



Developing the Next Generation of Structural Engineers

Part 2: Structural Engineer Opportunities and Attributes

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This is the second article of a four-part series on the opportunities and challenges we face in developing the next generation of structural engineers, based on the author's keynote address at the SEI Structures Congress in March 2012.

Structural Engineering Opportunities

What does our view of the future world mean for future generations of structural engineers? I see opportunities on three levels:

- 1) The creation of all of constructed works needed to meet these global challenges – affordable housing, public transportation, renewable energy, and water distribution and treatment systems – all involve, on some level, structural engineering. With the possible exception of construction management, structural engineering is the most broadly applicable of the civil disciplines.
- 2) American engineers are well-positioned to take global roles by doing the higher-value, more creative work. We are good at thinking outside the box. America's national culture facilitates leadership, innovation, and entrepreneurship. A key strategy, then, is positioning our industry and its future professionals to exploit these qualities.
- 3) Finally, to tackle society's grand challenges, we need more engineers in leadership roles that are non-traditional: setting policy, leading major societal initiatives, and even politics. The US Congress would work better if it were populated with more engineers and fewer lawyers.

Attributes of the Structural Engineer of the Future

If we could fast-forward forty years, the new breed of structural engineer would be unrecognizable to us today.

No. 1: Global Practitioner

The successful global practitioner will work with varying technical standards, indigenous materials and construction techniques. Here,

strong technical fundamentals and knowledge of performance-based design will be critical. Just as important, however, is the ability to embrace different cultures, values, languages, and business practices. Tomorrow's engineer must be globally aware and adept.

No. 2: Collaborative Leader

Tomorrow's engineers must be able to see their role in its societal context. This entails being able to define society's important problems, not just solve them – to champion major initiatives and help to craft public policy, not just implement it.

Projects are becoming increasingly complex. Technical knowledge is exploding. We need to engage stakeholders of many backgrounds. This all demands that the new breed of structural engineer be able to lead collaborative teams. To be a collaborative leader, tomorrow's engineer must be dynamic, agile, and flexible. Most importantly, great collaborative leaders have to be great communicators – orally and in writing.

No. 3: Creator/Innovator

To meet the imperative for resource-responsible construction, tomorrow's structural engineer will invent new construction materials and systems, as well as innovate new processes and approaches to problems. We need to be creative and entrepreneurial. We all will need a bit of John Roebling or Gustav Eiffel in us.

No. 4: Integrator

In engineering problem-solving, we are taught to break problems down into smaller and smaller pieces. Tomorrow's engineer must be able to engage in lateral, functional thinking as well as vertical, in-depth thinking; to synthesize as well as analyze; to integrate knowledge from a variety of sources; to integrate complex systems. To do this, we must be able to span disciplinary boundaries.

No. 5: Master of Uncertainty

The new breed of structural engineer must be able to embrace problems of uncertainty, help others understand it and make good decisions in the face of it. Balancing risk and reward among

project team members is an important strategy for providing value through innovation. We need to accept ambiguity as a new permanent condition.

No. 6: Expert of Technical Fundamentals

While many things about the engineer of the future look different, we must not only retain but strengthen our solid expertise in technical fundamentals. Blind reliance on computers can erode our ability to make reasoned judgments that involve common sense and intuition.

Needed Change

How do we develop all the competencies of this extraordinary future engineer/leader? We first must take as a given that, tomorrow more than ever, a career in engineering requires a commitment to life-long learning. Comprehensive gain of knowledge and skills will be an intensive, ongoing effort until the engineer retires. Given this, the single biggest need in advancing the development of the next generation of engineers is to sort out what we expect from each of the phases in the career-long spectrum of a professional's development; from formal university training to pre-licensure apprenticeship to post-licensure professional development.

Presently we have redundancies, gaps, inefficiencies; missed opportunities in our system. We expect too much from the undergraduate curricula and, as a consequence, it is getting watered down. Firm leaders send mixed messages to academic leaders about our needs and expectations of their graduates. On the one hand, we espouse the virtues of a solid grounding in technical fundamentals and soft skills; on the other, we send recruiters to university job fairs and seek out practice-ready professionals with knowledge of the latest versions of codes and analysis software.

As a general strategy, the earliest material addressed in an engineer's development should be that which is most fundamental and most likely to be invariant over the course of a career. The changing stuff should be left for later, most particularly on-the-job experience and continued learning. ■

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In the next article, we will consider the industry actions required to bring about the needed changes.

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