Integrated Disciplines

PCI Foundation-sponsored precast concrete studio at Clemson University joins architecture, civil-engineering students to expand knowledge, gain contacts, and prepare for careers

— Craig A. Shutt

Students in the "Precast Performative Morphologies" program at Clemson University, supported by the PCI Foundation, learned about precast concrete attributes in a variety of ways, including taking plant tours at local precasters Tindall Corp. and Metromont Corp.

Clemson University's architecture studio emphasizing precast concrete design, which just finished its first year, featured unique aspects that expanded on the typical program supported by the PCI Foundation. It joined students from architecture and civil-engineering classes to collaborate on projects, giving both insights and expanding their knowledge of the material. It also showed where bumps in the road could occur when their careers begin.

The primary goal was to create a series of studios, lecture courses, and seminars that explores the benefits of precast concrete in various design settings, from small-scale components to large structures, explains Carlos Barrios, PhD, assistant professor of architecture and instructor of the studio. "We also wanted to create strong ties between architecture and civil-engineering students and connect them to the industry and design professionals. These connections provide them with insights into precast concrete design and the relationships they will develop in their professional careers."

The program was initiated through discussions with the School of Architecture Chair, Kate Schwenssen, FAIA, and the regional PCI Chapter. The school conducted a pilot program in 2013 to investigate how precast concrete instruction could best fit into the curriculum. The six-week exercise included 38 architectural graduate students and was conducted by Dr. Barrios and professors Dan Harding, Dr. Ufuk Ersoy, and Dustin Albright.

The pilot program proved a success, with three students awarded the top three prizes in Clemson's Graduate Research Fair that year. They also were invited to and showcased their work at PCI's national convention. "The results were very positive," Barrios says. "We felt we had enough evidence to indicate we could move forward with a multiyear program."

Precast Performative Morphologies

Clemson then worked with Peter Finsen, executive director of Georgia/Carolinas PCI, on a proposal for a longer-term initiative to be sponsored by the PCI Foundation. The resulting "Precast Performative Morphologies" program created a precast concrete architecture design studio in the fall semester, with additional immersion in Structures I and II courses. It continued in spring semester with Creative Inquiry, an undergraduate research-based seminar course, and graduate research in Special Topics in Architecture & Technology.

Dr. Barrios worked with Dr. Brandon Ross, assistant professor in the Glenn Department of Civil Engineering, who teaches the Advanced Performance Concrete courses to involve structural-engineering students. The civil-engineering students serve as consultants on the architecture students' programs, working one-on-one for one hour of the 12 hours spent each week in class work. "An incredible synergy develops and exposes students to complementary disciplines they'll be working with in their careers," says Barrios.

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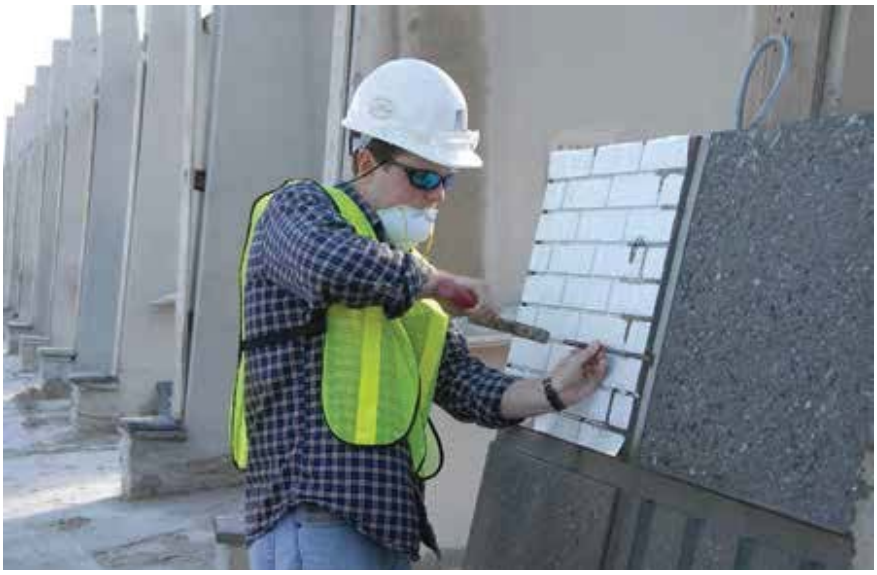
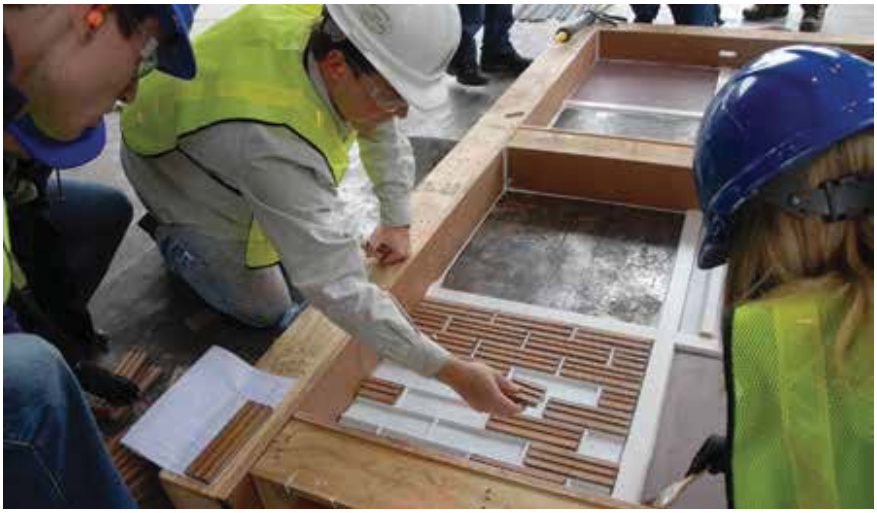
The program won approval from both the university and the PCI Foundation. "The PCI Foundation's purpose is to create partnerships with universities that help us create unique experiences that teach precast design to architecture, engineering, and construction-management students," explains Marty McIntyre, PCI Foundation executive director. "Once



During plant tours, students take a hand-on approach, seeing their designs and specifications come to life and then helping to finish pieces. "They like to see the tangible results of their work," says Professor Barrios.



Students in the program see every aspect of precast concrete production during their plant tours. Here, they learn how to fabricate 4- x 4-foot insulated panels with four distinct finishes—thin brick, formliner, sandblast, and retarded finishes.

students really start to understand the basics about precast concrete design, we find that they can use it to create designs that are cutting edge. We are definitely starting to see that at Clemson."

Dr. Barrios agrees the program has enhanced the students' course work. "At first, it was a challenge, because the students don't quite have a real grasp of the possibilities offered by precast concrete," he says. "They presume it's a material for building parking garages or long-span structures. They don't understand how much can be done."

Part of the program's success resulted from support from local precasters. PCI producer members Metromont Corporation and Tindall Corporation have plants nearby, with several Clemson graduates on staff, and they were enthusiastic. "Both have shown a strong commitment to our academic efforts," Barrios says. The companies offered plant tours and have employees sit on project-review boards to give feedback. "That was important for us to feel confident in moving forward."

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The precasters visited the classes, and Finsen gave an introductory lecture on high-performance precast concrete design. "Clemson did a tremendous job of inserting the precast concrete material into its curriculum," Finsen says. "The program they've created is truly unique. Most precast concrete studios are one-semester units, but Clemson has done much more."

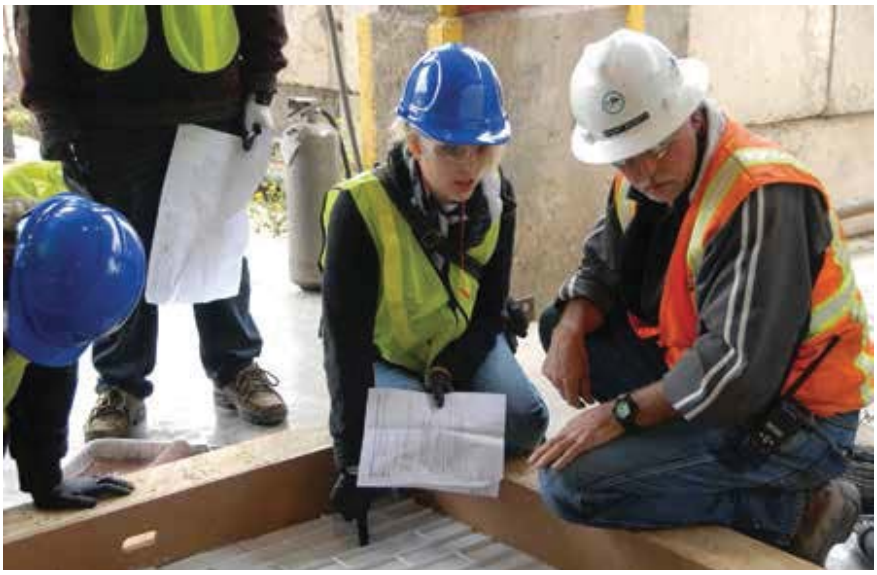
Three Projects Featured

The fall course work featured three precast-concrete oriented class projects. The first centered on designs created by award-wining Japanese architect Tadao Ando, who creates structures primarily using cast-in-place concrete. The students were tasked with redesigning an Ando structure in precast concrete. "It teaches them about the product and provides an introduction to panelization and designing with precast concrete," Barrios explains. He then has them alter one geometric element to create their own precast concrete components.

The second project has become "a signature of our studio program," Barrios says. It had the students design repetitive precast concrete modules based on tessellations, a key focus for Barrios' research. They design components with repetition and create a scaled-down mold (usually from plywood or rubber) that can cast the pieces. "It presents precast concrete through techniques of geometric modeling, mathematics, and wallpaper symmetry groups. It's very useful to help them understand how to maximize casting efficiency and reuse of molds." Repetition is the key to economy, but it doesn't have to be dull, Barrios says.

The third project involved designing a large-scale structure. The pilot study centered on a transit hub. In fall of 2014, they worked on a high-rise building in New York City, which proved challenging. "We tried to do it as a total-precast concrete structure, and the complexity and intricacies of such a scale and size were challenging," he explains. "In the new year, we may try a smaller project or a long-span design. The goal is to give them freedom to explore different ways of achieving their goals."

The students have been enthusiastic about the material and the learning methods. "They get very excited about the partnerships



The local precasters have embraced the program, working closely with the Clemson students to demonstrate how precast concrete components are produced. They also participate in project-review boards and visit classes for discussions.

with the precasters and seeing their operations," he says. In one class, the students assisted in the fabrication of 4- × 4-foot insulated panels with four distinct finishes—thin brick, formliner, sandblast, and exposed aggregate. They cast the panels at the precast plant one day and returned the next day to strip the panels and apply the finishing techniques. "They loved that. They like to see the tangible results of their work."

The precasters also benefit, notes Finsen. "The students are like sponges, picking up ideas, samples of materials, networking, and getting contact information."

Planning The Future

For the fall 2015 course, Dr. Barrios intends to delve into elements of Islamic tesselations as they relate to architecture and precast concrete. "There are very elaborate patterns that develop in terms of geometry, and the students can learn to replicate that in precast concrete."

For that work, he will have additional help from the design profession. The program has added three local architectural firms, LS3P, Craig, Gaulden Davis, and the Boudreaux Group, plus civil-engineering firm Devita & Associates to its support team. "They have a detailed understanding of precast concrete and have committed to mentoring students and sitting on our project-review boards," he says. "It really shows the commitment of the profession and industry to aid education and make it a success."

The program gives students a leg up on some of the challenges they will face—including interpersonal ones. "The students are always excited to join with students from other disciplines, but it can lead to frustration," he says. "They have to learn how to talk to each other in ways they both can understand. They learn that the civil-engineering students have a much different perspective on projects, and their language is not always the same. But these are things they should understand, because they will encounter them in their careers. This work will help them ease into situations they will face."

The program has received three more years of funding from the PCI Foundation, and Dr. Barrios has high hopes for its continued success. "A key to the program is the partnership of architecture and civil engineering," he says. "Emphasizing the cross-disciplinary aspect really gives our program a unique aspect. It has come together very well. It was the right moment with the right people to pull this together."

Finsen agrees. "It's a unique approach to involve civil engineering. It also lets them get their hands dirty by working with local precasters. When these students graduate, they will have a significant head start on other graduates looking to work in the field, and they will have expertise that many others don't about the versatility of precast concrete. That's the key concept of the studios."

Course work focuses on three projects, comprising value-engineering cast-in-place concrete to precast concrete, working with tessellations, and designing a large-scale structure.

Clemson's program is unique in having civil-engineering students participate in some of the classes, giving the architectural students a different perspective on the projects they are designing.

Organizational Design

Architecture has been taught at Clemson for more than a century. The school is part of the College of Architecture, Arts and Humanities, which also comprises the departments of Planning and Landscape Architecture, Planning, Art, Performing Arts, Construction Science, Philosophy and Religion, Languages, English, Communication Studies, and History.

The school offers a four-year Bachelor of Arts in Architecture degree with an enrollment of 270 students and a Master of Architecture degree with more than 100 students. A PhD in Planning, Design and the Built Environment also is offered. The graduate program features a specialized Architecture + Health option, one of only two such programs in the country.

The PCI Foundation fosters educational and research initiatives focused on innovative approaches to the integrated and sustainable use of precast concrete design, fabrication, and construction. One of its goals is to support the inclusion of precast concrete programs at accredited colleges and universities.