Knowledge to Practice:

aci Foundation

Recap of SDC Technology Forum 45

The Strategic Development Council (SDC) hosted another successful Technology Forum when industry leaders met in La Jolla, CA, to hear about solutions to issues in the industry and technologies that will promote progress. "Green Design," "Sustainability," "Resilience," "Embodied Carbon"—the definitions and relationships between these terms were discussed at SDC Forum 45, as were new technologies to ensure that building with concrete continues to be a sustainable choice. The following presentations highlighted different aspects of this common goal:

Evan Reis, Executive Director of the US Resiliency Council, noted that sustainability is more than just green design. He proposed that "Green Building + Resilience = Sustainability" and that resilience is as important to long-term sustainability as green design. He urged the concrete industry to be a leader in quantifying the social, economic, and physical returns that durable concrete construction can deliver. Building with concrete can help communities, businesses, and homes be more resilient, and thus more sustainable, in a way that no other building material can. Visit **www.usrc.org**.

The Embodied Carbon in Construction Calculator, or EC3 Tool, started as an inspired response to a technology client's request to measure the embodied-carbon impacts for a major campus redevelopment. The technology is being developed and hosted through the Carbon Leadership Forum at the University of Washington under the key leadership of Kate Simonen, Associate Professor and Director of the Carbon Leadership Forum, and Don Davies, President, Magnusson Klemencic Associates. EC3 is meant to be a robust, next-generation, open-source database of North American embodied-carbon Environmental Product Declaration (EPD) material data. While still in the early development stages, there are hopes it will become the key database behind future life-cycle assessment evaluations.

Ready mixed concrete production produces a significant amount of wastewater through washing of equipment. A novel carbon dioxide (CO_2) treatment to allow the use of high solids concrete wash water to be used as mixture water was examined. Sean Monkman, Vice President of Technology Development, CarbonCure Technologies, explained how beneficiating concrete wash water with CO_2 was found to reduce or eliminate negative aspects associated with prior attempts to use untreated water (set acceleration, workability loss, and strength reduction). This technological approach could allow three waste streams (CO_2, wash water, and wash water solids) to be reused to produce more sustainable concrete.

Save the Date

SDC Technology Forum 46 will be held August 27-29, 2019, at the Kimpton Hotel Monaco Pittsburgh, Pittsburgh, PA. Visit **www.acifoundation.org** for more details and to register.

Performance-Based Concrete Specifications and Embodied Carbon

There is a growing trend for owners to ask for lower-carbon building materials, which has led to the development of performance-based concrete specifications. A panel of speakers explored the obstacles and questions that performance-based concrete specifications have raised. Kate Simonen, Associate Professor, University of Washington, and Director of the Carbon Leadership Forum, started the panel by describing the big picture for low-carbon construction. Themes of "Value" versus "Impact" were highlighted by examples contrasting concrete value versus cement content. Don Davies, Magnusson Klemencic Associates, examined performance versus prescriptive specifications from an engineering viewpoint. A case study highlighting the performance-based design and estimated built performance of the newest San Francisco International Airport terminal was shared. Alana Guzzetta, National Research Lab Manager for US Concrete, discussed specifications from the concrete producer's point of view. Data were presented on the overall performance of concrete mixtures that use supplementary cementitious materials (SCMs) and compared to traditional concrete mixtures, and the evaluation of a product using an EPD was reviewed. Finally, Jeremy Gregory, Executive Director of the Concrete Sustainability Hub and Research Scientist at the Massachusetts Institute of Technology, envisioned the potential future of designing concrete mixtures with low environmental impact by leveraging advances in machine learning to optimize concrete mixtures for environmental impact, strength, durability, and other performance measures.

Technology Advancement for the Industry

SDC has supported several initiatives in recent years to bring the concrete community together to improve concrete construction in North America. Attendees were able to hear from speakers on this vision to optimize the use of concrete to serve society's needs.

James Toscas, James Toscas Associates, urged the industry to promptly define an updated strategy for the concrete industry in terms of long-term and newly developing trends. He defined the Concrete Technical Operating System (CTOS) as the technical environment in which concrete structures are designed, constructed, operated, maintained, renewed, and decommissioned. Toscas

recommended implementing the strategy by encompassing all the factors that affect, support, or hinder the CTOS. He imagines a future for the concrete industry in which:

- "Possible meets Necessary";
- "Innovative meets Routine";
- "Brilliant meets Boring";
- "Creativity meets Convention"; and
- "Yesterday's Triumph meets Tomorrow's Challenge."

Tracy Marcotte, CVM, summarized her team's findings from a recently completed literature survey on "Concrete Durability and Service Life Requirements in Global Codes and Standards." Durability design—as a flexible framework of choices and decision-making for designing, executing, and managing concrete structures—is just starting to be treated in a comprehensive manner in the United States. She reported that globally, other nations, regions, and institutions have worked to achieve consensus and document best practices and durability requirements for new and existing structures, including both prescriptive- and performance-based durability and service-life requirements, with varying levels of success and impact. Marcotte noted that "ACI codes and standards are used in 40+ countries around the world." From this perspective, ACI has an opportunity to develop a next generation of powerful and effective performance-based codes to provide tremendous global impact.

Recommendations from this survey that would guide ACI in this endeavor to arm design professionals and constructors to sustain and revolutionize our world include:

- Standardize terminology;
- Harmonize knowledge of expert committees into codes;
- Develop new documents in durability and service life;
- Execute statistically valid survey of concrete users and innovators; and
- Deliver education and outreach beyond expert concrete institutes.

Additionally, Concrete 2029 organizers gathered to discuss and identify the most important opportunities in our industry.

Other Key Presentations

Pete Barlow, Contech Services, Inc., discussed a new guide from ACI Committee 546, Repair of Concrete, that recommends certain practices for using prepackaged powdered construction products. Cementitious packaged materials are used for a range of construction and repair activities, and the new ACI 546 guide provides recommended practices for site use, testing, jobsite quality control, and quality assurance for use of these materials.

Erick Aldrich, SRK Engineering, presented "Wall Innovations Utilized in the Mid-Coast and LOSSAN Corridor Rail Projects." Several traditional retaining walls planned for the project were replaced with precast concrete counterfort walls, which have been around for over 40 years but are recently becoming more popular because of their cost savings, speed of construction, and diverse aesthetic options. Overall, the use of the precast counterfort walls saved the project $5M and months on the project schedule, while also showing no performance failures or movement.

Junfeng Ma, Mississippi State University, showed the audience the power of leveraging virtual reality (VR) for safety training for the precast/prestressed concrete industry. The advancement of VR technology provides new opportunities to simulate the dangerous and risky conditions in a virtual environment to prepare trainees with necessary awareness and skills for their daily operations. VR job training could help reduce employee injuries and improve companies' safety records.

Petros Sideris, Texas A&M University, presented on "Hybrid Sliding-Rocking (HSR) Columns for Seismic Resilience and Accelerated Construction." The HSR column design integrates end rocking joints, intermediate sliding joints over the column height, and internal unbonded post-tensioning. Because joint sliding is a nondamaging mode, following a strong earthquake, the system can be easily reset to its original undeformed state, using small mechanical or hydraulic jacks. With this design, tension damage has been eliminated; the peak base and shear forces and foundation demands have been reduced; and the seismic deformation demands have been reduced.

Scott Nelson and Billy Searles, Kiewit Infrastructure West Co., discussed how collaboration and cooperation among the major project players fast-tracked the successful public-private partnership (P3) construction of the Carlsbad Desalination Plant. Some of the important lessons learned were:

- Design drives success of the project;
- Validation and agreement on service-life criteria are required early;
- Concurrent design and construction promote the quickest schedule;
- Process design and procurement is the critical path;
- Permit expectations must be known early;
- Performance guarantees on process design ensures quantity and quality of water as well as chemical and power consumption; and
- Engineering, Procurement, Construction (EPC)-led QA/QC promotes the most economical and schedule-efficient project.

Attendees were also able to tour the University of California, San Diego Jacobs School of Engineering Seismic Laboratory. For information on any of the presentations or to contact presenters, please send inquiries to Tricia Ladely at tricia.ladely@acifoundation.org.