March/April 2025
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ON THE COVER: Brunelleschi's Dome in Florence, Italy featured on page 9.

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FEATURE ARTICLES

DEPARTMENTS

ICRI Mission and Strategic Plan Benefit Members and the Industry

PRESIDENT'SMESSAGE

GERARD MOULZOLF

Just getting back from two days at World of Concrete (WOC) and it's time to start writing another president's message for the *Concrete Repair Bulletin*!

Almost all of the ICRI board members attended our WOC board of directors meeting and our remarkable annual WOC Kick-off party, this year held at the Nomad Bar at the Park MGM. Every year it is a reunion of friends, colleagues, and business partners with outstanding food and drinks. We were so grateful to have many of our board members help staff our ICRI booth at the WOC, helping us tell the ICRI story to attendees from all over the world. Our amazing full-time staff team and leader-volunteers did an amazing job showcasing ICRI and keeping attendees informed about who we are and what we provide the industry. We signed up dozens of new members and — thanks to Past President Brian MacNeil — we signed up our newest Supporting Member, ConJet.

I would like to thank all 42 of our Supporting Members for their financial commitment to ICRI and their support of our mission to "make the concrete built-world safer and last longer." In addition to all the benefits granted to Supporting Members, ICRI has added two new benefits, which include one complimentary registration to an ICRI convention each year and two complimentary registrations for the online portion of the Concrete Surface Repair Technician (CSRT) certification. Anyone in their company can use these.

As we look ahead, I'm excited to see familiar and new ICRI members in Austin for the Spring Convention, April 13 to 16, 2025. Our social events start Monday afternoon with a BBQ lunch buffet at Cooper's BBQ just up the street from the convention hotel including brisket, ribs, chicken, and all the trimmings. From there, it will be a short bus ride up to the Texas State Capitol Building for guided tours of this impressive 1888 building, where the workings of the Texas Legislature will be observable from the galleries in the House and Senate Chambers. The Tuesday evening event is planned for the Punch Bowl Social venue in downtown Austin. A build-your-own taco buffet and open bar will

get attendees primed for competitions in bowling, ping-pong, cornhole, foosball, darts, and loads of arcade games. From there, it is an easy stroll onto Austin's Sixth Street, where music venues abound!

A special note to our amazing chapter leaders: Make sure you get your event notifications to our staff for inclusion into our calendar and the CRB. I am trying to get out to all chapters I can this year — and it started already with the Florida West Coast Sporting Clays tournament I attended on January 30. Great event, great job, and great BBQ — with over 125 shooters! I may have even taken home a trophy. See you all soon!

Gerard Moulzolf
Gerard Moulzolf
President, International Concrete Repair Institute


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INTRODUCING OUR NEW COLUMN

MENTALHEALTHMATTERS

by SAFE Project


CAL BEYER, CWP

In recent years, the International Concrete Repair Institute (ICRI) has increased its advocacy for mental health in the workplace and at the jobsite. This mission is led by ICRI's 120 Environmental Health and Safety Committee which is dedicated to building a culture of safety in the concrete repair industry through training and education. Scott Greenhaus, retired executive from Structural Technologies (an ICRI Supporting Member) and current vice chair of the ICRI Committee 120 Environmental Health and Safety, has been one of the leading voices promoting the need to expand both physical safety and mental health in the industry.

2024 FALL CONVENTION ADDRESSES PHYSICAL SAFETY AND MENTAL HEALTH

At the 2024 ICRI Fall Convention in Denver, Greenhaus provided an overview of the ICRI 120 Environmental Health and Safety Committee's Total Worker Health Initiative. Greenhaus illustrated how ICRI has made major progress addressing physical health and wellness. He specifically referenced updates to the 120.1 *Guidelines and Recommendations for Safety in the Concrete Repair Industry*, in addition to the transition from hard hats to helmets initiative led by **Hard Hats to Helmets (H2H)** to reduce exposure to traumatic brain injury.[1,2] Finally, Greenhaus highlighted how ICRI has prioritized mental health and wellness by sharing resources on both suicide prevention and opioid use in the construction industry.[3]

Following his presentation, Greenhaus introduced a guest speaker to discuss human capital risk management and how mental health affects the construction industry. Cal Beyer is the Senior Director for SAFE Workplaces for national nonprofit SAFE Project. Beyer discussed how mental and behavioral health have an enormous impact on the human and financial resources of companies. Beyer described behavioral health as an underlying mental health condition combined with substance misuse or substance use disorder.

Beyer's presentation was well received by those attending, with many attendees surprised by the statistics that were shared. These data points underscored how high the construction industry ranks among other industries in mental health issues (anxiety and depression), heavy and binge drinking, substance use disorder (addiction), suicide, and overdoses. In most categories, construction and the mining industry are ranked either number one or two.

THE BIRTH OF A NEW COLUMN

ICRI is pleased to announce a new column that is being launched for 2025-2026. With the positive reception of the presentation, ICRI staff asked Beyer and SAFE Project to consider becoming a regular contributor to the *Concrete Repair Bulletin (CRB)* on the topic of mental health for the concrete repair industry. In addition, Greenhaus offered to assist by sharing concrete repair industry insights to Beyer and SAFE Project for a targeted message. This article is the debut of Mental Health Matters. In each issue, Beyer and the Marketing and Communications team at SAFE Project have agreed to develop brief text and a companion resource on various topics to educate owners, leaders, managers, and supervisors how to address mental health in their companies. An important part of this column is to make the content relatable to the families of ICRI member companies, too.

INTRODUCING SAFE PROJECT AND THE AUTHOR

Cal Beyer, CWP, is the Senior Director of SAFE Workplaces for national nonprofit SAFE Project. *SAFE* stands for *Stop the Addiction Fatality Epidemic.* SAFE Project works with veterans and caregivers, communities, campuses (college and K-12 schools), and workplaces to teach substance use prevention and addiction treatment and recovery.

Beyer has over 30 years of experience as a risk management and safety professional. He has been dedicated to construction and manufacturing since 1996. He has been an advocate for workplace mental health since the mid-1990s. He was an inaugural appointee to the National Action Alliance for Suicide Prevention Workplace Task Force in September 2010 when it was formed. He has served on its Executive Committee since 2016. Beyer helped launch the mental health and suicide prevention initiative in the U.S. construction industry in 2014 while working for a contractor in Washington state. *Engineering-News Record* named him a Top 25 Newsmaker in 2016 for identifying the need for suicide prevention awareness in the industry. Reach Beyer at cal@safeproject.us or via cell at 651-307-7883.

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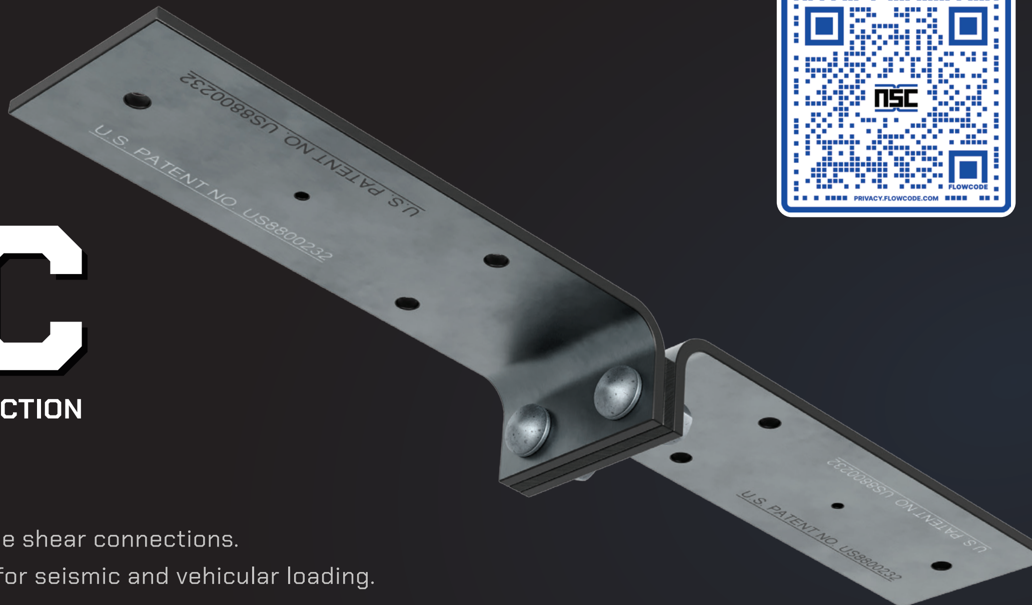

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A Very Brief History of Time: From Ancient Cementitious Materials to the Marvels of Modern Concrete

by Jeremy Begley

Concrete, the ubiquitous building material of modern civilization, has a history as rich and enduring as the many structures comprised of it. From ancient civilizations crafting rudimentary cementitious materials to today's high-performance concretes, the story of concrete is one of innovation, adaptability, and resilience. In this article, we take a journey through time to explore how this fundamental material evolved, the marvels it has created and its testament to human ingenuity, and the challenges we face today with aging concrete infrastructure and our roles within the repair industry to address these issues as well as concerns with sustainability. This article serves to illuminate both our past achievements and current responsibilities.

ANCIENT BEGINNINGS: THE DAWN OF CEMENTITIOUS MATERIALS

Concrete's origins extend far beyond Roman innovation, with rudimentary forms of mortar and cementitious materials dating back millennia. The Romans, often credited as the first concrete engineers, built upon the work of earlier civilizations. Sir Isaac Newton's words, "standing on the shoulders of giants," aptly describe this progression.

Evidence of early cementitious materials emerges around 10,000–9000 BC at Göbekli Tepe in modern-day Turkey, the world's oldest known religious site. Its lime-plastered floors resemble a precursor to modern terrazzo. By 6500 BC, builders in present-day Syria and Jordan used lime mortars derived from calcined limestone in fire pits, advancing construction methods for walls, floors, and waterproof cisterns critical to desert survival.

Egyptians further advanced cementitious materials around 2500 BC, employing gypsum-based mortars in pyramid construction. Their mastery of material properties laid the groundwork for future innovation.

The Greeks and Romans refined lime-based mortars by incorporating volcanic ash, or pozzolana, to create hydraulic cement capable of setting underwater. This innovation enabled Roman engineers to construct enduring architectural marvels such as the Pantheon and aqueducts. Their use of arches, domes, and advanced geometric designs, combined with the remarkable durability of Roman concrete, remains a testament to their ingenuity in both material technology and building geometric practices. The durability of Roman concrete is attributed to the formation of rare mineral phases within the matrix, a discovery that continues to influence modern research.[1,2,3,4]

Fig. 1: Brunelleschi's Dome in Florence, Italy (Duomo di Firenze) (Image courtesy of the author)

THE MEDIEVAL PERIOD: A PAUSE IN PROGRESS

Following the fall of the Roman Empire, advancements in concrete technology stagnated. Builders reverted to simpler mortars and stone construction methods, leading to a period of relative dormancy in cementitious material innovation.

Independently in China, incremental discoveries were taking place over the millennia. Even as progress stalled in the West during the Middle Ages, innovation was thriving in the East. Organic additives like sticky rice were used in later stages of the Great Wall's construction to enhance durability and flexibility, which subsequently improved seismic performance. This showcased China's unique advancements in cementitious material science.[3]

THE RENAISSANCE: A REVIVAL OF ROMAN TECHNIQUES AND PRACTICES

Progress in concrete resumed during the Renaissance, fueled by renewed interest and rediscovery of ancient engineering and mix design texts, like those of Vitruvius. Concrete was used mainly for projects where water-resistant properties were desired, but its use remained limited. Advances largely involved adapting Roman concepts of structural geometry, weight distribution, and using lime mortar, stone, and brick in construction (e.g., Brunelleschi's Dome pictured in Figure 1).

THE INDUSTRIAL REVOLUTION: THE BIRTH OF MODERN CEMENT

The 18th and 19th centuries saw significant concrete advancements driven by industrialization. In 1756, John Smeaton used hydraulic lime in the Eddystone Lighthouse, creating a durable binder for harsh marine environments. In 1824, Joseph Aspdin patented Portland cement, which revolutionized construction with its superior strength and versatility. Its improved production through kiln technology made it widely available and scalable, enabling the construction of skyscrapers, bridges, dams, and more. Portland cement became the cornerstone of modern concrete, shaping much of today's built environment.[4]

THE 20TH CENTURY: ERA OF CONCRETE ENGINEERING INNOVATION AND GROWTH

The 20th century witnessed unprecedented advancements in concrete technology and uses. Innovations such as reinforced concrete and eventually prestressed concrete and admixtures expanded the material's capabilities and applications.

Reinforced concrete, first developed in the mid-19th century by Joseph Monier, became widespread in the early 1900s. By embedding steel rebar within the concrete matrix, engineers achieved a material that combined the compressive strength of concrete with the tensile strength of steel.[5]

Prestressed concrete further enhanced the material's load-bearing capacity. By applying pre-tension or post-tension forces to the embedded steel tendons, engineers could counteract tensile stresses, enabling longer spans and more slender structures.

In the early 20th century, material was the primary cost driver. Plentiful skilled labor was less expensive. Innovations in reinforced concrete and arch design reduced material use, optimizing costs in bridges and dams. Engineers also carefully studied hydration heat issues for mass concrete design.

Fig. 2: Glen Canyon Dam, a concrete arch-gravity dam built in the 1960s on the Colorado River, impounds Lake Powell and provides flood control, irrigation, and hydroelectricity in the American West (image courtesy of the author)[2]

These advancements underpinned iconic U.S. projects like the interstate highway system, bridges, skyscrapers, and monumental dams, boosting the economy and contributing to its rise as a global superpower. These structures inspired similar feats worldwide, setting a new standard in construction (Fig. 2).

In time, chemical admixtures such as water reducers, accelerators, and air-entraining agents further refined concrete's performance, broadening its application and reliability.

THE PRESENT: AGING INFRASTRUCTURE

Today, concrete is the most widely used manmade material on Earth. It forms the backbone of our bridges, dams, buildings, and roads. However, much of this infrastructure is aging, presenting significant challenges for engineers and policymakers.

The American Society of Civil Engineers (ASCE) has raised alarms about the state of U.S. infrastructure through its report card. Established in 1998, the report assigns letter grades every four years, assessing their condition and performance. As indicated in Figure 3, the most recent cumulative grade in the 2021 Report Card, a C-, provides a sobering assessment of the state of U.S. infrastructure and highlights the urgency of addressing aging structures.[6]

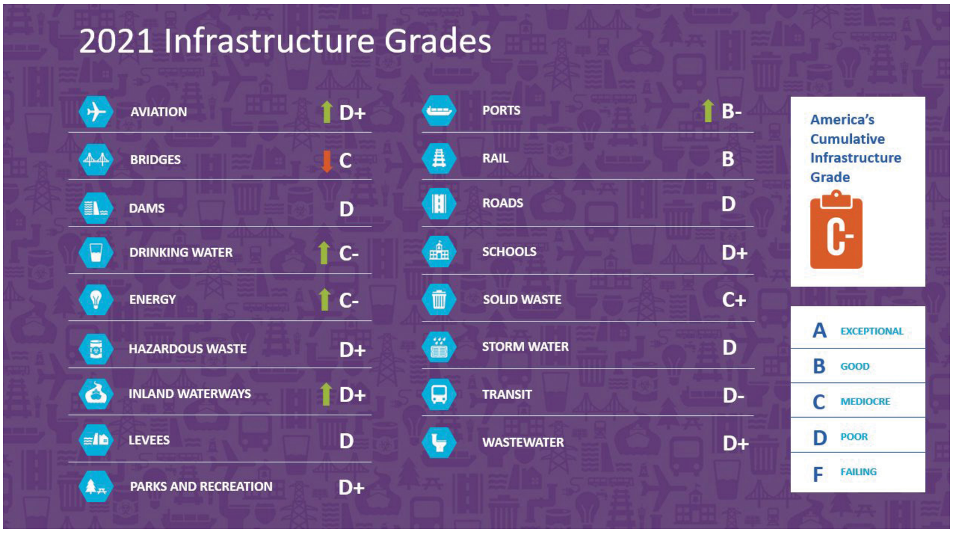

Fig. 3: 2021 ASCE Report Card[6]

Despite remarkable engineering feats of the past, time has taken its toll on these structures. Many were designed for shorter service lives than modern expectations demand, and they now face increased loads, environmental stresses, and evolving design standards.

The challenges are multifaceted. Key signs of structural distress include cracking, spalling, delamination, deformation, and yielding, often stemming from a combination of reasons such as:

- **Increased Loads:** Infrastructure today often endures demands far beyond its original design, such as heavier vehicles, greater traffic volumes, higher occupancy, or unanticipated loading at time of design. For example, the Francis Scott Key Bridge, built in 1977, was never designed to handle the impacts of massive modern cargo ships. Designing for such loads then would have been deemed excessively conservative and costly.

- **Evolving Standards:** Advances in engineering knowledge and stricter safety codes have led to more robust designs with higher capacity and redundancy. Improved material standardization, better understanding of vulnerabilities like steel reinforcement corrosion, and lessons learned from past failures. Additionally, a statistically based design approach helps provide more accuracy and reliability considering the probability of failure and uncertainties in loads and material strengths. However, older structures may require replacement, retrofitting, or downgrading design usage to meet modern standards and guidelines to ensure public safety.

- **Environmental Hazards:** Technological advancements have revealed greater risks from natural events like floods and earthquakes. Climate change compounds these risks through stronger storms, shifting precipitation patterns, and temperature fluctuations. Exposure to freeze-thaw cycles, pollution, and chemical environments can accelerate deterioration. Today, improved materials and admixtures help mitigate these risks for new structures, but many existing ones remain vulnerable.

- **Quality Control**: Poor construction practices can compromise long-term performance. Problems such as inadequate soil compaction, inconsistent water-cement ratios, improper curing, and subpar materials and aggregates can lead to settlement, cracks, voids, and corrosion. These issues weaken structural integrity and reduce service life.

- **Poor Maintenance**: Limited budgets often force agencies to defer repairs, accelerating deterioration and raising rehabilitation costs. Early detection through monitoring and maintenance programs can prevent catastrophic failures, such as the San Giorgio Bridge collapse in Italy, where deferred maintenance had fatal and costly consequences.[7] Any money that was saved not performing critical maintenance was trivial in respect to demolition, reconstruction, and the ensuing lawsuit. Proper funding is essential, but public safety must remain the top priority. Many fields are resorting to risk-informed decision-making to help prioritize repairs and allocate resources effectively, addressing the most critical deficiencies first.

COST EFFECTIVENESS OF REPAIR AND REHABILITATION

Repair and rehabilitation are often more economical than replacement, with potential savings of three to ten times the cost, not to mention faster and less disruptive to service (e.g., occupancy and business operation, vehicle traffic and/or toll generation, power generation).

Extending the service life of structures is a crucial consideration for every asset manager. A modest investment in a repair or series of repair interventions can result in significant cost savings and a better return on the overall investment in the structure's lifespan, as illustrated in Figure 4. Delaying interventions increases the likelihood of deterioration, leading to higher costs for repairs or full replacement, compounded by the effects of inflation.

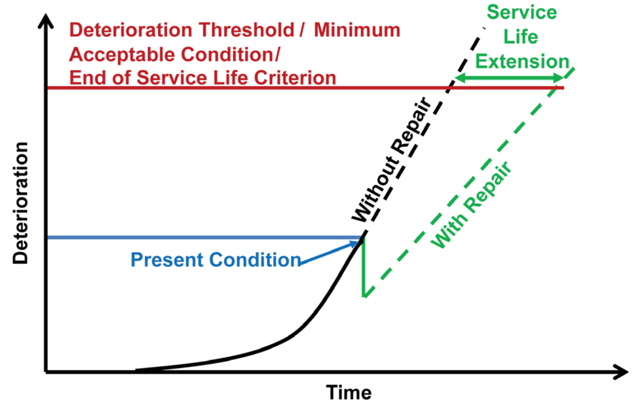

Fig. 4: A generalized, simplified extended service life cycle for structural rehabilitation

Note that the long-term program may involve a series of repair interventions to extend the service life. It is highly recommended to revisit the September/October 2024 CRB article, "Data-Driven Approaches for Optimizing Concrete Bridge Deck Preservation," which discusses the principles of a structural rehabilitation program in greater detail.[8]

For example, the 2017 rehabilitation of the Oroville Dam spillway after its failure due to design vulnerabilities and poor foundation conditions was significantly more costly than if deficiencies could have been identified sooner (see Fig. 5 and Fig. 6).[9]

Additionally, the recent incident at Lake Lure Dam underscores the importance of timely interventions. Although the dam had recently secured funding and was in the process of undergoing repairs to meet safety guidelines, Mother Nature threw a curve ball and did not work within the schedule constraints. Fortunately, the dam ultimately did not fail, but it led to sizable additional costs to repair the damage to the abutments and the destruction downstream.

INNOVATIONS AND SUSTAINABILITY

Concrete production contributes significantly to global carbon dioxide (CO_2) emissions, making sustainability a top priority. Portland cement is responsible for approximately 8% of worldwide CO_2 emissions due to the chemical process of calcination and the energy-intensive nature of cement production.[10]

Fig. 5: (above) Damage due to erosion near downstream section of Oroville Dam main spillway (image courtesy of MAPEI)

Fig. 6: (below) Aerial view of spillway anchoring repairs at Oroville Dam (image courtesy of MAPEI)

Innovative approaches, including the use of supplementary cementitious materials (SCMs) like pozzolans (e.g., fly ash, slag, rice husk ash, metakaolin) and limestone in Portland Limestone Cement (PLC) as well as alternative binders like geopolymer concrete, aim to reduce the environmental footprint. These innovations, coupled with efforts to incorporate recycled materials and reduce reliance on virgin sand, reflect the industry's commitment to sustainability. Self-healing concrete, graphene enhanced concrete, ultra-high-performance concrete (UHPC), as well as roller compacted concrete (RCC) and 3-D printing, represent the cutting edge of material science and placement techniques, promising greater durability and construction efficiency.

As mentioned earlier, repair and rehabilitation can lead to direct economic savings. It also contributes cultural value through historic preservation by maintaining the character and legacy of iconic structures. Additionally, these methods minimize material waste and environmental impact, conserving resources like additional cement and suitable sand and reducing landfill use. Organizations like the Center of Excellence for Preservation and Service Life Extension (P+Ex) are driving awareness and education to promote these practices, highlighting both the environmental and economic benefits of preservation (Fig. 7).

In the U.S. alone, over 400 million cubic yards of concrete are placed annually, which contribute an estimated 80 million tons of CO_2 to the atmosphere. With an inventory of 12 billion cubic yards of existing concrete, the environmental footprint is vast. Each additional day of service life translates to a reduction of approximately 6.6 million tons of CO_2. Extending the service life of existing concrete infrastructure can significantly reduce our carbon footprint and stands as one of the greenest initiatives we can promote.[11,12,13]

THE ROLE OF CONCRETE REPAIR PROFESSIONALS

Concrete repair professionals play a crucial role in addressing these challenges. Intervention in a structure's life can lead to service life extension and save considerable costs along the way, not to mention making a difference with climate initiatives. A range of repair techniques can be employed to address diverse issues and provide customized solutions to extend the service life of structures. These techniques can include surface and full-depth repair, structural rehabilitation and strengthening, crack injection, corrosion protection, waterproofing, and joint repair. Modern advanced materials, such as UHPC, fiber reinforced polymers (FRP), and specialized repair mortars, adhesives, sealers, grouts, and membranes, offer many possibilities for strengthening and preserving existing infrastructure (e.g., I-80 Verdi Bridge shown in Figures 8 through 10).

Fig. 7: P+Ex is a non-profit center of excellence organization focused on preserving and extending the service life of concrete structures. Website: pexcoe.org/

Figure 8: I-80 Verdi Bridge, Nevada, showing cut concrete and exposed rebar prior to repair mortar application (image courtesy of MAPEI).

Fig. 9: I-80 Verdi Bridge, Nevada, showing cementitious fiber-reinforced, fluid mortar for formed repair (image courtesy of MAPEI).

CONCLUSION: THE PATH FORWARD

Concrete has shaped human civilization, enabling extraordinary achievements from ancient times to modern marvels and innovations. As professionals in the International Concrete Repair Institute (ICRI), we are uniquely positioned to address our pressing infrastructure and environmental concerns. From designers and engineers to contractors and suppliers, we have the power to advocate for stronger prioritization of maintenance and policy reforms, ultimately improving the state of our infrastructure.

Organizations like ICRI and P+Ex are at the forefront of raising awareness, fostering education, and providing professionals with the tools needed to extend the service life of critical structures. It is our collective responsibility to spotlight the critical importance of concrete repair—not only for industry stakeholders but for the benefit of society and the planet. By emphasizing practical advantages like cost savings in addition to historic preservation and minimized environmental impacts, we can showcase the expanded value of this work. Through collaboration and innovation, we can honor concrete's enduring legacy while paving the way for a stronger, more sustainable future for generations to come.

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Fig. 10: I-80 Verdi Bridge, Nevada, return to normal operation and traffic (image courtesy of MAPEI)

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Jeremy Begley serves as the Business Development Leader for Hydropower and Dams Projects at MAPEI Corporation and is based out of the Denver Metropolitan Area. Previously, he was a Project Structural Engineer at Gannett Fleming in the Dams & Hydraulics group. With over 11 years of structural design and analysis experience, eight of those years were dedicated to the static and dynamic evaluation of concrete gravity and arch dams, as well as their appurtenant reinforced concrete hydraulic structures. In his role, Jeremy also supported the Safety and Security Group in assessing the structural vulnerability of critical hydropower assets against manmade threats, including explosives and sabotage. His prior experience spans residential, industrial process, and nuclear facilities.

Jeremy holds a Bachelor of Science in Civil Engineering from Colorado State University and a Master of Science in Structural Engineering from the University of Colorado Denver. His master’s thesis focused on performance-based testing and using field data to validate a dynamic numerical model of a concrete double-curvature arch dam. He is a licensed Professional Engineer in multiple states. He is an active member of several professional organizations, including the U.S. Society on Dams (USSD), the Association of State Dam Safety Officials (ASDSO), the American Concrete Institute (ACI), the International Concrete Repair Institute (ICRI), and the American Society of Civil Engineers (ASCE).

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Using Drone Imagery and Photogrammetry for Structural Health Monitoring

by Chakradhar Gondi, PE

Structural health monitoring (SHM) refers to the process of evaluating the condition of structures to detect damage, ensure safety, and extend service life. It involves the use of various technologies, such as nondestructive evaluation (NDE) methods, sensors, data analytics, and advanced imaging techniques, to monitor, assess, and analyze the performance of structures under operational or environmental loading. Advances in drone technology and photogrammetry have revolutionized SHM by offering detailed, efficient, and non-invasive solutions for assessing structural conditions. This article explores the application of drone imagery and photogrammetry in SHM, focusing on their methodologies, advantages, and applications using real-world case studies.

INTRODUCTION TO DRONE TECHNOLOGY AND PHOTOGRAMMETRY

Unmanned Aerial Systems (UAS), commonly known as drones, are increasingly utilized in structural assessments to obtain high-resolution aerial imagery and detailed orthomosaic maps. UAS allow inspectors to quickly access difficult-to-reach areas, minimizing human risk and reducing inspection times. By capturing hundreds of images that are later processed through photogrammetry, engineers can create 3-D models, measure dimensions, and identify structural vulnerabilities.

Photogrammetry involves processing overlapping photographs taken from different angles to recreate detailed visual and spatial representations. By processing images taken from different angles, photogrammetry software generates accurate 3-D reconstructions of objects and surfaces. In SHM, photogrammetry is used to monitor erosion, material degradation, displacement, and deformation over time. When combined with drone technology, photogrammetry provides comprehensive visual data for assessing infrastructure integrity.

METHODOLOGY

Here are the steps involved in implementing drone imagery and photogrammetry for structural health monitoring:

- **UAS Deployment:** High-resolution cameras or specialized sensors (e.g., infrared) are mounted on drones. Federal Aviation Administration (FAA)-certified pilots are required to operate drones, ensuring compliance with regulations and safe flight operations.[1] Flight paths are pre-programmed or manually controlled to capture overlapping images of the structure from various angles.

- **Photogrammetry Processing:** Collected images are processed using software to generate detailed 2-D maps and 3-D models. These models provide dimensional accuracy, enabling precise measurements of defects or structural features.

- **Data Fusion with Other NDE Tests[2]:** The photogrammetric images can also be combined with the results of other NDE techniques, such as Ground Penetrating Radar (GPR) and Impact Echo Scanning (IES).[3,4] GPR and IES techniques are useful for detecting internal reinforcement and thickness of concrete members. They can also be helpful in identifying voids, rebar corrosion, and evaluating the integrity of concrete members. Engineers can overlay the NDE test results on photogrammetric models, thus integrating the visual survey features with internal conditions of concrete members.

- **Analysis and Reporting:** Reports typically include visual documentation, 3-D models, and repair recommendations. Engineers analyze the results of UAS survey, photogrammetry, and other NDE tests to identify defects, assess risks, and develop recommendations for maintenance or repair.

Figure 1: (left) Google Earth (2/13/23) vs (right) UAS Orthomosaic (10/3/24) Sketch

APPLICATIONS IN STRUCTURAL HEALTH MONITORING

The following are some applications of drone imagery and photogrammetry in structural health monitoring:

- **Post-Disaster Assessments:** After natural disasters, drones are instrumental in quickly assessing structural damage across large areas. This application was evident in the aftermath of recent hurricanes like Ian, Helene, and Milton where drones provided vital information for emergency response and restoration planning.
- **Bridge Inspections:** High-resolution images allow engineers to detect cracks, spalling, and other surface issues. This can be combined with other NDE technologies like GPR and IES.
- **Tall Structures and Towers:** Drones enhance these inspections by providing detailed images of high elevations efficiently and safely, reducing the need for extensive equipment like cranes and minimizing risk to personnel.
- **Monitoring Aging Infrastructure:** Drones play a key role in monitoring aging structures and historic buildings by documenting changes over time. Photogrammetry offers a reliable baseline for comparison, enabling the detection of progressive deterioration.
- **Construction Quality Control:** During construction, drones can be used to verify alignment, dimensions, and other design parameters. Photogrammetry ensures accurate documentation of as-built conditions.

Some of the concepts discussed above were used in conducting post-storm emergency inspections for various infrastructure projects in Florida that were impacted by hurricanes Helene and Milton in 2024. Two of these case studies are included in the next sections.

CASE STUDY 1: POST-STORM ASSESSMENT OF A JETTY AFTER HURRICANE HELENE

The subject structure is a 600-foot-long jetty composed of riprap and located on the coast of Gulf of Mexico in Florida. The jetty experienced damage after hurricane Helene on September 26, 2024, including significant sand displacement and minor movements due to storm surges and high winds. A UAS survey was conducted on October 3, 2024, capturing 500 aerial images that were processed to create an orthomosaic map of the jetty. An orthomosaic image is a high-resolution aerial image taken by a UAS. When stitched together with specialized software using a process called orthorectification, these images can be used to create a highly detailed, distortion-free map and enhance the visibility of details. The orthorectification process removed perspective from each individual image to create consistency across the entire map. Figure 1 shows the comparison between the orthomosaic image created from UAS survey and the Google Earth image dated February 13, 2023.[5]

The UAS and orthomosaic study identified the following findings:

- Sand displacement of 2 to 3 feet was observed along the northern perimeter of the jetty.
- Minor movement of riprap was detected at the western edge of the jetty and seawall.
- Minor debris, including wood, plastic, and buoys, accumulated within the riprap.

To address the damage observed during the inspection, it was recommended to reestablish grading and replace sand removed during the hurricane. The installation of larger riprap along the western portion of the jetty was suggested to mitigate further erosion and potential displacement during future storms. It was also advised that the debris within the riprap be removed to prevent any long-term issues.

CASE STUDY 2: BRIDGE ASSESSMENTS AFTER HURRICANE HELENE

Following Hurricane Helene, inspections were conducted on multiple bridges in Florida to assess structural condition of the bridges. Inspections were performed using a combination of hands-on assessments and UAS surveys. A hands-on inspection was conducted above deck, while limited visual inspection above the waterline was performed using UAS. Drone imagery extended visual inspections to hard-to-reach areas, providing comprehensive data on structural conditions.

Figure 2 shows the sample inspection photos of the UAS survey of bridge 1. Bridge 1 showed spalling and exposed corroded reinforcement at one pier cap in end bay. Figures 3 and 4 show the sample inspection photos of the UAS survey of bridge 2. Bridge 2 exhibited shifted bearings and spalling on the abutments.

BENEFITS OF DRONE AND PHOTOGRAMMETRY APPLICATIONS IN SHM

- **Enhanced Safety:** Drone inspections eliminate the need for inspectors to access hazardous areas directly, reducing the risk of accidents.
- **Cost-Effective:** Drone surveys are faster and more economical compared to traditional manual inspections.
- **High Accuracy:** Photogrammetry provides detailed measurements and 3-D models, enabling precise identification of structural issues.
- **Time Efficiency:** Drone imagery reduces inspection durations, allowing for quicker identification of vulnerabilities and faster implementation of repairs.
- **Comprehensive Coverage:** Drones cover large areas in minimal time, ensuring complete and thorough assessments of expansive structures.

Figure 2: Bridge 1 Pier cap showing spalling and exposed corroded steel reinforcement

Figure 3: Bridge 2 North abutment shows bearings contracted ½" to the South

Figure 4: Bridge 2 South abutment, showing concrete spalling

CHALLENGES AND LIMITATIONS

While UAS technology offers significant advantages in structural health monitoring, it does not eliminate the need for hands-on inspections. The use of drones is not a replacement for human expertise, but rather an innovative tool in the inspector's toolbox. Due to the inherent limitations of drone-based visual investigation, UAS is best utilized as a complementary tool to strategically target areas for further manual inspection. Some of the limitations include:

- **Weather Dependency:** Adverse weather conditions can hinder drone operations.
- **Data Processing:** Large volumes of imagery require significant processing time and computational resources.
- **Skill Requirements:** Drone operation and photogrammetry analysis demand specialized training and expertise. An expert should accompany the UAS pilot during operations to direct the flight paths and identify specific areas of interest. Additionally, the data collected during a UAS survey requires interpretation by skilled professionals who can analyze the results and integrate them with other inspection techniques.
- **Regulatory Constraints:** Drone usage is subject to local regulations and flight restrictions, which may limit certain inspections.

FUTURE DIRECTIONS

As technology continues to evolve, the integration of AI and machine learning with drone photogrammetry is expected to further enhance SHM. Automated defect detection, predictive modeling, and real-time data analysis will streamline inspection processes and improve the accuracy of assessments. Additionally, advancements in drone design and imaging sensors will expand the capabilities of SHM, allowing for more detailed and expansive surveys.

CONCLUSION

Drone imagery and photogrammetry are transforming the landscape of structural health monitoring. The case studies of the marine jetty and bridges highlight the efficacy of these technologies in post-disaster assessments and routine inspections. By leveraging drone technology, engineers can conduct safer, faster, and more accurate evaluations, ultimately contributing to the longevity and resilience of critical infrastructure.

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Corrosion Assessment Fundamentals for Reinforced Concrete Structures

by Stephen Garrett, Zack Coleman, and Drew Witte

INTRODUCTION

For reinforced concrete structures, one of the most common and detrimental issues is corrosion of embedded reinforcement and associated deterioration. Fortunately, engineers and asset managers can employ corrosion assessment tools to better understand the current condition of a structure, estimate future performance, and monitor changes in condition with time. Detailed corrosion assessments with focused use of nondestructive testing (NDT) methods and material testing, coupled with service life modeling and life cycle cost analysis (LCCA), provide a holistic approach to preservation that can refine decision-making regarding maintenance, repair, and rehabilitation strategies.[1,2]

Effective use of corrosion assessment techniques can provide value in assessing a range of structure types including bridges, parking structures, building envelopes, marine structures, and buried or earth retaining elements. Like any tool, effective implementation of corrosion assessment techniques requires an understanding of functionality and limitations of the method and equipment. This article introduces some of the most common corrosion assessment methods and considerations for their implementation.

Reinforced Concrete Deterioration

Depending on the exposure environment, concrete structures can be subject to various physical and chemical deterioration mechanisms that can weaken, erode, or crack the concrete. Reinforcing steel embedded in concrete can also cause damage from corrosion. When reinforcing steel corrodes, the resulting corrosion products are less dense than the original metal and their formation generates expansive/tensile stresses in the encapsulating concrete. As corrosion progresses, tensile stresses overcome the tensile capacity of the concrete, resulting in cracking, delaminations, and spalling (Fig. 1).

Basics of Corrosion Chemistry in Reinforced Concrete

Corrosion is an electrochemical process requiring four conditions: moisture or an electrolyte for ionic connectivity; electrical connectivity; an anode; and a cathode. The latter two are electrically connected metal surfaces with differing electrochemical potentials, which in reinforced concrete can occur in the same rebar or between different rebar that are otherwise electrochemically connected (Fig. 2). At the anode, metallic iron oxidizes to produce positive iron ions and free electrons. The electrons travel through the metallic path to the cathode, where they are consumed through the conversion of oxygen to hydroxide ions. The negatively

Corrosion rate testing of reinforced concrete

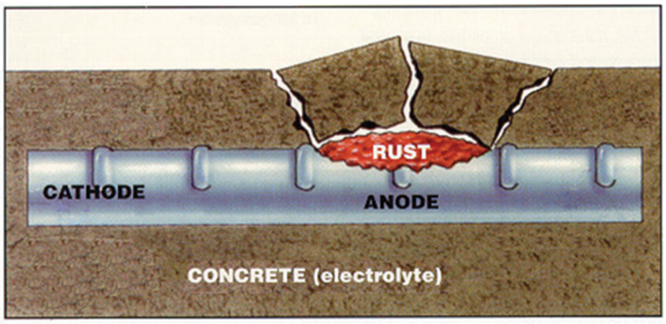

Fig. 1: Excerpt from ICRI 510.2 showing corrosion-induced cracking and spalling[3]

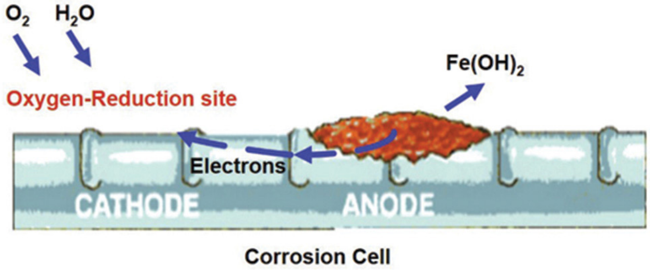

Fig. 2: Excerpt from ICRI 510.2 showing basic corrosion cell[3]

charged hydroxide ions travel through the electrolyte to the anode, where they combine with the iron ions to form the iron oxide corrosion products.

Conventional concrete has a naturally high pH (approximately 12 to 14). In this environment, the corrosion products formed from the carbon-steel corrosion process are stable, creating a "passive layer" and preventing further corrosion. However, this passive layer can be locally disrupted by chlorides or become unstable if the pH of the concrete environment is lowered below roughly 11.[4] Once steel depassivates, expansive iron oxide corrosion products form, leading to cracking and spalling (Fig. 3). A variety of methods are available to characterize the extent and rate of corrosion reactions.

VISUAL ASSESSMENT AND DELAMINATION SURVEYS

A wealth of information about the condition of a structure is obtained from visual assessment and delamination surveys. The types or patterns of surface staining, cracking, and spalling in concrete elements can inform the causes of potential distress.

Acoustic sounding methods can be used to detect delamination by identifying an audible change (dull or hollow sound) of the concrete from impacts; ASTM D4580, *Standard Practice for Measuring Delamination in Concrete Bridge Decks by Sounding*, provides guidance for conducting such surveys.[5] Other forms of delamination surveys may also prove feasible, including infrared thermography techniques and ground-penetrating radar; additional discussion on these methods can be found in ICRI 210.4 *Guide for Nondestructive Evaluation Methods for Condition Assessment, Repair, and Performance Monitoring of Concrete Structures*.[6]

NONDESTRUCTIVE EVALUATION—CORROSION SURVEYS

Electrochemical NDT methods can be used to evaluate the corrosion condition beyond what can be determined from visual and delamination assessments alone. The techniques are used to survey the activity, risk, and rate of corrosion in a concrete structure. Guidance on selecting and executing these methods can be found in technical documents prepared by ICRI Committee 210, ACI Committee 228, and AMPP Committee SC-12.[6,7,8] Measurements from each method should be evaluated in relation to the assessed structure to understand the effects of exposure conditions and existing distress. Several test methods are discussed in detail below.

Important considerations for conducting and interpreting corrosion results are temperature and humidity conditions. Ambient and surface temperature should be measured during testing, and the NDT methods should be employed when temperatures are above freezing. Furthermore, an understanding of seasonal changes in temperature and humidity is necessary for understanding changes in likely corrosion rates.

Fig. 3a: Example of corrosion in reinforced concrete; corrosion and spalling near drain

Fig. 3b: Corroded, embedded rebar with adjacent corrosion-induced cracking

Fig. 4: Rebar continuity verification

Fig. 5a: Half-cell survey method — rolling half-cell survey of bridge deck

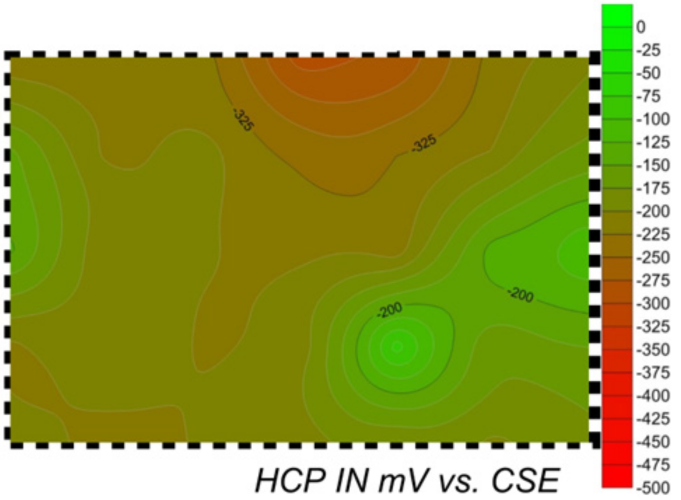

Fig. 5b: Example of contour plot showing voltage gradients and corrosion hotspots

Considerations for Reinforcement Continuity

For the purposes of NDT, drill points are made to the rebar for grounding the equipment and for evaluating connectivity between test regions by measuring direct-current voltage and resistance (Fig. 4). Epoxy coatings can reduce connectivity which, in addition to the barrier protection, improve the corrosion resistance by electrically isolating the rebar. Alternating-current (AC) resistance has also been used in epoxy-coated reinforcement to evaluate global connectivity as a means to infer degree of electrical isolation.[9] Reinforcement continuity is also an important consideration for developing corrosion mitigation strategies (e.g., cathodic protection system design).

Corrosion Potential

The objective of half-cell corrosion potential (HCP) testing is to identify anodic and cathodic regions in the structure. HCP testing (Fig. 5) is standardized for reinforced concrete structures in ASTM C876.[10] A reference electrode comprises one "half-cell" which is placed in contact with the surface of the reinforced concrete; the anode or cathode is the other "half-cell." The potential of the structure is measured relative to the reference electrode using a voltmeter. HCP testing requires direct electrical connection to the reinforcement.

More negative (i.e., more anodic) potentials are generally associated with active corrosion while more positive (i.e., more cathodic) potentials are typically indicative of passive metals. Several methods for interpreting HCP data are summarized below.

- **Numeric Magnitude Technique.** This method entails using absolute thresholds given in ASTM C876 (-200 and -350 mV) to classify corrosion as active, passive, or uncertain. As noted in ASTM C876, these thresholds are only applicable for certain exposure conditions and structure types, such as atmospherically exposed structures with uncoated reinforcement. These thresholds are not applicable to submerged or earth-retaining structures, or structures reinforced with coated or alloyed reinforcing steel. While these ranges may be reasonable rules of thumb, they should not be used as the only interpretation criteria, since they can provide less-than-useful or false predictions of corrosion state.[11,12]

- **Potential Difference Technique.** This technique involves identifying large spatial gradients in potential difference, which are typically indicative of localized corrosion.[10] One rule of thumb is that a change of -100 mV over one foot is indicative of corrosion, but actual conditions will likely vary for each structure, and verification of findings should be performed using other NDT methods and destructive verification.

- **Statistical Analysis.** This method entails identifying different statistical distributions of data within a full HCP dataset. Active and passive reinforcement tend to exhibit different statistical distributions; therefore, this method can be used to select a potential threshold for identifying active corrosion.[12] This threshold is tailored to the concrete component from which the data was collected, making it a more versatile method for interpreting HCP data than the Numeric Magnitude Technique, if a sufficiently large sample size can be collected.

Fig. 6: Corrosion rate measurements

Instantaneous Corrosion Rate

Measuring the instantaneous corrosion rate allows practitioners to estimate the rate of reinforcement loss. A variety of different approaches exist that correlate in-situ electrical properties to corrosion rate. Such methods commonly utilize a ground connection, a working electrode, and a reference electrode (Fig. 6). The working electrode applies a known electrical current to the concrete, and the reference electrode measures the resulting change in voltage of the reinforcement. The current and voltage are used to calculate corrosion rate. As noted by ACI Committee 228, the measured corrosion rate can vary depending on the equipment and approach employed to measure corrosion rate (e.g., potentiostatic polarization resistance or galvanostatic pulse testing).[7] Therefore, there are no standard interpretation criteria applicable for all corrosion-rate tests.

Corrosion rate measurements are not only affected by the state of the underlying reinforcement, but also temperature and environmental conditions when the test is performed. Accordingly, prior to instantaneous corrosion rate testing, HCP measurements are typically collected first to understand where reinforcement is actively corroding. It is also important to note that the measurement is referred to as “instantaneous” corrosion rate because it is the measurable rate at the specific time of testing, and the true rate will fluctuate with seasonal in temperature and humidity. Therefore, care should be taken in interpreting corrosion rate measurements.

Fig. 7: Surface resistivity measurements

Electrical Surface Resistivity

Electrical resistivity is a measure of the capacity of a material to resist the flow of electrical current. In concrete structures, resistivity is empirically correlated with risk of corrosion. The corrosion current utilizes the ionic path through the concrete pore solution, and lower resistivity environments will be more conducive to promoting corrosion reactions. Among other factors, the composition of the pore solution and tortuosity of the pore network affect concrete resistivity. If corrosion is occurring (as identified through the methods described above), surface resistivity measurements can offer insight into the relative rate of corrosion at different locations in the structure.[7]

There is presently no ASTM standard for field measurements of surface resistivity. AASHTO T 358 and RILEM TC 154-EMC provide guidance for interpreting surface resistivity measurements of laboratory and field data, respectively.[13,14] The four-point Wenner test, shown in Fig. 7, is typically used in the field to measure the surface resistivity in the near surface of the concrete concrete, at a depth corresponding to roughly twice the spacing of the resistivity probes.

Fig. 8a: Carbonation Field Test—spray-applied pH indicator (phenolphthalein) at drill holes of incremental depths

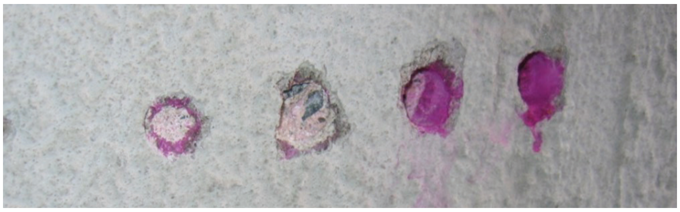

Fig. 8b: Carbonation Field Test—spray-applied pH indicator (phenolphthalein) at drill holes of incremental depths

VERIFICATION OF NDT RESULTS AND MATERIAL TESTING

While this article focuses primarily on corrosion NDT methods, some discussion on material sampling and testing is prudent. Detailed corrosion evaluations commonly include inspection openings; core sampling; corrosion product sampling; carbonation evaluation; and chloride-concentration testing.

Inspection Openings and Core Sampling

For calibration/verification purposes, it is best practice to perform some level of destructive verification for any NDT method. Inspection openings (at cores or other locations) can aid in verification of electrochemical NDT by verifying active corrosion and related delamination (Fig. 3b), measuring section loss, and sampling corrosion products for more detailed analyses. Core samples can be used for further evaluation to identify possible corrosion mechanisms.

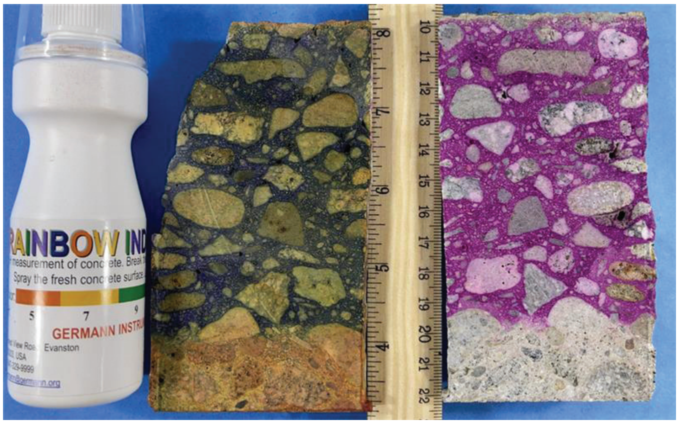

Fig. 9a: Carbonation—core treated with both phenolphthalein and rainbow indicator to show pH range through carbonation front

Fig. 9b: Carbonation—core treated with both phenolphthalein and rainbow indicator to show pH range through carbonation front

Carbonation Depth Evaluation

Carbonation causes depassivation of the steel by lowering the pH of the concrete, and this phenomenon can be measured. At drilled holes and cores, a pH indicator (phenolphthalein) can be applied to estimate the approximate carbonation front; the color change to pink occurs above a pH of 9 (Fig. 8). In reality, pH change in concrete is a continuum, and more accurate measurements can be taken on freshly fractured laboratory samples, using a variable color pH indicator (i.e., "rainbow indicator") (Fig. 9).

Chloride Concentration Evaluation

Chloride ions can accumulate and depassivate reinforcement, and while a "lower bound" concentration value (0.2 percent by weight cement) is often cited as the threshold for corrosion initiation, probabilistic distributions provide a more realistic characterization of the risk of chloride-induced corrosion.[5] The total amount of free chlorides (i.e., unbound) can be measured through laboratory testing of water-soluble chloride concentrations.[16] However, often it is more convenient to analyze the total chlorides present in a sample, including both bound and unbound chlorides, through acid-soluble testing.[17] An example of a chloride titrations setup is shown in Fig. 10.

Fig. 10: Titration of powder sample for chloride concentration evaluation

Chloride concentration evaluation is a complex topic, and in general a variety of factors need to be considered when developing test plans, including but, not limited to: depth of chloride ingress; magnitude and source of chloride exposure; aggregate size as related to core diameter and slice depth required; effect of constituents such as latex or polymers; and original contamination (i.e., "background chlorides") from admixtures or contaminated mix constituents (e.g., aggregates).

Powder samples obtained through field-drilling into the structure at incremental depths can provide a cursory screening of bulk chloride concentration. However, for more advanced analyses, core samples should be extracted, and chlorides should be measured at discrete locations through the cover concrete. Core sampling and slicing allow for greater precision in testing and interpretation of concentration profiles. Typically, core samples are sliced at important depths through the cover concrete and above the reinforcement (Fig.11, Fig. 12). Deeper slices in the concrete or substrate, away from exposure, can also be tested to identify if there is "background" or initial exposure.

Fig. 11: Core sample prepared for chloride testing

OPPORTUNITIES AND CHALLENGES

As noted by the Association for Materials Protection and Performance (AMPP), there is no one protocol for performing a corrosion assessment, due to the wide range of reinforced concrete structures.[8] Rather than using any one NDT method in isolation, corrosion assessments are most effective when they are tailored to a specific structure and when data from multiple NDT methods are leveraged. Frequently, an effective corrosion assessment requires adapting the work to the findings and conditions as they are revealed.

NDT methods for corrosion evaluation are founded on fundamental scientific principles of the electrochemical corrosion process. When properly deployed, these methods provide a wealth of information about the complex corrosion mechanisms present in reinforced concrete structures. However, to appropriately interpret the results, a thorough understanding of the corrosion process is necessary. Furthermore, as with any NDT method, verification through inspection openings and coring should be performed. The core samples can then be used to further the investigation through material testing by determining the depth of carbonation front and chloride concentration profiles.

The methods of corrosion evaluation described in this paper are specific to characterizing corrosion of embedded reinforcement. Such assessment may be only a part of a broader assessment, including evaluation of other deterioration mechanisms. The data should not be used in isolation of other findings or analyses. The implications of section loss and loss of concrete cover could have broader structural implications that may warrant actions beyond only local repairs. Corrosion evaluations contribute to a health-check of a structure, serving as a baseline for comparing actual to expected performance, and the resulting data can be used for service-life modeling and developing comprehensive structural assessment and rehabilitation programs.

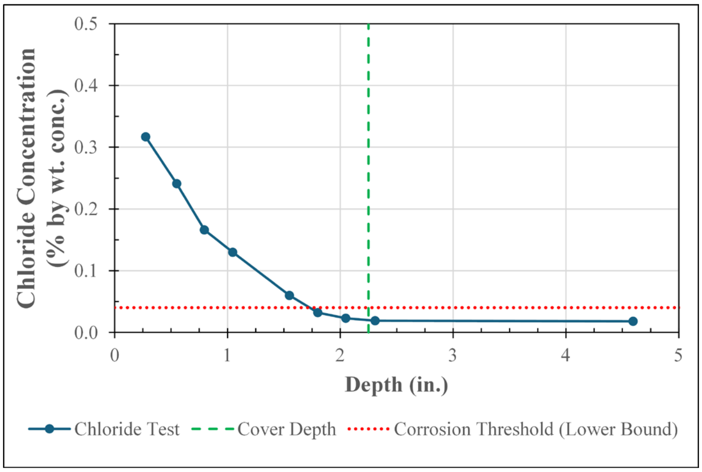

Fig. 12: Example chloride profile showing chloride ingress and negligible background contamination; depth measured from topside/exposed surface of structure. Note: corrosion threshold shown was converted to percent by weight of concrete

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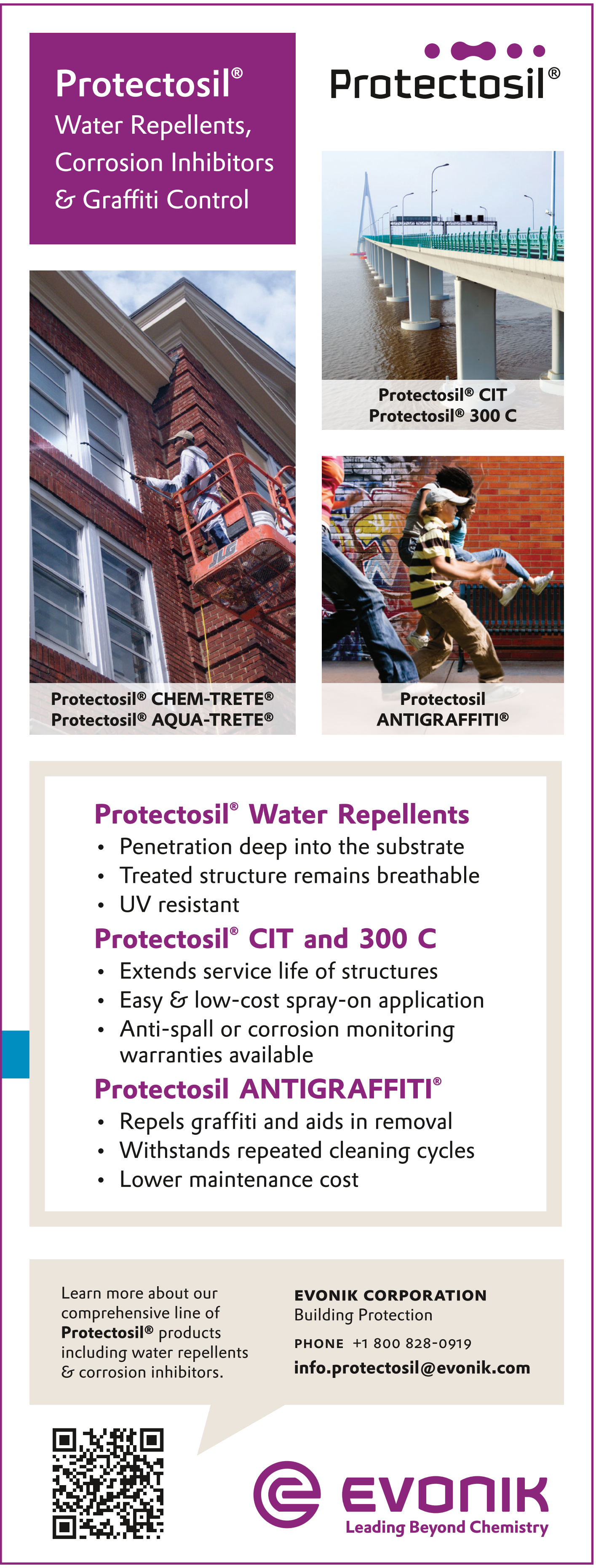

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RAPID SETTING REPAIR MORTAR FOR SLOPED GRADES

This is a fast setting, one component, cementitious, repair mortar that is shrinkage compensated, pozzolan and microfiber modified, and contains an integral corrosion inhibitor. It is designed for horizontal and formed vertical and overhead structural repairs, and is uniquely formulated for use on sloped grades.

EUCLID CHEMICAL

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www.euclidchemical.com

Get Involved with ICRI

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/volunteer-job-board/ for more information.

WOMEN IN ICRI

SPOTLIGHT— Kim Deibel

by Michelle Nobel, Women in ICRI Committee Member

KIM DEIBEL

Kim Deibel is a Senior Manager and Senior Engineer at Braun Intertec Corporation in Minneapolis, Minnesota; she is an active member of the Minnesota Chapter and is currently an At-Large Board Member. Kim has held various leadership roles within the chapter, including vice president, president, and past president and has served on both the Membership Committee and Education Committee throughout her 13 years of involvement with ICRI.

At the national level, Kim has recently begun participating in the WICRI group and Committee 210 - Evaluation. She has attended multiple national conventions and plans to become more involved in her professional activities starting in 2025.

Kim attended Michigan Technological University (MTU) in Houghton, Michigan, where she graduated in 2002 with a degree in civil engineering. Throughout her studies, she particularly enjoyed her structural engineering classes and concentrated on that area. From a young age, Kim had a passion for math and science, often taking apart her toys, building roads for her toy cars, and constructing designs with Legos. While her experiences with Legos may be common, they genuinely reflect her curiosity about how things work and are built. Knowing she wanted to pursue a career in a STEM field, she chose to attend an engineering school, which ultimately led her to specialize in civil engineering.

Kim began her career as a structural engineer at a curtain wall subcontractor, where she designed curtain wall systems and worked on high-rise buildings in the field. She noted, "Most people don't think of windows needing to be engineered, but when winds reach over 120 mph, you hope that an engineer designed them." Most of her projects were located in downtown Chicago, where she contributed to buildings that transformed the skyline.

Upon entering the consulting world, she quickly realized that concrete assessment and repair were essential. This type of work intrigued her the most. When she first started, her manager John Amundson, and her colleague Terry Babcock, who were both heavily involved in ICRI, encouraged her to get involved with the ICRI Minnesota Chapter. As they say, the rest is history!

Kim's husband Patrick is an electrical engineer who she met in college. They have two daughters, Kate, age 11, and Sophie, age 9, along with a black Labrador named Ruby. The girls take dance classes, which keeps the entire family busy. Kim danced for many years during her youth, and watching her daughters perform on stage truly melts her heart. As a family, they enjoy hiking together. Additionally, Kim loves to read and work out in her home gym in the basement whenever she can find the time.

I am excited to welcome Kim to our incredible organization and the Women in ICRI Committee. It is inspiring to see ICRI attract such a remarkable individual who will help lead both the organization and the WICRI committee into the future. I believe Kim will make many friends here and will contribute significantly to both ICRI and the Women in ICRI Committee.

WOMEN IN ICRI IS COMPRISED OF WOMEN AND MEN WORKING TO FOSTER GREATER INCLUSION OF WOMEN THROUGHOUT THE CONCRETE CONSTRUCTION INDUSTRY THROUGH NETWORKING EVENTS, INDUSTRY OUTREACH, AND MENTORING.

ICRI
CONCRETE REPAIR
Restore | Repurpose | Renew

Project Awards

Recognizing Outstanding Concrete Repair, Restoration, and Preservation Projects

ICRI conducts an annual awards program to honor and recognize outstanding projects in the concrete repair industry. Entries are received from around the world, and the winning projects are honored each year at the annual ICRI Awards Luncheon at the ICRI Fall Convention.

ALL PROJECTS MUST BE SUBMITTED BY JULY 1, 2025

Receive a $50 early bird discount if you submit by May 30!

START PREPARING NOW ▸

The submission form is extensive and will take some time. You will need the following:

- Current ICRI Company Membership
- Owner Permission Letter
- Brief Project Abstract
- Detailed Project Presentation
- Pictures
- Payment

JUDGING CRITERIA ▸

Entries will be judged on uniqueness, use of state-of-the-art methods, use of materials, functionality, value engineering, and aesthetics. A panel of judges, selected by the ICRI Awards Committee, will review every entry, so make it as interesting as you can in 2,000 words.

Scan the QR code to learn more about the ICRI Project and Safety Awards

www.icri.org/awards

CERTIFICATIONUPDATE

CSMT PROGRAM AT WORLD OF CONCRETE 2025

The ICRI Concrete Slab Moisture Testing (CSMT) Program had another successful program in January 2025, as ICRI participated in the World of Concrete at the Las Vegas Convention Center from January 20 through January 23, 2025.

ICRI hosted 25 people at World of Concrete—including four people who were re-certifications (after 5 years), one person performing their second recertifications (after 10 years), and three who joined the program for the education only. That left 17 individuals who went through the entire certification process, including a demonstration and workshop as well as performance exams at the back of the South Hall on Day 2. ICRI extends thanks to lead instructor Peter Craig and additional instructor Scott Tarr, who helped with the class and the performance exams. It was a fully engaged class; everyone passed both the written and performance exams. ICRI congratulates our World of Concrete Drilling Contest winners Derek Beerbower, Jeff Alexander, and Jeremiah Warzynski, who all did an excellent job of hitting closest to the 2-inch mark.

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

The winners of the drilling contest that accompanies the testing for ASTM F2170 during the CSMT program are (left to right) Jeremiah Warzynski (1st place), Derek Beerbower (3rd place), and Jeff Alexander (2nd place)

CHAPTERS COMMITTEE CHAIR'S LETTER

DAVID GRANDBOIS
Chapters Chair

CAN YOU BELIEVE THAT IT IS 2025?! WHERE HAS THE TIME GONE?

I want to take this moment to thank all of you for your continued support to ICRI national and your local chapters. Our goal for this year is to continue to grow the membership and provide support to all members, existing and new. If we all take a moment to reach out to three individuals within our network who are currently not members of ICRI and invite them to an event (or even consider joining), we can help with this growth goal.

With this growth goal, we can all reflect on the common goal that we share: to provide the best possible experience to members and non-members alike. I challenge us to continue to make a conscious effort to implement the guidelines listed in the Chapter President's Guide.

- Check the monthly roster and update contacts, welcome new members, and check on and follow up with renewals.
- Complete event checklists and provide event information to ICRI Headquarters to be shared on the website.
- Email chapter news items to ICRI National so the newest information is shared.
- Update the calendar of events to have the most current information and share this information with ICRI National.
- Update the chapter website and webpage so that all information about events and the chapter is current.
- Promote chapter events, national events, and ICRI certifications.
- Thanks for your continued support on these items.

I cannot wait to see you all at the Spring Convention, April 13-16, 2025, at the Austin Marriott Downtown in Austin, Texas. The theme is "Keep Concrete Weird: Unusual Projects."

With this in mind, we have another item to celebrate—Dale's 20th Anniversary! I hope you can all make the trip to help us celebrate. Last, please remember to share ALL your chapter events and schedules with us so that we can humbly brag about what you have going on. With this, you will also want to update your website so that these events are reflected clearly and correctly.

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

***"AS SOMEONE RELATIVELY NEW TO THE CONCRETE RESTORATION INDUSTRY,** one of the very first things I did after starting my new job was join my local ICRI chapter. It immediately gave me access to best-in-class training.."*

- JEFF KONKLE, MAK CONSTRUCTION PRODUCTS GROUP

www.icri.org/chapters

ICRI**CHAPTER**NEWS

CENTRAL OHIO GOLF OUTING

The ICRI Central Ohio Annual Golf Outing was a tremendous success, bringing together industry professionals for a day of networking, friendly competition, and great weather on the course. With a fantastic turnout, participants enjoyed a well-organized event, engaging conversations, and a few impressive shots along the way. The chapter leadership thanks all the sponsors and attendees; as a group, they were able to strengthen connections within the industry while supporting future initiatives. The Chapter looks forward to an even bigger event next year!

A day on the golf course does wonders for networking and connections

MINNESOTA MEGA DEMO 2025

The Minnesota Chapter of ICRI hosted their annual Mega Demo on Friday, January 10, 2025. The topic was Corrosion; there were five presentations along with two hands-on demonstrations. The first presentation was a study conducted by Mark Chauvin from WJE in conjunction with Paul Pilarski from MnDOT. As part of Mark's Master's degree program, he studied three different corrosion mitigation strategies on the structural members of a busy bridge in Minneapolis. The second presentation was given by Nick Drews with Vector, reviewing galvanic anodes and cathodic protection. Nick also demonstrated how to measure corrosion potential. The third presentation was given by Andrew Jones and Atri Rungta from Evonik. They discussed the causes and prevention strategies to minimize corrosion in reinforced concrete.

We were very fortunate to have Bijan Mahbaz from InspecTerra in attendance to explain and demo his iCAMM technology, which can detect corrosion in concrete. Last, Charlie Sault from No Corrosion LLC provided an overview of the Dockside Condominiums project and the strategies employed to extend the service life of the building using a combination of advanced cathodic protection. Five Professional Development credits were provided to attendees. The Lifetime Achievement award was given to Jessi Meyer, FICRI, for her continuous commitment to the Minnesota chapter. The Cement Masons, Plasterers & Shophands Local 633 Training Center graciously provided their space for us to host the day. Eighty people attended.

ICRI CONCRETE REPAIR CHAPTERS

ICRI has 38 chapters, including two student chapters, in metropolitan areas around the world. Chapters hold technical presentations, educational meetings, symposia, and local conventions on repair-related topics.

CHAPTER CALENDAR

ICRI Chapters are hosting events in 2025. Be sure to check with individual chapters by visiting their chapter pages to determine if they have made any plans after this publication went to print. You can also contact a Chapter Leader from any chapter to ask if they have added an event.

BALTIMORE-WASHINGTON
March 20, 2025
MARCH MADNESS WATCH PARTY
The Greene Turtle Sports Bar and Grill
Columbia, MD

CAROLINAS
May 15 & 16, 2025
CHAPTER SPRING CONFERENCE
Hotel Indigo
Mount Pleasant, SC

CHICAGO
March 20, 2025
MARCH MADNESS EVENT
Smoke Daddy BBQ – Wrigleyville
Chicago, IL

FLORIDA WEST COAST
April 25, 2025
CHAPTER DEMO DAY
Topic: Building Resilience through Restoration
St. Pete College
Clearwater, FL

MINNESOTA
March 20, 2025
ANNUAL FUNSPIEL
Saint Paul Curling Club
Saint Paul, MN

NORTH TEXAS
May 9, 2025
SPORTING CLAY CLASSIC
Elm Fork Shooting Sports
Dallas, TX

VIRGINIA
March 27, 2025
SPRING CHAPTER SYMPOSIUM
Colonial Heritage Golf Club
Williamsburg, VA

PRODUCTINNOVATION

BOOSTING CONCRETE DURABILITY: THE ROLE OF SERVICE LIFE PREDICTION MODELS AND MCI®

Concrete, one of the world's most widely used materials of construction, has an undying enemy: Corrosion. If left unchecked, corrosion expands reinforcing metals, leading to cracking, spalling, and gradual deterioration of the structure. Because concrete structures are so costly and energy-intensive to build, it is hard to overemphasize the importance of making them last as long as possible for financial and environmental reasons. With this in mind, Ashraf Hasania (Cortec®MCI® Technical Sales & Product Manager) recently shared the importance of service life prediction models and Migrating Corrosion Inhibitors (MCI®) in helping engineers achieve a structure's desired lifespan.

For more information, visit our website at www.cortecmci.com.

PEOPLEON**THE**MOVE

CORTEC® WELCOMES CONCRETE RESTORATION EXPERT TO MCI® TEAM

We are thrilled to introduce James Masterfield as our new MCI® Regional Sales Representative – Central US. James joined the team in October 2024 to fill the crucial role of MCI® support for Midwestern US clients from Chicago to Denver. As a board member for the ICRI Chicago Chapter with extensive historic restoration experience, James comes highly qualified, enthusiastic about Migrating Corrosion Inhibitor™ (MCI®) technology, and eager to build a stronger concrete industry overall.

REBECCA GUZA POISED TO PROPEL CORTEC® TO NEW HEIGHTS OF INNOVATION

Corrosion solutions provider, Cortec® Corporation, is pleased to announce the hire of Rebecca Guza, Ph.D., as Director of Innovation and Product Technologies. This new role will lead R&D, compliance, and technical services while fostering collaboration with other departments to drive cohesive innovation at Cortec®.

WANT TO SEE YOUR PRODUCT OR NEWS FEATURED IN THE *CRB*?
Send your content to editor@icri.org!

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

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