Supporting Results in Research

The Concrete Research Council and you—an important partnership

Imagine the potential benefits to the concrete industry if there was:

- A group that ACI technical committees can turn to for help in coordinating research to address technical problems and challenges the committee is facing?
- A coordinating and respected organization that members of the research community can approach for constructive review and possible endorsement? Where seed money funding could be pursued and leveraged for full funding?
- An organization that can coordinate and leverage the resources of the concrete industry's foundations and other funding organizations?
- A coordinated option for companies in the concrete industry to support research that can remove hurdles preventing growth of a market segment?
- An organization that can work with sister organizations to leverage research with other strategies and tools to address industry challenges and advance new technologies?

The good news is such an organization exists: the Concrete Research Council (CRC). One of CRC's top priorities is to make sure the concrete industry is both aware of this unique entity and how to participate in it. The ultimate ability of CRC to serve and advance the concrete industry is limited only by the participation of those who will benefit most.

Recently, the council's leadership has been working hard to expand and improve CRC and its process to leverage its position in the industry and the relationship with its ACI Foundation sister councils: the Strategic Development Council (SDC) and the Scholarship Council. The revised CRC process is designed to better serve and communicate between the parties involved in and benefiting from concrete research (Fig. 1).

Fig. 1: CRC's role in concrete research

HOW DOES CRC FUNCTION?

Perhaps the best way to explain the enhanced CRC process is to answer the questions posed:

…a group that ACI technical committees can turn to for help in organizing research?

CRC reaches out twice a year to all ACI technical committees in an effort to determine research needs. At the end of each ACI convention, the ACI Engineering Department sends an e-mail to the Technical Committee Chairs that contains a link to the Biannual Report, asking them to report on all of their committee's efforts and goals.

The last question on the report asks "Has your committee identified a research issue that would assist your committee in meeting its mission?" Each committee's answer to this question is forwarded to CRC for review. CRC will follow-up with each responding Committee Chair to gather additional information and investigate ways of moving the research forward. Potential CRC help can include assistance in locating a research team and/or research organization, assistance in creating a research proposal, formal review and potential CRC endorsement, and CRC seed money and assistance in further research funding. CRC also works closely with its parent ACI Foundation and sister councils to find solutions to research needs.

Of course, ACI technical committees don't need to wait for the next ACI convention to begin working with CRC. CRC's Executive Committee regularly meets throughout the year and can address all requests for assistance as they arise.

…a coordinating organization that the research community can approach for constructive review and where seed money funding could be pursued?

CRC has been addressing this need for years and continues to work hard on this critical task. Researchers can submit their proposals directly to CRC for review and constructive comment, as well as possible endorsement and/or seed money. While seed money is important in the overall funding of a project, the real advantage offered to full funding efforts is the endorsement of the ACI community through CRC. CRC's endorsement is a well-respected and objective credential that researchers are able to leverage into full funding. A guide for submitting a proposal to CRC can be found on CRC's Web page at **www.ConcreteResearchCouncil.org**.

…an organization that can coordinate and leverage the resources of the concrete industry's foundations and other funding organizations?

CRC works closely with its sister councils—SDC and the Scholarship Council—to explore and put into motion opportunities to support research that is essential to ACI and the concrete industry. CRC also works closely with a number of foundations and other organizations to coordinate and promote research initiatives and funding.

The ACI Foundation has a formal Memorandum of Understanding (MOU) with the Charles Pankow Foundation and the RMC Research & Education Foundation, and is coordinating a similar MOU with the CRSI Education & Research Foundation. CRC is the council that manages the ACI Foundation's participation in these MOUs and other relationships.

A prime example of CRC's coordination of these organizations and resources is the recent industry push to advance concrete's functionality in the building information modeling (BIM) arena. When SDC identified BIM as an Industry Critical Technology, an effort to establish research on the development of Industry Foundation Classes, a basic unit of communicating attributes about an object in BIM, was initiated. CRC worked with SDC to coordinate funding for the project

Fig. 2: CRC acknowledges its Sponsoring Members, whose commitment to the future of the concrete industry makes CRC's work possible

through the ACI Foundation's MOUs. In the end, sponsorship of the effort through the Charles Pankow Foundation and the RMC Research & Education Foundation was accomplished and this key work was able to proceed.

…an outlet for concrete industry companies to support research that can remove hurdles preventing growth of a market segment?

The foundational support of CRC Sponsoring Members is critical to making the system work. Figure 2 shows CRC's Sponsoring Members whose commitment to the industry has enabled CRC to leverage industry-wide resources into the many past research advancements that have and will continue to grow the concrete industry. Through Sponsoring Membership, CRC provides an opportunity for organizations within the concrete field to contribute resources to an entity that will pool those dollars

CYCLIC LOAD TEST AND ACOUSTIC EMISSION METHOD

Paul Ziehl, University of South Carolina, was the principal investigator of the project, "Cyclic Load Test and Acoustic Emission Methods of In-Situ Load Testing: Comparison and Development of Evaluation Criteria." Citations for the published research appeared in the *ASCE Journal of Performance of Constructed Facilities* and the *ACI Structural Journal*.

Code-related conclusions and recommendations: ACI 318 has not been changed; however, ACI 437R-03 and ACI 437.1R-07 both describe the cyclic load test (CLT) method and the acoustic emission (AE) method. A load testing method incorporating the CLT method is underway within ACI Committee 437, Strength Evaluation of Existing Concrete Structures.

Implementation of research findings into practice: The CLT method has been widely implemented. The AE method in combination with this method has been implemented in two prior cases. Based on the National Institute of Standards and Technology grant "Self-Powered Wireless Sensing Network for Structural Bridge Prognosis" (5 years, $18 million), with joint venture partners Physical Acoustics, the University of Miami, Virginia Tech, and the University of South Carolina, it's likely that the AE method will become much more widely implemented in the not-too-distant future. This grant was made possible in large part due to CRC seed funding of $10,000.

with those of other organizations to address industry research needs in a way no one company could.

CRC strongly encourages all concrete-related businesses to consider an investment of $5000 to become a CRC Sponsoring Member and, in so doing, make an investment in the future of the concrete industry. Participation as a CRC Sponsoring Member demonstrates a commitment to excellence and the advancement of our industry.

More information on becoming a CRC Sponsoring Member can be found at the CRC Web site.

…an organization that can work with sister organizations to leverage research with other strategies and tools to address industry challenges and advance new technologies?

As mentioned previously, CRC is one of three councils that make up the ACI Foundation.

SDC is a group of industry leaders that are guiding the way to unite concrete developers, producers, and customers to facilitate the advancement of concrete technology in a way that results in improved industry efficiency and quality that benefits all. Obviously, research often plays a significant role in advancing SDC initiatives. CRC works closely with SDC to promote and explore research options and funding. This relationship continues to result in coordinated successes for the concrete industry.

CRC's relationship with the Scholarship Council is a natural one, given the link between universities and research. The Scholarship Council works hard to ensure that the concrete industry has an excellent source of future professionals. The Scholarship Council also plays an important role in providing future human resources for the concrete industries' research efforts. CRC is working with the Scholarship Council to coordinate efforts to match students and universities with research efforts.

RESULTS OF CRC-SPONSORED RESEARCH

Two recent projects (refer to the sidebars on "Cyclic Load Test and Acoustic Emission Method" and "Strut Strength in Deep Concrete Members") serve as examples of what CRC can help accomplish.

FILLING THE NEED FOR RESEARCH

CRC is fulfilling a necessary role in the concrete industry with great results and success. CRC is now poised to take on a growing role and expand that research success to benefit all participants in the concrete industry. The only limit on future growth is tied into the amount of participation by the industry. CRC offers access and opportunity to everyone in the concrete field to advance the concrete technology research efforts.

Consider participating by visiting **www.ConcreteResearchCouncil.org**.

STRUT STRENGTH IN DEEP CONCRETE MEMBERS

Gustavo J. Parra-Montesinos and James K. Wight, University of Michigan, were the principal investigators of the project "Experimental Evaluation of Strut Strength in Deep Concrete Members with Minimum Shear Reinforcement," published in the *ACI Structural Journal*.

Code-related conclusions and recommendations: 1) Results from the research confirmed that strut strength factors given in Appendix A of ACI 318 are adequate for use in normal-strength concrete "bottle-shaped" struts crossed by either no reinforcement ($\beta_s = 0.60$) or crossed by the minimum transverse reinforcement specified in Section A.3.3.1 ($\beta_s = 0.75$); 2) The provisions for required minimum transverse reinforcement in normal-strength concrete members given in Appendix A of ACI 318 should be reevaluated. Substantial differences in the required amount of reinforcement were obtained when applying the provisions in Sections A.3.3 and A.3.3.1 to the test beams, with the former leading to substantially larger reinforcement ratios; and 3) Results from the tests of four high-strength concrete beams suggest that, as a minimum, an effective web reinforcement ratio of 0.01, calculated according to Section A.3.3.1, should be provided in high-strength concrete members when a strength factor $\beta_s = 0.60$ is used.

Implementation of research findings into ACI 318: Wight is currently a member of ACI Subcommittee 318E. He has brought the results from this research to the attention of the committee. The conclusion that current strength factors for normal-strength concrete "bottle-shaped" struts crossed by either no reinforcement or minimum transverse reinforcement are adequate was recently used to challenge a code change proposal aimed at always requiring minimum reinforcement in two perpendicular directions. The committee was also informed of major discrepancies in the minimum amount of reinforcement when following Section A3.3 compared to Section A3.3.1.

Implementation of research findings into practice: The impact of the research results on design practice is tightly related to changes (or lack of changes) made to the Code, based on the test results. For example, if the recent Code change proposal to always require minimum reinforcement in two directions would have been successful, the design practice for deep members would have been substantially impacted. Thus, the research results showed the adequacy of the current provisions and helped prevent an unjustified change in design practice, demonstrating the value of this research.