

Molin Concrete builds precast concrete teaching structure at UMD

One of the main objectives of a PCI Foundation grant is to encourage precast concrete manufacturers to partner with schools of architecture, engineering, and construction management to find unique ways to bring precast concrete education to students. The goal is to prepare students to apply their classroom knowledge to challenges they will encounter in the working world.

Working together, Molin Concrete Products of Lino Lakes, Minn., and the University of Minnesota Duluth (UMD) designed a teaching structure that helps engineering students understand more than precast concrete design concepts. The precast concrete demonstration structure allows students to



Molin Concrete Products of Lino Lakes, Minn., and the University of Minnesota Duluth designed this precast concrete demonstration structure as a teaching tool, shown from the back, which allows students to observe, touch, and visualize concepts in real time. Courtesy of Ben Dymond.



The front view of the completed precast concrete demonstration structure in the University of Minnesota Duluth (UMD) teaching high bay laboratory shows the UMD Bulldog logo, which was cast face down in the form with a gold-colored architectural concrete mixture, and thin brick. Courtesy of Ben Dymond.

observe, touch, and visualize concepts in real time. Molin designed, produced, and erected a scaled building that is about 12 ft (3.7 m) tall. It was installed in February 2018 as part of the Resilient Precast in the Engineering Curriculum (RPEC) program that is being established in UMD's Civil Engineering Department, along with collaborators in the Mechanical and Industrial Engineering Department and the MBA program.

The RPEC program is supported by the PCI Foundation, Molin Concrete Products, PCI Midwest, and the Minnesota Prestress Association, which represents 18 PCI-certified producer members in the upper Midwest.

"We primarily use the demonstration structure during class to discuss how precast structures are assembled and contrast the differences with cast-in-place structures. The diversity of the structure is the key," says Ben Dymond, assistant professor at UMD. "Students are exposed to precast architectural features, precast structural features, connections, construction methods, and plan reading as it relates to the building. We also have the architectural panel of the structure, with the UMD Bulldog logo, facing through a glass wall that exposes it to university tour groups and incoming students."



Ben Dymond, assistant professor at the University of Minnesota Duluth, points out features of the precast concrete demonstration structure to a group of students enrolled in a Prestressed Concrete Structures class. Courtesy of Ben Dymond.

The demonstration structure was erected inside of the UMD Swenson Civil Engineering Building in the instructional high bay laboratory. “Students have reacted very well to the structure,” Dymond says. “They love being able to visualize concepts in the classroom and then transfer them to real life, all within 100 ft [30 m] of each other. I think the structure is invaluable. It helps us reach students who learn visually and puts the icing on the cake for students who want to connect all the dots. After having this teaching tool available, it would be hard to go back to life without it.”

Installation on campus was also a great teaching tool, says John Saccoman of Molin Concrete Products Co. in Lino Lakes, Minn. “During installation, many students stopped dead in their tracks to watch this structure being assembled inside the lab and asked numerous questions. All of our business and engineering groups are excited to start educating undergrads and grad students utilizing precast/prestressed concrete by assisting in classrooms, giving production plant tours and field tours, and being involved with the PCI Big Beam Competition.”

The demonstration structure was erected using a forklift in lieu of a crane due to the laboratory’s interior constraints. After laying a 7 × 8 ft [2.1 × 2.4 m] “foundation” panel, the front architectural panel was erected and oriented to face outward into the building’s entrance. A UMD logo was cast face down in the form with a gold colored architectural concrete mixture, and thin brick was also used to create the panel. The negative pattern of the copyright logo artwork was cut out of foam, which now resides by the structure for students to visualize the fabrication method.

Although students are unlikely to design a structure of this size, it allows them to see a range of precast concrete products and understand how they come together. Several

connections and unique features were implemented in the building, and a large majority of the connections and features were left exposed for use as a teaching tool. The demonstration structure includes the following:

- thin-brick architectural wall panel with logo and exposed sandwich panel connector
- plain gray shear wall panel with exposed reinforcement, a window blockout, and an embedded electrical box
- shop drawings attached to the shear wall panel
- square column with a corbel
- a first-floor ledger beam and a roof rectangular beam
- hollow-core slab first floor (with opening) and cantilevered roof with partially filled cores
- safety warning lines on the roof

RPEC is a multidisciplinary educational program that combines the traditional approach to concrete engineering education with cutting-edge knowledge related to resiliency and business management.

Traditionally, engineers learn the basics of concrete design while possibly discussing precast concrete, but they fail to investigate why to choose precast concrete or how resilient precast concrete fits into an organizational dynamic. The RPEC program addresses those questions and others while challenging students to push the envelope of resiliency in precast concrete. The program includes content in four courses: Design of Reinforced Concrete Structures, Prestressed Concrete Structures, Fundamentals of Organizational Management, and a Senior Design Capstone.

Once a student completes the curriculum, the student’s transcript will display an official UMD certificate noting his or her special interest in resiliency and precast concrete design.

—Benjamin Z. Dymond, John Saccoman, and Marty McIntyre