



Developing the Next Generation of Structural Engineers

Part 3: Reform in Education and Training

By Glenn R. Bell, P.E., S.E., SECB

Note: This is the third article of a four-part series on the opportunities and challenges we face in developing the next generation of structural engineers. It is based on the author's keynote address at the SEI Structures Congress in March 2012. The last article addressed the attributes required of future engineering generations. This article addresses educational and industry reform needed to develop those attributes. (See STRUCTURE magazines September and October 2012 issues for Parts 1 and 2, respectively.)

Development of Future Structural Engineers

The premise that university education beyond a four-year degree is required of structural engineers should be so obvious by now that it is practically self-evident. Every other learned profession from medicine to occupational therapy accepted this long ago.

Undergraduate

In the future, the undergraduate degree will be a pre-professional credential, teaching a broader body of knowledge with less urgency for technical specialization. The bachelor of science degree should assure a solid grounding in the foundational requirements for math and sciences, particularly chemistry and physics. A broad curriculum of engineering fundamentals should be stressed to provide the engineer with analytical and technical problem-solving methods that will be needed throughout his or her career. We should also expand our focus on the humanities and social sciences. This will lay the foundation for soft skills such as general problem-solving, leadership, entrepreneurship, innovation and communication. We are learning that soft skills are best taught when experiential learning leverages classroom techniques.

Graduate

Similar to other professions like medicine and law, the graduate engineering degree should be considered the accredited professional degree. This should not only be where technical depth is delivered, but also include continued content on professional practice. I believe that 30 credit hours of graduate education are not enough. We need twice this.

Engineer Internship

Looking beyond formal university education, we have much opportunity in raising our expectations from the Engineer Intern experience. Here we could model some of the better practices of medical residency, such that engineers-in-training would

be exposed to a sufficiently broad set of experiences through a sort of rotation that is coupled with continuing formal education. Similarly, the American Institute of Architects (AIA) defines a comprehensive internship professional development program known as IPD. Engineer Interns would more directly "shadow" their Professional Engineer mentors, rather than merely acting as their assistants. Mentoring during apprenticeship is a critical means for gaining competency in skills like leadership and project management.

Continuous Learning

What about education and professional development that is ongoing in the decades of an engineer's career after licensure? To understand the magnitude of the challenge this represents, consider that the period of time from the onset of an engineer's education in undergraduate school to retirement is around 50 years. That part of those 50 years which ends at attainment of licensure is ten years or less. What about the other 40 years? To bring more structure to the notion of life-long learning, we need to develop bodies of knowledge for continuing education after registration. However, much of the current effort given to developing a body of knowledge ends at the attainment of licensure. There is little for company leaders to draw upon for post-licensure professional development. In my own firm, we invest significant amounts each year in developing and delivering custom-made professional development for our staff and managers. I know many firms in our industry do the same. This is wasteful and ineffective. We need to define our expectations for this critical period of professional development and share resources.

The Relationship between Practice, Education, and Research

For structural engineers to meet future challenges, we must radically redefine the relationship between practice, education, and research. The practice, education, and research should be so integrated

as to be incestuous. A highly productive, creative, value-producing structural engineering profession of the future will engage in a continuous chain where research leads to innovation, leading then to teaching and learning, then feeding back to more research, innovation, and teaching.

We need to strengthen the connection between academia and practice through a greater number of practitioners teaching in universities and exposing more professors to practice. Again, we can borrow from the medical profession in this regard.

Inertia and Resistance

We should not underestimate the challenges in driving change of this magnitude. To many, these changes will be frightening and threatening. We can expect inertia and resistance from many sources. Disappointingly, we see pushback by some to the seemingly obvious need to require graduate education as a prerequisite to licensure. My friends in academic leadership positions tell me it will be very difficult to change the university paradigm that so often values research at the expense of teaching. And how do we encourage employer firm leaders to invest in the long-term view of an employee's professional development in a competitive economy that values short-term returns, and in which multiple job changes have become the norm?

Raising the Bar

Development of the next generation of structural engineers is part of a larger vision to raise the stature and practice of structural engineering in general. We need fundamentally to restructure our roles and our position in society to open up the kinds of opportunities for structural engineers to contribute in a more meaningful and impactful way. The advancement of our practice and the advancement of our professionals must go hand-in-hand. The American Society of Civil Engineers (ASCE) has coined this its *Raise the Bar Initiative*.

The next and final article will review some of the ongoing efforts by ASCE, SEI, and others to move our profession forward, and will close with a call for action by all in the structural engineering community. ■

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