Knowledge to Practice:

aci Foundation

Researching Steel Fibers for Increased Strength

Earlier this year, the Concrete Research Council (CRC) approved the funding of four deserving research projects. This edition of *Knowledge to Practice* features the third of the four projects; the subsequent edition will include the final remaining research concept.

The project "Deformed Steel Fibers as Minimum Shear Reinforcement in Deep, Prestressed Concrete Hollow-Core Slabs" aims to generate the necessary experimental data to evaluate the conditions under which steel fibers could be used as minimum shear reinforcement for deep precast, prestressed concrete hollow-core slabs. This research is supported by ACI Subcommittee 318-G, Precast and Prestressed Concrete, with Gustavo J. Parra-Montesinos, University of Wisconsin-Madison, serving as the project's Principal Investigator.

Precast, prestressed concrete hollow-core slabs provide a lightweight, low-cost, and easy-to-assemble building resource for both residential and commercial construction. Research has shown that the web-shear cracking strength of relatively deep hollow-core slabs could be substantially lower than that calculated following the current ACI Code provisions (V_{cw}). The ACI Building Code thus requires the use of minimum shear reinforcement in hollow-core slabs with depths greater than 12.5 in. (318 mm) wherever the factored shear is $V_u > \phi 0.5 V_{cw}$, where ϕ is the strength reduction factor. Normal bar-type shear reinforcement cannot be used in hollow-core slabs due to their manufacturing process. Often, if additional shear strength is required, the hollow cores are filled with concrete. This measure increases cost, slab weight, and labor.

This research project will conduct a total of 32 tests at the Wisconsin Structures and Materials Testing Laboratory. Testing variables will include fiber type, dosage, shear span-to-effective depth ratio, slab manufacturing process, and distance from slab end to first critical section for shear. Materials tests will also be conducted to develop performance-based acceptance criteria for fiber-reinforced concrete.

Parra-Montesinos has experimented previously with deformed steel fibers for shear reinforcement. He led a Precast/Prestressed Concrete Institute-funded study and is optimistic about this current research project. "The use of deformed steel fibers in relatively low dosages was found to approximately double the shear strength of 16 in. deep hollow-core slabs. Thus, there is significant potential for the use of fibers as shear reinforcement so that deep hollow-core slabs can be designed for the full web-shear cracking strength," he stated.

The results generated from this research could be used to develop a code change proposal in collaboration with ACI Subcommittee 318-G. Deformed steel fibers could

Setup for hollow-core slab testing *(photo courtesy of Gustavo J. Parra-Montesinos)*

Hollow-core slab installation *(photo courtesy of Spancrete, Waukesha, WI)*

potentially broaden the use of hollow-core slabs impacting the precast, prestressed industry as a whole.

Latest Research Product from CRC-Sponsored Projects

CRC91, Setting Bar-Bending Requirements for High-Strength Steel Bars, is now available. For more information on all research products from CRC co-funded projects, visit **www.concreteresearchcouncil.org/home/projects**.

Annual Emerging Technology Technical Session Sponsored by SDC

The Strategic Development Council (SDC) announces that its annually sponsored Emerging Technologies in Civil Infrastructure Technical Session will take place October 26, 2016, at The ACI Concrete Convention and Exposition in Philadelphia, PA. The session will highlight new developments in preliminary design guidelines and construction of concrete wind turbine towers. Concrete provides a cost-effective means to increase the height of towers, enabling capture of more wind energy. Other benefits of concrete wind turbine towers include:

- On-site or off-site component fabrication;
- Site assembly with fewer fatigue critical joints;
- Enhanced dynamic performance;
- Reduction of foundation volume;
- Minimal maintenance costs;
- Increased service life due to high fatigue resistance of concrete; and
- More robust tower base to accommodate greater capacity turbines in the future.

More information about this event can be found in the ACI Convention Program Book, ACI Convention App, and at **www.concrete.org**.

ACI Foundation Award Winners for 2016

SDC's Jean-Claude Roumain Innovation in Concrete Award is awarded to an individual who is an innovator within the concrete industry. The 2016 recipient is Gaurav Sant, University of California, Los Angeles, "For improving our understanding of how mineral fillers and supplementary cementing materials influence cement hydration rates and methods for accurately characterizing and predicting these effects, and for his work in the development of a CO_2 neutral cement."

The CRC's Arthur J. Boase and Robert E. Philleo Awards are given in recognition of a person or organization who have performed outstanding research. The Boase is awarded for research in the field of structural concrete; the Philleo is awarded for research of concrete materials.

The 2016 Arthur J. Boase Award recipient is Dominic J. Kelly, Simpson, Grumpertz and Heger, "For his contributions to update the reinforced concrete building code by efforts in major research on state-of-the-art technology of steel reinforcing bar manufacturing and design practices, and general revisions based on current research and practices."

The 2016 Robert E. Philleo Award recipient is Jan Olek, Purdue University, "For his life-long contributions to advancements in concrete materials science and translating research findings into concrete infrastructure applications, as well as for training and mentoring generations of concrete researchers and scientists."

ACI Foundation's awards are announced during the opening session of ACI's fall convention. More information about each award, awardee, and previous awardees is available at **www.concretesdc.org** and **www.concreteresearchcouncil.org**.

CRC Currently Requesting Research Proposals

CRC seeks to advance the concrete industry through funding various concrete research projects that further the knowledge and sustainability of concrete materials, construction, and structures and is currently requesting proposals for grant funding. Proposals are due by December 1, 2016. Proposals submitted after the due date will be returned without review. A summary of the CRC call for proposals protocol is as follows:

- Topics are encouraged from all areas of concrete research;
- CRC will fund a minimum of two worthy research projects for the 2017 cycle;
- Maximum CRC funding is $50,000 per project;
- A letter of support of the research concept by an ACI technical committee is required;
- An individual researcher can serve as the principal investigator on only one proposal submitted;
- Industry partnering and project cost sharing are encouraged;
- CRC issues gift grants and stipulates that funds are not subject to overhead charges (indirect costs). Noncompliant proposals in this regard will be returned without review; and
- Principal investigators shall follow the published CRC Grant Proposal Guide.

Research proposals should be submitted to Ann Daugherty, Director, ACI Foundation, at ann.daugherty@acifoundation.org. Submit the entire package in a single PDF. Separate letters of support or other supporting information will not be accepted. Selection of awarded projects and notification to principal investigators will be made shortly after The ACI Concrete Convention and Exposition – Spring 2017.

Current information and more detailed proposal requirements are available at **www.concreteresearchcouncil.org**.