



Training the Structural Engineer

Part 1

By Stan R. Caldwell, P.E., SECB

Structural engineering education today is a real mess! The problem starts with the young students who are traditionally attracted to our profession. Almost without exception, they like math and science much more than other subjects. Many, if not most, are more comfortable interacting with other people through their computers and mobile devices than doing so in person. This left-brained, somewhat introverted group is the raw material that feeds the pipeline year after year. Thus, the stereotype begins early.

Most structural engineering students initially pursue a BSCE degree. Unfortunately, the requirements to earn it have dropped precipitously, from nearly 150 hours in 1960 to an average of about 125 hours today. Over this period, civil engineering has grown into a very broad field with many areas of specialization and complexity. Academic departments understandably strive to expose their undergraduates to all areas of civil engineering. The result is a curriculum that now amounts to little more than an introduction to the field. It does not provide much breadth of knowledge beyond civil engineering. Even worse, it utterly fails to provide anything close to the depth of knowledge necessary to start a career in a specialty such as structural engineering.

As an example, just a few years ago a summer intern arrived at my firm in May, having just received a BSCE from a leading civil engineering program. His area of emphasis was structural engineering; he had earned a 4.00 GPA; and, he planned to return to school in August and pursue a master's degree. I initially gave him a very simple concrete design project. Two weeks later, after observing no progress, I sat down with him to discuss the apparent problem. It turned out that his formal education in concrete amounted to just six weeks of study abroad in Spain. He knew that "concreto" was gray and hardened with time, but little else.

As a second example, I recently served on the visiting committee for an ABET-accredited civil engineering program. To my amazement, I discovered that it offered its undergraduates no concrete design courses whatsoever, and only one steel design course, which was optional.

For many years, structural engineering students have been urged to pursue a graduate degree. The master's degree has been the "sweet spot" for entering the structural engineering profession for at least the past two decades. It typically requires 30 to 36 hours, and the majority of those are spent in a single specialty. Consequently, a structurally-focused master's degree typically provides the depth of knowledge needed to start a career in structural engineering. However, it provides little or no additional breadth of knowledge beyond that which was acquired as an undergraduate. This is truly unfortunate. Without a breadth of knowledge, and a bit of right-brained thinking, young structural engineers are unlikely to emerge as future leaders.

Most structural engineers spend their time designing beams, columns, frames, trusses, connections, and the like. They do not lead their project teams, their firms, their profession, or society. Preferring to avoid risk, and constantly reminded that failure is not an option, they seldom innovate. Instead, they believe that good design work "to the code" is their highest calling, and they derive considerable satisfaction when their designs become reality. Sadly, in twenty years or so, the majority of these engineers will likely be just as obsolete as telephone operators, bank tellers, and travel agents are today. Most of their work will have been replaced by automation, and much of the remainder will have been sent overseas to be done at lower cost. Without substantial change, it is likely that the profession of structural engineering will shrink dramatically.

An SEI task committee recently completed a two-year study on the future of our profession. Their ground-breaking report, *A Vision for the Future of Structural Engineering and Structural Engineers: A Case for Change*, is available as a free download at www.asce.org/SEI. The committee concluded that there are two keys to success: Future structural engineers must become *leaders* and *innovators*. It is my view that most structural engineers today are neither.

Bridging the gap will take time, and the process must start with education. A much more diverse group of young students must be

attracted to the profession. By that, I specifically mean diversity of thought, of personality, and of interests. Also, the antiquated notion of professional education at the undergraduate level must finally be abandoned. How can this possibly be achieved?

One radical plan, which I have grown to support in concept, is sometimes referred to as "The Law School Model". Under this plan, students will be encouraged to seek an undergraduate degree in any field that interests them. Beyond good grades, the only prerequisites will be math, physics, and chemistry. A degree in biology, political science, or psychology will be viewed just as highly as a degree in engineering. A year (not six weeks) of study abroad will be viewed as a plus.

After graduation, those students pursuing careers in structural engineering will take entrance exams for their preferred structural engineering schools. Those schools will be similar to law schools in many respects. After two or three years of focused structural engineering study, starting with statics and ending with the latest cutting-edge technology, graduates will receive professional structural engineering degrees. If this plan works as intended, those graduates will be a diverse group of well-rounded individuals with the skills and attitudes necessary to lead and innovate in a very different world. ■

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The focus of this two-part article is on training the future structural engineer prior to licensure. Part 1 addresses training in the classroom and laboratory. Part 2, which will appear in a future issue, addresses training in and around the workplace.

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