrends in Concrete Construction

FRED GOODWIN

More than twice as much concrete and mortar is used in construction than all other industrial building materials including wood, steel, plastic, and aluminum.[1] The total mass of concrete manufactured since the middle of the nineteenth century will soon exceed one trillion metric tons with about one-fourth of this amount reinforced with steel.[2] This is enough to cover the entire planet with a few millimeters of concrete. Thermodynamically, this steel will eventually corrode and cause rapid deterioration of concrete. It is estimated that between now and 2030, an investment larger than the value of today's worldwide infrastructure (over $50 trillion U.S.) will be required just to keep up with the projected global GDP growth.[3] The concrete repair industry should be a growth opportunity. It is unlikely that society will replace conventional concrete and reinforcing steel anytime soon.

Despite how much concrete is used and its vital role in our world, there are many things we still do not know about the material. The chemistry of cement is fairly well known, but once it is mixed into concrete the story quickly becomes much more complicated.[4] Portland cement is produced by heating limestone and clay minerals in a kiln to about 1,450° C (2,640° F) to form clinker, grinding the clinker, and adding 2 to 3 percent of gypsum.[5] The properties of cement are influenced by the ratio of calcium to silica to aluminum to iron along with other minor ingredients in the raw mix; the rate of heating and cooling to form clinker, and the fineness of grinding of the clinker. During the finish grinding, a few percent of gypsum is added in the milling process. Cement sets when mixed with water by way of a complex series of chemical reactions still only partly understood. The different constituents slowly hydrate, and the interlocking of their hydration products gives cement its strength. Analysis of hydrating cement is difficult because most analytical techniques require time, involve heating, transmission of light, or use of a vacuum, all of which change or are opaque to the hydrating cement.

Reinforced concrete is a hybrid between liquid and solid, granular and colloidal, gel and crystalline, smooth and rough, compact and porous, metal and mineral, compression and tension, brittle and ductile, material and process, technicality and art, whose properties are influenced over at least 8 orders of magnitude[6, 7, 8] (Fig. 1).

The addition of admixtures further complicates concrete, since admixtures typically act on the hydrating cement. "Admixtures confer several beneficial effects on concrete including reduction in water requirements, increased workability, controlled setting, accelerated hardening, improved strength, better durability, desired coloration, and volume changes. The use of admixtures is generally based on trial-and-error because of an incomplete understanding of their mechanism of action."[9] Additives that retard the setting time at one level can accelerate the setting time at a different dosage.[10, 11] Different chemistry superplasticizers added separately improve fluidity but if combined can thicken the concrete dramatically or be used to stabilize grout.[12] Nearly any change in temperature, mixing time, or admixture will affect the air content of concrete.[13]

Concrete is complicated, and this provides opportunities for technology improvement. Several megatrends have been identified that will greatly impact the future use of concrete. According to the World Economic Forum, the engineering and construction (E&C) sector has been slower than other sectors to adopt and adapt to new technologies. While some innovation has occurred, overall productivity has remained nearly flat for the last 50 years. E&C have historically taken a conservative approach to product design and delivery, leading to silos in project management and a fragmented industry. This slow pace of innovation matters because of the great scope and scale of E&C. The industry accounts for about 6% of global GDP and is growing. E&C is the largest consumer of raw materials and other resources, using about 50% of global steel production and more than 3 billion tons of raw materials. Any improvement in productivity and successful adoption of modern innovative processes will have a major impact. For example, a 1% rise in productivity worldwide could save $100 billion a year.[14]

There are many different descriptions of megatrends but limiting the scope to these four covers much of the predictive landscape: Sustainability, Digitalization, Urbanization, and Automation.

Regarding sustainability, concrete compares favorably to other construction materials in several models. Over the last 40 years, U.S. cement manufacturers have reduced the energy used to produce a metric ton of cement by roughly 40 percent. Industrial byproducts (such as waste solvent and discarded car tires as fuel sources and bottom ash, utility boiler slag, foundry sands, iron mill scale and limestone fines, etc., as raw materials) that otherwise would end up in landfills, now represent more than 15 percent of total cement plant energy consumption in the U.S. Concrete structures are long-lived, such as pavements that have an average service life of 30-50 years. Concrete consumes

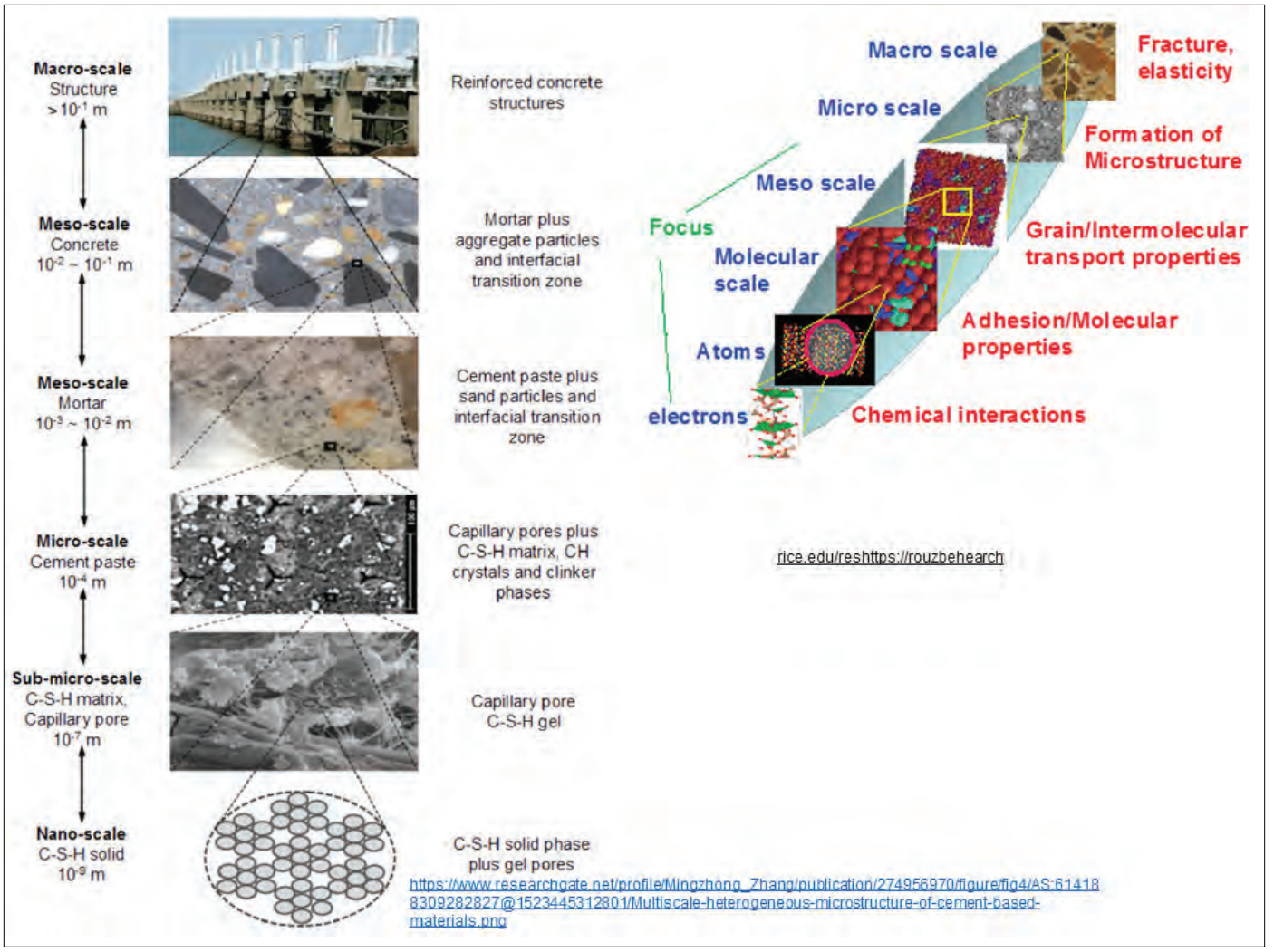


Fig. 1: Illustrations of concrete properties vs. scale

minimum materials, energy and other resources for construction, and requires little to no maintenance throughout its service life. Concrete does not rust, rot, or burn. Concrete is resilient by being resistant to natural and man-made disasters. Because of its durability, concrete structures will not require additional carbon release to produce additional materials used for repair.[15, 16]

Concrete technology is far from the end of its evolution. Corrosion of reinforcing steel and other embedded metals is the leading cause of deterioration in concrete.[17] While there are many interesting innovations in concrete technology to address reinforcement corrosion issues, two ideas seem to stand out and have synergy between them. Many researchers are investigating adding bacteria or fungi along with a food source that secretes calcium carbonate into cracks as they form to create self-healing concrete in narrow cracks. Recently, research has found nitrite-producing bacteria can produce corrosion inhibition by a parallel process using another type of bacteria.[18] Keeping cracks sufficiently narrow and providing ductility to concrete can be accomplished with a technology known as Engineered Cementitious Composite (ECC).[19, 20, 21] ECC uses fibers whose properties of adhesion and elongation are balanced with the tensile strength of the cementitious material so that after a crack forms instead of the crack widening, another very narrow crack forms. This results in many very narrow cracks that can be addressed with elastomeric coatings or penetrating sealers while increasing the tensile strength of the member using non-corroding fibrous reinforcement.

Concrete also claims to be the most recycled material. Construction and demolition (C&D) waste is a central component of the solid waste stream, amounting to roughly 25 percent of total solid waste nationally. The largest part of C&D material is concrete, which encompasses around 70 percent of C&D generated material before recycling, according to the U.S. EPA.[22] Over 140 million tons of concrete are recycled annually, according to the Construction & Demolition Recycling Association. Construction and demolition waste (CDW) accounts for about 25 percent of all solid waste but is not considered in the more commonly tracked Municipal Solid Waste accounting, so there is no personal connection like we have with steel (80 million tons

recycled per year), glass (3.4 million tons recycled per year), paper (43 million tons recycled per year), or plastics (3.1 million tons recycled per year).[23, 24, 25, 26] The largest use for recycled concrete is as the fine aggregate used for road base construction, followed by use for soil stabilization and landscaping materials.[27] Concrete is also a large user of industrial waste materials, including fly ash, silica fume, and granulated ground blast furnace slag.

Digitalization can be thought of as a method, practice, or process of converting information into a digital form which is computer readable to make that information more feasible to archive, readily access, and share.[28] By 2020, analysts predict there will be 526 million pieces of manufacturing equipment capable of communicating through sensor-enabled networks. These connected machines stream health and status data, which is captured by other machines or by monitoring systems. Should the data fall outside of normal parameters, alerts are triggered, allowing workers to immediately resolve the problem, or in some cases prompting the equipment to self-adjust. When analyzing equipment status and performance data to determine trends, it is possible to predict potential malfunctions and maintenance needs to proactively schedule maintenance during times of least impact and avoid unexpected, costly downtime. Once a company has implemented remote monitoring and predictive maintenance solutions, it is possible to take the next step toward predicting product and construction quality by tracking and measuring the durability of the concrete mixture and reporting on compliance to international standards based on predictive qualities of the concrete, instead waiting for analysis results from a laboratory or overly conservative compositional specifications. Streamlining logistics affords a large opportunity for improvement by collecting, comparing, and integrating data from multiple sources to identify best practices or anomalies that can be used to make smart decisions that improve production.[29] One major component of digitalization is Building Information Management systems (BIM). BIM is forward-looking digital planning and working method integrating the work of all stakeholders involved in construction. With BIM, a building is built twice—first virtually and then physically. The physical construction process begins only after the virtual building meets all expectations and specifications, saving time and costs while improving quality and avoiding conflicts between trades and stages of construction. Changes are easier to make in the virtual model than in a real physical building and can extend the value creation beyond planning and construction phases to the long-term, cost-intensive operation phase and eventual restoration, renovation, repair, and rehabilitation of the structure.[30]

Half of humanity (3.5 billion people) live in cities today, but by 2030, almost 60 percent of the world's population will live in urban areas. Of this urban expansion, 95 percent will take place in the developing world. Currently, 828 million people live in slums and the number keeps rising. The world's cities occupy just 3 percent of the Earth's land, but account for 60-80 percent of energy consumption and 75 percent of carbon emissions. This rapid urbanization is exerting pressure on fresh water supplies, sewage, the living environment, and public health. The high density of cities can bring efficiency gains and technological innovation while reducing resource and energy consumption.[31] This shift in population will increase the demand for new infrastructure as well as increase the value of preserving the resources already constructed. Because concrete is the material of choice for most urban infrastructure, the trend toward urbanization will further increase the importance of concrete.

Automation will continue to arrive in the concrete industry. As mentioned previously, a tremendous potential for improvement in construction efficiency exists through automation. If construction-sector productivity were to catch up with that of the total economy, this would boost the sector's value added by an estimated $1.6 trillion, adding about 2 percent to the global economy, or the equivalent of meeting about half of the world's infrastructure needs. One-third of this opportunity is in the United States.[31] Since 1995, productivity in manufacturing has nearly doubled, while remaining nearly flat in construction.[33] One of these rapidly emerging productivity enhancers will be additive manufacturing (AM), also known as 3D printing with concrete. Additive manufacturing is a procedure that forms layers to create three-dimensional (3D) solid objects from digital models, allowing creatives, engineers, architects, and designers to make customized designs in a one-step process. Printing of concrete construction materials requires mix formulations in which the setting time of the paste, shape stability of first few layers, and interlayer bonding between the layers are thoroughly controlled and investigated for optimization. AM has many ground-breaking benefits for the construction sector and could offer multiple advantages over traditional techniques, including reduced material waste (up to 30%),

lower energy use, in-situ production, extended architectural design freedom with lesser resource demands and related CO2 emissions over the entire product life cycle. It also induces changes in labor structures (including the aging workforce), provides a safer working environment, and generates shifts toward more digital and localized supply chains. Automation through AM with concrete has the potential to improve consistency of production, increase the versatility of concrete construction, and reduce the need for formwork. Issues to be resolved include performance standardization, standards for materials, interlayer bonding, and structural design.[34] The commercial success of 3D concrete printing lies in the robustness of the design and manufacturing process, the ability for architects and engineers to design certifiable components and building elements, and in the value of the manufactured components. Although the value of automation to the industry lies with the health of an aging workforce and dealing with skilled labor shortages, the value of the component is dictated by its quality. Quality is created by manufacturing precision, material performance, and in some components, the aesthetic: ever more so in the current age of personalization and adaptation of design for individual cases. AM with concrete can potentially provide "value added" through the design of additional functionality and digitally controlling the manufacturing process.[35]

In conclusion, concrete is far from being a mature and boring industry. These are only some of the technical advances that are forthcoming. Our understanding of the material and our innovations in technology will continue to make concrete the most common and least understood construction material.

***Fred Goodwin*** *is the outgoing chair of the ICRI Technical Activities Committee (TAC).*

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# SECRETARIAT UPDATE

ANDREW FULKERSON

What do awards, contests, guidelines, and chapter members all have in common?

These have all been IDEAs recently submitted to the Secretariat to be reviewed, pondered, and discussed in our monthly meetings that occur the first Friday of each month. Each member of the Secretariat brings years of experience in ICRI and their respective fields to better understand the IDEAs as submitted, directing them to the proper committee(s), and ensuring that the IDEA is not lost in the shuffle.


The most recent IDEAs that have been submitted include:

1. **Photo Contest**—This is an IDEA that was submitted to collect industry photographs for developing an ICRI photo library to be used by the committees for their guidelines, presentations, etc.

2. **Emerging Professionals Award**—There are many young professionals that put their heart and soul into ICRI activities at both the national and chapter levels. This would be an award to recognize young professionals who actively participate in ICRI.

3. **New Member Orientation**—How many of us joined ICRI not knowing what we were getting into? How many of us joined because our company was a supporting/company member and we were asked to get involved? This IDEA was submitted to create a webinar or presentation outlining the benefits of ICRI to new members and to better outline how they can be involved at the chapter and national levels.

4. **New Volunteer Orientation**—Similar to number 3, this would provide training to volunteers who offer their assistance within ICRI for various committee and chapter duties to know what it means to volunteer within our great institute.

5. **Concrete Surface Profiles (for the Flooring Industry)**—Taking one of our largest monetary contributors, the CSP chips, and offering a condensed version for the flooring industry. This would be offered with a guideline and written in terms of wood, tile, carpet, resinous flooring contractors, and manufacturers in mind.

As you can see, we receive a multitude of ideas from our membership. What happens next after they are reviewed within the Secretariat?

Once submitted and discussed, we vote to see if there is a need for the IDEA within ICRI. We also take advice from the ICRI staff and past Secretariats in attendance. If accepted, we then discuss which committees will be tasked with introducing the IDEA to their committee and following through with its inception into the proper media form within ICRI. Once accepted, an acceptance letter is drafted and sent to the committee chairs as well as the original submitter of the IDEA. If the original submitter wants to be involved with the creation of the IDEA at the committee level, we encourage them to contact the appropriate chairperson assigned.

In some instances, we must make the hard decision to deny IDEAs as they do not benefit ICRI or do not fit within the scope and mission statement of ICRI. This does not mean that the IDEA is a "bad" idea, it just means that ICRI is not the proper platform for the inception of the submitted thought. We do try to give direction on the reason why the IDEA has been denied and where that submitter may take their thought, such as another organization or other industry platforms that may be better suited to handle the IDEA with their experience and expertise.

If a submission involves ICRI at a level that cannot be determined within the monthly meeting, we do seek insight from the Executive Committee, ICRI President, and/or the ICRI Management Company Ewald Consulting on how to handle it. Once this feedback is received by the Secretariat, the acceptance or denial process resumes.

If you have an IDEA, please submit it!

***Andrew Fulkerson*** *is a member of the ICRI Secretariat and a member of Committees 310 and 320; past chair of Committee 310; past member of TAC (2 terms) and Committee 710; and past VP of the Northern Ohio Chapter.*

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# Waterproofing with Style: Nissan Stadium Upper Deck and Upper Concourse Waterproofing and Repair Case Study

by David G. Tepke, Bryan T. Wood, and Christopher S. Bathgate

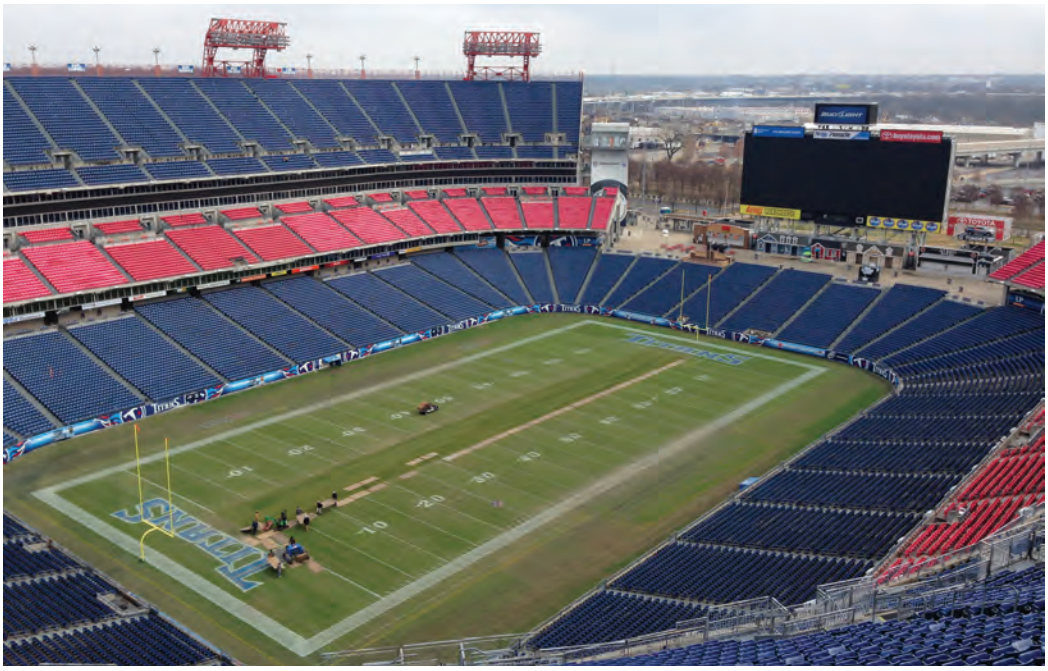

Fig. 1: Nissan Stadium

## INTRODUCTION

Major sports stadiums not only serve as the setting for spectators to witness events, but also act as a part of the event experience itself. Leaks in suites, distressed concrete, ponding water and deficient components can detract from the overall enjoyment of the event and compromise safety and stadium service life. Structural repairs, waterproofing repairs, and preservation techniques must be suitable for long-term effectiveness. However, they must also maintain sightlines and be aesthetically appealing. This article discusses some of the key functional and aesthetic aspects of repairs and waterproofing to a multi-use sports and entertainment stadium.

Nissan Stadium is a 69,000+ seat venue located on the bank of the Cumberland River in Nashville, Tennessee (Fig. 1). It is home to the Tennessee Titans and accommodates a number of major sporting and entertainment events annually. A condition assessment was conducted in 2014 to evaluate deterioration as well as leaks in suites and other conditioned spaces. This led to a concrete repair and waterproofing project at select portions of the upper deck and upper concourse during the 2016 NFL off-season to address primary areas of concern. Coordination with a concurrent seating replacement project and a multitude of off-season music and sporting events required meticulous and expedited planning, response, and execution by stadium officials, construction manager, specialty contractors, and engineer. The existing upper deck includes precast concrete risers on cast-in-place reinforced concrete raker beams and columns. The upper concourse is cast-in-place structural concrete with an unbonded topping slab over a split slab waterproofing system. The upper concourse area includes a number of concession stands and restroom facilities.

Fig. 2: Example of pre-existing expansion joint condition at upper deck

Fig. 3: Expansion joint system installation at concourse after installation of angle, adjacent concrete repair, and nosing materials

Waterproofing and concrete repairs to address deterioration, deficiencies, and leaks included:

- Expansion joint replacement;
- Upper deck precast concrete, infill step and landing repairs;
- Joint and crack sealants;
- Improvement of guard rail anchorage;
- Sloped bonded concrete overlay and coatings with necessary rail and step modifications at Upper Deck Row A overhang;
- Restroom and concession stand waterproofing coatings; and
- Concourse topping slab repairs

## EXPANSION JOINTS TO ADDRESS LEAKS IN SUITES

The stadium includes three major expansion joints on each side of the upper deck/upper concourse sections. Between the major structural movement joints at the upper deck are precast riser joints where risers are connected to raker beams via grouted dowel on one end and dowel in sealant at the other. Upper deck and upper concourse expansion joints are 6 to 8 in (150 to 200 mm) wide. Riser-to-riser joints are approximately 2 to 3 in (50 to 75 mm) wide. The condition assessment revealed deterioration and failure of these joints (Fig. 2), permitting significant leakage into conditioned spaces.

New seismic silicon/impregnated foam hybrid pre-compressed expansion joint systems were installed at all upper concourse expansion joints (Fig. 3), including in concession stands and restrooms, as well as at each of the major upper deck expansion joints and precast riser-to-riser joints from the bottom cantilevered overhang (Row A) to eleven rows above the vomitory wall for protection of conditioned spaces below (Fig. 4 and 5).


Fig. 4: Expansion joint material installation at upper deck after sawcutting and nosing installation (note removed guardrails for repairs)

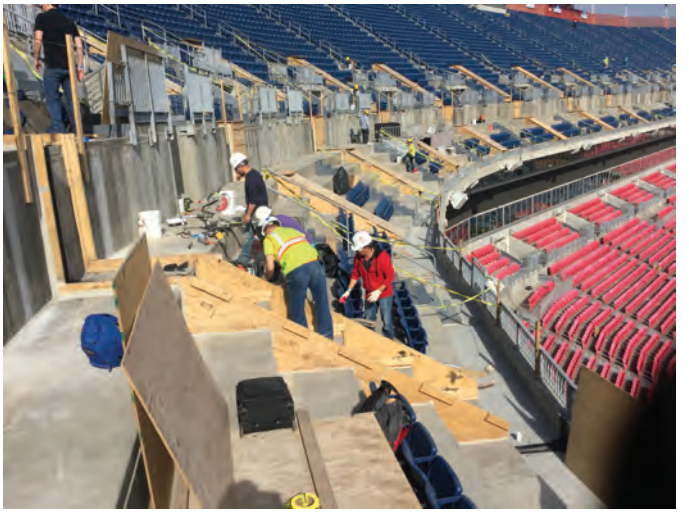

Fig. 5: Upper deck repairs in progress (note Row A at overhang at upper deck and temporary joint protection)

Concourse expansion joints were fire-rated to maintain the intent of the original design. Adjacent distressed concrete was repaired and steel angles were installed to create stable surfaces to adjoin polyurea nosings at concourses (Fig. 3). Ends of precast concrete riser sections at the upper deck were sawcut as necessary to create relatively uniform widths, reducing the number of joint material width transitions throughout the length of the joints. Where trimmed precast slabs fouled guard rail anchorages, or existing anchors were unacceptably close to edges of concrete, supplemental guard rail anchor connections were installed. Covers were installed over all joints on walking surfaces to maintain safe conditions.

Considerable effort was expended to protect open joints and interior spaces from potential rain events during construction. Temporary enclosures were constructed for each expansion and riser-to-riser joint location at the upper deck. The covers were designed to be easily installed and removed for work. Figure 5 shows the upper deck scope area and locations of temporary protection.

## UPPER DECK CONCRETE REPAIRS, SEALANTS, AND GUARDRAIL ANCHORAGE MODIFICATION

The project included replacement of select deteriorated cast-in-place infill steps and landings resulting from severe loss of matrix cohesion associated with materials-related distress (Fig. 6). Landings in some cases acted as substrates for guardrail anchorage. These landings and steps were replaced with pre-packaged, pre-extended, polymer-modified, self-consolidating cementitious repair material and reinforced for crack control. All components were coated with a traffic grade urethane deck coating with broadcasted aggregate for slip resistance, and striped at nosings.

Precast joints were typically sealed with silicone sealants. Precast joint sealant repairs, expansion joint repairs, and replacement of deteriorated landings required the vomitory wall guardrails be removed for access. Many of the existing guardrail fasteners had inadequate anchorage into the substrate with some anchors extending into sealant joints or deteriorated concrete. To provide adequate anchorage, new extended galvanized guardrail post anchorage base plates were adhesively anchored into vomitory walls a sufficient distance away from joints and edges (Fig. 7). Pre-fabrication of new base plates and bolted connections to existing components resulted in a more expeditious installation that helped to meet the schedule demands between stadium events.

Removal of seats associated with the simultaneous seating repair project provided complete visual access to precast components. A number of embedded precast riser connections were visibly distressed or had failed (Fig. 8). Modified connections using supplemental angles on the underside of risers and concrete repairs were installed to restore connectivity (Fig. 9).

## DRAINAGE, BONDED OVERLAYS, AND RAIL MODIFICATIONS

Insufficient slope, considerable ponding, deteriorated coatings and damage from freezing and thawing cycles were characteristic of the lower seating row at the cantilevered Row A upper deck overhang (Fig. 10). Deteriorated concrete was removed to sound substrate. The surface was prepared to a concrete surface profile of CSP 7+ per ICRI 310.2R[1] and moisture conditioned to receive the new bonded overlay. Prepackaged polymer-modified cementitious repair material specially formulated by the manufacturer for low cracking potential was used for the repair (Fig. 11). Because of the repair depth, the repair mortar was extended with 3/8 in (9.5 mm) nominal maximum size aggregate preconditioned to a saturated-surface dry condition. A scrub coat of neat material was used prior to application of the overlay material. Specifications required tensile bond testing in accordance with ASTM C1583[2] after surface preparation and after

Fig. 6: Distressed concrete landings with deficient guardrail anchorage and aged sealants prior to replacement

Fig. 7: Modified guardrail anchorages and new silicone sealants

Fig. 8: Failed sealants and distressed precast connections as observed after seat removal as part of the concurrent work

Fig. 9: Repairs in progress at upper deck (note that repairs also included installation of supplemental angles on the back of risers)

the installation of repair mortar at a frequency of 3 tests per 1000 sf (93 $m^2$) with stipulation for addressing failed tests and tests below the 250 psi (1.7 MPa) minimum or as established during the mock-up. Testing of the prepared surface provided some challenges due to the aggressive surface profile (ICRI CSP 7+). The average of valid tests during the mock-up was 210 psi (1.45 MPa). Per project specifications, the permissible average in production was 90% of this value (190 psi [1.3 MPA]) with no individual result under 75% (160 psi [1.1 MPa]). In the limited situations where these requirements were not achieved in production, additional testing was conducted to evaluate and confirm acceptability. A traffic-grade urethane deck coating with broadcast aggregate was installed after the topping slab was sufficiently cured.

The new bonded overlay is thickest near steps and tapers to provide adequate slope to drains. A strength check of affected components, step cadence uniformity, guardrail configuration, and sightlines all had to be considered in

Fig. 10: Example of Row A distress

Fig. 11: Installation of scrub coat and sloped bonded overlay at Row A

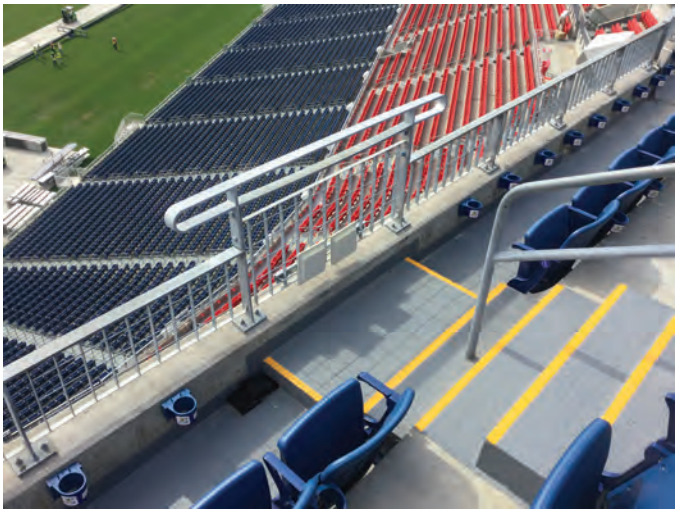

Fig. 12: Row A repairs including new landings, coatings, and minimally modified rails to maintain sightlines

the repair. To address issues caused by sloping, the last step was modified to become a landing and guardrails were altered to meet code requirements associated with fall protection (Fig. 12). The code official, owners, design team, and construction team evaluated several options for adequately addressing safety while minimizing impact to spectator sightlines.

## RESTROOM AND CONCESSION STAND COATINGS

The investigation revealed deficiencies in waterproofing below the unbonded concourse topping slab. A significant concern communicated by stadium facilities officials was the consistent leaking into interior spaces below the split slab system when restroom and concessions are cleaned. The owner also desired to upgrade the pre-existing aesthetics of the restroom flooring. Slip resistance for safety, appropriate bond to the existing concrete, tolerance to cracks present in the topping slabs, long-term durability, tolerance to moisture vapor due to possible presence of water within the split slab system, heat and chemical resistance at concession stand areas, and aesthetics in the restrooms were all major design parameters associated with the waterproofing coatings. In addition, the finish could not be excessively textured due to associated risks of damaging cleaning equipment.

A multiple layer 1/4 in (6 mm) nominal thickness urethane slurry resinous coating system was used to meet these demands. Restroom waterproofing coating generally included urethane slurry broadcast with silica sand, epoxy bond coat with red, white, and blue vinyl flakes matching the Titans' colors, epoxy grout coat, and urethane seal coat with aluminum oxide. Concession stands were monotone grey and included the slurry coat, epoxy topcoat and seal coat with aluminum oxide. Coatings included a 4 in (100 mm) cove at wall transitions. Cracks and transitions were treated with flexible epoxy and reinforcement prior to coating application. Primer was used as required. Where required, slab sections were replaced prior to coating. Floors were shot-blasted to obtain profile and ground at inaccessible areas.

Mock-ups were prepared to review aesthetics, demonstrate application, evaluate bond strength, and evaluate the amount of aluminum oxide necessary for slip resistance. A minimum bond strength of 200 psi (1.4 MPa) per ASTM D7234[3] and dynamic coefficient of friction (DCOF) greater than 0.42 ("High Slip Resistance Potential" classification corresponding to a "lower probability of slipping") per ANSI/NFSI B101.3[4] was included in the performance specifications. Three levels of aluminum oxide broadcast were evaluated and friction testing was conducted by the manufacturer. Friction and bond testing were conducted in production by the manufacturer and installer, respectively, for quality control. Reported bond test and friction results exceeded specification requirements in production. Figure 13 illustrates a finished restroom area with the vinyl flake finish.

In addition to scheduling constraints discussed elsewhere in this article, challenges included detailing around and in concession stand freezer areas; transitions with new expansion joints; and removal, storage, protection, and reinstallation of partitions and concession stand equipment without damage or mistaking proper locations for reinstallation.

## CONCOURSE TOPPING SLAB REPAIRS

Severe cracking was prevalent at a number of concourse topping slab areas. Random, less frequent cracks were treated individually whereas sectional replacement of the topping slab was utilized at areas of more extensive cracking (Fig. 14) and as part of expansion joint repairs. Pre-established elevations and weight restrictions required careful consideration.

Fig. 13: Restroom floors after installation of resinous waterproofing with flake finish

Fig. 14: Concourse slab repairs in progress

Slab repairs generally included higher-strength insulation board and drainage mat. Existing slab thickness at areas excavated for repair varied, with some sections observed to be on the order of 1 to 1-1/2 in (25 to 38 mm) thick. In some cases where the existing slab was excessively thin, it was not possible to include insulation board and still maintain appropriate slab thickness. A hygrothermal analysis of a typical slab cross-section revealed that insulation was not required to prevent condensation in the conditioned spaces. After consulting ownership concerning the reduced energy efficiency, the insulation was omitted at some locations to allow for adequate slab thickness. Reinforcing steel bars were centered in the 3 in (75 mm) nominal topping slab and pins were installed at the perimeter of repairs. Existing joint spacing was replicated. Concrete specification requirements implemented as part of the project included:

- Non-reactive aggregate as demonstrated by ASTM C1260[5] or ASTM C1567[6] expansion <0.10% at 30 days or ASTM C1293[7] expansion <0.04% at 1 year;
- Minimum 28-day strength, f'c = 4,500 psi (31 MPa);
- Incorporation of shrinkage-reducing admixture; and
- Fresh air content 6%; Average hardened air void spacing factor (ASTM C457[8]) < 0.008 in (0.2 mm)

A specialized lightweight, low-shrinkage concrete was used to minimize crack tendency and provide long-term durability of the new topping. ASTM C 457 testing was conducted during trials to confirm adequate air-void system stability in the air-entrained concrete. Concrete was pumped to the concourse. In total, more than 4,000 sf (372 $m^2$) of topping slab was replaced. The exterior concourse area was coated after repairs were installed.

## SCHEDULING CONSTRAINTS AND COORDINATION WITH OTHER WORK

Considerable effort was required by the construction manager to accommodate the work of this project, the concurrent seat replacement project, and off-season events. This included full use of the facility near mid-project for the week-long Country Music Awards Festival. Events required that guardrails be functional in the midst of their alteration and expansion joint enclosures be removed in areas where spectators were permitted. Review of upper deck concrete risers, replacement of sealants, concrete repairs and replacement of expansion joints had to occur between the time seats were removed and reinstalled as part of a separate contract so as not to unnecessarily delay that work. This included repairs to precast connections at distressed riser areas that were identified only after seats were removed. Supplemental clip angles were used from the underside of the risers to address conditions where possible to minimize impact to that project. The construction manager also acted as owner's representative to coordinate engineering and construction efforts. The need to execute the work in a systematic way and inspect the work simultaneous to

performing the work required considerable coordination between owner, contractor, and designer. The end result was a project completed on-time and prior to the start of the NFL season.

## SUMMARY AND AESTHETIC CONSIDERATION AND IMPACT

Repairing and preserving a stadium requires not only technically appropriate repairs, but repairs that blend in with the existing structure and contribute to the stadium aesthetics so that the event experience is not diminished. This project illustrates waterproofing with aesthetics with a challenging schedule and unique conditions for material performance. An aesthetically pleasing, slip-resistant, functional waterproofing was used in restrooms to meet the overall stadium theme. Modifications to guardrails at overhangs were selected with minimal profile so that sightlines were not excessively impacted. Waterproofing of expansion joints, precast joints, and concrete surfaces provides protection against leaks into occupied spaces. For this project, water tightness was achieved through a synergy of installed repairs with a significant improvement of the user aesthetics.

## ACKNOWLEDGMENTS

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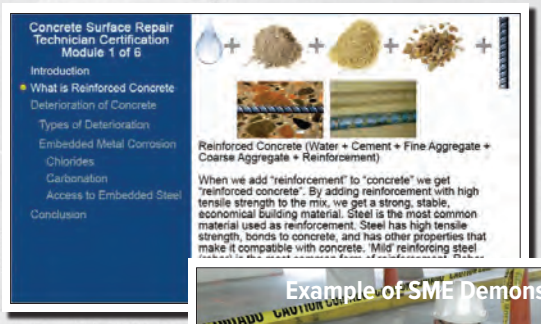


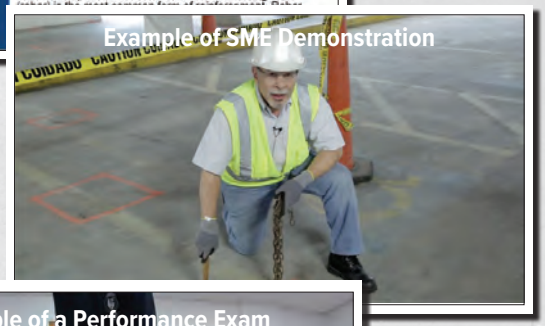
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# Waterproofing with Aesthetics, Making it Dry and Appealing to the Eye—One Decorative Option

by Rich Cofoid

Fig. 1: Single color example (note highly textured non-slip surface)

There is a huge and increasing demand for many waterproofed surfaces to be usable and livable areas. Think balconies, rooftop terraces and pools, fitness areas, and patios. It is in these areas that aesthetics and design play an important role in usability, value, and ultimate owner satisfaction. One decorative option that is gaining in popularity is a cementitious overlay that is generically known as the spray down/knock down (SD/KD) system.

Installed for decades as a slab-on-grade decorative concrete option, the products used in this process are manufactured by many companies and have been marketed under different brand names over the years. Immediately recognizable around pool decks, technical advances have resulted in a system that can be used on almost any wear-bearing surface, including over most waterproof membranes.

The benefits of the spray down/knock down cementitious overlay are many. First and foremost, it's pleasing to the eye. With different application methods and an endless array of colors, its design possibilities are almost endless. Easy to install as well as easy to maintain, the SD/KD system is economical enough to fit most budgets. As a highly textured surface, it meets non-slip standards and is considered a safety first choice. The polymer-modified chemistry combined with a topical sealer make these surfaces freeze/thaw resistant and with a high compressive strength results in an extremely durable surface. So, what's not to love?

## EQUIPMENT AND MATERIALS

The cementitious grout is sprayed down using a compressor, hopper, and gun (the same equipment used for texturing drywall and to popcorn ceilings), so the looks that one can achieve are unlimited. Variables include how wet or dry the grout is mixed, the pressure used to spray the material down, and the size of the orifice on the gun. Each of these variables gives you a different texture, look, and feel.

One word of caution before using a SD/KD system over a waterproof membrane is that if the membrane and overlay components aren't from the same manufacturer, make sure the two have been tested together as a compatible system, both manufacturers approve the application, and will stand by their warranties. There are turnkey systems on the market that have successful track records.

Fig. 2: Multi-color example with taped tile and diamond pattern

Fig. 3: Applying base coat

## SURFACE PREPARATION

As an elastomeric waterproof membrane is the first system applied, follow the manufacturer's specifications and directions for the membrane application. While there may be differences from one brand to the next, most will require the surface be tested for suitability. This typically includes a moisture and adhesion test. The surface is then prepared to an average concrete surface profile of CSP 3.[1] Cracks are repaired, joints are filled, and surface repairs are made as necessary. Next, detailing is required along horizontal to vertical junctures, and low-lying areas are flashed to prevent bird baths in the finished surface. When completed, the preparation should result in a clean, dry, and profiled surface.

## SYSTEM INSTALLATION

Most waterproof membranes are applied at an average of 40 to 60 wet mils (0.04 to 0.06 in) or 25 to 40 sf per gallon (0.6 to 1.0 $m^2$ per liter). Waterproof membrane application usually begins with a primer. Again, each system has its own guidelines that should be followed to ensure a watertight surface. Once your elastomeric membrane is down and cured, it is time to install the SD/KD system. The first step in this process is a primer. Generally, there are two methods used for this step, each one is sanded to refusal with clean, dry silica sand. The first method uses a second layer of waterproof membrane, but this one at a much thinner application of roughly 8 to 12 wet mils (0.008 to 0.012 in) or 150 to 200 sf per gallon (3.7 to 4.9 $m^2$ per liter), then sanded to refusal while still wet. The second method uses an application of epoxy at roughly 100 sf per gallon (2.45 $m^2$ per liter), sanded to refusal. Always check with the system manufacturer and follow their recommendations.

After the primer is fully cured, poorly bonded sand is scraped off and the surface is broomed, vacuumed, or blown clean. The surface is now ready for the SD/KD overlay application; however, there is one more decision to be made. How is the SD/KD overlay to be colored? There are two basic choices: either a single color surface which is normally accomplished by sealing the surface with a pigmented acrylic sealer (Fig. 1) or an integrally colored grout that is sealed with a clear acrylic sealer (Fig. 2). The advantage of an integrally colored grout is that stencils or taped patterns can be used to create tile or stone designs or to have multiple colors in the finished surface.

Fig. 4: Applying spray (texture) with compressor, hopper, and gun

No matter which method is used, a base slurry coat of the grout (Fig. 3) is applied no thicker than 1/4 in (6 mm). If applied too thinly, the decorative coating may crack because it is a stiff surface over the top of an elastomeric membrane. Once the base coat is dry, the texture coat is applied and then knocked down with a pool trowel while still in a workable state (Fig. 4).

### Single Color

If the finished surface will be a single color, the grout is sprayed down at roughly an 80% coverage. One helpful tip is to use different colored grouts for the base coat and spray coat. White on white or gray on gray is difficult to make differentiate when spraying, particularly on a bright sunny day. Once finished, the surface is left to cure overnight. The next day, a floor scraper is used to knock off any burrs or sharp edges and the surface broomed vigorously

Fig. 5: Application of pigmented acrylic stain sealer

Fig. 6: Application of color coat over stencil on multi-color project

Fig. 7: Application of spray (texture) coat over color coat on multi-color project

to remove any poorly bonded texture. Vacuumed or blown clean, the surface is then sealed with a pigmented acrylic sealer (Fig. 5). Typically, two coats are necessary to ensure a completely sealed and solid color surface. Some manufacturers recommend only using water-based sealers because the solvents used in solvent-based sealers may adversely affect the waterproof membrane should it migrate into or come in contact with the membrane.

### Multi-Color

For a multi-colored surface over a taped pattern or stencil, two spray steps are necessary. The initial coat, or color coat, requires a smaller orifice on the gun and a higher air pressure. The result is a finer spray that will cover the surface 100%. (Fig. 6). After the color coat is finished, the air and orifice are adjusted to spray the second, or texture coat, at a 70-80% coverage, which is then knocked down with a pool trowel (Fig. 7). The tape or stencil is lifted and the area allowed to cure overnight. The surface is then prepared for sealer application the same way as mentioned in the single color technique, by scraping, brooming, and cleaning. In order to protect this multi-color surface, a clear acrylic sealer is used in lieu of the pigmented sealer used in the single color process and again, two coats are used.

## SUMMARY

Properly applied, Spray Down/Knock Down (SD/KD) cementitious overlays create beautiful and durable surfaces on areas large and small (Fig. 8 and 9). For both new construction and renovations, they offer a budget-friendly option in an endless array of colors and textures to match any décor or theme.

## REFERENCES

1. ICRI 310.2R, *Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair*, International Concrete Repair Institute, St. Paul, MN, 2013, 48 pp.

Fig. 8: Checkerboard pattern uses three colors to add interest and value to otherwise plain surface

Fig. 9: Endless possibilities of design and color options

**Rich Cofoid** is the Senior Marketing and Product Line Manager for the Euclid Chemical Company, a leading manufacturer of tools and chemicals for the Decorative Concrete Industry. Among his duties at Euclid, Rich heads up the two-day decorative concrete training seminars the company holds at its facilities near Tampa, Florida. The training includes installation of cast-in-place systems, overlays systems, stains, and high performance coatings.

Additionally, Rich travels the country and holds training classes for local contractors through Euclid's national network of distributors. His training sessions includes many years at World of Concrete, the Concrete Décor Show, ASCC, ACI, and the AIA. With a Bachelor of Science degree from the University of Colorado, Rich's experience prior to Decorative Concrete includes franchising, with an emphasis on training new business owners, as well as owning and operating several businesses.

# ICRI Co-Sponsors Professors Workshop

*ACI/PCA Event held July 22-26, 2019*

ICRI sponsored David W. Scott, PhD, Professor and Chair of Dept. of Civil Engineering and Construction at Georgia Southern University, Statesboro, Georgia, to speak on concrete repair at the Professors Workshop—a workshop focused on providing resources and information to educators for improving the teaching and training of university students. David teaches a concrete repair curriculum and his well-received presentation was the only presentation on concrete repair at the workshop. Ken Lozen, ICRI Technical Director, also gave a presentation on ICRI, outlining member benefits and the educational resources available to the 21 educators and others in attendance.


David W. Scott, PhD, Professor and Chair, Georgia Southern University


Ken Lozen, FICRI, FACI, ICRI Technical Director

# 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 (see page 46 of this *CRB* issue), 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**.

# Spokane City Hall Building Restoration

by Rusty Boicourt

Fig. 1: City Hall Building overlooking the 1974 World's Fair Pavillion

## INTRODUCTION

Built in 1929 as the northwest distribution center for Montgomery Ward, the Spokane City Hall Building was obtained by the City of Spokane, Washington in 1981 and converted to government offices and public use. The historic City Hall Building overlooks Lower Spokane Falls adjacent to Riverfront Park in Spokane's Central Business District (Fig. 1). The 139,950 sf (13,000 $m^2$), gravity-frame, cast-in-place column-and-beam structure is a wonderful example of the classic Art Deco style, which adds character to Spokane's downtown of older masonry buildings and newer glass storefronts. This was the first major structure in Spokane to employ the Art Deco style and one of the first to use reinforced concrete. The building is also an example of structures that were originally intended to last 50 to 100 years, but are now required to last much longer. The City has no plans to move out of the building and would like to continue to call it home for as long as possible.

## BUILDING CONDITION AND ASSESSMENT

Apart from occasional painting and limited patching of the damaged exterior concrete walls, no substantial restoration had occurred since construction, and the building was beginning to show its age. The exterior of the building was pock-marked with spalls and deteriorated edges (Fig. 2). A forensic evaluation identified the primary distress as freeze/thaw damage, corrosion of shallow reinforcing, and other problems related to moisture penetration. A significant amount of the horizontal concrete surfaces, such as the decorative parapets and window sills, were slowly decomposing from environmental exposure. A fairly thick carbonated zone was also identified in the concrete, which rendered much of the shallow reinforcing susceptible to corrosion. Most of the damage was the direct result of the failure to properly waterproof the structure. Not surprisingly, the City's challenge was how to properly waterproof the building to arrest the current failures now and prevent, or at least slow, future ones.

Fig. 2: Typical damage to the building prior to restoration

## REPAIR PROGRAM

Before any waterproofing could occur, the damaged exterior surfaces of the building had to be restored and stabilized. The repair effort consisted of standard sawcutting and chipping to repair freeze/thaw damaged elements, rebuilding decorative details, and repairing delaminated portions of the walls. Because of the corrosion damage to shallow reinforcing, some of the repairs included exposing corroded rebars and protecting them from corrosion with sacrificial anodes or removing them completely. This was the case with much of the parapet cap (Fig. 3). The 1929 concrete lacked an adequate entrained air-void system and was, therefore, not resistant to freeze/thaw cycles. The intermountain northwest climate is particularly cruel to concrete and freeze/thaw damage is common. ACI 201.2R-16,[1] Section 4.2.5 "Preventing frost damage in existing concrete that lacks adequate air-void system," discusses exactly this problem. The ACI guidance recommends that such compromised concrete must be kept dry with an internal humidity below 75 to 80 percent.

The building evaluation and repairs were performed in accordance with the International Concrete Repair Institute (ICRI) and American Concrete Institute (ACI) guidelines and ACI 562-16.[2] The repairs were considered non-structural because structural elements such as columns and beams were not impacted. Only decorative elements and the outer portion of the building envelope were repaired. The project was performed under the direction of a licensed design professional and a repair consultant. The entire building exterior was visually inspected and every concrete surface was acoustically sounded during the project. The criteria for repair included concrete that was at risk of falling, surfaces exhibiting delamination, cracking related to corrosion, and significant imperfections in the appearance of the exterior wall surface.

Some of these imperfections were the result of previous, improperly performed repairs, and some were the result of poor quality control during original construction. One

Fig. 3: Restoring a decorative parapet cap

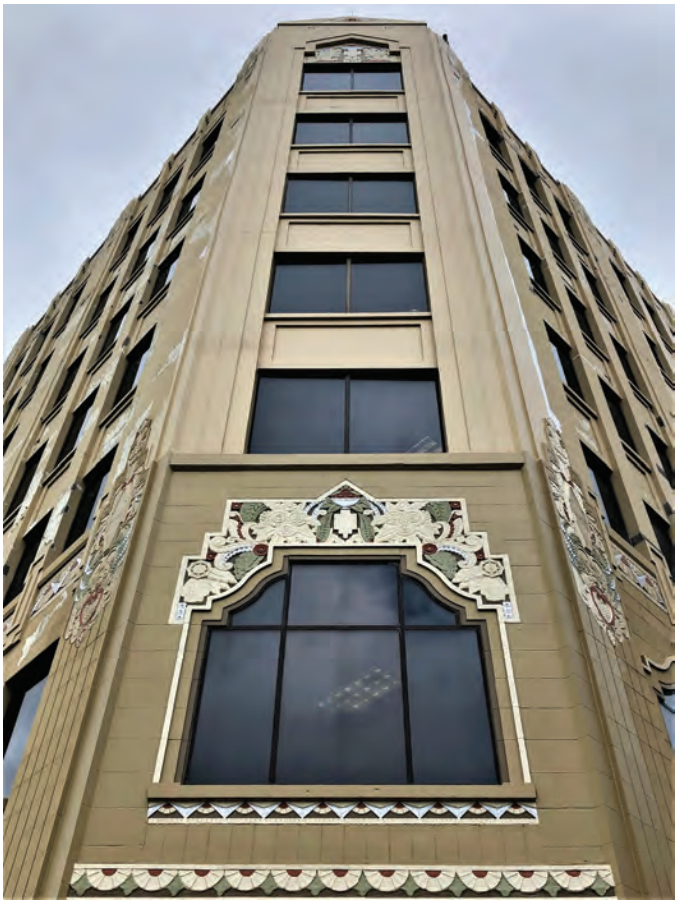

Fig. 4: Repaired elevation awaiting paint coatings

unexpected challenge was matching the appearance of the repaired areas to the surrounding concrete. Throughout most of the building, the formed concrete wall surfaces were irregular or hummocky. To achieve an acceptable appearance, the contractor was required to shape the repair mortar to match the texture of the adjacent concrete wall surfaces. A nice, smooth repair amid a rippled wall surface would stick out like a sore thumb. Because the City Hall Building has such significant historic and architectural value, the final visual impact of the repairs was a major concern.

Fig. 5: Restored Art Deco medallion

Fig. 6: Close-up of restored decorative medallions and window sills

The final tally of repairs was over 700 repair areas at the exterior walls and substantial rebuilding of over 300 ft (90 m) of parapet cap.

## WATERPROOFING

Once the damaged concrete was restored (Fig. 4), the waterproofing effort began. Because the air-void system of hardened concrete cannot be modified, the only lasting solution was to keep the concrete as dry as possible.

### Building Exterior

After surface repairs, the entire building was pressure washed and flaking paint scraped away. Vegetation growing on the surface of the building was removed as was any embedded debris in the concrete. New caulking was installed around windows. Butt-joints in precast and masonry elements were repointed. The entire building was primed and painted with a breathable, 100% acrylic, high-build, elastomeric coating having a final rating of 13 perms (dry cup). The performance criteria for the coating was demanding: the coating needed to bridge small cracks and be flexible; resist water and carbon dioxide penetration yet ventilate moisture vapor; be chemically inert and durable to ultraviolet light; and had to allow for application in low temperatures. Older buildings tend to leak a great deal of air and heat, and the Spokane City Hall Building was no exception. The leaks meant that humid air would be migrating through the concrete and the coatings, which emphasized the need for a breathable material. An unexpected advantage of the leaky building was that it remained warmer than the ambient air, which allowed the contractor to continue to apply repair mortar into the late fall.

### Decorative Elements

In addition to the primary coating, the decorative elements required re-touching. These once colorful ornamental panels consisted of large, precast medallions set into the cast-in-place concrete (Fig. 5 and 6). These panels are the main architectural feature of the building and restoring their bold and vibrant colors was important. The red, green, brown, and grey contrasts to the mostly tan building give City Hall its iconic festive, yet formal look. The adornment of a permanent costume on this otherwise massive and imposing structure, which is typical of Art Deco buildings, is the source of its charm.

### Horizontal Surfaces

The next challenge was the horizontal surfaces where water had the potential to accumulate and penetrate the concrete. For these surfaces and wherever possible, repairs were made to shed water. The 7-story building included many high-relief, decorative, precast panels at the top and near the street level. These elaborate reliefs created hundreds, maybe thousands, of orthogonal transitions in the exterior wall. Bevels between vertical and horizontal faces were restored or added.

The window sills were reinforced with a small-diameter rebar with very little clear cover—in most places less than 1 in (25

mm). Carbonation depth of the exterior concrete walls was up to 2 in (50 mm) in some locations. Anywhere that shallow rebar and deep carbonation overlapped, rebar corrosion would be inevitable. Wide spread corrosion of steel in the window sills, which numbered roughly 300, would result in a very costly and lengthy repair. For these reasons, the choice was made to make the window sills as waterproof as practical. Multiple options were evaluated, including roof coatings, traffic coatings, epoxies, and metal flashing.

The final decision was based on cost and aesthetic considerations, as well as availability of materials and issues of constructability. For large horizontal surfaces, such as the parapet cap and the window sills, additional waterproof coatings were used. Initially, a fluid-applied, aliphatic, elastomeric roof coating was chosen for these surfaces (Fig. 7). For reasons of cost and logistics, it was decided to apply three coats of the high-build acrylic to the window sills and only use the aliphatic coating on the parapet cap.

The importance of this step in the project cannot be overstated. The original freeze/thaw deterioration was caused by repetitive freezing cycles of saturated concrete. If special measures were not taken to protect the parapet cap and other horizontal surfaces, the repairs would not be effective and new damage would quickly emerge.

## CONSTRAINTS AND LOGISTICS

In addition to the technical challenges, the height of the building and limited access from the street level impacted the project. The repairs and painting were all done from multiple drop stages over the course of about 7 months of work within a 14-month period with multiple mobilizations. As the project moved into the winter months, the contractor made daily surface temperature measurements, and prediction models of temperature were generated to plan for the next few days. No mortar repairs or painting was allowed if temperatures would fall below that specified by the material manufacturer within the coming 24-hour period. The contractor also attached small tents to the wall surface to protect fresh repair areas from rainfall when storms were in the forecast.

### Spokane City Hall Building Restoration

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Fig. 7: Elastomeric aliphatic roof coating protecting parapet cap

## SUMMARY

A critical factor in the success of the project was the nearly continuous communication between the client, design team, and the contractor. As new challenges arose, the designers were able to recommend repairs that were quickly approved by the client and implemented by the contractor. The extra effort taken during the project was essential to delivering a repair with long-term durability.

## REFERENCES


1. ACI Committee 201, *Guide to Durable Concrete* (ACI 201.2R-16), American Concrete Institute, Farmington Hills, MI, 2016.

2. ACI Committee 562, *Code Requirements for Assessment, Repair, and Rehabilitation of Existing Concrete Structures and Commentary* (ACI 562-16), American Concrete Institute, Farmington Hills, MI, 2016.



**Rusty Boicourt** is a licensed professional geologist and concrete materials expert. He is a member of ICRI and served on Committee 150, which produced the ACI/ICRI Guide to the ACI 562 Repair Code, the industry's guide to the code on concrete evaluation and repair. He holds numerous Master Certificates from World of Concrete and is an ACI Residential Concrete Foundation Technician and ICRI Concrete Slab Moisture Testing Technician. As a forensic materials specialist, he has completed over 100 concrete non-destructive evaluations including complex concrete repair and restoration projects. He is president of Veritas Material Consulting in Boise, Idaho.

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# Evolution of the ACI 562 Code—Part 6

## Quantification of in-place concrete strength using core tests

by F. Michael Bartlett

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### EXISTING CONCRETE STRUCTURES—LEARNING LESSONS AND ADVANCING SOLUTIONS

ACI Committee 562, Evaluation, Repair, and Rehabilitation of Concrete Buildings, strives to advance the practice of engineering and improve the repair and rehabilitation of existing concrete structures. ACI Subcommittee 562-E, Education, is dedicated to helping engineers, building officials, contractors, owners, inspectors, and others by conveying information in more detail than is possible solely through the ACI 562 Code and Commentary. To this end, and in the hope of improving these documents, members of ACI 562 are providing a series of articles under the main theme "Existing Concrete Structures—Learning Lessons and Advancing Solutions."

Through this series, the committee members explain the rationale behind some of the changes in the ACI 562-16 Code as well as share example problems, ideas, concepts, and the thoughts discussed in ACI Committee 562 meetings. It is also anticipated the series will help the committee address questions from the engineering and construction sectors, solicit answers to problems, and review areas of needed research.

Chapter 6 of *Code Requirements for Evaluation, Repair, and Rehabilitation of Concrete Buildings (ACI 562-13) and Commentary*[1] allows an existing structure to be assessed using in-place concrete strengths quantified from core test results. This article will demonstrate how the ACI 562-13 provisions are a simplification of the "Alternate Method" presented in Section 9.4.2 of ACI 214.4R-10[2] and provide brief examples of their application. The ACI 562-13 provisions are identical to those specified in the current and previous editions of *Canadian Highway Bridge Design Code* (CAN/CSA S6-14).[3]

Further, the ACI 562-13 provisions have been incorporated in Chapter 6 of ACI 562-16[4] and are therefore generally termed the ACI 562 provisions in this article. For clarity, example calculations in this article are provided in in.-lb. units only.

### EQUIVALENT DESIGN STRENGTH

The procedures in ACI 562 are designed to quantify an equivalent design strength for direct substitution into conventional strength equations that include strength reduction factors specified in Section 5 of ACI 562-13 or ACI 562-16.[4] This equivalent design strength corresponds to the lower tenth percentile of the in-place strength, and so is slightly conservative as it has been shown that the specified strength of concrete $f_c'$ represents the 13% fractile of in-place concrete wall and column strengths.[5]

Table 1 presents the equations used to quantify the equivalent specified concrete strength $f'_{c,eq}$ in ACI 214.4R-10 and ACI 562. The ACI 214.4R-10 equations are based on a lower bound estimate of the mean in-place concrete strength $(\overline{f_c})_{CL}$ for a specified confidence level $CL$, whereas the ACI 562 equation corresponds specifically to a 90% confidence level. If Eq. (1) and (2) are combined to eliminate $(\overline{f_c})_{cCL}$, the form of the resulting equation is identical to that of Eq. (3). As will be demonstrated herein, however, Eq. (2) can be adapted to apply to cores of different diameters subjected to different standard moisture conditions before testing, whereas Eq. (3) is applicable to 4 in. diameter cores tested in the as-received condition in accordance with ASTM C42/C42M, *Standard Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete*.[6]

### BASIS OF ACI 214.4R-10 PROCEDURE

In the ACI 214.4R-10 procedure, the mean and standard-deviation of the in-place concrete strength, $\overline{f_c}$ and $s_c$, respectively, are determined after the core strengths $f_{core}$ are converted to equivalent in-place strengths using

$$f_c = F_{l/d} F_{dia} F_{mc} F_d f_{core} \quad (4)$$

where factors $F_{l/d}$, $F_{dia}$, $F_{mc}$, and $F_d$ are strength correction factors that account for the effect of the core length-to- diameter ratio, diameter, moisture condition, and damage due to drilling, respectively, on the concrete core strength. The magnitudes and accuracies of these factors are presented in Table 2, an abridged version of ACI 214.4R-10 Table 9.1.

The overall uncertainty of the estimated in-place strengths is a combination of the sampling uncertainty and the uncertainty due to the accuracy of the strength correction factors. These two sources of uncertainty are statistically independent, and so are simply added under the square root in Eq. (2). The first term captures the effect of the sample size on the variance of the mean in-place strength $s^2c / n$, where $n$ is the number of specimens tested. The factor $T$ is obtained from a one-sided Student's $t$ distribution with $(n - 1)$ degrees of freedom,[7] that depends on the desired confidence level. In the second term, $s_a$ is computed using

$$s_a = \bar{f}_c\sqrt{V_{l/d}^2 + V_{dia}^2 + V_{mc}^2 + V_d^2} \qquad (5)$$

where the dimensionless coefficients of variation, $V_{l/d}$, $V_{dia}$, $V_{mc}$, and $V_d$ for the length-to-diameter ratio, diameter, moisture condition, and drilling damage factors, respectively, are also shown in Table 2. The accuracy of the product of the strength correction factors does not diminish as the number of specimens increases, so a confidence limit on this uncertainty can be computed using a factor $Z$ from the standard normal distribution.

The factor $C$ in Eq. (1) converts the mean in-place strength to the desired 10% fractile of the in-place strength.[2] For a structure consisting of many members cast from many batches of cast-in-place or precast concrete, $C$ equals 0.83 or 0.87, respectively.[2] To estimate the 13% fractile of the in-place concrete strength, Bartlett and MacGregor[8] recommend $C$ = 0.85 for cast-in-place construction.

## Example calculation using ACI 214.4R-10 procedure

Six 8 in. long, 4 in. diameter cores, tested in the as-received condition, break at compressive strengths of 3870, 4160, 5230, 5020, 4190, and 3860 psi. Determine the equivalent-to-specified strength if the cores are obtained from: (a) a cast-in-place concrete structure; or (b) a precast concrete structure.

**Table 1:**
**Equivalent-to-specified concrete strength equations in ACI 214.4R-10 and ACI 562**

| ACI 214.4R-10 | ACI 562-13 and ACI 562-16 |
|---|---|
| $f'_{c,eq} = C(\bar{f}_c)_{CL}$ (1) | $f'_{c,eq} = 0.9\bar{f}_{core}\left[1-1.28\sqrt{\frac{(k_cV)^2}{n}+0.0015}\right]$ (3) |
| where | |
| $(\bar{f}_c)_{CL} = \bar{f}_c - \sqrt{\frac{(Ts_c)^2}{n}+(Zs_a)^2}$ (2) | |

**Table 2:**
**Magnitude and accuracy of strength correction factors for converting core strengths into equivalent in-place strengths[2]**

| Factor | Magnitude | Coefficient of variation $V$, % |
|---|---|---|
| $F_{l/d}$: $l/d$ ratio* (as-received† condition) | $1-(0.130-\alpha f_{core})(2-\frac{l}{d})^2$ | $2.5(2-\frac{l}{d})^2$ |
| $F_{dia}$: diameter, 4 in. | 1.00 | 0.0 |
| $F_{mc}$: core moisture content (as-received) | 1.00 | 2.5 |
| $F_d$: damage due to drilling | 1.06 | 2.5 |

*Constant α equals $3(10^{-6})$ 1/psi for $f_{core}$ in psi, or $4.3(10^{-4})$ 1/MPa for $f_{core}$ in MPa
†Standard treatment specified in ASTM C42/C42M

In either case, the core strengths must be converted to equivalent in-place strengths using Eq. (4). From the values given in Table 2, $f_c = F_{l/d}F_{dia}F_{mc}F_d f_{core} = 1.0 \times 1.0 \times 1.0 \times 1.06\, f_{core} = 1.06\, f_{core}$. The resulting in-place strengths are 4102, 4410, 5544, 5321, 4441, and 4092 psi, with a mean in-place strength of 4652 psi and a standard deviation of 627 psi. From Table 9.4 of ACI 214.4R-10, $T$ = 1.48 at the 90% confidence level for $n$ = 6 specimens. The accuracy of the core strength correction factors is quantified as

$$\begin{aligned} s_a &= \bar{f}_c\sqrt{V_{l/d}^2 + V_{dia}^2 + V_{mc}^2 + V_d^2} \\ &= 4652\sqrt{0.00^2 + 0.00^2 + 0.025^2 + 0.025^2} \\ &= 164 \text{ psi} \end{aligned}$$

and from Table 9.3 of ACI 214.4R-10, $Z$ = 1.28 at the 90% confidence level. Thus, from Eq. (2)

$$\begin{aligned} (\bar{f}_c)_{CL} &= \bar{f}_c - \sqrt{\frac{(Ts_c)^2}{n}+(Zs_a)^2} \\ &= 4652 - \sqrt{\frac{(1.48\times 627)^2}{6}+(1.28\times 164)^2} \\ &= 4218 \text{ psi} \end{aligned}$$

From Eq. (1) and Table 9.5 of ACI 214.4R-10, for the cast-in-place structure $f'_{c,eq}$ = 0.83 × 4218 = 3500 psi, and for the precast structure $f'_{c,eq}$ = 0.87 × 4218 = 3670 psi.

## BASIS OF ACI 562 PROCEDURE

The ACI 562 procedure is derived from the ACI 214.4R-10 procedure by making the following assumptions and simplifications:

1. It is assumed that the equivalent specified strength is desired at the 90% confidence level. Thus, the Z-value of 1.28 is moved outside of the square root sign and a new parameter, $k_c = T/1.28$, replaces $T$ in the first term under the square root. Values of $k_c$ are shown in Table 3;
2. For simplicity, the conversion of core strengths to equivalent in-place strengths is not made. Thus, the mean core strength $\overline{f}_{core}$ is moved to the left of the square brackets and the variability of the core strengths in the first term under the square root is represented by the coefficient of variation of the strengths $V = s_{core} / \overline{f}_{core}$, where $s_{core}$ is the standard deviation of the core strengths. The value of 0.9 at the front of the right-hand side of Eq. (3) is therefore approximately the product of the average $C$ value for precast and cast-in-place construction of 0.85 times the correction factor accounting for damage due to drilling of 1.06; and
3. The second term under the square root, 0.0015, is an approximation to the sum of the squares of the coefficients of variation that quantify the accuracy of the strength correction factors due to length-to-diameter ratio, moisture condition, and drilling damage.

$$\text{For } l/d = 2, V_{l/d}^2 + V_{mc}^2 + V_d^2 = 0^2 + 0.025^2 + 0.025^2 = 0.00125.$$

$$\text{For } l/d = 1, V_{l/d}^2 + V_{mc}^2 + V_d^2 = 0.025^2 + 0.025^2 + 0.025^2 = 0.00188.$$

Here 0.00125 < 0.0015 [the value used in Eq. (3)] < 0.00188.

If these simplifying assumptions are violated for a particular core test data set, then the equivalent-to-specified strength may be determined using the procedures specified in ACI 214.4R-10.

### Example calculation using ACI 562 procedure

The core strength data analyzed previously will be reanalyzed using the ACI 562 procedure. The reported core compressive strengths of 3870, 4160, 5230, 5020, 4190, and 3860 psi, which corresponds to a mean core strength of 4388 psi, a standard deviation of core strengths of 591 psi, and so a coefficient of variation of the core strengths $V$ of 591/4388 = 0.135. From Table 3, $k_c$ = 1.15 for $n$ = 6 specimens. Thus, from Eq. (3)

$$f'_{c,eq} = 0.9\overline{f}_{core}\left[1 - 1.28\sqrt{\frac{(k_c V)^2}{n} + 0.0015}\right]$$

$$= 0.9 \times 4388\left[1 - 1.28\sqrt{\frac{(1.15 \times 0.135)^2}{6} + 0.0015}\right]$$

$$= 3580 \text{ psi}$$

This value is bounded by the two values computed for precast and cast-in-place construction using the same core strength data following the ACI 214.4R-10 procedure.

**Table 3:**
**Coefficient of variation modification factor $k_c$**

| $n$ | $k_c$ |
|---|---|
| 2 | 2.4 |
| 3 | 1.47 |
| 4 | 1.28 |
| 5 | 1.20 |
| 6 | 1.15 |
| 8 | 1.10 |
| 10 | 1.08 |
| 12 | 1.06 |
| 16 | 1.05 |
| 20 | 1.03 |
| 25 or more | 1.02 |

If only three specimens are tested and the same mean and standard deviation of the core strength are obtained, $k_c$ for $n$ = 3 specimens is 1.47 and $f'_{c,eq}$ = 3340 psi. If 10 specimens are tested, $k_c$ = 1.08 and $f'_{c,eq}$ = 3650 psi, therefore increasing the number of specimens offers diminishing returns.

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# Evolution of the ACI 562 Code—Part 7

## Interface bond between existing concrete and repair materials

by Jared E. Brewe, J. Gustavo Tumialan, and Paul L. Kelley

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### EXISTING CONCRETE STRUCTURES—LEARNING LESSONS AND ADVANCING SOLUTIONS

ACI Committee 562, Evaluation, Repair, and Rehabilitation of Concrete Buildings, strives to advance the practice of engineering and improve the repair and rehabilitation of existing concrete structures. ACI Subcommittee 562-E, Education, is dedicated to helping engineers, building officials, contractors, owners, inspectors, and others by conveying information in more detail than is possible solely through the ACI 562 Code and Commentary. To this end, and in the hope of improving these documents, members of ACI 562 are providing a series of articles under the main theme, "Existing Concrete Structures—Learning Lessons and Advancing Solutions."

Through this series, the committee members explain the rationale behind some of the changes in the ACI 562-16 Code as well as share example problems, ideas, concepts, and the thoughts discussed in ACI Committee 562 meetings. It is also anticipated the series will help the committee address questions from the engineering and construction sectors, solicit answers to problems, and review areas of needed research.

Virtually every repair project on existing concrete structures includes the placement of new concrete or other repair materials against existing concrete. This is especially true when the structures contain concrete elements damaged by corrosion of the existing internal steel reinforcement.

The corrosion mechanism produces corrosion by-products (rust), which have a greater volume than the original steel. The expansion of the rust produces bursting tensile stresses in the concrete. These stresses ultimately exceed the concrete tensile strength, leading to cracking, delamination, and eventual spalling of the concrete over the reinforcement. Concrete repair for corrosion damage typically involves removal of deteriorated concrete, undercutting (concrete removal around reinforcement), possible application of penetrating corrosion-inhibiting chemicals to the newly exposed concrete surfaces, possible application of a protective coating on the reinforcement, and restoration of the concrete section by placing a repair material capable of encapsulating and protecting the reinforcement.

Occasionally, changes in use or occupancy result in increased load demand (and perhaps other serviceability demands), and existing structural elements may not have sufficient capacity to support the anticipated loads. These elements, with demand greater than capacity, must be strengthened by adding external post-tensioning, additional elements, or strengthening systems bonded to the existing concrete surface. Bonded strengthening systems may include section enlargement with bonded concrete and reinforcement, bonded or mechanically anchored steel plates, or bonded fiber-reinforced polymer (FRP) systems. Each of these strengthening systems rely on composite behavior with the existing concrete element to support applied loads. In this article, only bonded and/or mechanically anchored concrete repair materials are addressed with a discussion of the revised interface-bond provisions and the rationale for the performance limits.

The performance of a repair or strengthening system will depend on the development of bond between the existing concrete and the added material, and this is dependent on proper design and selection of construction materials and methods. The design of the interface between the existing concrete substrate and repair material must include consideration of the ability to transfer forces (or stresses) across the interface.

Two primary components are available to provide force transfer: (1) bond between the existing concrete substrate and repair material; and/or (2) reinforcement across the interface.

## FORCE TRANSFER MECHANISMS AT INTERFACE

### Bond with substrate

Where a suitable concrete substrate is available and adequate repair practices are employed, development of sufficient bond strength between existing and new materials can be readily achieved. A suitable concrete substrate, referred to as "sound" concrete, consists of existing concrete that is not damaged, contaminated, or otherwise inherently weak due to original deficiencies in materials or due to deterioration from environmental exposure. Getting to sound concrete requires the removal of a portion of the existing concrete. There are numerous tools available to remove deteriorated concrete and to prepare the existing substrate for repair application, including hydrodemolition, shotblasting, and manual chipping. ICRI 310.2R-2013[1] summarizes the various available methods and the associated concrete surface profiles that can be achieved.

ICRI 310.2R-2013 and ACI 364.7T-02(11)[2] provide discussions on microcracking (sometimes called "bruising") caused by the various surface preparation techniques. Although microcracking is often not detectable by visual observation, it can significantly reduce the bond capacity of the substrate by creating a weakened layer slightly below the newly exposed surface. Testing of the bond interface is needed to verify that the selected surface preparation technique has not resulted in critical microcracking of the substrate. If microcracking is discovered, it must be removed with abrasive blasting or other delicate demolition tools.

### Interface reinforcement

Reinforcement that crosses the interface is also commonly used to provide force transfer. ACI 562-16[3] includes a definition for interface reinforcement as, "existing or supplemental reinforcement that is properly anchored on both sides of an interface, post-installed reinforcement such as adhesive anchors or mechanical anchors, or other mechanical connections providing a method of force transfer across an interface." This definition recognizes that any reinforcement that crosses the interface, existing or supplemental, will restrain interface separation and increase the maximum interfacial shear resistance.

The previous version of the Code, ACI 562-13,[4] included requirements for bond in Section 7.4. Specifically, Section 7.4.1 states: "The required bond strength shall be at least 1.5 times greater than the calculated design bond force at the repair material to existing concrete interface."

ACI Subcommittee 562-D, Design, sought to improve and clarify this and other bond-related requirements as ACI 562-16 was developed. As ACI 562 is generally a performance-based code, ACI Committee 562 endeavored to limit the inclusion of prescriptive requirements related to the design of the bond interface. The committee adopted performance limits for interface design, and so, ACI 562-16 relies on ACI 318-14[5] for the prescriptive requirements used to design the interface.

ACI 562-16 Chapter 7—Design of Structural Repairs includes design provisions in Section 7.4—Interface bond. This section provides requirements and guidance to design the interface between the existing concrete substrate and repair materials. Requirements include calculating the demand on the interface and calculating the capacity of the interface using interface bond, interface reinforcement, or both. Section 7.4 is applicable to bond interfaces for repair materials consisting of cementitious and polymer concretes, fiber-reinforced concrete, or mortar. Design provisions for chemically bonded materials, such as epoxy-bonded steel plates and FRP strengthening systems, are provided in separate provisions of Chapter 7.

## THE INTERFACE DEMANDS

### Forces

Section 7.4.1 of ACI 562-16 requires determination of the shear and tension demands across the interface between the repair material and the existing substrate. It also requires the designer to consider factored loads to provide acceptable performance at the ultimate limit states. Designing the interface for factored loads was chosen so the interface capacity would be sufficient to resist service-level loads, deformations, and related cracking and delamination. The load combinations are also consistent with the strength requirements in ACI 318-14. Section 7.4.1 also requires consideration of restrained volume change including shrinkage of repair materials and differential thermal expansion or contraction of dissimilar materials. Shrinkage of the repair materials is the major consideration because most concrete repairs are performed on concrete that has reached its ultimate shrinkage prior to the repair, thereby providing restraint to the new repair material. The design should also consider any significant differences in the thermal expansion coefficients for the substrate and the repair material, especially if the repair work is exposed to the environment or there is significant seasonal and/or daily variation in temperature. Finally, the design should provide material that has sufficient tensile resistance to minimize cracking or delamination due to volume change.

For the majority of concrete repairs, the primary force component on the repair interface is shear. The ACI 562-16 Commentary Section 7.4.1C indicates that calculations of these interface demands can be complex due to the interaction between the volume change effects and loads applied to the structural component. The structural component being repaired, repair size and orientation, repair depth, and strength and stiffness of the existing and repair material can all influence the demand on the repair interface.

Shear demand in repaired flexural members is determined per Section 16.4.4 or 16.4.5 in ACI 318-14:

● Per Section 16.4.4 (nominal interface shear stress)

$$v_u = \frac{V_u}{b_v d} \text{ ; and}$$

● Per Section 16.4.5 (change in flexural compressive or tensile force in any segment of the composite [concrete plus repair] member)

$$v_u = \frac{C}{A_{interface}} = \frac{T}{A_{interface}} = \frac{A_s f_y}{b_v l_h}$$

Variables in these equations include the effective depth $d$, repair width or interface width $b_v$, and length $l_h$. Figure 1 illustrates a typical beam soffit repair. Designing for resistance to interface demands according to Section 16.4.5 will provide a repair capable of developing the tensile reinforcement in the flexural member, even if the repair zone completely isolates the reinforcement (refer to Fig. 1) and even if $l_h$ extends from the point of maximum moment to the inflection point.

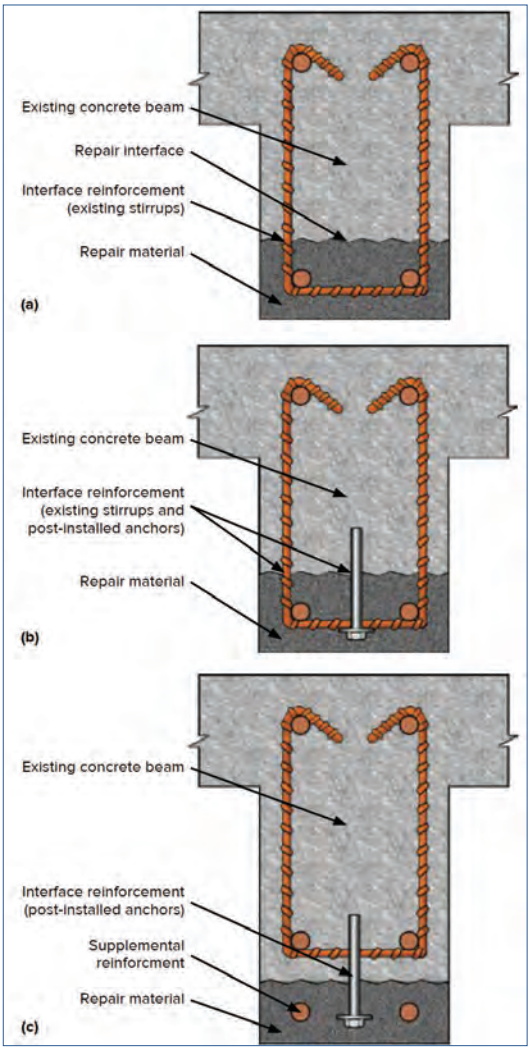


Fig. 1: Typical beam soffit repairs: (a) beam with sufficient stirrups; (b) beam with insufficient or corroded stirrups; and (c) beam with section enlargement

Additional approaches such as shear flow can be used to determine the demands on repair interfaces; however, this requires more complex calculation.

## INTERFACE CAPACITY

There are two primary components for interface capacity: (1) bond between the existing concrete substrate and repair material; and (2) reinforcement across the interface. In ACI 562-16, Section 7.4, repair materials consist of cementitious and polymer concretes, fiber-reinforced concrete, and mortars bonded to the existing concrete substrate. Figure 1 illustrates different combinations of the repair interface and interface reinforcement.

### Calculation of bond contribution to shear capacity

ACI 562-16, Sections 7.4.2 and 7.4.3, permit the bond contribution to interface-shear capacity up to 60 psi (0.41 MPa), with no shear reinforcement crossing the interface. This limit is based on the nominal horizontal shear strength of 80 psi (0.55 MPa), per ACI 318-14, Section 16.4.4.2, which applies to concrete placed against hardened concrete intentionally roughened without the minimum required horizontal shear reinforcement. The 60 psi capacity is derived from the 80 psi multiplied by a strength reduction factor $\phi$ of 0.75.

This horizontal shear methodology is commonly used to design for composite action in topping-slab construction, where the fabrication process for the base concrete element (such as hollowcore planks) restricts placement of shear transfer reinforcement or where the concrete topping thickness is insufficient to allow anchorage and development of shear transfer reinforcement. Based on the authors' experiences, interface reinforcement is typically not required for small slab repairs supporting common design loads; however, interface reinforcement is typically required in narrow concrete elements, such as beams or joists, and some interface reinforcement is beneficial in almost all large repairs. For example, we often use interface reinforcement along construction joints and along anticipated cracks of large overlays.

### Calculation of interface reinforcement contribution to shear capacity

When the calculated demand exceeds 60 psi, interface reinforcement is required to transfer the forces across the interface. ACI 562-16 allows the licensed design professional (LDP) to select the design methodology. ACI 562-16 also permits the LDP to design the interface reinforcement to carry all shear forces across the interface (refer to Section 7.4.6).

As stated in the definition for interface reinforcement, the reinforcement must be properly anchored on both sides of the interface. The designer may consider existing transverse reinforcement crossing the interface (such as newly exposed stirrups) as interface reinforcement, provided the reinforcement is adequately anchored on both sides of the interface and it has adequate remaining cross-sectional area to resist all or a part of the interface force. Anchorage requirements for stirrups (transverse reinforcement) is defined in ACI 318-14, Section 25.7.1. Generally, transverse reinforcement with a standard stir-

rup hook around longitudinal reinforcement can be considered to be anchored. The interface reinforcement also can be in the form of supplemental reinforcement, such as post-installed anchors. The strength of post-installed anchors is governed by the possible anchor failure modes determined in accordance with ACI 318-14, Chapter 17. For elements with narrow widths such as beams and joists, the strength of post-installed interface reinforcement will likely be limited by the edge distance from the anchor hole to the edge of the existing member, as this distance will often be less than the critical edge distance required to develop the basic strength limited by concrete breakout or bond of the anchor in tension.

## QUALITY CONTROL AND QUALITY ASSURANCE

As previously noted, repair detailing and construction practices are the primary factors controlling bond between different materials. ACI 562-16 provides the following three-tier requirements for quality control and quality assurance (QC and QA):

1. Where the interface-shear demand is less than 30 psi (0.21 MPa), ACI 562-16, Section 7.4.2, requires only bond-integrity testing. The limit of 30 psi was established as half of the design interface-shear capacity of 60 psi without interface reinforcement. This reduction was selected as ACI 318-14 requires minimum shear reinforcement when the shear demand is greater than half the design shear capacity (refer to ACI 318-14, Section 9.6.3.1). Bond-integrity testing is specified at the discretion of the LDP and may include surface sounding (such as hammer or chain dragging) or nondestructive testing (such as impact echo or ground-penetrating radar) to identify the presence of weakened planes or microcracking within the existing substrate due to the surface preparation procedure.

2. Where the interface-shear demand is greater than 30 psi, ACI 562-16, Sections 7.4.3 and 7.4.4, require quantitative bond strength testing, unless the shear demand is completely resisted by interface reinforcement (refer to Section 7.4.5). Quantitative bond strength testing is further defined as direct tension pulloff testing in accordance with ASTM C1583/C1583M, "Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)," or a similar quantitative test method. The Code further specifies the minimum number of tests as three on a project as a minimum requirement; however, it does not specify the acceptance criteria or frequency of testing, leaving that job-specific determination to the LDP.

   ACI 562-16, Commentary Section 7.4.3C, notes that bond capacity of the repair interface has primarily been evaluated through direct tension pulloff testing, as shown in Fig. 2. Other methods exist to evaluate interface-shear capacity (such as the slant shear test per ASTM C882/C882M, "Standard Test Method for Bond Strength of Epoxy-Resin Systems Used With Concrete By Slant Shear," or the guillotine shear test using cores); however, these tests are not practical for implementation in the field. The relationship between the interface-shear capacity and the tensile bond capacity is dependent on the quality of the existing concrete substrate and the repair material. A discussion of the various test methods to evaluate bond capacity is provided in Reference 7. The intent of testing is to confirm that the existing concrete substrate with the specified or approved preparation method is capable of developing the assumed bond capacity. ICRI 210.3R-2013[8] states that: "Experience demonstrates that bond strengths of 250 psi (1.7 MPa) or greater can be achieved with available surface preparation and repair techniques…." ICRI 210.3R-2013 also states that: "Legitimate test values…lower than 175 psi (1.2 MPa) that fail at the bond interface or superficially within the existing concrete substrate may indicate a partially damaged, contaminated, or otherwise inadequate bond surface."

   The Code requires the LDP to determine a suitable number of tests needed to confirm the assumed design basis. The LDP must establish a minimum acceptance criteria and testing frequency considering the design demand, size of the project, type of repair, and consequences of failure. ICRI 210.3R-2013 provides guidance on the number of tests that should be performed.

3. Where the interface-shear demand is resisted entirely by reinforcement, testing of the interface is not required (per ACI 562-16, Section 7.4.5). The shear friction provisions of ACI 318-14, Section 22.9, provide a precedent for this exception. As indicated in the commentary to that Code section, shear resistance is primarily due to dowel action for concrete placed against hardened concrete not intentionally roughened, and a friction coefficient $\mu$ of 0.6 has been shown to be adequate for the design of the interface reinforcement. Where it is neither practical nor possible to perform quantitative bond strength

Fig. 2: Direct tension pulloff testing

testing, this provision provides the LDP an alternative of adding more reinforcement to eliminate testing.

This provision does not eliminate testing of the bond interface where the interface reinforcement design includes consideration of the contribution of the roughened surface (using a friction coeffiecient m of 1.0 for shear friction design). Testing is also required where the interface reinforcement is designed per the horizontal-shear transfer provisions of ACI 318-14, Section 16.4.

Relevant construction issues include surface preparation and installation of interface reinforcement, repair materials, QC measures, and QA testing. Although the LDP does not typically specify means and methods of construction, the LDP is required to specify testing requirements in the construction documents per ACI 562-16. ACI 562-16 requires the LDP to specify the type and frequency of tests to confirm proper bond between the substrate and overlay. For pulloff testing of repair material, ICRI 210.3-13 provides guidance. Also, per Section 7.4.7, the LDP should specify the required testing for the interface reinforcement. For tension testing of mechanical or adhesive anchors, ACI 355.2-07[9] and 355.4-11[10] provide requirements.

## SUMMARY

The interface bond requirements in ACI 562-16 are based on established requirements and design methodologies included in ACI 318 and which are familiar to engineers. The ACI 562-16 requirements were introduced to harmonize the design of repairs with the design of interfaces between different materials used in new construction. ACI Committee 562 endeavored to limit the prescriptive requirements included in ACI 562-16.

The LDP may include consideration of the contribution of bond between existing and new concrete materials and or the contribution of interface reinforcement. Minimum QA/QC requirements are included in ACI 562-16 to improve the quality and service life of the repairs.

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Additional information on ASTM Standards discussed in this article can be found at www.astm.org.

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# State of the Institute

by Gigi Sutton, MBA, ICRI Associate Executive Director

Since 2009, ICRI has published highlights of the State of the Institute report in the *Concrete Repair Bulletin* (*CRB*). The full State of the Institute report is used by the board of directors and executive committee as a measurement tool to review the successes of ICRI's policies and programs from year to year.

There have been great things happening with ICRI over the last year.

## FINANCES

ICRI continues to operate with a healthy financial portfolio. In 2018-2019 (fiscal year July 1 to June 30), ICRI budgeted for a small anticipated deficit to continue its plan to finance a number of major projects with projected healthy returns on investment. The original budget called for a deficit of $41,548 but ended at an approximate deficit of $12,960. After a 15-month budget year (2017-2018), allowing ICRI to more strategically place its year-end in June rather than April, ICRI has grown its reserves from 4.75 months to 5.22 months as it works toward an operating income reserve of approximately 6 months.

Charts 1-3 show the distribution of funds. Chart 3 shows continual growth over the last few years. ICRI has been very forward-thinking in not just maintaining its reserves, but using them strategically to finance projects and programs that will not only offer return on investments, but will help ensure that ICRI remains a vital and vibrant organization.

Chart 1: **Revenue 2018-2019**

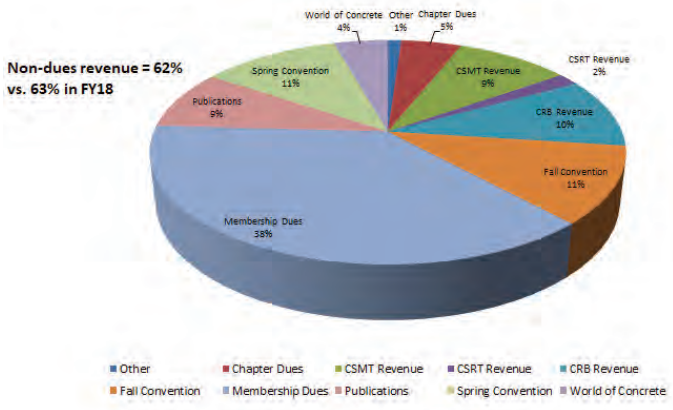



Chart 2: **Expenses 2018-2019**

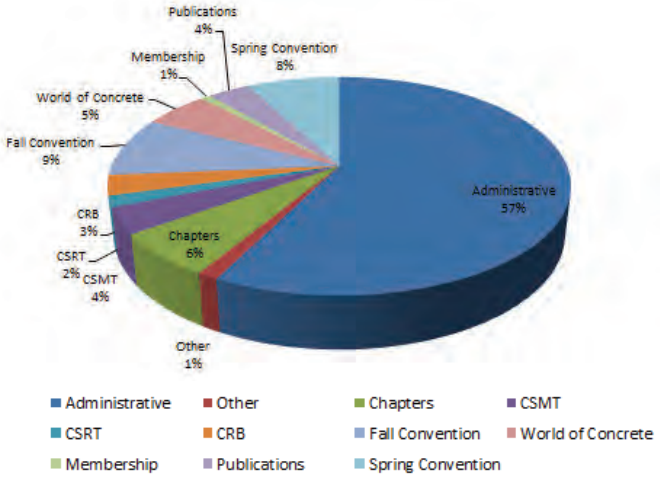
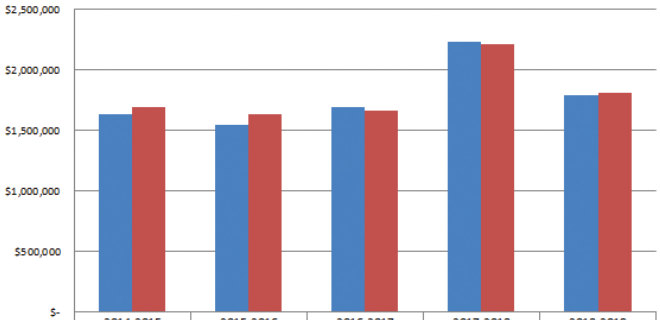



Chart 3: **Operating Revenue & Expense Comparison**

*2017-18 was a 15 month fiscal year




| | 2014-2015 | 2015-2016 | 2016-2017 | 2017-2018 | 2018-2019 |
|---|---|---|---|---|---|
| Revenue | $1,629,994 | $1,545,010 | $1,684,981 | $2,225,162 | $1,790,429 |
| Expense | $1,685,713 | $1,631,653 | $1,662,794 | $2,212,018 | $1,803,389 |

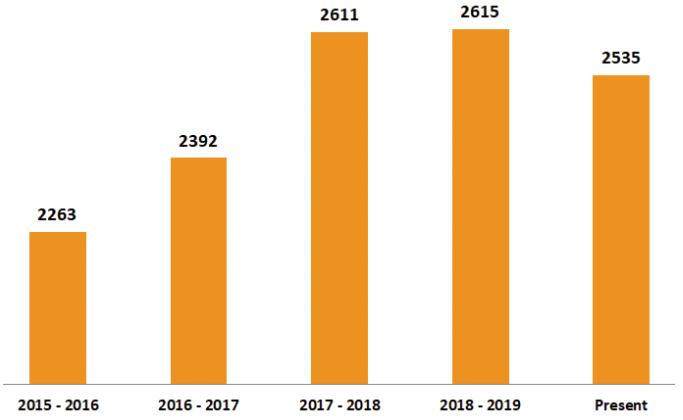
2018-2019 Budgeted net income was $(41,548), actual net was $(12,960).

## MEMBERSHIP

ICRI's membership numbers remain steady with more than 2,500 members worldwide. ICRI's membership committee and staff are working on a member recapture campaign, a database cleanup, as well as a new membership referral and recognition program.

Membership revenues remain steady as well with fewer conversions from Company to Individual memberships in recent months. The committee continues to review the benefits associated with both member types in an effort to enhance the value of company membership. A dues increase implemented on July 1, 2019, will help boost dues revenue for the Institute in the latter half of 2019.

Chart 4: **Membership Trends**




## CHAPTERS

ICRI Chapters have always been vitally important to the overall success of ICRI. As you can see in Chart 5, the vast majority of ICRI national members also belong to a local chapter—and quite a few members actually belong to more than one chapter. Chapter membership has grown in 2019 as more members associate themselves with more than one ICRI chapter. Successful ICRI programs currently in place to help chapters include the Chapter Delegate program at conventions and Chapter Roundtable meetings where chapter leaders are invited to regional Roundtable meetings to meet and interact with national leaders as well as leaders from other chapters, to share ideas, success stories, lessons learned, and more.

Chart 5: **39 Chapters in 2018-19**

Total Number of Chapter Members


65.7 average number of members per chapter.

The Institute is working to add new chapters with the help of volunteers and members. Areas building interest are: Oklahoma; Mexico; the Middle East; Mumbai; and Newfoundland, Canada.

## SECRETARIAT

The formation of the ICRI Secretariat continues the important role of producing results. The Secretariat has been instrumental in managing more than 60 new ideas, all presented by ICRI members over the past three years. The task of the Secretariat is to assure that ideas and issues are heard, disseminated, and managed by the appropriate ICRI committees and task groups without regulating the actual implementation.

## TECHNICAL ACTIVITIES

ICRI continues to build on its technical expertise and has re-activated Committee 150 in support of ACI 562 code adoptions and is patrticipating in updating the joint ACI/ ICRI Guide to the new ACI 562-19 Repair Code.

ICRI has updated two guidelines (210.4R and 320.1R) and added the "Guideline for Use of Penetrating Surface Applied Corrosion Inhibitors for Corrosion Mitigation of Reinforced Concrete Structures" (510.2).

Other items of note in technical activities include:

- a Specifying Concrete Repair webinar from Committee 110 was held on July 31, 2019, and had more than 250 attendees with an on-demand version available;
- a pull-off testing webinar by Committee 210 is in the works for Fall 2019;
- rebar cleanliness samples are being developed in Committee 210;
- Crack identification training modules are being developed in Committee 320; and
- An FRP Technician certification program is being developed in Committee 330.

## CERTIFICATION

The ICRI Concrete Slab Moisture Testing Certification (CSMT) program continues to train and re-certify technicians and produce significant revenue for the Institute. The certification team held five regular classes, two partner-sponsored classes, and two in-house classes in 2018-2019. Total participation remained steady from the previous year (186 vs. 194) as did the number of those becoming certified for the first time or recertified (163 vs. 163). In addition:

- Demonstration and workshop participation have significantly increased with more than 90% of Tier 2s participating and paying the extra fee;
- Re-exams offered at classes have been highly successful (increasing the passing rate considerably);
- A fifth test method (ASTM 3191) was added to the program;
- Exam translation in French completed and Spanish

# State of the Institute *(continued)*

version will be finalized soon; and
- The distribution of the ASTM standards electronically has been implemented.

The ICRI Concrete Surface Repair Technician (CSRT) certification program's total revenue and net income was below original projected program ROI and budget. The team has live performance exams planned for Minnesota in October 2019 and in Philadelphia after ICRI's Fall Convention in November 2019. Plans are in the works for Ohio and the Port Authority of New York/New Jersey to host a live performance exam. A modified grading rubric was approved by the Certification Committee in 2019 to help with passing rates.

Additional certification activities:
- Work is nearing completion on a new FRP Technician Certification Program;
- ICRI is now a Certified AIA CES Provider;
- Chapter and partner rebate programs were established and implemented;
- The team brought the certification exam processing in-house, saving on printing fees and certificate production time;
- The certification team has also been working with the Federal Highway Administration (FHWA) to get the CSRT into Owner Requirements;
- The team has presented informational programs at the Canadian Concrete Expo as well as to ICRI Chapters and local AIA/CSI Groups;
- The certification team continues to participate with the Construction Specifications Institute (CSI) to provide speaking opportunities and work toward inclusion of CSMT and CSRT rcertification equirements into MasterSpecs.

## MEETINGS AND CONVENTIONS

Networking continues to be very important to ICRI members, and nowhere is this more evident than at meetings and conventions. Besides being great fun for attendees, conventions play a vital role in the success of ICRI. In addition to the many networking opportunities, conventions are where members come together to learn, and perhaps most importantly, where, through much dedication and effort, volunteers produce the products and programs that drive ICRI. Convention attendance has been strong. At the 2018 Fall Convention in Omaha, Nebraska, ICRI welcomed 280 attendees and 47 exhibitors, and at the 2019 Spring Convention 273 attendees and 39 exhibitors made the Jacksonville, Florida, event a success!

## ICRI REBRANDS

In 2018 the ICRI Executive Committee approved a proposal by the ICRI Marketing Committee to rebrand the institute. A new brand and logo were rolled out in early 2019 showcasing a modern vibe and ICRI's desire to show repair in a positive light. With this change the traditional globe has been modernized, and the new logo highlights a new tag line, "RESTORE | REPURPOSE | RENEW," to further promote ICRI's mission.

The ICRI website, communications, and *Concrete Repair Bulletin* are being updated with the new brand. Updated logos have also been created for all ICRI chapters as well as new logos for members to share and use on their websites.

Chart 6: **Convention Attendance**

| Year | Season | City | Attendance |
|---|---|---|---|
| 2019 | Fall | Philadelphia | TBD |
| | Spring | Jacksonville | 273 |
| 2018 | Fall | Omaha | 280 |
| | Spring | San Francisco | 252 |
| 2017 | Fall | New Orleans | 232 |
| | Spring | Montreal | 312 |
| 2016 | Fall | Cleveland | 336 |
| | Spring | Puerto Rico | 225 |
| 2015 | Fall | Ft. Worth | 336 |
| | Spring | New York City | 364 |
| 2014 | Fall | Kansas City | 287 |
| | Spring | Reno | 243 |
| 2013 | Fall | Chicago | 324 |
| | Spring | Tampa | 294 |
| 2012 | Fall | Rancho Mirage, CA | 208 |
| | Spring | Quebec City | 277 |


The accomplishments and successes detailed in this report have only been possible with the incredible support ICRI receives from its members—whether it be from serving on the board, on a technical or administrative committee, or at the local level in countless and often unrecognized ways. ICRI appreciates all the efforts that continue to help ICRI stand out and benefit both our members and the industry as a whole.

Good things are on the horizon for ICRI. There is much more education, much more networking, and many more opportunities for you as an ICRI member to take advantage of your membership and make an impact on the industry.

# CONCRETE REPAIR CALENDAR

**SEPTEMBER 25-26, 2019**
**ICRI Certification: Concrete Slab Moisture Testing**
*Baltimore, MD Area*
Website: **www.icri.org**

**OCTOBER 10, 2019**
**ICRI Certification: Concrete Surface Repair Technician Live Performance Exam**
*Minneapolis, MN Area*
*Hosted by ICRI Minnesota Chapter*
Website: **www.icri.org**

**OCTOBER 14-15, 2019**
**ICRI Certification: Concrete Slab Moisture Testing**
*Hosted by FCICA, the Flooring Contractors Assoc.*
*Atlanta, GA*
Website: **www.icri.org**

**OCTOBER 20-24, 2019**
**The ACI Concrete Convention and Exposition - Spring 2019**
*Cincinnati, OH*
Website: **www.aciconvention.org**

**NOVEMBER 11-13, 2019**
**2019 ICRI Fall Convention**
***Historic Restoration: The Art and Science of Preserving Structures***
*Philadelphia, PA*
Website: **www.icri.org**

**NOVEMBER 14, 2019**
**ICRI Certification: Concrete Surface Repair Technician Live Performance Exam**
*Philadelphia, PA Area*
*Hosted by ICRI Delaware Valley Chapter immediately following the ICRI Fall Convention*
Website: **www.icri.org**

**FEBRUARY 3-7, 2020**
**World of Concrete 2020**
*Las Vegas, NV*
Website: **www.WorldofConcrete.com**

**MARCH 23-25, 2020**
**2020 ICRI Spring Convention**
***Repairs in New Construction***
*Vancouver, BC, Canada*
Website: **www.icri.org**

**MARCH 29-APRIL 2, 2020**
**The ACI Concrete Convention and Exposition - Spring 2020**
*Chicago, IL*
Website: **www.aciconvention.org**

**OCTOBER 4-6, 2020**
**2020 ICRI Fall Convention**
*Minneapolis, MN*
Website: **www.icri.org**

# ICRI COMMITTEES

## Administrative Committees

**ICRI Board of Directors**
Chair: Chris Lippmann, HDSupply

**Awards Committee**
Chair: Brian MacNeil, Kryton International Inc.

**Certification Committee**
Chair: Thomas Donnelly, Sika Corporation

**Chapters Committee**
Chair: Michelle Nobel, Sika Corporation

**Conventions Committee**
Chair: Ingrid Rodriguez, Ingrid Shawn Corp.

**Education Committee**
Chair: Bryan Heery, Everclear Enterprises, Inc.

**Executive Committee**
Chair: Chris Lippmann, HDSupply

**Fellows Committee**
*Open to attend, must be a fellow to join.*
Chair: Peter Golter, 3M

**Finance Committee**
Chair: John McDougall, Baker Restoration

**Marketing Committee**
Chair: Jessi Meyer, Cortec Corporation

**Membership Committee**
Chair: Jeff Barnes, Barnes Consulting

**Nominating Committee**
*Contact chair with questions, open only to those elected.*
Chair: Brian Daley, C.A. Lindman of South Florida LLC

**Publications Committee**
Chair: Jerry Phenney, MAPEI

## Technical Committees

**Technical Activities Committee (TAC)**
Chair: Mark Nelson, Nelson Testing Laboratories

**TAC-A Technical Programs**
Chair: Peter Golter, 3M

**Committee 110—Guide Specifications**
Chair: Liying Jiang, Simpson, Gumpertz & Heger

**Committee 120—Environmental Health and Safety**
Chair: Paul Farrell, Carolina Restoration and Waterproofing

**Committee 130—Procurement Methods and Relationship Arrangements**
Chairs: Jeffrey R. Carlson, Consulting Engineers Group, Inc., and Michael Saulnier, ABC Supply

**Committee 160—Life Cycle and Sustainability**
Chair: I-Wen Huang, BASF

**Committee 210—Evaluation**
Chairs: Charles Mitchell, Eastern Testing & Inspection and David Rodler, Smislova, Kehnemui & Associates, P.A.

**Committee—310 Surface Preparation**
Chair: Pete Haveron, Texas Concrete Restoration, Inc.

**Committee 320—Concrete Repair Materials and Methods**
Chair: Mark Kennedy, Simpson Strong-Tie Company, Inc.

**Committee 330—Strengthening and Stabilization**
Chair: Tarek Alkhrdaji, Structural Technologies

**Committee 410—Masonry**
Chairs: Jason Coleman, O'Donnell & Nacarrato, Inc.

**Committee 510—Corrosion**
Chair: Jorge Costa, Durability, Inc.

**Committee 710—Coatings and Waterproofing**
Chair: Mark Nelson, Nelson Testing Laboratories

## Advisory Committees

**Coordination Committee**
Chair: Rick Edelson, Edelson Consulting Group LLC

**Secretariat**
Chair: Jeffrey S. Barnes, Barnes Consulting Group, LLC

## Special Interests

**Women in ICRI**
Organizers: Katherine Blatz, BASF South East Asia Pte Ltd, and Monica Rourke, MAPEI

ICRI committees are open to **all** and they are looking for **your** involvement. Lend your expertise and help improve the industry! For more information on ICRI committees visit the committee page at **www.icri.org**.

# INDUSTRYNEWS

## SIMPSON STRONG-TIE RECEIVES DAVID WEEKLEY HOMES'S DISTINGUISHED "PARTNERS OF CHOICE" AWARD FOR 15TH CONSECUTIVE YEAR

Simpson Strong-Tie, the leader in engineered structural connectors and building solutions, has earned the homebuilding industry's most coveted award—the "Partners of Choice" award, conferring highest honors for both quality and service — for the 15th consecutive year from David Weekley Homes, the nation's largest privately-held home builder. Simpson Strong-Tie is one of only two companies to receive the prestigious Partners of Choice award — which denotes an "A" ranking in either quality or service, or both — for all 15 years since the program began, and has received a double "AA" rating for both quality and service for nine years in a row.

The Partners of Choice award is part of the David Weekley Homes Supplier Evaluation Platform, a rigorous quarterly review of the builder's more than 200 national trading partners. Approximately 1,000 team members participate in the review. Their feedback provides partners an opportunity to evaluate and improve their channel alignment and performance. Survey feedback is offered to suppliers and conducted through a series of individual and group discussions, mentoring calls and strategy sessions to ensure ongoing improvement. The award program celebrates the suppliers who earn an "A" in quality, service or both within a 12-month period.


Simpson Strong-Tie is one of only 18 companies to receive the 2019 double "AA" ranking for the award.

## CONSOLIDATION ANNOUNCEMENT

As the leader in surface preparation and polishing products, Blastrac Global is announcing the consolidation of three of its business units. As market leaders, we are combining resources to take the products of Blastrac, Diamatic, and Cyclone Technology to new heights.

BLASTRAC
Diamatic
Cyclone TECHNOLOGY

The plan for each product is business-as-usual but, behind the scenes we are combining assets in marketing, training, engineering, and sales support functions to expand our top-class customer support and education.

You will continue to see the same Red Diamatic and Blue Blastrac products that have been industry leaders for over 30 years. In addition, we have Cyclone technology high-pressure water cleaning systems. All product lines will be manufactured in our Oklahoma City facility and sold through distribution or one of our nine locations across the US and three locations across Canada. These locations are factory locations that serve as repair/rental and sales offices. In addition to this, we have a loyal Distribution network with multiple locations across North America.

As always, our products are manufactured to the highest quality specifications and meet UL, ULCSA, and NEC safety standards for North America. These are standards that few, if any, of our competitors can claim.

Our products are engineered for our customers to meet the market needs. This commitment carries on to our vast inventory of parts and consumables. Our inventory allows for continued service on machines that date back 15 plus years.

Blastrac, Diamatic and Cyclone look forward to an exciting future serving our customers with even more products and support. Watch as we update our websites and bring new services and support functions to the market.

## INFRASTRUCTURE ASSET MANAGEMENT CONFERENCE

The Center for Integrated Asset Management for Multimodal Transportation Infra-

structure Systems (CIAMTIS), a regional University Transportation Center sponsored by the US Department of Transportation, is organizing the inaugural Transportation Asset and Infrastructure Management (TAIM) Conference on October 28-29, 2019, at the Penn Stater Hotel and Conference Center in State College, Pennsylvania. The conference will focus on three thematic areas, including:

- application of innovative materials and technologies,
- condition assessment and health monitoring, and
- infrastructure management and innovative financing.

The conference will bring together stakeholders within the mid-Atlantic region to discuss research that may be implemented into practice; discuss new policies or procedures in the transportation infrastructure industry; see demonstrations of new products or equipment; learn about best practices from relevant transportation projects; and network with colleagues in the region. The target audience for the event includes professionals from federal, state, and local transportation agencies; contractors and materials suppliers; engineering consulting firms; and faculty and students from academia.

Visit https://www.taim.psu.edu/ for more information.

## JQ ANNOUNCES STRATEGIC INITIATIVES FOR FIRM LEADERS IN MAJOR MARKET SECTORS

JQ recently announced that it has formed four major market sector initiatives in response to the firm's growth and momentum in key architectural market sectors, according to JQ's CEO Stephen H. Lucy, PE Each initiative is led by a veteran JQ leadership team member with primary responsibility for developing and maintaining client relationships, and identifying and positioning for project pursuits within their respective markets.

Lucy named the following firm leaders to oversee and expand these major markets:

*Commercial Market Sector—Dallas, TX*
**John J. Hoenig, PE, COO** and partner will lead the commercial market for JQ. Hoenig is based in the firm's downtown Dallas, TX office where he is the COO and provides strategic and operational leadership across the firm and oversees the Buildings group and its work across the country.

*Higher Education and K-12 Market Sector—Fort Worth, TX*
**Carlo Taddei, PE, LEED AP** and principal will lead the higher education and K-12 market for JQ. Taddei is principal of JQ's Fort Worth, TX office where he is responsible for the office's performance, client interaction, and consulting and review of projects from design to construction.

*Healthcare Market Sector—Houston, TX*
**Akshai Ramakrishnan, PE,** and principal will lead the healthcare market for JQ. Ramakrishnan is principal in JQ's Houston, TX office and has 18 years of experience working on a wide range of projects encompassing design, construction administration, and forensics.

*Government Market Sector—Dallas, TX*
**Stephen H. Lucy, PE and CEO of JQ** will lead the firm's efforts in the government market. Located in the firm's Dallas headquarters, Lucy co-founded the office in 1994 and is responsible for the strategic growth of the firm. Lucy is a recognized leader in the A/E/C community and has an extensive portfolio of delivering award-winning projects using various project delivery methods for more than 30 years. He also has expertise in historic preservation and renovation projects and has worked on restoring more than 40 Texas county courthouses.

## SIMPSON STRONG-TIE HOSTS FELLOWSHIP FOR SCHOLARSHIP RECIPIENTS

Simpson Strong-Tie, the leader in engineered structural connectors and building solutions, hosted 32 Simpson Strong-Tie®Student Scholarship Program award recipients from universities across the country as part of its new fellowship program. Students awarded the scholarship are incoming 2019–2020 juniors and seniors majoring in civil or structural engineering, architecture or construction management.

The Simpson Strong-Tie Fellowship is a three-day event in northern California providing participating students opportunities to network with industry professionals and fellow scholarship awardees, meet with Simpson Strong-Tie executives and tour the company's headquarters along with its Tye Gilb Research Laboratory, the largest privately held structural engineering lab in the nation. They visit one of the company's production facilities to view the manufacturing process and the cutting-edge technologies and robotics used to help make the company's products. Students also participate in hands-on installations and demos using Simpson Strong-Tie products and visit a local jobsite so they can see the products in use.

Simpson Strong-Tie established the Student Scholarship Program in 1998. Since then, it has awarded more than 850 scholarships to students in nearly 100 participating universities, providing more than $1.2 million in support. As part of the Simpson Strong-Tie Student Scholarship Program, the company established the fellowship event in 2016 to provide awardees insight into the building industry as they progress into their professional careers.

### INTERESTED IN SEEING YOUR NEWS IN THIS COLUMN?

Email your 150-200 word industry news to editor@icri.org. Content for the November/December 2019 issue is due by October 1, 2019 and content for the January/February 2020 issue is due by December 1, 2019. ICRI reserves the right to edit all submissions.

## ACI CERTIFICATION VERIFY APP NOW AVAILABLE FOR DOWNLOAD

The American Concrete Institute (ACI) has released its new ACI Certification Verify app. The app allows users to quickly and easily verify the status of ACI-certified individuals through three search options: (1) verify an individual's certification ID number, (2) search by an individual's name, and (3) find the total number of ACI-certified individuals in an area. Download the app through the Apple App Store.

ACI has certified more than 400,000 concrete finishers, technicians, supervisors, inspectors, managers, and more since the 1980s. Currently, there are more than 123,000 active ACI certifications across 25+ popular programs worldwide.

Creating this app provides further value to those working in the field, who may not have quick and easy access to a computer. The ACI Certification Verify app helps the entire verification process move more quickly and easily so jobs can move forward, with the same functionality of the popular concrete.org/verify web-based verification tool.

The app is currently available in iOS platforms. An Android version is expected to be available soon.

To learn more about ACI Certification or to download the app, visit whyACIcertification.org.

## ACI FOUNDATION IS NOW ACCEPTING FELLOWSHIP AND SCHOLARSHIP APPLICATIONS

The ACI Foundation announces that applications are now being accepted from graduate and undergraduate students for its 2020-2021 fellowships and scholarships. A recent addition to the available fellowships is the ACI Middle Eastern Fellowship—specifically for graduate students studying in Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.

ACI Foundation fellowships are offered to both undergraduate and graduate students studying at accredited American or Canadian institutions. Students must obtain two endorsements, with one being from an ACI member. Fellowships provide the following benefits:

- An educational stipend of $10,000 or $15,000 USD;
- Airfare, hotel, travel stipend, and registration to attend three ACI conventions;
- Assignment to an industry mentor;
- An internship, if required; and
- Recognition at ACI Conventions, in *Concrete International*, and on ACI Foundation's website.
- ACI Foundation scholarships are offered to graduate and undergraduate (Stehly Memorial Scholarship) students. International students are eligible for scholarships. Among other requirements, students must obtain two endorsements with one of the endorsements being from an ACI member. Each ACI Foundation scholarship includes:
- An educational stipend of $5,000 USD; and
- Recognition in *Concrete International* and on the ACI Foundation's website.

The purpose of the ACI Foundation's student fellowship and scholarship program is to identify, attract, and develop outstanding professionals for productive careers in the concrete industry and was first awarded in 2002. For the 2019-2020 academic year, the ACI Foundation distributed more than $200,000 to nineteen deserving students through the support of ACI, ACI chapters, generous donors, and industry partners. The ACI Foundation believes attracting students to the concrete industry provides both excellent career opportunities for students and helps to secure a bright future in the concrete industry. These fellowships and scholarships showcase the ACI Foundation's goals of investing in people and the future of the industry.

The deadline for applications is November 1, 2019. Additional application details are available at acifoundation.org/scholarships.

## TACA GIVES 100 CHILDREN NEW BICYCLES

*TACA's Emerging Leaders Academy and Children's Charities of Fort Worth Team Up on Charitable Initiative*

Nearly 100 Fort Worth children in need are now enjoying brand new bicycles, thanks to Texas Aggregates & Concrete Association's (TACA) Emerging Leaders Academy. Through the Children's Charities of Fort Worth, the Academy presented over half of the bicycles to children on August 3 at the Fort Worth Trinity Park, which was the second of two bike presentations held this summer. The bikes were assembled by Academy participants and other TACA volunteers at TACA's Annual Meeting in Grapevine this past June.

TACA's Emerging Leaders Academy is a rigorous three-year program designed as a platform for personal and professional development for members of the aggregate, concrete, and cement industries. In its fourth year, the Academy provides engaging coursework dedicated to developing leadership skills and offers accredited industry leader certification.

The community service initiative is a key part of the program in which Academy participants identify, fundraise for, and coordinate a donation to a charity they believe will have the biggest community impact. Third-year participants are tasked with choosing the charity.

Over the past three years, the total value of the Emerging Leaders Academy community service initiatives is over $100,000 in contributions, including parts and labor.

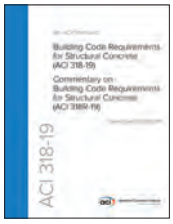
For more information on TACA and its Emerging Leaders Academy, please visit www.tx-taca.org.

## ACI 318-19 BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE

The American Concrete Institute announces that ACI 318-19 Building Code Requirements for Structural Concrete is now available in print and digital formats.

Now with full-color illustrations to improve clarity, ACI 318-19 includes major technical changes in higher reinforcing steel yield strengths; the addition of shotcrete and deep foundation provisions; seismic requirements for deep foundations and other applications; vertical seismic motions; nonlinear analysis for seismic design; modification to development length equations; and updated shear design provisions and equations. A variety of other industry needs are now addressed in ACI 318-19, including updates to provisions on post-tensioning, precast concrete, concrete durability, lightweight concrete, and more. ACI 318-19 identifies qualification training programs for inspectors/installers and lists certification requirements. It is anticipated that the final code requirements of ACI 318-19 will be referenced in the 2021 International Building Code.

ACI 318-19 is available in print and digital formats at concrete.org. Versions are currently available in English with inch-pound units and Spanish with SI units—additional versions and languages will be available soon. ACI 318-19 is also immediately available to subscribers of the online ACI Collection of Concrete Codes, Specifications, and Practices. ACI 318 Plus—a new product currently in development and targeted for launch in mid-2020—will provide subscribers with digital/interactive access to ACI 318-19 along with access to related resources.




Additionally, the Institute is hosting public and in-house seminars to introduce users to ACI 318-19—visit concrete.org for locations and to learn more.

### THE CONCRETE CONVENTION AND EXPOSITION

More than 2,000 engineers, students, contractors, educators, manufacturers, and material representatives from around the world will convene at the Duke Energy Convention Center and Hyatt Regency Cincinnati, Cincinnati, OH, USA, October 20-24, 2019, to collaborate on concrete codes, specifications, and practices. Technical and educational sessions will provide attendees with the latest research, case studies, best practices, and the opportunity to earn Professional Development Hours (PDHs).

The ACI Convention is an opportunity to showcase companies, projects, current events, and landmarks, and offers numerous networking events where you can expect to meet with many of the industry's top engineers, architects, contractors, educators, manufacturers, and material representatives from around the world.

Visit aciconvention.org for more information.

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# PEOPLE ON THE MOVE

## SIMPSON STRONG-TIE VP SAM HENSEN APPOINTED TO LOCAL HABITAT BOARD OF DIRECTORS

Simpson Strong-Tie, the leader in engineered structural connectors and building solutions, announced Vice President and General Manager of Connectors and Lateral Systems Sam Hensen has been appointed to the Habitat for Humanity East Bay/Silicon Valley board of directors.

Sam has been a vice president and general manager at Simpson Strong-Tie since 2014. He began his career with the company in 2000 as an engineer and in 2005 was promoted to engineering manager for the southeast United States. He is a licensed professional engineer in California and holds a number of connector product patents, including for a column cap, a nail plate hanger with bendable tabs and a twisted stud-to-plate tie. Sam is a graduate of the University of Southern California.

"I feel fortunate to have been part of many Habitat builds over the years in several different regions, including Texas, Arizona, Northern and Southern California," says Hensen. "I'm very appreciative of this new opportunity to serve on Habitat East Bay/Silicon Valley's board of directors. The work they do means secure, affordable housing for local families, which is critical in a region where economical housing is severely limited. I'm looking forward to helping Habitat sustain this work and am proud of the ongoing mission that Simpson Strong-Tie shares with them to help people through the design and building of safer, stronger structures."

Habitat East Bay/Silicon Valley President and CEO Janice Jensen notes, "I'm thrilled to welcome Sam to our board of directors. Not only has he been a champion for Habitat at Simpson Strong-Tie — a major partner for over two decades — but he's proven that he's willing to roll up his sleeves and volunteer with us, too. We're excited to have Sam's innovative spirit and his passionate dedication to affordable housing. I know he'll be a fantastic addition to Habitat's governance team."

Simpson Strong-Tie has been a national partner with Habitat for Humanity International for 13 years. Since 2007, the company has contributed nearly $4 million toward Habitat's goal of helping provide families in need with an affordable and decent place to call home.

## TEXAS LATH & PLASTERING CONTRACTORS ASSOC. APPOINTS PRESIDENT

Joe Kerlee, Regional Manager for QUIKRETE® Wall Systems in the Southwest was recently appointed president of the Texas Lath & Plastering Contractors Association (TLPCA). In his role, Kerlee helps steer efforts to elevate the quality of stucco manufacturing and installation through the TLPCA's education and awareness programs targeted at members, building departments, architects and specifiers, builders, lath and plaster contractors across Texas.

Kerlee began his tenure at QUIKRETE in 2011 and currently leads a team of stucco professionals in Kansas, Missouri, Oklahoma, and South Texas dedicated to delivering the highest quality products, customer service, and technical support on projects of all sizes and scope. Prior to joining QUIKRETE®, Kerlee gained experience in many aspects of masonry, stucco, veneer stone and EIFs at a major masonry distributor in Ft. Worth, Texas. This experience along with a background as a carpentry contractor gives Kerlee a unique perspective and skill for serving customers. An active fisherman and outdoor enthusiast, Kerlee and his wife Ava have three daughters and three grandchildren.

## MAPEI'S JEFF JOHNSON TO SERVE ON FCICA EXECUTIVE BOARD

MAPEI Corporation announces that Jeff Johnson, Business Manager for Floor Covering Installation Systems (FCIS), has been elected to serve as Vice Chairman of Associates on the Executive Board of the Flooring Contractors Association (FCICA). Elected by FCICA members in good standing, those on the FCICA Executive Board serve a three-year rotational term.

Johnson has been an active member of the FCICA for more than 20 years, and in his role as MAPEI's FCIS Business Manager has actively participated on the FCICA's Education, Membership and Associates Committees, as well as being a presenter at numerous conventions and mid-year events. Prior to accepting the nomination for Vice Chairman of Associates, Johnson served on the FCICA Board of Directors for a year. In his new position on the Executive Board, he will preside over meetings, promote the benefits of active membership to his associates, and represent the voice of the associate membership at the Executive Board level.

"It is exciting for me personally to be involved with the actual workings of the FCICA," Johnson said. "It is even more exciting because they have really sharpened their focus in serving the professional, commercial floor-covering contractor. I am looking forward to my continued participation on the FCICA Executive Board and hope to be a strong voice for the associates, as well as a valued contributor to the future growth of the organization."

### INTERESTED IN SEEING YOUR NEWS IN THIS COLUMN?

Email your 150-200 word news to editor@icri.org. Content for the November/December 2019 issue is due by October 1, 2019 and content for the January/February 2020 issue is due by December 1, 2019. ICRI reserves the right to edit all submissions.

# ICRI**CHAPTER**NEWS

## CHAPTER CALENDAR

**BALTIMORE-WASHINGTON**
*September 19, 2019*
CHAPTER DINNER MEETING
Panel Discussion
Topic: Permitting of Repair & Restoration Projects
Maggiano's Tysons Corner
McLean, VA

*October 3, 2019*
ANNUAL GOLF TOURNAMENT
Timbers at Troy
Elkridge, MD

**CAROLINAS**
*October 24 & 25, 2019*
FALL CONFERENCE
Embassy Suites Golf Resort
Greenville, SC

**CENTRAL OHIO**
*October 3, 2019*
FIRST ANNUAL GOLF OUTING
Crown Hill Golf Course
Williamsport, OH

**CHICAGO**
*September 13, 2019*
ROOFTOP NETWORKING EVENT
Wrigley Field Rooftop
Chicago, IL

*September 17, 2019*
CHAPTER DINNER MEETING
Panel discussion with Women in Restoration
Erie Café
Chicago, IL

**DELAWARE VALLEY**
September 27, 2019
ANNUAL FALL GOLF OUTING
Rock Manor Golf Club
Wilmington, DE

*October 16, 2019*
DINNER MEETING
Embassy Suites Airport
Philadelphia, PA

**FLORIDA WEST COAST**
*October 18, 2019*
TECHNICAL SESSION: DEMO DAY
University of South Florida
Tampa, FL

**GEORGIA**
*September 26, 2019*
CHAPTER LUNCHEON
Maggiano's
Dunwoody, GA

*October 24, 2019*
CHAPTER LUNCHEON
Maggiano's
Dunwoody, GA

**GREAT PLAINS**
*September 5, 2019*
LUNCH & LEARN SEMINAR
Speakers: Ivan Romo, Situra, Inc. and John Harder, Balco
Strategic Air Command & Aerospace Museum
Ashland, NE

**INDIANA**
*September 11, 2019*
CHARITY GOLF OUTING
Benefiting Anna's Celebration of Life Foundation
Plum Creek
Carmel, IN

**METRO NEW YORK**
*September 19, 2019*
ANNUAL FALL GOLF CLASSIC XVI
Cedar Hill Country Club
Livingston, NJ

**MICHIGAN**
*October 3, 2019*
DINNER MEETING WITH WMU
Joint Meeting with ASCE Student Chapter
WMU Fetzer Center
Kalamazoo, MI

**MINNESOTA**
*October 10, 2019*
FALL TECHNICAL SESSION
AET Offices
St. Paul, MN

**NORTH TEXAS**
*September 12, 2019*
MEMBERSHIP MEETING
Topic: Repair of Post-Tensioned Structures
Speaker: Nate Poen, Structural Technologies
Las Colinas Corporate Center
Irving, TX

**NORTH TEXAS**
*October 4, 2019*
JESSE POINTS MEMORIAL GOLF CLASSIC
Waterchase Golf Club
Fort Worth, TX

**NORTHERN OHIO**
*October 8, 2019*
CHAPTER MEETING
Topic: Project Profile – Engineer's Viewpoint
Speaker: Mark Churpek, Wiss, Janney, Elstner Associates
Crown Plaza Cleveland South
Independence, OH

**QUEBEC PROVINCE**
*October 17, 2019*
ANNUAL DINNER SEMINAR
Topic: Samuel de Champlain Bridge
Speaker: Guy Mailhot, Chief Engineer
Sheraton Hotel
Laval, QC

**ROCKY MOUNTAIN**
*September 26, 2019*
ANNUAL SPORTING CLAYS
Kiowa Creek Sporting Club
Bennett, CO

**SOUTHEAST FLORIDA**
*October 4, 2019*
ANNUAL GOLF TOURNAMENT
Jacaranda Golf Club
Plantation, FL

**TORONTO**
*September 24, 2019*
CHAPTER SEMINAR DAY & LOBSTERFEST
Joint Seminar Day ICRI/ACI
8 Technical Presentations followed by Lobsterfest
Mississauga Grand Event Center
Mississauga, ON

**VIRGINIA**
*September 12, 2019*
FALL SYMPOSIUM
Topic: Repair, Restoration, and Sustainability of Precast Concrete
Colonial Heritage Golf Club
Williamsburg, VA



ICRI CONCRETE REPAIR CHAPTERS

## MINNESOTA HOSTS SPRING TECHNICAL SESSION

The Minnesota Chapter sponsored a Spring Technical Session on May 23, 2019, in Minneapolis. It was attended by 19 people. The topic was "Façade Repair at the London House Hotel, 360 N. Michigan, Chicago." The presenter was Mike Naponelli, RA with Klein & Hoffman. The intricate details of the façade repair were fascinating and there were many questions throughout the presentation.

The London Guarantee and Accident Building, originally built in 1923, is a Chicago landmark building and considered one of Chicago's finest examples of the Beaux Arts-style Architecture. For nearly a century, the building provided prime office space for many Chicago businesses. The original owner, The London Guarantee and Accident Company, provided insurance to many of the busy Chicago stockyards, which were prominent in the early part of the century. After 91 years of operating as an office building, new ownership converted the building's usage to retail and hotel. The conversion was part of the building's adaptive re-use program which began in 2014 and was completed in late 2016, creating The London House Hotel.

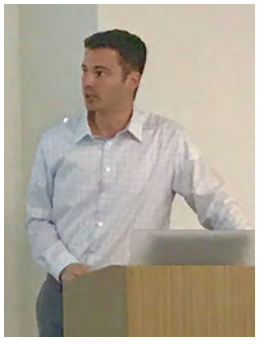
The façades are primarily clad in Standard Buff Indiana Limestone accented with decorative terra cotta coursing at the 17th, 18th and 21st floors. Large carved limestone colonnades, balustrades, urns, vases, and griffins provide unique enrichments throughout the façades. The building is capped with a prominent 70-foot limestone and terra cotta cupola overlooking Michigan Avenue.

Given the significant extent of limestone spalling and deterioration present throughout the exterior facades, Klein and Hoffman, Inc. prepared a comprehensive rehabilitation program to revitalize the neglected façades. The repair program focused on restoring the limestone as close as possible to its natural beauty and appearance. Approximately 400 tons (5,000 cubic feet) of Indiana Limestone were provided for the project. Over 1,200 limestone units of varying sizes were replaced throughout the façades. Each stone was water-blasted to provide texture and color that closely matched the existing 90-year-old stones.

Project challenges included accessing and maneuvering the large stone into place, some 20 stories above grade. Ten limestone urns were reset across the rooftop parapet. Each limestone urn weighed approximately 4,000 pounds and required a crane to be lifted into place. The urns had been removed 15 years prior because of significant outward displacement and concern they may fall 21 stories to the sidewalks below. The Corinthian column capitals at the building's main entrance were damaged and missing large sections of the acanthus leaves and scrolls. Given the level of detail required at the columns, ornate Dutchmen were installed and hand carved in-situ to allow for the capitals' elegant details to be matched precisely.

A majority of the work was performed from swing-stage scaffolds; however, the extent of façade repair at the upper floors of the building was so extensive that pipe scaffolding was erected from platforms cantilevered out from the 17th floor. At these locations, entire cornices and belt courses were removed and rebuilt. All of the work was performed over the busy sidewalks at Wacker Drive and Michigan Avenue, where thousands of pedestrians pass by each day.

Upon completion of the repairs, the limestone and terra cotta facades were cleaned to remove decades worth of carbon build-up and organic growth, allowing the London House to once again shine as it originally did in the '20s.



The Minnesota Chapter welcomed guest speaker Mike Naponelli, RA, Klein & Hoffman, who presented a historic Chicago building façade repair case study

Guests learned quite a bit about the intricate project and the unique challenges it presented

## MICHIGAN HOSTS SPORTING CLAYS EVENT

The Michigan Chapter hosted its second annual Sporting Clays shooting event on June 6, 2019. The annual social event has been a success, this year drawing 35 shooters to the Detroit Gun Club in Walled Lake, Michigan. It was a great night for an outing and we even added a few mosquitoes to our membership.

Shooters competed at 14 stations and relaxed afterward with dinner and a raffle. Shooting 96%, Chad Lenzi was this year's winner—winning the grand prize of Tiger baseball tickets! Other prizes were raffled off, with the proceeds going to the Michigan Chapter Scholarship program.

The Michigan Chapter's Sporting Clays event is a big draw for local members

## MINNESOTA GOLF OUTING HOSTED AT NEW VENUE

The Minnesota Chapter held its annual golf outing on July 23 at Bunker Hills Golf Course in Coon Rapids. This was a new venue for the outing and the weather was perfect for our 140 attendees. The team of Chris Larson, Central Roofing; Matt Barlau, Central Roofing; Anthony Leon, Kraus Anderson; and Stephan Michno, Kraus Anderson, were the tournament's winning team finishing at -16. The runners up were John Huh, Dan Weller, Mark Taschuk and Braeden Kleven.

Minnesota Chapter Golf Outing 1st Place team

Minnesota Chapter Golf Outing 2nd Place team


Registration area at the new course

Outing Sponsors

## NORTHERN OHIO HOSTS GOLF OUTING

On July 26, 2019, the Northern Ohio Chapter hosted its Annual Golf Outing at Manakiki Golf Course in Willoughby Hills. Fifty-two golfers enjoyed the warm, sunny weather and camaraderie on the links. The foursome of Troy Testerman, Ed DeTullio, Josh Rentz and Bill Hamge were the winners with an 11 under par score of 61. Second place went to the team of Wes Gilmore, Dante Marimpietri, Chad Daubenmire, and Todd Daubenmire with a score of 63.

After a full round of golf, the entire group enjoyed a BBQ dinner in the clubhouse along with a prize drawing for all attendees. Stay tuned for more information on the chapter's next social event at the new Top Golf Facility in Cleveland, Ohio, later this year.

In other news, the new Northern Ohio Chapter website is now up and running. Go to https://icrinohio.com/ to keep up with the Chapter. News, upcoming meetings, and social event information will be posted on the website. You will also be able to register for events and make payments for events through the website. The Chapter also has a Twitter account to keep members up to date. The account name is @ICRIOhio.

## INDIANA HOSTS GO-KART NETWORKING EVENT

The Indiana Chapter hosted a night of networking and fun at Speedway Indoor Karting on June 6, 2019! The members and guests enjoyed racing go-karts on a 14 turn, multi-level track. Dinner and drinks were served afterward at the 1911 Grill.


ICRI Indiana Chapter members gathered for an evening of Go-Kart racing for their June networking event


It was a unique evening on a private course and everyone had fun


Chapter's three medal winners for the fastest lap times are from left to right; Matt Gaughan with NEW Group took first place, Kevin O'Gara from Jobsite Supply came in second place; and Kyle Gordon with Western Specialty Contractors brought home the third place medal

ICRI CONCRETE REPAIR CHAPTERS

## FLORIDA WEST COAST BOASTS BUSY JUNE OUTINGS

The first week of June was a busy one for the Florida West Coast Chapter. On June 5, 2019, the chapter hosted its 2nd Annual Cigar and Whiskey Tasting Social at the Bad Monkey in historic Ybor City in Tampa. Members and guests gathered to network and enjoy the Cuban flavor of Ybor. Many new faces, including contractors, manufacturers, engineers, and suppliers came to learn about the chapter. Representatives from Whistle Pig Whiskey were in attendance providing the whiskey choices for the evening. Authentic Cuban food was provided along with hand-rolled cigars by a native Ybor City roller. Great conversation and new friendships were enjoyed by all in atendance.

On June 7, 2019, the chapter again assembled to participate in a Community Project Day at the Boys & Girls Club in Pinellas Park, FL. This project was an opportunity for members to come together to give back to the community by repainting a building on the Boys & Girls Club campus. This community day was a collaborative event organized by Tom White, Inc., a gold level sponsor of the Florida West Coast Chapter. Sun Paints & Coatings, a long-standing member in the chapter, generously donated all the paint for the project. Many thanks to the members that came out to provide the Boys and Girls Club with a fresh new look.

Florida West Coast Chapter Members enjoying their 2nd Annual Cigar and Whiskey Tasting Social at Bad Monkey in historic Ybor City, Tampa

Florida West Coast Chapter Members volunteered to work together to provide a fresh coat of paint for the Pinellas Park Boys & Girls Club

## CHICAGO HOSTS ANNUAL GOLF OUTING

In June, the Chicago Chapter of ICRI hosted its 24th annual Golf Outing & Scholarship Fundraiser at White Pines Golf Course. All enjoyed the warm beautiful day. A day of golf provided a much-needed break from the rigors of our industry in the midst of another busy construction season.

Golf outing participants pictured left to right are: Chapter Vice President Mike Wiscons, Chapter Secretary George Mulholland, member Jim Nugent, and member Gary Hayes

## QUEBEC CHAPTER HAS A BUSY SPRING

On June 13, 2019, ICRI Québec had their summer happy hour at the Terrasse St-Ambroise. The event was a success, despite the uncertain weather. A total of 38 participants were able to enjoy the last-minute sunshine, drinking McAuslan beer and sampling wood-fired pizza. It was a great opportunity to have a good time with colleagues in the concrete repair industry at the start of the summer season. The Chapter appreciates all those that participated!

Then, on June 29, 2019, the Chapter held their traditional Montreal Impact Soccer Match Social. The special gathering space allowed for a casual atmosphere. The evening included food and drink and a total of 24 ICRI members were able to join us at the stadium. Everything came together, perfect weather and an exciting match allowed us to spend a nice social evening together.

Before all that, the ICRI Chapter joined forces on April 4, 2019, with the local ACI Chapter to hold a one-day seminar on the Durability and Maintenance of Concrete Infrastructure. The seminar included eight different presentations, a total of nine speakers, and nearly a hundred participants. The comments received unanimously praised the quality of the presentations and the teamwork of the two organizations. The seminar was followed by time for networking where many of the participants and speakers stayed to continue their discussions and meet new people.


Terrasse St-Ambroise was the site of the June networking event for ICRI Quebec

ICRI Quebec met at Saputo Stadium, a soccer-specific stadium at Olympic Park in Montreal, Quebec, for networking during a Montreal Impact match

ICRI Quebec met with local ACI members during a one-day seminar in April

# ICRI**CHAPTER**NEWS

## CHAPTERS COMMITTEE CHAIR'S LETTER

MICHELLE NOBEL
Chapters Chair

As we head into Fall and spend our last days of Summer vacationing with our friends and families before the kids go back to school, it's a great time to look back on what you've done within your chapters. Look at the previous year's Chapter Awards paperwork. Where are the deficiencies where you can gain points in next year's Chapter Awards? There is still time to change it up a little to gain points. In the insightful words of Charles Darwin, "It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change." If you're struggling to come up with new ideas for your chapter, please feel free to reach out to me or any of your past chapter leaders to see what you can do to change the status quo. Every chapter should be striving to achieve its goals—whether it's to increase membership, add more social and educational events, or the elusive Chapter of the Year Award. If you don't have set goals, then you don't have something for which to strive.

The Fall ICRI Roundtable will be in Chicago, Illinois, September 23-24, 2019. The Chicago, Indiana, Central Ohio, Greater Cincinnati, Northern Ohio, Michigan, Minnesota, Iowa/Illinois, Great Plains and Mid South ICRI Chapters will be invited. I always look forward to seeing old friends and making new friends at the ICRI Roundtables. I find that events that have been successful for one chapter can be used in other parts of the country to make another successful chapter event. I always come away with new ideas and a renewed sense of excitement for invigorating our chapter. If you've never attended an ICRI Roundtable, it's a great way to share your chapter's successes (and failures). If you're in the Chicago area at the time of the ICRI Roundtable, reach out to Dale or me if you'd like to be included.

The ICRI Fall Convention will be in Philadelphia, Pennsylvania, November 11-13, 2019, "Historic Restoration: The Art and Science of Preserving Structures", at the DoubleTree Hilton Philadelphia Center City. The Delaware Valley Chapter has a lot planned for this convention. It has something special planned for the November 11 Veteran's Day and for ICRI President Chris Lippmann. You'll have to come to the convention to find out all the details. I know you won't want to miss a thing!

Remember to sign up your delegates for all the conventions. It's one of the benefits of being an ICRI member and it helps get points for the ICRI Chapter Awards.

Other dates to mark on your calendar are:

**Concrete Slab Moisture Testing**
September 25-26, 2019 in Baltimore, Maryland

**ACI Fall Convention and Expo**
October 20-24, 2019
Cincinnati, Ohio

**Concrete Slab Moisture Testing**
October 14-15, 2019
Atlanta, Georgia

**ICRI Chapter Roundtable**
September 23-24, 2019
Chicago, Illinois

**2019 ICRI Fall Convention**
November 11-13, 2019
Philadelphia, Pennsylvania

**World of Concrete 2020**
February 2-7, 2020
Las Vegas, Nevada

**2020 ICRI Spring Convention**
March 23-25, 2020
Vancouver, British Columbia

**2020 ICRI Fall Convention**
October 4-6, 2020
Minneapolis, Minnesota

**World of Concrete 2021**
January 19-22, 2021
Las Vegas, Nevada

For ICRI Chapter and other events, visit: https://www.icri.org

Remember to submit your chapter events and information by using the "Submit a Chapter Update" link found on your chapter's national webpage, so your events and information can be listed on the ICRI national website.

At ICRI, we encourage members to support each other and their chapters—you never know who you'll run into or from where you'll get your next project lead. I often get asked for local contractors, engineers, consultants, or general information from ICRI members who work in other parts of the country. It's the relationships that you build that help build your success. In the astute words of Dale Carnegie, "You can make more friends in two months by becoming interested in other people than you can in two years by trying to get other people interested in you." So, go out and get interested in other ICRI chapters and see what new ideas and rewards can be achieved!

Remember to always be kind to everyone, travel safe, and I'll see everyone in Chicago for the next ICRI Chapter Roundtable!

Sincerely,
Michelle Nobel
2019 Chapters Committee Chair

### 2019/2020 CHAPTER NEWS DEADLINES

JANUARY/FEBRUARY 2020
November 10, 2019

MARCH/APRIL 2020
January 10, 2019

Send your Chapter News by the deadlines to Dale Regnier, Director of Chapter Relations, daler@icri.org

**For the latest ICRI Chapter information, visit www.icri.org**

# PRODUCTINNOVATION

## CORTEC® DELIVERS POWERFUL MCI® WATER/OIL/STAIN REPELLANT WHILE MEETING REGULATORY DEMANDS

Cortec® has again met the demands of an ever-changing regulatory landscape, now with the successful reformulation of MCI® POWR 100, a powerful three-in-one concrete surface treatment for water repellency, oil/stain resistance, and corrosion protection. This multi-functionality makes MCI® POWR 100 particularly beneficial for commercial buildings, parking garages, bridges, and industrial floors exposed to high levels of oils, greases, or water.

MCI® POWR 100 works in three ways. First, the silane component of MCI® POWR 100 provides water repellency by chemically reacting with the cementitious substrate under proper application, decreasing the ingress of aggressive materials. Second, the oleophobic additive modifies the concrete surface to increase resistance to oil and food stains. Third, the MCI® component penetrates deep into the substrate, forming a protective, molecular barrier on embedded reinforcement to reduce the rate of corrosion at the rebar surface.

To reassure customers that the new formulation does not negatively impact the water, oil, and stain resistance of MCI® POWR 100, the product underwent multiple tests—in some cases being assessed alongside a standard silane sealer. The results of testing showed that MCI® POWR 100 still delivered the required water, oil, and stain resistance characteristics, while performing competitively and sometimes superior to a traditional silane sealer in water and oil.

To learn more about MCI® POWR 100, please visit: https://www.cortecvci.com/Publications/PDS/MCI-POWR-100.pdf.

## NEW PROSOCO CLEANER MEETS EPA SAFER CHOICE DIRECT-RELEASE CRITERIA

A new all-purpose cleaner and degreaser from PROSOCO called Klean 'N Release Cleaner is now certified with the U.S. EPA Safer Choice program and meets its direct-release criteria for products with outdoor uses.


Enviro Klean® Klean 'N Release Cleaner is ideal for cleaning a variety of interior and exterior surfaces including windows, countertops, bathtubs, sinks, patios and sidewalks. It works on multiple substrates such as natural stone, limestone, marble, granite, masonry, tile, metal and more.

This fragrance-free cleaner is formulated to be safer for people and the environment by using readily biodegradable ingredients. Water-rinsable Klean 'N Release Cleaner contains no phosphates, colorants, hazardous solvents or environmentally harmful surfactants. It's also safer to use around plants, lawns, pets and wildlife. Klean 'N Release is strong enough for general cleaning in new construction and safe for historic restoration projects.

This easy-to-use cleaner is dilutable with up to 10 parts water to offer an economical and effective concentrate solution.

"Klean 'N Release is an ideal fit for our customers in the construction and building maintenance sectors," said Dwayne Fuhlhage, sustainability director for PROSOCO. "The Safer Choice label is recognized in the LEED, WELL, Living Building Challenge, and federal procurement standards. This designation makes it easy for specifiers and purchasers to find effective products."

Safer Choice is a voluntary program of the EPA that certifies product ingredients meet rigorous human health and environmental criteria. Safer Choice-certified products contain safer ingredients without sacrificing quality of performance.

For more information visit: https://prosoco.com/product/klean-n-release-cleaner/

## SIMPSON STRONG-TIE® BTH BECOMES FIRST CODE-LISTED, COST-EFFECTIVE SOLUTION FOR CONNECTING BRICK VENEERS ACROSS 2" TO 3" AIRSPACES

Simpson Strong-Tie, the leader in engineered structural connectors and building solutions, has secured code listing for its high-performance BTH brick tie, a first-of-its-kind, cost-effective solution for connecting stone and brick masonry veneers to light-frame construction across spans of two to three inches.

Introduced in August 2018, the BTH brick tie has been a significant innovation, helping contractors and homebuilders meet the ever-increasing spacing requirements of modern, high-performance residential wall systems. The BTH is fabricated from 22-gauge galvanized steel, and is designed to provide the flexibility needed to span wider airspaces between veneer and framing.

To secure code listing for the BTH, Simpson Strong-Tie worked with the International Code Council Evaluations Services and industry stakeholders to develop testing guidelines for this innovative and emerging product category. Code listing for the BTH was approved on June 29.

"Until now, builders were challenged with finding an answer to the increased spacing requirements in the wall cavity while still meeting code," says Sam Hensen, vice president of connectors and lateral systems for Simpson Strong-Tie. "The BTH is a first-of-its-kind, high-performance solution allowing contractors to build the way they want to build with code-listed confidence and without breaking the bank."

The BTH is field-adjustable in two places and can be installed with either side facing

up, providing strength and versatility across varied jobsite conditions and offering labor-stressed contactors a fast and simple solution. Additional BTH brick tie features and benefits include:

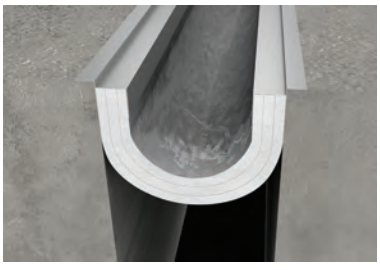
- Embossments supply added strength when connecting wood framing and veneer across wider airspaces
- Holes at the end of the tie provide strength in the mortar with a minimum of 1½" embedment
- Dual field-bendable zones allow for easy adjustment to airspaces within the 2"–3" range

For more information about the BTH high-performance brick tie, including spacing tables and design schematics, visit strongtie.com/bth.

## BALCO USA INTRODUCES METAFLEX® PRO SERIES OF FIRE BARRIERS FOR LARGER EXPANSION JOINTS

MetaFlex Pro fire barrier products feature time-saving one-piece installations with easy splicing, and have been tested to standards UL 2079 and ASTM E 1966 with high performance in fire and temperature resistance, cycle movement and air leakage prevention.

Balco Inc, Wichita, KS, a leading manufacturer of high-performance construction products, introduced the MetaFlex Pro family of fire barriers: MetaFlex Pro 2 Hr, Metaflex Pro 3 Hr, Metaflex Pro Shear, and Metaflex Pro Undermount. These four products were designed with the installer in mind, featuring simplified installation. Tested to UL 2079 standards these products meet all of the International Building Code (IBC) requirements and test standards for fire resistance and protection. Available for floor expansion joints up to 18" maximum open conditions, they cover nearly every commercial building application.



The Metaflex Pro 2-Hr and 3-Hr both offer a single package installation with factory installed flanges that feature easy, drop-in convenience for the contractor. With this design, Balco has eliminated the need for fire caulking along the sides of the joint and simplified splicing. All of this adds up to significant savings in labor costs and time on the job.

Metaflex Pro Shear shares the same features and performance of Metaflex Pro 2-Hr and 3-Hr, while also allowing for up to 100% shear movement. This is a must-have feature in areas prone to higher seismic activity.

Metaflex Pro Undermount offers a 2-Hr rating from the bottom of the slab. This is especially useful in retrofit conditions, applications with penetrations running through the joint, or other situations that would prevent installation from above.

Other features of the MetaFlex Pro product line are:

- Contains no asbestos, solvents or other hazardous materials;
- Doubles as smoke barrier, passes air leakage testing as per UL 2079
- Contributes to Leadership in Environmental and Energy Design (LEED®) credits under the categories of 1) recycled content for steel and ceramic blanket, 2) regional material;
- Additional MetaFlex Pro product solutions currently in development;
- Standard one-year warranty, five-year warranty when installed by a Balco-certified technician.

For more information visit www.balcousa.com.

## SIMPSON STRONG-TIE COMPLETES SEISMIC TESTING FOR ENHANCED CODE LISTING OF CONCRETE AND MASONRY REINFORCEMENT SYSTEMS

Simpson Strong-Tie, the leader in engineered structural connectors and building solutions, has secured seismic code listing of its high-performance FRCM fabric-reinforced cementitious matrix and FRP fiber-reinforced polymer solutions for the reinforcement and strengthening of concrete and masonry structures.

Comprehensive seismic testing was conducted at the Simpson Strong-Tie Tyrell Gilb Research Lab and other locations to establish the strength of FRCM and FRP systems when subjected to seismic forces. Tyrell Gilb is the only privately owned lab with an accredited seismic testing facility, including a seismic shake table and a cyclic/static test frame that can test wall sections up to five stories high.

The 6.4-magnitude and 7.1-magnitude earthquakes that occurred on July 4 and July 5 outside of Ridgecrest, California, underscored the critical need for composite systems designed to repair structural damage from seismic events and that could provide the code-listed structural resiliency to withstand future events.

"Larger earthquakes like the ones in Southern California are a reminder of the ongoing necessity for seismic retrofit applications that can provide significant flexural, axial and shear strength gains with reduced preparation and installation time," says Brad Erickson, engineering manager of Composite Strengthening Systems for Simpson Strong-Tie. "With completion of seismic testing of FRCM and FRP, Simpson Strong-Tie is able to offer the most thorough code listing for any available composite strengthening system, and we still have the only code-listed precured carbon laminate as well."

Simpson Strong-Tie is at the forefront of research and development for seismically resilient construction systems, including participating in the world's largest shake table test to determine how buildings perform and where they fail during earthquakes and other natural disasters. The updated FRP code report has added ductility for column strengthening and for beam strengthening, as well as in-plane shear strengthening of slabs and of concrete walls. The new FRCM code report includes the following structural applications:

- Axial strengthening of columns
- Flexural strengthening of slabs
- Flexural and shear strengthening of beams

- Out-of-plane flexural strengthening of concrete masonry walls
- In-plane shear strengthening of concrete masonry walls

In addition to seismic testing, both the FRCM and FRP were tested for performance against fire, achieving a four-hour UL fire-rated assembly and a Class 1/A rating for ASTM E84 flame spread and smoke development.

For more information visit strongtie.com/css.

## SIKA CORPORATION IS PROUD TO ANNOUNCE THAT SIKAFIBER® ENDURO® PRIME IS ONE OF THE FIRST MACRO FIBERS TO OBTAIN AN ICC EVALUATION SERVICES (ES) REPORT FOR AC383

Sika is proud to announce that SikaFiber® Enduro® Prime is one of the first macro fibers to obtain an ICC Evaluation Services (ES) Report for AC383. The ICC (International Code Council) is dedicated to developing model codes and standards used in the design, building and compliance process to construct safe, sustainable, affordable and resilient structures, such as the International Building Code and the International Residential Code. The ICC Technical staff develops Acceptance Criteria (AC) for new and innovative products which are approved by the Evaluation Committee during open public hearings. The Evaluation Committee is made up entirely of code officials. The AC for Polyolefin Chopped Strands (Macro Synthetic Fiber) for use in concrete is AC383.

The ICC-ES Reports verify that new and innovative building products comply with code requirements and recommendations for use. SikaFiber® Enduro® Prime, manufactured in Chattanooga, TN, had to go through a battery of stringent third party testing to achieve the ICC ES Report 4282. The testing for the evaluation report included the following; Freeze Thaw (ASTM C666), Plastic Shrinkage Cracking Resistance (ASTM C1579), Ring Shrinkage (ASTM C1581) and the Flexural Performance of Fiber Reinforced Concrete (ASTM C1609). SikaFiber® Enduro® Prime excelled at all of the testing at a minimum dosage of 3 pcy.

For more information visit: https://icc-es.org/evaluation-report-program/reports-directory/.

## PROSOCO ANNOUNCES NEW INTERIOR MASONRY DUSTPROOFER

A new product from PROSOCO helps prevent further dusting of exposed interior masonry surfaces.

Interior Masonry Dustproofer is a ready-to-use, environmentally safe, waterborne silicone emulsion that's effective on brick, mortar, natural stone and other porous masonry substrates. It seals in dust to prevent further dusting.


Leaving treated surfaces water-resistant, Interior Masonry Dustproofer dries to a clear, matte finish and retains the substrate's natural breathable properties.

Surfaces treated with Interior Masonry Dustproofer will also be more resistant to blushing, efflorescence, mildew and other moisture-related stains.

Low-odor Interior Masonry Dustproofer is VOC-compliant with all national, state and district regulations.

Interior Masonry Dustproofer was developed because of the rising trend of exposed masonry in interior spaces, particularly in older buildings that have been rehabilitated and repurposed.

"PROSOCO has made its mark for 80 years in the construction industry by closely following industry and architectural trends and developing products to meet those specific demands," said Jake Boyer, leader of PROSOCO's cleaners and protective treatment group. "As a private, family-owned business, we're also nimble enough to research, develop and introduce products to market in order to respond quickly to market trends."

"We've already realized through its introductory testing phase that Interior Masonry Dustproofer will be popular on projects with exposed interior masonry and helping maintain healthy, dust-free interior environments."

For more information, visit: https://prosoco.com/product/interior-masonry-dustproofer/.

## SIMPSON STRONG-TIE INTRODUCES CORROSION-RESISTANT 1/4" STAINLESS-STEEL SCREW ANCHOR APPROVED FOR CRACKED-CONCRETE APPLICATIONS

Simpson Strong-Tie, the leader in engineered structural connectors and building solutions, has introduced the first 1/4"-diameter stainless-steel screw anchor designed for lighter-duty applications in severely corrosive environments. It's code listed for use in cracked concrete.

Part of the broad line of code-listed stainless-steel Titen HD® heavy-duty screw anchors (THDSS) from Simpson Strong-Tie, the new 1/4" THDSS screw anchor combines the corrosion resistance of Type 316 stainless steel with the undercutting ability of harder, heat-treated carbon steel. The THDSS helical-coil threads feature a serrated carbon-steel leading thread that cuts a channel so the stainless-steel threading can securely interlock with concrete and masonry.

Traditional carbon-tipped stainless-steel anchors are vulnerable to rust and expan-

sion that can crack the concrete, but the helical-coil carbon thread of the THDSS greatly reduces the anchor's overall carbon-steel quantity, making it much less likely to cause concrete damage if corrosion occurs. For comparison, a 1/2" x 5" THDSS screw anchor contains less than 1% carbon steel, while other stainless-steel screw anchors of the same size can contain as much as 18% carbon steel.

The addition of the 1/4"-diameter anchor to the THDSS lineup (which also includes diameters of 3/8", 1/2", 5/8" and 3/4") rounds out the company's offering of stainless-steel anchors suitable for bridge, marine, water-treatment plant, and heavier civil-construction and retrofit applications where corrosive elements pose a hazard to standard carbon-steel screw anchors. In addition to their strength and environmental adaptability, all Titen HD® screw anchors install easily with an impact wrench or hand tool.

"Titen HD screw anchors have quickly become a trusted anchor solution because they offer the performance that designers need and the ease of installation that contractors demand," says Simpson Strong-Tie senior product manager Mike Steiber. "When the job calls for installation in multiple types of environments, including corrosive environments, wedge anchor and adhesive options often face difficult spacing and installation issues, so for applications that need stainless-steel anchors, Titen HD provides a new standard for the market."

Stainless-steel Titen HD anchors are code listed for a wide variety of applications in IAPMO UES ER-493 (for concrete) and ICC-ES ESR-1056 (for masonry). For more information about the family of THDSS screw anchors, visit: https://www.strongtie.com/products/go/anchors/titenhdss

## NEW SIMPSON STRONG-TIE GUIDE FOR CONCRETE CONSTRUCTION SOLUTIONS MAKES PRODUCT SELECTION QUICK AND EASY

Simpson Strong-Tie, the leader in engineered structural connectors and building solutions, has announced the release of its Anchoring, Fastening Systems and Restoration Solutions for Concrete and Masonry product guide, a comprehensive yet streamlined reference guide designed to aid customers in quickly identifying the right products across the company's extensive line of concrete construction solutions.

Created for dealers, engineers, and contractors, the concrete construction product guide makes it easy to specify project-appropriate solutions, with robust product pages that include detailed features and benefits, installation sequence visuals and notes, associated tools and products, and information on specific market segments within the building and repair industry.


"We know contractors are pressed for time and that dealers are often asked to help recommend the right hardware for the job, so we've designed the concrete solutions product guide to get them quickly to the information they need," says Ryan Kaelin, director of Concrete Construction Products for Simpson Strong-Tie. "You shouldn't have to sift through a lot of information to get to a specific solution, and we've organized the product guide in a concise way with those customer needs in mind."

For more information, or to view or download a PDF of the Simpson Strong-Tie® Anchoring, Fastening Systems and Restoration Solutions for Concrete and Masonry product guide, visit strongtie.com.

## PROSOCO LAUNCHES LIQUID INTEGRAL COLORS FOR CONCRETE OVERLAYS

Repair contractors, architects and building owners now have a safer, more consistent option to integrally add color to concrete flooring overlays.

PROSOCO's new Integral Color for Overlays is a pre-measured, concentrated liquid designed to integrally color cement mixtures for overlays and polishable overlays. Available in nine colors, Integral Color for Overlays blends easily into overlays during the mixing process to create attractive hard surfaces.

The UV-resistant, easy-to-mix colors produce uniform and consistent color results in overlay applications.


The liquid formulations are less messy than powdered integral colors and also safer. They're non-hazardous and water-based, and come in 10-ounce packages for easy shipping.

All nine colors will also be readily stocked and available for order any time, according to Nick Savage, leader of PROSOCO's Consolideck concrete floor products.

Integral Color for Overlays colorants are also VOC-compliant, non-flammable, non-toxic, non-corrosive and low-odor.

Integral Color for Overlays is suitable for overlays in outdoor or indoor applications. These integral color concentrates are compatible with other Consolideck products that color, densify, dustproof, add sheen, and protect from stains.

For more information visit: https://prosoco.com/product/integral-color-for-overlays/.

## INTERESTED IN SEEING YOUR NEW PRODUCT IN THIS COLUMN?

Email your 150-200 word product information to editor@icri.org. Content for the November/December 2019 issue is due by October 1, 2019 and content for the January/February 2020 issue is due by December 1, 2019. One (1) high resolution product photo may be included. ICRI reserves the right to edit all submissions.

# NEWMEMBERS

## COMPANY MEMBERS

**Beccote**
Ashhurst
New Zealand
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*Allan Bernadas Go*

**Conspec**
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## ADDITIONAL INDIVIDUALS FROM MEMBER COMPANIES

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# SIKA COMPLETES ACQUISITION OF PAREX

Sika has completed the acquisition of Parex on May 23, 2019. Sika and Parex are two strong companies that are highly complementary in product offering and channel penetration. With this acquisition, Sika will expand its product portfolio for the building finishing market and further strengthening its world leader position in construction chemicals.

Visit parexusa.com or usa.sika.com for more information.

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