FEBRUARY 2018 V. 40 No. 2

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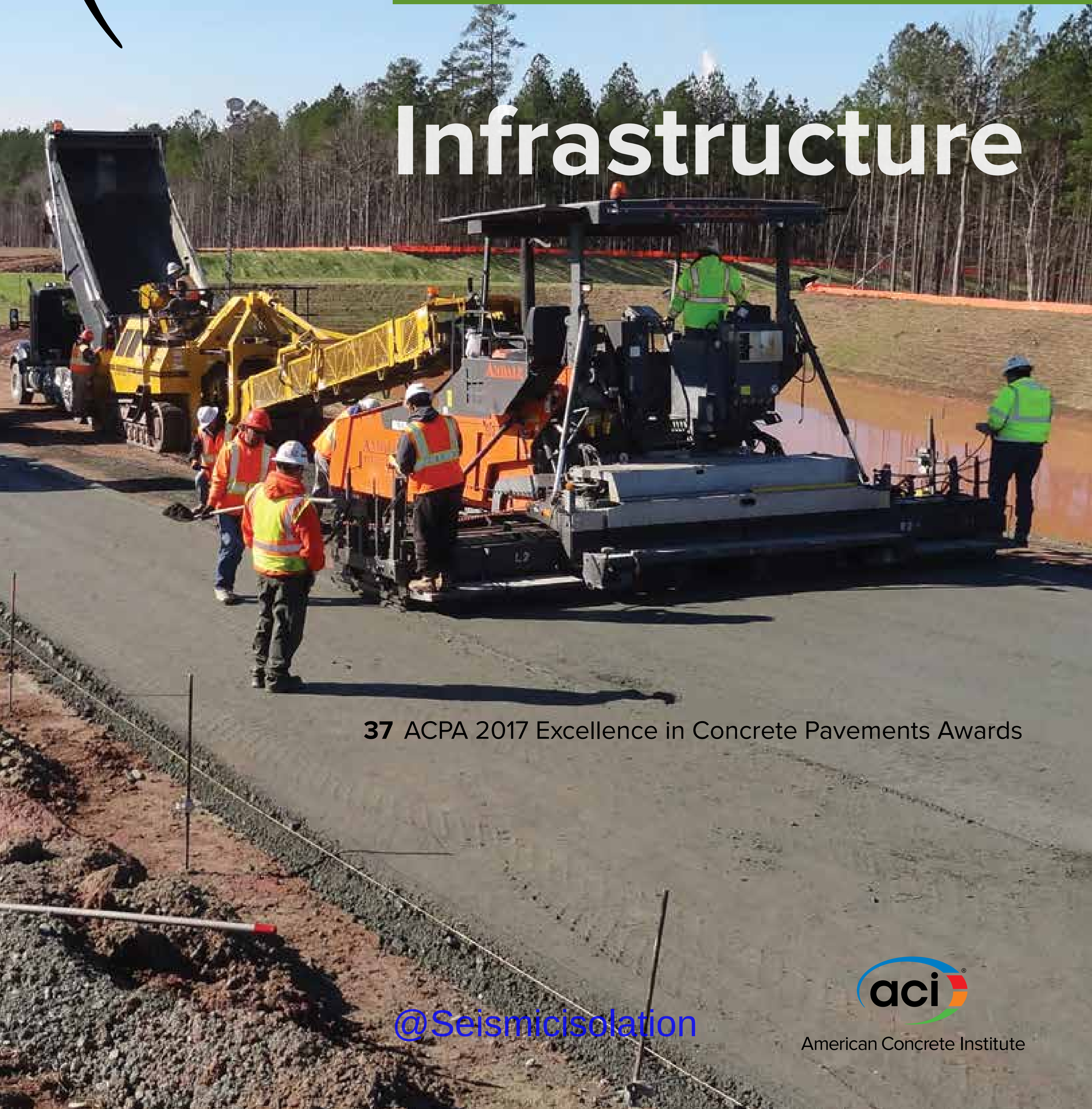
The Magazine of the Concrete Community



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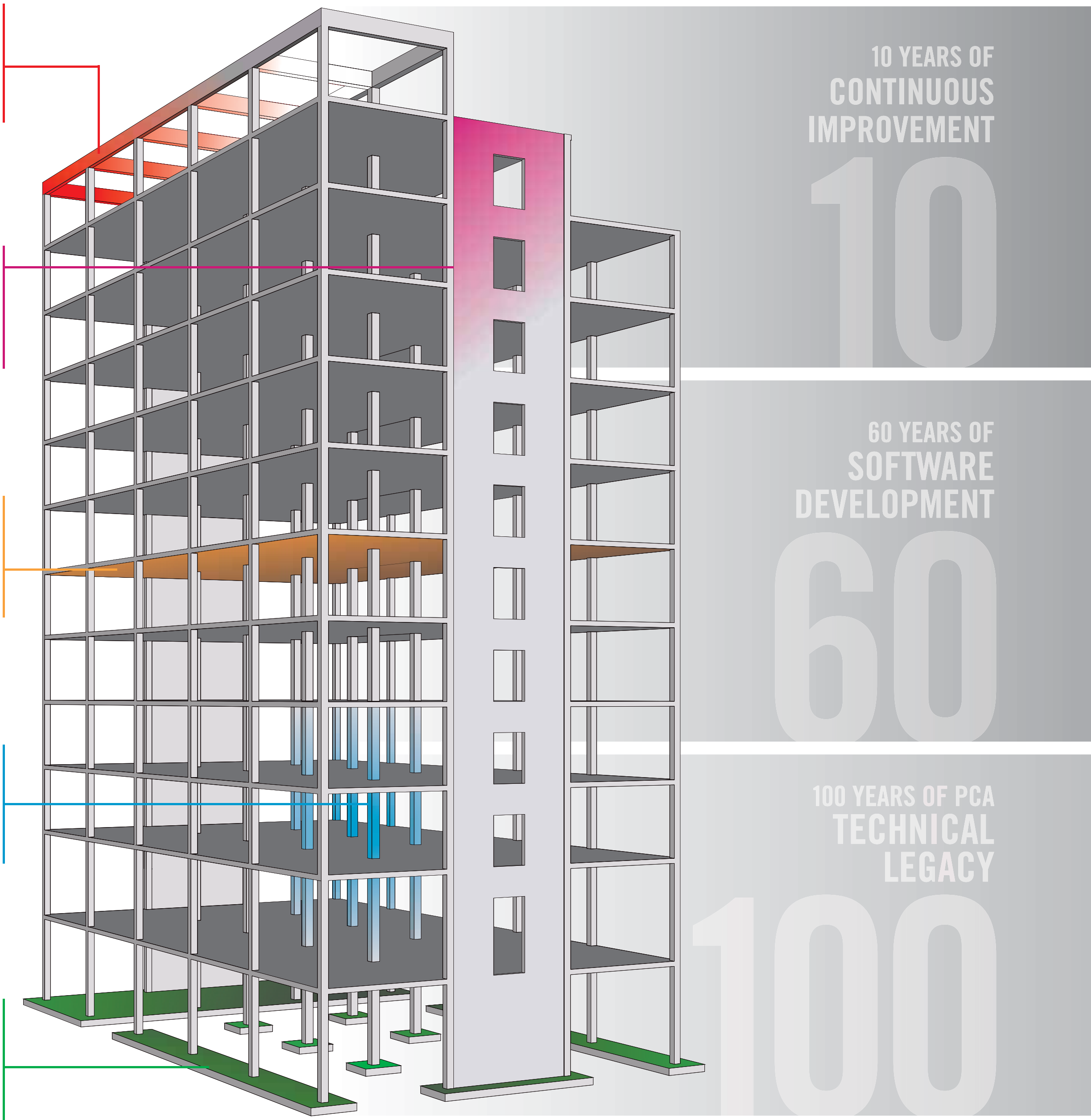

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Concrete Essentials Seminar Series

Presented by the American Concrete Institute

March 26-27, 2018, Dubai, UAE

Held during The Big 5 Heavy

The American Concrete Institute will host the Concrete Essentials Seminar Series at The Big 5 Heavy show in Dubai, UAE, March 26-27, 2018. The 2-day seminar series will give participants an in-depth look into topics including concrete durability, repair, self-consolidating concrete, and more. Additionally, the seminar series will feature a three-part course on the ACI Building Code Requirements for Structural Concrete which—under a recently signed agreement with the Gulf Cooperation Council Standardization Organization—will be used to develop a Gulf Building Code.

For more information on how to participate in the Concrete Essentials Seminar Series and The Big 5 Heavy, visit **www.thebig5heavy.com**.

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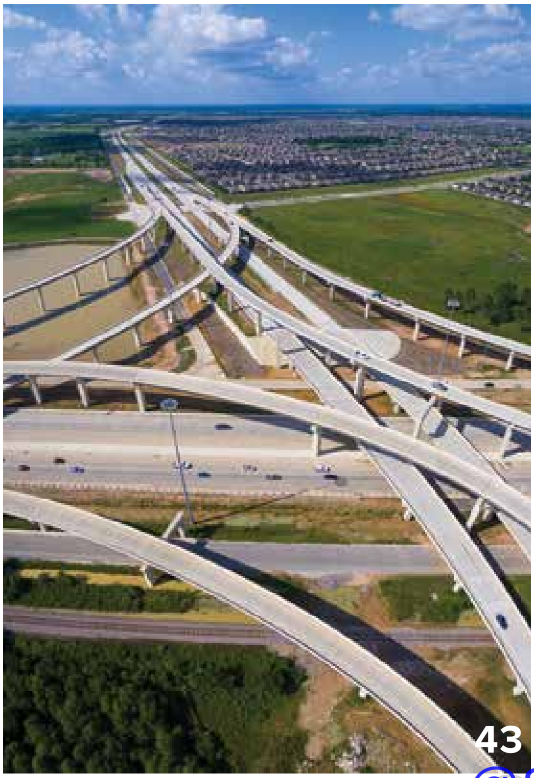
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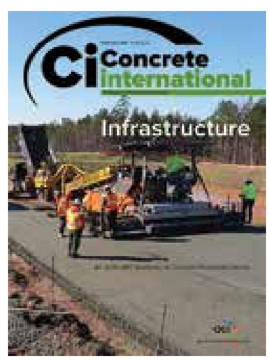

A haul road at the Brickhaven Ash Unloading Facility in Moncure, NC, required a 1 ft thick roller-compacted concrete pavement on a 1 ft thick cement-treated base. For more information on this and the other 2017 Excellence in Concrete Pavements award-winning projects from the American Concrete Pavement Association, see the article on p. 37.

departments

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IN **Ci**

Local Resources

Dams and pavements are the dominant applications for roller-compacted concrete (RCC), and both uses are discussed in this month's *CI*. In "RCC Dam Construction" (p. 31), authors Randall P. Bass and Gary Horninger provide a primer on the design and construction of RCC dams. They also highlight some recent dam projects—all amazing. In "ACPA 2017 Excellence in Concrete Pavements Awards" (p. 37), we read that a major retailer has adopted RCC pavement for its distribution centers. This is intriguing news, as the retailer has a worldwide presence that portends a massive potential for future RCC work.

As with all concrete types, the production of an RCC project requires adequate local resources—materials, equipment, and *expertise*. Based on this month's News (p. 9), Chapter Reports (p. 14), and summary of activities at the 2017 Fall Convention (p. 19), ACI is making great progress toward ensuring a steady supply of the latter.

For example, reports from ACI chapters in Ecuador, Florida, Peru, Mexico, the Philippines, and India show that local chapters are engaging students through site visits, seminars, and competitions. And activities at the recent convention further demonstrate ACI's committment to students and young professionals, with new student competitions, the ACI Student Forum, and a session featuring career advice. Combined, they show that ACI has a worldwide presence that portends a solid future for the industry at large.

Technical expertise and education gained through engagement with ACI will surely benefit the infrastructure—both locally and internationally.

Rex C. Donahey

President's
Memo

ACI's Twofold Approach to Sustainability

Khaled W. Awad
ACI President

During the last ACI Concrete Convention and Exposition in Anaheim, CA, at the 10th anniversary of the ACI Concrete Sustainability Forum, I was asked by the Forum Chair Koji Sakai to highlight ACI's work in the area of sustainability. Koji has been a longtime proponent of concrete sustainability and instrumental in raising the global awareness of its importance to the industry. First, we should recognize that the topic of sustainability is quite controversial today, to say the least.

Is sustainability about climate change, carbon reduction, or designing and building resilient communities and infrastructure? Has the approach of "green buildings" been successful in curbing energy consumption or was it by itself an isolated initiative, inherently good but not good enough to induce the desired change?

It is difficult to address these questions with clear-cut answers. One might expect that they would remain open for some time, until humanity collectively decides where sustainability belongs on the priority scale.

ACI is not waiting for this to happen. The Institute has already taken several steps to ensure that the global concrete community is empowered with knowledge on sustainability and on the effective tools and practices to achieve it. The Institute has a series of on-demand courses, webinars, and publications addressing sustainability of concrete, and several technical committees have addressed sustainability in their documents.

Still, it is important to be candid when the topic of sustainability is discussed.

Sustainability is not finding its way easily into regulations, codes, or standards. Most building code officials consider that it is already covered by life safety considerations or resilient designs so they do not perceive the greater need for addressing all facets of sustainability in concrete construction.

Let me go back to a discussion I had in Berlin, Germany, several years ago with Professor Dennis Meadows from Massachusetts Institute of Technology. Dennis co-authored the book *The Limits to Growth*, which demonstrated through economic models that the world resources were finite and that humanity might reach a period (between 2010 and 2030—in other words, now!) when the world economy can no longer grow.

When I asked Dennis what if these models were wrong, he said the models have been tested many times since 1972 and were totally defendable. So I asked him: What is the way out? What can keep growth going? He finally acknowledged that while all the models were 100% correct, they could not factor "human ingenuity." No economical or mathematical model can capture or quantify innovation.

At the Strategic Development Council (SDC) meeting last September in Reston, VA, most of the presentations were about carbon reduction and sustainable concrete. From alternative cementitious materials to carbon capture to producing limestone aggregates, the focus was on a greener concrete. It was clear from the presentations and discussions that breakthroughs in sustainability adoption would come from innovation in materials and processes rather than from regulations. Breaking the commercial hindrances associated with sustainability can be achieved through innovation.

This is exactly where ACI has strategically intervened when it substantially increased funding for the ACI Foundation, allowing SDC to accelerate the fostering of innovation and providing increased funding for research.

On a second, albeit more tactical front, there are several important initiatives at ACI. The Materials Chapter of the first ACI Guide on Sustainability will be published in 2018. I seize this opportunity to thank Julie Buffenbarger, the outgoing Chair of ACI Committee 130, Sustainability of Concrete, for her relentless efforts in leading the charge on the first ACI document on concrete sustainability. I am also optimistic that under the leadership of Sean Monk, the new Committee 130 Chair, we will progress steadfastly toward a comprehensive document by 2019. I was fortunate to work with him on the development of the Concrete Construction Sustainability Assessor Certification Program, and I have seen first hand his sharp and efficient work style.

Additionally, during the last fall convention in Anaheim, ACI launched its first Eco Concrete Competition, with great interest and participation from students from around the world.

ACI will keep working diligently through codes, standards, and guides to integrate sustainability.

Still, the transformational change is more likely to come from human ingenuity, and I'm pleased to report that ACI has stepped up substantially with its support on that front.

Khaled W. Awad
American Concrete Institute

ACI Committee Document
Abstracts

The following ACI documents will soon be available:

"Report on Practices for Evaluation of Concrete in Existing Massive Structures for Service Conditions (ACI 207.3R-18)"

Reported by ACI Committee 207, Mass Concrete

John W. Gajda, Chair; Christopher C. Ferraro, Secretary; Fares Y. Abdo, Jeffery C. Allen, Terrence E. Arnold, Katie J. Bartojay, Anthony A. Bombich, Teck L. Chua, Timothy P. Dolen, Darrell F. Elliot,[*] Barry D. Fehl, Mario Garza, Michael G. Hernandez, James K. Hicks, Rodney E. Holderbaum, David E. Keifer, Ronald L. Kozikowski Jr., Gary R. Mass, Tibor J. Pataky, Jonathan L. Poole, Henry B. Prenger, Ernest A. Rogalla, Ernest K. Schrader, Kuntay K. Talay, Nathaniel F. Tarbox, Stephen B. Tatro, Michael A. Whisonant, and Fouad H. Yazbeck, Members; Randall P. Bass, Robert W. Cannon, Eric J. Ditchey, Brian A. Forbes, Allen J. Hulshizer, Richard A. Kaden, and William F. Kepler, Consulting Members.

*Deceased

Abstract: This report identifies practices for evaluating the physical properties of concrete in existing structures. Although general knowledge of the structural design used for the principle structures of a project is essential for determining procedures and locations for evaluation of the concrete physical properties, analysis for the determination of structural capacity is not within the scope of this report. This report recommends project design, operation and maintenance records, and in-service inspection data to be reviewed. Existing methods of making condition surveys and nondestructive tests are reviewed, destructive phenomena are identified, methods for evaluation of tests and survey data are presented, and preparation of a final report is discussed.

"Guide to Presenting Reinforcing Steel Design Details (ACI 315R-18)"

Reported by Joint ACI-CRSI Committee 315, Details of Concrete Reinforcement

Richard H. Birley, Chair; Anthony L. Felder, Secretary; Mark Douglas Agee, Gregory P. Birley, David H. DeValve, Grant Doherty, Pedro Estrada, David A. Grundler Jr., Robert W. Hall, Todd R. Hawkinson, Dennis L. Hunter, David W. Johnston, William M. Klorman, Javed B. Malik, Christopher J. Perry, and Peter Zdgiebloski, Members; Dale Rinehart, Consulting Member.

Abstract: This document guides designers of concrete structures on how to determine information and design details that are required to prepare reinforcing steel fabrication details and placing drawings. The guide stresses the importance of this information to ensure that the reinforcing steel detailer effectively and accurately captures the intent of the designer, presenting it in a manner that is clear and unambiguous to the reinforcing steel fabricator and placer. Recommendations are also provided concerning the review of placing drawings.

"Report on Ferrocement (ACI 549R-18)"

Reported by ACI Committee 549, Thin Reinforced Cementitious Products and Ferrocement

Antonio Nanni, Chair; Corina-Maria Aldea, Secretary; Nemkumar Banthia, Christian Carloni, Paolo Casadei, Antonio De Luca, Michael E. Driver, Ashish Dubey, Mahmut Ekenel, Brad L. Erickson, Garth J. Fallis, John Jones,[*] Barzin Mobasher, Hani H. Nassif,[†] James E. Patterson, Alva Peled, Larry Rowland, Surendra P. Shah, Yixin Shao, Lesley H. Sneed, and J. Gustavo Tumialan, Members; Gordon B. Batson, James I. Daniel, Antoine E. Naaman,[†] Paul Nedwell,[†] P. Paramasivam,[†] and Parviz Soroushian, Consulting Members.

[*]Chair of subcommittee that prepared this report

[†]Members of subcommittee that prepared this report

Abstract: This report provides an overview of the history, formulation, construction, and applications of ferrocement. The focus of this report is to create an awareness in engineers, architects, and potential end-users of the characteristics and capabilities of ferrocement.

News

2018 ACI Collection of Concrete Codes, Specifications, and Practices

ACI has released the 2018 ACI Collection of Concrete Codes, Specifications, and Practices. Formerly known as the Manual of Concrete Practice (MCP), the ACI Collection is the most comprehensive and largest single source of information on concrete design, construction, and materials, with nearly 50 codes and specifications and more than 200 practices—including all guides and reports.

The ACI Collection features "Building Code Requirements for Structural Concrete (ACI 318-14)," "Specifications for Structural Concrete (ACI 301-16)," and "Code Requirements for Assessment, Repair, and Rehabilitation of Existing Concrete Structures and Commentary (ACI 562-16)." Additional categories in the ACI Collection include concrete materials, properties, design, construction, reinforcement, specialized application, repair, structural analysis, and innovation, plus popular topics such as slabs, formwork, and masonry.

The ACI Collection is available as an online subscription, a USB drive, and an eight-volume set of books. Specifically developed for individual users, the online subscription to the ACI Collection includes access to every new ACI document as soon as it is published, plus metric and historical versions of ACI's codes and specifications.

Individual volumes of the ACI Collection are also available, plus special online access for multiple users, entire offices, and large multi-national companies.

To subscribe or order, please call +1.248.848.3800 or visit **www.concrete.org**.

TRB Library Snap Searches

The Transportation Research Board's (TRB) Library, part of Transportation Research Information Services (TRIS), has released 26 topical overviews under a new series called "Snap Search." A Snap Search provides a summary of TRB research reports that are underway or completed, upcoming events, and committees that cover these specific topics. Produced by TRB's Library, Snap Searches are designed for the busy researcher or professional who would like to quickly get up to speed on complex research topics.

Visit **www.trb.org/InformationServices/Snap.aspx**.

New Individual ACI Membership Benefits

Effective now, all ACI individual members receive free digital access to the Institute's 200+ practices—including all guides and reports—plus free shipping in the continental United States. Additionally, members will have the added benefit of using two new substantial discounts toward:

- Digital access to ACI's 50 active codes and specifications on structural, environmental, and residential concrete; repair; and more, including current and historic versions; and
- Access to the new, annual subscription of ACI University's monthly webinars and on-demand courses.

Based on feedback indicating preference for immediate, digital access to information, ACI structured its improved individual membership benefits around immediate digital access to ACI's practices, while providing substantial discounts to add digital access to ACI's codes and specifications, too.

Members will also now receive free media mail shipping in the continental United States. These new benefits are in addition to current benefits: *Concrete International* magazine, *ACI Materials Journal, ACI Structural Journal*, event discounts, ACI University course tokens, access to the ACI Career Center, inclusion in the ACI Member Directory, and the opportunity to join committees.

"Now is the absolute best time to become an ACI member," said Melinda G. Reynolds, ACI Director, Membership and Customer Service. "ACI has always been the premier community dedicated to the best use of concrete. With these new additions to ACI's individual membership benefits, members can join the ACI community while also getting more of the tools they need to stay informed, learn, and do their jobs."

For more information, visit **www.concrete.org/membership**.

New ACI Webinar on Engineering Ethics

Scheduled for March 6, 2018, 1:00 p.m. EST, the "Engineering Ethics" webinar will review various codes of ethics, provide case studies, and recap lessons learned. The webinar's learning objectives include understanding of codes of ethics and their applications, reporting requirements and potential penalties for ethical violations, the professional and ethical responsibilities of a civil engineer, and the standards of professional and ethical responsibility to determine an appropriate course of action.

"Engineering Ethics" will be presented by Norbert J. Delatte Jr., FACI. Delatte is the M.R. Lohmann Endowed Professor of Engineering and the Head of the School of Civil and Environmental Engineering at Oklahoma State University, Stillwater, OK. He is also the author of *Beyond Failure: Forensic Case Studies for Civil Engineers* and *Concrete Pavement Design, Construction, and Performance*, second edition. In addition, he is the Editor of ASCE's *Journal of Performance of Constructed Facilities*.

For more information on this and other webinars, visit **www.concrete.org/education**.

CAM and CCI Merge to Create AOE

Advancing Organizational Excellence (AOE) is a full-service consulting firm resulting from the merger of Creative Association Management (CAM), Farmington Hills, MI, and Constructive Communication, Inc., Dublin, OH.

CAM has provided full-service association management expertise, as well as strategic and operational planning, since 1990. Clients include the Post-Tensioning Institute, American Coal Ash Association, American Shotcrete Association, Slag Cement Association, and Building Owners and Managers Association of Detroit.

Founded in 2001, Constructive Communication, Inc. (CCI), specialized in marketing strategy, public relations, social media, graphic design, and communications tactics for the architecture, engineering, and construction (AEC) sector and other industrial sectors. Representative clients include the International Grinding and Grooving Association, LORD Corporation, Stream + Wetlands Foundation, the Concrete Industry Management Program, CTS Cement, D.S. Brown, and others.


Kimberly Kayler, President, AOE

Kimberly Kayler, President and Founder of CCI, has been named as President of AOE. In her role as President of CCI, she has helped clients define strategy and develop marketing action plans. A past member of the ACI Board of Direction, Kayler chaired the ACI Marketing Committee and is a past member of the ACI Construction Liaison, Membership, Convention, Financial Advisory, and Chapter Activities Committees. She also is the past Chair of the ACI Global Marketing and Research Task Group. Her previous ACI task group activities include International Conferences, Strategic Planning, Branding, and Convention Opening Session. She is Co-Founder of the Women in Concrete Alliance (WICA) and leads efforts to create networking programs for women in the concrete industry.

Kayler received her BA in journalism from The University of Arizona, Tucson, AZ, and her MS in organization and management with an emphasis in leadership from Capella University.

AOE will operate out of CAM's existing headquarters in Farmington Hills, MI. CCI team members joining AOE are Amy Numbers, Kari Moosmann, Ashley Kizzire, Kristin Dispenza, and Lindsay Chelf. For more information, visit **www.theaoeteam.com**.

ACI Partners with Indonesian Society of Civil and Structural Engineers

ACI recently signed an International Partnership Agreement with the Indonesian Society of Civil and Structural Engineers (HAKI). This new agreement formalizes the desire to collaboratively develop and disseminate information on concrete and concrete structures. ACI also signed an agreement with the Society to translate CCS-0(16), Concrete Fundamentals, into Bahasa Indonesian.

Dradjat Hoedajanto, President of HAKI, was instrumental in working to have Indonesia adopt ACI 318M, Metric Building Code Requirements for Structural Concrete and Commentary, in the 1980s. Indonesia is currently working to upgrade their concrete code to ACI 318M-14 with a target completion date of August 2018.

ICRI Elects New Officers and Board members

Members of the International Concrete Repair Institute (ICRI) have elected new officers and board members for 2018, including Ralph C. Jones, Structural Engineering Associates, as President. The terms began on January 1, 2018. To support Jones, the ICRI membership also elected: President-Elect, Chris Lippmann, Kenseal Construction Products Corp.; Vice President, Mark LeMay, JQ Engineering, LLP; Secretary, Elena Kessi, Aquafin Building Product Systems; and Treasurer, John McDougall, Baker Roofing Co., Inc.

Brian Daley, C.A. Lindman of South Florida, LLC, served as President in 2017 and will continue his service on the board as Immediate Past President. Fred Goodwin, BASF, will continue serving as an ex-officio member of the Executive Committee in his role as Chair of the Technical Activities Committee.

The membership voted in five new Board members to serve 3-year terms: Ingrid Rodriguez, Ingrid Shawn Corporation; Kevin Robertson, King Packaged Materials Co.; Pete Haveron, Texas Concrete Restoration, Inc.; Jason Coleman, O'Donnell & Naccarato, Inc.; and Adam Hibsham, Valcourt Exterior Building Services.

"I'm pleased and honored to be elected President of the International Concrete Repair Institute for 2018. It is exciting to be able to contribute to the leadership team of an association that is dedicated to restoring the value of and improving the functionality of the places we work and live," Jones said. "Outgoing ICRI president Brian Daley has worked tirelessly to ensure that ICRI is in a great position to continue to make a positive impact on the industry. I look forward to advancing programs currently in place to promote education of concrete repair strategies. Other goals include developing a Global Task Force to promote ICRI to additional locations beyond North America, and outreach to younger members of our industry."

The returning Board members include Jeffrey S. Barnes, Barnes Consulting Group; Steven R. Bruns, Wiss, Janney, Elstner Associates, Inc.; David Marofsky, MAPEI Corporation; Brian T. McCabe, Concrete Protection & Restoration, Inc.; and Gerard Moulzolf, American Engineering Testing, Inc.—terms ending in 2018; and Paul Farrell, Carolina Restoration & Waterproofing, Inc., a C.A. Lindman company; Jon Connealy, Logan Contractors Supply, Inc.; Brian MacNeil, Kryton International Inc.; Andy Garver, Pullman; and Julius Hader, Bengoa Construction, Inc.—terms ending in 2019.

ACI Sustaining Members

are the foundation of our success.

To provide additional exposure to ACI Sustaining Members, *Concrete International* includes a 1/3-page member profile and a listing of all Sustaining Member organizations. All Sustaining Members receive the 1/3-page profile section on a rotating basis.

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The Euclid Chemical Company
Fibercon International, Inc.
Full-Tilt Constructors, Inc.
Future Tech Consultants
GCP Applied Technologies
Keystone Structural Concrete LLC
Kleinfelder
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Lehigh Hanson
Lithko Contracting, Inc.
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Multiquip Inc.
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To learn more about Euclid Chemical, please visit their website at **www.euclidchemical.com** or call +1.800.321.7628.

Their dedication to ACI is appreciated. Their willingness to share knowledge and their continued support have greatly enhanced the progress of the concrete industry.

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FIBERCON is continually refining its products and developing solutions to remain the leader in the steel fiber reinforcement.

For more information about Fibercon, visit **www.fiberconfiber.com** or call +1.724.538.5006.

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For more information about Twining Concrete Insight, please contact Dr. Boris Stein at +1.562.426.3355.

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For more information about W. R. MEADOWS, visit their website at **www.wrmeadows.com**.

Chapter Reports

Students from the ESPOL Student Chapter – ACI

Participants at the FIU Student Chapter – ACI Student Seminar and Networking Event

ACI ESPOL Students Visit the Port of Manta

The Port Authority of Manta (APM), in conjunction with Manta Port Terminal (TPM), welcomed engineering and oceanography students from the Escuela Superior Politécnica del Litoral (ESPOL) Student Chapter – ACI on November 17, 2017.

APM and TPM representatives presented a summary of the Port of Manta's services, management, and projects. Also in this presentation, Cesar Delgado Otero, former Director of APM, discussed topics related to the design and construction of the Manta breakwater. After meeting all the security standards, they conducted a tour of the International docks and the Fishing and Coastal Terminal of the Port of Manta.

These visits are part of the "Know My Port" campaign, facilitated by APM through the APM website and official channels, to provide students from Ecuador with knowledge of the port operations to instill a sense of ownership, because it is the port of all Ecuadorians. "This is how we promote a true city-port relationship," said José David Recalde, APM Manager.

FIU Student Chapter – ACI Student Seminar and Networking Event

The Florida International University (FIU) Student Chapter – ACI held a student seminar and networking event, "How Concrete Builds," on October 13, 2017. The event featured a lab tour, hands-on demonstrations, lectures, panel discussions, company networking, and a raffle. Speakers included Nelson Hernandez, Lehigh Cement (Concrete 101); Diep Tu, Florida Concrete & Products Association (Precast/Prestressed 101); Bill Dickens, GCP Applied Technologies (Chemical and Mineral Admixtures); and Lloyd Kennedy, Finfrock Industries (How Precast Builds).

The program was sponsored by the Florida Prestressed Concrete Association and the Florida Concrete and Products Association. FIU student organizers for the event included Nazanin Rezaei, Francisco Chitty, Mohamadtaqi Baqersad, Daniel Castillo, Juan Gonzalez Pena, and David Garber, Faculty Advisor.

ACI Hosts Latin American Chapter Roundtable in Peru

Chapter officers representing 10 Latin American countries gathered in Cusco, Peru, November 20, 2017, for a Chapter Roundtable meeting focused on increasing student membership and developing regional concrete competitions. The roundtable was held in conjunction with a Concrete Ball Competition and the XII Convencíon Internacional organized by the Peru Chapter – ACI.

The Concrete Ball Competition was held in the civil engineering lab at Universidad Nacional San Antonio Abad del Cusco. Eleven teams and approximately 60 students from Cusco, Lima, Trujillo, Huaraz, and Apurimac participated in the event. Unlike the traditional concrete bowling ball event hosted by ACI, the Peruvian students created a concrete fútbol with a scoring field and goalpost, representing the region's popular sport football, also known as soccer in the United States.

The winners of the Concrete Ball Competition included:

- First place ($1000)—Universidad San Ignacio de Loyola, Lima (UNSIL);
- Second place ($750)—Universidad San Antonio de Abad del Cusco (UNSAAC); and
- Third place ($500)—Universidad Peruana de Ciencias Aplicadas, Lima (UPC).

In addition to the prize money awarded by the Peru Chapter, ACI presented a check for $5000 to the first-place winners to fund their travel to the ACI Concrete Bowling Ball Competition to be held during The ACI Concrete Convention and Exposition in Salt Lake City, UT, on March 25, 2018.

ACI staff, Peru Chapter officers, and Bill Rushing, CAC Chair (far right), with the Concrete Ball Competition first place team from Universidad San Ignacio de Loyola

Chapter Roundtable participants wearing Cusco hats provided by the Peru Chapter – ACI

Following the student competition, the Chapter Roundtable was hosted at the JW Marriott in Cusco. Presenters for the roundtable included John Conn, ACI Director of Chapter Activities; Bill Rushing, ACI Past President and Chair of the Chapter Activities Committee (CAC); Kanette Worlds, ACI Student, Faculty, & Young Professionals Activities Coordinator; and Karla Kruse, Chair of the Student & Young Professional Activities Committee (SYPAC).

Student activities and competitions were key topics for the event along with the new "local member" category developed by ACI that will grant local chapter members access to additional resources such as the ACI membership directory, three education tokens, a membership certificate, and the electronic version of *Concrete International*. The objective is to help local chapters enhance their membership benefits and introduce them to partial benefits available exclusively to ACI individual members.

The XII Convencíon Internacional event took place at the Cusco Convention Center on November 21-22, 2017. Speakers included ACI Board of Direction members Bill Rushing and Antonio Nanni, and Gustavo Tumialán, FACI.

For more information, visit the chapter's facebook page at **www.facebook.com/AciPeruOficial/?ref=br_rs**.

SGI Student Chapter – ACI Seminar on "Practical Guidelines for Durable Concrete"

Sanjay Ghodawat Group of Institutions (SGI) Student Chapter – ACI organized a seminar on "Practical Guidelines for Durable Concrete" on September 8, 2017, at SGI, Atigre, Kolhapur, Maharashtra, India. The seminar was presented by N.V. Nayak, Principal Advisor, Gammon Engineers and Contractors Private Limited, India, and author of *Foundation Design Manual* and co-author of the

Bolivia Chapter – ACI officers with Bill Rushing, CAC Chair (far left), and John Conn ACI Director of Chapter Activities (far right)

Nayak talked with civil engineering students about how to make good quality concrete

Handbook on Advanced Concrete Technology and *Sustainability of Concrete*.

Nayak discussed practical guidelines on how to make durable concrete, such as use of supplementary cementitious materials (SCMs), Indian innovations of Alcofine and Ultrafine Fly Ash, curing of concrete, and permeability of concrete with references to case studies. Nayak also emphasized the importance of 7-day curing. He presented a few case studies related to 7-day curing and discussed the advancement in concrete technology due to chemical admixtures. The storage, admixture saturation points, and robust admixture points were highlighted during the seminar.

Nayak visited the SGI Geotechnical Engineering and Concrete Technology laboratory and discussed good practices in making durable concrete with postgraduate and undergraduate students. He also talked about ongoing undergraduate student projects and encouraged students to be innovative in the field of concrete technology.

Chetan S. Patil, SGI Student Chapter – ACI Faculty Advisor, expressed many thanks to Nayak for his participation.

Philippines Chapter – ACI held its first Concrete Bowling Ball Competition

Two teams each from the University of the Philippines Diliman and Manuel L. Quezon University qualified for the Fiber-Reinforced Concrete Bowling Ball Competition held on November 11, 2017, at Manuel L. Quezon University, Diliman in Quezon City, Philippines. Approximately 50 people attended the competition, including professionals, faculty, students, and parents.

The winners of the Fiber-Reinforced Concrete Bowling Ball Competition included:

- First place (P12,000)—University of the Philippines (Team A);
- Second place (P10,000)—Manuel L. Quezon University (Team A); and
- Third place (P7500)—Manuel L. Quezon University (Team B).

The Philippines Chapter – ACI plans to organize an annual student concrete competition with more local universities. Future competitions will include egg protection device and concrete cylinder challenges.

ACI President Khaled Awad Visits Mexico

ACI President Khaled Awad visited Mexico for a week, traveling to different regions promoting ACI's vision and its global strategy.

First, Awad attended a seminar on Durability in the Great Projects, organized by the Northwest Mexico Chapter – ACI in Tijuana, where he gave a presentation about ACI and the new ACI 562 Concrete Repair Code. Next, he visited Hermosillo, the city where the Northwest Mexico Chapter's headquarters is

ACI President Khaled Awad presented at a seminar in Tijuana, Mexico

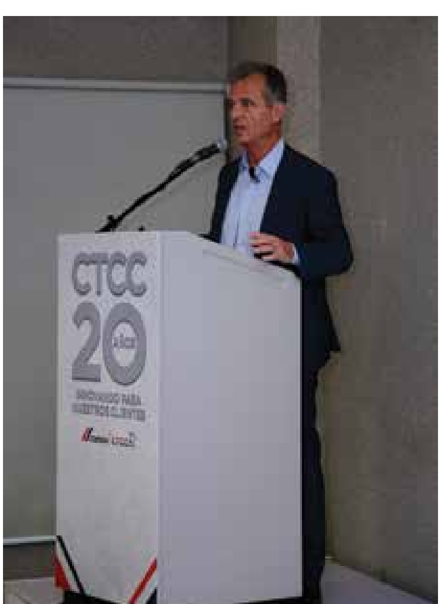
First-place winners of the Concrete Bowling Ball Competition, University of the Philippines (Team A)

ACI student chapter meeting participants in Hermosillo, Mexico located, to participate in the first meeting of ACI Student Chapters of several participating universities in Mexico. Both events were supported by the Northwest Mexico Chapter – ACI and chaired by Juan Carlos Rocha and Fabián González Valencia.

Awad then traveled to Mexico City as part of the celebration of the 20th anniversary of the Cement and Concrete Technology Center of CEMEX, where he shared project details of the Kingdom Tower in Jeddah with different representatives from the concrete industry.

Lastly, Awad participated in the 3rd Concrete Solutions Congress and the 1st Ibero-American Precast Congress in Cancún, organized by the Mexican Association of Ready Mixed Concrete (AMIC), the Mexican National Association of the Precast and Prefabrication Industry (ANIPPAC), and the Mexican Association of Concrete Pipes (ATCO).

Throughout the last week of October 2018, Khaled interacted with concrete industry leaders in Mexico, enhanced the presence of ACI in Mexico and Latin America, and also achieved various commitments of local collaboration to continue advancing the knowledge of concrete.



Awad at the 20th anniversary celebration of the Cement and Concrete Technology Center of CEMEX

Knowledge to Practice:

ACI Foundation

SDC Announces Three New Research Collaborations

In January, the ACI Foundation's Strategic Development Council (SDC) agreed to support three important projects related to high-strength reinforcement, an SDC-identified industry critical technology. As such, the ACI Foundation will co-fund the projects, described herein, along with major sponsor, the Charles Pankow Foundation. The results of the research are needed by both ACI 318 and practicing engineers; as the date will aid in developing future code provisions to benefit the industry. The projects include:

Foundation mats with high-strength reinforcement—Jack Moehle, University of California, Berkeley

The Architecture, Engineering, and Construction (AEC) industry increasingly is using high-strength reinforcement as a means of reducing reinforcing quantities and congestion in thick foundation mats. This research would establish the performance of thick reinforced concrete elements using high-strength reinforcement versus conventional Grade 60 reinforcement and would potentially open the door to its widespread use. The research would also help resolve the issue of whether shear reinforcement is required in thick concrete foundation mats.

Development of large high-strength headed reinforcing bars—David Darwin, University of Kansas

The proposed research builds on recent large-scale studies that have led to the development of proposed modifications to the ACI Building Code that would allow the use of headed bars with yield strengths as high as 120 ksi (827 MPa) in concretes with compressive strengths as high as 16 ksi (110 MPa), a significant extension of the current Code limits of 60 and 6 ksi (414 and 41 MPa), respectively. The proposed research will broaden the application of this important method for anchoring reinforcement, and it will greatly extend the application of high-strength concrete.

Normal- and high-strength continuously wound ties (CWTs)—Bahram Shahrooz, University of Cincinnati

The proposed research is intended to expand the use of CWTs to develop a simpler way to provide one continuous tie and/or hoop configuration in a column or shear wall boundary. This relatively new type of transverse reinforcing hoop is anticipated to provide installation and performance advantages over conventional hoops. Such benefits will become particularly advantageous if CWTs are fabricated from high-strength steel (HSS), such as ASTM A615/A615M Grade 100 [690].

CRC Announces a New Research Product

The ACI Foundation's Concrete Research Council (CRC) announced the release of the research product "Seismic Performance Characterization of Beams with High-Strength Reinforcement" by Duy V. To and Jack Moehle, University of California, Berkeley. The ACI Foundation co-funded the work, along with major sponsor, the Charles Pankow Foundation. Information on CRC research products can be found at **www.acifoundation.org/research/research-projects**.

Register for Concrete 2029 Workshop and SDC Forum 43

Concrete 2029's next workshop will take place February 28, 2018, at the McCormick Resort in Scottsdale, AZ. SDC Technology Forum 43 will be held March 1-2, 2018, also at the McCormick Resort.

The Forum is meant to bring industry leaders together to discuss industry issues, hear about results of recent research, and showcase emerging technologies. This Concrete 2029 workshop will focus on technology, specifically high-strength steel and how to break through barriers to implementation.

Visit **www.acifoundation.org/sdc** for updates on the forum and workshop agenda, hotel information, and registration for each event.

Ann Daugherty is the Director of the ACI Foundation, where we strive to improve the concrete industry by funding and fostering critical research and new technologies, and by integrating the younger generation into our industry. For more information, contact ann.daugherty@acifoundation.org.

Have an idea for research that will benefit the concrete industry or support an ACI document or code change? Visit **www.concreteresearchnetwork.org** and fill out an online concrete research need form.

Making Connections and Setting an Attendance Record

Record-breaking ACI Concrete Convention and Exposition in Anaheim

A record number of 2235 attendees participated at The ACI Concrete Convention and Exposition – Fall 2017, held in Anaheim, CA, October 15-19, 2017. Hosted by the Southern California Chapter – ACI, with a program based on the theme of "Making Connections," concrete industry professionals from around the world convened at the Disneyland® Hotel to collaborate on concrete codes, specifications, and practices.

Colleagues gathered for sessions, committee meetings, student competitions, networking and social events, and the ACI Excellence in Concrete Construction Awards. On the evening of October 16, 2017, the highest "Excellence" award was presented to R·torso·C, located in Tokyo, Japan. Eleven additional global projects were recognized during the Gala event.

"Members and the global concrete community continue to convene at ACI conventions to learn from each other, share innovations, celebrate accomplishments, and develop the Institute's technical content," stated Ron Burg, ACI Executive Vice President. "For anyone who hasn't yet attended one of our twice-annual conventions, I encourage you to consider joining us in 2018."

Technical and educational sessions provided attendees with the latest research, case studies, best practices, and the opportunity to earn Professional Development Hours (PDHs). Additionally, ACI held over 300 committee meetings, an industry trade exhibition, and networking events, such as the Concrete Mixer where attendees and guests gathered on the Magic Kingdom Lawn for an evening of networking, entertainment, and great food.

Other highlights of the convention were Contractors' Day, the International Forum, Concrete Sustainability Forum, and a joint seminar with the Japan Concrete Institute on preserving existing infrastructure.

Southern California Chapter – ACI Convention Committee

Co-Chairs: Kirk McDonald and Chris Forster
Contractors' Day: Donald Kahn
Exhibits: Charles Kerzic and Stefan Reder
Finance: Robert Cleeland, Marty Hansberger, Ed Luce, Pat Murena, and Ken Sears
Guest Program: Heather Caya
Hot Topic: Robert Graine and Dave Nau
Publicity: George Smith and Jon Sansom
Secretary: Rod Elderton
Social Events: Tina McIntyre and Janeen Oliver
Student Activities: Josh Hamilton, and Neal Lynch
Technical Program: Chris Garcia, Ann Harrer, and Paul Heis
Treasurer: Gary Kirk

At the Opening Session, ACI President Khaled Awad (left) presented certificates of appreciation to Southern California Chapter – ACI Convention Committee Co-Chairs Kirk McDonald and Chris Forster

Student Egg Protection Device Competition

Testing an entry in the Student Eco Concrete Competition

Universidad Nacional de Ingeniería was the first-place team in the EPD Competition

The University of Sherbrooke took first place in the Eco Concrete Competition

Student Competition Results

Egg Protection Device and Eco Concrete

The winning teams in the Student Egg Protection Device (EPD) Competition and the Student Eco Concrete Competition received cash awards. The objective of the EPD Competition is to design and build the highest-impact-load-resistant plain or reinforced concrete EPD, and to learn about concrete's benefits related to durability, impact resistance, and other real-life aspects which an EPD competition simulates. The top finishers included:

- First place: Universidad Nacional de Ingeniería, students Kevin Arturo Laines Velarde, Ronald Bryan Valderrama Castro, Alex Condori Salluca, Christiams Jesús Santos Accor, and Jason Luis Villalobos Pineda; José C. Masías Guillén, Faculty Advisor;
- Second place: Universidad Autónoma Metropolitana Azcapotzalco, students Leiding Guadalupe García Gutiérrez, Allyson Melisa López Díaz, Juan Carlos Hernández Mora, Eduardo Osorio Rosas, Juan Carlos Trejo Juárez, and José Luis Vivar Emiterio; José Juan Guerrero Correa, Faculty Advisor; and
- Third place: San Jose State University, students Amer Zreika, Andrea Coto, Carmen Cutay, Jesus Ramos, Komalpreet Kaur, and Rami Zayed; Akthem Al-Manaseer, Faculty Advisor.

The objective of the Student Eco Concrete Competition is to promote the idea of environmental performance in concrete mixture design as an important aspect of sustainability. Teams had the mission to develop an innovative concrete mixture with the lowest possible environmental impact and with optimal mechanical and durability performance attributes. The competition results were:

- First place: University of Sherbrooke, students Cedric Gauthier, Charles-Etienne Bouchard, Philippe Dubois, Sebastien Cloutier, and Redha Esselami; Arezki Tagnit-Hamou, Faculty Advisor;
- Second place: Valparaiso University, students Rebecca Valliere, Jeffrey Moore, and Grace Jackson; Jacob Henschen, Faculty Advisor;
- Third place: New Jersey Institute of Technology, students Jennifer Guerrero, Stephon De Silva, Nikolaos Benyamin, and Marco Fernandez; Anlee Orama, Faculty Advisor; and
- Fourth place: California State University, Chico, students Hayden Kaae, Cody Stauffer, Danny Lakowski, Steve Smythe, and Damien Bonis; Mohammed Albahttiti, Faculty Advisor.

Concrete Projects Competition

The winners of the ACI Concrete Projects Competition, sponsored by ACI Committee S801, Student Activities Committee, were announced at the ACI Convention in Anaheim. They include:

- First place: Full Design and Implementation Drawings of Three Reinforced Concrete Units, students Ramah M. Khalil and Khaled M. Fodail, Alexandria University; Zaki I. Mahmoud, Faculty Advisor;
- Second place: The Effect of Lightweight Materials on Properties of Cement Mortar, student Yasser Sattar Hassan, University of Technology; Ziyad Majeed Abed, Faculty Advisor; and
- Third place: Evaluation of Punching Shear Strength Models of Interior and Edge Slab Column Connections Reinforced with GFRP Bars, student Jordan Keith Carrette, University of Manitoba; Ehab El-Salakawy, Faculty Advisor.

For more information on upcoming ACI student competitions, visit **www.concrete.org**.

Environmental Safety: A Hot Topic at ACI Student Forum

The impact of civil engineering on the environment before and after natural disasters were key themes at the ACI Student Forum held at the ACI Convention in Anaheim. Approximately 80 students heard from representatives from seven universities spanning four continents.

The Student Forum provides ACI student chapters and university teams with a platform for highlighting their activities and achievements. Kanette Worlds, ACI Student, Faculty, and Young Professional Activities Coordinator, moderated the session. Worlds introduced ACI President Khaled Awad, who spoke to students about why he decided to pursue a career in the concrete industry and encouraged them to dream big.

Nazanin Rezaei, President of the Florida International University (FIU) Student Chapter – ACI, touched on the chapter's involvement with community clean up post-Hurricane Irma. The FIU students were temporarily evacuated from the university when the severe weather warning was issued. Angel Lozano, President of the Universidad Autonoma de Nuevo Leon Student Chapter – ACI, showed photos of damage to two mid-rise buildings following the recent earthquake in Mexico City, Mexico. He emphasized the value of ACI's Special Inspector Certification Program as a key to preventing future building collapses during the design and testing phases of construction.

Topics covered in other presentations included:

- Escuela Superior Politecnica Del Litoral student activities include ACI certification training, construction site tours, seminars, and participation in ACI student competitions;
- The University of Sherbrooke Student Chapter – ACI has 124 graduate and undergraduate members. The university helped to create the ACI Student Eco Concrete

Exhibitors

Exhibitors at The ACI Concrete Convention and Exposition – Fall 2017 included:

Aquafin, Inc.
BASF Corporation
Bekaert Corporation
Burgess Pigment Company
Buzzi Unicem USA
CalPortland
Cervenka Consulting
ChemCo Systems Inc.
Clark Construction Group, LLC
Concrete Reinforcing Steel Institute
Concrete Sealants, Inc.
CRC Press, Taylor and Francis
Dayton Superior
Decon USA Inc.
Design Data
DPR Construction
ELE International
The Euclid Chemical Company
FARO Technologies, Inc.
FiberForce Fibers by ABC Polymers
Foam Concepts Inc./P.A.G Foam
Fortec Stabilization Systems
GCP Applied Technologies
Geofortis Pozzolans
Germann Instruments, Inc.
Giatec Scientific Inc.
Headed Reinforcement Corp.
Humboldt Mfg.
Hycrete, Inc.
ICC Evaluation Service
International Concrete Repair Institute
International Zinc Association
Kryton International Inc.
Largo Concrete Inc.
Morley Construction Company
Myers Construction Materials Testing Equipment
NASA Centennial Challenges 3D-Printed Habitat
Nickel Institute
Owens Corning Infrastructure Solutions LLC
Pentair
PERI Formwork Systems, Inc.
Plexxis Software
Poraver North America Inc.
Portland Cement Association
Premier CPG
Proceq USA, Inc.
QuakeWrap Inc.
Radarview LLC/UCT
Reinforced Earth
Rhino Carbon Fiber
Sika Corporation
Silica Fume Association
Slag Cement Association
Smith-Emery
Speciality Products Group
Structural Group
Technical Consultants Inc.
Trinity Lightweight
Twining, Inc.
University of Florida
Vector Corrosion Technologies Inc.
Vulcan Materials Company
Wacker Neuson
Western Specialty Contractors
Xypex Chemical Corporation
Zircon Corporation

Adrienne Goetz, Conrad Paulson, and Ann Harrer of Wiss, Janney, Elstner Associates, Inc., discussed the topic of "Unexpected Journeys in Engineering: A Conversation across Generations"

At the session "What I Wish I Knew: Negotiating Early Job Offers" (from left): Megan Huberty, American Engineering Testing, Inc.; Destry Kenning, Nox-Crete; Somaye Nassiri, Washington State University; Lauren G. McCauley, Balfour Beatty Construction; and Matthew P. Adams, New Jersey Institute of Technology

Competition. Student chapter activities include technical visits, educational seminars, and regular participation in ACI competitions;

- Universidad de Cuenca hosted a successful international symposium in September 2017 with more than 600 attendees. The two-day seminar featured expert speakers from a variety of disciplines and countries including Roberto Nunez, civil engineering professor at North Carolina State University;
- Although students from the Indian Institute of Technology Madras Student Chapter – ACI compete in many local competitions, the events in Anaheim were the chapter's first ACI student competitions;
- Qatar University students Rabeh Almashhadani and Mohamed Abdelsalam were awarded a free trip to attend the Fall 2017 ACI Convention after winning a local concrete cylinder competition hosted at the university; and
- In addition to organizing a "Cajun-Tuf Concrete" competition, the University of Louisiana Lafayette also competes in the ASCE Concrete Canoe Competition. The ACI/ASCE joint student chapter worked together for the Clean the Coast community service project that educates students about Louisiana's coastland while giving back to the community.

The Student Forum was followed by the Student Lunch. ACI President Khaled Awad addressed the audience, talking about his days as a young engineer. He advised the students that whatever part of the industry you are involved with, there is always something in ACI that will give you an edge. "The more you engage with ACI, the more you will find your edge," Awad stressed.

The main feature of the Student Lunch was a panel discussion with Conrad Paulson, Ann Harrer, and Adrienne Goetz of Wiss, Janney, Elstner Associates, Inc., titled "Unexpected Journeys in Engineering: A Conversation across Generations." They talked about the work environment at varying stages of their careers and the changes that have happened, such as how much computer technology has progressed. The students were reminded that jobsite conditions will never change; even with quality assurance/quality control and design checks, things can go wrong and there is no substitute for hands-on inspection.

What I Wish I Knew: Negotiating Early Job Offers

Another session of interest to young professionals and students was sponsored by ACI Committee S806, Young Professional Activities. Matthew P. Adams, New Jersey Institute of Technology, and Megan Huberty, American Engineering Testing, Inc., moderated a panel discussion about negotiating a very first job offer or transferring jobs early in a career. This session of perspectives and advice from young professionals and young faculty who have recently gone through the process themselves also included Lauren G. McCauley, Balfour Beatty Construction; Somaye Nassiri, Washington State University; Destry Kenning, Nox-Crete; and Patrick Barnhouse, American Engineering Testing, Inc.

Session attendees were invited to participate in a workshop exercise, with groups role playing as potential job seekers and human resources corporate representatives.

Focus on Preserving Existing Infrastructure

ACI President Khaled Awad welcomed attendees to the 3rd ACI/JCI Joint Seminar on Existing Structures. This four-part seminar included a series of presentations that explored topics related to the challenges in the preservation of existing concrete bridges and building infrastructure. Challenges of preservation of infrastructure include the development of maintenance strategies to address long-term durability concerns, examination of the response to unexpected loadings, and the development of standards for repair/retrofit of existing structures.

The seminar keynote presentation "Research Interest in RC Structures: From Mechanical Behaviors to Durability," focused on the Japan Society of Structural Engineers (JSCE) seismic design code, and how properly designed or strengthened structures fared after the Great East Japan Earthquake in 2011.

Attendees learned that although some damage was recognized in reinforced concrete structures, zero or slight damage was observed on structures designed or strengthened based on the codes developed after the Great Hanshin Earthquake. However, the damage from the tsunami was devastating. Many reinforced concrete bridges were damaged and girders were washed away. Reinforced concrete buildings, however, showed strong resilience against the tsunami.

Reinforced concrete structures constructed in the coastal regions of Japan suffer salt attack problems. For the past 30 years, a great increase in deterioration of reinforced concrete bridge structures due to corrosion of reinforcing bars has been remarkable in the area facing the Sea of Japan. Various countermeasures have been developed and carried out in the field. As far as the durability is concerned, it takes a long time either to examine the deterioration mechanism or to find out the effectiveness of countermeasures. Research and technical developments on this issue were presented.

The final session in the seminar featured a panel discussion to develop plans for future collaboration between ACI and JCI and develop strategies for infrastructure preservation.

Fiber-Reinforced Polymer Symposium

The 2-day symposium attracted interest from researchers, practitioners, and manufacturers involved in the use of fiber-reinforced polymers (FRPs) as reinforcement for concrete masonry structures, including the use of FRP reinforcement in new construction and FRP for strengthening and rehabilitation of existing structures.

Symposium Co-Chair Raafat El-Hacha spoke on steel-free hybrid bridge deck systems and noted that, "These systems have advantageous properties compared to conventional materials and are very cost-effective. A structure can only be as strong as its weakest component. Thus, to design a real-life application hybrid bridge deck system, it is of the utmost importance to determine the maximum performance level and structural limit of each individual component within the system."

The experimental, analytical, and numerical validations of using FRP composites were discussed, as well as insights needed for improving existing guidelines. Technical papers featured discussions on sustainability, novel applications, new technologies, and long-term field data that will result in greater acceptance and use of FRP composites technology by practitioners.

Strengthening International Ties

At the International Forum, ACI Vice President David Lange welcomed global attendees to the ACI Convention. Attendees gathered at the forum to meet with ACI international partners, ACI chapter representatives, and ACI leadership about worldwide events, activities, initiatives, and common themes of interest to the concrete materials, design, and construction industry.

Updates on activities and plans were provided from the Iraq Chapter – ACI, Hasan Al-Nawadi; Korea Concrete Institute, Chang-Sik Choi; Italy Chapter – ACI, Paolo Casadei; Japan Concrete Institute, Hitoshi Shiohara; India Chapter – ACI, S.K. Manjrekar; Canada-India Research Center of Excellence, Nemkumar (Nemy) Banthia; Jordan Concrete Association, Ahmad Suleiman; Instituto Nicaragüense del Cemento y del Concreto (INCYC), Andres Lee; Polish Academy of Sciences, Maria Kaszynska; and RILEM, Kamal Khayat.

James K. Wight, Chair, Committee on Codes and Standards Advocacy and Outreach, also gave a short presentation on the proposed ACI Technical Cooperation Program (Technical Exchanges). This program will assist ACI technical committee members who want to cooperate with non-U.S. technical groups working on related topics, strengthening cooperation with international technical organizations while increasing the knowledge base for ACI technical committees.

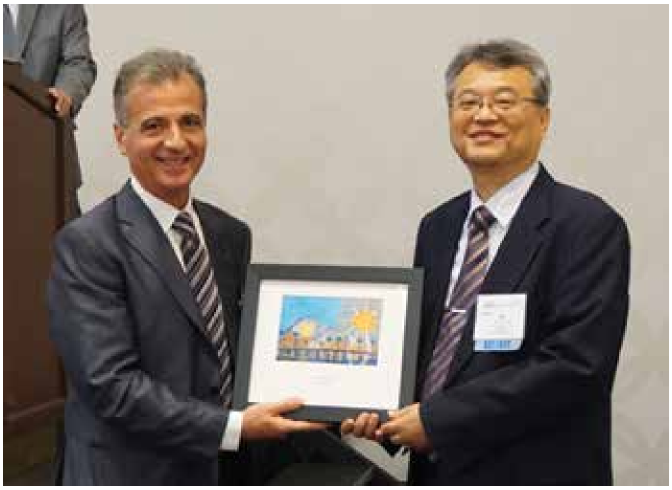
The forum was followed by a lunch presentation by Jae-Hoon Lee, Yeungnam University, and Hong Gun Park, Seoul National University, focusing on "Cooperative Efforts between Academia and Industry for the Development of Concrete Technology in Korea."

Lee and Park's presentation introduced the Korean experience in developing national standards and concrete technology since the 1960s, when the large-scale construction of buildings and infrastructure started. During the last two decades, various research programs have been conducted to develop a more rational design code and concrete technology, enabling Korean engineers to design and construct diverse civil structures and buildings. The roles of the Korea Concrete Institute and universities in the development of concrete technology and construction in Korea were presented, showing several examples of infrastructure and mega buildings.

Contractors' Day Highlights

A special Contractors' Day session on "Mega Projects – Challenging the Southern California Concrete Industry" included presentations on high-profile projects that are changing the Southern California concrete industry. The session included discussion of concrete mixtures, evaluating demands for mass concrete, challenges related to materials properties to meet structural demands based on seismic requirements, and challenges with logistics and field operations associated with major projects.

Evaluating construction information with respect to constructability, and the application of ACI documents, were the themes for a four-part session honoring Ward R. Malisch, ACI Honorary Member. The "Concrete Construction Symposium" presented information about the latest knowledge in concrete construction and materials, evaluating



ACI President Khaled Awad thanked Jae-Hoon Lee (left), Yeungnam University, and Hong Gun Park (right), Seoul National University, for their presentation at the International Lunch

the appropriate use of specification information, and troubleshooting projects to resolve issues.

Attendees also enjoyed a lunch presentation focusing on unique applications of concrete in new construction as part of the ongoing expansion of the Disney® theme parks. Speaker Kent Estes, Walt Disney Imagineering, spoke about the challenges in design, engineering, and construction—particularly the entryway plaza of the new Shanghai Disneyland®.

A two-part session on "Creep and Shrinkage of Concrete—Honoring Professor Adam Neville" featured experts sharing their knowledge on the subject. The objective of the session was to identify the importance of concrete creep and shrinkage in the design and construction of tall buildings and understand how they are considered in projects. Presenters explained the role of shrinkage and tensile creep in early-age cracking and design guidance on its control.

International Workshop on Structural Concrete

Gathering and sharing information on the development and application of concrete design standards throughout the Americas and beyond was the focus of the International Workshop on Structural Concrete: Technology Advancement and Adoption in the Americas. The workshop took place October 14, 2017.

Developed by ACI Committee 318, Structural Concrete Building Code, the workshop convenes periodically to bring together international users of ACI 318 and other ACI documents. The workshop disseminates the latest developments and helps ACI understand how its standards and guidelines can better address the needs of its users. Sessions included:

- New Tools from ACI—Presentations were given on reports and standards from ACI of interest to the international community, including new Spanish translations of ACI 301 Tolerances and ACI 117 IPS-1 Updated to ACI 318-14; ACI 318-14 Chapter 26 on Construction Documents and Inspection; and major updates expected for ACI 318-19;
- Nonlinear Analysis in Earthquake-Resistant Design—This session presented examples of the use of nonlinear analysis in the earthquake-resistant design of buildings in the United States and Chile, and included a presentation on the development of ACI 318-19 provisions for the use of nonlinear analysis methods;
- Seismic Design of Walls—Three presentations in this session covered the use of walls in three Latin-American countries (Chile, Colombia, and Mexico), followed by a presentation of how ACI 318 might accommodate these international applications; and
- New News—Three presentations discussed strut-and-tie modeling, advancements in adoption of high-strength reinforcement use in ACI 318, and initial reports from Mexico City's recent earthquakes.

Next event: "Concrete Elevated" in Salt Lake City

The next ACI Concrete Convention and Exposition will take place in Salt Lake City, UT, at the Grand America & Little America, March 25-29, 2018. Convention activities will include:

- International Lunch with special guest speaker Koichi Maekawa;
- Student Fiber-Reinforced Concrete Bowling Ball Competition;
- Student Networking Reception;
- Reception Honoring Professor Michael P. Collins;
- Student Lunch with speaker Nikki Stone, Olympic Gold Medalist;
- Contractors' Day Lunch with speaker Matt Townsend, Leadership Consultant; and
- An industry exhibition showcasing up to 70 exhibitors.

Registration is open online through March 5, 2018, and discounted rates are offered until February 25, 2018. To learn more about the ACI Convention and to register, visit **www.aciconvention.org**.

ACI Concrete Sustainability Forum Celebrates 10 Years

by Koji Sakai and Julie K. Buffenbarger

The ACI Concrete Sustainability Forum X was held on October 17, 2017, at The Concrete Convention and Exposition in Anaheim, CA. The Forum originated as a 2008 workshop in St. Louis, MO,[1] when ACI Committee 130, Sustainability of Concrete, was formed. Forums have since taken place in New Orleans, LA; Pittsburgh, PA; Cincinnati, OH; Toronto, ON, Canada; Phoenix, AZ; Washington, DC; Denver, CO; and Philadelphia, PA.[2-9]

The 10th Anniversary ACI Concrete Sustainability Forum featured presentations from eight speakers, including the presidents of both ACI and *fib*. Moderator Koji Sakai stated in his introductory comments that the Forum series has showcased 75 speakers since its inception, and has resulted in the following tangible impacts:

- The Concrete Sustainability Forum has significantly contributed to the promotion of "sustainability thoughts and measures" in the concrete and construction industries;
- Sustainability has been introduced into the *fib* Model Code 2010[10] and ACI Building Code 2014[11]; and
- Societal circumstances have changed dramatically in the last 10 years. Social quality indicators now address the change in the conditional factors in daily life, as embodied in economic, sociopolitical, sociocultural, and environmental dimensions as a related issue of sustainable urban development. With this revelation, it can be concluded that we are entering the second stage for sustainability realization. Sakai also introduced:
- The National Oceanic and Atmospheric Administration (NOAA) Climate Report 2017[12];
- The Financial Stability Board's Task Force on Climate-Related Financial Disclosures (TCFD) released its recommendations for helping businesses disclose clear, comparable, and consistent information about the risks and opportunities presented by climate change[13]; and
- The movement toward the *fib* Model Code 2020.

The NOAA report provides distressing data that show drastic increases in global surface and sea surface temperatures, atmospheric greenhouse gas content, and sea levels—all strong indicators of a changing climate. The FSB-TF report recommends: "The effect of climate change on the business balance and assets of firms should be disclosed with investors' needs." The report also quotes the task force Chair, former New York City Mayor Michael R. Bloomberg, who stated: "Increasing transparency makes markets more efficient and economies more stable and resilient." Sakai concluded the opening remarks by suggesting that concrete-related industries adopt the sustainable framework that will be implemented in *fib* Model Code 2020.

Observations from the Presidents of ACI and *fib*

Khaled Awad, ACI President, welcomed attendees to the celebration of the 10th Anniversary of the Forum and discussed ACI's approach to sustainability. Awad noted that diligent efforts and education must continue for integration of sustainability into codes and standards, as challenges include political issues as well as the inherent complexities of blending life-safety requirements with sustainability and resilient design considerations. He also introduced thoughts from the 1972 book *The Limits to Growth*,[14] which discussed the eventual collapse of production and living standards that were predicted by models that coupled exponential economic and population growth with a finite supply of resources. Awad emphasized that "innovation" is a must to prevent such circumstances, and he indicated that increased funding for the ACI Foundation is expected to accelerate and foster innovation. In closing, Awad mentioned the ACI Concrete Construction Sustainability Assessor Certification Program, which is expected to be launched in 2018.

Hugo Peiretti Corres, President of *fib* (International Federation for Structural Concrete), defined *fib*, which was founded in 1998 by merging FIP (Euro-International Committee for Concrete) and CEB (International Federation for Prestressing) and discussed *fib*'s role in sustainability. *fib*'s statutes are to develop, at an international level, the study of scientific and practical matters capable of advancing the technical, economic, aesthetic, and environmental performance of concrete constructions. *fib* introduced Commission 3, Environmental Aspects of Design and Construction, 20 years ago, and this established the "framework of sustainability." In 2015, Commission 7, Sustainability, was founded.

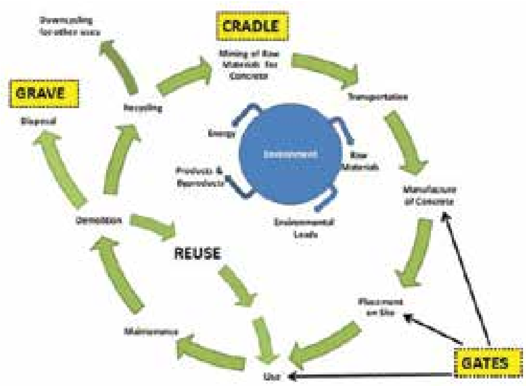


Fig. 1: Generic life cycle of a concrete product *(adapted from Jose, Aguado and Getta[15])*

Corres reported that the *fib* Model Code 2010 serves as a basis for future codes for concrete structures, and it presents new developments regarding concrete structures and structural materials. It also introduces concepts that will help achieve optimum behavior during the complete life cycle of structures, from conceptual design to dismantlement. He emphasized the importance of sustainability as a fundamental requirement in conceptual design. Model Code 2020, which is now under development, will be based upon sustainability (a holistic treatment of societal needs and impacts, life cycle cost [LCC], and environmental impacts) in both the design of new structures and all the activities associated with the through-life management and care of existing concrete structures, including matters such as in-service assessment and interventions to extend the life and improve the performance of these structures.

Sustainability Activities within ACI, *fib*, and ISO

Julie K. Buffenbarger, Chair of ACI Committee 130, Sustainability of Concrete, reported on the status of the guide the committee is developing. The document consists of two volumes: "Materials" and "Guidance Manual for Practitioners." The latter volume is being written for the design community. It encompasses climate change and resilience; design-, construction-, and use-phases; end of service life; codes; rating systems; and tools.

Buffenbarger stated that while concrete has intrinsically low carbon emissions (embodied energy) per unit volume, its economic affordability as a building material drives global volumes to more than 20 billion tons, thus contributing significantly to anthropogenic (man-made) greenhouse gas emissions overall. Regarding climate change and resilience, she emphasized that concrete structures offer a first line of defense against natural and man-made disasters.

The guidance document will discuss the attributes of concrete and their impacts throughout a concrete product's life cycle (Fig. 1).[15] For example, during the use phase of a concrete building, the thermal mass effects of concrete can result in energy savings for heating and cooling. Buffenbarger concluded that concrete is a construction product that plays an important, positive role in minimizing the impacts on built civilization by providing social, environmental, and economic benefits that lead to a favorable sustainable return on investment (SROI).

Petr Hájek, Chair of *fib* Commission 7, defined "sustainability" as the survival of humans on the earth, where serious issues such as climate changes, depletion of natural resources, environmental quality changes, and socioeconomic problems exist. The framework on the advantages of concrete structures in environmental, social, and economic aspects includes energy efficiency and resource savings; quality of the indoor environment; and security, safety, and economic efficiency. Hájek stressed the significance of an "integrated life cycle approach" toward viewing sustainability—holistically through examining life cycle considerations and predicting future performance.

In regard to the prediction of life cycle performance, four scenarios were shown: standard development of functionality (performance), development of functionality by increasing performance level, resiliency after disaster, and increased resiliency performance level. Hájek reviewed current activities of *fib*, and he outlined the foci of the seven task groups: sustainable concrete structures, application of environmental design, recycled materials, sustainable civil structures, environmental product declarations (EPDs), resilient concrete structures, and sustainable concrete masonry. He reviewed the status of the *fib* Model Code 2020, which will adopt a "sustainability" framework. Hájek concluded that sustainability should become a basic concept for the design, construction, operation, and maintenance of any concrete structure.

Koji Sakai, Chair of ISO/TC 71/SC 8, Environmental Management for Concrete and Concrete Structures, discussed the present and future of the ISO 13315 series of standards. The series is intended to provide the framework and basic rules on environmental management related to concrete and concrete structures. It also provides detailed rules designed to reduce environmental impacts of concrete structures—from the production of concrete constituents to the demolition of the final structure—all while also accounting for economic and social effects. ISO 13315-1, General Principles[16]; ISO 13315-2, System Boundary and Inventory Data[17]; and ISO 13315-4, Environmental Design of Concrete Structures[18] have been published. Currently, ISO 13315-6, Use of Concrete Structures, and ISO 13315-8, Label and Declaration, are under development at the committee draft (CD) and draft international standard (DIS) stages. Sakai emphasized that there are four benefits in the use of the ISO 13315 series: inventory data can be calculated with common transparent rules, environmental impacts can be quantitatively evaluated, the development of innovative concrete technologies can be promoted, and sustainability design can be conducted. He also strongly encouraged the application of those standards as a general practice.

New Technologies for Sustainability

Akira Hosoda, Yokohama National University, Yokohama, Japan, described application of "revolutionary" systems for the construction of long-life infrastructures. The systems were developed in 2007 at Yamaguchi Prefecture, Japan, in the form of a checklist featuring 27 fundamental items for preparation, transportation, placement, compaction, and curing practices. He mentioned that "revolutionary" means proper construction management practices. Remarkable reduction of harmful cracks was attained by application of these management systems. Hosoda indicated that this system has been extended to the Tohoku region, which was severely damaged by the earthquake and tsunami in 2011. Concrete structures in this region are exposed to severe deicing environments, so durability design and modified construction management were added to the original system. Protections adopted for durability design include use of fly ash or slag cement, a low water-cementitious materials ratio (*w*/*cm*), long-term curing, use of an expansive additive, inclusion of epoxy-coated reinforcing bars, and provision of sufficient air entrainment. Regarding the validity of such multi-protection measures, Hosoda stated the importance of LCC analysis from the cost data for past rehabilitations of a bridge, and it was concluded that the increased durability of the reinforced concrete slab was more economical than future repair. Hosada discussed the benefits of LCC evaluation, noting the importance in introducing sustainability design in balanced consideration with social, economic, and environmental aspects. Finally, Hosoda stated that the developed durability design systems are being supported by the Japanese government, and its practice extends to other regions.

Nemy Banthia, University of British Columbia, Vancouver, BC, Canada, discussed sustainability and fiber-reinforced concrete (FRC) in a holistic sense. Banthia introduced two classes of FRC, based on fiber dosage. In the low fiber dosage class, durability improvements such as low permeability under stress, reduced diffusion, enhanced pore refinement, reduced propensity for plastic shrinkage cracking, and control of reinforcement corrosion were demonstrated. In the high fiber dosage class, toughening, ductility, and high strain capacity were achieved. The latter FRC class can include eco-friendly ductile cementitious composites (EDCC), which demonstrate an elasto-plastic constitutive response and strain tolerance exceeding 6%. EDCC was recently used for seismic strengthening of unreinforced masonry (URM) in school buildings in British Columbia, Canada. Banthia asserted that in comparison to plain concrete, FRC offers a far more sustainable solution for both long-term durability and cost.

Fig. 2: ACI Concrete Sustainability Forum X speakers. From left: Nemy Banthia, Akira Hosoda, Fengming Xi, Petr Hájek, Khaled Awad, Hugo Peiretti Corres, Koji Sakai, and Julie K. Buffenbarger

Fengming Xi, Institute of Applied Ecology, Chinese Academy of Science, discussed the global CO_2 sink created by concrete carbonation. Xi opened his talk with the examination of the "carbon cycle" and society's impact on such. Carbon is net exchanged between atmospheric carbon, terrestrial carbon, and ocean/coastal carbon. Humankind adds CO_2 to this cycle by burning fossil fuels for transportation, energy, and industrial processes. Xi noted that while CO_2 emissions from the cement industry are attributed to energy emissions (about 50%) and process emissions from the decarbonation of limestone (about 50%), he emphasized that concrete carbonation is a highly ignored carbon sink. Carbon uptake—the cumulative total of CO_2 removed from the atmosphere over the entire life cycle of the product—occurs in concrete cement, mortar cement, construction waste cement, and cement kiln dust products. Using a concrete building as an example, he stated that carbon uptakes occur during the carbonation of concrete throughout the building's service life, its demolition, and in its secondary use stage by measurement of the carbonation layer. Carbonation coefficients can be determined for each of the concrete strength classes by application of Fick's diffusion law, assessing concrete surface area, and the building's exposure conditions. Xi estimated that the global carbon uptake by carbonating cement-based materials in 2013 was approximately 2.5% of the global CO_2 emissions from all industrial processes and fossil-fuel combustion in the same year, which is equivalent to 22.7% of the average net global forest carbon sink from 1990 to 2007. Xi also stated that the CO_2 emissions from cement manufacture are overestimated. In closing, he offered the following ideas for concrete to become a low-carbon material:

- Efforts to mitigate CO_2 emissions should prioritize the reduction of fossil-fuel emissions over cement process emissions, given that produced cement entails concomitant creation of a carbon sink;
- Using renewable energy sources for process energy in cement production, coupled with enhanced weathering of concrete waste to increase the completeness and rate of carbonation, may further reduce the impacts of cement manufacture; and
- Carbon capture and storage technology application to the cement process emissions may produce cements with net negative CO_2 emissions.

Actions for the Next Decade

As an introductory comment for discussion, Sakai stated: "When the Forum began in 2008 it was filled with excitement, although there was no direction for sustainability and uncertainty as to which path should be taken by the industry to achieve sustainable products and structures with concrete. However, after 10 years, new technologies and systems have been developed for the sustainability of concrete. What actions should be taken in the next decade?" Multiple responses to this question were received from the audience and speakers, including:

- Mandatory education at colleges and universities on the application of sustainability to engineering and architectural design;
- Code specification mandating the adoption of sustainability practices, similar to *fib* Model Code 2020;
- Renewable energy use increase at cement, concrete, and related concrete product manufacturing plants;

Paris Agreement and COP23

The 23rd Conference of the Parties (COP23) of the United Nations Framework Convention on Climate Change took place in Bonn, Germany, November 6-17, 2017. The conference confirmed its firm decision to oversee and accelerate the completion of the work program under the Paris Agreement by its 24th session (December 2018). The target of the Paris Agreement is to reduce anthropogenic emissions and enhance greenhouse gas sinks to hold the increase in the global average temperature to well below 2°C (3.6°F) above pre-industrial levels. The ACI Concrete Sustainability Forum will continue to contribute in the search for solutions for the concrete sector.

- Increased cement clinker performance;
- Governmental incentives or taxes designed to reduce emissions; and
- Innovative solutions to lower CO_2 in cement and concrete manufacture, delivery, and construction methodology.

In closing, technologies and practices have been adopted to lower the carbon footprint in the cement and concrete sectors over the last decade; however, there is still room for growth, adoption, and implementation of an enhanced sustainability framework. Change in the culture of a mature industry is a difficult and complex process. Nevertheless, assimilation of innovation and technology that provides reduced environmental demands, higher social value, and smart economics for concrete construction must be embraced to further the sustainable vision.

Acknowledgments

The authors would like to thank all the speakers for their invaluable contribution, as well as Steve S. Szoke, ACI Engineer, and Kevin Mlutkowski, ACI Director of Marketing, for their great efforts in the event preparation, and the participants who contributed to the fruitful discussions.

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Selected for reader interest by the editors.

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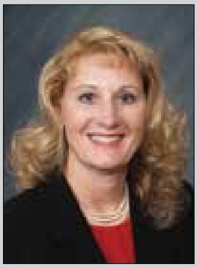

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RCC Dam Construction

Examples, project details, and design considerations

by Randall P. Bass and Gary Horninger

Roller-compacted concrete (RCC) is a low- or no-slump concrete mixture, typically placed with earth-moving equipment, for mass concrete applications. It differs from soil cement in that it is typically batched with engineered aggregates and has a higher cement content, resulting in greater compressive strength and durability.

RCC has been used to construct everything from dams to pavements. Its application for dams differs significantly from paving applications because dam placements must accommodate:

- Varying horizontal and vertical geometry;
- Limited access to the placement surface;
- Horizontal RCC lift placements of about 1 ft (0.3 m) compacted thickness;
- Integration of facing systems to protect RCC from exposure and provide a watertight barrier on the upstream face only; and
- The need to incorporate spillways, outlet works, galleries, joint treatments, and other features and treatments.

The type and configuration of a dam are primarily dictated by site conditions. Earth embankment gravity dams, for example, are well suited for sites with deep bedrock or soft foundation material. Straight RCC gravity dams are good candidates for sites with rigid foundation material and well-defined valleys with steep side slopes. It is also possible to incorporate bends into RCC gravity dams to take advantage of favorable foundation or abutment conditions. In contrast to earth embankment dams, RCC dams can be constructed with integral, wide spillways. This provides a significant cost advantage for projects that require large flood routing capacity, as large spillways for earth dams must be constructed separately from the dam.

RCC in Dam Construction

Some sites are suitable for composite dams comprising two or more construction types. Deep Creek Dam in Yadkin County, NC, is one such example. The dam site has shallow, competent bedrock on the right side of the valley and deeper, more variably weathered rock on the left side of the valley. The cost-efficient solution was to construct a 23 m (75 ft) high RCC gravity spillway and abutment closure section over the competent bedrock, coupled with a zoned earth embankment for the remainder of the impounding structure (Fig. 1). For such structures, special attention must be given to the interfaces between the deformable earthfill and rigid RCC materials. Cohesive soils compacted at optimum moisture

Fig. 1: Deep Creek Dam is a composite dam with an RCC gravity spillway and abutment closure section and an earth embankment section: (a) completed dam *(© photo courtesy of Aerial Photo Pros)*; **and (b) construction of the earth embankment section** *(© photo courtesy of Sky Site Images)*

content must be used at the wraparound to limit seepage and allow settlement of the embankment along the contact. Also, the chimney drain in the embankment must extend the full length of the downstream wrap. Other composite dams have been constructed using RCC and rockfill embankments, including the Saluda Dam in South Carolina and Duck River Dam in Alabama.

RCC gravity dam construction can also be used to build self-contained embankments. Taum Sauk Dam, in Reynolds County, MO, is an outstanding example—with a total length of over 1 mile (1.6 km), it holds the U.S. record for the quantity of RCC placed for a dam. The structure contains a hydroelectric pumped storage reservoir atop Proffit Mountain (Fig. 2). The unusual kidney bean shape was necessary to maximize storage volume.

RCC can also be used to raise existing concrete dams. For example, the original concrete San Vicente Dam in San Diego CA, was raised 117 ft (35.7 m) by building up the section on the downstream side (Fig. 3). To date, this is the largest RCC construction dam raise in the world.

Fig. 2: Taum Sauk Dam, designed by Paul C. Rizzo Associates, Inc., is composed of several million yd^3 of RCC and with inner and outer facings of conventional concrete *(photo courtesy of ASI Construction LLC)*

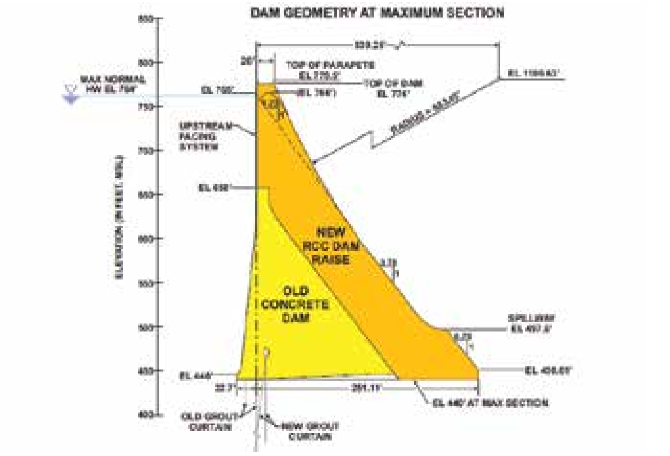


Fig. 3: RCC was used to raise the San Vicente Dam *(illustration courtesy of MWH, a Stantec company)*

Other examples of RCC dams in the United States include Big Haynes Creek near Conyers, GA; Hunting Run Dam near Fredericksburg, VA; and Portugués Dam near Ponce, Puerto Rico. The latter project was designed as an RCC arch-gravity dam that transfers some loading to the abutments through its arched shape (Fig. 4).

Project details and design concerns

For dam construction, RCC is placed in 1 ft lifts. The lifts make it easy to form steps that provide macro roughness elements in RCC spillways. The step and riser elements create turbulent pockets that provide significantly more energy dissipation than can be obtained using a smooth chute. The turbulence also bulks spillway flows with an increased amount of entrained air, resulting in lower residual energy at the basin and a much-reduced potential for cavitation (shock wave damage from water vapor bubble collapse). Thus, designers can use smaller terminal stilling basins.

Lift interfaces and joints require special attention to protect against seepage and damage. Leakage is mitigated using a facing that includes a robust positive water barrier. Because dams can be subjected to vegetation growth, weathering, and cyclic freezing, facing systems are also used on downstream faces. Typical facings comprise precast concrete, conventional concrete, or grout-enriched RCC (Fig. 5), any of which create a durable and resilient shell for the RCC mass.

Fig. 4: The RCC arch-gravity Portugués Dam has a total length of 1230 ft (375 m) *(photo courtesy of U.S. Army Corps of Engineers)*

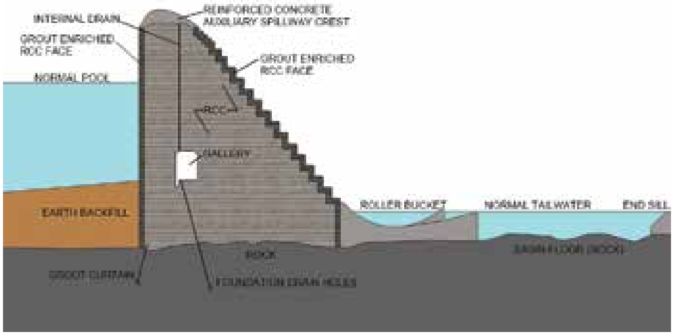


Fig. 5: Grout-enriched section at Deep Creek Dam *(© illustration courtesy of Schnabel Engineering)*

Fig. 6: A grout-enriched facing mixture is placed between previously placed RCC and formwork: (a) a mechanical vibrator is used to consolidate and combine the two mixtures; and (b) a completed test section *(© photos courtesy of Schnabel Engineering)*

Grout enrichment is the addition of a cementitious grout to the face of the RCC placement to effectively increase the cement content and density of the mixture (Fig. 6). RCC is held back from the formed face and the grout is introduced and mechanically vibrated to consolidate and combine with the RCC.

Because they are completed as part of the RCC lift placements, grout-enriched facing systems are less intrusive to the overall project schedule than conventional concrete facings. Current placement technologies do not result in a stable air void matrix within the grout, so grout-enriched facing systems are used only in climates that rarely experience freezing-and-thawing cycles. However, research is underway to optimize the stability of the air matrix within the grout and to refine the grout placement and consolidation methods.

RCC dam facing has also been constructed using geomembranes attached to precast concrete panels. Precast concrete facing panels are typically tied into the RCC lifts with anchors (Fig. 7), and installation can involve several processes if the panels include a liner requiring thermal welding and testing prior to RCC placement. Over the last two decades, exposed liner systems have been placed on the upstream face of older dams with seepage problems as well as on new dams. Because these systems are placed directly on the upstream face of the dam after it is completed, RCC production rates are not impacted.

Fig. 7: Facing panel installation with anchors embedded between RCC lifts *(© photo courtesy of Schnabel Engineering)*

Test section

Construction of a test section is a common project requirement with RCC dams (Fig. 8). This allows the contractor to demonstrate that the proposed means, methods, and equipment are capable of meeting project specifications. Lift joints, facing system, and consolidation of the RCC mixture can be also evaluated using a test section. If tests

Fig. 8: A test section is used to demonstrate conventional concrete facing for Taum Sauk Dam *(photo courtesy of ASI Construction LLC)*

Fig. 9: Two views of Hickory Log Creek Dam, Cherokee County, GA, with a stepped spillway that rises to 180 ft (55 m), making it the tallest RCC dam in the state and the fourth tallest in the world at the time of its construction *(© photos courtesy of Schnabel Engineering)*

Fig. 10: Fox Creek Dam, Fleming County, KY, is an example of an ogee weir cast over RCC *(© photo courtesy of Schnabel Engineering)*

indicate the need for modifications, the test section can be further segmented to verify acceptable results. Another benefit of test section construction is that the contractor's workforce becomes familiar with the materials and optimum placement processes prior to beginning work on the dam.

Spillways

A properly designed spillway will safely dissipate kinetic energy that accumulates as the flow accelerates down the chute. For RCC dams, conveyance and dissipation are accomplished through one or more of the following: stepped spillway chutes, straight or converging smooth chutes, flip buckets, and stilling basins. When highly concentrated flows, high heads, nonstandard design geometries, or unusual operations are encountered, it is beneficial to conduct scale model studies to verify conventional simulations of flow conditions. Such studies can uncover issues that are not readily apparent through conventional analyses and computer models.

Stepped spillways—the chutes downstream of spillway control sections—have been constructed using the stepped RCC placement technique (Fig. 9). Spillway step sizing is strongly influenced by hydraulic requirements, but step height is normally an even multiple of RCC lift thickness. This approach improves hydraulic performance while facilitating project construction sequencing and cost containment. As previously stated, the surfaces of stepped spillways are formed using conventional concrete or grout-enriched RCC. Stepped spillways are generally constructed with training walls to guide discharges down the face of the dam. For some projects, the spillway is incised within the cross section of the nonoverflow portion of the dam, with the turned section of the RCC mass faced with conventional concrete to perform the function of training walls.

Ogee weirs (Fig. 10), sharp crested weirs, and a variety of gates have been constructed on the crest of RCC dams as control sections. These structures involve the integration of cast-in-place sections with the top lifts of RCC at the spillway location. The conventional concrete is anchored into the RCC mass for stability.

Other Design Considerations

This article can't cover all RCC dam design and construction considerations in detail. However, it is possible to highlight some of the key issues that dam designers must consider.

Intakes/outlets and internal galleries

Unlike paving applications, RCC dams generally have obstructions such as intake/outlet structures and internal galleries (Fig. 5). These features interrupt the continuous placement of RCC material. Intake/outlet structures may be conventional cast-in-place concrete towers constructed upstream of the main dam. The outlet conduit typically passes through the placement footprint, and this requires special attention to detail. It is likely that RCC will be placed below and around the conduit, but special treatment is recommended around the conduit perimeter to prevent seepage at the interface between the conventional concrete and RCC.

Internal galleries are also common for RCC dams. Galleries permit access to the interior of the dam for inspection. They also collect water from internal, foundation, and face drains. Galleries can be constructed by mining the RCC. Alternatively, they can be formed of conventional or precast concrete.

Mined RCC galleries involve staged placement of loose, uncemented material that is subsequently excavated when the RCC placement reaches a set elevation. The resulting rough-faced walls of the gallery allow direct inspection of the RCC inside the dam.

Formed galleries are constructed by placement of braced forms (conventional formwork or precast concrete) at the gallery location and placing RCC or conventional concrete adjacent to the forms. Formed galleries will generally have smoother walls than mined galleries, but they hinder direct inspection of the RCC inside the dam. A variation of this concept is to construct a grout-enriched formed gallery, using similar procedures as used for grout-enriched facing.

Cracking and joints

RCC dams can bear significant hydraulic loads and are thus subject to seepage. Uncontrolled cracking in the RCC monolith is undesirable for both seepage and load-bearing considerations, so efforts must be taken to control cracking caused by factors such as:

- Local and global stresses and strains induced by thermal loads (that is, inadequate management and control of heat of hydration);
- Foundation discontinuities such as sharp vertical elevation changes;
- Variations in load deformation of adjacent foundation materials; and
- Stress concentrations near sharp transitions in dam geometry.

Some cracking issues are common to most dam sites, while others reflect responses to site-specific issues. While cracking can be minimized by mitigating the causative factors, some situations dictate the creation of a purposeful crack—a transverse joint depending on the length of the dam and the size of the placement. If cracking cannot be tolerated, provisions must be incorporated into the design to maintain structural integrity and adequate seepage control.

Transverse joints are constructed in several ways. One common method is to use a steel plate to insert polyethylene film into the RCC lift. The plastic sheet is wrapped around the

Fig. 11: Transverse joint construction by inserting and removing a plate in fresh RCC *(© photo courtesy of Schnabel Engineering)*

plate and a loader or other machine is used to press the wrapped plate through the lift thickness. Such joints are located where seepage can be collected and monitored. Figure 11 illustrates joint construction in the RCC placement by inserting and removing a steel plate in the RCC.

Horizontal joints also receive special attention. To maximize the bond between each RCC lift, specifications require lift surfaces to be kept clean and moist. Specifications also generally establish a maximum RCC lift surface exposure, in degree hours, beyond which the contractor is required to apply a bedding mortar on the noncompliant lift surface immediately prior to placement of the next lift.

Placement

RCC dams may also require additional attention to the cleanliness of the lift joints, placement of bedding mortar at conduit encasement perimeters, and the temperature of the fresh mixture and the placement. It is not uncommon to pressure wash and vacuum the surfaces between lifts, and bedding mortar may also be required.

Bedding mortar is typically a sand-cement mortar mixture that is spread thinly across the lift joint immediately before the next RCC lift is placed to promote bonding between the lifts. A retarding admixture may be specified for the bedding mortar to maintain workability and allow the subsequent RCC lift to be placed. Bedding mortar is typically deposited from the mixer truck or conveyor and spread with squeegees by hand.

Temperature control takes on greater importance in dams than in some other RCC applications. Specifications usually have temperature restrictions for both the fresh RCC mixture and the placement temperature. Some specifications may limit the maximum temperature of the fresh RCC to 75°F (24°C). This may require precooling the aggregates, placement at night, or other measures including ice or liquid nitrogen cooling.

Summary

RCC dams are ideal for sites with relatively shallow, rigid foundation material, particularly if the sites require large flood routing capacities. Although RCC dams require facing materials for protection against seepage and environmental damage, RCC lift construction facilitates the creation of stepped spillways that efficiently dissipate energy. Other design considerations include galleries, transverse joints, and bond between RCC lifts.

Selected for reader interest by the editors.

Randall P. Bass, Principal at Schnabel Engineering, joined the company in 2004. His dam engineering career began with the Georgia Safe Dams Program, followed by a work history that includes a national civil engineering firm and the Portland Cement Association, where he focused on RCC and soil cement for water resources applications. Bass has participated in several dam owner training workshops and was on a peer review team for the U.S. Army Corps of Engineers' national dam safety program. He received his BS and MS in civil engineering from the Georgia Institute of Technology, Atlanta, GA. Bass is active in the Association of State Dam Safety Officials and the United States Society on Dams. He is a licensed professional engineer in Georgia and several other states.

ACI member **Gary M. Horninger** is an Associate at Schnabel Engineering and has been with the company for 19 of his 28 years in professional practice. His focus on dam engineering and construction finds him often in the field for site investigations, construction oversight, and occasionally as a resident engineer. Horninger has also been the construction materials testing manager on projects ranging from new buildings with post-tensioned slabs to renovation of historic buildings. He serves on the Board of Directors of the Eastern Pennsylvania and Delaware Chapter – ACI. Horninger received his BS and MS in civil engineering from Drexel University, Philadelphia, PA. He is a licensed professional engineer in six states.

ACPA 2017 Excellence in Concrete Pavements Awards

The American Concrete Pavement Association (ACPA) named the recipients of its 28th Annual "Excellence in Concrete Pavements" awards, recognizing quality concrete pavements constructed in 2016 in the United States and Canada and honoring the associated contractors, engineers, and project owners. Two levels of achievement are awarded. Recipients of the ACPA 2017 Excellence Gold Awards, the highest level, are described in the following text. For the complete list of winning projects, visit **www.acpa.org**.

Reliever and General Aviation Airports

Reconstruction Project at Northwest Missouri Regional Airport, Maryville, MO

Evaluations at the Northwest Missouri Regional Airport resulted in low pavement condition index numbers for a portion of the airport's Runway 14-32, the north turnaround, and the northernmost taxiway connector from the apron. Also, deterioration of the north 4000 ft (1200 m) of the runway required emergency replacements of select concrete panels on an annual basis since 2011.

The project involved pavement demolition; fly ash stabilization of the subgrade; in-place recycling of the existing 6 in. (152 mm) concrete pavement for reuse as aggregate base course; and installation of drainage pipe, underdrains, and a new edge lighting system.

The airport was closed for the duration of the project to allow for the complete removal and replacement of the northernmost 4000 ft of runway pavement. A geotextile fabric was installed between the subgrade and base course to minimize the intrusion of fines into the base course, and a total of 38,000 yd^2 (32,000 m^2) of 6 in. concrete pavement was placed over the base course.

Stringless grade control was used for establishing the subgrade, base course, and pavement elevations. Sequenced paving lanes were used to avoid driving on the base course during paving.

Project credits: Ideker, Inc., Contractor; City of Maryville, MO, Owner; and Jviation, Inc., Engineer.

Commercial Service and Military Airports

Runway/Taxiway Reconstruction, Detroit Metropolitan Airport, Romulus, MI

The reconstruction of Detroit Metropolitan Airport's Runway 4L/22R required nearly 450,000 yd^2 (376,000 m^2) of concrete pavement, encompassing 6.5 miles (10.5 km) of airfield space. The runway is 10,000 ft (3000 m) long and 150 ft (50 m) wide.

Sequenced paving lanes on the Northwest Missouri Regional Airport

Reconstruction of Runway 4L/22R at Detroit Metropolitan Airport

The airport is Detroit's international hub, so the airport authority had to "fast track" the design and construction. Runway 4L/22R is used for aircraft arrivals and can accommodate operations in low-visibility conditions, making it critical to the airport's operations. The project also involved reconstruction of the associated taxiway system to provide a safe connection from the runway to the passenger terminals.

The planning, design, and construction incorporated sustainable practices, including the reuse of stormwater for dust control during construction, along with other initiatives. This project was completed on schedule, allowing Ajax to achieve the maximum allowable incentives outlined in the contract.

Project credits: Ajax Paving Industries, Inc., Contractor; Wayne County Airport Authority, Owner; and RS&H, Engineer.

Roller-Compacted Concrete (Industrial)

Walmart Distribution Center, Mebane, NC

The completion of the roller-compacted concrete (RCC) pavement at Walmart Distribution Center No. 6858 was the first RCC paving project built by Wal-Mart Stores, Inc. Wal-Mart is now specifying RCC for other distribution centers in the United States.

The Mebane distribution center project required 83,300 yd^2 (69,700 m^2) of 10.5 in. (267 mm) thick RCC; 7100 yd^2 (5900 m^2) of 6 in. (152 mm) thick RCC; 5400 yd^2 (4500 m^2) of 11 in. (279 mm) reinforced concrete dolly pads; and 2450 ft (750 m) of curb and gutter.

Despite project challenges such as site preparation delays, adverse winter conditions, and the complex details of the dolly pads, pavement construction was completed in just over 6 months.

Project credits: Morgan Corp., Contractor; Wal-Mart Stores, Inc., Owner; and Kimley-Horn, Engineers.

Industrial Paving

Circle Test Track Reconstruction at GM's Milford Proving Grounds, Milford, MI

The General Motors (GM) Milford Proving Grounds (MPG) was created in 1924, starting with 7 miles (11 km) of test roads on 1125 acres (455 ha) of land. By 1964, MPG had 73 miles (117 km) of test roads and a test track on 4011 acres (1623 ha) of land. The MPG Circle Test Track was constructed in November 1963. It comprises an upper concrete shoulder, five concrete driving lanes posted for speeds of up to 100 mph (160 km/h), and inner asphalt shoulders. The test track has a circumference of about 4.5 miles (7.2 km) and parabolic banking, with a 30% bank angle at the upper driving line. When it was completed, the expected service life for the track was 30 to 50 years.

The track is used for both development and durability testing, with about 900 vehicles traveling an estimated 1.5 million miles (2.4 million km) each year. After more than 5 decades of such heavy service, reconstruction of the track was needed. The project included patching of lane 5; removal and replacement of four concrete driving lanes and an inner asphalt shoulder; milling and replacement of asphalt ramps to the test track; resealing joints in the upper shoulder and lane 5; installation of an edge drain inboard of the inner shoulder; subgrade improvements; and installation of improved signage, electrical service, and striping.

The 8 in. (203 mm) thick pavement design included the latest Michigan Department of Transportation special provisions for high-performance concrete. GM also required that the new pavement incorporate a dolomite aggregate, as was used in the original pavement. The design matched the original 20 ft (6 m) transverse contraction joint spacing, but it also required four radial expansion joints to be placed at equal intervals around the track. The transverse and longitudinal joints were modified to be coated with an enhanced epoxy.

RCC construction at Walmart Distribution Center, Mebane, NC

Circle Test Track reconstruction at the GM Milford Proving Grounds

Placement of RCC pavement at the Brickhaven Ash Unloading Facility

State Highway 52 was restored using patching and diamond grinding

GM required ride quality evaluations for the new pavement surface. After Mean Roughness Index (MRI) evaluations and "seat of your pants" ride quality judgments by GM test drivers at speeds exceeding 150 mph (241 km/h), the 18 lane miles (29 lane km) of new pavement required corrective action at only one location in one lane.

Project credits: Ajax Paving Industries, Inc., Contractor; General Motors, Owner; and PEA, Inc., Engineer.

Roller-Compacted Concrete (Special Application)

Brickhaven Ash Unloading Facility, Moncure, NC

Andale Construction and HDR Engineering worked together to design a RCC pavement haul road that will carry 160,000 lb (73,000 kg) off-road haul trucks making 350 trips per day. The design called for 1 ft (0.3 m) thick RCC pavement on a 1 ft thick cement-treated base (CTB), all constructed on top of a 60 mil (460 micron) high-density polyethylene liner. The project scope also included two ramps, each with 10-degree inclines, and a 1000 ft (305 m) long by 30 ft (9 m) wide concrete trench for rail access to the loading area. The CTB was placed on the liner to protect it during construction of the trench. Trench construction involved 2000 yd^3 (1500 m^3) of concrete and 250,000 lb (113,000 kg) of steel reinforcement, and it was completed in 20 days. Lastly, the 1 ft thick, double layer RCC pavement was placed, requiring only 6 paving days.

Project credits: Andale Construction, Inc., Contractor; Green Meadows, LLC, Owner; and HDR Engineering, Engineer.

Concrete Pavement Restoration (CPR)

State Highway 52 CPR Project, Winneshiek County, IA

The hills of Northeast Iowa are a scenic attraction for tourists traveling on Iowa's State Highway 52. To ensure a smooth and quiet pavement and minimize traffic delays, the Iowa Department of Transportation (DOT) developed plans for an effective concrete pavement restoration (CPR) project that included partial-depth repairs, full-depth repairs, shoulder retrofits, dowel bar retrofit, diamond grinding, and joint resealing.

After the project was under contract, the DOT and Wicks Construction/Iowa Civil Contracting discovered that additional pavement restoration would be needed. Full-depth patching quantities doubled and the total area requiring partial-depth repairs increased by a factor of almost 13. The additional work added $2.5M to the original $6.2M contract. Despite the increased work, the project was successfully completed while still carrying traffic.

Project credits: Wicks Construction Inc., and Iowa Civil Contracting, Inc., Contractors; Iowa DOT, Owner; and WHKS & Co., Engineer.

Municipal Streets and Intersections (>30,000 yd^2)

I-49 and Peculiar Way Interchange Improvements, Peculiar, MO

The I-49 Interchange with Peculiar Way is in a growing area of Cass County, MO. The city of Peculiar and the Missouri Department of Transportation (DOT) partnered to fund a new diverging diamond interchange (DDI) to improve access to schools from I-49 and west of the highway.

The DDI design allows traffic to cross from the right side of the road to the left side at two signalized intersections on either side of the interchange. These crossovers allow for free flowing right turns in advance of the crossovers, and free flowing left-turns between the crossovers. In addition to construction of the DDI, Peculiar Way was extended from School Road through the interchange to Peculiar Drive, creating new access to the northern region of Peculiar.

The project involved more than 130,000 yd^3 (99,000 m^3) of excavation; 4300 ft (1300 m) of storm sewer; a new overpass; two signalized intersections; 6500 yd^2 (5400 m^2) of sidewalk

Construction of the diverging diamond interchange at I-49 and Peculiar Way

and median islands; 17,000 ft (5200 m) of curb and gutter; and more than 50,000 yd^2 (42,000 m^2) of concrete paving.

Project credits: Emery Sapp & Sons, Inc., Contractor; Missouri DOT, Owner; and George Butler Associates, Inc., Engineer.

Municipal Streets and Intersections (<30,000 yd^2)

State Highway 42, Sister Bay, WI

Wisconsin's WIS 42 corridor is predominantly a two-lane highway connecting as well as serving as the "main street" of many communities. Businesses along the project route are heavily dependent on tourist traffic, so when reconstruction of a section of WIS 42 was needed in the Village of Sister Bay, WI, the project requirements were carefully balanced with the needs of the affected businesses. The project team focused on safety enhancements, protection of the environment, minimizing future maintenance needs, and minimizing the disturbance to the local economy and tourism industry. Public outreach was a priority to keep the local public officials and businesses informed of the progress. In consideration of the importance of tourism and the associated seasonal population influx, construction was split into eight stages.

Early in the project, Vinton Construction proposed the placement of high-early-strength permanent concrete pavement in lieu of using temporary asphalt paving. Paving the 1.54 lane mile (2.5 lane km) project with 20,389 yd^2 (17,050 m^2) of 8 in. (203 mm) concrete was completed 163 days ahead of schedule, and the construction cost was $173,000 under the contractor's bid amount.

WIS 42 serves as the "main street" of many communities

Heavy rains were a major challenge during construction of County Road M-56

Project credits: Vinton Construction Company, Contractor; Wisconsin DOT and Village of Sister Bay, Owners; and REI Engineering, Inc., and Village of Sister Bay, Engineers.

County Roads

County Road M-56, Dickinson County, IA

The summer population of Dickinson County increases to 100,000 people each year, as vacationers and anglers gather in Iowa's Great Lakes region. Many tourists access the area using US Highway 9. County Road M-56 is a heavily traveled north-south artery that intersects US Highway 9.

A new 30 ft (9 m) wide concrete pavement with 2 ft (0.6 m) earth shoulders was designed to carry the traffic. Shoulder access was unavailable, so Cedar Valley Corp., LLC (CVC), trimmed and placed concrete with one machine. The modified dual-lane trimmer configured with a dumping belt placed the concrete and allowed the crew sufficient space to set contraction joint dowel baskets on the trimmed grade before the concrete was placed ahead of the paver. The trimmer/placer operator electronically manipulated a swinging dump chute to spread the concrete in front of the paver and over the recently placed baskets. This also helped maintain a consistent head of concrete.

The day after CVC erected a portable plant, heavy rains began, dropping 6 in. (152 mm) of rain during 8 of the following 12 days. The plant site was so saturated that CVC had to abandon its material drive-over. CVC used a hopper conveyor belt to transfer aggregates from higher ground to be closer to the plant, as well as a bulldozer and motor grader to aid the movement of haul trucks in and out of the plant site.

Although the project area was closed to through traffic, CVC had to maintain local access. Dickinson County specified a temporary 2325 ft (709 m) long rock access road, but the 5 in. (127 mm) of rock placed on a virgin field required considerable effort, and the situation worsened with almost daily rains. A recycled asphalt base helped the trucks move in and out of the facility.

CVC achieved excellent smoothness on the project and earned 86% of the maximum smoothness incentive bonus and nearly $14,000 in thickness bonus. CVC crews also finished the project in 35.5 working days, well under the specified 50-day limit.

Project credits: CVC, Contractor; and Dickinson County, IA, Owner and Engineer.

State Roads

US-56 Reconstruction, Gray, KS

This project involved the reconstruction of US-56 in the towns of Ensign and Montezuma, KS. The scope for the 7.6 lane mile (12.2 lane km) project included placement of 56,920 yd^2 (47,590 m^2) of 9 in. (229 mm) concrete pavement, supported by 4 in. (102 mm) of cement-treated base (CTB), all constructed in four distinct phases.

Compliance with strong specifications for erosion control has become a major factor in all highway construction projects. During the grading and subsequent operations, considerable attention was devoted to preventing sediment from leaving the project site.

Koss Construction produced the CTB and concrete using a pug mill and a mobile plant. The contractor's quality control department continually tested the concrete. During each test, ambient air temperature, concrete temperature, slump, air content, and unit weight were determined and verified to be within the project specifications. Flexural strength test beams were made at the beginning and end of each day of paving, and random coring was performed to verify thickness.

The project was completed within 319 working days.

Project credits: Koss Construction Co., Contractor; Kansas DOT, Owner; and Transystems, Engineer.

US-56 reconstruction was completed within 319 working days

One of the 17 horizontal curves on the Allamakee-B-38-Postville project

Overlays, Streets, and Roads

Allamakee-B-38-Postville, Allamakee County, IA

The 5.46 mile (8.8 km) project contained 17 horizontal curves and 23 vertical curves that closely followed a meandering, existing profile. Seven of the vertical curves exceeded 3%, and one approached 6%. The work was executed by Cedar Valley Corp., LLC (CVC). Allamakee County was deluged with 7.5 in. (191 mm) of rain in June alone, but then the weather took a turn for the worse. Some 26.7 in. (678 mm) of rain fell between July and September, and the area was declared a state and federal disaster area.

This obstacle was compounded by the traffic control plan for the job, which specified that all adjacent property owners would be able to traverse the project at all times. CVC had to keep property owners informed as to when their driveways would be impacted, as the roadway was the owner's only access route in this hilly terrain. CVC crews also had to accommodate wide farm equipment and numerous grain trucks as the fall harvest was well underway during the construction. Despite these challenges, profilometer measurements verified that CVC completed pavement with an average smoothness of 2.39 in./mile (38 mm/km) along the entire project length.

Project credits: CVC, Contractor; and Allamakee County, Owner and Engineer.

Overlays, Highways

State Highway 13 Resurfacing Project, Moffat County, CO

Castle Rock Construction Company (CRCC) constructed a 6 in. (152 mm) concrete overlay on State Highway 13, north of Craig, CO. To produce the concrete for this project, CRCC mined and processed 47,000 tons (43,000 tonnes) of rock and sand. The company's concrete batch plant provided the concrete for all 131,000 yd^2 (110,000 m^2) of the overlay. Prior to placing the overlay, the road's existing asphalt surface was roto-milled to smooth both the profile and cross slope. The milled asphalt was then placed as road base material for the shoulders.

During excavation, the contractor had to clean out a ditch and culvert pipes to create better flow and prevent the ditch and neighboring land from flooding. After the work was done, CRCC placed riprap to keep the slopes from eroding.

Colorado State Highway 13 was reconstructed using a 6 in. concrete overlay

Colorado State Highway 119 was reconstructed using 9 in. dowelled concrete pavement

Project credits: CRCC, Contractor; Colorado DOT - Region 3, Owner; and Colorado DOT - Region 3, Craig Residency, Engineer.

Urban Arterials and Collectors

State Highway 119 Reconstruction, Longmont, CO

State Highway 119 between I-25 and County Line Road is a growing corridor north of Denver that connects Longmont to Boulder and the surrounding cities. This 4 mile (6 km) highway reconstruction project included placement of 200,000 yd^2 (167,000 m^2) of 9 in. (229 mm) dowelled concrete pavement; 75,000 yd^2 (63,000 m^2) of full depth reclamation; and placement of 18,000 yd^3 (14,000 m^3) of riprap. The project also included deck resurfacing on two bridges; the construction of new approach slabs; placement of 75,000 yd^3 (57,000 m^3) of embankment material; and removal of 135,000 yd^2 (113,000 m^2) of pavement.

The 2013 floods in Colorado had caused scouring around the piers of the St. Vrain Creek bridge and a box culvert in Idaho Creek. The Colorado Department of Transportation (DOT) required repair of the flood damage as well the installation of protection against future flooding. Castle Rock Construction Company (CRCC) used inflatable coffer dams to divert water and worked in phases to keep the waterways flowing as they completed the repair work. Riprap was placed on the slopes for over a mile (1.6 km) and around the structures in the waterways to prevent future damage.

Throughout the project, major focus was placed on minimizing adverse impacts on the traveling public. Efforts included the use of an adaptive traffic signal system that minimized traffic disruptions by changing the timing of signals to accommodate traffic flows. CRCC efforts were successful, as the project was completed in December 2016, well ahead of the contracted summer of 2017 completion deadline.

Project credits: CRCC, Contractor; Colorado DOT - Region 4, Owner; and Colorado DOT - Region 4, Boulder Residency, Engineer.

Divided Highways (Rural)

South Lawrence Trafficway (K-10), Douglas County, KS

The scope of the South Lawrence Trafficway (K-10) project entailed the construction of a new alignment for state highway K-10. The new, four-lane freeway completes K-10 from the south junction of U.S. 59/K-10 to existing K-10 on the east side of Lawrence.

The project included the construction of bike paths and creation of more than 300 acres (121 ha) of new wetlands; the relocation of sections of Louisiana Street, 31st Street, and Haskell Avenue; and the extension of 31st Street. The project also included large-scale earthworks, drainage systems, soil stabilization, and utilities work. Major efforts were made to avoid disruption to the 927 acre (375 ha) Baker Wetlands during construction of the roadway embankment. These efforts included the use of recycled timber mats and limiting equipment ground pressure to 5 psi (30 kPa). Sound walls and landscaping were added to provide increased protection to the ecosystem after construction.

The project required the construction of 21 bridges; 4.35 million yd^3 (3.3 million m^3) of grading; 527,000 yd^2 (441,000 m^2) of concrete paving; and 102,000 ft^2 (9500 m^2) of sound wall. The 9.5 in. (241.3 mm) concrete pavement was placed using stringless paving equipment. The pavement spanned 6.33 miles (10.19 km), for a total of 43.23 lane miles (68 lane km).

Project credits: Emery Sapp & Sons, Inc., Contractor; Kansas Department of Transportation, Owner; and HNTB Corp., Engineer.

Major efforts were made to avoid disruption of an existing wetland during construction of the South Lawrence Trafficway (K-10)

Divided Highways (Urban)

Grand Parkway Project, Houston, TX

When completed, SH 99 will be a 180 mile (290 km) highway traversing seven counties in the Greater Houston Area. SH 99 construction comprises 11 segments. Zachry was the managing joint-venture partner of Zachry-Odebrecht Parkway Builders (Z-O), the developer and lead contractor responsible for the development of SH 99 segments F1, F2, and G, comprising 37.8 miles (61 km) of divided two-lane controlled access toll road that intersects 19 major roads and includes four major interchanges.

Z-O worked with the Texas Department of Transportation (TxDOT) to design, construct, and maintain the road. The project scope included 120 bridges; one river crossing; 1.8 million yd^2 (1.5 million m^2) of concrete paving; frontage roads and associated drainage; right-of-way acquisition management of approximately 480 parcels (2127 acres [861 ha]); and the design, coordination, and relocation of 177 utilities. The project team accelerated construction through planning and sequencing of its activities, as well as using an on-site precast yard to fabricate beams and deck panels.

Project credits: Zachry Construction Corp. and Odebrecht Construction, Inc., Contractors; TxDOT, Owner; and Parsons Transportation Group and The Transtec Group, Inc, Engineers.

One of the four major interchanges on Houston's Grand Parkway Project

Three-Sided High-Rise in Mexico City

Torre Reforma provides a model for concrete construction in earthquake zones

With its distinctive triangular volume and towering concrete walls, Torre Reforma is an aesthetically pleasing addition to the skyline of Mexico City, Mexico (see Fig. 1). Arup worked with L. Benjamin Romano Arquitects (LBRA) to ensure that the 57-story mixed-use building was not only striking in appearance but also safe in its performance—a concern in the seismically active location.

"Arup has been indispensable in helping to transform my architectural vision into an efficient and buildable structure," said Benjamin Romano, Principal of LBRA. "They have provided innovative solutions to the complex seismic issues in Mexico City and have been instrumental in helping the bidding contractors understand that Torre Reforma is not more complex than standard vertical construction; it just applies traditional construction methods, that contractors are already familiar with, in a new and different way."

Tabitha Tavolaro, Associate Principal at Arup and Project Manager for Torre Reforma, said, "Building tall structures in Mexico City often means working in constrained conditions. Challenges can include small or irregular sites, coordinating diverse teams, and, of course, seismic hazards. In this project, we partnered with LBRA to create robust solutions that bring value to the client as well as the community."

Fig. 1: Torre Reforma, Mexico City, Mexico: (a) front elevation; and (b) the north façade

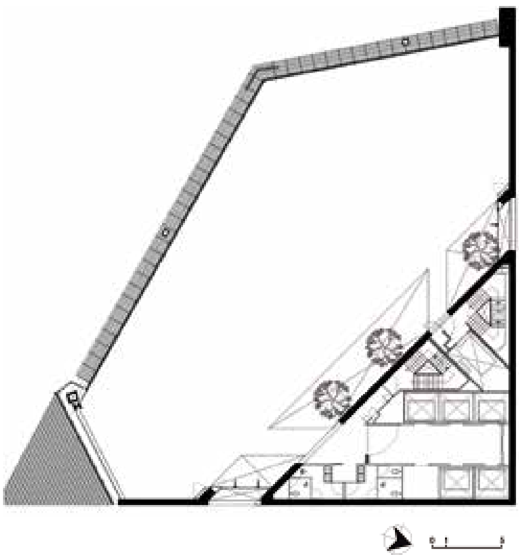


Fig. 2: A plan view of Level 41 at Torre Reforma. The north and east façades comprise perforated reinforced concrete shear walls

Fig. 3: Structural components of Torre Reforma: (a) shear wall formwork; and (b) atrium view of truss and perforated concrete shear wall

An Aesthetic Structure

Romano's design departs from the norm not only in form but also in its merging of materials with structure. Arup devised pre-tensioned double-V hangers that brace the glazed façade and simultaneously create a signature visual identity for the building. Because the architecture is so closely aligned with its material expression, the finish of the concrete is critical. Several design mixtures were evaluated; the final choice flowed well and created a surface that's free of honeycombing or flaws. The concrete was placed in increments of 700 mm (28 in.), highlighting the subtle variations in color that occur naturally across multiple concrete placements.

The Core in the Corner

In conventional skyscrapers, vertical circulation is typically located in the central core of the building. At Torre Reforma, the elevators and egress stairways are contained in the apex of the triangle (see Fig. 2). This, paired with the long-span pyramidal floor trusses that allow plumbing, electrical, and mechanical systems to be concealed within the structure, results in maximum ceiling heights and a column-free interior, facilitating unobstructed, dramatic views over adjacent Chapultepec Park and the city from every level.

Designed for Stability

Set in an area with a long history of significant seismic activity, skyscraper construction in Mexico City poses complicated engineering challenges. Because Torre Reforma is triangular in plan, the building has an inherent tendency to twist when subjected to wind or earthquake. Arup applied a comprehensive time-history analysis to establish the performance of the structure under extreme seismic conditions and engineered a solution that is both locally appropriate and consistent with international best-practice designs for tall buildings (Fig. 3). Torre Reforma will be able to withstand the full range of earthquake activity projected for a period of 2500 years. According to Tabitha Tavolaro: "The building resisted the September 7th and September 19th seismic events with zero observable structural damage."

Green Goals

In addition to its structural innovations, the building offers extensive sustainability features. Pre-certified as a LEED Platinum Core and Shell project, Torre Reforma has multiple water conservation systems, including rainwater collection and gray- and black-water recycling plants. Interior temperatures are moderated using a combination of automated and passive ventilation. The tower's two reinforced concrete façade walls also contribute to the energy efficiency of the building—reducing the cooling load by protecting the interior from direct sun and providing thermal mass to modulate diurnal temperatures.

—Arup, **www.arup.com**

Selected for reader interest by the editors.

What's New from aci

TECHNICAL DOCUMENTS

CP-19 22nd Edition: Technician Workbook for ACI Certification of Concrete Strength Testing Technician

This workbook contains information about the ACI Concrete Strength Testing Technician (CSTT) certification program, study questions, sample checklists, and a practice exam, as well as reprints of all the resource materials referenced by the certification examinations.

CP-1 36th Edition: Technician Workbook for Concrete Field Testing Technician—Grade I

A study guide for the examinee, this workbook provides information and instructional material on the required ASTM testing procedures.

ACI UNIVERSITY ONLINE COURSES

On-Demand Course: Hot-Dip Galvanized Rebar: It Works

Learning Objectives

1. Discuss the hot-dip galvanizing process.
2. Identify reasons specifiers choose galvanized reinforcing steel (corrosion protection, durability, longevity, availability, sustainability, and cost).
3. Understand design issues affecting hot-dip galvanized reinforcing steel performance in concrete.
4. Recognize the positive environmental and economic contributions of hot-dip galvanizing to the goals of sustainable development.

Continuing Education Credit: 0.1 CEU (1 PDH)

On-Demand Course: Evaluation of Concrete Structures

Learning Objectives

1. Explain the tasks and responsibilities of owner groups, licensed design professionals, and contractors on concrete evaluation, repair and renovation of deteriorated or damaged concrete structures.
2. Identify potential evaluation methods and strategies for rehabilitation of concrete structures.
3. Describe techniques to renovate and repair damaged or corroded parking deck slabs with unbonded post-tensioned tendons.
4. Recognize the engineering challenges of evaluation and repair of existing structures. Describe successful techniques to repair and renovate deterioration in prestressed precast concrete parking structure, including punching shear overstress in slabs, and spalling at deck expansion joints.

Continuing Education Credit: 0.1 CEU (1 PDH)

On-Demand Course: New Developments in Chemical Admixtures—An ACI 212 Update

Learning Objectives

1. Identify the important changes in the ACI 212R-16 Report on Chemical Admixtures for Concrete from the previous version.
2. Describe some different ways concrete mixed with admixtures, properly designed to improve concrete workability, finishability, strength, and durability properties, adds sustainability qualities to concrete structures.
3. Explain how workability retaining admixtures effects the concrete workability properties at the point of truck delivery.
4. Identify some effects viscosity modifying and rheology modifying admixture have on improving the workability of concrete.
5. Discuss effects of some admixtures have on placing, compacting, and finishing pervious concrete pavement.

Continuing Education Credit: 0.15 CEU (1.5 PDH)

Products & Practice

Atlas Copco HiLight V4 and LED HiLight V5+

Atlas Copco's HiLight V4 and the LED HiLight V5+ light towers are lightweight, compact, and include the company's HardHat® canopy for extreme durability in rugged applications such as construction and roadbuilding. A HiLight V4 tower has four 1000 W metal-halide lamps and can illuminate an area of up to 4000 m^2 (43,000 ft^2). A HiLight V5+ tower features long-lasting, energy-efficient LED bulbs and can illuminate an area up to 5000 m^2 (53,000 ft^2). The LED lamps are rated for 10,000 hours and are able to withstand a range of challenges, from vibrations during transport to harsh work environments.

—Atlas Copco, **www.atlascopco.com**

MOVEO IR Videoscope

Karl Storz's infrared MOVEO® IR Videoscope is a portable video endoscope for direct-view inspections of confined and hard-to-reach spaces. It features a fully integrated display, LED infrared source, and intuitive operating software. The IR Videoscope is designed to fit in the operator's hand and can be used for extended periods without operator fatigue. The complete system, particularly the tungsten-braided sheath, was built to meet the demands of remote operations. The sheath's four-way deflection and precise angulation of up to ±150 degrees provide safe and effective performance of inspection functions. The operator can choose between 1.5 and 3 m (5 and 10 ft) of working length.

—Karl Storz, **www.karlstorz.com**

Allen MP245 Mechanical Pro Riding Trowel

The MP245 Riding Trowel is Allen's most compact hydraulic power steering riding power trowel. Although it is compact, it has the same ergonomics, features, and durability found in Allen's larger riders. The compact size of the machine allows it to fit on slabs where bigger riders will not, eliminating the need for multiple walk-behinds. MP245 features include hydraulic joystick power steering; 22 hp (16 kW) Honda engine; two 36 in. (914 mm) diameter, four-blade nonoverlapping rotors; rotor speeds from 45 to 165 RPM; electric powered spray system for retardant application; and cruise control.

—Allen Engineering Corporation, **www.alleneng.com**

BarChip MQ58

Elasto Plastic Concrete's BarChip MQ58 is a high-performance structural macro synthetic fiber concrete reinforcement, optimized for pavements and industrial floors. The unique design and material composition of BarChip MQ58 fibers allow them to remain embedded below the concrete surface without any changes to normal finishing processes. BarChip MQ58 has a dosage rate of 2.5 to 5 kg/m^3 (4 to 8 lb/yd^3), is added "Bags and All" to the mixer with initial batch water, and can be pumped through 50 mm (2 in.) rubber hoses. The fiber reinforcement conforms to ASTM C1116/C1116M Type III and EN 14889-2.

—Elasto Plastic Concrete, **www.elastoplastic.com**

MK Diamond 5 in. IXL Hinged Vacuum Shroud

Designed for use on grinders, the MK Diamond Products' 5 in. (127 mm) IXL Hinged Vacuum Shroud uses the air velocity created by the rotating grinding wheel to channel dust particles away from the work surface. This technology improves removal of abrasive dust particles, which enhances the grinding process by increasing visibility and extending the cup wheel life. The shroud can be used for grinding, cleaning, leveling, removing epoxies, urethanes, paint, and other coatings on concrete or masonry. The shroud is made from an "abrasive resistant" plastic to prevent wear from the grinding process. The hinged nose shroud easily flips to the side for grinding against walls and edges.

—MK Diamond Products, **www.mkdiamond.com**

MovinCool Portable Spot Air Conditioners

DENSO Corporation's MovinCool portable spot air conditioners enhance the drying of construction materials such as drywall joint compound, paint, and flooring adhesives. The industrial strength blowers pull in large volumes of moist air and push out warm, dry air that can be directed at wet areas. The self-contained air conditioners can be rolled into position. Drying begins immediately after the exhaust duct is attached and the unit is powered up.

—DENSO Corporation, **www.denso.com**

SCOFIELD Ready-Mix Truck Defoamer

SCOFIELD Ready-Mix Truck Defoamer is a blend of air release and detraining additives designed for use in concrete, mortar, or cementitious overlay systems. The air detrainer reduces bug holes and large air voids that interfere with the creation of polished floors, floors to be coated, or high-density/high-strength interior floors and structures. It can be used routinely in concrete mixture designs and for batch correction of young mixtures with unexpectedly high air levels. The defoamer can be used with all Scofield integral coloring products.

—SCOFIELD, **www.scofield.com**

Hilti 22 V Tool Line

Hilti 22 V tools feature Hilti's 22 V CPC Li-ion batteries with backwards-compatible technology. The SF 6H-A22 hammer drill/driver incorporates Active Torque Control (ATC) for greater operator control. ATC minimizes kick back by shutting off the tool if the housing begins to rotate too quickly. The SID 4-A22 impact driver is compact and ergonomic, allowing control and precision in screw fastening applications. The driver has four ultra-bright LEDs positioned around the chuck for improved illumination of the base material, and three gears and electronic speed control allow easy switching between different driving speeds. The SF 10W-A22 ATC drill/driver can drill up to 6 in. (152 mm) holes in multiple layers of wood. It features four gears for drilling in metal and other base materials. The RC 4/36 radio charger is a rugged combination of a radio and battery charger built for tough jobsite conditions. It delivers great audio quality while charging Hilti 18 V, 22 V, or 36 V Li-Ion batteries.

—Hilti, Inc., **www.hilti.com**

Web Notes

CEMEX Go

CEMEX Go is a fully digital customer integration platform. Users can review their history of transactions, track their shipments real-time via GPS, receive instant notifications of their order status, adjust orders, and have full visibility and transparency of information needed to better manage business. Users get more done in less time by simplifying and streamlining interactions with CEMEX and reducing administrative tasks.

—CEMEX, **www.cemex.com**

Book Notes

fib Bulletin 82 Precast Segmental Bridges

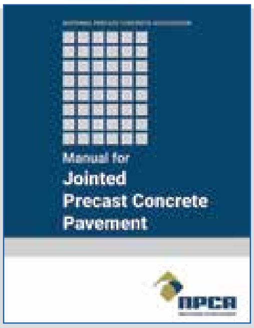
fib Bulletin 82 "Precast Segmental Bridges" provides a historical overview of precast segmental bridge development. It describes the available techniques for production of the elements and construction of bridges. This book addresses the strong interaction between design, production, and construction; specific aspects of design, production and construction; and maintenance, repair and demolition. *fib* Bulletin 82 also presents case studies. The report concludes with a bibliography and exemplary projects.

—*fib*, **www.fib-international.org**

183 pp.; ISBN: 978-2-88394-122-9

Products & Service Literature & Videos

Jointed Precast Concrete Pavement



The National Precast Concrete Association (NPCA) worked closely with two expert practitioners to create a photo- and schematic-rich manual that provides comprehensive information on precast concrete pavement. The document covers topics such as pavement design, shop drawing preparation, panel fabrication, installation details, project execution, and maintenance of completed installations. The manual is a living document and will be updated on a continual basis. The document can be viewed at **https://precast.org/wpcontent/uploads/2017/10/JPrCP_Manual_2017.pdf**.

—NPCA, **https://precast.org**

Anchorage Systems

Fortec Double T Anchor

Fortec Stabilization's Double T Anchor is a U-shaped carbon fiber-reinforced polymer (CRFP) composite connector that is surface-prepped for installation. The CRFP profile was designed using finite element models to evaluate horizontal and vertical forces. Fortec Double T Anchors significantly reduce relative movement between adjacent double-T flanges while allowing for a small amount of flex in the joint. Physical tests were used to verify that the connectors can withstand over 10 times the flange movement that would occur without the support of an adjacent flange. In addition, cyclic tests have shown that the connector can withstand over 1,000,000 cycles of strain that would be imposed in a standard installation.

—Fortec Stabilization Systems, **http://fortecstabilization.com**

MB Stud Extender

The MB Stud Extender is designed as an adjustable height support chair for embed/weld plates. It eliminates the need for wood forming or "wet setting" of embed plates in the top-face of a concrete panel. The MB Stud Extender is available in 1 and 1-1/4 in. (25 and 32 mm) sizes and adds up to 5 in. (127 mm) to the length of the stud. It is ideal for use in insulated panels, as it can extend through the foam without creating a thermal bridge.

—Meadow Burke, **http://meadowburke.com**

SDS/2 Concrete

SDS/2 Concrete provides tools to automate detailing and fabricating of reinforcing bars. Users can automatically generate detailed bending and placing schedules, as well as placement drawings, from three-dimensional model information. Concrete embeds are simplified with SDS/2. Features include automatic creation of embed plates, full design calculations for embeds, two-dimensional drawings created with little to no cleanup, and layout tools for continuous embeds.

—SDS/2, a Nemetschek Company, **https://sds2.com**

H-B TBS Thermal Brick Support

Hohmann & Barnard's (H-B) TBS Thermal Brick Support is engineered from the ground up to reduce thermal bridging at brick veneer support angles, improving the energy efficiency of the building. The brick veneer support system for masonry wall construction allows for the installation of continuous insulation behind the support angle. The system can be designed for use with standard concrete inserts or with H-B's Sharktooth Insert, which allows adjustments in multiple directions to accommodate construction tolerances. The TBS Thermal Brick Support is available in hot-dip galvanized steel or Type 304 and 316 stainless steel.

—Hohmann & Barnard, Inc., **www.h-b.com**

Simpson Strong-Tie SET-3G High-Strength Anchoring Adhesive

Simpson Strong-Tie SET-3G™ High-Strength Anchoring Adhesive is formulated to yield superior performance in threaded rod anchor and reinforcing bar dowel installations, in cracked and uncracked concrete, and at elevated temperatures. The two-component, one-to-one-ratio, epoxy-based anchoring adhesive formula dispenses in a uniform gray color to match surrounding concrete surfaces and can be installed in downward, horizontal, vertical, and overhead orientations. SET-3G adhesive is designed for dry or water-saturated use conditions with temperatures between −40 and 176°F (−40 and 80°C).

—Simpson Strong-Tie, **www.strongtie.com**

Trubolt+ Wedge Anchor

ITW Red Head®'s Trubolt+® Wedge Anchor features a high-strength studded body that can resist high wind and seismic tension. It can be used in both cracked and uncracked concrete. The anchor is designed to have 360-degree contact with concrete, providing a strong hold. Trubolt+ anchors can be placed close to free edges of concrete, and they can be closely spaced.

—ITW Red Head, **www.itwredhead.com**

Kryton International Acquires Cementec

Kryton International Inc. acquired Calgary-based Cementec Industries Inc., a manufacturer of concrete additive solutions. Hard-Cem®, the integral concrete hardening admixture developed by Cementec, provides concrete with resistance to abrasion and erosion. With this admixture, concrete floors and infrastructure can last up to six times longer than untreated concrete. Cementec also manufactures silica fume products that are used to densify and strengthen concrete. These Cementec solutions can be used in conjunction with Kryton's Krystol Internal Membrane™ (KIM®) system.

Morley Builders Celebrates 70-Year Anniversary

Founded in 1947, Morley Builders has been in the construction landscape of Southern California. Company Founder Morley Benjamin's vision began with the construction of single-family housing for veterans returning from WWII. Along with partner Sherman (Tex) Given, the company soon took on more projects of structural steel and concrete. The company led the recent construction renaissance within the Los Angeles Broadway District, reflected in the adaptive reuse of the Ace Hotel/United Artists Building.

LafargeHolcim Builds Retail Network for Construction Materials in Latin America

LafargeHolcim opened its first Disensa franchise store in Mexico. Disensa provides self-builders and smaller contractors access to LafargeHolcim's building solutions as well as other construction materials and services. The Group also established a training center in Mexico that provides training on product know-how, store management, marketing, and finance. Future Disensa franchises will be introduced in markets of Colombia, Central America, and Argentina.

Makita USA Expands Distribution and Training Capabilities with Dallas-Area Facility

Makita® USA expanded its capabilities with a new distribution and training center located in Wilmer, TX, just outside Dallas. The building includes a 4000 ft^2 (370 m^2) training center, offering tailored curriculum and hands-on training. For dealer partners, training will focus on increasing their knowledge of Makita's technologies. For contractors and end users, the focus is application-driven, as users are shown the right accessories and the right tools for the job.

Rudy Ricciotti Wins Colored Concrete Works Award 2017

LANXESS presented its third Colored Concrete Works Award in Berlin, Germany, on May 17, 2017, to a distinguished architect who has achieved something unique in the use of colored concrete. The award went to Rudy Ricciotti for his "Musée des Civilisations de l'Europe et de la Méditerranée" (MuCEM) project in Marseille, France. The building is constructed of a total of 1100 m^3 (1440 yd^3) of concrete in the form of prefabricated concrete slabs and 250 m^3 (330 yd^3) of in-place concrete. The dark gray color tone was provided by the LANXESS pigments Bayferrox 330 and Bayferrox 318.

Construction Industry Round Table Announces Board and Chairman Elections

The Construction Industry Round Table (CIRT), the national business trade association comprised of approximately 120 chief executives from design and construction companies doing business globally, elected Wayne A. Drinkward as Chairman for a 1-year term. He succeeds H. Ralph Hawkins, Chairman Emeritus of HKS, Inc. Drinkward was elected during CIRT's Annual Spring Meeting, which occurred during Infrastructure Week in Washington, DC, and which also welcomed new directors.

Meadow Burke Opens Headquarters in Tampa, FL

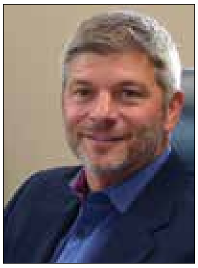
Meadow Burke combined its manufacturing, distribution, engineering, and business support functions into a new facility at 6467 South Faulkenburg Road, Riverview, FL. To support the ongoing growth of the business and form a single customer-focused location necessitated the construction of a new facility, which incorporates Meadow Burke's tilt-up and reinforcing accessories and was engineered by the Meadow Burke team. The 48,000 ft^2 (4500 m^2) facility incorporates "hot shot" manufacturing capabilities to provide shorter lead times on products prevalent in the Southeastern United States, in addition to special request items. The distribution center features space-functional racking for efficient inventory management.

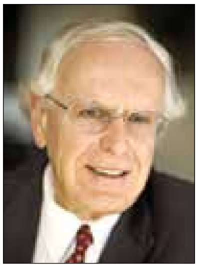
Concrete Industry Foundation's 2017 Honors Dinner

The Concrete Industry Foundation, Inc. (CIF) sponsored its Second Annual Scholarship Awards Dinner on September 12, 2017, at The New York Athletic Club, New York City, NY. Now in its 24th year, CIF awarded 11 scholarships of $2000 to students from engineering, architecture, and technical programs in the New York metropolitan area. The Humanitarian Fellow Medal was presented to Jay Badame, President and COO of AECOM Tishman. The CIF 2017 James Anderson Distinguished Service Award was presented to Reginald D. Hough, a worldwide architectural concrete consultant. The CIF Lifetime Achievement Award was presented posthumously to Vincent J. DeSimone, Founder and Chairman of DeSimone Consulting Engineers.

On the Move


Kesselmayer


Stimac


Bažant

Walter P Moore announced two Senior Principals and six Principals. ACI member **Mark Williams**, Senior Principal, Managing Director/Houston Diagnostics, specializes in rehabilitating critical structures that are exposed to aggressive environments such as bridges, hyperbolic paraboloid cooling towers, stadiums, parking structures, and building enclosures. He is a member of ACI Committees 342, Evaluation of Concrete Bridges and Bridge Elements, and 345, Concrete Bridge Construction, Maintenance, and Repair; and Joint ACI-ASCE Committees 334, Concrete Shell Design and Construction, and 343, Concrete Bridge Design.

Daron Hester, Senior Principal, Director of Operations/ Diagnostics Houston, specializes in solving structural, façade, and dampproofing issues, and conducts assessments, develops repair documents, and performs construction administration services.

Thomas Duncan, Principal, Managing Director/Traffic Houston, has led projects ranging from traffic simulations to traffic design. His portfolio includes data collection and forecasting, as well as designing, planning, and developing road realignments and improvements.

Armen Megerdoomian, Principal, Senior Parking Consultant/Parking Los Angeles, is the West Coast Parking Lead for Walter P Moore. He approaches his niche from the perspective of the users: both drivers and pedestrians.

Susendar Muthukumar, Principal, Senior Engineer/ Structures R&D Austin, specializes in advanced structural modeling, steel design, post-tensioned concrete design, vibration analysis, and performance-based engineering.

Ricardo Martinez, Principal, Project Manager/Structures Houston, manages commercial project types such as office and mixed-use developments, healthcare, sports, parking garages, research facilities, and high-rise luxury residential.

Erin Kueht, Principal, Project Manager/Structures Houston, manages a variety of complex structural projects in sports, education, commercial, and healthcare.

Raquel Ranieri, Principal, Project Manager/Structures Los Angeles, specializes in lean construction and seismic design, and works on complex projects for large institutions in higher education, entertainment, and sports.

The Precast/Prestressed Concrete Institute (PCI) named **Michael Kesselmayer** its Managing Director of Quality Programs. Kesselmayer will lead the certification staff, serve as the staff liaison with the Quality Activities Council, and help represent PCI and its certification programs with outside organizations. He joins PCI after 37 years with the testing and inspection firm Professional Service Industries (PSI). Kesselmayer is experienced in the construction materials testing and inspection industry with developing, implementing, and ensuring compliance with quality and safety programs, including concrete materials testing. He has held leadership roles in ASTM Committees C09, Concrete and Concrete Aggregates, and E36, Accreditation and Certification. Kesselmayer served on the Executive Group of Cement and Concrete Reference Laboratory, and has also served on the Board of Directors and as Chairman of the American Association for Laboratory Accreditation.

Braxton-Bragg named **Rick Stimac** CEO following Rich Hassert's retirement. Stimac recently served as Vice President/ Chief Sales and Marketing Officer of Gustave A. Larson Co. He has more than 25 years of leadership experience in various markets.

Honors and Awards

ACI member **Feraidon Ataie**, Assistant Professor of Engineering, California State University, Chico (CSU-Chico), won the 2017 ASTM International Professor of the Year Award. The award recognizes the contributions of educators in developing students' understanding of standards. Ataie joined CSU-Chico as a faculty member in 2014, and has been the Concrete Industry Management (CIM) Program Director since 2015. He incorporates ASTM International standards into his classwork, including courses in the fundamentals of concrete and concrete repair. Ataie also developed a workshop on volumetric concrete at the 2017 World of Concrete. He received his bachelor's degree in civil engineering from Kabul University, Kabul, Afghanistan, and his master's and doctoral degrees in civil engineering from Kansas State University, Manhattan, KS. Ataie is a member of ACI Committees 123, Research and Current Developments; 211, Proportioning Concrete Mixtures; and 236, Material Science of Concrete.

ACI Honorary Member **Zdeněk P. Bažant**, Professor at Northwestern University and former director of Northwestern's Center for Geomaterials, received the American Society of Mechanical Engineers' (ASME) Medal at the Society's 2017 International Mechanical Engineering Congress and Exposition. Bažant was recognized "for developing a statistical theory of the strength and lifetime of quasi-brittle materials of random material properties, as well as verifying it with experimental evidence and demonstrating its relevance to structural safety." ASME further cites Bazant "for formulating a kinetic energy release theory for material comminution into particles or random sizes under extreme strain rates." A Fellow of the American Academy of Arts and Sciences, Bažant is the recipient of seven honorary doctorates from universities around the world. He is a member of various ACI committees.

Calls for

Papers

Analysis and Testing for Bridge Evaluation and Design

Meeting: Technical session on "Advanced Analysis and Testing Methods for Concrete Bridge Evaluation and Design" at The ACI Concrete Convention and Exposition – Fall 2018, October 14-18, 2018, in Las Vegas, NV; sponsored by ACI Committee 342, Evaluation of Concrete Bridges and Bridge Elements, and Joint ACI-ASCE Committee 343, Concrete Bridge Design.

Solicited: Presentations are invited on state-of-the-art and emerging technologies for the strength evaluation and design of concrete bridges using advanced computational analysis and load testing methods. The following topics are considered: advanced nonlinear modeling and nonlinear finite element analysis, structural versus element rating, determination of structure-specific reliability indices, load testing beyond the service level, load testing to failure, and use of continuous monitoring for detecting anomalies.

Requirements: 1) presentation title; 2) author/speaker name(s), title, organization, and contact information; and 3) an abstract of up to 200 words. The Special Publication will follow the ACI Publications Policy. Authors are encouraged to consult the ACI Author Guidelines, which describe the requirements for submission of manuscripts.

Deadlines: Abstracts are due by February 12, 2018; final papers are due by October 31, 2018.

Send to: Ben Dymond, University of Minnesota – Duluth, e-mail: dymond@d.umn.edu; and Bruno Massicotte, Polytechnique Montréal, e-mail: bruno.massicotte@polymtl.ca.

Material Science and Engineering

Meeting: 9th International Conference on Material Science & Engineering (IMS2018), July 23-25, 2018, in Toronto, ON, Canada.

Solicited: Abstracts of 200 to 250 words are invited. For accepted abstracts, at least one author must register for the conference for the paper to be published in the conference program and proceedings. We encourage our colleagues to limit their submission to not more than two abstracts per author (one poster and one paper). All abstracts will be reviewed by members of the technical committee.

Requirements: All submissions must be in Microsoft Word format and should include a separate title page listing the following: title of paper, author(s), organization affiliation(s), complete mailing address, e-mail address, and keywords (three to four keywords).

Deadlines: Abstracts are due by February 28, 2018; final text is due by April 31, 2018.

Send to: Khandaker M. Anwar Hossain, Ryerson University, e-mail: IMS9_2018@ryerson.ca; telephone: +1.416.979.5000, ext. 6452/7867.

Offshore and Marine Concrete Structures: Past, Present, and Future

Meeting: Two-part technical session on "Offshore and Marine Concrete Structures: Past, Present, and Future" at The ACI Concrete Convention and Exposition – Spring 2019, March 24-28, in Quebec City, QC, Canada; sponsored by ACI Committee 357, Offshore and Marine Concrete Structures.

Solicited: Offshore and marine concrete structures have not received enough attention in the recent past, at least in the United States. The complexity and safety concerns associated with these structures are such that they probably need more attention compared to many other types of concrete structures. Also, offshore and marine concrete structures are so global in nature that there is a higher need for better coordination and synchronization of design, construction, inspection, and maintenance practices in different parts of the world. This two-part session will highlight the past, present, and future of marine concrete structures. Academics, researchers, practitioners, engineers, scientists, and manufactures from all across the world will benefit from this session.

Potential topics for the session include, but are not limited to, the following: overview of offshore and marine concrete structures; materials technology; advances in design and construction practices; advances in inspection, maintenance, and repair practices; innovative and emerging technologies; international practices; landmark and historic projects; lessons learned from the past; and a path forward for offshore and marine concrete structures.

Papers will be peer reviewed and accepted papers will be included in an ACI Special Publication.

Requirements: 1) Paper title; 2) author/speaker name(s), title, organization, and contact information; and 3) an abstract not exceeding 300 words.

Deadlines: Abstracts are due by March 15, 2018; manuscripts of selected papers are due by May 15, 2018.

Send to: Mohammad S. Khan, High Performance Technologies, Inc. (HPTech), e-mail: mkhan@hptech-inc.com.

Cement-based Materials and Structural Concrete

Meeting: SynerCrete 18, Interdisciplinary Approaches for Cement-based Materials and Structural Concrete, October 24-26, 2018, in Funchal, Madeira Island, Portugal.

Solicited: The theme of SynerCrete 18 is "Synergizing Expertise and Bridging Scales of Space and Time."

Conference topics will include concrete technology and advanced material testing, multi-scale in time and space modeling and experiments, multi-physics simulation and structural design, BIM and structural concrete, robotics and cement-based materials, digital fabrication, on-site monitoring and structural condition assessment, new materials, and fiber-reinforced concrete and nonmetallic reinforcement.

Requirements: Submit an online abstract of 500 words maximum in plain text. Visit https://synercrete.com for more information.

Deadline: Abstracts are due by March 23, 2018.

Contact: info@synercrete.com.

Structural Health Monitoring of Intelligent Infrastructure

Meeting: 9th International Conference on Structural Health Monitoring of Intelligent Infrastructure (SHMII-9), August 4-7, 2019, in St. Louis, MO; organized by Missouri S&T.

Solicited: SHMII-9 will address the theme of "Transferring Research into Practice." Abstracts and papers are solicited to report the research and development of new and emerging technologies, the new guideline and innovative approach to facilitate technology transfer, the unique field demonstrations of existing and new technologies, and the development of special programs of general interest. Preference will be given to abstracts and papers focused on transferring research into practice. Visit https://shmii-9.mst.edu for more information.

Deadline: Abstracts are due by May 1, 2018.

Technical inquiries: Genda Chen, SHMII-9 Conference Chair, e-mail: gchen@mst.edu, telephone: +1.573.341.4462.

Notable Concrete in Las Vegas and Vicinity

Document: Compendium of notable concrete in Las Vegas and vicinity for e-publication at The ACI Concrete Convention and Exposition – Fall 2018 in Las Vegas, NV, October 14-18, 2018; compiled by ACI Committee 124, Concrete Aesthetics and co-sponsored by the Las Vegas Chapter – ACI, AIA Las Vegas/AIA Nevada, and SEASoN. The document will also be available as an electronic file on the ACI website, and may be excerpted in *Concrete International*. Images submitted will be stored and available as electronic files on the ACI website and may be used in ACI educational and promotional materials. Exceptional images may merit placement on the cover of *Concrete International*.

Solicited: Image and brief description of notable concrete (cast-in-place, precast, post-tensioned, masonry, or tilt-up) in all types of uses—buildings, monuments, pavement, silos, bridges, crypts, furniture, retaining walls, utility poles, tanks, sculpture, culverts, plazas, and whatever else has caught your attention. Significance may be historical, aesthetic, sustainable, functional, structural, construction-related, unusual use or application, or simply personal affection.

Requirements: 1) Name and location of submission; 2) image (photograph, drawing, or sketch) that is not copyrighted; 3) brief description that establishes significance and lists credits; and 4) submitter's name, title, organization, city and state, telephone, and e-mail address. Location information should include zip code. Submit all information in electronic format: image as JPG or TIFF file at least 1 MB (but no more than 4 MB); text in e-mail or as Microsoft Word document (120 words maximum). No PDF files, please.

Deadline: Materials are due by July 1, 2018.

Send to: Michael J. Paul, Larsen & Landis, 11 W. Thompson St., Philadelphia, PA 19125, mpaul@larsenlandis.com.

Prestressed Concrete with Conventional and Nonconventional Materials

Meeting: Technical session on "Prestressed Concrete with Conventional and Nonconventional Materials" at The ACI Concrete Convention and Exposition – Fall 2019, October 20-24, 2019, Cincinnati, OH; sponsored by ACI Committee 345, Concrete Bridge Construction, Maintenance, and Repair.

Solicited: The special session will focus on the recent advancement of prestressed concrete for bridges and structures using conventional and nonconventional materials. Presentations and technical papers will include the conceptual development of innovative prestressed concrete, laboratory experiments, numerical modeling, and case studies. State-of-the-art prestressing techniques and nonconventional materials such as fiber-reinforced polymer (FRP) composites to address the sustainable performance of concrete members will also be considered. An ACI Special Publication will be published.

Requirements: 1) Presentation/paper title; 2) author/speaker name(s), title, affiliation, and contact information; and 3) an abstract of 200 words.

Deadlines: Abstracts are due by July 31, 2018; final papers are due by November 30, 2018.

Send to: Yail Jimmy Kim, University of Colorado Denver, e-mail: jimmy.kim@ucdenver.edu; and Hiroshi Mutsuyoshi, Saitama University, e-mail: mutuyosi@mail.saitama-u.ac.jp.

Calls for Papers: Submission Guidelines

Calls for papers should be submitted no later than 3 months prior to the deadline for abstracts. Please send meeting information, papers/presentations being solicited, abstract requirements, and deadline, along with full contact information to: Keith A. Tosolt, Managing Editor, *Concrete International*, e-mail: keith.tosolt@concrete.org. Visit www.callforpapers.concrete.org for more information.

Meetings

FEBRUARY

6-8 - **2018 NCMA Annual Convention**, Indianapolis, IN
https://ncma.org/ncma-annual-convention

7-8 - **Canadian Concrete Expo**, Toronto, ON, Canada
http://canadianconcreteexpo.com

9-10 - **ICON Expo 2018**, Indianapolis, IN
http://iconexpo.org

9-13 - **2018 ICPI Annual Meeting**, Indianapolis, IN
www.icpi.org/2018annualmeeting

20-24 - **2018 PCI Convention and National Bridge Conference**, Denver, CO
www.pci.org/PCI/News-Events/Event_Display.aspx?EventKey=CONV18

22-24 - **The Precast Show 2018**, Denver, CO
http://precast.org/theprecastshow

THE CONCRETE CONVENTION AND EXPOSITION: FUTURE DATES

2018 — March 25-29, Grand America & Little America, Salt Lake City, UT

2018 — October 14-18, Rio All-Suite Hotel & Casino, Las Vegas, NV

2019 — March 24-28, Quebec City Convention Centre and Hilton Quebec Quebec City, QC, Canada

2019 — October 20-24, Duke Energy Convention Center & Hyatt Regency Cincinnati Cincinnati, OH

For additional information, contact:
Event Services, ACI, 38800 Country Club Drive,
Farmington Hills, MI 48331
Telephone: +1.248.848.3795
www.concrete.org/events/conventions.aspx

ACI Industry Events Calendar:

For more information and a listing of additional upcoming events, visit **www.concrete.org/events/eventscalendar.aspx**. To submit meeting information, e-mail Lacey Stachel, Editorial Coordinator, *Concrete International*, at lacey.stachel@concrete.org.

MARCH

4-7 - **2018 NSSGA Annual Convention**, Houston, TX
www.nssga.org/major-event/nssga-2018-annual-convention

5-6 - **5th Ibero-American Congress on Self-Compacting Concrete and Special Concrete (HAC 2018)**, Valencia, Spain
http://hac2018.hac-bac.webs.upv.es/en_presentation.html

5-10 - **IFCEE 2018**, Orlando, FL, www.ifcee2018.com

6-10 - **2018 CSDA Convention & Tech Fair**, Maui, HI
www.csda.org/?page=Convention2018

11-13 - **ASA 20th Anniversary Event: First ASA Shotcrete Convention and Shotcrete Technology Conference**, Napa, CA
www.shotcrete.org/pages/news-events/20thAnniversary.htm

19-21 - **RILEM Spring Convention**, Barcelona, Spain
www.rilem.net/agenda/1206

24-27 - **ACPA Annual Convention**, San Diego, CA
www.concretepipe.org/event/acpa-annual-convention-3

APRIL

3-6 - **4th Doctoral School LC3, Characterisation methods of blended cements**, Lausanne, Switzerland
www.lc3.ch/doctoralschool

5-7 - **2018 TMS Spring Meeting**, New Orleans, LA
https://masonrysociety.org/meetings/2018-tms-spring-meeting

16-18 - **Advances in Materials and Pavement Performance Prediction**, Doha, Qatar, www.am3p.com

APRIL/MAY

29-1 - **16th International Congress of Polymers in Concrete (ICPIC2018)**, Washington, DC
http://icpic2018.unm.edu

MAY

6-9 - **PTI Convention 2018**, Minneapolis, MN
www.post-tensioning.org/page/PTI-Convention

6-10 - **60th IEEE-IAS/PCA 2018 Cement Conference**, Nashville, TN, www.cementconference.org

Sinopsis en español

El Foro de sostenibilidad del ACI celebra 10 años

Sakai, K., y Buffenbarger, J.K., *Concrete International*, V. 40, No. 2, febrero de 2018, págs. 25-29

El Foro X de sostenibilidad del ACI se celebró en 2017 en el ACI Concrete Convention and Exposition en Anaheim, California. El Foro contó con presentaciones de ocho oradores, incluidos los presidentes del ACI y fib. Los temas presentados incluyeron actividades de sostenibilidad dentro del ACI, fib, y ISO, nuevas tecnologías para la sostenibilidad, y acciones para la próxima década.

Construcción presa RCC

Bass, R.P., y Horninger, G., *Concrete International*, V. 40, No. 2, febrero de 2018, págs. 31-36

Se destacan las características clave de las presas de concreto compactado con rodillo (RCC por sus siglas en inglés), usando varios tipos de presas como ejemplos. Los temas incluyen interfaces de capas, sistemas enfrentados, vertederos, entradas y salidas, galerías internas y juntas. Las secciones de ensayo se recomiendan para capacitación y para demostrar que los sistemas, métodos y equipos propuestos para un proyecto cumplirán con las especificaciones del proyecto.

ACPA 2017 Premios de Excelencia en Pavimentos de Concreto

***Concrete International*, V. 40, No. 2, febrero de 2018, págs. 37-43**

La American Concrete Pavement Association (ACPA por sus siglas en inglés) nombró a los ganadores de su 28º Premio Anual de "Excelencia en Pavimentos de Concreto", reconociendo los pavimentos de concreto de calidad y honrando a los contratistas, ingenieros y propietarios de proyectos asociados. Se otorgaron premios de nivel de oro y plata a 29 proyectos construidos en 2016 en los Estados Unidos y Canadá. Los premios de nivel de oro se resumen en este número.

Tres lados de altura elevada en la Ciudad de México

***Concrete International*, V. 40, No. 2, febrero de 2018, págs. 44-45**

Torre Reforma, un edificio de uso mixto de 57 pisos, es una nueva adición al horizonte de la Ciudad de México, México. El edificio es de planta triangular con elevadores y escaleras de salida contenidas en el ápice del triángulo y cerchas piramidales de piso de largo vano. Las cerchas encubran los sistemas de plomería, eléctricos y mecánicos, y permiten alturas de techo máximas y un interior sin columnas, lo que facilita vistas sin obstáculos sobre la ciudad desde todos los niveles.

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Chloride Concentration in Soil and Exposure Classes

Q. *I'm designing a structure that will be exposed to chlorides in soil, so I'm reviewing the requirements listed in Table 19.3.2.1 — Requirements for concrete by exposure class, in ACI 318-14.[1] The chloride concentration in the soil is lower than the concentration in seawater, so can I specify concrete with a strength value between 2500 and 5000 psi (17.2 and 34.5 MPa), based on C1 and C2 exposure classes, respectively?*

A. ACI 318-14 does not take into account the amount of salt present. Exposure to any amount of salt is considered a concern for corrosion. In the case you describe, if the soil is moist, the chlorides will penetrate the concrete toward the reinforcing steel and can initiate corrosion, even at concentrations well below that of seawater. Therefore, the project described in the question clearly falls into Exposure Class C2, which requires a maximum water-cementitious materials ratio (*w*/*cm*) of 0.40 and a minimum specified compressive strength of 5000 psi.

References

1. ACI Committee 318, "Building Code Requirements for Structural Concrete (ACI 318-14) and Commentary (ACI 318R-14)," American Concrete Institute, Farmington Hills, MI, 2014, 519 pp.

Thanks to Terry Holland, Auburn Township, OH, Chair of ACI Subcommittee 318-A, General, Concrete, and Construction, and R. Doug Hooton, University of Toronto, Toronto, ON, Canada, for providing the answer.

Cleaning Slabs during Tilt-up Construction

Q. *Does ACI provide recommendations on cleaning concrete slabs during tilt-up construction?*

A. ACI 551.1R-14[1] discusses this topic. Section 6.2.2 states that "some form of cleaning may be necessary to ensure complete removal of all bond breaker residue." While it recommends contacting "the bond breaker manufacturer for specific cleaning recommendations," it also notes that cleaning may be difficult:

"Bond breaker residue on casting slab and wall panel surfaces can be difficult to remove depending on the type of product used and how heavy it was applied. Residue from wax-containing bond breakers is virtually impossible to completely remove, which may result in compatibility concerns with subsequently applied liquid floor treatments, floor coverings, and wall paints and coatings."

References

1. ACI Committee 551, "Guide to Tilt-Up Concrete Construction (ACI 551.1R-14)," American Concrete Institute, Farmington Hills, MI, 2014, 42 pp.