Knowledge to Practice:

aci Foundation

Developing a Pervious Pavement Design Procedure

Earlier this year, the Concrete Research Council (CRC) approved the funding of four deserving research projects. This edition of *Knowledge to Practice* features the fourth and final project; the three previous editions of *Knowledge to Practice* featured the other research concepts.

Toward a mechanistic pavement design of pervious concrete pavement

This project seeks to contribute to the creation of a design procedure for pervious concrete pavement (PCP). PCP is a desirable technology for municipalities and project owners due to its ability to percolate rainwater at a rapid rate. This infiltration of rainwater helps to minimize water from pooling on the surface of pavements, thus decreasing the risk of hydroplaning and wet weather accidents. PCP is a relatively new technology and despite its benefits does not have a reliable design procedure for researchers and professionals to follow.

Somayeh Nassiri and J. Daniel Dolan, both of Washington State University (WSU), Pullman, WA, will serve as the principal investigators for this project. Research will be conducted through both field and laboratory testing. Field testing will include lightweight deflectometer (LWD) testing on several PCP installations on WSU's campus and other sites. Pavement moduli will be back-calculated using the LWD deflection data. This data will be used to create an input database for a range of structural designs and materials. Laboratory testing will evaluate fatigue behavior of PCP in both dry and wet conditions and with four different degrees of porosity.

"Pervious concrete pavements are becoming more and more popular but no pavement thickness design procedure is available," Nassiri said. "Many highway agencies, cities, and counties are struggling with how to approve the thickness design for pervious concrete pavements in the absence of a design procedure. This study is aiming to close this gap and take the necessary steps toward a design procedure." The results of this research will be coupled with field-performance data of PCPs from across the country as it becomes available. ACI potentially could use the results from this research as well as future field tests to establish codes, guidelines, and best-practice principles for PCPs.

Concrete 2029 and SDC Technology Forum #40 Recap

Concrete 2029

A group of about 35 prominent individuals, led by Peter Emmons, CEO of STRUCTURAL Group, met in Salt Lake City, UT, the day before the SDC Technology Forum #40 to outline more detailed plans for three goals of the Concrete 2029 roadmapping effort. Those goals are: 1) improve the workforce supply; 2) improve the quality of in-place concrete; and 3) increase construction productivity.

Topics of discussion included ideas for attracting a capable and competent workforce at all levels of the concrete construction industry; how quality intersects with aesthetics and requirements; the access and acceptance of tools and technologies that can provide real-time feedback on quality and productivity; and metrics, training, management, and process improvement. If you're interested in getting involved in the Concrete 2029 initiative, e-mail Doug Sordyl, SDC Managing Director, at douglas.sordyl@concretesdc.org.

Strategic Development Council (SDC) Technology Forum #40

SDC's Technology Forum #40 took place September 8-9, 2016, in Salt Lake City, and was another successful, industry-oriented meeting of about 65 concrete industry leaders. In addition to participating in the first roadmapping workshop for Concrete 2029, attendees took time from the presentations on recent trends and innovations in the concrete industry to tour Salt Lake City's historic Temple Square. Highlights of the Forum #40 presentations and discussions include:

Hexcrete Project Team and Wind Tower Technologies

Some of the Forum 40 attendees during tour of Temple Square

presented the latest methods in concrete wind turbine tower construction. The wind tower generation industry recognizes concrete as the building material of choice to overcome the transportation and construction barriers to wind towers in excess of the current 80 m (262 ft) height limit for steel towers. Concrete's ability to go much higher in more economical modes positions concrete to be at the leading technological edge of taller and greater capacity wind turbine towers. A new ACI document, ITG-9 Report on Design of Concrete Wind Turbine Towers, financially supported by SDC, will soon make its debut.

The carbon footprint of construction materials is under increasing scrutiny and researchers are developing ways to reduce or neutralize the carbon dioxide (CO_2) production in concrete manufacturing. Two such researchers presented findings from their work on reducing the CO_2 production in the life cycle of traditionally produced cement. Gaurav Sant, University of California, Los Angeles, posed a beneficial use solution to CO_2—a direct carbonation method of capture and enrichment to create an entirely new construction material. Morgan Abney, NASA, described how the Bosch Process—used to provide astronauts with air to breathe and water to drink—can apply to CO_2 capture during cement production and potentially produce a more durable concrete.

Whether supplementary cementitious materials (SCMs) are used in concrete to reduce environmental impact, reduce cost, or to improve performance, there are some concerns about the fluctuating regional availability of traditional SCMs. Pulverized post-consumer (recycled) glass has been posited as an alternative SCM, and a group of representative glass manufacturers and industry organizations met to present and explore the barriers of technical rigor, codes, and standards and market acceptance that glass pozzolan faces to be considered a viable option.

Benefits of using magnesia-based mixtures for repair concrete were demonstrated by a representative of MG-Krete.

Three-dimensional (3-D) printing with concrete could be the next major technological advancement in the concrete industry. But how will printed concrete measure up to current performance standards? National Institute of Science and Technology (NIST) research on the methods and applications of 3-D printing and the measurement science that can inform performance-based standards were presented. Such measurement standards can be expected to assist with the commercialization of this technology.

Visionary companies such as Compass Research are conducting conceptual research on self-assembling formwork in response to flat construction productivity rates, skilled labor shortages, and architectural and artistic design limitations. While future predictions are based on an extension of current reality, what are the big game changers that the industry doesn't even know about yet?

Verifi displayed its advanced technology solution for measuring and managing concrete properties while in transit to the jobsite. The system promises to improve quality and productivity and optimize material use, and it's expected to lead to more effective and efficient use of ready mixed concrete.

For more information or to get in touch with any of the speakers, contact Ann Daugherty, ACI Foundation Director, at ann.daugherty@acifoundation.org.

Looking Forward to More Innovative Concepts

SDC Technology Forum #41 will be held February 23-24, 2017, in Dallas, TX. The next Concrete 2029 Workshop will be held February 22, 2017, prior to the forum, and will roadmap:

- Improving the quality of concrete as related to durability; and
- Shortcomings in the image of concrete as a product.