September/October 2021
Vol. 34, No. 5

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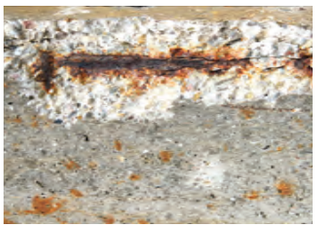


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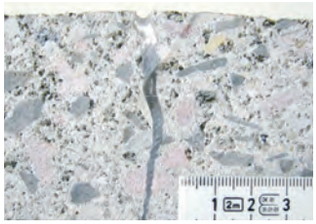

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ON THE COVER: New Trends and Technologies in Concrete Repair. Photo: EXACT Technology

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NOTE FROM THE EDITOR

Fall is in the air and everyone is busy trying to get projects completed. The Industry is continuing to have issues with manpower, material shortages and material price increases as COVID seems to be returning in many parts of the country. ICRI is still planning to host the 2021 Fall Convention (October 11-13) in Minneapolis, Minnesota.

The theme of this issue of the Concrete Repair Bulletin is *New Trends and Technologies in Concrete Repair*. Articles include: *Case Study on the Repair of Catalytic Reformer Support Structure*; *Structural Health and Corrosion in High-Rise Structures*, and *Investigations of Aging Concrete Structures*. The issue also features an *Overview of ICRI Technical Guidelines 320.1R-2019 Guide for Selecting Application Methods for the Repair of Concrete Surfaces* and *320.2R-2018 Guide for Selecting and Specifying Materials for Repair of Concrete Surfaces.*

ICRI continues to hold certifications classes for Concrete Surface Repair Technicians (CSRT) and for Concrete Slab Moisture Testing (CSMT). Check the ICRI website for dates and locations. Please continue to send in your ICRI chapter events and updates to Dale Regnier.

I hope you are having a great Fall and look forward to seeing you in Minneapolis in October for the ICRI Fall Convention!

Jerry Phenney
RAM Construction Services
Editor, Concrete Repair Bulletin

PRESIDENT'SMESSAGE


ELENA KESSI


ERIC HAUTH

Dear ICRI Friends,

We write this message at a time of guarded optimism for a future beyond the pandemic. As we look ahead, we cannot wait to welcome back attendees to ICRI's Fall Convention in Minneapolis on October 11-13!

With the theme, *Evaluation and Forensics—Despair to Repair*, this convention promises exceptional networking, education, and opportunities to advance the industry. This is your chance to get back together with your ICRI colleagues from across the continent. If you have not already, get yourself registered now at www.icri.org!

We also write this article following the tragic collapse of the condominium in Surfside, Florida. While the causes of this tragedy have not been fully determined, this devasting event put into sharp focus for the public and building professionals the critical work of quality concrete evaluation, assessment, and repair.

With a mission to advance quality throughout the industry, ICRI has a unique role to play promoting awareness and adoption of its guidelines, educational content, and certification programs.

Following this tragedy, ICRI took some important initial steps to organize and offer on-demand content free to the public and available on its learning management system. You can view this content under the Resources tab of the ICRI website. We anticipate growing our efforts to reach a much broader audience—from building owners to facilities managers—to ensure that the technical guidance of ICRI is widely known and available.

While we look forward to growing the impact of ICRI, each year we pause to evaluate the fiscal year that just passed. On pages 36-41, we present the current State of the Institute. Despite all the challenges posed by the pandemic, we are extremely pleased to report that ICRI finished the last fiscal year with a positive net income relative to budget, growth in our operating reserves, new innovations that stemmed from the need to go virtual, and a combined team of volunteers and staff working effectively together. In other words, the state of the institute is strong!

Please take some time to review the State of the Institute and do not hesitate to contact us with your thoughts and suggestions for the future. For now, we wish you a great remainder of the summer and we look forward to seeing you in Minneapolis or at a future ICRI chapter event!

Sincerely,

Elena Kessi
2021 ICRI President

Eric Hauth
ICRI Executive Director

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TACTALK


MARK NELSON

TAC GOAL FOR 2021—ESTABLISH A UNIVERSAL TECHNICAL COMMITTEE CALENDAR

The last of our four TAC goals for 2021 is to create a Universal Technical Committee Calendar. Thanks to Dale Regnier, the goal has been accomplished. All ICRI technical committee members can now track upcoming technical committee meetings through the calendar set up on the ICRI website. This calendar is especially important because our Technical Committees are now scheduling video meetings between conventions. To keep that calendar current, we continue to ask the Technical Committee chairs to timely inform Dale, our Technical Committee Secretary, of your upcoming meetings.

Fall Convention—Minneapolis

The upcoming ICRI Fall Convention will be our first in-person convention in almost two years. I look forward to personally seeing everyone again in Minneapolis. As you return to an ICRI Convention, you will notice the Technical Committee meetings will have a slightly different look. Each meeting is scheduled for 55 minutes, so no two Technical Committee meetings will overlap. We will no longer need to choose between competing Technical Committee meetings. Also, if you are unable to attend the Convention, you can still participate in the Technical Committee Meetings. Each Technical Committee Meeting Chair will run a hybrid meeting which will include a Zoom link to allow non-attending committee members a chance to view and comment on the meeting. You can find these Zoom meeting links on the 2021 Fall Convention webpage, or you can always contact the individual Technical Committee Chair directly to find out more information on how you can attend.

New Committee 130 Chair

I would like to thank Jeffrey Carlson, CEG Engineers, and Michael Saulnier, NOVA Engineering & Environmental, for leading Committee 130 for the past few years. I would also like to thank Marthe Brock of Master Builders Solutions for taking over as the new Chair of Committee 130, as well as Jeff Ohler, the TAC Contact, for working so hard to breathe new life into this important Committee. At this time, we can also announce a change to Committee 130 starting with the upcoming Convention. The Committee is now named Guidelines for Contracts, Warranties, and Agreements. Covering these critical topics, we expect this committee to grow quickly. If you want to get involved with this committee, please contact Marthe at marthe.brock@mbcc-group.com.

ICRI Technical Committee Chairs

Following is a list of the ICRI Technical Committee Chairs. If you want to become more active in ICRI and the repair industry, please feel free to contact them directly to learn more about their committees.

- **Liying Jiang**, *Jensen Hughes*
  Committee 110—Guide Specifications
- **Paul Farrell**, *Carolina Restoration & Waterproofing*
  Committee 120—Environmental Health and Safety
- **Marthe Brock**, *Master Builders Solutions*
  Committee 130—Contracts, Warranties, and Agreements
- **Vincent LaPointe**, *SIMCO Technologies*
  Committee 160—Life Cycle and Sustainability
- **Charles Mitchell**, *SK&A*
  Committee 210—Evaluation *(Co-Chair)*
- **David Rodler**, *SK&A*
  Committee 210—Evaluation (*Co-Chair)*
- **Peter Haveron**, *Texas Concrete Restoration*
  Committee 310—Surface Preparation
- **Mark Kennedy**, *Construction Sales Group, Inc.*
  Committee 320—Concrete Repair Materials and Methods
- **Tarek Alkhrdaji**, *Structural Technologies*
  Committee 330—Strengthening and Stabilization
- **Jason Coleman**, *Wiss, Janney, Elstner Associates, Inc.*
  Committee 410—Masonry
- **Jorge Costa**, *Durability, Inc.*
  Committee 510—Corrosion
- **Eric Muench**, *Sika Corporation*
  Committee 710—Coatings and Waterproofing

Mark Nelson *is chair of the ICRI Technical Activities Committee (TAC).*

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SECRETARIATUPDATE


JOHN McDOUGALL

While much of the behind-the-scenes efforts of ICRI this summer are focused on the Fall Convention—our first in-person convention since Fall 2019—we have kept the Secretariat focused on the newer initiatives. In the last year, we have aggregated all of the open initiatives, and through a series of meetings with staff and the leadership, we have accomplished a few key tasks. We have assigned a time commitment to each task, both hours and calendar time, to provide a realistic schedule to complete the tasks, as well as assign a value to reflect the priority as it relates to the overall benefit to ICRI and the repair Industry.

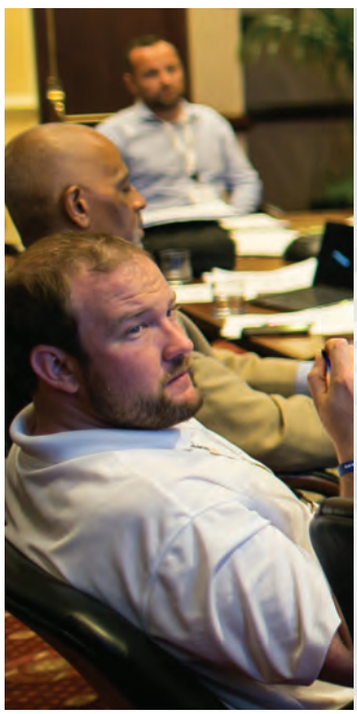
With this information, we are able to push the 90 percent complete initiatives over the finish line, and share a more realistic time commitment to the volunteers who will push these initiatives across the finish line. The goal of the Secretariat is to shepherd the ideas, concepts, new products, new ideas—the initiatives—through the inner workings of ICRI to ensure the right committees, at the right time in the process, get involved and support the initiative to see it become successful.

As always, there is much work to be done, and there are opportunities to get involved as a volunteer at any level you

can offer. We have opportunities for 1-3 hours of effort over a month to help some initiatives move along, and we have need for more sustained efforts. If you have the drive to serve, we have a spot for you. This is your Institute; your service helps us serve the industry.

Check out the volunteer board https://www.icri.org/page/job-board for an ever-evolving list of open needs. If you see something that feels like a good fit, jump in on it. If your passions and talents are not a good fit for the postings, call me and we will find something that suits you.

John McDougall *is ICRI President-Elect, Secretariat Chair, CSRT certified, and Past President of the ICRI Carolinas Chapter.*



Volunteer

Why Volunteer?

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

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

Follow Your Interests

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

Length of Commitment

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

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Structural Health and Corrosion in High-Rise Structures

by Jorge Costa and Sten Henriksen

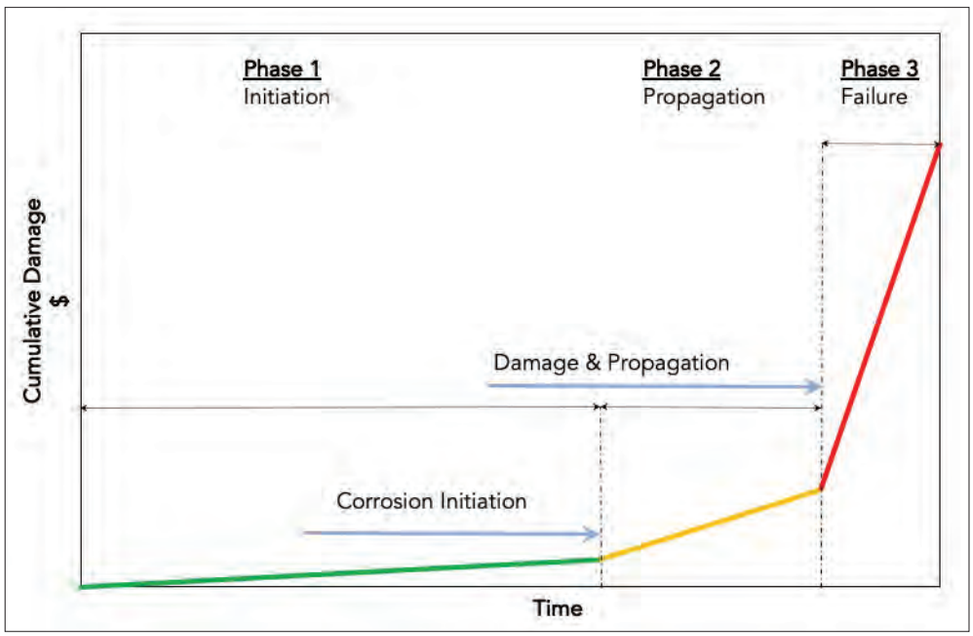

Fig. 1: The corrosion cycle consists of initiation, propagation, and failure phases

Corrosion of embedded metals is recognized as one of the primary degradation mechanisms for reinforced concrete structures. The corrosion process in concrete is well understood and many owners must now address this as a key component of a comprehensive restoration and maintenance strategy. Typically, when structures are compromised by corrosion, structural repairs and topical restoration take precedence and priority over long-term corrosion mitigation. Restoration of structural integrity should be the highest priority, but while these repairs may provide corrosion mitigation at the repair sites, a holistic approach must be undertaken to ensure long-term mitigation and avoidance of the corrosion life cycle. Treating the symptoms without a defined strategy to address the underlying cause often results in a repetitive cycle of costly, disruptive, and time-consuming repairs, permanent damage, and service life reduction.

The state-of-the-art diagnostics, technologies, and products for corrosion protection have significantly advanced during the last several decades. Many reliable options are now available to prevent, diagnose, or mitigate corrosion. How can we determine which are the most appropriate and cost-effective for our structure? Valuable help with this important decision comes from understanding the structure's corrosion life cycle.

SERVICE LIFE AND STRUCTURAL HEALTH

According to the World Health Organization (WHO), health is a state of "complete physical, mental, and social well-being and not merely the absence of disease or infirmity."[1] Health for structures may be described as a state of reliable and safe operation for the intended use as originally designed. In humans, conditions that affect well-being include unexpected disease and loss of function caused by aging. In structures, unexpected disease could be analogous to conditions not designed for and aging could be equated to wear-out, gradual degradation, and loss of material properties over time. For both humans and civil structures, a "life expectancy" is commonly estimated. Healthy life expectancy for humans continues to increase as the medical knowledge grows and new preventive and corrective treatments for diseases are implemented. Likewise, civil and structural engineers now use advanced, efficient designs and materials for resilient and sustainable structures, capable of resisting hurricane strength winds,

severe earthquakes, floods, and more frequent weather-related events. However, service-life expectancies for older structures were commonly established assuming that aging mechanisms, such as corrosion, are inevitable and would eventually lead to loss of function.

In 1982, Kyösti Tuutti introduced the concept of a corrosion life cycle model for reinforced concrete structures exposed to corrosive agents.[2] This model is often quoted in the literature and provides a useful tool to understand the progression of corrosion damage over time. Based on the Tuutti model, the service life of a structure affected by corrosion can be divided into three distinct phases: 1) Initiation; 2) Propagation; and 3) Failure (Fig. 1). During the *initiation* phase, corrosive agents such as chlorides and carbon dioxide permeate the concrete surfaces and penetrate through cracks, pores, and other imperfections present in all concrete surfaces and structures. Over time, sufficient contaminants penetrate to the depth of the reinforcing steel, causing corrosion to initiate. Once corrosion begins, the structure enters the second phase of the corrosion cycle, *propagation*. During this phase, corrosion reactions are taking place on the surfaces of the steel. Anodic and cathodic sites are created, and oxidation occurs. Not all surfaces corrode simultaneously as this process is not uniform. Interactions between contaminated and non-contaminated areas tend to aggravate the corrosion process at anodic sites resulting in the creation and accumulation of oxides at these locations. Although corrosion may be active in this phase, damage may not be visible (Fig. 2). The third and last phase, *failure,* occurs when the stresses created by the growing oxides generate cracks, delaminations, and spalls in the concrete surrounding the corroding metals (Fig. 3). This leads to structural compromising, advanced deterioration, and potentially structural failure. Recognizing the structure's position in this cycle is key to selecting and implementing the most effective and timely countermeasures to disrupt the corrosion process (Fig. 4).

LOOKING AT THE HEALTH OF OUR STRUCTURES

In humans, deteriorating health results in symptoms that can be picked up by our sensory system. Signals include fevers, pain, fatigue, etc. This usually results in a reactive visit to the doctor or the hospital. Preventive check-ups are beneficial, but not all people take these preemptive measures.

When a structure's health deteriorates, the indicators include visible damage, rust spots, cracks, etc. When this occurs, structural assessments are performed that may lead to repairs, particularly if structural integrity is at risk. Preventive check-ups for structures help detect and treat corrosion and other conditions that affect structural health early. These include techniques and methods that help determine the health of the structures to prevent or minimize their consequences. Chemical analysis of concrete samples can determine if corrosive agents, such as chlorides or sulfates, are present or if the concrete is carbonated. Electrical resistivity tests can help determine the risk of corrosion and assess the concrete's susceptibility to future corrosion. Half-cell potential tests can help determine the corrosion activity of the embedded steel. Corrosion rate testing can determine the rate at which it may be occurring. Which of the many tests and techniques are most ap-

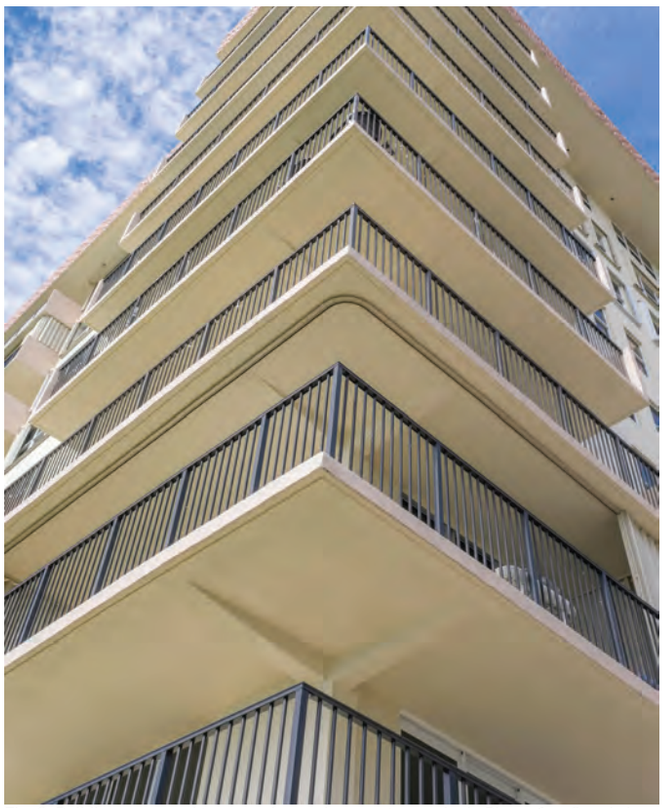

Fig. 2: Buildings exposed to corrosive environments may be in Phase 1 or 2 and show no obvious indications of corrosion—testing makes it possible to know if corrosion is active (Photograph courtesy of No Corrosion, LLC, West Palm Beach, Florida)

Fig. 3: Typical damage on a structure in Phase 3, Failure—repairs are necessary and corrosion protection will prevent recurrence (Photograph courtesy of No Corrosion, LLC, West Palm Beach, Florida)

propriate to diagnose the state of corrosion? Again, help with this question may come from the corrosion life cycle model (Fig. 5).

Corrosion avoidance is best implemented during initial construction. Designs that consider environmental exposure, concrete mixes that incorporate corrosion inhibitors, corrosion-resistant reinforcements, and waterproofing membranes and sealants that prevent the ingress of corrosive agents are all strategies that could result in a long tenure in Phase 1.

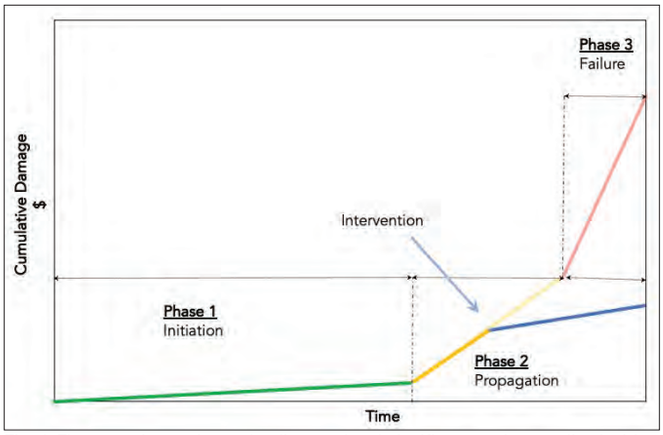

Fig. 4: The corrosion cycle can be disrupted and significant savings realized with a well-timed intervention

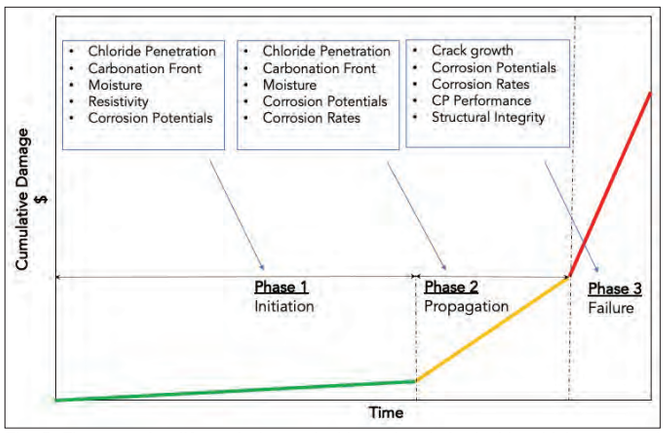

Fig. 5: The corrosion life cycle is a valuable tool to help decide which tests and assessments are appropriate given the age and condition of the structure


Fig. 6: The reference electrode is one of various types of sensors used to measure corrosion activity in concrete—newer sensors are smaller, reliable, and cost effective

Unfortunately, it is not uncommon in new construction to focus on structural integrity and efficient constructability while putting less emphasis on durability. Information that could help understand the structure's progress along the corrosion life cycle curve during Phase 1 include water ingress, chloride penetration, and carbonation along with visual inspections for exposure conditions and premature physical damage. Passage to Phase 2 occurs when threshold levels of contamination are reached at the reinforcing steel depth, or the carbonated front arrives. Corrosion cells are created, and the electrochemical process of corrosion begins. Visual signs of corrosion-related damage are not yet apparent, but the corrosion activity is present. Tests and measurements at this stage would include chloride and carbonation measurements, corrosion potential measurements, and corrosion rate measurements. With this information, proactive strategies such as cathodic protection may be implemented to avoid damage.

In Phase 3, damage appears; if untreated, it could result in failure. At this stage, it is important to monitor continued corrosion activity, particularly after local and limited repairs are performed with or without corrosion protection strategies in place. It is preferable to implement repairs that incorporate an appropriate corrosion protection strategy to avoid the repair cycles that accompany the corrosion life cycle. Corrosion tests such as half-cell measurements and corrosion rate testing could provide information about the effectiveness of the corrosion protection strategy. If no strategies or the incorrect strategies are implemented, the information could be used to predict and budget the next round of repairs.

TRENDS IN CORROSION MONITORING FOR CONCRETE STRUCTURES

Typically, corrosion assessments of concrete structures require the tests described above to be performed by trained technical personnel. Sufficient data points must be collected over time to develop the corrosion cycle curve for the structure. The high cost of performing these condition assessments often limits the necessary testing. Further, it may be difficult to convince owners and operators that investing in these surveys is justified, particularly when no significant damage is evident in Phases 1 and 2 of the corrosion cycle. Once the structure enters Phase 3, often the focus is on restoration. Repair professionals and owners alike increasingly recognize the value that can be achieved by knowing where the structure is situated in the corrosion life cycle curve. Properly used, this knowledge can lead to timely interventions that proactively address impending corrosion damage and result in service life extensions through corrosion control.

Advances in corrosion monitoring of concrete structures include using permanently installed corrosion sensors designed to monitor and collect data over time (Fig. 6). Sensors can be placed at strategically selected, high corrosion risk locations, or where corrosion damage may affect im-

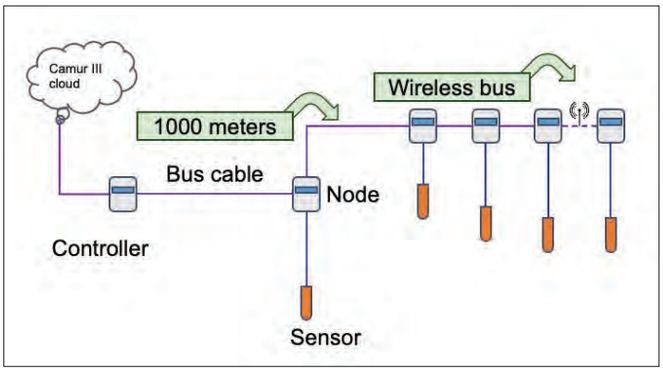

Fig. 7: Secure cloud servers, digital architecture, favorable economics, and the availability of multiple types of sensors are making structural health and corrosion monitoring an attractive and effective method for proactively managing and delaying the aging of concrete structures caused by corrosion (Image courtesy of Protector A/S, Tranby, Norway)

portant structural components. Monitoring systems—some available with remote operation and management of cathodic protection systems—are capable of collecting and processing information obtained from large numbers of sensors (Fig. 7 and 8). Corrosion monitoring systems can be scaled up with additional sensors and be combined with other structural health monitoring sensors, such as strain, temperature, humidity, crack growth, and displacement gauges.

Corrosion monitoring systems can be installed at any time during the corrosion life cycle of a structure. The highest return on the investment is realized when the monitoring systems are installed during initial construction. Unfortunately, corrosion and health monitoring of high-rise structures has largely been ignored in new construction. Other "high-value" structures such as bridges and other critical infrastructure, often constructed in highly corrosive environments, are including structural health monitoring systems either from inception or retrofitted later. Although monitoring is highly beneficial even in later stages, in general, the earlier the better. Later in the life of the structure makes it more expensive to install and misses the benefits of monitoring progression along the corrosion cycle from the baseline established during initial construction.

CONCLUSION

As structures age, many parallels can be drawn between structural health and human health. Corrosion in concrete structures is analogous to human aging, with the exception that corrosion can be predicted, avoided, monitored, and mitigated. Technological advances permit owners and design and restoration professionals to assess the risk of corrosion, determine the state of corrosion, and select optimum countermeasures at the most appropriate time during the life of the concrete structures.

Understanding the corrosion life cycle of the concrete structures, given their construction and exposure conditions, can be an effective tool in the selection of effective countermeasures to safely and reliably extend the service life of structures exposed to corrosive conditions. The corrosion life cycle can also facilitate the selection of appropriate testing and evaluation assessment to establish the state of corrosion of the concrete structures. With this knowledge, repair and restoration professionals can develop reliable and sustainable designs and corrosion mitigation strategies, escape the cycle of repairs, and effectively extend the service life of concrete.

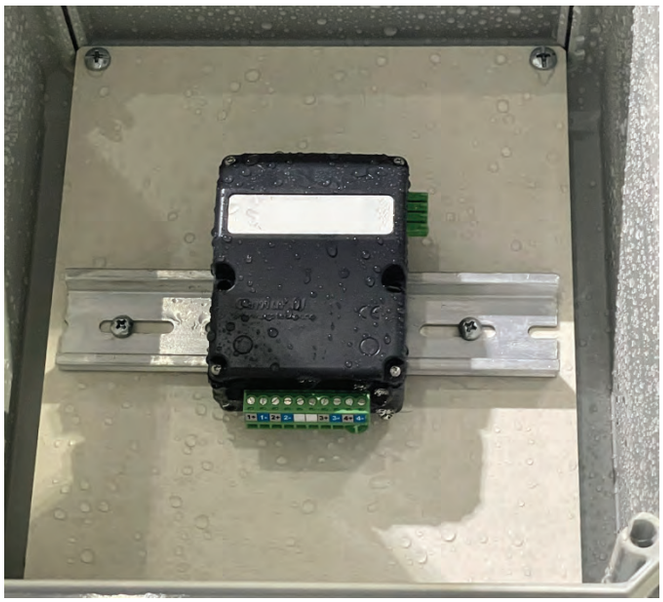
Fig. 8: Analogue to digital converter capable of monitoring four corrosion sensors—this technology allows digitization and management of large amounts of data efficiently as designs are "plug and play" and can be easily scaled or modified to accommodate cathodic protection systems if needed (Photograph courtesy of No Corrosion, LLC, West Palm Beach, Florida)

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Sten Henriksen is Senior Consultant at EC Consulting Partnership, South Miami, Florida. He is a Civil Engineer with more than 50 years of experience with construction and civil works. Sten has been involved with assessments and analysis of corrosion affected buildings in the United States and Canada since 1989. He is an expert in electrochemistry related to corrosion of reinforcing steel in concrete.

Investigations of Aging Concrete Structures

by Stewart Abrams and Peter Lytle

Fig. 1: Condition of a water treatment plant that was constructed in 1907

In my first year of college, one of my favorite TV shows was about an inspector traveling to different U.S. cities assigning grades to several types of infrastructure, with most of them receiving a failing grade. Not much has changed since the last episode aired in 2011, with the average grade of America's infrastructure being a C-.[1] United States infrastructure (Fig. 1) and other assets such as buildings or parking garages are reaching or have surpassed their expected service life. With a quick internet search, you may come across titles such as “Crumbling U.S. Infrastructure” or “America’s Infrastructure Is Falling Apart.” With funds limited in both the government and private sectors, the question is how to best allocate funding to either extend the expected service life or determine the extent of total replacement.

A condition survey is often used for identifying and defining areas of distress, while also providing a history of inspection for the subsequent life of the structure. The objective of a condition survey is to identify and assess the cause and extent of distress due to corrosion, fire, earthquakes, and other structural failures. Condition surveys help prioritize the distressed areas and the ability to plan the most cost-effective remedy.

Conventional methods such as sounding, crack mapping, chemical testing, steel reinforcement testing, and petrographic examinations; and innovative technology such as half-cell potential/linear polarization, impact-echo, ground penetrating radar, and UAS (Unmanned Aircraft System) can help evaluate these structures and decide if full demolition or replacement of critical sections of a structure is necessary.

METHODOLOGY

The first step in producing a proper condition survey is to gather data such as the history of the structure from the client and owner, along with drawings, records, and previous repair reports. Other information such as period of construction, exposure conditions, and the first occurrence of distress is also important.

After the initial data collection, the scope of work must be determined. The previously collected data should provide

enough information to decide if the entire structure needs to be evaluated or if the evaluation needs to be isolated to areas of distress. After determining the evaluation area, the scope of testing needs to be identified, such as what areas will get nondestructive testing, analytical methods, and destructive testing.

Field Testing

During the visual inspection, detailed data collection needs to take place. As the visual inspection is being completed, items such as workmanship, structure serviceability, material deterioration mechanism, and general health of structural and nonstructural elements should be noted. Other items to consider are the quantities of distress, types of cracks and patterns, visual obstructions, color and texture of concrete surfaces, and leakage/seepage. Photographs taken during the visual inspection are an important part of the survey.

It may be beneficial to deploy a drone (UAS) to aid with the inspection (Fig. 2) and to perform photogrammetry. Photogrammetry can be useful in quickly determining the pattern and length of cracks and concrete repair areas.

The next step of a survey is assigning non-destructive testing (NDT) to see beyond the surface and provide the diagnostic of various issues with limited disturbance to the site. In a broad sense, NDT allows internal characteristics of concrete to be examined without disturbing the structure during testing. Generally, more than one test method is required to obtain useful data. There are also some disadvantages to performing NDT, such as environmental conditions or construction details that may distort results and lessen the degree of accuracy of determining signs of distress. Every survey is different, but in most cases, nondestructive testing requires some destructive testing.

The most common and simple NDT is sounding (Fig. 3) using a rotary percussion device or chain drag/hammer per ASTM D4580[2] to locate areas of distress not yet visible. This procedure consists of tapping or striking the concrete surface to identify a dull or hollow sound, indicating delamination in the concrete. The test quickly helps map out areas that will need to be repaired.

To accompany sounding, the use of impact-echo or ultrasonic pulse velocity (UPV) is often used to help further evaluate the concrete structure. The impact-echo method (ASTM C1383[3]) uses impact-generated stress (sound) waves which are created by striking the test surface with a metal sphere. The stress wave propagates through the concrete and is reflected to a transducer by internal flaws, voids, and/or external surface distress features, such as a concrete-air interface caused by a delamination. The transducer relays the stress wave data to a laptop computer which produces graphs of the voltage versus time and amplitude versus frequency. The location and shapes of these graphs can be interpreted to determine the properties of the test medium. Ultrasonic pulse velocity (ASTM C597[4]) utilizes pulses of longitudinal stress waves that are generated by an electro-acoustical transducer that is held in contact with one surface of the concrete under test. After traversing through the concrete, the pulses are received and converted into electrical energy by a second transducer located a distance from the transmitting transducer. Comparatively, higher velocity is obtained when concrete quality is good in terms of density and uniformity. Pulse velocity, like the impact echo can identify internal flaws, voids, and/or external surface distress features, such as a concrete-air interface caused by delamination.

To locate reinforcing steel, Ground Penetrating Radar (GPR) can be used. The results of a GPR scan will quickly detail the depth of cover and layout of reinforcing steel. Once reinforcing steel is located, coring locations can be identified with confidence that steel reinforcement will not be encountered. The scans can be compared to the original construction drawings and to actual in-place field conditions during the structural repairs. Another useful tool to use with Ground Penetrating Radar (GPR) is a ferromagnetic rebar cover meter (Fig.4). The device works by emitting electromagnetic waves through the concrete and

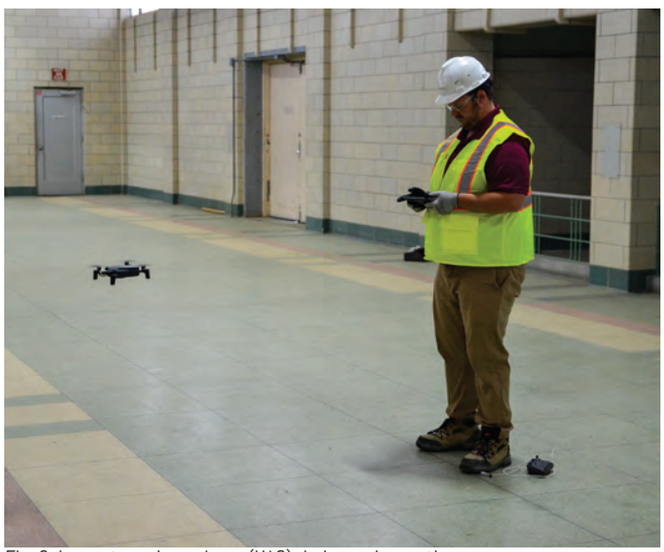

Fig. 2: Inspector using a drone (UAS) during an inspection

Fig. 3 Sounding using a chain drag

Fig. 4: Inspector using ferromagnetic rebar locating device

Fig. 5: Inspector performing half-cell potential testing

measuring the disruption in the magnetic waves which is correlated to the size of the reinforcing steel, typically within one bar size.

To assess corrosion in a concrete structure, a survey will often be completed using half-cell potential (Fig. 5). Half-cell potential testing (ASTM C876[5]) uses an electrical current to estimate the corrosion probability for the area by connecting to embedded reinforcing steel and using an electrode. The method involves some destructive measures to locate and expose a reinforcing bar to complete the electrical circuit. A test grid is usually established in the field and a potential contour map is developed over the test area. The test determines the probability of corrosion and does not necessarily indicate active corrosion. The test method helps identify potential areas of corrosion in concrete that should be repaired to prolong the life of the structure.

The rate of corrosion (linear polarization) technique uses a handheld unit utilizing the Wenner 4-pin method of electrical resistance to estimate actual corrosion rate. The device provides multiple and directional parameters that are tested in a single measurement with a real-time contour map of corrosion rate and electrical resistivity. The software of the device calculates the corrosion rate in micro-millimeters per year (µm) and places the rates into four categories; Passive/Low (< 10 µm/year), Moderate (10 to 30 µm/year), High (30 to 100 µm/year), and Severe (>100 µm/year). The test locations for this method are usually determined based on the half-cell potential contour map (Fig. 6). The testing requires the location, estimated size, and estimated depth of cover of the reinforcing steel.

Laboratory Testing

The most common laboratory test performed on concrete is compressive strength testing (ASTM C42[6]). Typically, a core is extracted from a concrete structure and tested to determine the strength of the concrete. Concrete strength often varies by the location of the concrete in a structural element, with the concrete at the bottom tending to be stronger than the concrete at the top of a concrete member. Core strength is also affected by core orientation relative to the horizontal plane of the concrete as placed, with strength tending to be lower when measured parallel to the horizontal plane. These factors should be considered in planning the locations for obtaining concrete samples and in comparing strength test results.

Another common laboratory test for a condition survey is determining the grade and size of reinforcing steel per ASTM A615[7] and ASTM A370[8]. These test methods are useful for determining proper structure loads and if the reinforcing steel meets project drawings and specifications.

To check for carbonated concrete, phenolphthalein stain is usually applied to concrete surfaces. Phenolphthalein is a pH indicator that turns from colorless to magenta at a pH

between 9 and 10. When the stain remains colorless after application, the concrete is usually carbonated at a pH below 9. The carbonation process occurs in concrete that is moist and typically exposed to greater amounts of carbon dioxide over a large period of time. The carbon dioxide dissolves in the pore water from carbonic acid, which in turn reacts with the calcium hydroxide producing calcium carbonate. The calcium carbonate lowers the pH of the concrete, which removes a protective passive oxide layer that forms around the reinforcing steel allowing the steel to corrode faster. This process has been found to occur in high-quality concrete at a rate of 0.039 in (1 mm) per year.[9] Additionally, carbonation occurs faster in areas intermittently exposed to water flow and areas with moist air flow.

Another threat to the corrosion of reinforcing steel is chloride ion or deicing salts, although they may be available as contaminants in the original concrete mix. Usually, a powder sample is collected from a concrete core or drilled from a concrete surface and analyzed for the presence of water-soluble chlorides by ASTM C1218[10]. According to ACI 222R[11], the recommended maximum allowable chloride content by weight of cement is 0.08 percent for new construction concrete. Because corrosion of steel reinforcing is generally considered to begin at a chloride ion content of between 0.025 and 0.033 percent by weight of concrete,[12] knowledge of chloride content can aid in determining the likelihood of the onset or presence of corrosion. Typically, a chloride profile is used to determine the chloride ion content at various depths in the concrete, especially at steel reinforcement depths.

Finally, one of the most important laboratory tests that can be performed is petrographic examination (Fig. 7). Visual and stereomicroscopic examinations are performed in accordance with ASTM C856[13] and can usually predict the performance of hardened concrete based on the composition of aggregates and cementitious materials, hardened air content (ASTM C457[14]), and potential exposure to the elements and chemicals. Petrographic analyses can also be used to determine the reason(s) for the non-performance of concrete or determine if the concrete meets project specifications. During the examination, portions of the ground cement paste are examined for the presence of fly ash, ground granulated blast furnace slag (GGBFS), and matrix carbonation using a polarized light microscope and refractive index oils. To aid in the examination, a 25 to 30 micron-thick, thin-section of a concrete core is prepared and examined for Alkali-Silica Reaction (ASR), Delayed Ettringite Formation (DEF) (Fig. 8), and other manifestations of chemical attack of concrete. One property that a petrographic examination cannot determine is water/cement ratio of the concrete. ASTM C856 states that because of the variable nature of pastes, age of pastes, and exposure to a variety of external influences, there is no generally accepted standard procedure that employs microscopical methods for determining the water/cement ratio of hardened concrete. However, if the concrete is a plain Portland cement mix, the water/cement ratio can be determined chemically by ASTM C1084.[15]

CONCLUSION

Often concrete structures are either left unmaintained or only provided with limited repairs. This commonly leads to more expensive repairs and may shorten the lifespan of the concrete structure. Because the condition of many concrete structures in the United States may require enormous repair investment, owners, property managers, and other stakeholders will look for a competitive edge for assessing repairs. While non-destructive testing (NDT) can

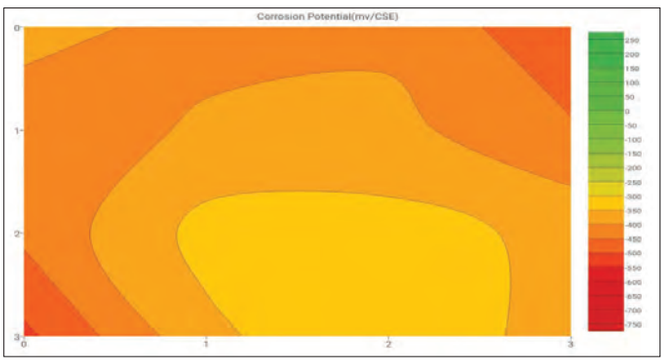

Fig. 6: Half-cell potential contour map


Fig. 7: Petrographic examination using a stereomicroscope

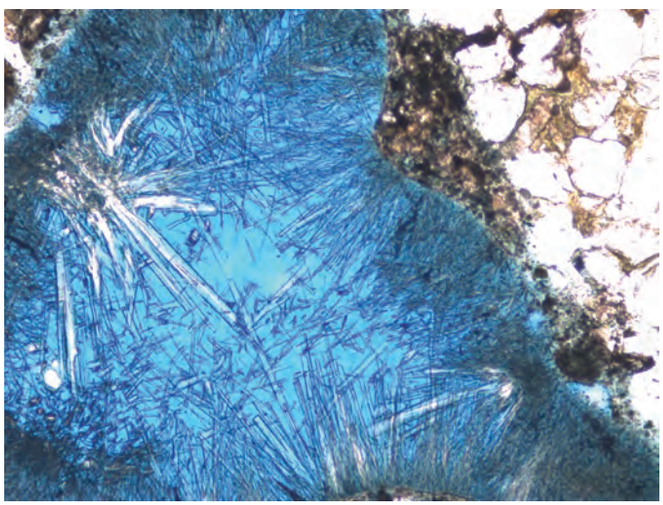
Fig. 8: Delayed Ettringite Formation (DEF) in a thin-section

help provide cost-effective measures, some destructive testing will almost always be needed. However, with an industry that is always looking for a competitive edge and advancement in technology, condition surveys and inspections will only become cheaper, faster, and provide more reliable data.

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Repair of Catalytic Reformer Support Structure

by Kurt Tyler and Daniel Pearson

Fig. 1: Catalytic reformer support structure

The catalytic reformer support structure is a conventionally reinforced cast-in-place concrete tabletop originally constructed in 1978 that supports a vertically oriented catalytic reformer and associated steel framing in a refinery on the Gulf Coast (Fig. 1). The concrete tabletop consists of an upper deck that measures approximately 26 ft (8 m) by 18 ft (5.5 m) and is 4.25 ft (1.3 m) thick. The upper deck has an octagonal penetration that allows the bottom head of the catalytic reformer and piping to pass through the deck (Fig. 2). Four square conventionally reinforced concrete columns span from the mat foundation to the upper deck.

The catalytic reformer is a vertically oriented pressure vessel that is over 124 ft (38 m) tall and supported with a conical skirt on the upper deck of the tabletop. The catalytic reformer has an operating temperature of 1000°F (538°C) and weighs nearly 370,000 lbs (370 kips) when fully loaded with catalyst. A catalytic reformer is used within a refinery to increase the quality and octane level of gasoline produced by the crude unit.

As a result of the operating temperature of the catalytic reformer, the upper deck of the reformer support structure experiences high temperatures. The sides of the octagonal penetration near the bottom head of the catalytic reformer reach sustained temperatures of 530°F (277°C) (Fig. 3). The nozzles and piping at the bottom of the catalytic reformer continuously emit steam, which engulfs the sides of the octagonal penetration and bottom of the upper deck.

Refinery personnel were aware that the upper deck of the catalytic reformer support structure had some level of deterioration, but the extent was not well known. Concern arose after several large concrete spalls fell onto the level below. Scaffolding was installed to catch future spalls and to mitigate future falling object hazards. Refinery personnel then contracted an engineer to perform a condition assessment and determine the criticality of repairs.

CONDITION ASSESSMENT

A condition assessment was performed during a planned short-term outage to avoid working in the radiant heat of

the catalytic reformer and consisted of a visual and tactile survey, limited NDE evaluation, material testing, and structural analysis.

Fig. 2: View of octagonal penetration in upper deck and piping associated with the catalytic reformer

Visual and Tactile Survey

The visual and tactile survey identified widespread spalling with exposed reinforcing and delamination of the sides of the octagonal penetration in the upper deck and along the bottom of the upper deck (Fig. 4). Original concrete cover was detailed at 3-in (75 mm) clear; however, in half of the faces, the concrete cover was found to be approximately 4-1/2 in (115 mm). Widespread cracking and delaminations in the top of the upper deck were also identified (Fig. 5). Even with the deeper concrete cover, corrosion of reinforcing steel was present throughout the sides of the octagonal penetration in the upper deck. Despite the amount of corrosion product observed on the reinforcing bars, the section loss measured on the primary reinforcing bars was generally minor after removing the corrosion product. The most significant finding regarding the exposed reinforcing steel was that many of the No. 5 (5/8 in [16 mm]) bar stirrups were fractured at the top corner bends.

Field and Material Testing

Discrete concrete hole drilling was also performed for carbonation and chloride testing (Fig. 6). Carbonation testing

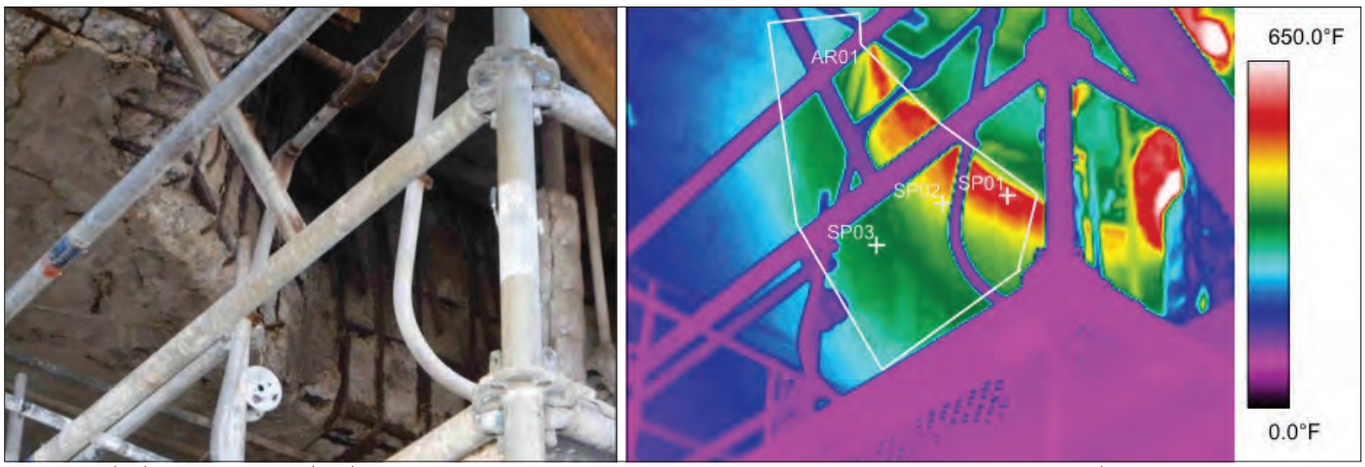

Fig. 3: Photo (left) and infrared image (right) showing the temperature profile of the sides of the octagonal penetration in the upper deck (view looking up at the bottom of the upper deck)

Fig. 4: Spalled concrete with exposed reinforcing on the sides of the octagonal penetration in the upper deck (fractured stirrups are visible)

Fig. 5: Widespread cracking on top of upper deck, typically emanating radially from the catalytic reformer

Fig. 6: Measuring depth of drilled hole used for chloride and carbonation testing

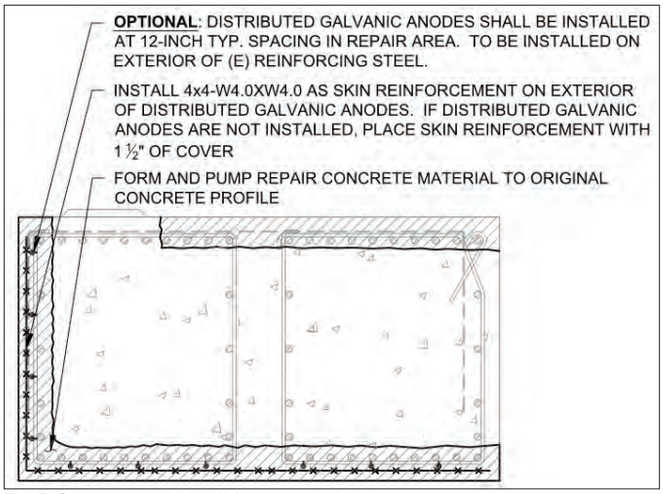

Fig. 7: Concrete repair detail for upper deck

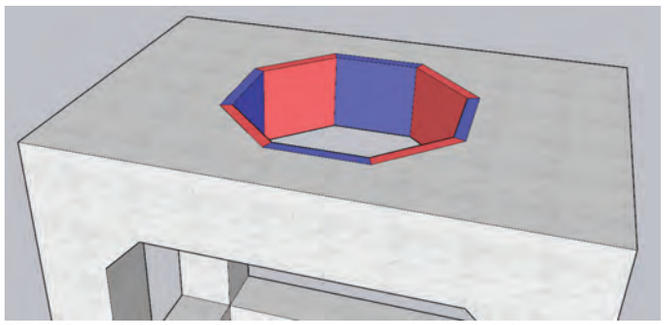

Fig. 8: 3D model of reformer foundation structure showing phasing of octagonal penetration repairs (Phase 1 repairs are shown in blue and Phase 2 repairs are shown in red)

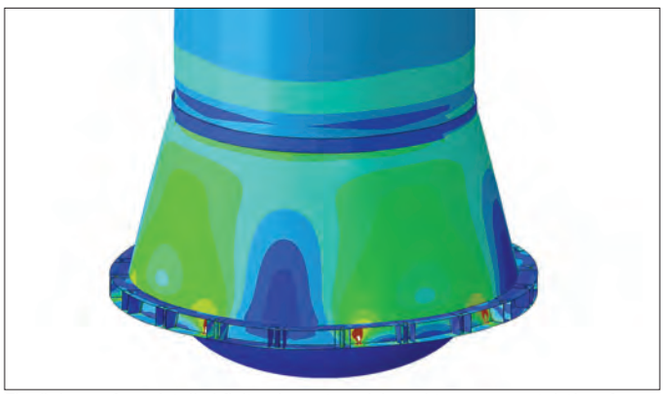

Fig. 9: Image from detailed finite element model used to assess catalytic reformer vessel and skirt during concrete removal

was performed by applying a pH indicator, phenolphthalein, after cleaning the drilled hole, and observing the color profile. At each of four test locations, powder was recovered as the hole was drilled, which was analyzed for the acid-soluble chloride content in general accordance with ASTM C1152[1], *Standard Test Method for Acid-Soluble Chloride in Mortar and Concrete*. The carbonation testing revealed that the depth of carbonation was minimal and ranged from 1/8 to 1/4 in (3 to 6 mm). The acid-soluble chloride concentrations for the samples retrieved within the octagonal penetration of the upper deck were between 0.15 and 0.24 percent by mass of sample. The original mix design for the concrete sampled was unknown; however, for an assumed cementitious content of 564 lbs per cubic yard (6 sack), an accepted chloride threshold for high risk of corrosion initiation of mild reinforcing steel is 0.09 percent (0.5 to 0.6 percent by weight of cement).[2] The chloride concentrations from the samples retrieved from the upper deck were well in excess of values expected to initiate corrosion.

Structural Analysis

Structural analysis of the catalytic reformer support structure was performed to understand the potential structural capacity reduction of the tabletop given the magnitude of the observed deterioration. It was determined that the catalytic reformer support structure had adequate structural capacity to support the in-service loads in its deteriorated condition at the time of the assessment.

Findings

Through the findings of the condition assessment, it was concluded that heat-related deterioration of the concrete and chloride-induced corrosion, significantly accelerated by the heat, were the primary causes of the distress conditions. While the support structure had adequate structural capacity to support in-service loads, repairs were recommended during the next major unit outage, known as a turnaround, as unmitigated corrosion and heat deterioration would continue to occur. The next turnaround in the crude unit was planned to be a 6-week period, during which major maintenance, inspection, and repair activities in the unit were to be executed.

REPAIR DESIGN

Following the condition assessment, refinery personnel authorized the design of repairs for the catalytic reformer support structure. The goals of the repairs were to restore the structural capacity and to extend the service life of the structure. Construction for the repairs was planned for the next turnaround.

The repairs consisted of partial depth concrete repairs with distributed galvanic anodes on the sides of the octagonal penetration and the bottom of the upper deck (Fig. 7) and required the removal of deteriorated and unsound concrete, and preparation of the concrete substrate to a Concrete Surface Profile (CSP) 7.[3] Refinery policies typically do not allow abrasive media blasting; as such all ex-

posed reinforcing was required to be power tool cleaned and meet the requirements of SSPC SP 3.[4] The fractured stirrups were supplemented with new lapped reinforcing steel. Welded wire reinforcing was detailed as skin reinforcing on the outside of the galvanic anodes to control crack widths on the exposed faces. Cathodic protection was detailed with eight unique zones so refinery personnel could monitor the performance of the system.

The repairs also included partial depth concrete repairs on the top of the upper deck. Localized partial depth concrete repairs were also detailed at specific locations on the columns and beams below the upper deck.

CONSTRUCTION CHALLENGES AND SOLUTIONS

This project involved several construction and schedule challenges that required unique solutions and a collaborative approach by the project team to successfully repair the deteriorated structure.

The concrete repairs on the sides of the octagonal penetration in the upper deck presented a challenge in the form of difficult working conditions. These repairs had to be completed in the cramped working space between the bottom head of the catalytic reformer and the sides of the octagonal penetration. The difficult working conditions extended the amount of time required to complete the repairs in this area. The contractor identified the construction ergonomics during preconstruction planning and adequately accounted for it during scheduling.

During construction, it was determined that the extent of deteriorated concrete in the upper deck was greater than anticipated, requiring the removal of concrete beyond what was planned, including directly below the catalytic reformer skirt base ring. The removal of concrete below the catalytic reformer skirt base ring would result in the skirt not being directly supported uniformly around the base as designed. To address this issue, the construction sequence was modified to occur in two phases, with each phase repairing four nonadjacent zones of the upper deck at a time (Fig. 8). A detailed finite element analysis of the catalytic reformer vessel and skirt was performed per API 579-1/ASME FFS-1[5], Fitness for Service, to ensure mechanical integrity and stability of the reformer during the repair procedure (Fig. 9). This sequencing allowed the additional deteriorated concrete to be removed, which resulted in a high-quality concrete repair while still meeting the demanding project schedule.

While the original schedule for the turnaround was 6 weeks, the schedule coincided with the onset of the COVID-19 pandemic. To minimize the total number of workers at the plant, the owner requested that night work be eliminated and extended the overall turnaround duration to 14 weeks. Accordingly, the overall turnaround schedule was extended; however, the owner requested that the concrete repairs be completed as quickly as possible. To meet the deadline, the contractor was allowed to utilize two, 12-hour shifts during portions of the construction to finish in 7 weeks.

Given the tight working areas and limited access, the contractor elected to pump a modified ready-mixed self-consolidated concrete (SCC) for the repair to achieve the desired properties of rapid strength gain and flowability, while maintaining pumpability during the summer months. Furthermore, frequent engineer site visits were made during construction to quickly address questions and concerns. One activity that the contractor identified as on the critical path was removal of formwork after the first phase of repairs. To support the earliest removal of formwork possible, laboratory testing was performed on the selected concrete mix to develop maturity correlations; maturity meters were installed in the repairs (Fig. 10). The additional testing and instrumentation provided confidence for the in-place concrete strength and allowed for the formwork to be removed as early as possible.

Fig. 10: Welded wire reinforcing, galvanic anodes, and concrete maturity meter in repair area

Fig. 11: Completed repair on the sides of the octagonal penetration in the upper deck

Fig. 12: Completed repair on top of upper deck

CONCLUSION

Despite the significant challenges presented by the difficult working conditions, extent of concrete deterioration, and aggressive project schedule, the repairs to the catalytic reformer support structure (Fig. 11 and 12) were completed on time. Refinery personnel were highly satisfied with the assessment, design, and repair implementation of the project team. The collaborative approach of the project team contributed to a safe and well executed project.

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Repair of Catalytic Reformer Support Structure

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Overview of ICRI Technical Guidelines 320.1R–2019 *Guide for Selecting Application Methods for the Repair of Concrete Surfaces* and 320.2R–2018 *Guide for Selecting and Specifying Materials for Repair of Concrete Surfaces*

by Mark Kennedy

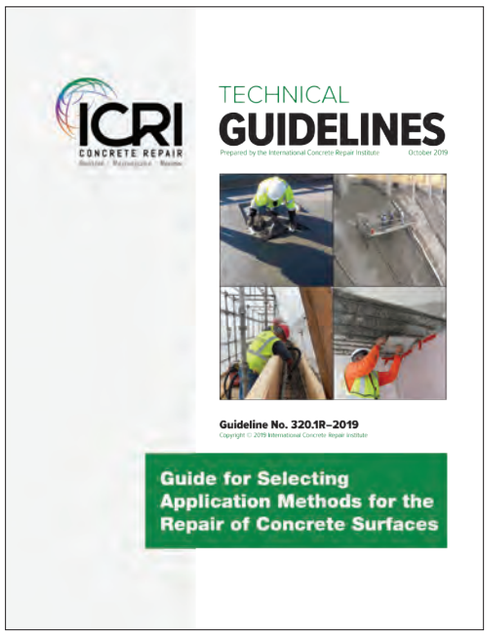

Fig. 1: ICRI Technical Guideline No. 320.1R-2019

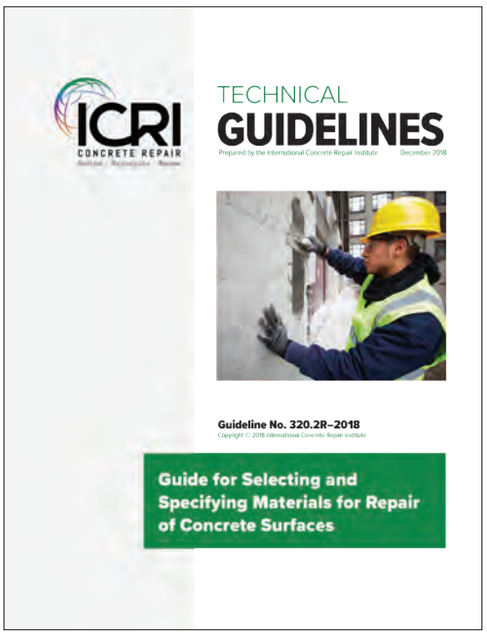

Fig. 2: ICRI Technical Guideline No. 320.2R-2018

ICRI Technical Guideline Nos. 320.1R–2019[1], *Guide for Selecting Application Methods for the Repair of Concrete Surfaces* (Fig. 1) and 320.2R–2018[2], *Guide for Selecting and Specifying Materials for Repair of Concrete Surfaces* (Fig. 2) aid the designer, specifier, contractor, and manufacturer to make rational informed decisions in selecting materials for the repair of concrete surfaces and assist with the selection of suitable methods of placement. Both guidelines should be considered as part of the repair process to arrive at a successful repair strategy.

These guidelines focus on the components and structure of the *selection process* for both *application methods* and *repair materials* and were developed to assist with the identification and prioritization of the performance requirements for repair materials and aid in the determination of the best method of placement specific to the repair under consideration. Depending on the project, multiple placement methods and repair materials may be needed, as we rarely see a one-size-fits-all approach in concrete repair.

The decision to repair a structure is based on whether safety has been compromised, the structure is salvageable or the conditions are tolerable without repair, and owner requirements (budget, time, serviceability, etc.). Once a decision to repair is made, a repair strategy should be developed to define the scope of the project including the alternatives required for surface preparation, repair material properties, and repair application methods.

PROJECT SPECIFICATIONS

Specification for the project should be provided by the design professional for use by suppliers; purchasers; and users of materials, products, or services to understand and agree upon the requirements of repair.

There are three common types of project specifications:

- *Prescriptive specifications* list specific ingredients, as well as quantities and tolerances of those ingredient, to be used as the recipe for the material formulation.

- *Performance specifications* list properties, methods for determining those properties, and acceptable values or ranges for those properties.

- *Proprietary specifications* list specific products or material sources that are acceptable.

Often, we see specifications that are combinations of one or more types, which can cause confusion when a hybrid proprietary/performance specification contains products that do not actually meet the performance requirements. There are also cases where a single proprietary product cannot be the sole source due to government requirements. In those cases, the phrase "or equal" is used. The criteria to determine whether a material is "equal" in composition, material properties, or performance is subjective in nature and results in questions as to whether an alternate material is indeed equal. To eliminate this confusion, performance-based specifications that reference specific material properties, repair applications, project constraints, and service conditions are becoming more popular to ensure a durable repair.

Every project and repair situation are unique by nature and can be categorized using a number of criteria including but not limited to type and extent of deterioration, structure type, exposure, working environment, personnel, and schedule. The specific location, size of repair, and accessibility to the repair will usually dictate which method of repair will need to be performed, as well as determine the product options that match the application method. Although the design professional may desire that a low-pressure spray-applied mortar be used for vertical repairs, access restrictions may prevent that specific application method from being used. To avoid conflicts due to constructability, a pre-construction meeting and walk-through should be required before repairs commence to determine exactly how each repair location will be addressed.

Once the work commences and the material and application method have been determined, surface preparation needs to be addressed. Surface preparation is the single most important factor that contributes to the success of a repair, regardless of the application method. When the repair material cannot adhere to the surface, the method of placement or quality of material make little difference. The substrate should be sound, roughened, clean, and saturated surface dry. ICRI 310.1R[3], 310.2R[4], and 310.3R[5] address different aspects of surface preparation, including proper repair area geometry, desired substrate roughness (i.e., concrete surface profile or CSP), types of methods and equipment used, desired cleanliness, and treatment of existing cracks and joints. If the repair cannot be performed *within the constraints of the project specifications*, which include *material selection, surface preparation, application method, experience level* of the repair contractor, and *jobsite conditions*, the repair material or the application method will need to be reassessed.

APPLICATION METHODS

Long-term durability is generally considered more important than the ease of application; however, sometimes trade-offs must be made to adapt a repair material or application method to the project. A good example would be the size of the repair and the amount of repair material required to complete the repair. Figure 3 shows how the volume of repair material required is influential in the selection of mixer type and application method. Large section replacement will require larger batch sizes. Conversely, if numerous small localized vertical and overhead repairs

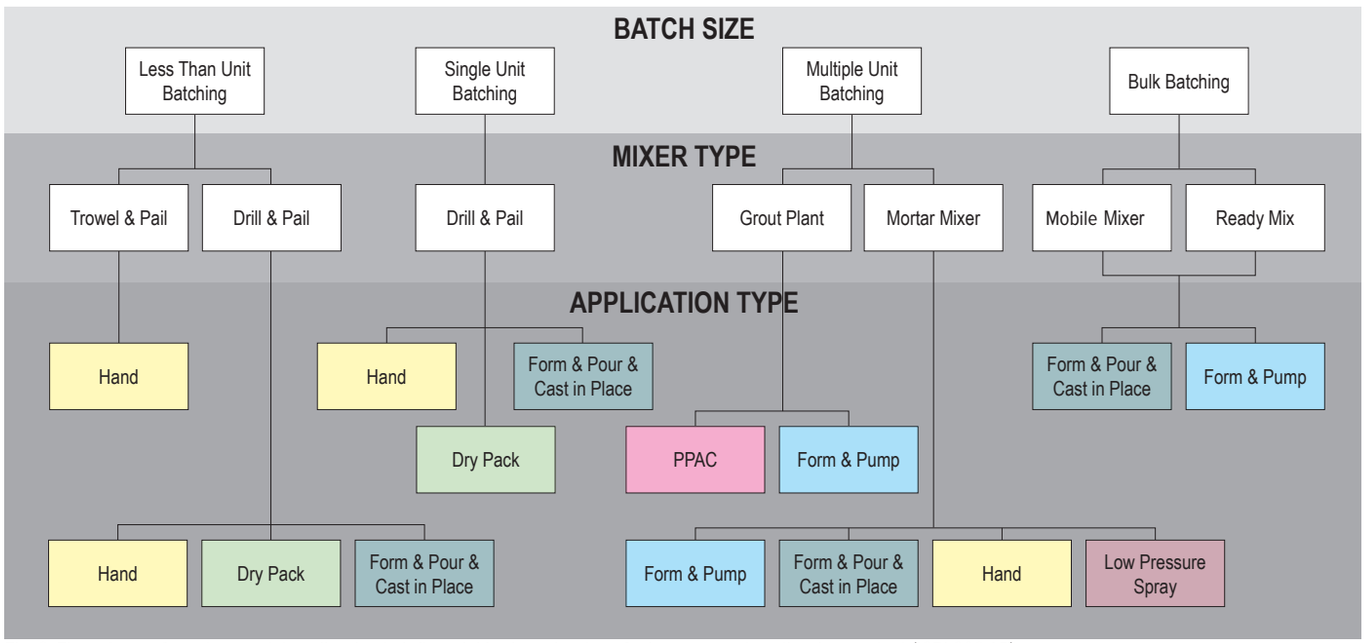

Fig. 3: The volume of repair material application is influential in the selection of mixer type and application method (ICRI 320.1R)

are required, large batch sizes are not ideal unless there are numerous workers that can install the mixed material before it is no longer useable. Neither material choice nor application method exist in a vacuum; therefore, both must be considered to ensure a quality repair.


Fig. 4: Unformed hand-applied application


Fig. 5: Form and pour application


Fig. 6: Wet-mix shotcrete application

In ICRI 320.1R, application methods are presented with general descriptions, best applications, material requirements, advantages, and limitations, and are divided into three basic categories with sub-categories as defined below:

Unformed

- *Unformed Hand-Applied* (Fig. 4) is generally placed by trowel using a non-sag repair material. Best for small non-structural repairs and small batches. Repairs are labor intensive and highly user-sensitive.

Formed

- *Dry Packing* uses a no-slump consistency repair material that is hand packed into a formed cavity using a trowel, hammer and rodding tool. Application should be confined on all but one side and only used on small repairs. This method is very labor intensive and largely dependent on the installer to achieve and maintain proper consistency and consolidation.

- *Form and Pour* (Fig. 5) uses a flowable consistency repair material that is poured into an enclosed space with formwork. This method results in a more consistent repair quality and is less sensitive to applicator skill level.

- *Form and Pump* is similar to Form and Pour, with the difference being the placement is accomplished using mechanical pumping equipment. Best suited for overhead and vertical applications. Formwork must be sufficiently rigid and watertight to withstand pumping pressures.

- *Preplaced Aggregate* is similar to the form and pump method with the difference of first filling the cavity with a selected coarse aggregate prior to pumping the cavity with a suitable repair material. Used where extremely low shrinkage is required or in difficult access applications, as well as underwater applications.

Pneumatically Applied

- *Dry-Mix Shotcrete* is a method where a dry repair material is placed into a shotcrete machine and transported by compressed air through the delivery hose to the exit nozzle where water and admixtures (if any) are introduced into the material stream and sprayed into place at high velocity to achieve proper compaction and bond to the substrate without the need for forms. Dry-mix shotcrete repairs are best suited for large vertical and overhead areas. Successful applications are highly dependent on the skill level of the nozzleman, especially in dense reinforcing steel applications.

- *Wet-Mix Shotcrete* (Fig. 6) is a method where a prebatched and thoroughly mixed repair material is placed into a wet shotcrete machine and transported via pump line to an exit nozzle where compressed air

and admixtures (if any) are introduced into the material stream then sprayed into place at high velocity to achieve proper compaction and bond to the substrate without the need for forms. Wet-mix shotcrete repairs are best suited for large vertical and overhead areas. Successful applications are highly dependent on the skill level of the nozzleman.

- *Low-Pressure Spray* is an application method using a pre-batched and thoroughly mixed low-slump repair material that is placed into a small concrete pump, then transported to an exit nozzle where compressed air is used to impel the repair material onto the surface. Bond with the prepared substrate is achieved through a combination of proper surface preparation, material properties of the packaged repair material, low-velocity impact, and pressure applied by hand-tooling the fresh material.

MATERIALS SELECTION

Once the application method is chosen, ICRI 320.2R aids the designer, specifier, contractor, and manufacturer to make rational and informed decisions in selecting materials for the repair of concrete surfaces.

The material selection process should account for owner requirements, causes of deterioration, service conditions, and application conditions to develop criteria for determining the material properties that will best meet the objectives of the design professional and owners. A visual representation of the model is detailed in Figure 7.

Material selection is a process of arriving at informed compromises. The expectations for the project need to be clearly understood. Owner requirements—including expected service life, appearance, and structure utilization—are project requirements that must be addressed at the outset. Service conditions including weather factors, chemical environment, and live loads must be assessed to identify the physical and mechanical properties needed for the repair. Application conditions such as expected weather during the repair process, access, project time frame, and operating conditions may critically affect material selection. ICRI 320.2R provides checklists for owner requirements, service conditions, and application conditions.

Repair materials should not be specified until the properties that will best satisfy overall project objectives are determined. These properties need to be identified and prioritized. Once the needs and performance criteria for the repair project are established, a list of desirable properties is developed.

Repair materials and system properties including dimensional, bond, durability, mechanical, electrochemical, and permeability need to be compatible with the parent material. Generally, the intent is to use a repair material or system that has similar properties that provide long-term performance. Giving high priority to ensuring compatibility between the repair material and the existing substrate will aid the design professional in making good material selection decisions.

The guide outlines various material properties and test methods to aid the design professional in determining the performance of various repair materials under consideration. Material properties discussed in the ICRI 320.2R guide include:

Bond Strength

- *Direct Tensile* tests measure the tensile bond or tensile

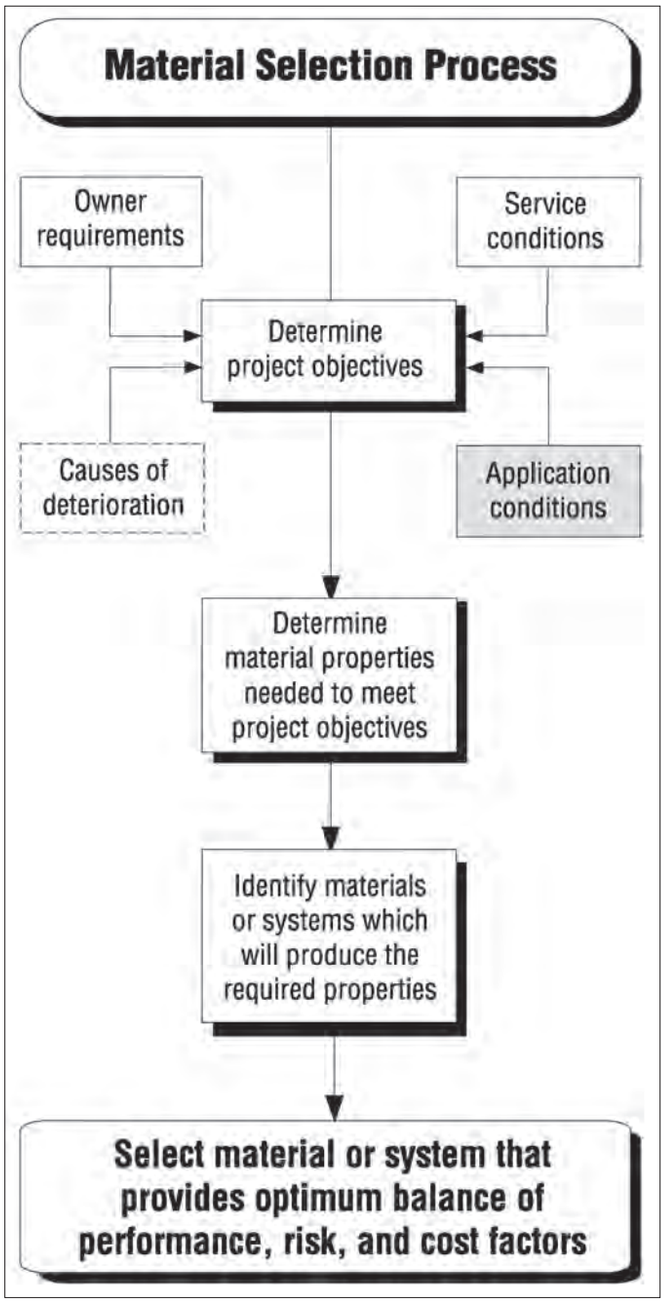

Fig. 7: Material selection process

strength of surface repairs and overlays. This testing can expose the location of the weakest link in the repair system (repair material, interface, and substrate).

- *Direct Shear* tests measure the shear strength of the bond between the repair material and the substrate. A special guillotine apparatus is used to subject core specimens to direct shear loads.

- *Slant Shear Bond* tests are the most often reported bond test by material manufacturers. Bond strengths determined by slant shear tests are highly dependent on the compressive strength of the substrate portion of the test cylinder.

Dimensional Behavior

- *Drying Shrinkage* tests measure the volume changes of a repair material as it cures. Excessive drying shrinkage can affect bond, ability to carry loads, durability, and appearance. It is extremely important to minimize drying shrinkage for cement-based materials.

- *Coefficient of Thermal Expansion* tests measure the rate that materials expand and contract with changes in temperature. For a given change in temperature, the amount of expansion or contraction depends on the coefficient of thermal expansion of the material. Thermal compatibility is especially important in large repairs.

- *Modulus of Elasticity* tests measure the stiffness of the repair material. Higher modulus materials will deform less under a given load than will lower modulus materials. Compatibility between the modulus of elasticity for a structural repair material and concrete substrate helps to achieve a uniform load transfer across the repaired section.

- *Creep (Tensile and Compressive)* tests measure time-dependent deformations due to sustained loading. For repairs that are not subjected to significant compressive forces, compressive creep may not be a significant property to consider; however, tensile creep is a significant property for repair materials. In structural repairs, creep of the repair materials generally should be similar to the hardened concrete substrate. For (non-structural) protective repairs, however, higher creep is sometimes considered to be an advantage because strain relaxation through tensile creep may reduce the potential for cracking.

- *Restrained Shrinkage* tests are used to determine restrained drying shrinkage and cracking potential of cementitious repair materials. Because concrete creeps in response to sustained loads, a complex interaction between strength gain, shrinkage, modulus, creep, and other factors governs the cracking potential of the material.

Durability Properties

- *Permeability* tests measure the rate of flow of a fluid (liquid or gas) into a repair material. Low material permeability reduces ingress of deleterious chemicals like chlorides or CO2 into the repair material, slowing the corrosion process.

- *Water Vapor Transmission* tests measure the steady water vapor flow in a unit of time through a unit area of a body, normal to specific parallel surfaces, under specific conditions of temperature and humidity at each surface. Impermeable materials can trap moisture at the interface between the repair and the substrate, which may result in debonding of the repair or further damage to the substrate.

- *Resistance to Freezing and Thawing* testing defines the level of deterioration from freezing and thawing cycles on a repair material.

- *Resistance to Scaling* testing determines the extent at which the surface of the repair material flakes or peels away from the near-surface portion of hardened concrete or mortar. Scaling is frequently initiated by the application of deicing chemicals in below-freezing conditions.

- *Sulfate Resistance* testing evaluates the chemical decomposition of certain binder compounds in hydrated cement paste.

- *Alkali-Aggregate Reaction* testing measures the potential for an alkali-aggregate reaction between alkalis from cementitious materials or other sources, and certain constituents of some aggregates. This reaction may cause abnormal expansion and cracking of mortar or concrete in service.

- *Abrasion Resistance* testing measures the resistance of the repair material surface to being worn away by rubbing and friction.

Mechanical Properties

- *Tensile Strength* testing measures the ability of the repair materials to withstand tensile stress. Higher tensile strength can generally be expected to improve the resistance of a repair material to internal tensile stresses such as those due to restrained volume changes.

- *Flexural Strength* testing measures resistance to bending. When repairs are likely to be subjected to bending, specifying flexural strength should be considered.

- *Compressive Strength* testing measures the ability of the repair material to carry compressive loads.

CONSTRUCTABILITY PROPERTIES

Constructability properties pertain to repair material properties during early age placement and include plastic properties, initial set, and curing requirements. Some properties that are designed to facilitate placement may adversely affect other material properties. Surface repair material selection must consider the physical properties (i.e. shrinkage, bond strength, modulus of elasticity) needed to produce a repair composite (Fig. 8) capable of fulfilling its intended function. Obtaining the desired results from the installed product can be difficult if constructability issues are not identified or properly communicated. For example, field conditions such as a combination of high wind and low humidity can adversely affect a material's shrinkage.

Constructability can also be influenced by the owner's requirements, including limited workspace, no tenant interference, night work only, short duration, no noise, no odors, no dust, etc. Most repair projects will also have unique conditions and special requirements that must be thoroughly examined before the final repair material criteria can be determined.

Issues that can impact constructability:

- *Flow Characteristics* refer to the properties which allow repair materials to penetrate and consolidate into repair cavities, which are critical for a successful repair. For most applications, slump or slump/flow requirements are satisfactory for specifying flowability.

- *Rate of Strength Gain*, as measured by compressive strength, is important to minimize shutdown time in many repair environments such as traffic areas. Insufficient strength gain prior to use may result in damage to the repair material or bond line. The desired strength and time duration should be specified where required.

- *Exothermic Temperature Changes* can negatively impact a concrete repair. The use of high-early strength cements generally results in rapid heat generation. In thick section repair applications, failure to recognize exothermic heat generation can result in thermal cracking.

- *Hot and Cold Weather* applications can have adverse effects on the performance of repair materials. Any combination of high temperature, low relative humidity, and wind velocity can result in excessive plastic shrinkage cracking, drying shrinkage cracking, poor or no bond, and poor surface finishes due to rapid setting. Cold weather's adverse effects include delayed strength gain, freezing of repair material, subsequent deterioration, and poor bond between the substrate and the repair material.

Fig. 8: Vertical surface repair creates composite with the existing concrete

- *Working Time* is the amount of time available after mixing until the material no longer has acceptable rheological performance or placement characteristics. Working time may become critically shortened and interfere with proper placement techniques at higher temperatures, especially for rapid hardening materials.

- *Compatibility with Surface Treatments* may impact the installation of surface-applied coatings, linings, membranes, or sealers. Delamination failures of surface-applied treatments can occur when an incompatible form release agent or curing compound is used in the repair material placement, which in turn inhibits the bond of the subsequent surface treatment.

- *Compatibility with Substrate* issues can occur when the repair material has an adverse chemical reaction when exposed to certain substrate conditions.

PRODUCT INFORMATION AND TEST DATA

A thorough investigation should be conducted to verify that the correct repair materials are being specified and used. Manufacturer provided product data sheets typically provide test data for a range of properties; however, not all manufacturers report the same data. The design professional needs to be aware that a "modified" test value might be completely allowable under a test standard but the modification might not be reasonable given the jobsite conditions. Additionally, some manufacturers publish completely different test standards in some cases. ICRI 320.3R[6], *Guideline for Inorganic Repair Material Data Sheet Protocol*, which is currently under review, seeks to standardize testing and reporting of data for cementitious repair materials.

Since jobsites do not typically mirror a laboratory environment, published test data should be evaluated based on the expected jobsite conditions at the time of installation. It is always preferable to conduct jobsite mockups and testing to verify expected performance whenever possible.

SUMMARY

Material and application method selection is a process of reaching informed compromises based on a host of variables related to a specific project. Everything from temperature at time of application, the skill level of the installer and the cost of the solution can impact both material and application method selection at every turn. Material selection can drive the application method and the same can be said of the application method driving material selection. ICRI Technical Guidelines 320.1R–2019, *Guide for Selecting Application Methods for the Repair of Concrete Surfaces* and 320.2R–2018, *Guide for Selecting and Specifying Materials for Repair of Concrete Surfaces* can provide the guidance needed to make those informed compromises that result in long-lasting, durable repairs.

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State of the Institute

by Elena Kessi, ICRI President, and Eric Hauth, ICRI Executive Director

What a year!

Unprecedented. Tragic. Pivot. New normal. Hopeful. These are just a few of the words that describe the year and several months we have all just been through. Looking back on the prior fiscal year of ICRI, we would be very remiss if we did not include three other words that come to mind: perseverance, gratitude, and commitment.

Perseverance: The concrete repair and restoration industry meets challenges head on. This past year plus is no different, with repair companies and professionals finding creative ways to get the job done in very challenging circumstances. This spirit runs through ICRI as well. As this State of the Institute shows, in some fundamental ways ICRI has come out of the pandemic era even stronger and better prepared for growth in the coming years. From the success of our virtual conventions to our improved learning management system, to our new product launch process, ICRI is poised to make an even bigger impact on behalf of the industry we care so much about.

Gratitude: We are so grateful to you, our ICRI members, for all that you do to make this such a unique and important organization. Through the most challenging of times, already dedicated volunteers stepped up even more—adapting to Zoom meetings both nationally and at the chapter level, ensuring continuity on a range of technical and administrative activities. Our incredible volunteers never missed a beat.

Commitment: In "membership speak," ICRI has always had a strong retention rate. What that really means is that our members commit to the organization. From our Supporting and Company members to our individual members, ICRI members show their commitment by staying involved and engaged. While we have lost some members during the pandemic era, the vast majority have stayed with us. More on that in the report that follows.

We invite you to spend a few minutes reviewing some of the important accomplishments of ICRI over the past fiscal year and opportunities for continued growth in this year's State of the Institute.

We welcome your input, comment, feedback, or ideas to make ICRI even stronger. Thank you again for your membership and dedication to ICRI!

INTRODUCTION AND OVERVIEW

Four key pillars anchor the work of ICRI: *Organization Strength. Industry Leadership. Organization Credibility. Professional Development.* We present the State of the Institute report guided by each of these four pillars.

ORGANIZATION STRENGTH

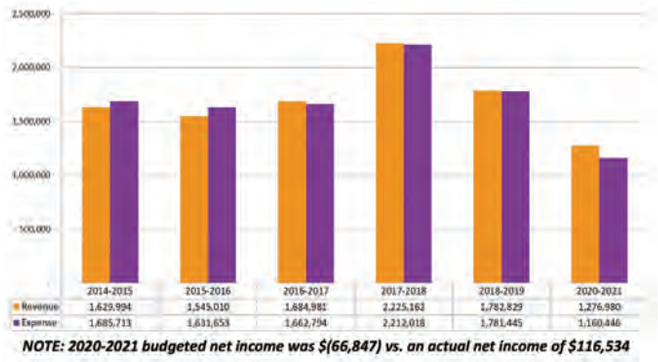
ICRI will have the resources, staff, and structures to fully support its strategic priorities.

Overall Financial Performance

Like everyone else, we entered the past fiscal year under a cloud of great uncertainty. Professional associations, which rely heavily on dues and in-person event revenue, faced their own unique headwinds. We conservatively budgeted, made some important staffing changes, and quickly adapted to online programs, not knowing how the year would turn out.

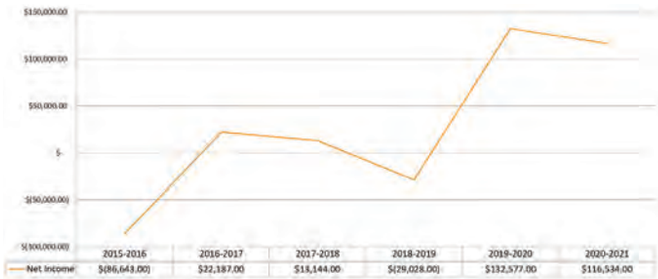
As the following charts show, we are very pleased to report that ICRI ended the fiscal year with a positive net income, instead of the expected budgeted loss. Although these are not the final audited results, we expect only minor changes to these figures.

Chart 1: Operating Revenue and Expense



NOTE: 2020-2021 budgeted net income was $(66,847) vs. an actual net income of $116,534

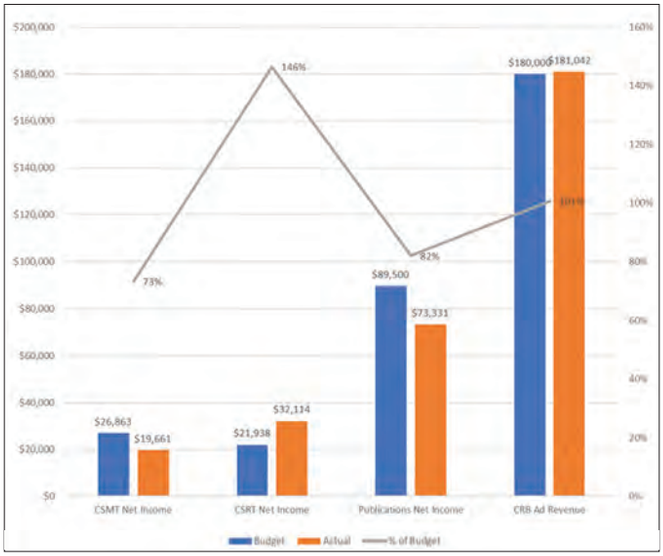
Chart 2: Net Income Trend Line



Major Program Drivers

The following chart, developed for ICRI's new organizational dashboard, provides a nice shorthand of the performance of non-convention program drivers—ICRI's two certification programs, publications/product sales revenue, and revenue from CRB ad sales. Despite the pandemic, ICRI met or exceeded budget for the Concrete Surface Repair Technician (CSRT) and CRB advertising revenue. As a completely in-person training program held back by the pandemic, the Concrete Slab Moisture Testing (CSMT) program lagged budget, but we are very bullish on the future performance of this program with new programs already taking place or in the planning stages. In addition, publications net income was down due to a decrease in CSP chip sales coupled with an unbudgeted purchase of new inventory.

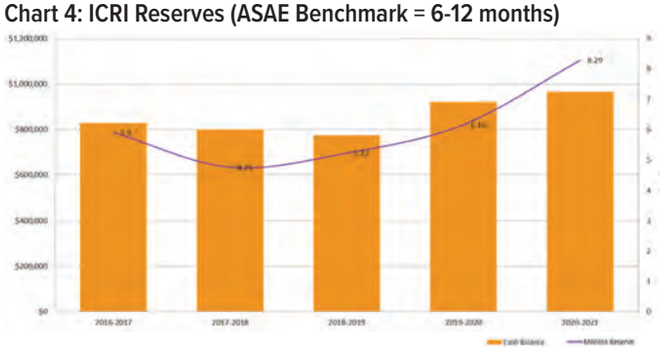
Chart 3: Major Program Drivers



Reserves

FY 20-21 represented an important milestone for ICRI's reserve funds. For the first time in its history, ICRI invested its reserve funds in a conservative, professionally managed portfolio. This enabled the organization to take advantage of long-term market growth. With only five months fully invested as of June 30, 2021, ICRI saw a gain of approximately 7 percent. Combined with our year-end cash on hand, the institute increased its reserves from approximately 6 months to approximately 8 months.

Chart 4: ICRI Reserves (ASAE Benchmark = 6-12 months)



ICRI Membership

Membership is something of a bad news, good news story for the prior fiscal. The bad news is that our previously reported membership numbers that exceeded 2,500 contained database errors, resulting in some double counting. This discovery led to an in-depth audit by Ewald Consulting

staff to ensure accurate membership data and a much-improved membership reporting process. The following chart, from the most recent membership report, shows that overall membership is just shy of 2,000 members with net growth over the past several months.

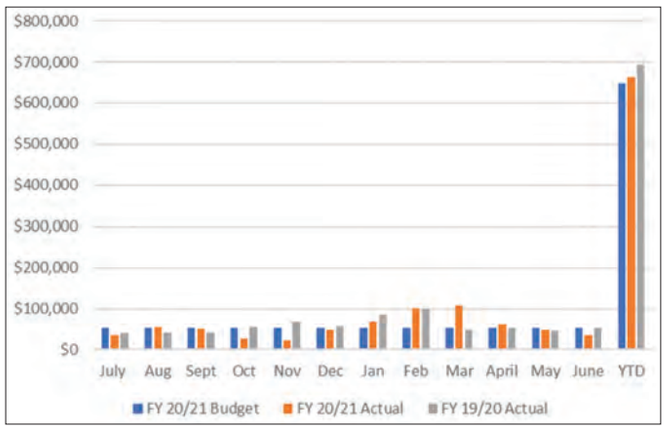
Chart 5: June 2021 Membership Report

Membership Breakdown	21-Apr	21-May	21-June
Overall Membership	1943	1960	1999
United States	1648	1673	1704
Canada	215	206	210
International	80	81	85
Company Membership	392	400	411
Supporting Membership	36	37	39
Individual Members	825	849	867
Educators	54	54	54
Government Members	20	20	20
Retired Members	19	19	19
Student Members	41	37	37
Honorary Members	5	5	5
Additional Company Members	342	325	330
Additional Supporting Members	209	214	217
Company Representative Member	395	400	411
Company Representative Member	37	37	39

Chart 6, below, shows the breakdown of ICRI company memberships. The continued decrease in the number of small company members (<$1 million in revenue) indicates the need to analyze the relative benefits of company membership at this level versus individual membership. This is an area for further evaluation by the Membership Committee.

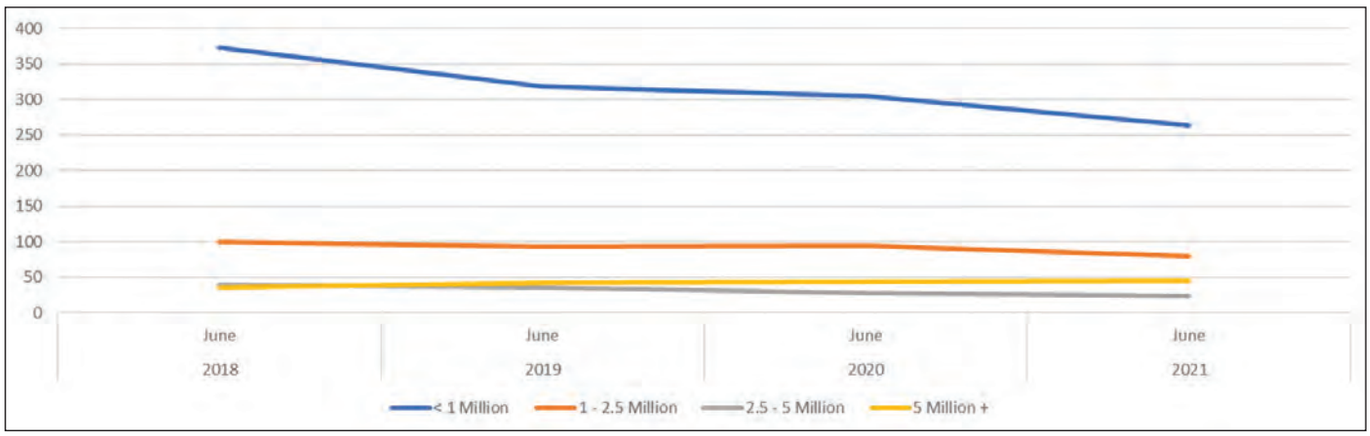
Now, the good news. Despite the significant headwinds of COVID-19 and the database challenges, overall membership *revenue* slightly *exceeded* our budget projections ($662,730 v. $648,3750). Membership net income was down slightly from FY 19-20 ($693,026); however, during a global pandemic and a significant economic downturn, the single biggest contributor to ICRI's bottom line held its own. That means that once again ICRI members continued demonstrating a high level of commitment to this organization. We could not be more grateful for that commitment during such a challenging period.

Chart 7: Membership Net Income by Month/Year



In addition, ICRI's Membership Committee has launched several critical strategies to better coordinate and focus the institute's membership retention and recruitment initiatives, including a new subcommittee focused on international membership development. There has never been a more important time for the work of ICRI and its members, so the efforts of the Membership Committee will be crucial to the future growth and impact of ICRI.

Chart 6: ICRI Company Membership Composition



INDUSTRY LEADERSHIP

ICRI will be a state-of-the-art, trusted, and reliable source of delivering best industry practices and professional networks in the repair industry.

ICRI Chapters

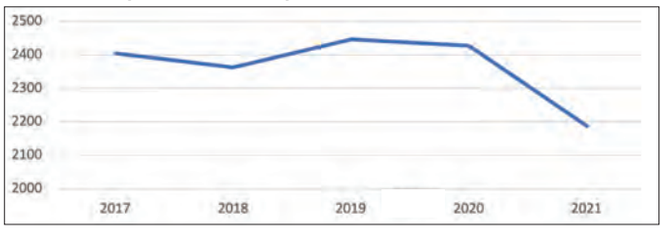
ICRI's 39 chapters are vital to the success of ICRI. The past year saw a slight decrease in overall chapter membership, from 2,427 to 2,188. However, as described above, much of this "decrease" is due to data anomalies and double counting.

While Chapters remained mostly locked down due to pandemic concerns and the shuttering of most available venues, ICRI and chapters kept in touch with members and offered several virtual options.

ICRI organized two well-received virtual Roundtable events. Unlike regional in-person Roundtables, the virtual events were open to all chapters, leading to even more cross-chapter information sharing. With the pandemic loosening its grip, we are excited to see many chapters holding live events and planning more for the months ahead.

As the following chart shows, chapter membership has fallen off somewhat; however, the decrease in FY 20-21 is largely due to the database anomalies described above. Some members have fallen off, but we are confident that both chapters and national membership are poised for a rebound—with some initial indications that the tide is already turning.

Chart 8: Chapter Membership Trends



Technical Activities

ICRI's technical activities are central to ICRI's mission and help to advance the industry. Here are some notable accomplishments over the past fiscal year:

ACI 562 Repair Code and Guide

- ICRI supported ACI's code adoption efforts in California, Connecticut, District of Columbia, Massachusetts, North Carolina, South Carolina, and Kansas with ICRI and local ICRI Chapters as co-proponents, preparing letters of support and providing member testimony.
- Code adopted in Florida, effective Dec. 31, 2020 (assisted by ICRI endorsement letter campaign).
- Committee 150 worked with ACI in updating the joint ACI/ICRI Guide to the new ACI 562-19 Repair Code by developing two new design examples (new guide published in Nov. 2020).

Technical Committees

- *Guide Specifications for Epoxy Injection* (110.2) published in Dec. 2020.
- *Guide Specifications for Cementitious Bonded Overlays* (110.3), *Updated Guide for NDE Methods for Condition Assessment, Repair, and Performance Monitoring of Concrete Surfaces* (210.4R), and *Guide for Design, Installation, and Maintenance of Protective Polymer Flooring Systems for Concrete* (710.1R, joint ICRI/SSPC/NACE) anticipated to be published in Fall/Winter 2021.

Professors Workshop

We participated in the ACI/PCA virtual professors workshop in July 2020 attended by 59 professors and presented ICRI's educational resources available for the training of students. Professors in attendance were offered complimentary 1-year individual memberships to access ICRI educational resources and member benefits.

The National Center for Construction Education and Research (NCCER) Training Curriculum

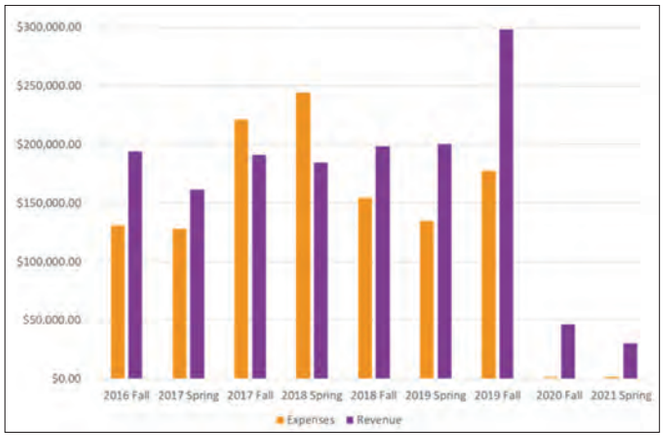
We provided subject matter expert members to develop a new Concrete Repair module for NCCER's updated Concrete Construction Level 2 training curriculum published in late 2020. ICRI was recognized as a sponsor for the revision efforts. In addition, ICRI SME members provided support in updating existing training modules in both the Level 1 and 2 Concrete Construction curriculums.

ICRI Fall and Spring Conventions

ICRI's two conventions each year provide unparalleled networking for concrete repair professionals. As the pandemic ground on, ICRI built on the experience of our "Virtual Vancouver" on-demand convention and launched two live virtual conventions in Fall of 2020 and Spring 2021.

The virtual conventions generated strong positive net income (Fall 2020: $45,000, Spring 2021: $29,000) and each attracted more than 200 attendees (Fall 2020: 285, Spring 2021: 207). Chart 9 shows that, while overall revenue was significantly lower than previous conventions, the quick pivot to virtual conventions by the ICRI staff and volunteers meant that almost all convention revenue added to the bottom line.

Chart 9: Convention Revenue and Expense



Importantly, the virtual experience led to two new innovations:

1. Going virtual enabled us to record and capture technical presentations for on-demand access on ICRI's learning management system. From these two virtual conventions alone, ICRI gained more than 30 new educational offerings that members and non-members can access. Going forward, we hope to capture many more technical presentations through video presentations of their live sessions and continue to grow our on-demand library for use by members and non-members.
2. For the first time in ICRI's history, virtual sparked the opportunity to coordinate, obtain, and showcase company video product demonstrations presented during both the Fall and Spring Conventions. This was a significant new undertaking that creates a springboard to build this offering into live conventions and offer these product videos year-round in a new ICRI Concrete Repair Solutions Center, to be launched in FY 21-22.

ORGANIZATION CREDIBILITY

ICRI will be a well-connected organization backed by a recognized and respected brand locally, nationally, and internationally.

New Product Launch Plan

To grow the reach of ICRI's technical products, the Technical Activities Committee and the Marketing Committee identified a critical need to implement a comprehensive product launch plan for new and updated technical products of ICRI. The goal is to ensure that ICRI products are widely distributed to the right audience at the right time. The Ewald marketing and communications team took this guidance and built a comprehensive product launch process that can be adapted to any new ICRI product. In FY 20-21, ICRI launched the first product under this plan—ICRI's New Guide No. 110.2-2020, *Guide Specifications for Epoxy Injection*.

This more disciplined product launch approach will be applied going forward to all major technical products developed by ICRI, helping to ensure widespread adoption of ICRI best practices and recognition of the incredible ICRI volunteers that make these products possible.

Women in ICRI

If you have read the CRB lately, no doubt you have seen prominent profiles of women difference-makers in concrete repair in recent issues. Women in ICRI are leading the way in helping ICRI realize a critical element of this pillar—stronger engagement of diverse participants. We will continue to build on this work to ensure that ICRI broadens its reach and appeal to diverse communities.

Website Reach

ICRI invested considerable time and energy during the previous FY enhancing its website, improving the user experience and access to critical content. Despite decreases in traffic—especially due to the suspension of in-person events that drive considerable traffic—the ICRI website is performing well.

The largest segment of users come to the ICRI website from organic searches (21,774 users), indicating that the continued work done throughout the year on Search Engine Optimization (SEO) and meta tags is helping drive relevant traffic to the ICRI website without spending advertising dollars.

As we continue to focus ICRI marketing, membership, and education efforts we expect to see traffic continue to improve.

Many reputable sites are referring to ICRI, which increases credibility and builds brand awareness. Table 1 shows the 5 non-search, non-ICRI owned channel referrals that drew the most users to ICRI's website.

Table 1: Top Referral Channels to ICRI Website

Source	Users	Sessions
concretenetwork.com	221	277
graco.com	151	172
wagnermeters.com	103	117
icri-quebec.org	91	109
sspc.org	80	81

Social media referrals increased compared to the previous report for LinkedIn. Twitter fell in sessions and session duration and Facebook traffic fell across the board in FY 20-21 as the primary source of social referrals.

LinkedIn was the biggest winner for ICRI in FY 20-21 driving 1,720 sessions and 4,055 pageviews.

Twitter was responsible for 316 pageviews and saw an increase of 3.95 pages per session from 2.11.

Overall, there was a decrease of 10.79 percent of sessions via social referral. This may have contributed to the overall decrease in sessions for the website in FY 20-21.

PROFESSIONAL DEVELOPMENT

ICRI will develop and deliver programs, products, and services that provide knowledge, build skills, and validate expertise.

Webinars

Over the past year, ICRI made continued strides in live webinar offerings. Specifically, ICRI offered 7 live webinars, including two solicited presenters and a 5-part series on moisture mitigation.

The latter, designed to continue the pre-pandemic momentum seen in the Concrete Slab Moisture Testing (CSMT) program, was the first ICRI webinar series and certificate program with a digital badge. Registration across the series averaged approximately 200 attendees, with total revenue of almost $19,000.

Certification Programs

Not surprisingly, the pandemic proved challenging for both of ICRI's certification programs, which include major in-person training components. Despite these challenges, creative decision-making and determination by staff and volunteers ensured important continuity and some notable accomplishments, including successes providing virtual recertifications to existing certification holders.

Concrete Slab Moisture Testing (CSMT)

- Conducted 1 in-house class in Columbus, Ohio (America's Floor Source), resulting in a total of 15 certified and 19 re-certified.
- Did not conduct other classes or participate in WOC or TISE West in Las Vegas, Nevada, due to Covid (re-certifications conducted virtually helped with revenue and net income).
- Continued developing a plan for a future class in Australia.
- Organized a class at the National Wood Flooring Association (partner) Expo in Orlando, which took place in July 2021.
- Planned for Fall 2021 classes in Baltimore and Minneapolis (in conjunction with ICRI Fall Convention)

Concrete Surface Repair Technician (CSRT)

- 113 total certified since launch in 2016—No live performance exams during FY 20-21 due to COVID.
- Total participation of 467 since launch in 2016—113 new participants this fiscal year (63 Education and 50 Certification)—shows significant growth in program participation as compared to 44 in FY 19-20.
- Net income of $32,114 exceeds budget of $21,938, due to increase in overall program participation, especially in the Education Course.
- *40 under 40* recipients and student members offered complimentary CSRT Education course.
- Benefit to supporting members includes complimentary CSRT Certification Courses.
- Planning live 2021 CSRT performance exam classes in Baltimore in September and Minneapolis in October.

SUMMARY AND CONCLUSION

It has been said that there is no growth in the comfort zone. That has never been truer for ICRI than the past two years. The incredible combined effort of our many volunteers, supporting, company, and individual members and a dedicated staff team has allowed us to weather a very challenging period and come through this past fiscal year in a better position on many fronts than we even anticipated.

Like any "growth opportunity," it has not been easy. But it has been worth it. The task ahead is to take the lessons learned and the progress made to grow ICRI's capacity for the opportunities ahead.

We are tremendously grateful for your membership in and dedication to ICRI and look forward to getting back together again in Minneapolis at the Fall Convention and at future chapter events in the months ahead. For now, we wish you safety and great success!

CONCRETE REPAIR CALENDAR

SEPTEMBER 22-23, 2021
ICRI Concrete Slab Moisture Testing (CSMT) Program
Baltimore, MD Area
Website: **www.icri.org**

SEPTEMBER 24, 2021
ICRI Concrete Surface Repair Technician (CSRT) Live Performance Exam
Baltimore, MD Area
Website: **www.icri.org**

OCTOBER 11-13, 2021
2021 ICRI Fall Convention
Minneapolis, MN
Website: **www.icri.org**

OCTOBER 14-15, 2021
ICRI Concrete Slab Moisture Testing (CSMT) Program
Minneapolis, MN Area
Website: **www.icri.org**

OCTOBER 14, 2021
ICRI Concrete Surface Repair Technician (CSRT) Live Performance Exam
Minneapolis, MN Area
Website: **www.icri.org**

OCTOBER 17-21, 2021
ACI Concrete Convention - Fall 2021
Virtual
Website: **www.aciconvention.org**

JANUARY 17-20, 2022
World of Concrete 2022
Las Vegas, NV
Website: **www.worldofconcrete.com**

APRIL 4-6, 2022
2022 ICRI Spring Convention
Vancouver, BC, Canada
Website: **www.icri.org**

INTERESTED IN SEEING YOUR CONCRETE INDUSTRY EVENT LISTED HERE?

Events can be emailed to editor@icri.org. Content for the November/December 2021 issue is due by October 1, 2021 and content for the January/February 2022 issue is due by December 1, 2021.

INDUSTRY NEWS

COORDINATED SYSTEMS CONSULTING ACQUIRES SURTREAT®

Coordinated Systems Consulting, a leader in the restorative construction industry, has acquired SURTREAT®, technologies specializing in surface applied solutions for structural repair and restoration. This acquisition comes as CSC (Coordinated System Consulting) aims to expand their portfolio of life extending construction technologies in order to provide their customers, partners and clients with the mosteconomical, environmentally friendly, efficient, and effective solutions for their structural repair and strengthening needs.

The purchase of SURTREAT®, based in Pittsburgh, Pennsylvania, further increases CSC's market share in the structural repair and strengthening market in the US, and beyond, as Surtreat Solutions operates around the world, including the Middle East, Mexico, Canada, and Europe. With their shared vision of minimizing the carbon footprint of concrete removal and replacement and providing customers with the most innovativesolutions on the market, both companies are excited for this newfound synergy.

Both companies remain focused on educating engineers, law makers, consumers, employees, etc., on the importance of understanding, treating, and curing the underlying issues causing the deterioration as opposed to treating the symptoms with a band aid approach that forego an understanding of repercussions to structureowners and the environment. Surtreat Solutions provides the migrating technology, research, and development to be able to offer permanent cures that will provide significant service life extension for the customer's asset with an environmentally friendly approach that is more efficient, effective, all at a lower cost.

INTERESTED IN SEEING YOUR NEWS IN THIS COLUMN?

Email your 150-200 word industry news to editor@icri.org. Content for the November/December 2021 issue is due by October 1, 2021 and content for the January/February 2022 issue is due by December 1, 2021. ICRI reserves the right to edit all submissions.

ASSOCIATIONNEWS

NEW CENTER OF EXCELLENCE FOR NONMETALLIC BUILDING MATERIALS ANNOUNCES EXECUTIVE DIRECTOR

NEx: An ACI Center of Excellence for Nonmetallic Building Materials has hired Dr. David A. Lange as Executive Director. He will oversee all NEx operations and initially focus on identifying and recruiting new members interested in advancing nonmetallic building materials.

Dr. Lange is a world-renowned construction material expert and Past President of the American Concrete Institute. He served as Associate Department Head for Civil and Environmental Engineering at the University of Illinois at Urbana-Champaign from 2004-2010, and was a faculty member for nearly thirty years. Lange also served as Director of the Center of Excellence for Airport Technology at the university for 15 years. Dr. Lange received his PhD in civil engineering from Northwestern University, Evanston, IL; his MBA from Wichita State University, Wichita, KS; and his BS in civil engineering from Valparaiso University, Valparaiso, IN.

In addition to new member recruitment, Dr. Lange will focus on establishing initiatives to grow education, awareness, research, standards development, and technology adoption related to nonmetallic building materials. To learn more or to get involved with NEx, visit nonmetallic.org or contact info@nonmetallic.org.

ACI FOUNDATION NOW ACCEPTING FELLOWSHIP AND SCHOLARSHIP APPLICATIONS

The ACI Foundation announces that applications are now being accepted from graduate and undergraduate students for the 2022-2023 academic year.

ACI Foundation fellowships are offered to both undergraduate and graduate students pursuing a concrete-related degree or program at an American or Canadian institution of higher education, or the applicable countries related to the ACI Foundation Middle East & North Africa Fellowship. The Barbara S. and W. Calvin McCall Carolinas Fellowship, the Burg-Coleman Iowa State '77 ACI Fellowship, the Darrell F. Elliot Louisiana Fellowship, and the Nick Bada - ACI Ontario Chapter Graduate Scholarship give priority to students from these states/provinces. Students must obtain two endorsements, with one being from an ACI member.

ACI Foundation scholarships are also offered to graduate and undergraduate students pursuing a concrete-related degree or program. International students are eligible to apply for most 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 $5000 USD; and recognition in Concrete International and on the ACI Foundation's website and social media.

The purpose of the ACI Foundation's student fellowship and scholarship program is to identify, attract, and develop outstanding professionals for future careers in the concrete industry. For the 2021-2022 academic year, the ACI Foundation distributed over $180,000 in tuition assistance to 22 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 for 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 this application period is November 2, 2021, at 11:59 p.m. EST. Additional application details are available at acifoundation.org/scholarships

NIBS CONSULTATIVE COUNCIL ISSUES MOVING FORWARD REPORT ON HEALTHY BUILDINGS

The National Institute of Building Sciences Consultative Council has issued its 2020 Moving Forward Report, looking closely at the importance of healthy buildings.

The report examines how buildings can protect and promote public health, providing recommendations for President Biden and policymakers on three components of healthy buildings: indoor environmental quality, the importance of design in promoting health, and promoting knowledge transfer between building owners and public health officials.

"Ensuring that the spaces where we live and work are healthy and safe for continued occupancy is critical to overcoming the pandemic," said Lakisha A. Woods, CAE, President and CEO of NIBS. "This is a fundamental pillar of public health and community resilience. The concept of healthy buildings goes well beyond continual sanitation of a building's indoor environment to eliminate pathogens."

The NIBS Consultative Council assembles high-level building community leaders to make collective recommendations directly to the President of the United States and policymakers to improve our nation's buildings and infrastructure.

Visit the Consultative Council, www.nibs.org, for more information or to read the full report.

ACI CONCRETE CONVENTION IN ATLANTA, GA, USA, WITH VIRTUAL OPTION

Engineers, contractors, educators, manufacturers, and material representatives will convene at the ACI Concrete Convention in Atlanta, GA, USA, October 17-21, 2021, 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). Select programming will also be available live or on-demand to attendees who choose to attend virtually.

The ACI Concrete Convention is an opportunity to showcase companies, projects, current events, research, and offers numerous networking events where you can expect to meet with many of the concrete industry's professionals. Attendees may also visit the exhibit hall to learn more about the many products and services offered by exhibitors.

Over 55 technical sessions will be presented live with on-demand viewing available afterwards, providing substantial opportunity to advance knowledge. The sessions will be available to those that registered for the in-person ACI Concrete Convention in Atlanta or those that register for the ACI Concrete Convention's Virtual Technical Sessions. All technical sessions will be available virtually through the convention platform and will be available for on-demand viewing after premiering live at the convention.

Throughout the convention, ACI will hold hundreds of committee meetings, 55+ technical sessions, an industry trade exhibition, networking events, and more.

To learn more about the ACI Concrete Convention and to register, please visit aciconvention.org.

AMERICAN CONCRETE INSTITUTE ANNOUNCES DIRECTOR OF INNOVATIVE CONCRETE TECHNOLOGY

The American Concrete Institute (ACI) is pleased to announce that Rex C. Donahey, Ph.D., will serve as the Institute's inaugural Director of Innovative Concrete Technology. In this newly created position, Donahey will be responsible for actively providing outreach by the Institute to trade organizations, companies, and individuals to attract emerging technologies for development within ACI.

Donahey will continue to serve as Editor-in-Chief of ACI's monthly magazine, Concrete International (CI) until his successor is named. In this role and in previous positions as a faculty member, a structural engineer, and a director of research and development for an industry supplier, Donahey has developed a strong understanding of the needs of contractors, designers, and suppliers. He earned his Ph.D. in civil engineering from the University of Kansas, Lawrence, KS, USA. A lifelong learner, he has also earned certificates in online courses covering design, deep learning, strategy, disruptive technology, and user experience for augmented reality applications.

Learn more at concrete.org.

ANNUAL REQUEST FOR CONCRETE RESEARCH PROPOSALS NOW OPEN

The The ACI Foundation's Concrete Research Council seeks to advance the concrete industry through the funding of concrete research projects that further the knowledge and sustainability of concrete materials, construction, and structures. The annual request for proposals is open now through December 1, 2021.

Principal investigators shall follow the requirements in the published RFP Application Guide, including the requirement to contact ACI Technical Committee Chairs by September 17, 2021, to request endorsement of the proposed research.

Selection of awarded projects and notifications to principal investigators will occur the week after the spring ACI Concrete Convention. Contact Tricia G. Ladely, Assistant Director, ACI Foundation, for additional research proposal information at Tricia.Ladely@acifoundation.org or +1-724-601-3075. Historical information on previously awarded projects and research is available at acifoundation.org/research. For more information or to apply visit ACIFoundation.org.

AMERICAN CONCRETE PUMPING ASSOCIATION (ACPA) RELEASES NEW SAFETY MATERIALS

The American Concrete Pumping Association (ACPA) has released new and updated safety materials to fulfill its ongoing

ASSOCIATION NEWS

mission of promoting safe concrete pumping practices. The first item, *Safety Bulletin: Use of Lay Flat Hose*, identifies and illustrates the handling guidelines for using ng lay-flat hoses on the job.

Lay-flat hoses allow for improved flow control and lower placement rates than standard concrete boom tip hoses and are a popular accessory when pumping is required in tight spaces such as ICF forms, columns, and walls.

The new safety bulletin complements the association's extensive safety library and is available for download on the association's website Safety/Training page: https://www.concretepumpers.com/content/safety-bulletin-use-lay-flat-hose

Next, the ACPA updated two of its Safety Guidelines for *Wind Velocity* and *Lightning*. These guidelines outline the ACPA's recommended practices in severe-weather events and more.

The *Safety Bulletin: Use of Lay Flat Hose* and Safety Guidelines for *Wind Velocity* and *Lighting*, are available for download on the association website at www.concretepumpers.com/content/contractors.

For additional resources on general safety, visit the ACPA's Safety/Training page, where safety materials are easy to find, and many are available for download at no cost. In addition, the ACPA's online catalog, www.concretepumpers.com/catalog, has materials available for purchase.

INTERESTED IN SEEING YOUR NEWS IN THIS COLUMN?

Email your 150-200 word association news to editor@icri.org. Content for the November/December 2021 issue is due by October 1, 2021 and content for the January/February 2022 issue is due by December 1, 2021. ICRI reserves the right to edit all submissions.

INTERNATIONAL CONCRETE REPAIR INSTITUTE

ICRI**CHAPTER**NEWS

CHAPTER CALENDAR

As the global pandemic begins to ebb, chapters are starting to host events. Be sure to check with individual chapters by visiting their chapter pages for any chapter events planned after publication of this *CRB* issue.

CHICAGO
September 2, 2021
LEE SIZEMORE MEMORIAL GOLF OUTING
And Scholarship Fundraiser
White Pines Golf Club
Bensenville, IL

CINCINNATI
September 22, 2021
23rd ANNUAL GOLF OUTING
Mill Creek Course at Winton Woods
Forest Park, OH

October 20, 2021
CHAPTER DEMO DAY
Offices of AG Engineering & Contracting
Loveland, OH

DELAWARE VALLEY
September 24, 2021
28th ANNUAL GOLF OUTING
Rock Manor Golf Club
Wilmington, DE
St. Petersburg, FL

GEORGIA
September 2, 2021
SUMMER SOCIAL AND MEMBER DRIVE
Cosmo's Pizza and Social
Lawrenceville, GA

September 30, 2021
CHAPTER LUNCH 'N' LEARN
Maggiano's Perimeter
Atlanta, GA

October 28, 2021
CHAPTER LUNCH 'N' LEARN
Maggiano's Perimeter
Atlanta, GA

GREAT PLAINS*September 9, 2021*
15th ANNUAL GOLF TOURNAMENT
Shoal Creek Golf Course
Kansas City, MO

HOUSTON
September 16, 2021
JOINT MEETING WITH ACI HOUSTON
Kirby Ice House
Houston, TX

INDIANA
September 2, 2021
ANNUAL GOLF EVENT
Plum Creek Golf Course
Carmel, IN

METRO NEW YORK
September 23, 2021
FALL GOLF CLASSIC XVIII
Cedar Hill Golf & Country Club
Livingston, NJ

NEW ENGLAND
September 27, 2021
CHAPTER GOLF OUTING
Turner Hill Country Club
Ipswich, MA

November 3, 2021
CHAPTER DINNER PRESENTATION
Topic: Insulation of Existing Masonry Buildings
Speaker: Sarah Gray, RDH Building Science, Inc.
Location TBD

NORTH TEXAS
September 16, 2021
CHAPTER MEMBERSHIP MEETING
Topic: Parking Structures – Assessment and Repair
Speaker: Stephen Lucy, JQ Engineering
Location TBD

October 1, 2021
Jesse Points Memorial Golf Classic
20th Annual NTX ICRI Golf Tourney
Waterchase Golf Club
Ft. Worth, TX

NORTHERN OHIO
September 20, 2021
GOLF OUTING & CLAM BAKE
Bunker Hill Golf Course
Medina, OH

SOUTHEAST FLORIDA
October 21, 2021
24th ANNUAL GOLF TOURNAMENT
Jacaranda Golf Club
Plantation, FL

VIRGINIA
September 30, 2021
FALL SYMPOSIUM & GOLF OUTING
Colonial Heritage Golf Club
Williamsburg, VA

October 28, 2021
CHAPTER DEMO DAY
Richmond Primoid Warehouse
Henrico, VA

MID-SOUTH CHAPTER GATHERS FOR BASEBALL

Several members from the ICRI Mid-South Chapter gathered recently at AutoZone field to see Memphis Play Nashville. It was a good, if not wet game. And everyone enjoyed the evening

NORTH TEXAS HOSTS HAPPY HOUR TO GET REAQUAINTED

At long last, North Texas Chapter members and guests reunited at a Happy Hour event at the Yard House in Irving, Texas on July 27. Heavy hors d'oeuvres coupled with a plentiful selection of libations were enjoyed by the more than 40 attendees. It was evident that everyone had missed these valued networking opportunities! Special thanks to our Happy Hour sponsors: Euclid Chemical and Sika Corporation!

As things slowly get back to some semblance of normalcy, plans are in the works for additional in-person events—a membership meeting on September 16 and the 20th Annual Jesse Points Memorial Golf Tournament on October 1 at Waterchase Golf Club in Fort Worth. We hope you will join us at these events!

Happy Hour at the Yard House with (left to right): Patrick Jorski, Pete Haveron, Casey Jones, Doug Smith, Parker Mink, and John Shook

WWW.ICRI.ORG

DELAWARE VALLEY HOSTS SUMMER SOCIAL

On a sunny Friday in June more than 50 members and guests of the Delaware Valley Chapter gathered to participate in a fun Summer Social. It was held at Levante Stables, a local brewery, and featured live music, excellent food and, or course, we sampled a few of the craft brews. The highlight of the day was a Corn Hole Tournament. The Aquafin team of Alex Gugliotta and Vincent Budnavage were the overall winners and each received a corn hole set. Everyone agreed that they had fun competing and the real winner was ICRI.

The tournament format allowed for plenty of socializing and many commented that the social was a great first event after the struggles of the last year. Many had not seen each other in person for over a year, so it was great to catch-up. Delaware Valley Chapter thanks Employing Bricklayers Association for sponsoring the food truck and also thanks the sixteen corn hole board sponsors. Their support and dedication to ICRI is invaluable and is truly appreciated.

The next Delaware Valley Chapter event will be the golf outing on September, 24, 2021.

Delaware Valley Chapter members and guests set up to start tossing

The Delaware Valley summer social was filled with sun and fun for all those in attendance

Tournament Winners from Team Aquafin were Alex Gugliotta (left) and Vincent Budnavage. The winners took home their own corn hole sets!

Everyone agreed, the real winners of the day were ICRI members who were able to socialize and network

More sun and fun at the Delaware Valley corn hole tournament

ICRI**CHAPTER**NEWS

CHAPTERS COMMITTEE CHAIR'S LETTER

MICHELLE NOBEL
Chapters Chair

It's been another excruciatingly hot summer in Florida. I can't wait for the cool fall weather to kick in! We've had our share of ups and downs the past year and a half. I'm hoping for better times ahead as we near the end of 2021. As Mae West put it, "*Too much of a good thing can be wonderful!*" I think we could all use some wonderful right now.

I hope that everyone has registered for the 2021 ICRI Fall Convention, October 11-13, in Minneapolis, Minnesota. I'm excited to see everyone. I know the Minnesota Chapter can't wait to host. They've been waiting for almost two years and working hard to make it a memorable event! If you have an axe to grind, you like to cruise, and you like hanging out with the ladies, then Minneapolis is the place to be October 11-13. You don't want to miss it!

The Women in ICRI Reception is from 3:00 to 4:00 pm on October 11, and the Women in ICRI Committee meeting is from 9:00 to 9:50 am on October 13. Men and women are encouraged to join the meeting, and we're always looking for women who would like to join this committee. Please join this group of accomplished and dedicated women. We may be from all walks of life from around the globe, but we share a sisterhood that's inspiring. We're also applauding the women that won the ICRI 40 under 40 Award, as we highlight members in the Concrete Repair Bulletin.

If you would like to join the Women in ICRI group, reach out to Tara Toren-Rudisill, TTorenrudisill@ThorntonTomasetti.com; Monica Rourke, MRourke@mapei.com; or me at mnobel@mapei.com.

ICRI is currently looking for a replacement for Ken Lozen. After over eight years as the Technical Director of ICRI, Ken is retiring. As long as I've been in ICRI, Ken has been there. He's been a tremendous asset to ICRI. I know that he will be hard to replace. Speaking on behalf of ICRI, I know that we all wish him well, and we hope he enjoys many years of retirement.

The Certification and Education programs offered by ICRI will go on. The information is on the Certification and Education tab on the ICRI.org website. Having a certification at your local chapter can benefit your chapter and add money to your coffers. Explore the same tab to learn about the CSRT program, CSMT program, webinars, training, tips on the learning center, and all that ICRI has to offer.

Dates to mark on your calendar:

- 2021 ICRI Fall Convention—October 11-13, 2021, in Minneapolis, Minnesota
- World of Concrete 2022—January 17-20, 2022, in Las Vegas, Nevada
- 2022 ICRI Spring Convention—April 4-6, 2022, in Vancouver, British Columbia

Please remember to send in your ICRI chapter meetings and events to be posted on the ICRI website. Find out what's happening in an area where you're traveling. It can be an opportunity to see what other chapters are doing for events. You can learn and meet new people, that end up becoming friends. It's better than dining alone! Following is the link to the calendar on the ICRI website for more information:

https://www.icri.org/events/event_list.asp

You can reach out to ICRI staff, the Executive Committee, your Region Director, or the leaders of your local ICRI chapter for help. ICRI is here to support you in your efforts.

In the astute words of Abraham Lincoln, *"The best way to predict the future is to create it."* Let's meet in Minneapolis to create some fond memories and new friendships that'll last a lifetime!

Please be safe, be kind, and I will see you all this Fall!

Sincerely,

Michelle Nobel
2021 ICRI Chapters Committee Chair
MAPEI Corporation

CHAPTER ACTIVITIES

NORTH TEXAS HOSTS INDUSTRY DEVELOPMENT ROUNDTABLE

On June 17, 2021, the North Texas Chapter hosted a virtual roundtable to discuss recent concrete repair industry experiences associated with challenges stemming from the increase in construction activity as pandemic restrictions have eased. A lively discussion was held with a group of about 20 members and industry friends regarding material costs and shortages, as well as issues with securing labor. Many points of view were shared by contractors, manufacturers, suppliers, and engineers on overcoming the issues based on their first-hand knowledge. Past trends and expectations for market behavior through the end of 2021 and beyond were provided.

While the recent months have made finding qualified personnel, sourcing materials, and pricing work a challenge, all agreed that now is as good a time as ever to be in the concrete repair industry. The NTX Chapter looks forward to returning to in-person membership meetings very soon!

PEOPLE ON THE MOVE

ANNOUNCING CARLSON STRUCTURAL ENGINEERING, INC.

Announcing the formation of Carlson Structural Engineering, Inc. a consulting firm in the Mid-Atlantic Region specializing in the evaluation, design, bidding, and monitoring of repairs to defects in existing building structures. The company was founded on the principles of providing superior customer service while developing cost effective, practical solutions to damaged buildings, including large scale residential (condominiums, apartments), commercial (offices, warehouses), and historic properties.

The founder, Mr. Christopher W. Carlson, P.E., SECB, has over 32-years of professional experience, and is known in the Mid-Atlantic region for providing on-time solutions to meet the needs of building owners and managers. He has been a contributing speaker, author, committee chair, Board member and President for local and national professional organizations including the ICRI Baltimore-Washington Chapter.

The firm offers expert assistance with remediating structural defects and water intrusion conditions in buildings and building-like structures of all ages including parking garages, retaining walls, foundation underpinning, balconies, plaza waterproofing, façades, and site drainage. Expert testimony is provided as well.

INTERESTED IN SEEING YOUR NEWS IN THIS COLUMN?

Email your 150-200 word news to editor@icri.org. Content for the November/December 2021 issue is due by October 1, 2021 and content for the January/February 2021 issue is due by November 1, 2021. One (1) high resolution headshot/individual may be included. ICRI reserves the right to edit all submissions.

TOP-THREE CORTEC PRIMER/TOPCOAT COMBOS FOR MICRO-CORROSION INHIBITING PROTECTION

General Whenever time and resources allow, painters typically achieve the best coatings results from applying both a primer and a topcoat. Once this route has been chosen, the next important step is to select the best primer/topcoat combination for the application. To help coaters make this decision where metals protection is concerned, Cortec® Corporation recommends these top-three primer-topcoat combinations from its portfolio of Micro-Corrosion Inhibiting Coatings™.

For those seeking extreme protection in harsh outdoor, unsheltered applications, Cortec's VpCI®-396/VpCI®-384 combination takes first place as the best Cortec® solvent-based coatings system.

The first go-to water-based option is Cortec's VpCI®-395/EcoShield® 386 combination.

For those who want to go the water-based route without the extra hassle of mixing a 2K primer, Cortec® offers VpCI®-375. VpCI®-375 is a water-based acrylic one coat DTM system that is resistant to sagging or running and forms a tough protective barrier. It is even better paired with EcoShield® 386, Cortec's outstanding single-component water-based topcoat.

Industrial painters will have different needs, restrictions, or preferences that factor into their final decision. Whatever the parameters, these three combinations are great ways to go for excellent performance with options for environmental or user benefits, 2K durability, or 1K convenience. Contact Cortec® today to learn more: https://www.corteccoatings.com/contact-us-2/

EUCLID CHEMICAL INTRODUCES NEW ANTI-WASHOUT CONCRETE ADMIXTURE

Euclid Chemical, a leading manufacturer of concrete and masonry construction products, has announced the release of EUCON AWA-P20, its new anti-washout concrete admixture.

EUCON AWA-P20 is a ready-to-use liquid admixture designed to modify the rheology of self-consolidating concrete and prevent the loss of cement and fine aggregate during the placement of underwater concrete, while not discoloring the concrete. Featuring thixotropic properties, it can also be used to reduce excessive bleeding and segregation of concrete or mortar during pumping.

Recommended for use with the PLASTOL line of polycarboxylate-based admixtures, EUCON AWA-P20 does not contain any added chlorides or chemicals known to promote the corrosion of steel. It also minimizes environmental impact by reducing concrete washout and eliminating the need for expensive de-watering during underwater construction.

EUCON AWA-P20 meets the ASTM C494 Type S standard specification for chemical admixtures for concrete applications, as well as the requirements of the CRD-C661-06 specification for anti-washout admixtures for concrete from the U.S. Army Corps of Engineers.

Learn more at www.euclidchemical.com.

SURFACE APPLIED CORROSION INHIBITORS (SACIS)

When it comes to selecting Surface Applied Corrosion Inhibitors (SACIs) for concrete repair and maintenance, it is important for engineers to know how and why to compare "apples to apples" instead of "apples to oranges." The International Concrete Repair Institute (ICRI) Technical Guideline No. 510.2-2019, "*Guideline for Use of Penetrating Surface Applied Corrosion Inhibitors for Corrosion Mitigation of Reinforced Concrete Structures*," provides a good place to start.

Cortec® Corporation offers the following SACIs as part of its MCI® Technology line to extend concrete service life:

Full-Strength SACI, No Water Repellent

MCI®-2020 is a top-of-the line option for use where a pure, high concentration penetrating corrosion inhibitor is needed. It is also available as MCI®-2020 V/O (for vertical/overhead use) or MCI®-2020 Gel (for injection beneath surfaces that cannot be disturbed or properly prepared).

Two-in-One Water Repellent SACIs

- MCI®-2018 (100% silane)
- MCI®-2019 (40% silane)
- MCI®-2021 (silicate)
- MCI®-2022 (silane/siloxane blend)

Contact Cortec® MCI® to learn more: https://www.cortecmci.com/contact-us/

TWO GREAT WELDABLE RUST PREVENTATIVES FOR HEAVY EQUIPMENT SUPPLIERS

Cortec® offers two excellent rust preventatives—BioCorr® and VpCI®-325—that have been fully approved for weldable applications through EHS and mechanical destructive testing at a heavy equipment manufacturer.

BioCorr® is a great option for anyone who wants a virtually undetectable dry film rust preventative that does not have to be removed before further component assembly and processing. In addition to its user-friendly advantages, BioCorr® is a USDA Certified Biobased Product that contains 64% USDA certified biobased content, offering a double advantage compared to messy petroleum-based products made from non-renewables. For those who still prefer a more traditional rust preventative that leaves behind an oily film, VpCI®-325 is another excellent weldable option. The tenacious film of VpCI®-325 displaces water and inhibits corrosion. Rather than being completely solvent-based, VpCI®-325 has a partial vegetable oil base, improving its environmental profile via a biobased, biodegradable raw material.

Learn more at:
https://www.cortecvci.com

INTERESTED IN SEEING YOUR NEW PRODUCT IN THIS COLUMN?

Email your 150-200 word news to editor@icri.org. Content for the November/December 2021 issue is due by October 1, 2021 and content for the January/February 2021 issue is due by November 1, 2021. One (1) high resolution product photo may be included. ICRI reserves the right to edit all submissions.

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