



Precast Bridge Studio Strengthens Connection between Academia and the Bridge Industry

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One of the bridge community's most remarkable accomplishments is that design codes worldwide continue to incorporate rigorous provisions to prevent connection failures of concrete bridges, even for high-seismic regions. For the past two decades, academics and industry have partnered to develop innovative concrete connections, including those for precast concrete bridges under the banner of accelerated bridge construction (ABC).

During that same time, however, the connection between students and the concrete bridge industry has remained weak. While design professionals have justifiably obsessed over maintaining a continuous load path for our bridges, we have paid scant attention to ensuring continuity in the relationships between our students and industry. The consequence is a shortage of adequately prepared young engineers, construction managers, and others who can readily enter the workforce and contribute

Precast Bridge Studio students meet with bridge mentor, Bob Fish, T.Y. Lin International. Photo: Eric Matsumoto.



to its future. This issue is particularly disconcerting as we face ever-increasing challenges in the transportation sector at the same time that a large wave of Baby Boomers are transitioning into retirement, leaving the bridge industry without their wealth of experience.

What can we do to improve this situation? Although there is no quick fix, ABC has shown us that success requires leaders, innovation, and, yes, precast concrete "connections"! For over a decade, the PCI Foundation (pci-foundation.org) has sponsored dozens of "precast studios" at universities as part of a curriculum development grant. These innovative immersion experiences in precast concrete connect students in architecture and other disciplines to the precast concrete industry. Many participating students have been inspired to enter the precast concrete industry and related industries.

Based on this successful track record, the PCI Foundation took a further step in fall 2018 to fund the first curriculum grant focused solely on bridges, dubbed the "Precast Bridge Studio" (PBS), at California State University, Sacramento (Sac State). This four-year grant has provided a new pathway for the precast concrete bridge industry to develop a long-term partnership with academia to directly support the education and training of the next generation of industry professionals and leaders. PBS aims to connect civil engineering and construction management students to members of the precast concrete bridge industry—including bridge designers, fabricators, construction managers, contractors, suppliers, and others—and thereby produce a new generation of students who are employable in the

industry immediately upon graduation. Specific connections are made by joining industry to the students on campus and linking students to industry in the workplace.

During PBS's first semester, its students were immersed in the precast concrete bridge industry primarily through a precast concrete design class reorganized to focus on bridge structures rather than buildings. Fifteen civil engineering students were grouped into five-person teams, and each team was tasked with designing a 300-ft-long, multispan, precast, prestressed concrete girder bridge located in the Sacramento region. The teams had to adhere to American Association of State Highway and Transportation Officials' *AASHTO LRFD Bridge Design Specifications* and focused on either the California wide-flange girder, the bathtub (U) girder, or the I-girder. Deliverables consisted of plans, design calculations, hand checks, construction sequencing, working-day schedules, and cost estimates.

This task—a tall order for any group of civil engineering undergrads—was especially challenging because one-third of the students were simultaneously taking their first reinforced concrete design class and all students lost two weeks of the semester due to the northern California Paradise Fire smoke days. Nevertheless, students embraced the challenge, calling it "the experience of a lifetime." Teams were motivated and strengthened by continual engagement with industry, which included team mentoring by consultant bridge engineers from T.Y. Lin International, Mark Thomas & Co., and MGE Engineering and oversight by the California Department of

Transportation (Caltrans). In addition to learning bridge design and construction management, students treasured the life lessons derived from a realistic project with deliverables, office visits, and accountability to a practicing engineer.

Precast concrete fabrication was foremost in the minds of students during the entire process. In fact, they unanimously ranked the visit to the Con-Fab precast concrete plant in Lathrop, Calif., as the highlight event of the semester. One student recalled, "Lecture could not prepare me for the surreal experience of seeing the over 100-ft long bridge girders at the Con-Fab plant. It completely blew me away." The students were eagerly anticipating the plant tour because Con-Fab chief engineer, Brent Koch, gave a class lecture, "A Day in the Life of a Precast Plant," the previous day. During the visit, students directly experienced the magnitude and intricacies of bridge girders, details for composite action and continuity, deck panels, precast concrete pavement, steel forms that matched their own girder design, tensioning strand on a prestressing bed, materials testing, and much more.

During a tour of the Sumiden Wire plant in Stockton, Calif., the students also witnessed production of plain and epoxy-coated strand and tensile testing

The semester was filled with interaction with many industry members, including lectures by individuals from Dura-Stress on long-span girders, Viking Construction on precast concrete versus cast-in-place bridge construction and construction sequence and schedule,

A student team presents its final bridge design before the Precast Bridge Studio judging panel and audience. Photo: Mike Kealey, Owl Productions.



Precast Bridge Studio students learn to use bridge design software during a PGSuper™ workshop led by BridgeSight Software president, Richard Pickings. Photo: Eric Matsumoto.

and Caltrans on bridge design specifications and cost estimating. Additionally, students took part in two precast concrete bridge design software workshops that equipped them to perform bridge design using PGSuper Design Software III. To make the precast connection more "concrete," every classroom event or field trip included a 10-question quiz.

By the end of the semester, the teams were ready to showcase their hard work through a formal presentation, "Design and Construction of a Multispan Precast/Prestressed Concrete Bridge," before a packed audience, half of whom were bridge industry members. The industry mentors and supervising faculty served as the judging panel.

The atmosphere was electric. Teams were initially anxious to present before so many industry experts, but they eventually relaxed and ended up doing such a great job that bridge firms began to offer jobs to students that very night. One of the members in attendance, PCI Foundation Board of Directors member Glen Switzer of Durastress, noted, "Right now we have 15 students in one semester that can come into our industry and become a vital part, especially in the bridge arena. They're familiar with the technology advantages and already have the ability to design precast concrete bridges."

Because of an active PCI student club at the university, undergraduates who were not enrolled in the PBS class were still able to connect with the precast concrete industry. These students participated in PBS field trips and

workshops, plus other events such as a new Precast Bridge Seminar series, which incorporated both civil engineering and construction management students—the first collaboration between these departments in the history of the college. Caltrans kicked off the series with "Accelerated Bridge Construction in California," and other industry partners presented at club meetings. Such events drew dozens of students because of the interesting topics, student officer enthusiasm, and, of course, lots of desserts and other treats.

The generous industry support of time and resources during fall 2018 has paved the way for further development of the PBS program for the next three years. In fall 2019, a new joint civil engineering/construction management bridge design and construction project is being offered, including engineering and construction mentors aided by assistant mentors.

With continued vision, guidance, and support from the PCI Foundation, PBS at Sac State can be a model for other universities to develop a strong, reliable "precast connection" between students and industry that will supply the fresh faces, innovative ideas, and vigor of a new generation needed for the growth of the precast concrete bridge industry. **A**

EDITOR'S NOTE

Students compiled a 15-minute video capturing the excitement of their PBS experience, which is accessible at <https://youtu.be/lKg1d-YEg1k>.

