aci Foundation

Knowledge to Practice

18 Annual Report

The ACI Foundation promotes progress, innovation, and collaboration in the concrete industry through strategic investments in research, scholarships, and ideas.

ACI Foundation Trustees

Spring 2018-Spring 2019

Michael Schneider
(Chair)
Baker Concrete
Construction, Inc.

Ann Masek
(Secretary)
ACI Foundation

Donna Halstead
(Treasurer)
American Concrete
Institute

Joseph Bracci
Texas A&M
University

Ronald G. Burg
American Concrete
Institute

Jeffrey Coleman
The Coleman Law
Firm, LLC

Cary Kopczynski
Cary Kopczynski &
Co, Inc.

Antonio Nanni
University of Miami

Debrethann Orsak
Cagley &
Associates, Inc.

Michael Paul
Larsen and Landis

Randall Poston
Pivot Engineers

Staff

Ann Masek,
Executive Director

Jennifer DeWall,
Development Director

Tricia Ladely,
Assistant Director

Alaina Vacha,
Administrative Coordinator

We believe in advancing the world through innovative concrete solutions.

From the Executive Director

Dear Friends,

Thank you for making 2018 a remarkable year for the ACI Foundation. This year marked a new era as our team tripled in size and has worked hard to expand our outreach while strengthening our programs and services.

This year wouldn't have been a success without our incredible donors. Because of you, the ACI Foundation provided $375,000 in research grants that funded eight essential research projects, distributed over $200,000 in fellowship and scholarship awards to 19 of the best students in the industry to help pay for their schooling, and also gave them access to attend The ACI Concrete Conventions and Expositions. Not only is the ACI Foundation impacting research and education but we also committed over $360,000 toward initiatives that serve new technology and innovation in the concrete industry.

That's a major testament to the commitment and compassion of our financial supporters, our incredible volunteers, and our staff!

A few program highlights include:

- Record level of funding for research;
- Secured 100% of ACI Board of Directors and ACIF Trustees contributions to the Foundation;
- Mailed our first annual appeal that raised over $13,000;
- Reorganized our council structures/terms and strengthened our policies to make a bigger impact;
- Funded a new Materials Fellowship that emphasizes studies of concrete materials;
- Awarded the Don Marks Fellowship for the first time ever—created for students who lean towards a builder's "hands-on" career in concrete; and
- Created a development committee that helped bring in over $85,000 in their first year of volunteering.

We are stronger than ever due to our continually expanding community who come together to donate time, resources, and talent in support of our important mission.

Thank you for serving our community.

All my best,

Ann Masek

Ann Masek
Executive Director
+1.248.848.3144
ann.masek@acifoundation.org

From the Chair

Dear Fellow Volunteers,

There is no denying the importance of concrete just like there is no denying the importance of being involved in ACI. Thank you to all the selfless ACI members who choose to collaborate, learn, or volunteer within ACI. Every day, you make a difference for the next generation all around the world. Together, we improve concrete to be more efficient, effective, versatile, affordable, sustainable, and so much more.

In addition to your volunteer efforts—your committee work, your research, your presentations, your award submissions—ACI has another important way to help build a better future: the ACI Foundation, which was established by ACI to help promote progress, innovation, and collaboration in the industry.

In its history, the ACI Foundation has funded nearly $5 million of work which funneled new technology, critical research, and people into ACI and the industry, creating enormous benefit and advancing construction and improvement in the quality of modern life.

It has been a privilege to help lead the ACI Foundation. In fact, my career through concrete has been leveraged by supporting the ACI Foundation. You, too, can pay it forward to bring more students into the industry, enhance all citizens' lives by building better with concrete through research, or stay current on technology that can improve how we build.

The ACI community has long joined together with the common goal of advancing concrete guides, codes, and standards and educating users of concrete. Let's broaden the ACI Foundation community—get involved today to keep this spirit of kinship through giving back!

Thank you,

Mike Schneider

Michael J. Schneider
Baker Concrete Co.
Senior Vice President
+1.513.539.4000
schneider@bakersharedservices.com

Making an Impact

$375,000 to 8 research projects

Over $360,000 to innovative technology

Over $200,000 to students

Frank-Nelson Muhande Musemate was born and raised in Kenya and moved to the United States about 5 years ago to pursue a university degree in civil engineering. When he was 10 years old, Musemate witnessed a bridge collapse in his hometown, leading to loss of lives and property. Ever since this accident, he has had a passion for engineering and construction, which motivated him enough to educate himself so he can help fix his nation's infrastructure and buildings.

Musemate comes from humble beginnings and had to finance his studies mainly through scholarship and fellowship grants. He said:

"One of the requirements in the program was to do internships during my summer break, so that pushed me to go out of my way to apply for different kinds of opportunities. The companies ranged from design companies to construction companies. I was able to visit construction sites where reinforced concrete structures were being built and got to see in person ACI specifications being implemented in a real-life setting. On the academic side, I was able to see how the ACI codes could be applied toward ensuring safe and reliable construction."

Since being awarded the ACI Baker Student Fellowship, Musemate has mentored other students applying for grants and offers this wisdom:

"Be honest and be truthful to yourself...be upfront on why you are pursuing the degree in engineering. If you're not sure why you are doing something, then you're not going to be 100% sure on how you will contribute to the future."

Musemate plans to earn a PhD and is grateful for the ACI Foundation and the opportunities it has given him.

To read the full story, visit acifoundation.org.

Fundraising

Giving in 2018

$262,496 raised

$195,811 new money

Nearly 75% increase!

The ACI Foundation hosted its first exclusive event, kicking off its new era of fundraising at The ACI Concrete Convention and Exposition in Las Vegas, NV, on October 14, 2018. Attendees learned more about the ACI Foundation and celebrated the achievements its supporters made possible, while having cocktails and hors d'oeuvres. A short program during the event highlighted the importance of research and new technology, engaging students, and giving back to the industry. Thank you to all the ACI members and business affiliates who attended and made the evening such a success!

Above and beyond the ACI spend policy contribution of over half a million dollars, the ACI Foundation, along with its volunteers, worked hard in 2018 gaining thousands of dollars in new funds to supplement and sustain growth.

Funds Raised for the ACI Foundation in 2018	
ACI Board and ACIF Trustee Giving Back campaign:	$58,793
ACIF Program and general donations:	$86,660
ACI member donations to ACIF after renewing ACI membership:	$2835
ACIF Fall Appeal:	$13,208
AOE generous donation given during 2018 Fall Convention:	$100,000
SDC underwritten sponsorships:	$1000
Total funds raised in 2018:	**$262,496**

"ACIF provides an excellent platform for people in the industry to pay back a fraction of their success. Their contribution will ensure the continued success of ACI to lead the concrete industry globally and for the ACI Foundation to prepare the leaders of tomorrow and be the force for technical breakthrough and innovation."

Khaled Awad

"The Foundation…is intended to facilitate idea and innovation that cannot be accomplished elsewhere within the different interests and silos of the concrete industry."

Tracy Marcotte

ACI Foundation 2018 Donors

Visionary ($15,000+):

Advancing Organizational Excellence (AOE)
American Concrete Institute
Khaled Awad
Baker Concrete Construction, Inc.
Carolinas Chapter – ACI
Louisiana Chapter – ACI

Innovator ($10,000 - $14,999):

Ronald Burg and Jill Humphrey
Jeff and Ayanna Coleman
CVM
Kimberly Kayler
David and Risë Lange
Randall and Bonnie Poston

Benefactor ($5000 - $9999):

Poppoff, Inc.
Sharon Wood

Scholar ($1000 - $4999):

Frances Griffith
Trey Hamilton III
Brad Inman
Jim Jirsa
Jack Moehle
Debby Orsak
Mike Schneider

Advocate ($500 - $999):

Ace Avant Concrete Construction
Joseph Bracci
Carriérs PCM Inc.
Holcim
Michael Kreger
New Mexico Chapter – ACI
Pittsburgh Area Chapter – ACI
Procon, Inc.
Brian Quinn

Friend ($25-$499):

Paul Albanelli
Lyad Alsamsam
American Society of Concrete Contractors
Hal Amick
Phillip Antis
Gergi Ashkar
Roger Baptiste
John Baranello
Barton Malow Company
BASF Admixtures, Inc.
Russel Baumgartner
Robert Behm
Michael Bley
Michael Bolatto
William Boone
David Bosley
Francis Brezny
Heather Brown
Pete Browne
John Brun
Nathan Charlton
Mark Cheek
Kun-Young Chiu
Concrete Contractors Interstate
Christopher Crouch
Michael DeBlasio
Rafael Discipulo
Anne Ellis
Euclid Chemical Company
Jiri Grygar
Donna Halstead
John Hayes
Heidi Helmink
Roberto Hernandez
HM Loke Consulting Engineering PC
Doug Hooton
Shuyeh Hsu
Joe Hug
John Johnston
Michael Jundt
Sriram Kalaga
William Klorman
Cary Kopczynski
Frank Kozeliski
Neven Krstulovic-Opara
Michael Leming
Giulio Leon Flores
Lawrence Levy
Heng Loke
Lynchburg Ready Mix Concrete Co.
Tewolde Lyob
Jeffrey Lyon
Harendra Mahendra
Steven Maresca
Ann Masek
McC, Inc.
Donald McMican
Bernard Meyers
Kevin Miley
Antonio Mireles
Jared Murray
Tony Nanni
Robert O'Brian
Michael and Paula Paul
William Porter
Daniel Post
PWE, Inc.
M. Qaddumi
Leonardo Reyes Madera
Dennis Roby
Sika Corporation
Robert Sinn
Standard Materials, Inc.
Steven Stelzer
Ron Stewart
James Van Wyk
Don Weempe
Stephen Wilcox
William Wilhelm
Michelle Wilson
Paul Zia

Key Volunteers

Nicholas J. Adams, Euclid Chemical Company
Scott M. Anderson, Pankow
Emmanuel K. Attiogbe, Construction Chemicals
Roger J. Becker, PCI
Claude Bedard, Euclid Admixture Canada, Inc.
Tonya Beesley, Baker Concrete Construction, Inc.
Anahid Behrouzi, CA Polytechnic State University
Richard P. Bohan, Portland Cement Association
Joseph M. Bracci, Texas A&M University
Michael C. Brown, WSP USA
Heather J. Brown, Middle Tennessee State University
Kirk Burns, Burns Concrete, Inc.
John P. Busel, ACMA
Rodney J. Chiodo, R-E-D Industrial Products
Matthew D. D'Ambrosia, MJ2 Consulting, PLLC
Om P. Dixit, Dixit Consultants, LLC
Jonathan E. Dongell, Pebble Technologies, Inc.
Anne M. Ellis, Charles Pankow Foundation
Chris A. Forster, Largo Concrete, Inc.
David W. Fowler, University of Texas at Austin
Beverly A. Garnant, American Society of Concrete Contractors
Mario Garza, Barton Malow Company
Benjamin A. Graybeal, Federal Highway Administration
Charles S. Hanskat, American Shotcrete Association
G. Terry Harris, GCP Applied Technologies

Neil M. Hawkins, University of Illinois at Urbana-Champaign
Cecil L. Jones, Diversified Engineering Services, Inc.
Danielle D. Kleinhans, Concrete Reinforcing Steel Institute
Lesley Suz Chung Ko, BASF Corporation
Carl J. Larosche, Wiss, Janney, Elstner Associates, Inc.
H. S. Lew, NIST
Colin L. Lobo, NRMCA
Claudio E. Manissero, ChemCognition, LLC
Paul F. Mlakar, Corps of Engineers
Vilas S. Mujumdar, Consulting Engineer
Gary G. Nichols, ICC Evaluation Service, LLC
Charles K. Nmai, BASF Corporation
Debrethann R. Orsak, Cagley Associates, Inc.
Aleksandra Radlińska, Pennsylvania State University
Joseph C. Sanders, Western Pacific Precast
Glenn E. Schaefer, Structural Technologies
Anton Karel Schindler, Baker Concrete Construction, Inc.
Jackie A. Sempel, Burk-Kleinpeter, Inc.
Michael M. Sprinkel, Virginia Transportation Research Council
Michael S. Stenko, Transpo Industries
Mark E. Williams, Walter P Moore and Associates, Inc.

Educa

Student Fellowships

ACI Foundation Student Fellowships are offered to high-potential students in concrete-related studies who are endorsed by an ACI member. The purpose of the Student Fellowship Program is to identify, attract, and develop outstanding professionals for productive careers in the concrete field. Please visit **https://www.acifoundation.org/scholarships.aspx** for more details.

2018-2019 ACI Foundation Fellowship Recipients:

Don Marks Memorial Fellowship

Matthew David Burton, University of Cincinnati

Presidents' Fellowship

Hope Hall, Oklahoma State University

Baker Student Fellowship

Jonathan Lyle, Arizona State University

Cagley Student Fellowship

Katelyn O'Quinn, University of Texas at Austin

Daniel W. Falconer Memorial Fellowship

Bret Robertson, Oklahoma State University

Darrell F. Elliott Louisiana Fellowship

Tyler Young, University of Louisiana at Lafayette

Tribute to the Founders Fellowship

Robert Devine, University of Notre Dame

Richard D. Stehly Memorial Fellowship

Grace Jackson, Valparaiso University

Barbara S. and W. Calvin McCall Carolinas Fellowship

Aaron Miller, The University of Alabama

Baker Student Fellowship

Hannah Patterson, Arizona State University

Charles Pankow Foundation Student Fellowship

Homero Sobrinho, University of New Orleans

tion

ACI Foundation Graduate and Undergraduate Scholarships

Funded primarily through generous donations, the ACI Foundation administers these scholarships, which are offered to high-potential graduate students in the concrete-related studies. The ACI Richard D. Stehly Memorial Scholarship is awarded to an undergraduate student.

2018-2019 ACI Foundation Scholarship Recipients:

ACI Scholarship

Joseph Arehart, University of Colorado Boulder

ACI Scholarship

Maranda Leggs, University of Oklahoma

W. Gene Corley Memorial Fellowship

Jessica Richard, University of California, Berkeley

Schwing America Scholarship

Jael Wettach-Glosser, Portland State University

Bertold E. Weinberg Scholarship

Andrew Foerster, Kansas State University

Richard D. Stehly Memorial Scholarship

Nicholas Rademacher, Rose-Hulman Institute of Technology

Stewart C. Watson Memorial Scholarship

Bjorn Vors, University of Saskatchewan

Katharine & Bryant Mather Scholarship

David Whitmore, Auburn University

Serving the industry by bringing high-potential students into the realm of concrete through tuition stipends, and professional exposure to the concrete industry and ACI by funding travel to attend The ACI Concrete Convention and Expositions.

Resea

Grant Funding in 2018

The ACI Foundation has been contributing financially to research projects since its inception in 1989.

The grant funding process for research proposals includes a thorough technical review and endorsement by an ACI technical committee. Because ACI technical committees touch every facet of concrete construction, the ACI Foundation can fund a broad variety of projects—enhancing how we construct buildings, bridges, roads, and the rest of the built infrastructure. In 2018, the projects ranged from studies of improvements in structural members and structural building systems, and performance-based design to material properties and tests to life-cycle assessment.

Project: Pre-Standard for Performance-Based Design for Wind

ACI Committee: ACI 375, Performance-Based Design of Concrete Buildings for Wind Loads

Principal Investigator: Don Scott - ASCE

Other Funders: Charles Pankow Foundation, AISC, ASCE

The ACI Foundation and ACI joined this industry-wide coalition to encourage performance-based design (PBD) in concrete design for wind. PBD can improve efficiency of design and construction and can potentially improve structural performance. To provide a PBD approach for wind in ASCE/SEI 7, where no guidance currently exists, system reliability targets must be developed. The project will document specific building response parameters and acceptance target limits for the main wind force-resisting system and cladding envelope system subjected to wind effects and environmental demands. The information developed could assist ACI 375 when updating its current documents. The project has broad industry support, including endorsement by FEMA, NIST, and several structural design firms.

Project: FEMA P695 Study - Enhanced Ductility: RC Coupled Wall Systems (ED-RCCW)

ACI Committee Support: ACI 318-H, Structural Building Code, Seismic Provisions

Principal Investigator: John Wallace - University of California

Other Funders: Charles Pankow Foundation

A known handicap exists in applying the provisions of the ACI 318 code to the seismic design of reinforced concrete shear walls using the International Building Code and ASCE 7: the types of walls defined in the ACI 318 code are not the same as those defined in IBC/ASCE 7. This inconsistency leads to confusion and, occasionally, misapplication of the ACI 318 code provision. The research, consisting of P695 studies, would begin to remedy this problem by creating a definition and design parameters for the most commonly used shear wall systems for high-rise construction: ED-RCCWs. This would lead to wider adoption of ductile coupled shear walls in general and would greatly clarify the design procedures for structural engineers.

rch

Thanks to donor contributions, the ACI Foundation was able to fund eight projects in 2018.

Project: Guideline Development for Use of Recycled Concrete Aggregates in New Concrete

ACI Committee Support: ACI 555, Concrete with Recycled Materials

Principal Investigator: Matthew Adams - New Jersey Institute of Technology

Other Funders: In-kind support from the John A. Reif, Jr. Department of Civil and Environmental Engineering

This research seeks to develop guidelines for the use of recycled concrete aggregates (RCAs) in new concrete and will therefore provide a much-needed link between existing research and practice. Despite extensive existing research and a significant history of use, instructions for use of RCA have not been widely incorporated into North American standards and guidelines. This project will include a holistic review of the existing literature and statistical analyses of existing data. The goals are to develop guidelines for the characterization of RCA and the creation of specifications for mixtures comprising RCA, which could enhance and support standards and specifications in ACI and other industry organizations.

Project: Nonlinear Modeling Parameters and Acceptance Criteria for Reinforced Concrete Coupling Beams

ACI Committee Support: ACI 374, Performance-Based Seismic Design of Concrete Buildings

Principal Investigator: Christopher Motter - Washington State University

Other Funders: Washington State University

Reinforced concrete coupled walls are often used in buildings to resist lateral demands from earthquakes and wind. The primary research objective is to fill knowledge gaps on the behavior of diagonally reinforced concrete coupling beams subjected to axial load through large-scale laboratory testing. Based on both new and previously existing work, a database will be created and used to develop new recommendations for nonlinear modeling parameters and acceptance criteria. The research is expected to provide key parameters that influence load-deformation behavior and address gaps in industry documents, including those in ACI 374 and 318.

Project: Structural Nanomodified Concrete: An Investigation of Critical Properties

ACI Committee Support: ACI 241, Nanotechnology of Concrete

Principal Investigator: David Corr - Northwestern University

Other Funders: Northwestern University

The end-user community (structural engineers, concrete specifiers) have shown significant interest in concrete with enhanced structural properties. This research project addresses creep, shrinkage, and durability of nanomodified concrete. Given proper handling, small dosages of carbon nanofibers and nanotubes exhibit potential as additives for structural concrete. These additives have the capability to improve critical properties such as modulus of elasticity, flexural strength, and cracking resistance. The study will address significant gaps in the state of knowledge of nanomodified concrete—gaps that are preventing its use as a structural material. The results of this work could bring new materials to concrete engineers, specifiers, and producers; and new markets could emerge to provide nanomaterials in additive or admixture forms.

Research, cont.

This project will investigate parameters affecting the shear friction capacity of concrete joints with high-strength reinforcement (HSR). The results will be used to improve shear-friction expressions, as well as allow contractors to consider different roughening techniques. If successful, the project results will have a significant impact on design and construction, possibly reducing the requirements for surface roughening and permitting the use of HSR, and influencing codes and standards changes in ACI 318 and ACI 374.

Project: Shear Friction of Concrete Joints with High-Strength Reinforcement

ACI Committee Support: ACI 318-H and -R Structural Building Code, Seismic Provisions and High Strength Reinforcement, and ACI 374, Performance-Based Seismic Design of Concrete Buildings

Principal Investigator: Paolo Calvi - University of Washington

Project: Collaborative Study for the Development of a Standard Critical Chloride Threshold Test Method

ACI Committee Support: ACI 222, Corrosion of Metals in Concrete

Principal Investigator: Ceki Halmen - University of Missouri - Kansas City

Other Funders: The Curators of the University of Missouri on behalf of the University of Missouri - Kansas City

The reported critical chloride thresholds in concrete show a wide degree of variability, which makes it challenging to make accurate service/remaining life predictions for structures in service and specify concrete for new construction. A significant source of this variability is the absence of a standard test for measuring chloride thresholds. This proposal will solve a major problem by unifying how chloride thresholds are measured and reported so that uncertainties associated with predicted service lives, specified performance, and scheduled maintenance operations are minimized. The work will impact many ACI committee documents and could lead to an ASTM standard and influence the *fib* Model Code for Concrete Structures and several NACE documents. The developed test will provide the input data for several service life software packages that are widely used by the industry, helping owners to assess the state of their structures more reliably and consistently so that they can make informed decisions about their future.

Life-cycle assessment (LCA) is mainly used to assess the environmental impacts of concrete structures. To better understand the extent to which some of the sources of variability and uncertainty affect the overall results of an LCA, it is important to understand how methods and assumptions, including technical specifications, such as mechanical and durability performance, functional unit, system boundaries, and allocation methods affect a structural LCA. The research will try to understand the effect of these factors on an LCA and harmonize them so that results of an LCA can be used with confidence and provide more certainty to the decision-making on the structure.

Project: Guideline Development for Life Cycle Assessment of Structural Concrete through Meta-Analysis and Harmonization

ACI Committee Support: ACI 130, Sustainability of Concrete

Principal Investigator: Hessam Azarijafari - University of Sherbrooke

Other Funders: Cement Association of Canada

Completed Research 2018

Information on all ACI Foundation-sponsored research, including final reports, can be found on the www.acifoundation.org/research/researchprojects.

Project: SEACON: Sustainable Concrete Using Seawater, Salt-Contaminated Aggregates, and Non-corrosive Reinforcement"

Principal Investigator: Antonio Nanni, University of Miami

The research addresses the issue of sustainability from the perspective of the construction material most used worldwide: concrete. This 2.5-year project started on October 1, 2015. It was proposed and carried out by a transnational consortium of six partners and four collaborators including two academic institutions, six companies, and a Department of Transportation. The goal of SEACON is to promote the use of best practices in both the production of concrete and reinforced concrete (RC) structures by implementing alternative materials. The aim is to reduce the use of critical resources by replacing them with alternatives that can be chloride-contaminated coupled with non-corrosive reinforcement. This approach would extend the affordability and sustainability of constructed elements under aggressive environmental conditions without affecting their longevity and durability.

Project: Re-examination of Punching Shear Strength and Deformation Capacity of Corner Slab-Column Connection

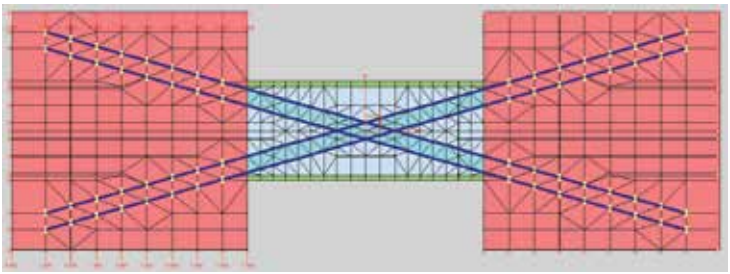
Principal Investigator: Min-Yuan Cheng, Assistant Professor at National Taiwan University of Science and Technology

This study examined the effects of slab flexural reinforcement on the punching shear strength and deformation capacity of corner slab-column connections without shear reinforcement. "Punching shear strength and deformation capacity of slab-column connections have been extensively studied previously," stated Cheng. "However, several controversial issues still exist for the applications of the code provisions, particularly on the corner connections. This research dives deeper into this area. The findings from our testing combined with previous research will help to move the concrete industry forward." Results from the new study and past studies indicate that punching shear strength and deformation capacity per ACI 318-14 are not conservative for corner slab-column connections. The researchers address this by proposing a new shear strength model in the report.

Project: Serviceability Behavior of Reinforced Concrete Discontinuity Regions

Principal Investigator: Robin Tuchscherer, Northern Arizona University (NAU)

The main objective of this study was to create a procedure for predicting the serviceability behavior of discontinuity regions analyzed using the strut-and-tie modeling method. This was accomplished by correlating the cracking behavior of test beams, in terms of crack width and total area of visible cracking, with the internal strain energy estimated from representative strut-and-tie models. A secondary goal of the project was to refine existing photogrammetric methods to collect crack width, crack area, and displacement data from digital images of test beams. The results of this study represent an encouraging step toward better estimation of cracking behavior of deep beams and discontinuity regions. Information from this research product may be used by ACI committees in the creation of new codes and standards.



High-Strength Reinforcement (HSR) Below are two projects, part of an overall plan endorsed and primarily funded by the Charles Pankow Foundation, to allow the general use of reinforcing steels with yield strength greater than 60 ksi (HSR), which may significantly improve the constructability and efficiency of earthquake-resistant structures. Several ACI 318 building code change proposals related to HSR have been introduced and accepted. The ACI 318 code has been improved by allowing HSR.

Project: High-Strength Steel Bars in Earthquake-Resistant T-Shaped Concrete Walls

Co-principal investigators: Andrés Lepage and Rémy Lequesne, University of Kansas

The focus of this study was on the use of high-strength steel in slender walls dominated by flexure and to determine experimentally the influence of selected reinforcing steel mechanical properties on wall deformation capacity. The principal investigator, Andrés Lepage, remarked on the results, "Walls designed for a target flexural strength using Grade 60 or Grade 100 reinforcement, with similar tensile-to-yield strength ratio, had similar strength and deformation capacity."

Project: Seismic Performance Characterization of Beams with High-Strength Reinforcement

Principal Investigators: Duy V. To and Jack Moehle, University of California, Berkeley

The steel industry is producing higher-grade steels, but with varying mechanical properties. The research program was to characterize the performance of reinforced concrete beams with high-strength reinforcement subjected to reversed cyclic lateral loading simulating earthquake effects.

This research explored critical material and structural behaviors at the boundaries of high-strength steel properties that could currently be achieved, which included stiffness and strength, local bond stress-slip relationship of bars anchored in adjacent concrete sections, spread of plasticity, inelastic rotation capacity, and ultimate failure characteristics.

They conducted both laboratory tests on beams and numerical (analytical) studies of archetype buildings to establish seismic demands for beams and columns. Key findings of the project showed variability of performance characteristics between Grade 60 and Grade 100 and which are detailed in the final report.

Technology and ideas

Striving to be the catalyst to optimize concrete to serve societal needs.

Better concrete for a better world

Intentional and focused investments in research and technology can help the concrete construction industry meet challenges that include a shrinking workforce, flat productivity growth, and environmental impact, among others.

The Strategic Development Council (SDC) helps by boosting the acceptance of new technologies (processes, methods, and materials), helping to fund research that validates using the technology in the field, monetary support to create technical guides in significantly less time than it takes for an SDO, assembling various industry groups for collaboration on common needs, leveraging individuals' expertise, and nurturing and guiding new technologies.

The SDC recently adopted four new goals to achieve its vision of optimizing the use of concrete for construction. Via innovative technologies and strategic initiatives, SDC strives to improve efficiency, sustainability, and economy of construction, and extend service life of structures.

SDC Technology Forums

We foster innovation by holding twice-yearly 2.5 day Technology Forums where industry leaders and experts connect to discuss industry challenges, and new technologies are given the opportunity to be evaluated and connect to industry, builders, and users of concrete. Industry challenges are explored, and new technologies are nurtured and guided.

4 Challenging Goals

Goal 1: Improve the durability of concrete

Goal 2: Improve the design and rules for design

Goal 3: Improve how innovation gets implemented

Goal 4: Improve productivity and quality performed by the contractor

What happens at our forums?

Steering group meetings

Targeted workshops

Presentations of technological interest

Showcase presentations on new or innovative technologies

Break-out sessions for a deeper dive

Visit https://www.acifoundation.org/technology/forums.aspx to view recent Forum agendas.

Technology Forum 43, Scottsdale, AZ, in March 2018

In Scottsdale, the focus was on innovation implementation and case studies in 3-D Printing in the concrete industry. The role of technology development served as a springboard to show ways that the concrete industry can morph from a project industry to a product industry. With a technology road map, our concrete product can hold pace with the innovation needed to keep up with the increasingly swift rate of change we experience globally. The workshop illuminated some of the spectrum of issues that the concrete industry faces with advances in technology, including:

- Proprietary versus nonproprietary technologies;
- Near-term versus long-term impact;
- Prescriptive versus performance codes and standards;
- Process-focused versus outcome-focused;
- Design-focused versus constructability-focused;
- Quality versus productivity; and
- Profitability versus sustainability.

Also highlighted were the obstacles experienced by industry members every day that prevent implementing innovation, such as:

- Legal and regulatory restrictions;
- Large investment already in existing approaches;
- Uncertainty of impact of innovation;
- Threats to an established market;
- Fragmentation of industry;
- Lack of communication, rapport, and collaboration; and
- Lack of resources.

Technology Showcases

- GCP Applied Technologies, Inc., presented on the benefits of control flow concrete;
- Surface Tech LLC's digital solutions—built by experienced concrete contractors, commercial and residential builders, and concrete suppliers—that provide best practices when supplying and building with concrete.

Technology Forum 44, Denver, CO, in September 2018

In Denver the acceptance and use of technical innovations in concrete projects was discussed by a panel of speakers from the viewpoints of owner, architect, design engineer, and concrete contractor. The value of assessing risk, sharing case studies, and filling a "need" was debated among the panel presenters and attendees. Anol Mukopaydhay presented "Performance Engineered Alkali-Silica Reactivity (ASR) Resistant Concrete," which included information on improved ASR test methods for aggregates and concrete. It may be of interest to expand this promising research on a broader range of materials.

Technology Showcases

- 3-D Printing – For Taller, More Effective Concrete Wind Turbine Towers – Xiaopeng Li, University of California, Irvine;
- Con-Cure NEX – award-winning devices for wireless transmission of concrete temperature and strength information;
- EdenCrete®—a carbon nanotube-enriched admixture that significantly improves the tensile and flexural strength of concrete.
- From Concrete to Glass: Seamless and Impermeable Graded Transition – Shadi Nazarian, The Pennsylvania State University

SDC initiatives in 2018

Improving Productivity with Building Information Modeling (BIM)

Volunteers within the SDC worked to promote the recent publication of "Guide to Use of Industry Foundation Classes (IFC) in Exchange of Reinforcement Models (ACI 131.2R-17)," which was in part funded by the ACI Foundation. This guide and its companion digital IFC will enable automation and reliable efficient exchanges of reinforcing bar information between software products provided by different software vendors. Volunteers and staff worked to collaborate with other industry groups such as BIM Forum and bSI (Building Smart International) to disseminate this important development. Looking to the future, ACI Committee 131, Building Information Modeling of Concrete Structures, is developing additional guides and IFCs for construction scheduling and design.

Improving Durability through a Global Perspective

The SDC committed to a "Literature Review of Concrete Durability and Service-Life Requirements in Global Codes and Standards" with CVM, King of Prussia, PA. The study will also consider the perceived effectiveness of each respective code by local users. Tracy D. Marcotte, CVM, will lead a team with strengths in ACI standards and industry practitioner experience in repairs and structural design that includes durability work in practice. SDC sees a growing need for professionals to be able to design, construct, and manage concrete structures that meet or exceed durability or service-life requirements. It is hoped that the information from the study will contribute to the recent initiative of ACI Committee 201, Durability of Concrete, which is developing mandatory standard practices focused on achieving concrete durability in both design and construction.

Improving Design and Rules for Design with Repair Research

SDC awarded funds to WJE for a research project, "Interface Bond: Development of Appropriate Horizontal Shear Provisions for Concrete Repair." The need for a rational method to assess interface bond strength in both new construction and repairs is well-recognized. In new construction, interfacial shear strength is a critical factor in design of overlays and in horizontal load transfer at corbels/brackets. In repair, interfacial shear stresses impact the performance of nearly all concrete repairs. Currently, interfacial bond strength in repairs is evaluated via tensile bond testing, which is a highly variable test, and underpredicts the true interfacial shear strength. Accordingly, current repair designs produced using Section 7.4 of ACI 562-16 may be over-conservative and excessively costly. A similar situation exists in new construction.

A rational shear test procedure and the associated potential alternate code provisions will create more economical repair designs and potentially allow for repair rather than replacement of existing structures. The research program's aim via parametric laboratory assessment of interface shear stress using the guillotine shear test, direct tension pulloff tests, and beam/slab tests, using a range of surface preparation and statistical and reliability analyses of the collected data, could do just that.

Improving Design and Rules for Design with High-Strength Steel Reinforcement (HSR)

SDC dedicated funding to three HSR research projects to further understand properties and performance of concrete made with HSR. By co-funding with the Charles Pankow Foundation, SDC committed to facilitating the general use of reinforcing steel with yield strength greater than 60 ksi in the building code, which may significantly improve the constructability and efficiency of earthquake-resistant structures. A main driver for higher grades is the need to reduce bar congestion, material quantities, and construction costs.

Foundation Mats with High-Strength Reinforcement
(Jack Moehle, University of California, Berkeley)

Development of Large High-Strength Headed Reinforcing Bars
(David Darwin, University of Kansas)

Normal- and High-Strength Continuously Wound Ties
(Bahram Shahrooz, University of Cincinnati)

SDC Member Organizations

- American Concrete Institute
- American Shotcrete Institute
- American Society of Concrete Contractors
- Baker Concrete Construction Inc.
- Barton Malow Company
- BASF Admixtures Inc.
- BergerABAM
- Beton Consulting Engineers LLC
- Burns Concrete
- CarbonCure Technologies
- Ceco Concrete Construction LLC
- Charles Pankow Foundation
- ChemCognition LLC
- Combined Creek Consulting
- Concrete Preservation Institute
- Concrete Reinforcing Steel Institute
- Convergent
- CTLGroup
- Ductilcrete Slab Systems
- The Euclid Chemical Company
- Ellis Global Group
- Expanded Shale, Clay and Slate Institute
- Florida Department of Transportation
- GCP Applied Technologies
- Hanley Wood LLC
- ICC Evaluation Service LLC
- International Concrete Repair Institute
- ISE Logik Industries
- James Toscas Associates
- Michigan Technological University
- Middle Tennessee State University
- Missouri University of Science & Technology
- MJ2 Consulting
- National Institute of Standards & Technology
- NAVFAC EXWL
- New Jersey Institute of Technology
- Nucor Steel Birmingham
- Oceans Technology Group
- Owens Corning
- Port Authority of NY & NJ
- Portland Cement Association
- Precast/Prestressed Concrete Institute
- Premier Construction Products Group
- Purdue University
- R-E-D Industrial Products
- Sika Corporation
- SIMCO Technologies Inc.
- Simpson Strong-Tie Concrete Repair Division
- Specialty Products Group

"The U.S. Army Corps of Engineers values its membership in SDC to foster our understanding of and help accelerate the acceptance of current technology in the concrete industry. USACE is responsible for over $250 billion of civil works infrastructure and the SDC provides a forum where, at senior levels, we can discuss strategic issues and tactics to support the sustainment of this infrastructure, which is owned by us all."

Brian H. Green, RPG, FACI, Research Geologist, U.S. Army Engineer Research Development Center

- STRUCTURAL
- Texas Transportation Institute, Texas A&M University
- Thornton Tomasetti Inc.
- Tourney Consulting Group LLC
- University of Kansas Infrastructure Research Institute
- University of Miami
- University of Sherbrooke
- U.S. Air Force Civil Engineer Support Agency USAF CESA
- U.S. Army Corps of Engineers
- U.S. Bureau of Reclamation
- Vector Consultants
- Virginia Transportation Research Council
- Walker Consultants
- Walter P Moore & Associates
- Webcor Builders
- Wind Tower Technologies LLC
- World of Concrete
- WJE Associates Inc.

2018 ACI Foundation Awardees

The Jean-Claude Roumain Innovation in Concrete Award, presented by the SDC for innovation in the field of concrete, as presented to Michael Sprinkel. Sprinkel is acknowledged for his development of epoxy and polymer overlays for bridge deck protection and other construction innovations that have strengthened the concrete restoration and repair industry.

The Robert E. Philleo Award, presented by the CRC for outstanding achievements in the field of concrete materials, was presented to Jason Weiss. Weiss is acknowledged for his outstanding contributions to the advancement of concrete technology through student advising; exemplary service to the profession; and innovative research on shrinkage-reducing admixtures, internal curing, material transport characterization with the formation factor, freezing-and-thawing modeling, and deicing salt damage.

The Arthur J. Boase Award, also presented by the CRC for outstanding achievements in the field of structural concrete, was presented to Conrad Paulson. Paulson is acknowledged for his exceptional work leading to the development and acceptance of high-strength reinforcing steel for concrete construction and its adoption into codes and standards.

Foundation

aci

Concrete Research Council
aciFoundation

Scholarship Council
aciFoundation

Strategic Development Council
aciFoundation

www.ACIFoundation.org

Your support of the ACI Foundation programs—such as the Scholarship and Fellowship program or our Research and Technology programs—will enable the ACI Foundation to support our future concrete leaders, and to help advance knowledge of concrete materials, structures, and innovative technology. *Thank you for your support!*

I'm interested in learning more about the ACI Foundation

Contact: Jennifer DeWall
Development Director, ACI Foundation
+1.248.848.3757
jennifer.dewall@acifoundation.org

Make a difference in the concrete industry! (click here)

Please accept my donation of $ _____ to the ACI Foundation.
◯ I wish my donation to remain anonymous.

Name: _____

Company: _____

Address: _____

City: _____ State/Province: _____

Country: _____ Postal Code: _____

E-mail: _____

Phone: _____

Allocate this donation to:

◯ ACI Foundation (general use)
◯ Scholarship Fund
◯ Concrete Research Fund
◯ Innovation and Technology Fund
◯ Sustaining Fund

Donations can be sent to the ACI Foundation by check or credit card.
To make a donation by phone, call Janice Clines at +1.248.848.3163.

Check # _____ **payable to *ACI Foundation* enclosed.**

(Checks must be drawn on a U.S. bank in U.S. funds.)

Mail to: ACI Foundation
Attn: Jennifer DeWall
38800 Country Club Drive
Farmington Hills, MI 48331 USA

Charge my ◯ Visa ◯ MasterCard ◯ American Express

ACCOUNT NUMBER	EXP. DATE	CVV CODE
CC ADDRESS (if different from above)		
SIGNATURE		

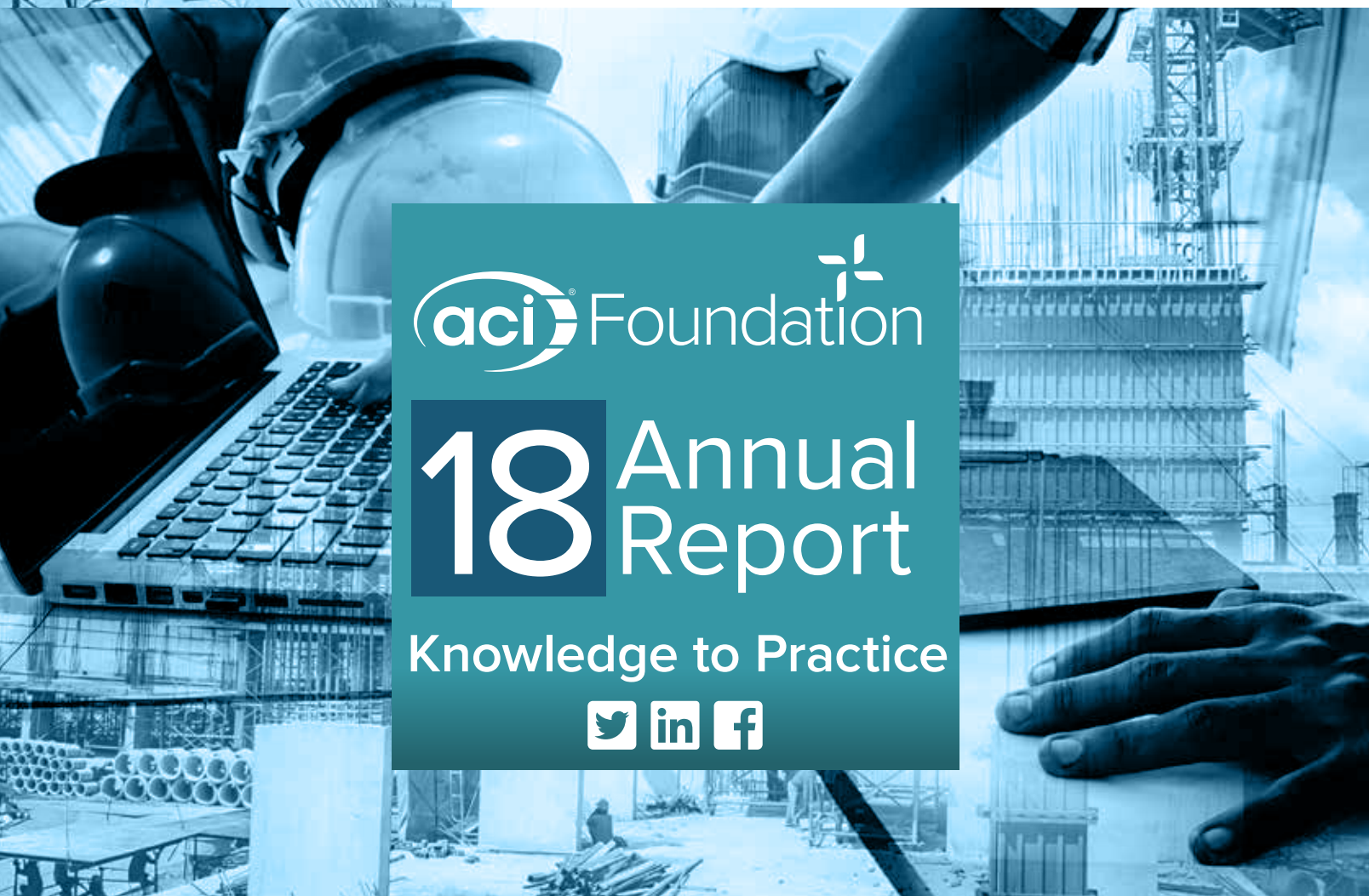
The ACI Foundation is a 501(c)(3) nonprofit organization and is a wholly owned subsidiary of the American Concrete Institute.

18 Annual Report

ACI Foundation
Knowledge to Practice

ACI Foundation
38800 Country Club Drive
Farmington Hills, MI 48331 USA

If addressee is no longer with your organization, please route to his or her replacement or supervisor.



ACI Foundation

18 Annual Report

Knowledge to Practice