MARCH 2020 V. 42 No. 3

Ci Concrete international

The Magazine of the Concrete Community

Decorative & Architectural Concrete

aci American Concrete Institute


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Concrete international
The Magazine of the Concrete Community

MARCH 2020 V. 42 No. 3


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March

Concrete international

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In 2018, the Australian Islamic Mission celebrated the completion of its mosque in the Punchbowl suburb of Sydney, Australia. Designed by architect Angelo Candalepas of Candalepas Associates, the mosque has an inspirational interior featuring a ceiling comprising 102 quarter-sphere muqarnas (minidomes) and a structural steel dome supported by a concrete ring beam. Prior to completion, the Punchbowl Mosque had already won the 2018 Sulman Medal for Public Architecture. To learn more, see the article starting on p. 37 *(cover photo by Adrian Curtin, courtesy of Boral Australia)*

departments

IN Ci

In Plain Sight

An architectural or decorative concrete project might be most positively perceived if it attracts minimal attention. That paradox creates challenges for designers, concrete producers, and contractors (artists) who create these embossed or polished concrete surfaces; but successful design and construction teams meet these challenges through expertise and communication.

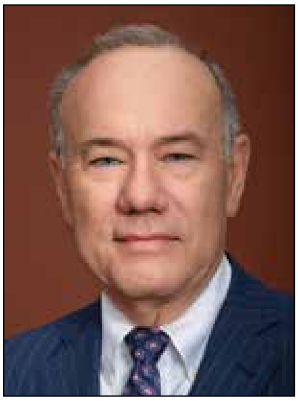
For example, a polished concrete surface should have a uniform color and consistent aggregate patterns to appeal to most owners, so the concrete polisher will need to communicate and negotiate with the concrete contractor to obtain a suitable canvas (see "CPC Position Statement #5, Effects of Slab-Surface Finish Density on Polished Concrete," p. 41). Generally, a formed concrete surface should also have a uniform color and a continuous surface, but neither goal will be met if the concrete cracks. To help avoid this issue, for example, the designers of Sydney's Punchbowl Mosque collaborated with the concrete supplier to obtain a low-shrinkage mixture (see "An Awe-Inspiring Place," p. 37).

ACI has a different challenge, as success often requires drawing attention to the work products of its volunteers and staff. Among the six position statements recently issued by ACI, many encourage the adoption and use of ACI's documents and certification programs by other organizations (see "News," p. 14). With communication and negotiation, the expertise embodied in those work products will be most positively received.

Rex C. Donahey

President's
Memo

ACI's Work on Sustainability



Randall W. Poston
ACI President

From recent discussions with concrete professionals around the world, I have learned that it may seem like ACI is not engaged on the topic of sustainability. Nothing could be further from the truth. This is my last President's Memo, so I feel it is important to end my formal communications with a discussion of what ACI is doing with respect to sustainability.

One of the largest initiatives that ACI has entered into related to sustainability is through the ACI Foundation's donation of $50,000, specifically by the Concrete Research Council (CRC), to the Concrete Leadership Forum (CLF), an industry-sponsored academic collaboration. This donation, along with donations from various partners in the concrete industry, is being used to develop an Embodied Carbon in Construction Calculator, named EC3, to provide transparent and realistic measures of embodied carbon in concrete construction. EC3 is now in a beta phase and is being tested by concrete design professionals in the industry.

This past December, ACI presented a webinar on the topic of embodied carbon in concrete construction, hosted by Past President Anne Ellis with a technical presentation by Kate Simonen, founding Director of the Carbon Leadership Forum and Professor in the College of Built Environments at the University of Washington. The webinar highlighted and developed pathways for "carbon-smart" building materials to be part of the global climate solution, and it included an introduction of the EC3 tool as a viable means for owners, designers, and contractors to reduce GHG emissions in their building projects. The webinar was recorded and is available as an on-demand course on ACI's website at **www.concrete.org/store/productdetail.aspx?ItemID=W1918**.

ACI Committee 130, Sustainability of Concrete, has recently issued a report—ACI 130R-19, Report on the Role of Materials in Sustainable Concrete Construction—that provides an excellent, fair, and balanced discussion about cement manufacturing and the production of greenhouse gases relative to other industrial sectors in the United States. The fact is that cement is at the lower end of the spectrum when compared to the oil, gas, and chemical industries, and it is in the middle of energy consumption and greenhouse gas emissions compared to the other major construction materials. Moreover, it should be noted that the amount of energy used in production of cement today is approximately 40% lower than the amount used 40 years ago.

It is worth noting that ACI 318-14, Structural Concrete Building Code, in Section 4.9, provided for the first time that sustainability requirements can be used in design, in addition to the strength, serviceability, and durability requirements of the Code. In ACI 318-19, additional sustainability provisions were introduced. Provisions for the use of alternative cements and recycled aggregates, within limits, are now outlined for concrete production.

For the current ACI 318 Code cycle, Chair Andy Taylor has formed a new subcommittee (ACI Subcommittee 318-N, Sustainability) to work on greatly expanding the concrete building code provisions related to sustainability design. This subcommittee is being chaired by Shana Kelley. The plan is for the subcommittee to develop an appendix for the Code that will provide for materials, methods, and procedures to design concrete structures for sustainability.

The approach for sustainability design will be based on the "cradle-to-grave" concept, which not only looks at the embodied carbon and operational carbon for a building but also includes life-cycle cost or other rational analyses to quantitively demonstrate the effects of design options. Traditional sustainability design only includes the embodied carbon—the CO_2 generated up to the start of the life of a building, referred to as the "gate" or "starting gate." The analysis of service life, durability, and resiliency has to be considered for a realistic view of the sustainability of a concrete building.

It is hard to believe that my presidency is ending at the beginning of April. I hope this last memo communicates to Institute members and partners that greenhouse gas (GHG) emissions and global warming are huge topics for ACI as well as the world at large. Significant work is in fact going on within the Institute with respect to sustainability. Sustainability is here to stay, and all of us in the concrete industry must embrace the concept and do our part to ensure that concrete structures built today provide sustainability for generations of users.

Randall W. Poston
American Concrete Institute

Calls for Papers

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*, 38800 Country Club Drive, Farmington Hills, MI 48331; e-mail: keith.tosolt@concrete.org. Visit www.callforpapers.concrete.org for more information.

Precast Concrete

Meeting: First International Conference on Precast Concrete (PRECON 2021), April 12-14, 2021, Wuhan, China; organized by Wuhan University of Technology, China, and Ecole Polytechnique Fédérale de Lausanne, Switzerland.

Solicited: PRECON 2021 is dedicated to the science of precast technologies and will provide a platform for academic scholars and industrial practitioners to present their research on the following topics: hydration kinetics under accelerated curing conditions, microstructure evolution under accelerated curing conditions, accelerated curing technologies for manufacturing precast concrete, new binders, chemical admixtures, durability and service-life prediction, cracking susceptibility, mechanical properties, and energy-efficient processing technologies.

Requirements: Authors are invited to submit a one-page abstract (up to 300 words without figures and tables) for both oral and poster presentations in accordance with the conference topics. For more information, visit www.precon2021.org.

Deadline: Abstracts are due by April 1, 2020.

Contact: precon2021@163.com, +86.27.87651856.

Superplasticizers and Other Chemical Admixtures in Concrete

Meeting: Thirteenth International Conference on Superplasticizers and Other Chemical Admixtures in Concrete, November 1-3, 2021, Milan, Italy; organized by the Italy Chapter – ACI and sponsored by ACI.

Solicited: Original papers are invited to be presented at the conference and to be included in the refereed proceedings. Papers on current research will be accepted for presentation and inclusion in a volume of supplementary papers. Papers on research that has just started can be presented as posters. Conference topics will include chemistry of superplasticizers, also known as high-range water-reducing admixtures (HRWRAs); HRWRA compatibility with cements, blended cements, and aggregates; compatibility issues involving HRWRAs and other chemical admixtures; development and applications of other chemical admixtures; viscosity modifying for new binders; and corrosion inhibitors.

Requirements: 1) author name(s), affiliations, and mailing address; 2) if more than one author, indicate who will be the corresponding author; and 3) abstract with a maximum length of 300 words, submitted to http://www.aciitaly.com/events/socac2021/.

Deadline: Abstracts are due by April 30, 2020.

Contact: Direct questions to Valentina Trinchese, Italy Chapter – ACI Secretary, aciitalychapter@gmail.com.

Recent Advances in Concrete Technology and Sustainability Issues

Meeting: Fifteenth International Conference on Recent Advances in Concrete Technology and Sustainability Issues, November 3-5, 2021, Milan, Italy; organized by the Italy Chapter – ACI and sponsored by ACI.

Solicited: Original papers are invited to be presented at the conference and to be included in the refereed proceedings. Papers on current research will be accepted for presentation and inclusion in a volume of supplementary papers. Papers on research that has just started can be presented as posters. Conference topics will include sustainability issues and carbon dioxide emissions; carbon dioxide emissions reduction in the manufacturing of portland cement; durability and corrosion; service-life prediction and life-cycle analysis; recycled and artificial aggregates; porous concretes and no-fines concretes; and polymer and polymer-modified concretes.

Requirements: 1) author name(s), affiliations, and mailing address; 2) if more than one author, indicate who will be the corresponding author; and 3) abstract with a maximum length of 300 words, submitted to http://www.aciitaly.com/events/ractsi2021/.

Deadline: Abstracts are due by April 30, 2020.

Contact: Direct questions to Valentina Trinchese, Italy Chapter – ACI Secretary, aciitalychapter@gmail.com.

Notable Concrete in Raleigh and Vicinity

Document: Compendium of notable concrete in and near Raleigh, NC, for e-publication at the ACI Concrete Convention – Fall 2020, October 25-29, 2020, Raleigh, NC; compiled by ACI Committee 124, Concrete Aesthetics, and cosponsored by Carolinas Chapter – ACI and the AIA Triangle Chapter. The document also will be available as an electronic file on the ACI website and may be excerpted in *Concrete International.* Images submitted may 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 (including cast-in-place, precast, post-tensioned, masonry, and 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) project name and location, including postal code; 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, province or state, telephone, and e-mail address. Submit all information in electronic format: image as JPG or TIF file at least 1 MB (but no more than 4 MB); text in e-mail or as MS Word document (120 words maximum). No PDF files, please.

Deadline: Materials are due by July 1, 2020.

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

Durability, Service Life, and Long-Term Integrity of Concrete Materials, Bridges, and Structures

Meeting: Technical session on "Durability, Service Life, and Long-Term Integrity of Concrete Materials, Bridges, and Structures" at the ACI Concrete Convention, October 17-21, 2021, Atlanta, GA; sponsored by ACI Committee 345, Concrete Bridge Construction and Preservation; moderated by Yail Jimmy Kim, University of Colorado Denver; Chris P. Pantelides, University of Utah; and Xianming Shi, Washington State University.

Solicited: In this session, presentations of both experimental and analytical investigations are of interest, which may include the durability of concrete structures reinforced with steel or fiber-reinforced polymer bars, modeling of service life for concrete under aggressive environments, and the structural integrity and resilience of rehabilitated members. The session will emphasize recent research findings and provide an opportunity to discuss present challenges and technical issues.

Requirements: 1) presentation title; 2) author/speaker name(s), title, organization, mailing address, telephone number, fax, and e-mail; and 3) abstract of 200 words.

Deadline: Abstracts are due by August 31, 2020.

Send to: Yail Jimmy Kim, University of Colorado Denver, jimmy.kim@ucdenver.edu.

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Read more about this month's featured Sustaining Members in the profiles below!

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News

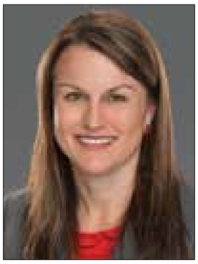
ACI Members Named to List of Most Influential People

Concrete Construction magazine recently released its 2020 list of the Most Influential People in the concrete industry. Four individuals were named to this year's list, and all have close ties to ACI: Jeffrey W. Coleman, Kimberly Kayler, Tim Manherz, and Scott M. Tarr.


Coleman

Jeffrey W. Coleman, FACI, is a licensed professional engineer and Attorney at Law and Principal Partner of The Coleman Law Firm, LLC, Minneapolis, MN. He is currently a Vice President of ACI and will begin a 1-year term as President of ACI at the conclusion of the ACI Concrete Convention – Spring 2020 in Rosemont/Chicago, IL. He was named a Most Influential Person by *Concrete Construction* "for being on the side of contractors and the concrete industry in legal issues."

Coleman received his BS in civil engineering in 1976 and his MS in structural engineering in 1977 from Iowa State University, Ames, IA. After completing his law degree in 1984, Coleman served as General Counsel for Ellerbe Associates, Inc. He started his own firm in 1991, which was quickly merged and renamed Coleman, Hull & van Vliet, PLLP. In 2013, he founded The Coleman Law Firm, LLC—committed to continuing his representation of engineers, architects, and the concrete construction industry. Coleman became a member of ACI in 1980. From his graduate work, he was appointed to the committee on concrete fatigue and eventually to a 10-year stint on ACI Committee 301. He is a past Chair and current member of ACI Committee 132, Responsibility in Concrete Construction. Coleman is also the author of the book *Legal Issues in Concrete Construction*, published by ACI in 2004 (second edition published in 2014).


Kayler

Kimberly Kayler is President of Advancing Organizational Excellence (AOE), a fully owned subsidiary of ACI. *Concrete Construction* named her to the list of its Most Influential People "for leading concrete industry associations—staff, boards, and members—to new levels of professionalism."

Kayler first came to the concrete industry in the 1990s as Marketing Director for Con-Steel Tilt-Up Systems. In 2000, she founded her own public relations firm, Constructive Communication Inc., with a focus on companies and associations in the construction industry. Her first client was the Tilt-Up Concrete Association, and her client list soon expanded to include for-profit companies.

Kayler became President of AOE in 2018. The AOE team provides association management as well as consulting services to public and private entities. Industry associations that are currently fully managed by AOE include the Post-Tensioning Institute, the American Coal Ash Association, the Slag Cement Association, and the Great Lakes Cement Promotion Council.


Manherz

Tim Manherz, Senior Vice President of Operations at TAS Commercial Concrete, Houston, TX, was named to the list of Most Influential People "for being the keeper of the industry's values." An active member of the American Society of Concrete Contractors, he also strives to represent contractors' interests on ACI's technical committees. Manherz is a member of Joint ACI-ASCC Committee 117, Tolerances, and ACI Committees 302, Construction of Concrete Floors; 330, Concrete Parking Lots and Site Paving; and 360, Design of Slabs on Ground. He and his co-authors received the 2020 ACI Construction Award for "Constructability of Embedded Steel Plates in Cast-in-Place Concrete," published in *Concrete International*, September 2018, pp. 28-34.


Tarr

Scott M. Tarr, FACI, is President of North S.Tarr Concrete Consulting in Dover, NH. He was named to this year's list of the Most Influential People "for helping contractors avoid problems with concrete slabs and toppings." He is a licensed engineer with nearly 30 years of experience in concrete floor slab design and flooring issues.

Tarr received his master's degree in civil engineering from the University of New Hampshire, Durham, NH. He cofounded North S.Tarr Concrete Consulting with partner Ron Kozikowski. The firm focuses on issues such as owner expectations for slabs, proper curing, and increasing the quality of toppings.

Tarr is Chair of ACI Committee 360, Design of Slabs on Ground, and a member of ACI Committees 301, Specifications for Structural Concrete; 302, Construction of Concrete Floors; 325, Concrete Pavements; and 330, Concrete Parking Lots and Site Paving.

Concrete Construction magazine also included a list of "Four Under Forty" for 2020. The individuals named to this list included:

- **Aaron Gregory**, Founder and President, Gregory

Construction, Huntsville, AL;
- **Stevie Ray Lloyd**, President, Lloyd Concrete Services, Forest, VA;
- **Kerri Smith**, Vice President and Territory General Manager, Baker Concrete, Fort Lauderdale, FL; and
- **Sherry Sullivan**, National Account Manager, PNA Construction Technologies, Toronto, ON, Canada.

For more information, visit **www.concreteconstruction.net/search?q=most+influential+2020**.

ACI Celebrates Certification Programs at World of Concrete

ACI hosted a celebratory booth event in honor of ACI certification at World of Concrete in Las Vegas, NV, on February 5, 2020. John W. Nehasil, ACI Managing Director, Certification, spoke on the Institute's nearly 40-year history of certifying more than 550,000 craftsmen, technicians, inspectors, and other concrete professionals; announced the launch of the first British Standards/European Norms-based ACI certification program; highlighted updated naming and requirements for the concrete Flatwork Finishing program; and introduced several new programs, including Post-Installed Concrete Anchor Installation Inspector, Shotcrete Inspector, Concrete Construction Sustainability and Resilience Assessor, and Non-Destructive Testing Specialist I – Concrete Strength.

During his remarks, Nehasil also walked attendees through the ACI Certification Verify app, a new tool that allows quick and easy verification of the status of ACI-certified individuals; outlined the veteran rebate program, an effort to assist U.S. veterans in obtaining ACI certifications; and provided updates on ACI certification exam offerings at the upcoming ACI Concrete Convention, March 29-April 2, 2020, in Rosemont/Chicago, IL.

In addition, the Institute raffled off several prizes and held a social media photo contest during the celebratory event.

New Position Statements from ACI

In support of the Institute's mission, ACI has published its first six position statements that support policy positions and state, federal, and international programs, rules, and regulations. These ACI position statements are focused on advocacy efforts related to code development and adoption, and future statements may focus on other ACI programs, services, and activities. Current position statements include:

- **Current Code and Standard Adoption**—Encourage the adoption and/or use of current building codes and standards;
- **Adoption of ACI Documents without Modifications**—Encourage the adoption and use of ACI products, including but not limited to codes and standards, without modification;
- **Acceptance of ACI Certification Programs**—Support acceptance of sampling, testing, inspection, and installation of concrete and related products and materials; encourage the use of certification programs developed and administered by professional societies in lieu of programs developed and administered by other entities; and support mandates or otherwise place preference on accreditation of individuals and entities engaged in providing services related to concrete and concrete products;
- **Concrete Knowledge**—Support research, technological advancements, and dissemination of concrete technology;
- **Enhanced Resilience**—Encourage or establish criteria related to enhancing the resiliency of the built environment; and, where appropriate, engage ACI and/or the ACI Foundation to facilitate programs and activities related to the role of concrete technology in achieving enhanced resiliency; and
- **Sustainability**—Encourage or establish criteria related to enhancing the sustainability of the built environment; and, where appropriate, engage ACI and/or the ACI Foundation to facilitate programs and activities related to the role of concrete technology in achieving enhanced sustainability.

"These position statements provide a vehicle for the American Concrete Institute to advocate on issues of code development and code adoption in support of our expanded mission," states Steve Szoke, ACI Advocacy Engineer.

"The Institute has used and will continue to use these statements to align ACI efforts with other industry organizations to more effectively influence programs, policies, rules, and regulations related to concrete and concrete technology," continues Kerry Sutton, ACI Advocacy Engineer.

Learn more at **www.concrete.org/positions**.

Participants at the ACI/KCI/TCI collaborative technical session

International Collaboration among Three Concrete Institutes

A four-part technical session titled "Advances in Construction, Evaluation, and Repair of Concrete Structures and Materials: International Perspectives with KCI and TCI" was organized with 22 speakers from ACI, the Korea Concrete Institute (KCI), and the Taiwan Concrete Institute (TCI). During the ACI Concrete Convention – Spring 2019, held in Québec City, QC, Canada, current and previous presidents and vice presidents of KCI and TCI delivered presentations along with other active members.

The sessions were moderated by Yail Jimmy Kim (University of Colorado Denver), Myoungsu Shin (Ulsan National Institute of Science and Technology, Korea), and Hung-Jen Lee (National Yunlin University of Science and Technology, Taiwan). Thomas Kang (Seoul National University, Korea) coordinated preconvention activities. The first part of the session was concerned with the seismic performance of concrete structures. The second part was about emerging materials for concrete application. The third focused on the repair and rehabilitation of existing members. The last part included recent advances in prestressed concrete and high-strength concrete.

These collaborative sessions strengthened the professional partnership among the three concrete institutes and fulfilled one of ACI's strategic objectives: global outreach.

PTI Launches Repair, Rehabilitation, and Strengthening Field Personnel Certification

The Post-Tensioning Institute (PTI) announced the launch of its newest Field Personnel Certification Program: Level 1 and 2 Unbonded PT Repair, Rehabilitation, and Strengthening. The announcement was made at World of

Concrete in Las Vegas, NV.

The 2-day program was developed to fill the increasing need for formal training of field personnel in the maintenance, repair, rehabilitation, and strengthening of existing, older structures. Traditionally, most certification training focuses on new construction.

"As structures age, there is a greater need for skilled field personnel to have the expertise and the ability to determine the causes of any deterioration taking place, to evaluate and perform any necessary testing of the structure, to analyze and consider the options for repair, and finally to execute the agreed-upon solution," said Miroslav Vejvoda, PTI Managing Director of Engineering and Professional Development.

The program covers several topics, including a review of basic post-tensioning installation, a discussion on new and historical post-tensioning systems, and an overview of evaluation details, repair techniques, troubleshooting, and safety considerations. The course also presents a number of case studies that illustrate multiple types of structures with a variety of deterioration types, along with information on the methods used in restoration.

Prerequisites for the Level 1 and 2 Unbonded PT Repair, Rehabilitation, and Strengthening Certification Workshop include a valid Level 1 or 2 Unbonded PT Certification by the participant. PTI's new workshop is scheduled in seven cities around the United States throughout 2020. Visit **www.post-tensioning.org/GetCertified** for more information.

Errata

In the January 2020 issue, in the article "Innovation" by Joseph V. Nasvik (pp. 43-47), a correction is needed. In the discussion of the Milwaukee Tool MX FUEL Equipment System, the text should have stated that two battery charges are equivalent to a full tank of gasoline for a conventional saw.

In the February 2020 issue, in "Products & Practice" (p. 53), the URL for the book *Assessment and Retrofit of Masonry Structures* should have been printed as **www.masonrysociety.org**.

Knowledge to Practice: ACI Foundation

Thank You to Our Donors for a Successful 2019 Fall Campaign!

Thanks to you, the ACI Foundation's second annual Fall Campaign in 2019 raised $40,500! Your contributions will strengthen the concrete community across the globe by empowering many students, researchers, and experts in the industry. This year's total was six times the total raised in 2018—we are blown away by your support!

A major component of the Fall Campaign's success was the extraordinary support of the Greater Miami Valley Chapter – ACI, as they matched every dollar up to $20,000! The 2019 Fall Campaign wouldn't have been half as successful without this partnership. Thank you, Greater Miami Valley Chapter – ACI, for helping to transform the future of the concrete industry.

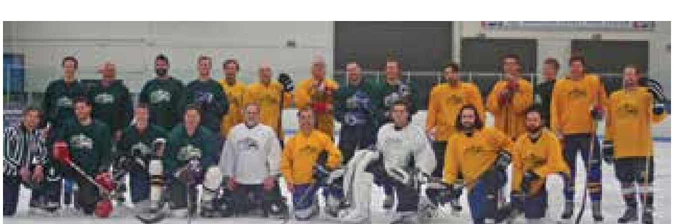
Stehly Memorial Hockey Game Coming to the ACI Concrete Convention – Spring 2020

On Monday, March 30, 2020, at 6:45 p.m., a group of hockey lovers will take to the ice for a good cause when the 10th-anniversary edition of the Richard D. Stehly Memorial Hockey Game comes to the ACI Concrete Convention – Spring 2020 in Rosemont/Chicago, IL.

The event is free to attend, but donations will be accepted. All money raised will fund the Richard D. Stehly Memorial Scholarship, which is awarded annually through the ACI Foundation to an outstanding student enrolled in an undergraduate degree program studying concrete with an emphasis on structural design, materials, or construction.

It's not too late to join in on the fun as we'd love to see more men and women sign up to play in the hockey game! After the game and comradery, all players are welcome to enjoy a reception at the rink. Additionally, bus trips are being organized to transport players and fans from the Hyatt Regency O'Hare to the Addison Ice Rink and back at no charge.

Richard D. Stehly, Past President of ACI, was an avid hockey player who often organized games for ACI members to participate in during conventions. Upon his passing, Stehly's friends and colleagues decided that the creation of a memorial game to raise funds for student scholarships in the industry would be the ideal way to honor his legacy.



Players from a past Richard D. Stehly Memorial Hockey Game

Thank you to the 2020 Stehly Memorial Hockey Game organizers!

Organizers include:

- Larry Sutter and Nick Popoff—Stehly Hockey Game Founders and Annual Organizers; and
- Walt Flood and Peter Stamatopoulos of the Illinois Chapter – ACI.

If you're interested in playing in the hockey game or have event questions, please connect with Larry Sutter at llsutter@mtu.edu.

Strategic Development Council Welcomes New Leadership

Diekemper

Bédard

We are happy to announce our 2020 Strategic Development Council's (SDC) Board of Direction roster. Our election yielded two reelected Directors, one returning Director, and one newly elected Director for the term ending in 2022. We welcome newly elected Director Phil Diekemper, CECO Construction, LLC, and returning Director Claude Bédard, the Euclid Chemical Company.

We would like to thank all SDC Board members for their time and commitment to providing strategic direction for advancement in the concrete industry. To learn more about the SDC, visit **www.acifoundation.org/technology**.

Concrete Research Council Request for Proposals

The response to the Concrete Research Council's (CRC) annual request for proposals was the highest to date. We received 49 completed research proposal packages, each of which includes research concept support by an ACI technical committee. A review of the proposals is currently underway, and results will be announced shortly after the Spring ACI Concrete Convention.

Scholarship Council Applications

The Scholarship Council (SC) has been reviewing the many completed applications for the 2020-2021 award year. Fellowship finalists have been notified, and we look forward to meeting them during the interview process at the Spring ACI Concrete Convention!

Chapter Reports

PSG Institute of Technology Student Chapter – ACI Organizes Guest Lecture

The PSG Institute of Technology and Applied Research Student Chapter – ACI in Coimbatore, India, organized a seminar on the topic “Concrete for Marine Structures and Marine Environments” for civil engineering students. The seminar took place on January 8, 2020. Saravanan Perumal, Senior Marine Structural Engineer with Advisian Worley Group in Canada, was invited to speak as the chief guest. The session commenced with a welcome address delivered by M.I. Abdul Aleem, Head of the Department of Civil Engineering.

In his talk, Perumal outlined topics that are essential for civil engineers in the workplace. He discussed project details pertaining to construction sites, material use, and limitations. He discussed the erection process, function, and working mechanism of marine structures such as wharves, breakwaters, and fender piles. He explained onshore operations such as mooring and berthing as well as mode of failure in piers. He also explained the mechanisms of deterioration of concrete in marine structures and concluded his talk with an animation that showed the construction of wharves.

Following Perumal’s presentation, the Head of the Department of Civil Engineering presented a memento to him.

Student attendees were very satisfied with the overall program, which was organized by the student chapter’s mentor, Elayaraja Sellappan; student chapter President, Sitharth Subramani S.; and student chapter Vice President, Dinesh Kanna M.

The Head of the Department of Civil Engineering presented a memento to the seminar’s chief guest, Saravanan Perumal

TIU Student Chapter – ACI Holds FRC Bowling Ball Competition

The Tishk International University (TIU) Student Chapter – ACI organized a Fiber-Reinforced Concrete (FRC) Bowling Ball Competition in cooperation with the Iraq Chapter – ACI on December 19, 2019, at Tishk International University’s Erbil campus.

Ten teams of civil engineering students participated in the event. The teams came from Erbil Polytechnic University (EPU), Raparin University, and Tishk International University. Each team participated with two concrete bowling balls with different mixture designs comprising fiber-reinforced lightweight concrete.

A team of judges monitored the process. Two tests were applied to the samples—one for each ball. During the compression test, the balls were compressed until cracks occurred in the sample. In the dropping test, the balls were dropped from a height of 2 m (6.6 ft).

The students participated in fun bowling games in between the two tests. The winners were determined based on the tests. The teams from TIU won first place and third place, and the second-place winner was the EPU team. Prizes awarded to the winners included flash memory drives, reusable water bottles, and watches.

The competition presented a platform for students to meet each other and to see the theories they have learned being put into practice.

ACI will host the FRC Bowling Ball Competition on March 29, 2020, during the ACI Concrete Convention in Rosemont/Chicago, IL. Learn more about regional concrete competitions at **www.concrete.org/students/studentcompetitions/regionalconcretecompetitions**.

Ten student teams participated in the Tishk International University FRC Bowling Ball Competition

Minnesota Concrete Council Chapter – ACI Holds FRC Bowling Ball Competition

The Minnesota Concrete Council Chapter – ACI organized their first student competition event on December 10, 2019, at St. Thomas University, St. Paul, MN.

A total of 11 students from three teams representing St.

Thomas University and Dunwoody College of Technology, Minneapolis, MN, participated in the FRC Bowling Ball Competition. The objective of the FRC Bowling Ball Competition is to demonstrate the behavior of fiber reinforcement within concrete, to gain experience in forming and fabricating a fiber-reinforced concrete element, and to encourage creativity with compliance in engineering design and analysis. Competition winners included:

- First place, Dunwoody College of Technology, $1000 prize;
- Second place, St. Thomas University, Team Firestone, $750 prize; and
- Third place, St. Thomas University, $500 prize.


Three teams comprising 11 students participated in the Minnesota FRC Bowling Ball Competition


Teams comprised students from St. Thomas University and Dunwoody College of Technology


Dunwoody College of Technology won the Minnesota FRC Bowling Ball Competition

The teams will use their cash prizes to fund their travel expenses to the ACI FRC Bowling Ball Competition at the ACI Concrete Convention in Rosemont/Chicago, IL. Learn more about the FRC Bowling Ball Competition at **www.concrete.org/students/studentcompetitions/frcbowlingballcompetition**.

ACI-ASConference 2019

The Singapore Chapter – ACI (ACI-SC) co-organized the ACI-ASConference 2019 that took place on November 8, 2019, with the Temasek Polytechnic School of Applied Science's Centre for Urban Sustainability.

The conference theme was "Sustainability for a Better Tomorrow." This theme was timely considering the effects of climate change and the urgent need to achieve sustainability for a better future.

The conference delegates and student participants were warmly received by Goh Lay Beng, Director of Temasek Polytechnic's School of Applied Science, whose welcome speech emphasized sustainability in the construction industry given the rapid economic growth in the Asia-Pacific region.

Guest of honor

The conference had the privilege of hosting guest of honor Ho Nyok Yong, President of the Singapore Green Building Council (SGBC). In his opening address, Yong stressed the importance of sustainability as the impacts of climate change have become increasingly evident in our day-to-day lives. He updated attendees on the efforts by SGBC to address sustainability issues in the built environment for Singapore's future.

One of the highlights of his speech was on Samwoh Smart Hub, which is poised to be the first positive-energy industrial building in Singapore when it is completed in 2020. Yong also commended ACI-SC and Temasek Polytechnic for their efforts in engaging student participants in conference activities.

Signing of memoranda of understanding

Following the guest of honor's address was the signing of two memoranda of understanding (MOUs) for a partnership between Temasek Polytechnic and ACI, and between Temasek Polytechnic and the ACI Singapore, Malaysia, India, and Philippines chapters.

The signing of these MOUs expressed a desire to foster closer working relationships among ACI chapters and a desire to bring the concrete community together to work on meaningful projects.

An MOU was signed by Temasek Polytechnic and ACI, from left: Peter Lam, Principal and CEO, Temasek Polytechnic; Goh Lay Beng, Director, Temasek Polytechnic School of Applied Science; John K. Conn, ACI Director, Chapter Activities; and Michael J. Morrison, ACI Manager, Certification Program Development

Launch of continuing education and training short courses

Two short courses were announced by the guest of honor, Ho Nyok Yong, through a digital animation and short video. These courses were a culmination of the MOUs signed between Temasek Polytechnic and ACI-SC, as well as the Singapore National Parks Board (NParks) in the preceding year.

The first course, “Inspection and Repair of Concrete Structures,” was jointly organized by Temasek Polytechnic and ACI-SC. This course aims to bring specialized knowledge in concrete inspection and repair to students and working adults in the industry.

The second course, “Design for Safety on Rooftop Greenery,” was jointly organized by Temasek Polytechnic and the Centre for Urban Greenery and Ecology of NParks. This course aims to promote forward-thinking designs on rooftop greenery with an emphasis on the safety aspects.

Launch of Singapore Student Chapter – ACI

The launch of the Singapore Student Chapter – ACI was announced at the conference. Membership comprises students from the National University of Singapore, Nanyang Technological University, Temasek Polytechnic, and Singapore Polytechnic.

For more information, connect with the Singapore Student Chapter – ACI at **www.facebook.com/pages/category/Local-Service/ACI-Singapore-Student-Chapter-109571967216063**.

Presentations by invited speakers

A total of 12 experts from renowned local and foreign institutions were invited to present on various topics involving sustainability in the following sessions:

- Session One, Sustainability in Partnership;
- Session Two, Sustainability in Green Materials Development;
- Session Three, Sustainability in Green Materials Processing; and
- Session Four, Sustainability in Education.

The invited speakers comprised the ACI Ambassador Ishita Manjrekar, Vice President, India Chapter – ACI; Qian Shunzhi, Assistant Professor, Nanyang Technological University; Sudharshan N. Raman, President, Malaysia Chapter – ACI; Somnuk Tangtermsirikul, Professor, Thammasat University, Thailand; Zhang Zuhua, Professor, Hunan University, China; Tan Jun Yew, Senior Technical Manager, Samwoh Innovation Centre Pte Ltd; Wong Teck Neng, Associate Professor, Nanyang Technological University; Cai Wei, Industry Manager, Wacker Chemicals [South Asia] Pte Ltd; Ang Zi Yang Adrian, Manager, Temasek Polytechnic; Mandar Godge, Scientist, Temasek Polytechnic; Leong Meng Fatt, Course Chair, Temasek Polytechnic; and Noor Faridah A. Rahim, Deputy Manager, Temasek Polytechnic.

ACI-SC Project Competition

The annual ACI-SC Project Competition was organized in conjunction with the conference. The competition, comprising submission of a project summary and poster presentations, aimed to facilitate the progress of the concrete industry toward innovative applications of high-quality materials and technologies.

There were two categories in this competition:

- Students’ Category—for polytechnic, institute of technical education, and junior college students; and
- Open Category—for students, academics, and researchers from universities and practitioners from industries.

The entries for the 2019 project competition were of very high quality. The shortlisted project summaries were presented in poster format at the conference to a panel of judges

ACI-SC Project Competition (Students’ Category), from left: Lu Jin Ping, President, ACI-SC; Kanette S. Worlds, ACI Student, Faculty, and Young Professionals Activities Coordinator; and Gold, Silver, Bronze, Merit, and Commendation Award winners

ACI-SC Project Competition (Open Category), from left: Lu Jin Ping, President, ACI-SC, with the Gold, Silver, Bronze, Merit, and Commendation Award winners

consisting of distinguished academics and practitioners in the concrete industry.

After a hard-fought competition among 11 finalist teams, a team of three students from Temasek Polytechnic clinched the Gold Award in the Students' Category for their project on "Development of Sustainable Fiber-Reinforced Mortar Using Mixed Plastics from Urban Wastes," while the Gold Award in the Open Category went to Samwoh Innovation Centre Pte Ltd for their work on "Innovative and Practical Methods for Sustainable Testing of Fresh Concrete Properties."

Holographic telepresence presentation and exhibition booths

A holographic telepresence showcase on climate change was presented by Temasek Polytechnic in the conference foyer, which was visited by many conference delegates and student participants.

Temasek Polytechnic's Centre for Urban Sustainability set up several booths on sustainable development technologies, which encompass waste recycling management and advanced materials research. ACI, ACI-SC, and the Singapore Student Chapter – ACI also had exhibition booths. Several sponsors also showcased products and technical know-how at their respective company booths.

Closing speeches

In their closing speeches, Lu Jin Ping, President of ACI-SC, and Wong Sook Fun, Head of Temasek Polytechnic's Centre for Urban Sustainability, both expressed heartfelt gratitude to all who contributed to the success of the conference. In total, more than 200 participants attended the conference.

For full details on the ACI-ASConference 2019 and ACI-SC Project Competition 2019, visit the Singapore Chapter – ACI website at **www.concrete.org.sg**.

Escuela Colombiana de Ingeniería Student Chapter – ACI

According to student Christopher A. Farfán Sánchez, the following activities were carried out by the Escuela Colombiana de Ingeniería (Colombian School of Engineering Julio Garavito) Student Chapter – ACI for the year 2019-2020:

General assembly—The student chapter's general assembly is a meeting held in mid-February for all students and teachers affiliated with ACI. There, the "adjustment of accounts" is made by the outgoing Board and the new Faculty Advisor. The new Board of Directors is also elected. This year, Nancy Torres Castellanos was elected Faculty Advisor, and Christopher A. Farfán Sánchez was elected President of the chapter.

Courses—Three courses were developed during this period: one is an introduction to AutoCAD and the other two are basic Revit courses. Approximately 40 students participated in each of these courses, which were led by qualified professionals who are experts in each of the tools.

Field trip—There was an opportunity to go on an educational field trip to the Titan plant. Approximately 40 students participated. Divided into groups of 10, students were given a tour of the plant and then attended a talk about mixture design. In addition, during the construction of the Colombian School of Engineering's new building E, several students learned about the construction process.

Approximately 40 Colombian students attended a field trip to the Titan plant

Conference—A conference on "Problems of Brick Façades and Other Structural Pathologies" was held by engineer Luis Guillermo Aycardi Barrero. Approximately 70 people attended. A raffle was held at the conference. Students were encouraged to question how they can contribute to meaningful social change.

Contests—This year, the Boliconcreto Contest was held during the ECIciencia week. This contest consisted of making a mixture design in a spherical mold and then simulating a bowling game. The concrete bowling balls were subsequently tested for compression and resistance. The contest was sponsored by TOXEMENT. Five groups participated, each consisting of five people.

Civil Engineers' Day—A special day for civil engineering students was organized jointly with other student chapters and research groups. Different recreational activities were carried out, raffles were held, and merchandise was sold.

Social support—Supporting vulnerable communities in the city of Bogotá, Colombia, was a major focus. The student chapter and the Asociación Colombiana de Facultades de Ingeniería (ACOFI) volunteered together for the IBE Challenge, which encouraged senior students at district schools to study engineering.

In addition, all the student chapters and research groups at the university participated in a large project in which members helped the community with engineering projects. Students socialized with the leaders of each chapter Board and the community.

Student Competitions—IBRACON 2019

The Brazilian Concrete Institute (IBRACON) organizes annual events to stimulate technical competition among students of civil engineering and architecture. During the 61st Brazilian Concrete Congress that took place October 15-18, 2019, in Fortaleza, Brazil, IBRACON organized several student competitions that were attended by 770 students from 52 national and international educational institutions.

The Egg Protection Device Competition challenges students to design and build an impact-resistant reinforced-concrete gantry. The main goal is to test students' ability to develop dynamic load-bearing structural elements. In 2019, the winning teams were:

- First place, Universidade Federal da Bahia;
- Second place, Universidade Federal de Pernambuco; and
- Third place, Pontifícia Universidade Católica de Minas Gerais.

Students participated in the IBRACON Egg Protection Device Competition

The Concrete Soccer Ball Competition challenges students to construct a resistant concrete sphere with preestablished dimensions and materials that is capable of rolling in a straight trajectory. This competition tests the skills of competitors in producing homogeneous and resistant concretes. The winning teams in 2019 were:

- First place, Instituto Mauá de Tecnologia;
- Second place, Instituto Federal de Santa Catarina; and
- Third place, Centro Universitário de Patos de Minas.

The High-Strength Colored Concrete Competition tests the ability of competitors to prepare high-strength, colored reactive powder concrete mixtures with predetermined dimensions that are capable of achieving high strengths in the axial compression test. The winning teams in the 2019 competition were:

- First place, Instituto Mauá de Tecnologia;
- Second place, Universidade Regional Integrada do Alto Uruguai e das Missões; and
- Third place, Universidade Federal de Santa Maria.

The Structural and Architectural Design Competition requires competitors to design a special structure in concrete. This year, IBRACON requested a design of a concrete modular footbridge to be implemented as the main design for footbridges for the Brazilian National Transportation Board. The winning teams were:

- First place, Universidade de São Paulo campus São Carlos;
- Second place, Universidade Presbiteriana Mackenzie; and
- Third place, Escola de Engenharia de Piracicaba.

The third edition of IBRACON's Self-Consolidating Concrete Competition evaluated students' ability to develop self-consolidating concrete mixtures with the lowest possible cement content and the highest strength in 24 hours. The winning teams were:

- First place, Universidade Federal de Pernambuco;
- Second place, Instituto Mauá de Tecnologia; and
- Third place, Universidade de Rio Verde.

IBRACON invites everyone to attend and participate in these competitions at the 62nd Brazilian Concrete Congress, which will be held September 1-4, 2020, in Florianópolis, Brazil.

Learn more at **www.ibracon.org**.

IBRACON's 61st Brazilian Concrete Congress included a number of student competitions

ACI's New Fellows

Members to be awarded at the ACI Concrete Convention – Spring 2020

ACI will recognize 18 members who have been honored with the rank of Fellow of the American Concrete Institute (FACI) at the ACI Concrete Convention in Rosemont, IL. The new Fellows will be introduced during the Opening Session and Keynote Address Presentation on March 29, 2020. This spring, the Concrete Convention is scheduled for March 29-April 2, 2020, at the Hyatt Regency O'Hare. More information can be found at **www.aciconvention.org**.

As stated in the ACI bylaws, a Fellow is an individual who has made "outstanding contributions to the production or use of concrete materials, products, and structures in the areas of education, research, development, design, construction, or management." The Fellows Nomination Committee selects those to be considered for the award and then forwards its recommendations to the Board of Direction for final action in the fall. Nominations may come from the committee itself, from local chapters, from the International Advisory Committee, or by petition signed by at least five current ACI members.

The ACI Board of Direction approved the nominations of this latest group of honorees in fall 2019. Including the new honorees, 632 members are current Fellows of the Institute. The rank of FACI was first established by the Institute in 1973.

ACI's new Fellows are:

Hakim S. Abdelgader has been a Professor in the Department of Civil Engineering at the University of Tripoli, Tripoli, Libya, since January 2003. He is also a visiting Professor at Gdańsk University of Technology, Gdańsk, Poland, from November 2018 to March 2020. Abdelgader has authored or co-authored more than 70 technical papers and reports.

He is a member of ACI Committees 221, Aggregates; 237, Self-Consolidating Concrete; 304, Measuring, Mixing, Transporting, and Placing Concrete; 444, Structural Health Monitoring and Instrumentation; and 555, Concrete with Recycled Materials. His research interests include building materials, concrete technology, cement replacement materials, concrete repair, self-consolidating concrete, concrete with recycled materials, underwater concreting, two-stage concrete, and concrete casting in fabric forms. Abdelgader has supervised nine graduate students from Libya, Poland, Ireland, and Iran.

He received his BS in civil engineering from the University of Tripoli in 1988 and his MSc and PhD in civil engineering from Gdańsk University of Technology in 1990 and 1996, respectively.

Eduardo Castell Ruano has more than 30 years of experience in structural and civil projects, including as an independent Consultant from 2015 to the present, an Engineering Design Manager at Moffatt & Nichol from 2012 to 2015, Director of the Structural Department at HMV Ingenieros from 2000 to 2015, Structural Engineer at HMV Ingenieros from 1995 to 2000, and Structural Engineer at

New Fellows of ACI

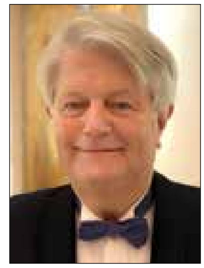
As approved by the ACI Board of Direction, the 18 members elevated to the rank of Fellow of the American Concrete Institute are:

Hakim S. Abdelgader, Tripoli, Libya
Eduardo Castell Ruano, Bogotá, Colombia
Juan F. Correal, Bogotá, Colombia
Xavier Destrée, La Hulpe, Belgium
Mahmut Ekenel, Brea, CA
William R. (Rod) Elderton, Rancho Cucamonga, CA
Mark F. Green, Kingston, ON, Canada
Issam Elias Harik, Lexington, KY
Riyadh Hindi, St. Louis, MO
O. Burkan Isgor, Corvallis, OR
Mohan Abraham Jacob, Mumbai, India
Ashok Kakade, Hayward, CA
Adam S. Lubell, Vancouver, BC, Canada
Mustafa Mahamid, Chicago, IL
Hayder A. Rasheed, Manhattan, KS
Scott T. Smith, Adelaide, Australia
Mohammed Sonebi, Belfast, UK
Kevin Wolf, Gresham, OR


Abdelgader


Castell Ruano


Correal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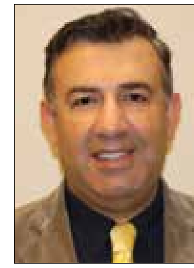

Ekenel


Elderton

Portland Cement Association (PCA) from 1989 to 1995. He was also a Lecture Professor of concrete design in the Department of Civil and Environmental Engineering at the Universidad de Los Andes, Bogotá, Colombia, from 1990 to 2015. He has been involved in civil and structural engineering projects in Colombia and many other Latin American countries, mainly in road infrastructure, bridges, sea and port, big and small hydroelectric and thermal generation projects, buildings, and facilities. He is also a consultant to the World Bank for Central America and Africa in structural, risk, vulnerability, and code regulatory aspects. In recent years, he has been carrying out the assessment of the building regulatory framework for the implementation of a World Bank intervention plan in Kenya, Malawi, and Uganda.

He has been a member of both ACI Committee 314, Simplified Design of Concrete Buildings, and the Republic of Colombia Chapter – ACI since 2004. He has also been a member and Board member of the American Society of Civil Engineers (ASCE) since 2013.

In addition, he has been a member of the Colombian Association for Earthquake Engineering (AIS) since 1989, including serving as its President from 2013 to 2015 and 2018 to present. He has also been a member of the Advisory Commission for the Colombian Building Code during the same time periods.

He received his BS in civil engineering from the Universidad de Los Andes in 1989 and his MSc in civil engineering with a major in structural engineering from the Universidad de Los Andes in 1991.

Juan F. Correal is an Associate Professor in the Department of Civil and Environmental Engineering at the Universidad de Los Andes, Bogotá, Colombia, and is a Civil Engineer with over 20 years of experience. He has advised more than 74 students in the structural field, and he has more than 136 publications on materials, design, and seismic behavior of structures.

Since 2000, Correal has been a member of ACI Committee 374, Performance-Based Seismic Design of Concrete Buildings, and ACI Subcommittees 318-D, Members; 318-L, International Liaison; and 318-S, Spanish Translation. He is also a member of the American Society of Civil Engineers (ASCE). He received the ACI Design Award for the paper "An Insight into the Space Building Collapse" in 2018. His research interests include seismic design and behavior of structures.

He received his undergraduate and master's degrees from the Universidad de Los Andes in 1998 and 1999, respectively, and his PhD from the University of Nevada, Reno, Reno, NV, in 2004. He is a licensed professional engineer in California.

Xavier Destrée is an independent R&D Consultant for the ArcelorMittal company (Grand Duchy of Luxembourg) in the field of steel fiber-reinforced concrete. He has authored and co-authored more than 40 papers and reports in the same field of engineering. Destrée has been an active member of numerous standards committees regarding steel fiber-reinforced concrete in Belgium, Holland, France, Sweden, the United Kingdom, Spain, and elsewhere in Europe.

Destrée is a member of ACI Committee 544, Fiber Reinforced Concrete, and ACI Subcommittee 544-D, FRC-Structural Uses. He was also part of the team that prepared ACI 544.6R-15, "Report on Design and Construction of Steel-Fiber Reinforced Concrete Elevated Slabs."

He is the author of several patents regarding worldwide successful applications of steel fiber-reinforced concrete, coining novel fiber types and new applications such as joint-free slabs on grade (1983) and suspended elevated steel-fiber concrete slabs (2004). Destrée pioneered steel fiber-reinforced concrete to develop suspended slabs and mat foundations starting in 1992.

Destrée received his degree in structural civil engineering from the University of Brussels, Brussels, Belgium, at the École Polytechnique de Bruxelles in 1978. He received his degree in business administration from Saint-Louis University, Brussels, Belgium, in 1982. He was awarded the Jacques Verdeyen Prize for his development on novel glass fiber-reinforced cementitious composites regarding the composition and structural design theory.

Mahmut Ekenel is a Senior Staff Engineer at ICC Evaluation Service, LLC, in Brea, CA. He has been working with ICC Evaluation Service for 14 years. Ekenel has published numerous technical papers throughout his career in regard to the use of waste materials in concrete, optimization of concrete aggregate sources, anchorage to concrete, fiber-reinforced concrete, three-dimensional (3-D) concrete construction, strengthening and rehabilitation of concrete structures using fiber-reinforced polymer (FRP) composites, and nondestructive test methods for FRP-strengthened concrete members.

Ekenel has been an active member of ACI since 2002 and is Secretary of ACI Subcommittee 544-F, FRC-Durability. He is also a member of ACI Committees 440, Fiber-Reinforced Polymer Reinforcement; 544, Fiber Reinforced Concrete; and 549, Thin Reinforced Cementitious Products and Ferrocement. Ekenel presented seven technical papers at five ACI conventions (four of them published in ACI Special Publications) and is currently helping develop three ACI Technical Notes. He was comoderator for three ACI sessions and was co-editor of three ACI Special Publications. He has been delivering technical presentations on building codes and concrete in various universities since 2005. Ekenel has also been a member of Chi Epsilon since 2002 and the American Society of Civil Engineers (ASCE) since 2003, and he has been working as an Associate Editor for ASCE's *Journal of Materials in Civil Engineering* since 2008.

In 2009, he was awarded the Outstanding Young Alumni award by Missouri S&T University's Academy of Civil Engineers.

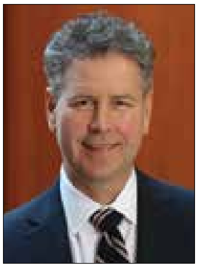
He received his BSc from Selçuk Üniversitesi, Konya, Turkey, in 1996; his MS from Southern Illinois University, Carbondale, IL, in 2001; and his PhD from Missouri S&T, Rolla, MO, in 2004, where he also worked as a Postdoctoral Researcher in 2005. Ekenel is a licensed professional engineer in California and Ohio.

William R. (Rod) Elderton retired from the Metropolitan Water District of Southern California in 2011. He was the Manager of the Soils and Concrete Team responsible for the specification, inspection, approval, and quality assurance testing of portland cement concrete and concrete materials.

He has been a member of the Southern California Chapter – ACI for over 40 years and has served on the Board of Directors, as Vice President, and as President on two separate elected occasions. He has also served as a Supplemental Examiner for the chapter's certification programs since their inception in the mid-1980s and is currently Chair of the chapter's Certification Committee and the designated Sponsoring Group contact. He received ACI's Certification Award in 2017 and has been designated by the chapter's Board of Directors as the Chapter Parliamentarian.

Elderton received his BS in civil engineering from California State University, Northridge, CA, in 1976 and is a veteran of the United States Navy, where he served in the Construction Battalion (Seabees) as an engineering aid.

Mark F. Green is Provost and Vice-Principal (Academic) at Queen's University, Kingston, ON, Canada. He is also a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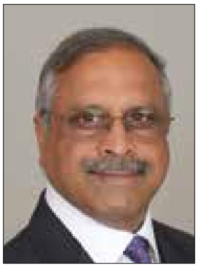

Kakade

Professor in the Department of Civil Engineering at Queen's University, where he has worked for 29 years. Green has authored or co-authored more than 250 academic publications in his field of structural engineering.

He is a member of ACI Committee 440, Fiber-Reinforced Polymer Reinforcement, and Joint ACI-TMS Committee 216, Fire Resistance and Fire Protection of Structures. He has served as Co-Chair of ACI Subcommittee 440-F, FRP-Repair-Strengthening, and as Co-Chair of ACI Subcommittee 440-C, FRP-State-of-Art; and he was the main editor of ACI 440R-07, "Report on Fiber-Reinforced Polymer (FRP) Reinforcement for Concrete Structures."

Green's research has advanced knowledge on the durability of concrete structures with FRPs in cold regions, on strengthening concrete beams with prestressed FRP sheets, and on the fire resistance of concrete structures with FRP. His research has led to the world's first post-tensioning tendon replacement application with FRP (Toronto, ON, Canada, December 2007) and the first field application in North America for strengthening bridges with prestressed FRP sheets (Winnipeg, MB, Canada, in October 2003). Furthermore, his research on fire resistance is widely identified as satisfying one of the most pressing research needs in applications of FRPs in civil engineering. His research and work with ACI Committee 440 have influenced several of their documents, including ACI 440R-07 and ACI 440.2R-17, "Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures."

A member of the Mohawks of the Bay of Quinte, Green has an active interest in encouraging diversity in engineering. He was the Co-Chair of the Queen's Truth and Reconciliation Commission Task Force and an advisor to Queen's Dean of Engineering and Applied Science on the development of the faculty's Aboriginal Access to Engineering Initiative.

Green received his BSc in mathematics and engineering from Queen's University in 1987 and his PhD from the University of Cambridge, Cambridge, UK, in 1991.

Issam Elias Harik is the Raymond-Blythe Professor in the Department of Civil Engineering at the University of Kentucky, Lexington, KY.

Harik is a member of ACI Committees 440, Fiber-Reinforced Polymer Reinforcement, and S803, Faculty Network; and Joint ACI-ASCE Committees 343, Concrete Bridge Design, and 441, Reinforced Concrete Columns. He is also a member of the American Society of Civil Engineers (ASCE) and the Precast/Prestressed Concrete Institute (PCI).

His research interests include field testing of bridges and culverts and the deployment of fiber-reinforced polymers in structural repair of concrete bridges. He has also authored or co-authored over 300 technical papers and reports.

He received his BS in 1977, his MS in 1979, and his PhD, in 1982 in civil engineering from Wayne State University, Detroit, MI. He joined the University of Kentucky in 1982.

Riyadh Hindi is a Professor of civil engineering and Associate Dean for Graduate Education and Research at Parks College of Engineering, Aviation, and Technology of Saint Louis University, St. Louis, MO. He has authored or co-authored over 75 technical papers and reports.

He is a member of several professional organizations, including the American Society of Civil Engineers (ASCE), the American Society for Engineering Education (ASEE), the International Association for Bridge Maintenance and Safety (IABMAS), and the Structural Engineering Institute (SEI). He is a Fellow of SEI. He is a past Chair of Joint ACI-ASCE Subcommittee 343-A, Design; and a member of ACI Committee 341, Earthquake-Resistant Concrete Bridges; and Joint ACI-ASCE Committee 343, Concrete Bridge Design. He is also a member and past Secretary of ACI Committee 342, Evaluation of Concrete Bridges and Bridge Elements, and Joint ACI-ASCE Committee 441, Reinforced Concrete Columns. He has chaired and organized many technical sessions.

He received his BS in civil engineering in 1988 and his MS in civil/structural engineering in 1992 from the University of Baghdad, Baghdad, Iraq. He received his PhD in structural and earthquake engineering from the University of British Columbia, Vancouver, BC, Canada, in 2001. He is a licensed professional engineer in British Columbia, Canada.

O. Burkan Isgor is a Professor of civil engineering and materials science at Oregon State University, Corvallis, OR. He is Chair of ACI Committee 222, Corrosion of Metals in Concrete, and a member of ACI Committees 236, Material Science of Concrete, and 365, Service Life Prediction. His research interests include durability of concrete, reinforcement corrosion, thermodynamic modeling of cementitious systems, and service-life modeling of concrete structures. He has authored or co-authored over 200 publications, including approximately 100 peer-reviewed journal articles.

He received his civil engineering degree from Boğaziçi University, Istanbul, Turkey, in 1995, and his MS and PhD from Carleton University, Ottawa, ON, Canada, in 1997 and 2001, respectively. He is a Fellow of the Canadian Society for Civil Engineering (CSCE) and is a licensed professional engineer in Ontario, Canada.

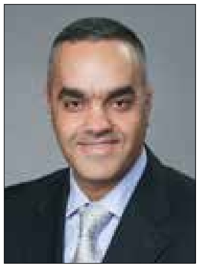
Mohan Abraham Jacob is a Structural Consultant and Project Management Expert with approximately 55 years of experience in the field of civil and structural engineering. He has served the Central Public Works Department (CPWD) of the Government of India in various capacities, culminating in his position as Additional Director General, CPWD, Government of India. Over the last 18 years, he has worked as a Consultant of eminence in civil engineering projects and arbitration.

He was the recipient of the ACI Chapter Activities Award in 2006. He has assiduously worked for ACI certification and ACI student chapter initiatives in the most remote parts of India. He played a pivotal role in steering the roundtable meetings of ACI chapters in Asia in 2015 during the International Conference held in India. He has contributed as a Chair of the Scientific Committee and Co-Chair for the R.N. Raikar International Conferences and made special efforts to involve his many international acquaintances in the last three biennial conferences, resulting in effective ACI outreach across multiple continents. Jacob has served the India Chapter – ACI in various capacities, including as Director (2000-2003), Hon. Secretary and Treasurer (2003-2008), Vice President (2008-2011), President (2011-2013), and Past President-Director (2013-present).

He is a renowned designer and administrator, and several landmark structures constructed under his leadership bear testimony to his engineering and project management skills. As a high-ranking official in the CPWD of the Government of India, he has made special efforts to connect federal government departments to ACI activities in India, which helped lead to ACI's certification efforts in India today. He actively mentors younger leadership at the chapter level to spread awareness about ACI in India and other Asian countries.

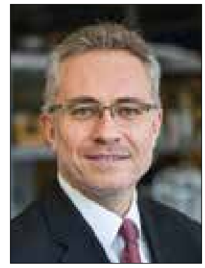
Jacob received his BE in civil engineering and his MS in soil mechanics and foundation engineering. He also received his diploma in specialized buildings from ACTIM, Paris, France.

Lubell

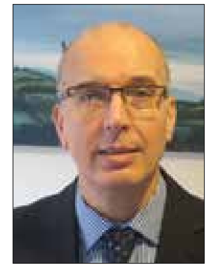


Mahamid

Rasheed



Smith



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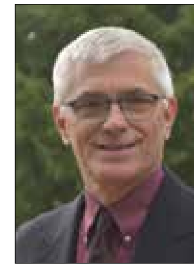

Wolf

Ashok Kakade is Principal Engineer and President of Concrete Science, Inc., Hayward, CA. He has approximately 40 years of experience in construction, forensic investigation, and repair of concrete structures. He has published various research articles and technical papers in *Concrete International*, *Concrete Repair Bulletin*, and other national and international technical journals. For several years, he taught concrete technology classes through the University of California, Berkeley, Berkeley, CA, engineering extension. He has also been involved in lecturing and organizing numerous technical education seminars.

Kakade is a past Chair and current member of ACI Committee 364, Rehabilitation. He is Chair of ACI Subcommittee 364-L, Liaison Subcommittee. He is also a member of ACI Committees 332, Residential Concrete Work, and 437, Strength Evaluation of Existing Concrete Structures. He is a Director of the Northern California and Nevada Chapter – ACI. He has been a long-standing member of various ASTM International technical committees and has received a 15-year service award. Kakade is a Fellow of the American Society of Civil Engineers (ASCE), International Concrete Repair Institute (ICRI), and Indian Concrete Institute (ICI).

He received his bachelor of engineering degree from the University of Bombay, Bombay, India, in 1979 and his MS in civil engineering from the South Dakota School of Mines & Technology, Rapid City, SD, in 1988. He is a licensed professional engineer in California, Nevada, and Arizona.

Adam S. Lubell is a Project Engineer with RJC Engineers, Vancouver, BC, Canada, with over 20 years of experience in the areas of design, assessment, and seismic upgrading of buildings and other structures. He is also an Adjunct Professor at the University of British Columbia, Vancouver, BC, Canada, and has authored or co-authored over 60 technical papers and reports.

Lubell is Secretary of Joint ACI-ASCE Committee 445, Shear and Torsion, and Joint ACI-ASCE Subcommittee 445-A, Shear & Torsion-Strut & Tie, and a past Secretary of ACI Innovation Task Group ITG-6, High Strength Steel Reinforcement. He is also a member of ACI Committees 318, Structural Concrete Building Code; 435, Deflection of Concrete Building Structures; 440, Fiber-Reinforced Polymer Reinforcement; 544, Fiber Reinforced Concrete; and S803, Faculty Network, as well as ACI Subcommittee 318-E, Section and Member Strength. He received the ACI Design Award in 2006. His research interests include the design and rehabilitation of reinforced and prestressed concrete structures and the development of structural detailing guidelines to allow the use of high-performance materials.

He received his BASc in civil engineering from the University of Waterloo, Waterloo, ON, Canada, in 1995; his MASc from the University of British Columbia in 1997; and his PhD from the University of Toronto, Toronto, ON, Canada, in 2006. He is a licensed professional engineer in Ontario, Alberta, and British Columbia in Canada.

Mustafa Mahamid is a Clinical Associate Professor in the Department of Civil and Material Engineering at the University of Illinois at Chicago (UIC), Chicago, IL. He has authored or co-authored numerous technical papers, design guides, book chapters, reports, and books.

He is Chair of Joint ACI-ASCE Committee 421, Design of Reinforced Concrete Slabs, and a member of ACI Committees 314, Simplified Design of Concrete Buildings; 435, Deflection of Concrete Building Structures; S802, Teaching Methods and Educational Materials; S803, Faculty Network; and the TAC Subcommittee on ACI/ASCE-SEI Joint Committees. He is also a member of Joint ACI-ASCE Committees 352, Joints and Connections in Monolithic Concrete Structures, and 441, Reinforced Concrete Columns.

Mahamid is a Fellow of the American Society of Civil Engineers (ASCE) and the Structural Engineering Institute (SEI). His research interests include joints and connections, earthquake-resistant design, and fire engineering. He received his BSc in civil engineering from The Eastern Mediterranean University, North Cyprus, Turkey, in 1999; his MS in civil engineering from Bradley University, Peoria, IL, in 2001; and his PhD in civil engineering from the University of Wisconsin – Milwaukee, Milwaukee, WI, in 2001. He is a licensed professional engineer in Wisconsin, Michigan, California, and Washington; a licensed structural engineer in Illinois; and a professional engineer in Newfoundland and Labrador in Canada.

Hayder A. Rasheed is the Thomas and Connie Paulson Outstanding CE Faculty and Professor in the Department of Civil Engineering at Kansas State University, Manhattan, KS. He has served on the Faculty of Civil Engineering at Kansas State University since 2001. He has authored one textbook, co-authored two reference books, and written over 80 journal papers.

Rasheed is a member of ACI Committees 369, Seismic Repair and Rehabilitation; 440, Fiber-Reinforced Polymer Reinforcement; S803, Faculty Network; and Joint ACI-ASCE Committees 335, Composite and Hybrid Structures, and 441, Reinforced Concrete Columns. He is a Fellow of the American Society of Civil Engineers (ASCE). His research interests include nonlinear behavior of reinforced and prestressed concrete members and systems as well as stability and response of fiber-reinforced polymer composite structures under extreme loading.

He received his BSc and MSc in civil and structural engineering from the University of Baghdad, Baghdad, Iraq, in 1987 and 1990, respectively, and his PhD in civil/structural engineering from the University of Texas at Austin, Austin, TX, in 1996. He has been a licensed professional engineer in Wisconsin since 1998.

Scott T. Smith is a Professor of structural engineering and Deputy Dean (International) in the Faculty of Engineering, Computer, and Mathematical Sciences at the University of Adelaide, Adelaide, Australia. He has over 20 years of research and teaching experience, has authored or co-authored over 250 scholarly articles and reports, and has delivered over 220 invited and conference presentations.

He is Chair of ACI Subcommittee 440-1L, Liaison Subcommittee; Co-Chair of ACI Task Group 440-TG3, Anchorage Task Group; and a member of ACI Committee 440, Fiber-Reinforced Polymer Reinforcement. On the international front, Smith is an Australian Committee Member of the Concrete Institute of Australia (CIA) and ACI Joint Subcommittee. He is also President of the International Institute for FRP in Construction (IIFC) and a recipient of the IIFC Distinguished Young Researcher Award. His research interests include the application of fiber-reinforced polymer composites to the built environment as well as sustainable concrete development.

He received his BE in civil engineering and his PhD (majoring in structural engineering) from the University of New South Wales, Sydney, Australia, in 1994 and 1999, respectively. In 2018, he received his MBA and DIC from Imperial College London, London, UK. Smith is a chartered professional engineer in Australia and a Fellow of the American Society of Civil Engineers (ASCE).

Mohammed Sonebi is a Senior Lecturer in the School of Natural and Built Environment at Queen's University Belfast, Belfast, UK. He has authored or co-authored over 82 journal papers, 138 conference papers, and 26 books/chapters.

He is a past Vice Chair of ACI Committee 552, Cementitious Grouting, and a member of ACI Committees 236, Material Science of Concrete; 237, Self-Consolidating Concrete; 238, Workability of Fresh Concrete; 241, Nanotechnology of Concrete; 552, Cementitious Grouting; and 564, 3-D Printing with Cementitious Materials, as well as ACI Task Group 236-TG1, Advanced Analysis Techniques for Concrete, and ACI Subcommittee 238-A, Student Workability. He is also a member of ASTM International Subcommittee C09.47, Self-Consolidating Concrete. His research interests include self-consolidating concrete, rheology of concrete, cementitious grouting, three-dimensional printing with cementitious materials, bio-based building materials, nanotechnology, fiber-reinforced polymers, and structural health monitoring of infrastructures.

He was awarded the Palmer Prize for best paper in Proceedings of the Institution of Civil Engineers – Structures and Buildings in 2017. He headed the Queen's University group that, with Bullivant Taranto Ltd., was named as the best Knowledge Transfer Partnership (KTP) in 2013 and was highly commended in the Engineering Excellence category. He was a finalist for Parliamentary Awards 2016 in the category of Innovation Leading to New Markets at Westminster (London, UK). In 2002, he was a member of the ACM Centre, University of Paisley, Paisley, Scotland, which as a partner in the Brite-Euram project on Self-Compacting Concrete was awarded a certificate by the Commission of the European Union as one of 10 finalist projects considered for the Descartes Prize.

He received his MEng in bridges, pavement, and structural buildings at EMI, Rabat, Morocco, in 1985; and his MSc in civil engineering and PhD from the University of Sherbrooke, Sherbrooke, QC, Canada, in 1992 and 1997, respectively.

Kevin Wolf is the Director of Technical Services for CalPortland Cement Company in the Pacific Northwest and Canada, where he is responsible for managing the Technical Services and Quality Assurance lab for that region.

He has been an active member of ACI since 1987. He is a member of ACI Committee 301, Specifications for Structural Concrete, and a past member of ACI Committees 304, Measuring, Mixing, Transporting, and Placing Concrete; 332, Residential Concrete Work; and 522, Pervious Concrete.

Wolf received his technical education at Mt. Hood Community College in Gresham, OR, where he studied civil engineering technology and where the concrete industry caught his interest. After starting his career working at an independent testing lab for 2 years, he went to work for CalPortland. This began his 40-year tenure as a Cement and Concrete Technician, gleaning information from ACI journals and using all the opportunities at ACI meetings and at other professional venues to expand his knowledge of cement and concrete. His technical interests include cement and supplementary cementitious materials, hydration, and the advancement of concrete as the highly technical building material it is. He also continues to serve as a member of ASTM International Committees C01, Cement, and C09, Concrete and Concrete Aggregates, and is past Chair of the Technical Committee for the Oregon Concrete and Aggregate Producers Association.

ACI's River of Knowledge

Highlights of the ACI Concrete Convention – Fall 2019

The worldwide community of concrete professionals gathers at the ACI Concrete Convention to advance technical knowledge. This common mission shared by ACI members was in action at the ACI Concrete Convention – Fall 2019, October 20-24, at the Duke Energy Convention Center and Hyatt Regency in Cincinnati, OH. The attendance total for the event was 2134, with 521 students participating.

A sold-out Excellence in Concrete Construction Awards Gala showcased outstanding projects from around the world as selected by ACI chapters and ACI International Partners. At the Opening Session and Keynote Presentation, guest speaker Mark Bowden reminded the attendees of the power of body language and how it can adversely affect the messages we try to communicate without us realizing it. The future of technology for business and the increasing use of augmented reality in the construction industry was discussed during the Contractors' Day Lunch. Other highlights during the week included:

International Forum and Workshop

ACI Vice President Jeffrey W. Coleman welcomed attendees at the International Forum on October 20, 2019. Attendees heard from ACI International Partners, ACI chapter representatives, and ACI leadership about events, activities, and initiatives of interest to the concrete materials, design, and construction industry.

The popular forum provides attendees with an opportunity to learn about other international organizations—and how ACI is working with its International Partners in a common pursuit of advancing concrete knowledge. Speakers and their organizations included:

- Khalifa Bin Hadda, Sharjah City Municipality, United Arab Emirates (UAE);
- Mohamad Abd-Alqader, Jordan Concrete Association;
- Alejandro Duran-Herrera, RILEM Latin America;
- François Toutlemonde, Paris Chapter – ACI;
- Sourabh Manjrekar, India Chapter – ACI;
- Amir Salih Mia, Qatar Chapter – ACI;
- Guillermo Loayza, Ecuador Chapter – ACI; and
- Ziad Awad, Lebanon Chapter – ACI and ACTS.

The forum was followed by a lunch presentation titled "Sustainability in the Latin American Cement Industry: How to Transform Challenges into Opportunities" by speaker Maria José García, Executive Director, Inter-American Cement Federation (FICEM). García provided an overview of the challenges being faced in Latin America and the Caribbean. A housing deficit has led to informal housing for many, resulting in a lack of sanitation and drinking water. The majority of the population in the region lives in coastal areas. This concentration of residents brings a problem of proper waste disposal. Also, uncontrolled burning of firewood increases greenhouse gas emissions.

At the Opening Session, ACI President Randall W. Poston (left) presented a certificate of appreciation to Tom Dorsey, Chair of the Greater Miami Valley Chapter – ACI Convention Committee

Greater Miami Valley Chapter – ACI Convention Committee

Committee Chair: Tom Dorsey
Contractors' Day: Brad Rogers
Exhibitors: Mark Cooper
Fundraising: Mike Schneider and Lisa Rogers
Guest Programs: Mary Michael Jett
Publicity: Mike Suter
Secretary: Tim Schirmann
Special Events: Mike Hornback
Student Program: Mandy Albrecht
Technical Sessions: Julie Cromwell
Treasurer: Robin Hahn
Volunteers: Robbie Cherry
At-Large: David Sharamitaro

In tandem with 26 different governments, FICEM has created several roadmaps to lower carbon emissions. Initiatives include reducing the use of clinker with alternative materials and working to develop new cements with less CO_2.

11th ACI International Workshop on Structural Concrete

Sharing information on the innovation, development, and application of concrete design standards throughout the world was the focus of the 11th ACI International Workshop on Structural Concrete. The workshop took place on October 19, 2019, with 97 participants. Sponsored by ACI Committee 318, Structural Concrete Building Code, the workshop brings 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:

Changes in ACI 318-19: This session contained a series of presentations describing recent changes to ACI 318-19, Building Code Requirements for Structural Concrete. The highlighted changes included new shear strength equations, high-strength reinforcement, the new Appendix A, and new seismic provisions.

Concrete Construction in the Middle East: Three sessions during the workshop were dedicated to discussing the innovation and challenges faced while building in the Middle East. The codes and standards used throughout the Middle East, the special construction considerations the region needs to address, and high-performance mass concrete were discussed.

Design of Super-Tall Reinforced Concrete Structures: The special design considerations of super-tall structures in UAE, South Korea, and Saudi Arabia were discussed in this three-session series. In each of the presentations, the role of building use, wind factors, and design were discussed.

Following the full-day sessions, a special poster session featuring the work of eight early career practicing engineers took place during the International Workshop reception.

Student competition participants from Universidad San Francisco de Quito

The ACI-James Instruments Student Award for Research on NDT, from left: ACI Committee 228 member F. Dirk Heidbrink; award winner Sepehr Pashoutani, University of Nebraska–Lincoln; and Faculty Advisor Jinying Zhu, University of Nebraska–Lincoln

Students and Young Professionals Activities

FRP Composites Student Competition

In the ACI Student Fiber-Reinforced Polymer (FRP) Composites Competition, students design, construct, and test a concrete structure reinforced with FRP to achieve the optimal load-to-cost ratio, predict the ultimate load, and predict the load that will result in a piston deflection of 3.5 mm (0.14 in.).

In the Structure Type 1 category, the top finishers were:

- First place, Universidad Central del Ecuador, Quito, Ecuador; Students: Amaguaya Pacalla Mario, Cárdenas Sánchez Marlon, Morales Arcos Luis Vicente, Quilumbaquín Álvarez Emerson Patricio, Albán Duque Erik Jonathan, Brito Fray Juan, and León Tapia Alexis; Faculty Advisors: Sánchez Oñate Diego Mauricio and Luis Wladimir Morales Gubio;
- Second place, Southern Illinois University, Edwardsville, IL; Students: Dalton Brookshire, David Rall, Paityn Jansen, Martin Witges, Holly Liebel, Josh Hemann, and Joel Kuhlmann; Faculty Advisor: Anne Werner; and
- Third place: Bannari Amman Institute of Technology, Coimbatore, India; Students: Govindhan Shanmugam, Gowtham Thirumoorthy, Ranjithselvan Karuppusamy, and Eniya Chandramouli Gunasekaran; Faculty Advisor: Manjunath Nochikkuttai Venkatachalam.

In the Structure Type 2 category, the winners were:

- First place: Universidad San Francisco de Quito, Quito, Ecuador; Students: Bernardo Carrera, Daniela González, Mirta Grefa, Elizabeth Rueda, and Melanie Soria; Faculty Advisor: Gustavo Tapia;
- Second place: North Carolina State University, Raleigh, NC; Students: Amy Butler and Renzo Cieza Morro; Faculty Advisor: Roberto Nunez; and
- Third place: University of Minnesota Duluth, Duluth, MN; Students: Joshua Comstock, Grant Magnuson, Matthew Henderson, Joshua Tomczak, and Brandon Anderson; Faculty Advisor: Mary Christiansen.

ACI-James Instruments Student Award for Research on NDT

The ACI-James Instruments Student Award for Research on NDT of Concrete is sponsored by James Instruments, Inc., a Chicago, IL-based manufacturer and distributor of nondestructive testing (NDT) systems. The award recognizes original research on NDT of concrete and is given by ACI Committee 228, Nondestructive Testing of Concrete.

The winning entry for 2018 was "Ground-Penetrating Radar Data Processing for Concrete Bridge Deck Evaluation" by Sepehr Pashoutani, University of Nebraska–Lincoln, Lincoln, NE. In Cincinnati, Pashoutani summarized this research at the Research in Progress technical session, sponsored by ACI Committee 123, Research and Current Developments. ACI Committee 228 member F. Dirk Heidbrink, Wiss, Janney, Elstner Associates, Inc., Northbrook, IL, presented the award. The award includes a cash prize of $1500 and free Spring Convention registration.

Taking your concrete knowledge to work!

The transition from college to the working world was the subject of the talk given by ACI Past President Ken Hover at the Student Lunch. Hover offered guidance on navigating "the real world," which is an uncertain world. But he assured the students that "your experience with the 'real world' will make you more comfortable with uncertainty."

He stressed that young professionals should not underestimate the value of knowledge and "knowing what is going on" to be able to contribute effectively to the work team. Hover advised the audience when they begin their careers to "pay attention, take notes, and ask questions." Seeking help when needed and always projecting a positive attitude are some key attributes for success.

What I wish I knew: Involvement with ACI

ACI Committee S806, Young Professional Activities, organized a session with five young professionals who related their experiences and individual paths within ACI. The overall connecting theme was "get involved as early as you can!" and find a champion as a mentor—whether that person is another student, a professor, or an engineer. "Seek out mentors because they can take you places you never thought you would ever expect to go," advised Anahid Behrouzi, California Polytechnic State University.

Dimitri Feys, Missouri S&T, discussed "How to get involved with technical committees as a young member." He suggested attending a committee meeting with a topic of strong interest to you. Make sure to be on time for the introductions at the start of the meeting. Begin by observing the committee at work, and then get involved by taking on smaller tasks, such as writing a paragraph section of a document as an associate member. Volunteering to organize a technical session is also a possibility.

Feys said, "Your hard work will be rewarded with more hard work." Recognition can lead to becoming a voting committee member. "This is a long-term process," he added.

ACI Concrete Convention – Fall 2019 Sponsors

Mississippi River Sponsors: Baker Concrete Construction and Greater Miami Valley Chapter – ACI.

Ohio River Sponsors: Anderson Concrete Corp.; CEMEX; and LafargeHolcim.

Allegheny River Sponsors: BASF Corporation; The Euclid Chemical Company; Forta Corporation; GCP Applied Technologies; Hilltop Companies; Irving Materials, Inc.; Janell, Inc.; Largo Concrete, Inc.; Lehigh Hanson; Lithko Contracting, LLC; PERI Formwork Systems; PlanGrid, an Autodesk Company; RMD Kwikform; Ruttura & Sons Construction Co.; Terracon Consultants, Inc.; and Webcor Builders.

Greater Miami River Sponsors: Advance Ready Mix Concrete, Inc.; Dugan and Meyers LLC; Ernst Enterprises; Indiana Chapter – ACI; Lebanon Chapter – ACI; Messer Construction Co.; Metzger/McGuire; Northern California and Western Nevada Chapter – ACI; Québec and Eastern Ontario Chapter – ACI; San Antonio Chapter – ACI; Sika Corporation; Skyway Cement Company; Somero Enterprises, Inc.; THP Limited; TWC Concrete Services, LLC; West Michigan Chapter – ACI; and Wiss, Janney, Elstner Associates, Inc.

Little Miami River Sponsors: Advantage Group Engineers, Inc.; AMSYSCO; Arcosa Lightweight; Carolinas Chapter – ACI; Ceco Concrete Construction LLC; Central Ohio Chapter – ACI; Contractors Materials Company; Greater Michigan Chapter – ACI; Kentucky Concrete Association; Keystone Structural Concrete, LLC; Las Vegas Chapter – ACI; New Jersey Chapter – ACI; Ohio Concrete; Prus Construction; San Diego Chapter – ACI; Sardinia Concrete; SMART Building Supply; Southern California Chapter – ACI; SRM Concrete; Structural Engineers Association of Ohio; and Turner Construction.

Licking River Sponsors: Arizona Chapter – ACI; Arkansas Chapter – ACI; Central Florida Chapter – ACI; Central Texas Chapter – ACI; Colorado Ready Mixed Concrete Association; Eastern Pennsylvania and Delaware Chapter – ACI; Georgia Chapter – ACI; GeoTechnology, Inc.; Houston Chapter – ACI; Illinois Chapter – ACI; Intermountain Chapter – ACI; Iowa Chapter – ACI; Kansas Chapter – ACI; Louisiana Chapter – ACI; Maryland Chapter – ACI; W.R. Meadows; Missouri Chapter – ACI; National Capital Chapter – ACI; New Mexico Chapter – ACI; Northeast Ohio Chapter – ACI; Richard Goettle, Inc.; Rocky Mountain Chapter – ACI; Russtech Inc.; Silica Fume Association; and St Marys Cement/Votorantim.

ACI Committee 213 poster competition, from left: Robert Thomas, Co-moderator, Clarkson University; Hossein Kabir, second place, University of Toronto; Ryan Boehm, first place, UT Austin; Adham Abu-Abaileh, third place, Bradley University; and Yaghoob Farnam, Co-moderator, Drexel University

Research poster competition

ACI Committee 123, Research and Current Developments, held its biannual poster competition. Students were invited to submit abstracts on previously unpublished information from in-progress or completed studies in any area of concrete structures or materials. The purpose of the session is to allow undergraduate and graduate students an open forum to present their research and solicit feedback from industry and research experts. The posters were evaluated by a panel of judges and the top three winners received cash prizes. The winners were:

- First place, Ryan Boehm, University of Texas at Austin, Austin, TX, “Experimental Investigation of the Face Reinforcement Ratio and Drilled Shaft Diameter in Drilled-Shaft Footings”;
- Second place, Hossein Kabir, University of Toronto, Toronto, ON, Canada, “Evaluating the Autoclave Expansion Test as a Performance Measure of Deleterious Levels of Periclase in Cement”; and
- Third place, Adham Abu-Abaileh, Bradley University, Peoria, IL, “A Statistical Approach to Derive Design Code for Shear Strength of Corrosion-Damaged Reinforced Concrete Beams.”

Spring 2020 Convention Offers Certification, Professional Development

ACI and the Illinois Chapter – ACI are hosting the ACI Concrete Convention this spring at the Hyatt Regency O’Hare

Convention Exhibitors

ADAPT Visicon
American Galvanizers Association
AOMS Technologies
Arcosa Lightweight
Baker Concrete Construction
BarSplice Products Inc.
BASF Corporation
Bekaert Corporation
BoMetals, Inc.
Buzzi Unicem USA
Červenka Consulting
CMEC, Inc.
COMMAND Center
Concrete Sealants, Inc.
Concrete Sensors
Con-Cure
Contractors Materials Co.
Controls Group USA Inc.
CRC Press / Taylor and Francis
Cresset Chemical Company
The Euclid Chemical Company
FDH Infrastructure Services
FiberForce by ABC Polymer
Forney, L.P.
GCP Applied Technologies
Germann Instruments
Gilson Company, Inc.
Green Umbrella
Gunite Supply & Equipment
Headed Reinforcement Corp.
Humboldt Mfg. Co.
Imerys
International Concrete Repair Institute
International Zinc Association
Irving Materials, Inc.
JSW Stud Rails
Kestrel Weather Meters
Kryton International Inc.
Lehigh Hanson
M.A. Industries, Inc.
MAPEI
Microban International
Myers Construction Materials Testing Equipment
NITROcrete
Olson Engineering
PERI Formwork Systems
PlanGrid, an Autodesk Company
Premier CPG
Proceq USA, Inc.
QuakeWrap, Inc.
Radarview LLC
Rattle Stick Concrete Tools
Resource International, Inc.
Rhino Carbon Fiber
RMD Kwikform
Silica Fume Association
SSRG
STRUCTURAL TECHNOLOGIES
Tech Sales, LLC
Terracon Consultants, Inc.
Vector Corrosion Technologies
Wicktek, Inc.
Xypex Chemical Company
Zircon Corporation

in Rosemont/Chicago, IL, March 29-April 2, 2020. The convention program includes more than 40 technical and educational sessions that provide attendees with the opportunity to learn and earn Professional Development Hours (PDHs) and/or Continuing Education Units (CEUs).

Some session selections include “21st-Century Steel Reinforcement: Simply Superior,” “Concrete through the Ages,” “Constructability and Shotcrete Construction in the Windy City,” and “Advancing Post-Tensioning: Strength in Concrete.” The Contractors’ Day Lunch will feature a presentation on mass concrete.

To learn more, visit **www.aciconvention.org**.

ACI will offer four ACI inspector certification program exams at the upcoming ACI Concrete Convention. Exams offered include:

- Concrete Quality Technical Manager;
- Concrete Construction Special Inspector;
- Concrete Transportation Construction Inspector; and
- Post-Installed Concrete Anchor Installation Inspector.

Certification exams will be offered at the Convention on April 1, from 7:00 a.m. to 6:00 p.m.

For more information on ACI’s certification programs, visit **www.ACICertification.org**.

Students from the University of Minnesota Duluth were among the top finishers in the ACI Student FRP Composites Competition

ACI Cement Physical Tester Certification

Procedures, Methods, Equipment, and Understanding Test Results

2 – 2.5 Day Program

This program includes classroom review and hands-on practice for standard paste and mortar tests associated with basic testing of cement.

The sessions include tips on test methods and understanding test results, as well as responsibilities of the cement technician and the impact of poorly maintained equipment.

ASTM Standards included:

✓ ASTM C109, Compressive Strength of Mortar
✓ ASTM C151, Autoclave Expansion
✓ ASTM C185, Air Content of Mortar
✓ ASTM C187, Normal Consistency of Hydraulic Cement
✓ ASTM C191, Time of Set by Vicat Needles
✓ ASTM C204, Blaine Fineness
✓ ASTM C305, Mixing of Pastes and Mortars
✓ ASTM C430, Fineness by the No. 325 Sieve
✓ ASTM C490, Practice for Determining Length Change
✓ ASTM C1437, Flow of Hydraulic Cement Mortar

Review & Certification Sessions Scheduled for 2020

- **St. Paul, MN**—American Engineering Testing—**April** 15-17
- **Frederick, MD**—CCRL headquarters—**May** 13-15
- **Denver, CO**—CRMCA at Colorado DOT—**June** 16-18
- **Tampa, FL**—CMEC—**July** 30-**August** 1
- **Fontana, CA**—Caltrans—**September** 22-24
- **Austin, TX**—Central Texas Chapter—**November** 17-19
- **St. Paul, MN**—American Engineering Testing—**December** 15-17

For more information about the certification program or to host a session, visit **concrete.org/certification** or call +1.248.848.3196.

An Awe-Inspiring Place

Sydney's Punchbowl Mosque showcases the architectural flexibility of concrete

by Deborah R. Huso

In 2018, the Australian Islamic Mission (AIM) celebrated the completion of its stark yet elegant mosque in the Punchbowl suburb of Sydney, Australia. Named after a nearby circular valley that nineteenth-century settlers called "the punch bowl," the suburb is located in Sydney's southwest and is known for its cultural diversity.

The Punchbowl Mosque's design, the brainchild of Greek-Australian architect Angelo Candalepas of Candalepas Associates in Sydney, features what some might call (but Candalepas downplays) a "brutalist" structure with a simplicity of exterior architecture that belies its inspirational interior. Almost the entirety of the structure is rendered in concrete. With no elaborate ornamentation other than gold calligraphy painted on minidomes in the main prayer hall, the combination of formed concrete with wood and stone detailing creates a space that is arresting in its delicate restraint.

Fig. 1: Punchbowl Mosque, Sydney, Australia, with main entry doors facing the street and a single minaret adjacent to the entry (left) *(photo by Brett Boardman, courtesy of Candalepas Associates)*

Concrete as Sculptural Material

Architecturally as well as spiritually, the design speaks to the efforts of AIM and Candalepas to improve interfaith relations in New South Wales. The main entry doors intentionally open to the street (Fig. 1), creating a sense of welcoming and transparency to passersby of all faiths. Adjacent to the entry, a single minaret is subtly incorporated into a wing of the building that frames the mosque's courtyard (Fig. 1).

The architect selected concrete as the primary construction material largely because AIM's construction brief called for a structure that would last 300 years. "Concrete is often mistaken for a material that is only solid and firm," says Angelo Candalepas, "but its ability to be cast in many types of forms gives it a potential that is not often realized." It is that potential that Candalepas sought to manipulate when selecting concrete as the construction material.

The final set of construction drawings were sent to the builder in the fall of 2014. That package included 1:20 scale detail sections showing the mosque's key elements, including details of the concrete ceiling of the mosque's prayer space. In addition to a concrete ring beam with a stepped soffit evoking a corbelled dome structure, the ceiling comprises seven rows of quarter-sphere muqarnas (ornamented vaulting formed as quarter-sphere minidomes) on the northwestern and southwestern sides of the space (Fig. 2). According to Candalepas, the drawings called for a Class 2C finish for all visible concrete in accordance with Australian Standard AS 3610. Project construction began in October 2015 with the mosque's basement car park.

The Muqarnas

The sculptural ceiling of the prayer space features 102 muqarnas spread across two faces of the ceiling like a honeycomb (Fig. 2). Because the

Fig. 2: A view from the floor of the main prayer hall, showing the stepped soffit of the concrete ring beam and rows of quarter-sphere muqarnas. Since this photo was taken, Turkish and Iranian calligraphers have inscribed the smooth and seamless concrete surfaces of the minidomes with the 99 names of Allah in gold calligraphy *(photo by Brett Boardman, courtesy of Candalepas Associates)*

Fig. 3: A mockup was used to verify methods and materials for construction of the muqarnas: (a) formwork with molded and coated fiberglass domes; and (b) finished surface after stripping the molds *(photos by Adrian Curtin, courtesy of Boral Australia)*

concrete was to serve as the painting surface for calligraphers, Candalepas did not want to use any chemical release agents. He also provided no option for patching damaged surfaces.

Thus, casting the muqarnas was the most challenging aspect of the construction. "There was a high level of concern [about] the finish that could be achieved for the exposed concrete surfaces, especially the muqarnas," says Paul Moore, Structural and Section Manager and Principal at Wood & Grieve Engineers, the firm that prepared detailed project designs and documentation and supervised structural work during the mosque's construction. To address this, Wood & Grieve documented reinforcing bars for these elements in three dimensions in Autodesk Revit, producing perspective views as well as the typical plan, sections, and elevations.

To ensure the finish could be achieved, Sydney-based builder Infinity Constructions Group made several test placements, including the construction of a mockup of the walls and lower muqarnas at the west corner of the building (Fig. 3). In addition to using the same formwork system and reinforcing layout as required for the actual structure, the mockup was constructed using the concrete mixture and curing techniques that were to be used in the final construction.

Each minidome is a quarter sphere, 1500 mm (59 in.) wide and 750 mm (29.5 in.) high, with a 30 mm (1-1/8 in.) diameter hole created at the center using a tube and a form tie. To allow light yet prevent water from penetrating the ceiling, the tubes were subsequently plugged with clear polymethyl methacrylate caps where they pierce the roof sheathing. The curved surfaces were formed using molded fiberglass domes with a smooth polymer coating. The dome forms were separated by 120 mm (5 in.) to create vertical, semicircular flat planes between the curved surfaces; the flat surfaces between the minidomes were cast against galvanized-steel sheets backed by plywood (shown in Fig. 4).

During construction, each fiberglass dome was penetrated at its center point by a single large form tie that extended to the sloped formwork for the roof of the building. The concrete thickness at this point was 350 mm (13-3/4 in.). "I had imagined we would be able to have large ties since I had desired the entire ceiling to have many small skylights," Candalepas notes. "In ancient Turkish mosques, the night sky was replicated within the domes. I found that the juxtaposition between the eternal values of the form-giving sphere [the dome] above the space was able to be enhanced with the mosque ceiling describing the night sky below it." He also noted that the concave surfaces "showcase the subtle gradation of light at different intensities and concurrently."

The formwork for the mosque ceiling was constructed and scaffolded to progressively step up and out by 810 mm (32 in.) vertically and horizontally with each row of muqarnas. According to Candalepas, "Stripping the lowest levels of formwork after the first concrete pours would, therefore, not be possible until all the remaining concrete pours for the mosque's ceiling and ring beam had been completed." The builder created flat shelves of formwork to set out the stepping profile of the raked ceiling to two sides of the mosque and then cut rectangular slots into these shelves at intervals that matched the set-out of the muqarnas.

"Fiberglass molds placed on the inside face of each formwork slot created the quarter-spherical domes [of the muqarnas]," Candalepas adds, noting that the concrete placements for the main prayer space took up to a full day to pump, given the complex geometry for the interior formwork. Candalepas says the builder cleaned and polished formwork each day before the next day's concrete placement.

Concrete for Sculptural Finish

During the production of the tender documents, Candalepas collaborated closely on concrete specifications with Sydney-based structural engineering firm Taylor Thomson & Whitting and concrete manufacturer Boral Australia. The team selected a white concrete mixture based on Boral's patented Envisia® system. Envisia mixtures contain a high supplementary cementitious material content and thus have a lower CO_2 footprint than conventional concrete mixtures. Aesthetics and long-term performance were also major considerations. As Candalepas notes, "Low-shrinkage performance, in particular, was a significant consideration given the complexity and volume of the concrete pours proposed for the main prayer space." Envisia concrete consumes much of the mixing water while it is setting, resulting in reduced volume loss from water evaporation. This results in 50% lower shrinkage than conventional concrete mixtures, yet the proprietary mixture can also achieve the same setting times and strength gain as more conventional mixtures.

Fig. 4: Muqarnas were formed using molded fiberglass minidomes spaced 120 mm (5 in.) apart, and the flat surfaces between minidomes were formed using galvanized steel on plywood panels: (a) view of minidome forms installed on scaffolding; (b) view of exterior formwork for the sloping roof; and (c) view of minidomes during stripping operations *(photos by Adrian Curtin, courtesy of Boral Australia)*

The Main Prayer Hall

The walls within the mosque's main prayer hall are typically 200 mm (8 in.) thick and include 300 x 600 mm (12 x 24 in.) pilasters. The walls stop short of the lower level of muqarnas, allowing outside light filtered through translucent glass to illuminate the minidomes from below. To meet thermal and aesthetic requirements, the wall areas between pilasters also have interior insulation as well as granite and hoop pine veneer plywood finishes. The concrete used to construct the walls had an 80 mm (3-1/4 in.) slump and a maximum aggregate size of 20 mm (3/4 in.). The concrete used to construct the muqarnas had a 120 mm (4-3/4 in.) slump.

The Dome

The designer initially envisioned the dome to be constructed in stone. However, after a series of prototypes were considered, a structural steel dome supported by a concrete ring beam was selected. The ceiling of the dome is finished with sheets of marine plywood with hoop pine veneer (Fig. 5). The stepped concentric circles of the ceiling and ring beam, along with the diffuse light provided by the dome's

Fig. 5: The dome is a structural steel structure that includes a clerestory base: (a) a view during construction, showing the steel structure above the concrete ring beam; and (b) a view after completion, showing the visual drama created by the diffuse lighting of the stepped ring beam and veneer ceiling *(photos by Adrian Curtin, courtesy of Boral Australia)*

oculus and clerestory, create an ethereal aesthetic in the main prayer hall.

The builder cast a 100 x 100 mm (4 x 4 in.) rebate into the top of the mosque walls and muqarnas to recess the construction joint for the flat concrete ceiling and profiled ring beam. Then the construction team fashioned a construction deck above the flat ceiling and placed the form for the ring beam, constructing it in two concrete placements (Fig. 6). Candalepas says the construction deck remained in place as the formwork for the muqarnas was stripped below it in December 2016. After that, the builder began working on the steel structure of the dome, clerestory glazing, and oculus. By the end of January 2017, the formwork of the muqarnas as well as the scaffolding had been stripped away to reveal the main prayer space's finished interior.

Fig. 6: Ring beam construction: (a) before the first concrete placement; and (b) before the second placement *(photos by Adrian Curtin, courtesy of Boral Australia)*

Appreciation

Punchbowl Mosque won the 2018 Sulman Medal for Public Architecture before it was completed in December 2018. The mosque opened for worship in the summer of 2019.

Note: Additional information on the Australian standard discussed in this article can be found at **www.standards.org.au**.

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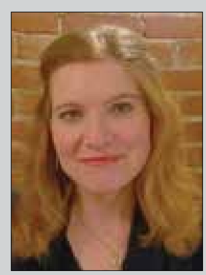

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Concrete Polishing Council
of the American Society of Concrete Contractors
Position Statement #5

Effects of Slab-Surface Finish Density on Polished Concrete

Machine troweling and manual troweling result in differing surface densities, with the former's surface being denser, harder, and darker in color. The various densities will be obvious in a polished surface, just as they are in the appearance of other concrete surfaces. Different surface densities will also result in color variations when adding color to the concrete surface, as the color will be absorbed differently in each area. Typical areas of concern are at slab edges, along construction joints, around protrusions like floor drains, and near wall edges and corners where manual finishing is likely to be used.

The photos illustrate the differences in a polished surface along a slab construction joint. Near the joint, the slab was finished with a handheld trowel. Away from the joint, the surface was finished with a walk-behind trowel. A distinct change in surface density was produced within an arm's length of the joint.

Variations in surface density can also be created by machine troweling using steel blades.

Although the polishing operation will expose differences in slab-surface density, the polishing contractor is not responsible for the resulting differences in appearance. The Concrete Polishing Council (CPC), a specialty council of the American Society of Concrete Contractors (ASCC), has developed "A Supplemental Checklist for Concrete to Receive a Polished Concrete Finish" (**https://ascconline.org**) to discuss options for avoiding these effects with the concrete contractor at the concrete slab preconstruction conference, including:

- Allowing finishers to machine trowel over the existing slab at construction joints;
- Minimizing the need for manual finishing at formed edges by using beveled edge-forms with supporting stakes driven below the form top;
- Minimizing the need for manual finishing near walls and other obstructions by using a walk-behind edge-finishing machine with a rotating guard wheel; and
- Minimizing mottling of the surface by machine troweling with plastic (Teflon™) blades rather than with steel blades.

More specific information on each of these items can be found in "Specifying the Concrete Slab to Be Polished" by Scharich et al., *The Construction Specifier*, August 2, 2016, and "Uniform Polished Concrete Starts with the Canvas" by Bartz et al., *Concrete Contractor*, August/September 2016. Both articles are available free at **https://ascconline.org/concrete-polishing-council/technical-documents**.

CPC polishing contractors will cooperate with owners, designers, construction managers, general contractors, and concrete contractors to discuss the effects of differing surface density on the polished concrete appearance. Selecting a deeper grind to expose more coarse aggregate may minimize the difference in appearance due to surface-density differences. However, grinding deeper may not meet the original aesthetic goal and is likely to result in additional charges that may include the cost of a grout coat.

Slab-surface finishing is the responsibility of other parties, and the difference in the polished surface appearance due to slab-surface finish density is not the responsibility of the polishing contractor.

If you have questions, contact your CPC polishing contractor or the CPC Technical Hotline at +1.888.483.5288 or at cpchotline@ascconline.org.

This position statement from the Concrete Polishing Council of the American Society of Concrete Contractors is presented for reader interest by the editors. The opinions expressed are not necessarily those of the American Concrete Institute. Reader comment is invited.

Purpose and Pitfalls of Submittals and Shop Drawings

Careful attention is needed in the submission, review, and approval process

by Kenneth A. Slavens

Submittals are a formalized means of communication in construction and are building blocks to a successful project. They can also have unwelcome consequences.

Shop Drawings and Submittals

American Institute of Architects (AIA) Document A201™ – 2017, "General Conditions of the Contract for Construction" (General Conditions), defines the role of shop drawings as the means to demonstrate "how the Contractor proposed to conform to the information given and the design concept expressed in the Contractor Documents for those portions of the Work...require[ing] submittals...." On any project you will need to review and assess the contractual obligations, but this overview references the requirements defined in the AIA document.

A common misconception is that submittals dictate the work to be performed. The AIA documents are clear, however, that the Contract Documents define the Work, and the AIA General Conditions state specifically that "submittals are not Contract Documents."

Before sending the submittal for review, a contractor must review the submittal for compliance with the requirements of Contract Documents and approve the submittal. When contractors send submittals to the design professional for review, contractors represent to the owner and the architect that they (1) reviewed and approved the submittal; (2) determined and verified materials, field measurements, and field construction criteria, or will do so; and (3) checked and coordinated the information in the submittal with the contract requirements.

A contractor is prohibited from performing any work covered in a submittal until it is approved by the architect or engineer. Once approved, contractors must perform the work in accordance with the approved submittal. There is a word of caution: even if the architect approves a shop drawing that includes a deviation from the Contract Documents, the contractor's obligation remains compliance with the Contract Documents—not the shop drawing.

If contractors want to propose an intentional deviation from the Contract Documents, there is a scheme to address that. The contractor must note the deviation when submitting the shop drawing and the architect must approve the deviation in writing as a minor change in the work or process a change order or change directive. If the architect approves the shop drawing but does not provide the required written documentation, the contractor remains at risk for the deviation in the submittals.

The architect's obligations are limited by comparison to the contractor's. The architect must review submittals and take the appropriate action as required by AIA Document B101™ – 2017, "Standard Form Agreement between Owner and Architect." Review is limited to checking for conformance with information in the Contract Documents and the design concept.

Review of Shop Drawings

There is a duty of good faith implied in the shop drawing review process. An example is the appeal that arose from a contractor's suit following termination in *Nova Contracting, Inc. v. City of Olympia* (Wash.App. 2017).

Nova contracted with the City of Olympia to replace a culvert. Nova had to provide various submittals to the City's Engineer for approval before construction could begin. The contract provided the City's approval was a prerequisite to starting work on items covered by a submittal, and the City's decision to accept or reject a submittal was final.

The City rejected many of Nova's submittals and resubmittals, which Nova argued was done improperly and motivated by an effort to prevent its performance. The termination of Nova was initiated in part due to Nova's failure to provide appropriate submittals.

The implied duty of good faith and fair dealing requires the parties to cooperate so each may benefit from full performance of the contract. The City argued there was no duty of good faith because the City had unconditional authority; that is, the City Engineer's decisions were final.

The court rejected the City's position and held the contract did not provide the City with the absolute right to reject all submittals for any reason. The City's judgments were to be guided by whether the submittal indicated Nova's work would comply with the contract. The City had to exercise discretion consistent with the contract's requirements.

The City's actions showing a lack of good faith included demanding all submittals be approved before Nova could begin any work contrary to industry practice and the contract, and the City's practice of rejecting the initial submittal for one reason and then rejecting the resubmittal for new and different reasons.

Impacts on the Scope of Work

Arguments can arise over whether shop drawings alter the scope of work. An unsuccessful effort to rely on shop drawings to change the scope of work can be found in *United States v. Henke Const. Co., et al.,* 157 F.2d 13 *(8th Cir. 1946)*. A contractor sought recovery for the cost of additional labor and material as the result of the government-owner's refusal to "consider, approve, or act upon" certain shop drawings.

In *Henke*, shop drawings were prepared with input from the tile installer and submitted to the government-owner; however, they were returned without action. The returned shop drawings did have a notation that no shop drawings were required for "this work."

The court concluded that the contractor's claim to additional payments for work shown on the shop drawings, but not within the scope of the contract, must fail because it assumed shop drawings were required for the work. The court noted shop drawings were returned without approval or disapproval and the only comment was to warn the installer to follow the contract requirements.

Liability and the Scope of Review

Claims of injured workers may have outcomes that differ depending on the review process, contract language, and how the injuries occurred. For example, approval of shop drawings that did not include temporary bracing or temporary connections was argued to be negligence by the design professional in *Waggoner, et al. v. W & W Steel Company, et al.*, 657 P.2 147 (Ok. App. 1983), when two workers died after a gust of wind caused an unsecured and unbraced piece of steel to collapse. The Oklahoma Supreme Court looked to the Contract Documents to determine the review process and purpose of shop drawings. The court concluded the contractor approved the shop drawings before submittal to the architect was required. The documents were clear that the contractor was "solely responsible for all construction means, methods, techniques, sequences, and procedures." But the architect was obligated to review "for conformance with the design concept...and with the information given in the Contract Documents."

The court concluded it was the duty of the contractor—not the architect—to see that the shop drawings included temporary connections, which is encompassed in the field construction criteria and construction means, methods, techniques, sequences, and procedures. The architect could not be held liable for the injuries sustained because of an unsafe construction procedure.

The ruling in *Waggoner* is in line with other opinions. For example, the Illinois Court of Appeals adopted the same essential position in *Block v. Lohan Associates, Inc., et al.*, 645 N.E.2d 207 (Ill. App. 1993), when a worker sustained severe head injuries in a fall while erecting the precast panels during construction of a new building. The court concluded the Contract Documents uniformly and clearly limited the architect-designer's responsibility regarding shop drawings to a determination of design conformance and not worker safety. The design professional did not have control or charge of the construction means, methods, techniques, sequences, or procedures or for safety precautions in the construction. The court made essentially the same finding for the structural engineering subconsultant to the architect.

Similar arguments were addressed in a suit by an injured plaintiff related to the absence of temporary barriers or handrails during construction with the same essential outcome in *National Foundation Company v. Post, Buckley, Schuh, & Jernigan, et al.,* 465 S.E.2d 726 (Ga. App. 1995). The design and placement of the handrails and barricades were temporary in the work-site area and a safety measure, not an inherent design requirement. The duty for worker safety was placed on the contractor, who exercises control and supervisory responsibly on the jobsite.

However, what if the approved shop drawings do not conform to the design? The courts may reach a different conclusion, as did the court in *Jaeger v. Henningson, Durham, & Richardson, Inc.*, 714 F.2d 773 (8th Cir. 1983). The design professional provided architectural services for an office building.

Two workers were injured during steel erection, arguably because a shop drawing had erroneously called for 14-gauge steel for a landing pan contrary to the specifications, which required 10-gauge steel. The design professional failed to notice the discrepancy in gauge and approved the shop drawing. The steel was fabricated in accordance with the approved shop drawing and later found to be the cause of the injuries.

The court concluded the design professional negligently failed to "supervise the shop drawings" under the contract and the proximate cause of the accident.

Delegation of Design

The design process can delegate design for certain aspects of the project. The Contract Documents will delegate the design to a supplier, vendor, or contractor with more specialized knowledge. However, the delegation and shared responsibility can cause complications in the submittal review process and the assessment of responsibility.

Conclusions

To have a successful project of any complexity, the submittal process must be followed and managed. Though not part of the "Work" as defined by the Contract Documents, the shop drawings ensure that the contractor complies with the contract's obligations, the designer's design is brought to fruition, and the delivered project is what the owner wants. When the process runs off of the tracks, it can create issues for all involved.

Careful attention to the contractual obligations related to the process and attention to details in the submission and review process will provide smooth project delivery without surprises, finger-pointing, or additional expenses.

Note: Additional information on the AIA documents discussed in this article can be found at **www.aiacontracts.org**.

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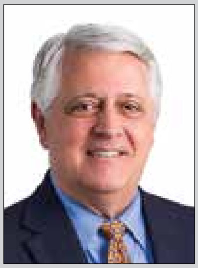

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Designing Underground Building Structures

Proposed load factors to make AASHTO loadings compatible with IBC design requirements

by Zhu Liu

Accelerating urbanization is incentivizing developers and government agencies to maximize functions within limited and concentrated footprints. As a result, cities are growing both upward and downward. The latter effect has created challenges for building designers, as no single code provides full guidance for the design of underground building structures.

Broadly speaking, there are two types of underground structures: longitudinal and vertical. Representative longitudinal underground structures are tunnels—for example, tunnels for roads or transit systems. These structures are typically developed by government agencies. Representative vertical underground structures are building structures—for example, transit stations or underground shopping malls. These structures can be developed by government agencies or private developers. Note that building basements are excluded from either category because they behave more as extensions of buildings from aboveground than as independent underground structures. While both longitudinal and vertical structure types are mainly constructed of concrete and experience similar loadings, they react quite differently to these loadings.

Regardless of the purpose and functions of an underground structure, the structural engineer must choose appropriate loads and load factors for load and resistance factor design (LRFD) methods (using ACI terminology—strength design). Loading at or near the surface—mainly from vehicles such as trucks—has a major effect on the total imposed load. Vehicle loadings are covered in detail in the American Association of State Highway and Transportation Officials (AASHTO) LRFD Bridge Design Specifications (AASHTO Bridge Specifications).[1] However, the AASHTO Bridge Specifications do not provide much design guidance for underground structures, as they are primarily focused on the design of highway bridge structures—structures that are horizontal, relatively flexible, and aboveground.

In 2009, the U.S. Department of Transportation Federal Highway Administration (FHWA) published a Technical Manual for Design and Construction of Road Tunnels – Civil Elements[2] (FHWA Tunnel Manual) to address "the increased use of underground space for transportation systems and the increasing complexity and constraints of construction and maintaining above ground transportation infrastructure…." This manual was developed as "a single-source technical manual providing guidelines for planning, design, construction, and rehabilitation of road tunnels…." However, it is not a design standard, and it refers to the AASHTO Bridge Specifications for load factors and load combinations. The AASHTO LRFD Road Tunnel Design and Construction Guide Specifications[3] (AASHTO Tunnel Guide) was published in 2017 as "an initial attempt to codify and standardize highway tunnel design." The AASHTO Tunnel Guide provides load factors, load combinations, and resistance factors developed in research project No. NCHRP 12-89,[4] in which a limited calibration was made based on results from the analysis of a circular bored tunnel.

In terms of topography and stiffness, underground building structures are unlike tunnels. Further, the design of an underground building structure is generally governed by the International Building Code (IBC) published by the International Code Council (ICC).[5] This standard provides detailed requirements for building design. However, it is relatively silent on the loads and load factors to be used for the design of underground structures, especially surcharge loads from vehicles.

Currently, practitioners tend to use one of two approaches for the design of underground building structures. One approach is to use the AASHTO Tunnel Guide to design the whole structure, even though it is debatable whether this guide applies to underground building structures. Designing per the AASHTO Tunnel Guide works well enough for a simple underground structure such as a pump station or any structure that is long in shape, where vehicle surcharge loads can have dominant effects. While these loads can also have dominant effects on the upper levels of multilevel underground building structures, the effects dissipate rapidly with increasing depth. Thus, loads not related to vehicles—such as dead load, building live load, hydrostatic pressure, and soil pressure—have dominant effects on the lower levels of a multilevel structure. Some of those loads interact with the responses of underground building structures, and this interaction differentiates the design complexity of single-level underground structures with that of multilevel underground structures by an order of magnitude. Underground building structure designs based on the AASHTO Tunnel Guide therefore tend to be overly simplistic and conservative. Even so, designers may use the AASHTO requirements simply because they are available, and it is convenient to apply one standard over the full depth of a structure.

A second approach is to design an underground building structure as a building, according to the IBC, but applying the load factors from the AASHTO Tunnel Guide. The main issue with this approach is a lack of compatibility between load factors and strength reduction factors. To achieve the appropriate reliability for designs, load factors from the AASHTO Tunnel Guide must be calibrated to be compatible with the corresponding strength reduction factors in the IBC code, similar to what was done for tunnels in Reference 4.

So, the designer of an underground building structure must choose between overly conservative design or incompatibility between load factors and strength reduction factors. The former choice will waste the owner's money, while the latter choice will result in unknown reliability. Ideally, officials from ICC would develop a complete design specification by performing a calibration of the load factors for AASHTO loads based on the IBC design methodology. Before that becomes available, however, this article proposes a compromise application of load factors from the AASHTO Tunnel Guide in IBC load combinations based on judgment and experience. A more detailed plan to calibrate load factors for underground concrete design can be developed as the next step, but that is beyond the scope of this article.

Design Codes

The AASHTO LRFD Tunnel Guide[4] comprises the current U.S. standard for tunnel design, and it will serve as the reference document in this article. The 2018 edition of the International Building Code[5] (IBC 2018) serves as a governing code for building design and construction. IBC 2018 "establishes minimum regulations for building systems using prescriptive and performance-related provisions." Typically, the local jurisdiction adopts IBC with some modifications to reflect local practice.

IBC 2018 provides load combinations based on ASCE/SEI 7-16.[6] The minimum design loads and load combinations in this reference are applicable for buildings and nonbuilding structures. While IBC 2018 refers to ACI 318-14[7] for detailed concrete structural design, including strength reduction factors applicable to concrete structures, it provides load factors based on ASCE/SEI 7-16 but with slight modifications. This article will focus on load factors from IBC 2018 unless the factor is defined only in the AASHTO Tunnel Guide.

Loads and Load Factors

The following is a summary of typical loads applicable to an underground building structure. The list is not exhaustive—only those loads that are relevant to underground building structures are provided. Terminology and definitions are duplicated verbatim from the pertinent codes. For each load, the load factors from the AASHTO Tunnel Guide and IBC 2018 are discussed and summarized in Table 1. Table 1 also provides my recommendation for the use of specific factors.

Dead load

Dead load, the most commonly defined loading in all codes, refers to self-weight of structural components and nonstructural attachments. Dead load is denoted *DC* in AASHTO documents and *D* in ICC documents. For all concrete structures, self-weight is a major load. The AASHTO Tunnel Guide does not provide a load factor for a structure with a very high ratio of *DC* to live load (*LL*). However, for this condition, the AASHTO Bridge Design Specifications[1] provides a *DC* load factor of 1.50 (refer to Table 3.4.1-2 in Reference 1) and IBC 2018 provides a *D* load factor of 1.4 (in Eq. (16-1) in Reference 5). For typical load combinations, the AASHTO Tunnel Guide's load factor for *DC* is 1.25 as maximum and 0.90 as minimum (refer to Table 3.4-2 in Reference 3), while the IBC load factor for *D* is 1.2 as maximum and 0.9 as minimum (refer to Section 1605.2 in Reference 5).

In each code, the maximum load factor applies when dead load contributes to the primary force effect, and the minimum load factor applies when dead load reduces the primary force effect. I recommend the load factors based on IBC for design of underground structures.

Wearing surface and utilities

Dead load of wearing surfaces and utilities (*DW*) is defined in the AASHTO Tunnel Guide, Section 3.5.1. The load factor applied to *DW* is 1.50 as maximum and 0.65 as minimum (refer to Table 3.4-2 in Reference 3). The provided load factor is greater than the typical maximum for *DC*, reflecting the potential for large variation of *DW* during the service life of a transportation structure.

Even though IBC does not define *DW*, it can be treated as a

Table 1:
Summary of specified and recommended load factors

Load type		AASHTO Tunnel Guide[3]			IBC 2018[5]	Recommended
Dead load (*DC*)	High *DC*/*LL*	N/A			1.4	1.4
	Maximum	1.25			1.2	1.2
	Minimum	0.90			0.9	0.9
Dead load of wearing surface and utilities (*DW*)*	Maximum	1.50			1.2†	1.2
	Minimum	0.65			0.9†	0.9
Vertical earth pressure (*EV*)*	Maximum	1.35			1.2†	1.35
	Minimum	0.90			0.9†	0.9
Live load (*LL*)	Primary	1.75			1.6	1.6
	Nonprimary	0.50			$f_1^{‡} = 0.5$	0.5
	Garages, assembly, *LL* > 100 lb/ft² (4.79 kN/m²)	N/A			$f_1^{‡} = 1.0$	1.0
Horizontal earth pressure (*EH*)		Active	At-rest	AEP§		
	Maximum	1.35	1.35	1.35	1.6	1.6
	Minimum	0.75	0.75	N/A	0.9	0.9
Earth surcharge (*ES*)	Maximum	1.35			1.6	1.6
	Minimum	0.75			0.9	0.9
Fluid load (*F*)	Heavy *DC*	N/A			1.4	1.4
	Maximum	N/A			1.2	1.2
	Minimum	N/A			0.9	0.9
Self-straining load (*T*)‖	Maximum	1.0#			1.2	1.2
	Minimum	0.5#			1.0	1.0
	Resist primary	N/A			0.9	0.9

*Not defined in IBC 2018

†Treated as *DC* and assigned identical factors

‡Companion load

§Apparent earth pressure (AEP) for anchored walls

‖Divided into multiple effects in the AASHTO Tunnel Guide

#Based on factors for force effect due to uniform temperature (T_u) in Table 3.4-1 of the AASHTO Tunnel Guide. Factors 1.0 and 0.5 are applied to cracked moment of inertia and gross moment of inertia, respectively

typical dead load and assigned identical factors. If the owner of the underground building structure also controls the wearing surfaces and utilities above the structure, use of the lower factors applied to *D* per IBC may be justified with reasonable and conservative estimates of *DW* (Table 1).

Vertical earth pressure

Vertical earth pressure (*EV*) from dead load of earth fill is defined in the AASHTO Tunnel Guide, Section 3.5.2. Note that due to the arching effect of the soil above underground structures, the weights above underground structures often exceed the total loads applied to underground structures by a large margin. The effect of vertical earth pressure also depends on the construction of the elements. Refer to the AASHTO Tunnel Guide, Section 3.5.2, for a detailed explanation. Per Table 3.4-2 of the AASHTO Tunnel Guide, *EV* can have load factors of 1.35 as maximum and 0.90 as minimum for either cut-and-cover and immersed tunnels or mined and bored tunnels.

EV is not defined in IBC. Some building engineers treat *EV* as a live load due to potential significant variation during the service life of an underground structure or horizontal earth pressure because both loads are caused by soil pressure. But the variability of this load is far lower than the variability of a typical live load or horizontal earth pressure. Treating *EV* as live load or horizontal earth pressure is thus too conservative. However, simply treating *EV* as *DC* may not be conservative. I therefore recommend the slightly more conservative load factors in the AASHTO Tunnel Guide for *EV* (Table 1). I also recommend that *EV* is treated similarly to *DC*.

Live loads

Many aspects of the AASHTO Tunnel Guide and IBC 2018 live load (*LL* and *L*, respectively) clearly differ. The following paragraphs describe some major differences.

AASHTO Tunnel Guide: This document refers to the AASHTO Bridge Specifications for the definition of live loads. Per the AASHTO Bridge Specifications, Section 3.6, live loads include two parts: Vehicle Live Load (*LL*) and Passenger Live Load (*PL*). *LL* is vehicle live loading on the roadways of bridges or incidental structures plus dynamic effects. Pedestrian *PL*, with a value of 0.075 kip/ft^2 (3.6 kPa), is intended to be applicable to sidewalks or pedestrian bridges. The vehicle live load is termed HL-93, and it consists of a combination of:

- Design truck or design tandem; and
- Design lane load.

The details of the HL-93 loading are not the focus of this article but can be found in Section 3.6.1.2 of the AASHTO Bridge Specifications.

Per Section 3.6.2 of the AASHTO Bridge Specifications, the dynamic load allowance (*IM*), which is a percentage increase of vehicle *LL*, has a significant effect on bridge design. *IM* ranges from 15 to 75% for bridges. For buried components deeper than 8 ft (2.4 m), $IM = 0$. Other dynamic effects, such as centrifugal forces (*CE*), braking forces (*BR*), and vehicle collision force (*CT*), have significant effects on bridges but have no or negligible effects on underground structures. The limited shear capacity between soil layers, passive capacity of the soil around a structure, and damping effect of soil are used to support the argument that a short-term effect will not significantly impact the design of underground structures.

Wheel loads are distributed over a tire contact area (TCA) defined as 10 x 20 in. (254 x 508 mm). If the depth of fill is less than 2.0 ft (0.6 m), then wheel loads are applied over the TCA. If the depth of fill is 2.0 ft or greater, wheel loads may be uniformly distributed over the TCA increased by either 1.15 times the depth of select granular backfill or the depth of the fill in all other cases. *LL* is further distributed based on the presence of multiple lanes or beams. For detailed information, refer to Sections 3.6.1.1.2 and 4.6.2.2 of the AASHTO Bridge Specifications.

For the purpose of this article, *LL* is used to represent the sum of both effects of *LL* and *PL* as defined in the AASHTO Bridge Specifications. Per Table 3.4-1 of the AASHTO Tunnel Guide, load factors for *LL* are given with maximum and minimum values of 1.75 and 0.50 respectively, depending on the limit states being evaluated.

IBC 2018: ASCE/SEI 7-16, referenced by IBC, defines *L* as "a load produced by the use and occupancy of the building or other structure that does not include construction or environmental loads such as wind load, snow load, rain load, earthquake load, flood load, or dead load." ACI 318 defines *L* as a load "not permanently applied to a structure, but is likely to occur during the service life of the structure (excluding environmental loads)." Section 5.3.4 of ACI 318 states that *L* shall include concentrated loads, vehicle loads, crane loads, loads on rails or barriers, impact effects, and vibration effects.

The *L* value may vary from 0 to the maximum to determine critical design loads. Load factors for *L* per IBC 2018 are 1.6 as primary load or f_1 as companion load, which can be 1.0 for public assembly ($L > 100$ lb/ft^2 [4.79 kN/m^2]) and parking garage structures or 0.5 for other cases. *L* can also be reduced based on the loaded area, using the ratio of influence area to tributary area for a given member. For design of underground structures, I recommend live load factors specified in IBC.

Horizontal earth pressure

Horizontal earth pressure (*EH*) includes pressure due to soil, groundwater, or bulk materials. IBC 2018, Table 1610.1, provides conservative values of *EH* (marked as *H*) for different backfill materials. Further refinement must be based on a geotechnical investigation.

The AASHTO Tunnel Guide, Section 3.5.2, provides a detailed description and discussion of *EH* for tunnel walls. Construction methods, sequencing, and soil types have large influences on the responses of walls under lateral earth pressure. Three types of pressures are provided: active pressure, at-rest pressure, and apparent earth pressure (AEP) for tunnel walls in the AASHTO Tunnel Guide.

Caution is required when applying lateral earth pressure on underground structures. For a typical underground building structure built using the cut-and-cover method, soil pressure applied to the structure is very similar to that of cut-and-cover tunnels. If an underground building structure is built using the top-down method, soil-structure interaction during both the construction phase and the permanent condition affects the values of *EH* to a large degree. The discussion of such interaction is beyond the scope of this article; a geotechnical engineer must be consulted for this case.

Unless a permanent drainage system is provided to limit the groundwater elevation to below the structure—rarely the case—the effect of hydrostatic pressure must be added to earth pressure. However, the submerged unit weight of soil can be used instead of full unit weight. For the extreme case of high groundwater, the load factor applied to hydrostatic pressure may create a case where the equivalent groundwater level after the load factor is higher than the ground level. For this case only, I recommend treating hydrostatic pressure as a fluid load (*F*), not *EH*. Refer to *F* in the following section for more discussion.

Where the effect of *EH* adds to the primary variable load effect, the IBC load factor is 1.6. Under the same condition, the AASHTO Tunnel Guide provides two load factors: 1.35 as maximum and 0.75 as minimum. Where the effect of *EH* resists the primary variable load effect and *EH* is permanent, a load factor of 0.9 must be applied to *EH*. *EH* is set to 0 for all other conditions. To stay on the conservative side, I recommend using IBC load factors.

Earth surcharge

An earth surcharge (*ES*) load is the result of surface loading within a certain distance from an underground structure. The surface loading can comprise buildings, vehicle *LL*, or temporary construction loads. The controlling uncertainty is the transmission of the *ES* load through the soil to the wall or other structure below the surface.[1]

Surcharge can result in a horizontal pressure applied to a vertical surface, or it can result in a vertical pressure applied to a horizontal surface. In either case, *ES* pressure decreases with depth. Refer to the AASHTO Bridge Specifications, Section 3.11.6, for a detailed description.

The AASHTO Tunnel Guide assigns a load factor of 1.35 as a primary load and a load factor of 0.75 when resisting primary loads. IBC 2018, Section 1610.1, specifies *ES* to be added to *EH*; therefore, *ES* has the same load factor as *EH*. I recommend using IBC load factors.

Fluid load

Fluid load (*F*) covered by IBC refers to loads due to fluids with well-defined pressures and maximum heights.[3] The load factors for *F* are the same as for *DC* because the maximum value is well controlled.

If *F* acts with or as the primary load, load factors of 1.4 or 1.2 apply. If *F* counteracts the primary load, a load factor of 0.9 applies when *F* is permanent, and a load factor of 0 applies when *F* is not permanent (Table 1).

Self-straining load

Self-straining load (*T*) includes forces arising from differential settlements of foundations or volume changes due to temperature, moisture, shrinkage, creep, and similar effects.

IBC does not provide much information about *T*, but it does refer to ASCE/SEI 7 for more details. ASCE/SEI 7 provides a load factor of 1.2 as the principal action and a load factor of 1.0 as the companion load. While ACI 318, Section 5.3.6, cautions about *T*, noting that it can cause significant forces or moments, the effects of *T* are not calculated or combined with other effects. Rather, the effects of *T* are accommodated with construction details based on past successful experience such as ductile connections or expansion joints or construction closure strips.

The AASHTO Tunnel Guide provides more detailed discussion of load factors of *T*, and it includes the force effects due to temperature, shrinkage, creep, settlement, and post-tensioning. For the normal strength case without extreme loading such as earthquake loads, the load factors for *T* are provided for deformation and force effect separately. The larger load factor, 1.2 per Table 3.4-1 of Reference 3, applies for deformation effect only, which is not the focus of this article. For force effect, the values of 0.5 and 1.0 are provided when the gross moment of inertia and cracked moment of inertia are used, respectively. See the AASHTO Tunnel Guide, Section 3.4, for more information.

For underground structures, the effect of *T* is often less than the effect of *T* on structures that are at ground level or aboveground. The continuous soil surrounding an underground structure helps to stabilize the structure against settlement, and it helps maintain stable temperature and moisture—thereby reducing long-term deflection due to creep. Post-tensioning is typically rarely used in underground structures due to complicated design and difficult construction details and sequencing. But the large quantities of concrete in underground structures increase the shrinkage effect if not dealt with appropriately. For this reason, I recommend grouping all the self-straining loads into one term as in ASCE/SEI 7, rather than using individual items per the AASHTO Tunnel Guide.

Basic Load Combinations for Strength Design

A typical underground structure with typical loads is shown in Fig. 1.

IBC 2018 provides seven load combinations, Eq. (16-1) through (16-7), for strength design. These equations are summarized in Table 2, along with my recommendations for applying them to the design of underground structures using corresponding effects per the AASHTO Tunnel Guide.

IBC Eq. (16-1) describes the case where the ratio of *D* to *L* is very high (column 2 of Table 2). Because *DC*, *DW*, and *EV* are all treated as dead loads in IBC 2018, they are included in my recommendation (column 3 of Table 2).

IBC Eq. (16-2) applies to the typical case where *L* is the primary effect. For a typical underground concrete structure, roof live load (L_r), snow load (*S*), or rain load (*R*)

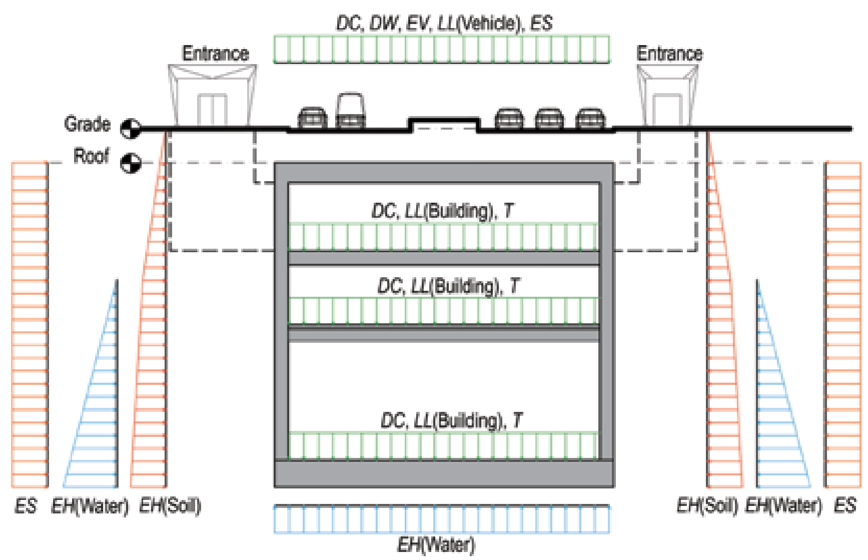

Fig. 1: Typical underground structural loading diagram. Loads are denoted using AASHTO notation

Table 2:
Summary of recommended load combinations for typical underground structures

IBC equation No.	Equation per IBC	Recommended equation with effect notation per the AASHTO Tunnel Guide
(16-1)	$1.4(D + F)$	$1.4(DC + DW + EV + F)$
(16-2)	$1.2(D + F) + 1.6(L + H) + 0.5(L_r \text{ or } S \text{ or } R)$	$1.2(DC + DW + F) + 1.35EV + 1.6(LL + EH + ES) + 0.5(L_r \text{ or } S \text{ or } R) + 1.0T$
(16-3)	$1.2(D + F) + 1.6(L_r \text{ or } S \text{ or } R) + 1.6H + (f_1L \text{ or } 0.5W)$	$1.2(DC + DW + F) + 1.35EV + 1.0LL + 1.2T + 1.6(EH + ES)$
(16-4)	$1.2(D + F) + 1.0W + f_1L + 1.6H + 0.5(L_r \text{ or } S \text{ or } R)$	
(16-5)	$1.2(D + F) + 1.0E + f_1L + 1.6H + f_2S$	$1.2(DC + DW + F) + 1.35EV + 1.0E + 1.0LL + 1.6(EH + ES) + 0.7S + 1.0T$
(16-6)	$0.9D + 1.0W + 1.6H$	$0.9(DC + DW + EV) + 1.0W + 1.6(EH + ES)$
(16-7)	$0.9(D + F) + 1.0E + 1.6H$	$0.9(DC + DW + EV + F) + 1.0E + 1.6(EH + ES)$

rarely have significant effects, as there is no defined roof. If, however, a large canopy covers the entrance structure, such as for a typical underground station, L_r may have a significant effect. While L is a primary effect, T is a companion load that includes multiple effects from the AASHTO Tunnel Guide. Column 3 of Table 2 shows IBC Eq. (16-2) with all possible loading for an underground structure included. For this load combination and thereafter, EV is treated independently from dead loads per the AASHTO Tunnel Guide.

For the case where L_r, S, or R are primary effects instead of L, IBC Eq. (16-3) applies. For a typical underground concrete structure, however, this is rarely the case. T, which includes force effects due to temperature, shrinkage, creep, post-tensioning, and settlement, must also be considered in this case. As discussed previously, f_1 is usually 1.0 for underground structures, and wind load W can be ignored except for design of an entry to an underground structure. Column 3 of Table 2 shows IBC Eq. (16-3) with all possible loading for an underground structure included.

When W and/or EH are primary effects, IBC Eq. (16-4) applies. While wind is a factor only for features such as entry and egress structures, EH can be a primary load for exterior walls for underground structures. T, as simplified previously to replace multiple effects defined in the AASHTO Tunnel Guide, should be considered in the equation. Because EH and T are independent of each other, T can be a primary or secondary load while EH is a primary load. While T is a primary load, the more conservative results will be used. Column 3 of Table 2 shows IBC Eq. (16-4) with all possible loading for an underground structure included. Note that for a typical case, Eq. (16-3) and (16-4) will yield the same load combination.

For the case where H and seismic load (E) are primary effects, IBC Eq. (16-5) applies.

The coefficient f_1 has been explained previously. The coefficient f_2 can be 0.7 for roof configurations (for example, saw tooth) that do not shed snow off the structure, and 0.2 for other roof configurations per IBC 2018. Snow load has a relatively minor or negligible effect on underground structures. Therefore, 0.7 will be used for demonstration purposes only. Whether T should be considered requires engineering judgment because seismic loads last for a very short period, often 1 minute or less. T should be considered as companion load only when T is an effect assumed to be locked in the structure prior to the earthquake event. Column 3 of Table 2 shows IBC Eq. (16-5) with all possible loading for an underground structure included.

For the case where DC resists W, IBC Eq. (16-6) applies. This is rarely applied except where a large canopy exists at the entrance. Column 3 of Table 2 shows IBC Eq. (16-6) with all possible loading for an underground structure included.

Lastly, for the case where DC resists seismic load, IBC Eq. (16-7) applies. Column 3 of Table 2 shows IBC Eq. (16-7) with all possible loading for an underground structure included.

Conclusions

Currently, building codes do not specifically provide load combinations for design of underground structures. This should be addressed by code bodies because it is becoming a more pressing issue as the modern urbanization trend continues.

Although ASCE/SEI 7-16, Section 2.3.5, allows the design professional to develop load combinations for a specific project, designers typically do not have the expertise, time, or budget to develop the factors. This article presents a set of recommended load combinations as a temporary solution until load combinations can be calibrated and supported by research.

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Selected for reader interest by the editors after independent expert evaluation and recommendation.

ACI member **Zhu Liu** is a Structural Lead with Jacobs Engineering Group, Boston, MA. He has more than 20 years of combined experience in concrete construction, precast manufacturing, and engineering consulting. His extensive experience related to all aspects of concrete provides a unique perspective for concrete structural design. His current work focuses on structural design of facilities and stations in transit-related projects as Engineer of Record. He is a member of ACI Committee 314, Simplified Design of Concrete Buildings. He is a licensed professional engineer in Massachusetts, Maine, and New Hampshire.

AGACAD BIM Software for Precast Concrete

AGACAD's BIM software allows users to create detailed models of precast concrete elements in Autodesk's Revit®. Prefabricated concrete walls, slabs, beams, and columns can be modeled to BIM level of development (LOD) 400 (an LOD 400 element is modeled at enough detail and accuracy for fabrication of the represented component without referring to notes or dimension callouts). Elements can include connection details, plates, grout tubes, and anchors. A floor can be divided into regions, and floor segments can be modeled as solid, hollow-core, or double-tee elements. Walls can also be divided, and joint widths can be defined between precast wall elements. Users can also decompose multilayer walls and check, edit, and write wall parameters. Documentation for production and assembly can be prepared within the program. The software also uses rules and templates to create element views with automatic dimensioning and to generate bills of materials and shop drawings.

—AGACAD, **www.aga-cad.com**

COMANSA 21CM750 Crane

The 21CM750 flat-top, modular crane can be used for prefabricated construction and construction of power plants, bridges, and other large-scale infrastructure projects. It is available in two models, with maximum loads of 37.5 and 50 tonnes (41.3 and 55.1 tons). The 37.5 tonne model can also load 50 tonnes by changing the front trolley and hooks. The jib and counterjib sections have six different configurations to enable adaption to different jobsite conditions, and they are optimized for fast and safe assembly and disassembly. The 21CM750 includes the Cube Cabin, a spacious cabin that won the iF Design Award 2018. As certified by Germany's TÜV SÜD, the 21CM750 is designed to comply with EN 14439 Cranes – Safety – Tower Cranes.

—COMANSA, **www.comansa.com**

Mecalac TA3SH Power Swivel Site Dumper

The TA3SH Power Swivel Site Dumper is designed to deliver superior versatility and performance on small or confined jobsites. The TA3SH is 13 ft (4 m) long and 6 ft 1 in. (4.4 m) wide. The Power Swivel technology features forward- and swivel-tipping mechanisms, allowing the load to rotate 90 degrees on either side before being tipped. The TA3SH's payload capacity is 6613 lb (3000 kg), making it ideal for concrete construction. All Mecalac Power Swivel site dumpers feature a heavy-duty locking device, which keeps the skip facing forward while on the move. Each Power Swivel site dumper meets the latest emissions compliance standards. All models are equipped with Tier IV engines rated at under 25 hp.

—Mecalac, **www.mecalac.com**

EarthCam AI-Powered Visual Data for Procore Daily Log Automation

EarthCam announced updates that help maintain a daily log of active jobsites with its Procore integration. EarthCam cameras can now deliver new levels of informative data to construction teams. Data can include AI image recognition of jobsite equipment and vehicle tracking, with up to 19 vehicle classifications automatically populated into hourly log entries within Procore; weather conditions from the Jobsite Weather Station, a 4G LTE wireless, solar-powered sensor; and visual documentation of waste and dumpster conditions. In all cases, content can be exported to a PDF or CSV file.

—Earthcam, **www.earthcam.net**; —Procore, **www.procore.com**

NITEGLOW Two-Stage Safety Nosing

NITEGLOW® two-stage antislip stair nosing with glow-in-the-dark technology is ideal for exit path markings, steps, and leading edges of landings. NITEGLOW meets NYC Local Law 26, 2015 IBC, and 2015 IFC code compliance and is well suited for either new construction or retrofit interior stair applications. Heat-treated corrosion-resistant aluminum substrate and a nearly diamond-hard aluminum oxide filler ensures long tread life under heavy pedestrian traffic. The bright, long-lasting photoluminescent epoxy filler is free of hazardous and radioactive substances. NITEGLOW is available in lengths to order, to a maximum of 8 ft (2.4 m). NITEGLOW two-stage safety nosing includes a replaceable antislip abrasive-filled top insert and a mill finish extruded aluminum base with a sure-hold anchor. An optional wood insert keeps the aluminum base clean during initial construction. Protective tape is also available.

—Wooster Products, **www.woosterproducts.com**

Neuvokas Corp GatorBar Glass

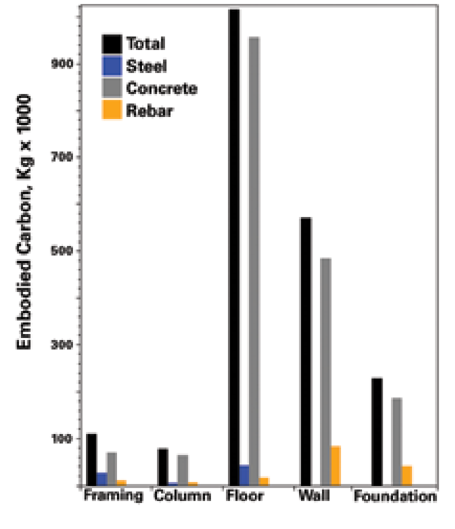
Four years after it introduced GatorBar® Basalt to the construction industry, Neuvokas announced the addition of GatorBar Glass to its product family. The new product, a glass-fiber reinforced polymer (GFRP) reinforcing bar, meets the ASTM D7957/D7957M specification. GatorBar products are manufactured with an advanced sliver-reducing, polyester-free resin system, and they provide a low-cost reinforcing solution for normal and corrosive environment applications.

—Neuvokas Corp, **www.neuvokascorp.com**

MobileDemand xTablet Flex 10A with Android

The xTablet Flex 10A with Android is an entry-level, lightweight tablet weighing only 2.4 lb (1 kg). The Flex 10A has built-in features like a briefcase handle and back hand strap for easy portability, along with a patented quick-release snap mount system. With its durable protective case and scratch- and shatter-proof screen protector, an xTablet can survive drops and perform reliably in dusty conditions. These tablets are equipped with Bluetooth, Wi-Fi, front- and rear-facing cameras, and a long-lasting swappable battery. The 10.1 in. (260 mm) touchscreen display works with a gloved finger or stylus, while an optional keyboard converts the tablet into a fully functional 2-in-1 style laptop. Requiring minimal IT support, Flex 10A for Android tablets are easy to set up and manage.

—MobileDemand, **www.ruggedtabletpc.com**



(photo courtesy of Thornton Tomasetti)

Thornton Tomasetti Beacon

Beacon is an embodied carbon measurement tool. The tool gives users the ability to calculate embodied carbon, allowing for more informed decisions throughout the design process. Beacon was introduced after an intensive, 3-year research-and-development process led by Thornton Tomasetti's CORE studio. The tool is an Autodesk Revit plugin that generates visualizations of a project's embodied carbon quantities by material type, building element, and floor levels, allowing designers to have insights as to where embodied carbon can be minimized. It also grades the project's embodied carbon levels against the Carbon Leadership Forum's database of models by building type. Beacon is currently available for download at **https://core-studio.gitbook.io/beacon**.

—Thornton Tomasetti, **www.thorntontomasetti.com**

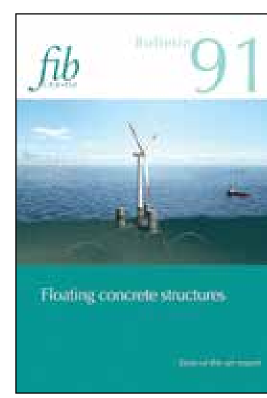
CFS 150-5 Steel Fibers Used in Chicago Office Tower

Concrete Fiber Solutions (CFS), along with Prairie Material and Goebel Forming, completed a massive floor installation at the 110 N. Wacker building in Chicago, IL, using steel fiber-reinforced lightweight concrete. The high-rise features composite metal deck floors with lightweight concrete reinforced with 25 lb/yd^3 (14.8 kg/m^3) of CFS 150-5 fibers. The use of CFS 150-5 steel fibers improved worker safety conditions and installation efficiency for the office tower. Manufactured in Chicago, CFS fibers are free from rust, oil, and other contaminants and are designed to meet or exceed the requirements of ASTM A820/A820M. CFS 150-5 fibers are 1.5 in. (38 mm) long with an aspect ratio of 38 and are deformed per the ASTM A820/A820M specification.

—Concrete Fiber Solutions, **www.concretefibersolutions.com**

Book Notes

fib Bulletin 91: Floating Concrete Structures by Task Group 1.2



This bulletin is the first document prepared by Task Group 1.2, Concrete Structures in Marine Environments. Floating concrete structures allow marine spaces to be used for important developments for urban areas, industrial plants, infrastructure, and energy production. This bulletin presents applications, projects, and conceptual ideas, and it discusses the potentialities of and innovations in structural concrete in marine environments. The use of structural concrete is becoming essential in these kinds of applications in terms of cost, durability, and sustainability. The floating structures presented in this bulletin may inspire future applications, which will present a challenge not only for structural designers but also for administrations, construction companies, and industrial entities.

CHF 100 (non-members); 100 pp.; ISBN 978-2-88394-134-2

—*fib*, www.fib-international.org

Products & Service Literature & Videos

ACPA Safety Bulletin for End Hoses

The American Concrete Pumping Association (ACPA) offers a short safety bulletin titled “Safe Practices for the Intended Use of Concrete Delivery and End Hoses.” The bulletin addresses the proper methods for using concrete delivery hoses and end hoses. End hoses have no additional mass at the discharge point, reducing the potential for serious injury should the hose move unexpectedly or whip as a result of the release of trapped air. Continually updating safety resources is part of ACPA’s mission to foster and promote a positive safety culture within the concrete pumping industry. The new safety bulletin complements the association’s safety library and is available for free download alongside many other safety-related downloads on ACPA’s Safety/Training webpage.

—American Concrete Pumping Association, **www.concretepumpers.com**

Product
Showcase

Decorative Concrete Products

Allen Engineering Corporation RP235 and RP245 Polishing Riders

The RP235 and RP245 Polishing Riders are designed with high-volume concrete polishers in mind. These riding trowels achieve high rotor speeds and high torque while polishing, and they come equipped with special dolly jacks that ensure easy indoor transportation, as well as allowing for quick change of polishing pads. They are built on an edging riding trowel frame to allow users to get close to walls while polishing. Both models include 180 RPM for high-speed burnishing or polishing; 40 lb (18 kg) propane bottles for more operating hours; 25 hp Kohler PCH740 Propane Engines; 7 gal. (26.5 L) retardant tanks to allow for more water application during the polishing process; two-point, top-mount lifting systems; and four-point tie-downs. In addition, a power steering option also comes standard on the RP245.

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

Spyder Products Diamond Edge Universal Cut-Off Wheel

The Diamond Edge Universal Cut-Off Wheel measures 4-1/2 in. (114 mm) in diameter and features 0.045 in. (1 mm) walls that can cut through reinforcing bars, masonry, and more. These wheels feature a diamond abrasive edge combined with a shatter-resistant steel core. The edge and core together ensure safe operation, reduced dust and debris, and a longer working life. These wheels are designed for use on angle grinders with a maximum RPM of 13,000.

—Spyder Products, **www.spyderproducts.com**

W.R. MEADOWS POURTHANE NS

POURTHANE® NS is an elastic, low-modulus, one-component, moisture-curing, nonsag polyurethane sealant. It maintains flexibility while providing outstanding durability in horizontal and vertical applications. To better match a variety of possible projects, POURTHANE NS comes in 11 color choices, including white, off-white, gray, aluminum gray, tan, redwood tan, stone, limestone, medium bronze, special bronze, and black. Applications include joints between precast concrete panels. No mixing or priming is required for use with concrete or masonry. A digital, printable color chart is available online.

—W.R. MEADOWS, **www.wrmeadows.com**

Bon Tool Co. BonWay Urethane Mats

The BonWay™ Decorative Concrete division of Bon Tool Co. expanded its decorative concrete product line with the addition of over 60 new urethane texture mats as a result of Bon Tool's recent purchase of the operating assets of Specialty Concrete Products. This expansion nearly doubled the available BonWay standard mat patterns and added many specialty stamps, including animal track stamps, leaf stamps, oceanic stamps, fossil stamps, and letter and number stamps. Additional mat patterns will be added in the coming year.

—Bon Tool Co., **www.bontool.com**

Milestones Fiber-Backed Form Liners

Milestones, Inc., offers lightweight, fiber-backed form liners in combination with their composite form core technology to transfer authentic detailed texture to concrete. They are flexible, reusable urethane liners with up to 5 in. (127 mm) of relief and detailed texture transfer. Carpet flooring from convention service companies is repurposed and used as the reinforcement backing for these form liners, keeping plywood out of landfills and reducing this product's carbon footprint. The liners weigh less than 3 lb/ft^2 (14.6 kg/m^2), which makes them easy to handle and could in some cases allow a reduction in crane size on a jobsite.

—Milestones, Inc., **www.milestones-online.com**

Lehigh White Cement AALBORG EXCEL

AALBORG EXCEL® is a self-leveling, fast-flowing, ultra-high-performance concrete (UHPC) premixed product developed under Lehigh White Cement's AALBORG INWHITE SOLUTION®. It may be combined with pigments and fibers, allowing users to balance project structure, function, and aesthetics. Properties such as high durability and high compressive strength (in the range of 140 MPa [20,300 psi]) make it suitable for architectural applications with thin and complex geometries. AALBORG EXCEL is based on FUTURECEM™, Cementir Group's newest binder patent technology. The technology behind EXCEL's binders does not include silica fume, quartz flour, slag, or fly ash—but the product still offers pozzolanic components from a sustainable source.

—Lehigh White Cement, **www.lehighwhitecement.com**

Nox-Crete Deco-Peel

Designed to remove old acrylic sealer from a decorative concrete installation, the Deco-Peel blanket system uses an engineered fabric saturated with a blend of environmentally friendly solvents that penetrate and soften decorative acrylic sealers. Deco-Peel solvents dissolve the worn-out acrylic sealer, then will evaporate from the surface. The blanket is placed down where the stripping is needed and saturated with Deco-Peel biodegradable stripper. Once it is dried completely—usually within 2 to 4 hours—the blanket can be peeled up and discarded after it has absorbed the acrylic resin. Treated surfaces can be resealed in as little as 24 hours. The product is ideal for spaces where damage to surrounding surfaces is a concern.

—Nox-Crete, **www.nox-crete.com**

Buddy Rhodes Vertical Mix

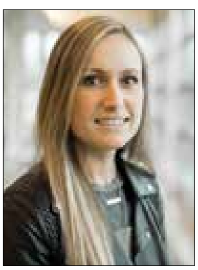
Buddy Rhodes Vertical Mix™ is a cement-based overlay that is easy to mix and apply to vertical surfaces for creating various textures by carving, sculpting, or stamping. The product is a lightweight, zero-slump formula and is used for creating themed environments, zoo and aquarium displays, decorative panels, and public sculptures. Vertical Mix is blended with RAMP™ Adhesion and Cure Promoter to a clay-like consistency and then applied to a minimum 3/4 in. (19 mm) thickness. Once cured, Buddy Rhodes's line of pigments can provide an extensive array of color possibilities, and their glazes can also be applied to the cured concrete to achieve more color effects. Vertical Mix has been tested per ASTM E84 and meets Class A requirements. It is a water-based, nontoxic, animal-friendly product with no VOCs.

—Buddy Rhodes Concrete Products, **www.buddyrhodes.com**

On the Move

O'Brien

The Concrete Sawing and Drilling Association (CSDA) appointed **Erin O'Brien** as its new Executive Director, following the retirement of Pat O'Brien, who served as Executive Director of the association beginning in 1992. O'Brien began her duties as Executive Director on January 1, 2020, and will lead the association at its Annual Convention and Tech Fair in Carlsbad, CA, March 31–April 4, 2020.

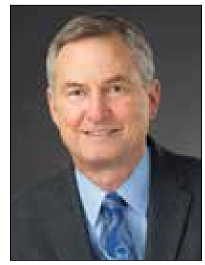


Van Zetten

After working for EllisDon for 7 years as a Materials Science Specialist, ACI member **Stacia Van Zetten** co-founded EXACT Technology, Toronto, ON, Canada. EXACT serves large infrastructure, high-rise, and precast clients across Canada and the United States to optimize processes with concrete materials. Van Zetten is on the Board of Directors for the Ontario Chapter – ACI and is a member of ACI Committees 134, Concrete Constructability; 201, Durability of Concrete; 207, Mass and Thermally Controlled Concrete; and 237, Self-Consolidating Concrete. She is also a member of the ACI Construction Liaison Committee. Van Zetten cofounded the Toronto Chapter of the International Concrete Repair Institute and is a member of CSA A23.1/A23.2. She is licensed as a professional engineer in Ontario and received her civil engineering degree from Ryerson University, Toronto, ON, Canada.

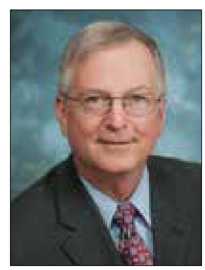
Anne Griffoin was appointed Head of Publication and Communication of RILEM Publications SARL. She will continue to fill the role of RILEM TAC Secretary and Website/Social Media Manager. Her skills cover a broad range of fields, including project coordination, information management, website development and management, and accounting. She received her master's degree in international relations from the Institute of Higher Studies in International Relations, Paris, France.

Honors and Awards



Boyer

Lance A. Boyer, FACI, President of Trademark Concrete Systems, Inc., was named to the Decorative Concrete Hall of Fame during the 2019 Concrete Decor Show in Arlington, TX. Boyer is Chair of ACI Committee C641, Decorative Concrete Finisher Certification. He received the 2016 ACI Education Award for the development of the ACI publication "Placing and Finishing Decorative Concrete Flatwork," which serves as a resource for the Decorative Concrete Finisher certification program and fills the need for a comprehensive educational document on the design, construction, and maintenance of decorative concrete flatwork. In addition to ACI, he is a member of the American Society of Concrete Contractors (ASCC). He received his BS in construction from Arizona State University, Tempe, AZ, in 1983. He is a licensed concrete and general contractor in California.



Moehle

The Earthquake Engineering Research Institute (EERI) awarded **Jack Moehle**, FACI, the George W. Housner Medal. The medal is awarded for extraordinary and lasting contributions to public earthquake safety through the development and application of earthquake hazard reduction practices and policies. Moehle is the Ed and Diane Wilson Presidential Professor of Structural Engineering at the University of California, Berkeley, Berkeley, CA, where he has taught since 1980. He was Chair of ACI Committee 318, Structural Concrete Building Code, during the most recent Code cycle, and he has served on the ACI Board of Direction and Technical Activities Committee. In addition to ACI Committee 318, he is a member of ACI Committees 133, Disaster Reconnaissance, and 369, Seismic Repair and Rehabilitation; as well as Joint ACI-ASCE Committee 352, Joints and Connections in Monolithic Concrete Structures. He is a licensed civil engineer in California.

Jaworski

The American Concrete Pavement Association (ACPA) presented its 2019 Marlin J. Knutson Award for Technical Achievement to ACI member **Paul Jaworski**, Product Manager at Minnich Manufacturing, Inc. The award is presented to an individual or group who has made significant contributions to advance the development and implementation of technical innovations and best practices in the design and construction of concrete pavements. It was presented in recognition of Jaworski's more than 40 years of expertise in concrete vibration and consolidation technology. Jaworski is Chair of ACI Committee 309, Consolidation of Concrete.

Industry Focus

Terra Contracting Restores Fremont Street Experience Concrete

Terra Contracting, through its Las Vegas distributor JES Supply, created a unique system used to repair and beautify the famed Las Vegas, NV, Fremont Street Experience in the first phase of a $35 million renovation. Since its creation in the mid-1990s, the Fremont Street Experience had lost its luster as the original epoxy concrete overlay deteriorated. Following a competitive request-for-proposal (RFP) process against seven other companies, Terra Contracting won the bid to revitalize the outdoor mall by combining multiple specialty products, including a polymer-based foundation; a surface that stands up to intense foot traffic and UV damage from the Las Vegas sun; and increased surface friction as required under the Americans with Disabilities Act (ADA). The Fremont Street Experience remained open 24/7 during revitalization, allowing the hospitality industry and adjoining businesses to serve guests with minimal interruption.

Ware Malcomb Expands in Canada

Ware Malcomb, an international design firm that first entered the Canadian market in 2007, announced the opening of a second office in Canada. The office is located in downtown Toronto, ON. Frank Di Roma, Principal, will oversee both Canadian offices. In addition, Christina Kolkas, Director of Interior Architecture and Design, will lead the growth, development, operations, and studio management of the new Toronto office, as well as continuing to lead the Vaughan Interiors Studio. Specializing in architecture, planning, interior design, branding, and civil engineering design for commercial real estate and corporate clients, Ware Malcomb has completed over 700 projects in Ontario, and the firm currently has active projects in six Canadian provinces.

HNTB Awarded National Program Management Oversight Contract

HNTB Corporation received a contract from the United States Department of Transportation's Federal Transit Administration (FTA) to provide project management oversight services in support of major transit capital projects nationwide. As project management oversight (PMO) contractor, HNTB will support FTA's technical and management role in assessing the ability of transit project sponsors to successfully implement FTA's capital programs. PMO contractors provide recommendations and insights to assist FTA in determining whether projects are managed effectively, are progressing on time and within budget, and are in accordance with the project sponsors' approved plans and specifications. PMO contractors also assist FTA in monitoring project sponsors' risk management, assessing readiness to advance projects to new phases, and providing technical assistance to ensure project success.

3-D Concrete Printing Planned for Offshore Wind Turbines

Accucode, Inc., and RCAM Technologies plan to develop wind-energy components using three-dimensional (3-D) printed concrete. This announcement comes after RCAM Technologies secured $250,000 from the Colorado Office of Economic Development and International Trade's Advanced Industries Accelerator Grant Program. The grant was awarded to RCAM Technologies for developing a 3-D printed concrete wind-turbine foundation that will reduce offshore deployment costs by up to $4 million per foundation and $400 million per wind plant. RCAM will use the funding to expand its 3-D concrete-printing capabilities at two partner locations: the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) in Golden, CO, and Accucode's new facility in Colorado Springs, CO.

RCAM will first install a large-scale 3-D concrete-printing system at NREL, where they will begin fabricating the fixed-bottom support structures for offshore wind turbines. After manufacturing and assembly processes have been tested, the 3-D printer will be moved to Colorado Springs for further research and development by Accucode's 3-D printing divisions. Accucode's team of engineers and concrete-printing experts will then use the equipment to develop and test 3-D concrete printing for a variety of renewable energy and civil infrastructure applications.

StonePoint Materials Acquires Standard Gravel Company

StonePoint Materials LLC announced the acquisition of Standard Gravel Company, LLC. Standard is a regional producer of sand and gravel serving eastern Louisiana and southern Mississippi from four active mine sites. The acquisition of Standard will complement and expand StonePoint subsidiary Southern Aggregates, LLC, the largest sand and gravel producer in Louisiana.

Zweig Group Announces Inaugural ElevateHer Cohort

Zweig Group announced the inaugural 2020 ElevateHer™ cohort, a special task force comprised of individuals with a commitment to promoting diversity as a means to combat recruiting and retention challenges in the architectural, engineering, and construction (AEC) industry. This group will operate as a think tank, developing strategies to help solve challenges related to recruiting and retention. All individuals, regardless of age, experience, gender, background, or job role, were encouraged to apply. The program kicks off with the ElevateHer Class of 2020, a cohort-style annual program designed to define key strategies and provide open-sourced, accessible action plans to tackle diversity and its role in recruiting and retention issues. Results from the 2020 class will be presented at a special ElevateHer Symposium on September 30, 2020, a preconference to Zweig Group's annual conference, Elevate AEC 2020, in Denver, CO.

The program's founding patrons include SGA Design Group, Forensic Analytical, CORE, JQ Engineering, and McAdams. Funds raised through patronage will be used to financially support program initiatives so that finances are not a barrier to program participation.

OxBlue Corporation Announces OxBlue Foundation

OxBlue Corporation, based in Atlanta, GA, a professional construction camera service provider, formed the OxBlue Foundation, a 501(c)(3) nonprofit, all-volunteer organization focused on educational initiatives related to science, technology, engineering, and mathematics (STEM). The OxBlue Foundation funds activities and events such as STEM-related field trips for local schools and continuing education for adults, as well as scholarships and more. The foundation's activities and educational programs focus on building diversity and expanding access for all people, regardless of gender, age, race, or financial circumstances. Initial funding for the OxBlue Foundation was a donation of $300,000 from OxBlue Corporation. Going forward, continued sustainable funding will be derived from OxBlue Corporation, employee matching grants, and external community partnerships.

USGBC Certifies Bank of America Tower LEED V4 Platinum for Core and Shell

The recently renamed Bank of America Tower, formerly Capitol Tower, was certified LEED® Version 4 (V4) Platinum for Core and Shell by the U.S. Green Building Council (USGBC). The Bank of America Tower is a 35-story, 775,000 rentable ft^2 (72,000 rentable m^2) office building in downtown Houston, TX. V4 is the most stringent LEED version to date, and Platinum is the highest level of green building certification offered by the USGBC. The Bank of America Tower's LEED V4 Platinum for Core and Shell designation is the first in the United States. Environmental features include daylight harvesting technology, a 40% parking reduction, tenant metering, vehicle charging stations, and a rainwater-collecting façade system.

Project credits: Skanska, Developer and General Contractor; Gensler, Architect; Walter P Moore, Structural, Civil, Parking, and Traffic Engineer; and OJB, Landscape Architect.

Hawaiian Dredging Construction Company Teams Up with Pype

Pype, a software-as-a-service family of products for the construction industry, announced an enterprise partnership with Hawaiian Dredging Construction Company, Inc. (HDCC), a full-service general contractor serving the state of Hawaii since 1902. HDCC came to Pype seeking an intuitive solution that could streamline the process of creating submittal logs. The general contractor was following a standard procedure of creating the logs from scratch using spreadsheet software, and the process took up to a month of skilled work to complete for large projects. Since deploying Pype AutoSpecs, HDCC has been able to reduce the time spent on developing submittal logs for large-scale projects from 1 month of skilled work to 1 week.

Rapid International Launches Rapid Tumbler

Rapid International Ltd, County Armagh, Northern Ireland, reentered the concrete truck mixer market with the launch of a sister company, Rapid Tumbler. Rapid Tumbler supplies premium lightweight truck mixers. Rapid Tumbler's first product to market was the RTM89 truck mixer. The mixer's 8 m^3 (10.5 yd^3) mixing drum is manufactured using long-life, high-strength Arcelor Mittal steel. These truck mixers also feature components from Bosch Rexroth and ZF Germany.

The official launch of Rapid Tumbler took place in December 2019 at Rapid's headquarters in Tandragee, County Armagh. The event was attended by many local and national ready mixed concrete companies as well as members of the Mineral Products Association Northern Ireland. Attendees had the opportunity to view the new truck mixer and meet with representatives from Mercedes, Volvo, Scania, and DAF truck manufacturers. The morning was concluded with a factory tour and a light breakfast.

Rapid International launched its sister company, Rapid Tumbler, in December 2019

Meetings

MARCH

2-4 - **CarbonPositive ’20 Conference and Expo**, Los Angeles, CA
www.carbon-positive.org

3-7 - **2020 PCI Convention**, Fort Worth, TX
www.pci.org/convention

5-7 - **The Precast Show 2020**, Fort Worth, TX
www.precast.org/theprecastshow

7-9 - **National Ready Mixed Concrete Association (NRMCA) Annual Conference 2020**, Las Vegas, NV
www.nrmca.org/Conferences_Events/AnnualConvention

10-14 - **CONEXPO-CON/AGG 2020**, Las Vegas, NV
www.conexpoconagg.com

11-13 - **HiPerMat 2020: 5th International Symposium on UHPC and High-Performance Materials**, Kassel, Germany
http://hipermat.uni-kassel.de

20 - **ASCC/TCA 2020 Safety Summit**, Houston, TX
https://ascconline.site-ym.com/event/2020safetysummit

23-25 - **2020 International Concrete Repair Institute (ICRI) Spring Convention**, Vancouver, BC, Canada
www.icri.org/event/2020-ICRI-Spring

23-25 - **DFI-PFSF Piling and Ground Improvement Conference**, Sydney, Australia
www.dfi.org/dfieventlp.asp?13385

THE ACI CONCRETE CONVENTION: FUTURE DATES

2020 — March 29-April 2, Hyatt Regency O’Hare Chicago/Rosemont, IL

2020 — October 25-29, Raleigh Convention Center and Raleigh Marriott, Raleigh, NC

2021 — March 28-April 1, Hilton and Marriott Baltimore, Baltimore, MD

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

MARCH-APRIL

31-4 - **CSDA 2020 Convention and Tech Fair**, Carlsbad, CA
www.csda.org/event/csda-2020-convention-tech-fair

APRIL

1-2 - **ASTM Symposium on Dimension Stone Use in the Built Environment**, Boston, MA
www.astm.org/MEETINGS/SYMPOSIAPROGRAMS/C18ID3676.pdf

6-9 - **Building Innovation 2020 Conference & Expo**, Arlington, VA
www.buildinginnovation.org

20-22 - **World Adhesive & Sealant Conference (WAC) 2020**, Chicago, IL
www.wac2020.org

27-29 - ***fib* Symposium 2020**, Shanghai, China
www.fibshanghai2020.cn/Data/List/topics

APRIL-MAY

30-2 - **The Masonry Society’s 2020 Spring Meeting**, Charlotte, NC
www.masonrysociety.org/meetings/2020-spring-meeting

MAY

3-6 - **Post-Tensioning Institute (PTI) 2020 Convention & Expo**, Miami, FL
www.post-tensioning.org/events/convention/upcomingconvention

7-8 - **International Conference on Cement-Based Materials Tailored for a Sustainable Future**, Istanbul, Turkey
www.cbmt2020.org

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 Rebecca Emanuelsen, Editor, *Concrete International*, at rebecca.emanuelsen@concrete.org.

Sinopsis en español

Un lugar impresionante

Huso, D.R., *Concrete International*, V. 42, No. 3, marzo de 2020, pág. 37-40

La Mezquita de Punchbowl, Sydney, Australia, es una estructura “brutalista” con una simplicidad de arquitectura exterior que oculta su inspirador interior. El techo escultural del espacio de oración tiene 102 mocárabes que se extienden a traves de dos caras del techo como un panal. La combinación del concreto formado con detalles de madera y piedra crea un espacio que atrapa en su contención delicada.

Declaración de posición del CPC (por sus siglas en inglés) #5: Efectos de la densidad del acabado de la superficie de la losa en el concreto pulido

***Concrete International*, V. 42, No. 3, marzo de 2020, pág. 41**

El fratasado a máquina y manual dan como resultado diferentes densidades de superficie que serán obvias en una superficie pulida. Sin embargo, la diferencia en el aspecto de la superficie pulida debido a la densidad del acabado de la superficie de la losa no es responsabilidad del contratista de pulido. El Concrete Polishing Council (CPC por sus siglas en inglés) ha desarrollado una lista de opciones que el contratista de pulido puede discutir con el contratista de concreto para ayudar a evitar los problemas estéticos asociados con las variaciones en la densidad de la superficie. Se resumen las opciones y se proporcionan enlaces a recursos adicionales.

Propósito y dificultades de las remisiones y los planos de taller

Slavens, K.A., *Concrete International*, V. 42, No. 3, marzo de 2020, pág. 42-44

El artículo habla de los planos de taller y las remisiones. Se centra en la importancia de la buena fe en el proceso de revisión de los dibujos de taller, el impacto de los dibujos de taller en el alcance del trabajo, y la responsabilidad y el alcance de la revisión. Se proporcionan varios ejemplos de casos judiciales relacionados con estos temas.

Diseño de estructuras de edificios subterráneos

Liu, Z., *Concrete International*, V. 42, No. 3, marzo de 2020, pág. 45-51

Los profesionales tienden a diseñar estructuras de edificios subterráneos según la AASHTO Tunnel Guide o de acuerdo con el International Building Code (IBC - por sus siglas en inglés) utilizando los factores de carga de la guía de túneles de la AASHTO (por sus siglas en inglés). Se examinan las ventajas y desventajas de ambos enfoques. Basándose en el juicio y la experiencia de ingeniería del autor, una aplicación de compromiso de los factores de carga de la AASHTO Tunnel Guide y las combinaciones de carga en el IBC es proporcionada.

What's New from aci

TECHNICAL DOCUMENTS

ACI 318-19: Building Code Requirements for Structural Concrete and Commentary (SI Units)

The "Building Code Requirements for Structural Concrete" ("Code") provides minimum requirements for the materials, design, and detailing of structural concrete buildings and, where applicable, nonbuilding structures. This Code was developed by an ANSI-approved consensus process and addresses structural systems, members, and connections, including cast-in-place, precast, shotcrete, plain, nonprestressed, prestressed, and composite construction.

ACI 421.1R-20: Guide for Shear Reinforcement for Slabs

Tests have established that punching shear in slabs can be effectively resisted by reinforcement consisting of vertical rods mechanically anchored at top and bottom of slabs. This guide reviews available types and makes recommendations for their design. The application of these recommendations is illustrated through numerical examples.

SP-336: Cracking and Durability in Sustainable Concretes

ACI Committees 130 and 224 sponsored and moderated two sessions at The ACI Concrete Convention and Exposition – Fall 2017, held in Anaheim, CA. The objective of the sessions was to review the use of innovative mixture designs which incorporated sustainable admixtures and supplemental cementitious materials, and the effect these sustainable technologies have on the cracking performance and durability of these concretes.

COLUSB20: 2020 USB ACI Collection of Concrete Codes, Specifications, and Practices

The ACI Collection of Concrete Codes, Specifications, and Practices is the most comprehensive concrete reference set available. It contains all of the widely used ACI concrete and masonry code requirements, specifications, guides, and reports. In fact, the ACI Collection includes over 250 of the most used documents on concrete technology. It includes the 2019 version of ACI's Building Code for Structural Concrete and Commentary (318-19).

COL20PACK: 2020 ACI Collection of Concrete Codes, Specifications, and Practices 9-Volume Set

The ACI Collection of Concrete Codes, Specifications, and Practices is the most comprehensive concrete reference set available. It contains all of the widely used ACI concrete and masonry code requirements, specifications, guides, and reports. In fact, the ACI Collection includes over 250 of the most used documents on concrete technology. It includes the 2019 version of ACI's Building Code for Structural Concrete and Commentary (318-19).

ACI UNIVERSITY ONLINE COURSES

On-Demand Course: Improve Concrete Performance with Slag Cement

Learning Objectives:

1. Identify and explain the short-term and long-term strength gains associated with the use of supplementary cementitious materials and their effect on the durability of concrete;
2. Analyze case studies and be able to explain the practical ways in which slag cement in combination with other cementitious materials can elevate the performance of concrete;
3. Explain how slag cement produces less permeable concrete.
4. Describe and explain the benefits of using slag cement in reference to workability, slump, and finishing properties and how it compares to other materials;
5. Identify the sustainable benefits of slag cement and the resources SCA has to test the different effects of mixture design; and
6. Describe what is included in the ACI 233R-17 Guide to the Use of Slag Cement in Concrete and Mortar, and how to navigate the document for future slag cement-related questions they may have.

Continuing Education Credit: 0.1 CEU (1.0 PDH)

On-Demand Course: Troubleshooting Concrete (3-part series)

Learning Objectives:

Troubleshooting Problems with Fresh Concrete

1. Identify the common potential problems that can occur with fresh concrete;
2. Summarize the various factors that can contribute to each of the potential fresh concrete problems;
3. Describe the role of the concrete producer, contractor, the testing laboratory, and standard specifications in addressing problems with fresh concrete; and
4. Explain how problems can be avoided or minimized.

Troubleshooting Defects in Concrete Slabs

1. Recognize the common potential problems that can occur in concrete slabs;
2. List the factors contributing to the common defects that can occur in concrete slabs;
3. Illustrate how construction practices can influence defects in concrete slabs; and
4. Provide recommendations to address surface defects in concrete slabs.

Evaluating Test Results and Troubleshooting Low Compressive Strength

1. Evaluate compressive strength data;
2. State the main reasons for low compressive strength;
3. Explain how nondestructive testing can be used to troubleshoot low compressive strength; and
4. Describe how low compressive strength problems can be avoided or minimized.

Continuing Education Credit: 0.3 CEU (3.0 PDH)

Public Discussion

ACI draft standards open for public discussion that are being processed through ACI's ANSI-approved standardization procedures can be found at **www.concrete.org/discussion**. These are not yet official ACI standards.

Document number	Title	Open for discussion	Discussion closes
301	Specifications for Concrete Construction	2/3/2020	3/19/2020
310.X	Specification for Polished Concrete Slab Finishes	2/3/2020	3/19/2020
332	Residential Code Requirements for Structural Concrete (ACI 332-XX) and Commentary	2/3/2020	3/19/2020
522.1	Specification for Pervious Concrete Pavement	2/3/2020	3/19/2020

Proposed Standards

Specifications for Concrete Construction (ACI 301)

The ACI Technical Activities Committee (TAC) approved processing the subject document through ACI's Standardization Procedure in July 2019 as did the ACI Standards Board in January 2020.

Therefore, this draft document is open for public discussion from February 3, 2020, until March 19, 2020. The document appears on the ACI website, **www.concrete.org/discussion**.

Pertinent discussion will be available on ACI's website and announced in a future issue of *Concrete International* if received no later than March 19, 2020. Comments should be e-mailed to discussion@concrete.org.

Specification for Polished Concrete Slab Finishes (ACI 310.X)

The ACI Technical Activities Committee (TAC) approved processing the subject document through ACI's Standardization Procedure in July 2019 as did the ACI Standards Board in January 2020.

Therefore, this draft document is open for public discussion from February 3, 2020, until March 19, 2020. The document appears on the ACI website, **www.concrete.org/discussion**.

Pertinent discussion will be available on ACI's website and announced in a future issue of *Concrete International* if received no later than March 19, 2020. Comments should be e-mailed to discussion@concrete.org.

Residential Code Requirements for Structural Concrete (ACI 332-XX) and Commentary

The ACI Technical Activities Committee (TAC) approved processing the subject document through ACI's Standardization Procedure in July 2019 as did the ACI Standards Board in January 2020.

Therefore, this draft document is open for public discussion from February 3, 2020, until March 19, 2020. The document appears on the ACI website, **www.concrete.org/discussion**.

Pertinent discussion will be available on ACI's website and announced in a future issue of *Concrete International* if received no later than March 19, 2020. Comments should be e-mailed to discussion@concrete.org.

Public Discussion

Specification for Pervious Concrete Pavement (ACI 522.1)

The ACI Technical Activities Committee (TAC) approved processing the subject document through ACI's Standardization Procedure in July 2019 as did the ACI Standards Board in January 2020.

Therefore, this draft document is open for public discussion from February 3, 2020, until March 19, 2020. The document appears on the ACI website, **www.concrete.org/discussion**.

Pertinent discussion will be available on ACI's website and announced in a future issue of *Concrete International* if received no later than March 19, 2020. Comments should be e-mailed to discussion@concrete.org.

Public Discussion and Closure

Public Discussion and Closure of "Qualification of Post-Installed Adhesive Anchors in Concrete and Commentary (ACI 355.4-19)"

The ACI Technical Activities Committee (TAC) approved the draft standard subject to satisfactory committee response to TAC comments in March 2019. The committee responded adequately to TAC's comments and all balloting rules were adhered to. Public discussion was announced on May 24, 2019, and closed on July 8, 2019. The committee responded to the public discussion. TAC reviewed the closure and approved it in November 2019. The Standards Board approved publication of the ACI standard in December 2019.

The public discussion and the committee's response to the discussion are available on ACI's website, **www.concrete.org/discussion**.

Advertiser Index

March *CI* Advertisers

For more information, contact:

Jeff Rhodes, VP Sales
MCI USA +1.410.584.8487
E-mail: jeff.rhodes@mci-group.com

CI Advertisers in the 2020 Concrete Product & Service Guide

Allplan, Inc.
+1.610.429.9800, www.allplan.com

CHRYSO Inc.
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Computers and Structures, Inc.
+1.510.649.2200, www.csiamerica.com

The Euclid Chemical Company
+1.800.321.7628; +1.216.531.9222, www.euclidchemical.com

GCP Applied Technologies
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Concrete Q&A

Sustained Load and Adhesive Anchors

Q. *Per Provision 17.8.2.2 in ACI 318-14[1] and Provision 26.7.2(e) in ACI 318-19,[2] adhesive anchor installer certification is required when installing horizontally or upwardly inclined adhesive anchors that are to support sustained tension loads. Can you clarify the definition of "sustained tension load" as it applies to these Code provisions?*

A. A sustained load is a tensile or compressive force applied for an extended period. For the design of post-installed adhesive anchors, however, we are concerned with long-term applied tension. For example, a pipe suspended below a reinforced concrete slab will subject an anchor to long-term tension due to the weight of the pipe and the fluid flowing through it.

Figures 1 and 2 show test results for two types of adhesive anchors. Figure 1 shows load versus displacement for an adhesive anchor exhibiting marked creep. The anchor was loaded in increments equal to 10% of its capacity under short-term loading (based on data for a similar anchor loaded to failure). At each load increment, the load was held constant for 2 minutes. At loads of up to 40% of the short-term tensile capacity, displacement remains constant under a constant load. Creep is evident at higher loads, however, as displacement increases under constant loads. Further, the peak load was only 80% of short-term tension load capacity.

Figure 2 shows displacement under sustained load for an adhesive anchor that is not susceptible to creep failure. The anchor load was ramped up to a percentage of its short-term capacity and was held constant (in this test, the data were obtained for a period of 27 years). While the displacement did increase over the initial portion of the test, displacement stabilized at about 100,000 hours (over 11 years) of sustained load.

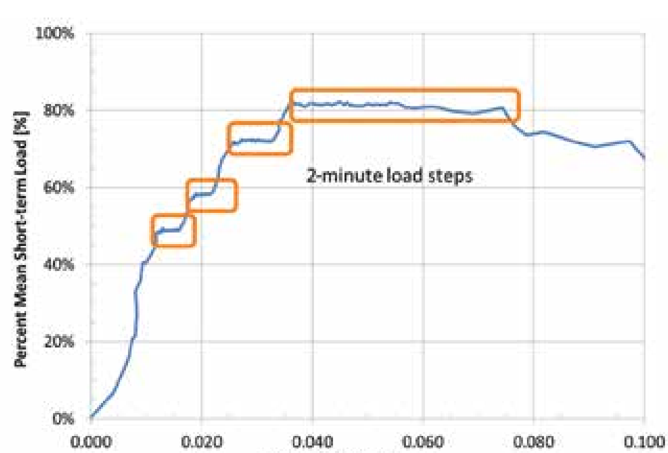

Fig. 1: Load versus displacement for an adhesive anchor exhibiting marked creep.[3] Creep is evident at loads greater than 40% of the short-term capacity, as large displacements occur under constant load (Note: 1 in. = 25 mm)

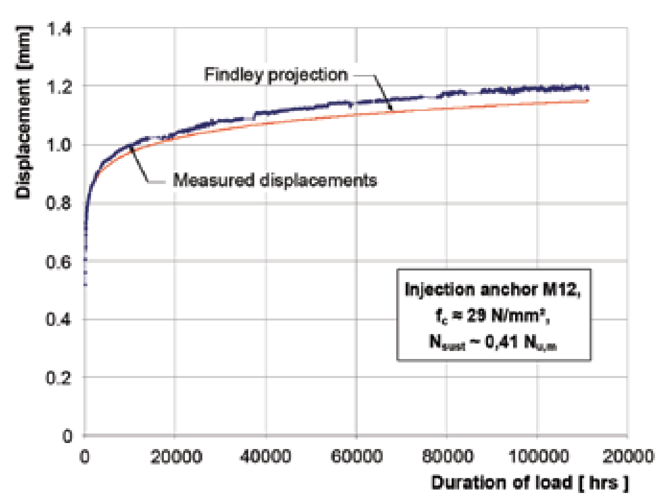

Fig. 2: Measured displacement versus time for an M12 (1/2 in. [13 mm]) adhesive anchor under sustained load,[4] including a comparison with projected behavior according to Findley's power law model.[5] The anchor was subjected to a sustained tension N_{sust} equivalent to 41% of the average failure load under short-term load $N_{u,m}$ (Note: 1 mm = 0.04 in.; 1 N/mm^2 = 145 psi)

Based on laboratory testing and experience, when designing adhesive post-installed anchors:

- Bond stress must be kept low to avoid producing a creep failure;
- The designer must decide on the service life, and this will dictate the percentage of the short-term load that can be applied as sustained load;
- The designer should specify adhesive anchors that have been qualified through testing; and
- Capacity of adhesive anchors should be obtained from qualified anchor reports.

Following these recommendations should result in adhesive anchor designs that are not susceptible to creep failure and are therefore capable of resisting sustained loads. As you noted in your question, the installation of anchors subjected to sustained loading must be performed by a certified installer. Also note that the installation must be inspected by certified inspectors (ACI 318-19, Section 23.13.1.6).

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.

2. ACI Committee 318, "Building Code Requirements for Structural Concrete (ACI 318-19) and Commentary (ACI 318R-19)," American Concrete Institute, Farmington Hills, MI, 2019, 623 pp.

3. Davis, T.M., "Sustained Load Performance of Adhesive Anchor Systems in Concrete," PhD dissertation, Civil Engineering, University of Florida, Gainesville, FL, 2012, 570 pp.

4. Eligehausen, R.; Blochwitz, R.; and Fuchs, W., "Behavior and Design of Adhesive Anchors Under Sustained Load," *Understanding Adhesive Anchors: Behavior, Materials, Installation*, SP-283, R.E. Wollmershauser and D.F. Meinheit, eds., American Concrete Institute, Farmington Hills, MI, 2012, pp. 9.1-9.13.

5. Findley, W.N.; Lai, J.S.; and Onaran, K., *Creep and Relaxation of Nonlinear Viscoelastic Materials with an Introduction to Linear Viscoelasticity*, first edition, Elsevier, 1976, 380 pp.

For additional related information, refer to "Qualification of Post-Installed Adhesive Anchors in Concrete (ACI 355.4-19) and Commentary," which can be found in the ACI Collection Online at **www.concrete.org/publications/collectiononline.aspx**.

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