The Positive Impact of University Research on Workforce Development

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At the 2024 Precast/Prestressed Concrete Institute (PCI) Convention in Denver, Colo., Dr. Eric Matsumoto gave a presentation to the PCI Committee on Bridges highlighting the phenomenal success of the PCI Foundation's Precast Bridge Studio, which he developed at Sacramento State University in collaboration with the California precast concrete bridge industry and industry partners such as state transportation agencies. In Dr. Matsumoto's program, undergraduate students are taught prestressed concrete design, and they have the opportunity to participate in the layout, selection, scheduling, and design of precast, prestressed concrete bridges through their Senior Design Capstone projects. Dr. Matsumoto's data and testimonials demonstrate that students have flocked to the program, welcoming the opportunity for hands-on experiences with industry mentors (consultants, precasters, and contractors) and real-world applications. By all meaningful measures, the program he developed has been wildly successful. His presentation also showed how the program can serve as an outreach model for PCI and other potential industry partners seeking to connect with engineering and related technology students and address the immediate need for workforce recruitment and development. (For a comprehensive description of the PCI Foundation–sponsored Precast Bridge Studio at California State University, Sacramento, see the Spring 2023 issue of *ASPIRE*®.)

Those of us who work in academia fully understand how much time and effort Dr. Matsumoto has invested to put this program together and to sustain it over several years. The Precast Bridge Studio is a true showpiece. I personally want to recognize the incredible effort that Dr. Matsumoto invested in the Precast Bridge Studio and express my admiration for him.

As our discussion in the PCI Committee on Bridges meeting evolved, there was an implicit lingering question as to whether other universities should implement similar programs. I believe more universities will be willing to participate in similar programs with collaboration from the PCI Foundation and other industry partners, and that Dr. Matsumoto's efforts can serve as an example for others.

During the discussion, it also occurred to me that many of my friends and colleagues in the prestressed concrete industry—especially those serving on technical committees and making significant contributions to the industry through their research, designs, and personal creativity and ingenuity—were initially attracted to the field of prestressed concrete while working at a university research laboratory, often as a graduate assistant working directly with a professor. One of my purposes in writing this article is to point out that college professor "types" and their research students have helped drive the growth of the prestressed concrete industry. Professors and students working toward a research goal advance not only knowledge and science but also the development of a primed workforce for the prestressed concrete industry. So, how do these students become a part of PCI and other segments of the prestressed concrete industry?

"Research students have helped drive the growth of the prestressed concrete industry."

My own involvement with PCI and the industry began after several years of industrial work experience, mostly in the heavy construction industry, when I found myself at the University of Texas at Austin. There, under the direction of my PhD advisor—my mentor and friend, Dr. Ned Burns—my research was focused on prestressed concrete. Specifically, my research topic was the use of debonded strands in precast concrete bridges. It was Dr. Burns who took me to my first PCI Committee Days meeting in Chicago, where I presented my research on strand bond to the Bridge Committee in the spring of 1990. The Bridge Committee met in a cramped converted hotel room, where no more than 20 people gathered around a single conference table—the space was crowded, but full of energy! I remember vividly a fascinating presentation about the Shelby Creek Bridge in Kentucky. That exciting project still provides a road map for creative engineering, demonstrating firsthand the amazing possibilities of building with prestressed concrete. Given my professional experience and my PhD research topic, my decision to join PCI as a student member in 1990 was a "no-brainer." I have been an active member since that first meeting.

As a new faculty member in 1992, my first research student was the recipient of a PCI-sponsored Daniel P. Jenny Research Fellowship in 1994. We performed strand bond testing that included the "big block" test—a modified "strand-bond pull-out test"—and friction tests on prestressing strand. His work was published in the *PCI Journal*, and I am proud that he has worked in the precast concrete industry for 30 years.

Two other research students of mine were recipients of PCI-sponsored fellowships. One student made concrete cylinders that were loaded at one day of age and, based in part on that research, the concrete compressive stress limit immediately after transfer of prestress

was increased from 60% to 70% of f'_c in ACI 318-08.[1] Another student worked on strand bond and helped develop the standard test for strand bond that was later adopted as ASTM A1081.[2]

I have worked with other PhD students who have continued to contribute to the precast concrete industry as professors. One is currently an associate professor at Mississippi State University. His PhD work developed high-performance concrete (HPC) with locally sourced aggregates. That work became the basis for material selection and mixture proportions for HPC in precast, pretensioned concrete bridge beams. Another former student's work focused on the need for air entrainment in HPC. He also studied prestress losses and is currently head of civil engineering at the University of Arkansas.

Among the more than 40 graduate students whom I have advised, 7 are currently teaching, or have taught, at various engineering colleges from Ohio to California, and more than half of the students have been directly involved with the precast, prestressed concrete bridge industry at some point in their careers.

So, my message to *ASPIRE* readers is that the research performed in the prestressed concrete field, whether supported by PCI or others within the precast, prestressed concrete industry, is important not only for the research itself, but for developing the workforce for the industry. I hope that I have illustrated that research funding and partnerships with universities can multiply the impact of a single research project.

In closing, I relate the following anecdote. At PCI Committee Days in 1994, I was asked how to get more professors involved in PCI. The importance of the question was not lost on me then, nor should its importance to the industry be underestimated. My answer was straightforward and to the point: provide more research funding opportunities, and the professors will come like horses to water. I believe that PCI has done that, and the continuous, committed stream of funding for university research has helped grow our industry as much as it helps develop the industry's workforce.

In this context, it is clear that the Precast Bridge Studio developed by Dr. Matsumoto should be replicated wherever possible. Dr. Matsumoto, the PCI Foundation, and the California Precast Association have provided an example to the industry of a program that is effective in attracting students. At the same time, PCI's continual efforts to support university research through research grants, and specifically through the growth of the Daniel P. Jenny Fellowship program, have also effectively advanced workforce development.

To understand the magnitude of this success, compare the 2024 Committee on Bridges to that of 1990. In 2024, bridge-related committee meetings were held in a ballroom at the Denver Convention Center for three full days, and attendance at some of the meetings surpassed 200. When I compare those meetings with my first Committee on Bridges meeting, I have to say that the industry has succeeded through the years in attracting capable, talented, creative, and committed individuals.

References

1. American Concrete Institute (ACI) Committee 318. 2007. *Building Code Requirements for Structural Concrete* (ACI 318-08) *and Commentary* (ACI 318R-08). Farmington Hills, MI: ACI.
2. ASTM International. 2021. *Standard Test Method for Evaluating Bond of Seven-Wire Steel Prestressing Strand*. ASTM A1081/A1081M-21. West Conshohocken, PA: ASTM International.

EDITOR'S NOTE

In addition to studio support from the PCI Foundation, universities can apply for research fellowships to fund precast concrete research. Since 1971, PCI has awarded over 150 fellowships. These fellowships have advanced the precast concrete industry through financial support of graduate engineering students and research while also engaging faculty in the precast concrete industry, introducing students to the benefits of precast concrete, and connecting students, faculty, and PCI members for future networking opportunities. For more information, visit pci.org/Fellowships.