A PROFESSOR'S PERSPECTIVE

Making Precast Concrete Part of the Core Curriculum

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Precast concrete has traditionally been the final lecture topic of reinforced concrete design courses. Many universities do not require a course in precast concrete or prestressed concrete, including both pretensioned and post-tensioned concrete designs, for an undergraduate (bachelor's) degree in civil engineering. However, bridge and precast concrete firms expect college graduates to be familiar with designing precast, prestressed concrete products such as double tees, beams, wall panels, culverts, and bridge girders. Engineers who have not been adequately exposed to the design, production, and installation of precast concrete elements have four options to choose from: learn precast concrete design on their own, ask their employer to assign someone to teach them precast concrete at work, convince their employer to not use precast concrete, or abandon their plan to work as a structural/bridge engineer and find another area of civil engineering to pursue. None of these options is beneficial to either the engineer or the employer.

One way to prepare students for a career in structural engineering including precast, prestressed concrete design is to have them take a semester-long course in precast concrete. In 2019, the PCI Foundation and the National Precast Concrete Association (NPCA) Foundation joined forces to fund a unique curriculum for precast concrete at Idaho State University (ISU) for four years. The precast concrete curriculum is the first studio jointly funded by the PCI and NPCA Foundations with a focus on transportation products such as bridges and culverts. ISU's Precast Concrete Engineering Studio is a three-credit-hour course that is offered every fall semester at the senior undergraduate and graduate levels. The studio has already been taken by 45 students and is a popular class. Many industry champions from across the nation have actively supported the studio and its growth.

The studio is very different from traditional design classes in civil engineering. It includes a variety of activities such as design lectures; visits to precast concrete production facilities; guest speakers; laboratory work and physical testing; introduction to complimentary PCI and NPCA resources; exposure to the latest technologies and materials such as ultra-high-performance concrete; participation in national PCI, NPCA, and American Segmental Bridge Institute (ASBI) student competitions; and opportunities to attend and present posters at the PCI Convention and The Precast Show. Some of the key activities for the class are discussed in the following sections.

Visits to Precast Concrete Plants

While it is common in traditional precast concrete courses to show videos and photos of how precast concrete elements are fabricated, students benefit much more from visits to actual precast concrete production facilities. When visiting in person, students can observe the whole process of how precast concrete elements are fabricated, cured, handled, and stored. The visits prepare students to identify the advantages and the limitations of precast concrete and give them an opportunity to directly interact with, listen to, and ask questions of the experts. The knowledge gained during a precast concrete plant tour will stay with the students for a lifetime. If they end up working in a bridge or structural engineering firm and a suitable project comes along, they might even consider proposing precast concrete for it. Furthermore, precast concrete yard personnel typically enjoy hosting students and faculty.

ISU is fortunate that several PCI and NPCA plants around the region have

Students pose during a plant tour, which is a key component of the Precast Concrete Engineering Studio at Idaho State University. The knowledge gained during a precast concrete plant tour will stay with the students for a lifetime. All Photos: Mustafa Mashal.

Students prepare concrete specimens for testing in the Idaho State University engineering materials laboratory.

always opened their doors for visits. Tours of precast concrete yards also build partnerships and collaboration between industry and academia on research, student competitions, and even internships.

Guest Speakers

To successfully prepare students for careers in precast concrete and bridge engineering, it is of utmost importance that the instructor teaching the class collaborate closely with industry champions. One effective way to help students learn about the state of the art for precast concrete is to invite speakers from the industry. Students always enjoy learning from industry experts about the practical aspects of what they are being taught in class and what they can expect as an engineer after graduating. Guest presentations also provide a chance for speakers to get to know students and consider them for future job opportunities in their firms.

Laboratory Work

Hands-on lab activities should be an integral part of teaching precast concrete. In most universities, it is a common practice to reserve structural laboratories primarily for research activities. However, all laboratories should be leveraged to teach precast concrete. Students will not only learn how to develop concrete mixtures and make precast concrete specimens; they will also learn how structural testing should be carried out in accordance with standards used in the precast concrete industry. Observations from testing and processing test data will remain with students far longer than the content of a purely theoretical lecture in the classroom.

Student Competitions

Participation in PCI, NPCA, ASBI, and other precast concrete and bridge-related competitions gives students opportunities to develop communication and hands-on skills, experience teamwork, practice technical writing, and network with industry leaders. For instance, there are some wonderful opportunities for students to take part in the PCI Convention and The Precast Show. In addition to the aforementioned benefits to the students, a competition can be a great venue for students to connect with future employers and peers from other institutions.

Full-scale testing of a precast concrete pipe.

Conclusion

Precast concrete should be considered part of the core curriculum in civil engineering, especially for students who are interested in pursuing a career in bridge engineering. In addition to theoretical design lectures, innovative and hands-on activities are an important component of an effective precast concrete curriculum. Partnerships and collaboration with the precast concrete industry are essential for the success of the curriculum. A course such as ISU's Precast Concrete Engineering Studio can prepare students for rewarding careers in the precast concrete and bridge industries. Given the success of the studio, ISU faculty are planning to make it a permanent class in the civil engineering curriculum.

Students from Idaho State University's Precast Concrete Engineering Studio with their professor during a poster session at the 2020 PCI Convention at The Precast Show.