



## Challenges Facing Young Structural Engineers

Why Are They Important and What Needs To Be Done?

By Jessica Mandrick, P.E., LEED AP and Jason McCormick, Ph.D., with the SEI Young Professionals Committee

As current leaders in structural engineering approach the end of their careers, it is increasingly important that young professionals take active measures to step into leadership roles. Leadership transition plays a vital role in the profession, but always brings with it challenges that differ from those of past generations. This article highlights select challenges identified by the ASCE Structural Engineering Institute's Young Professional's Committee.

### Challenges Facing Young Professionals in Practice

*Structural Engineering is a High Responsibility Profession*

Of paramount concern to structural engineers is the safety of the public. Many recent graduates feel nervous at their first jobs because of the high level of responsibility. Mistakes in practice can have high costs; meanwhile, clients expect quick responses. Each engineering firm should set standards on the internal technical review of projects. Also companies must strike a balance between the level of detail of work, including internal reviews, and the budget restrictions of a project. Training and mentorship are needed at all levels to encourage young professionals to develop quality work, gain confidence, and eventually step into management roles themselves.

Codes and standards set minimum safeguards for the profession. However, as codes grow more complex, they become increasingly susceptible to misinterpretation and misapplication. This is evident in the range of solutions that SEI receives for its trial design problems each year. Young practitioners need to develop familiarity with dense volumes of codes without the advantage of having utilized the codes in their simpler earlier forms. Even though the ultimate responsibility for design falls on the practitioner, external reviews are helpful to verify that standards are properly followed. The extent of external review currently required varies regionally. As a comparison of the two largest cities in the country, Los Angeles requires that engineers submit drawings

and calculations to a building department and conducts a review of both items; New York City requires submission of drawings, but does not require calculations or peer review except for critical projects. Young practitioners in many jurisdictions have never received feedback from outside their offices. Although the susceptibility of the West Coast to earthquakes prompts its strict enforcement of structural codes, densely populated areas could also benefit from more thorough reviews.

#### Action Items:

- *Develop a consistent standard of care within the industry.* This may involve increasing the rigor of external project review by local building departments, publishing guidelines on how to internally review projects, and increasing the understandability of codes and standards.
- *Train young professionals how to lead.* As a profession in which those who excel technically often ascend into management, firms should provide instruction on business and supervisory responsibilities through training sessions, recommended reading, or mentorship by firm leaders. Young professionals must similarly take leadership roles within project teams, guiding clients and architects towards cost saving and creative solutions.
- *Involve young professionals in professional committees.* Codes and standards committees should actively seek out the involvement of young professionals. Young professionals would learn the origins of code provisions, meet critical industry leaders, and prepare themselves to lead future committees.
- *Licensure of structural engineers.* In the interest of public safety, encourage states to license structural engineers as a distinct discipline with certain qualifications beyond those required for professional engineering licensure.

#### *Structural Engineering is Not Set Up to Accept Late Entrants*

A structural engineering education typically includes a required four year baccalaureate

with the strongly suggested addition of a master's degree. Admissions requirements for master's programs are largely based on coursework such as structural analysis, reinforced concrete, and steel design. Applicants with undergraduate degrees in related fields (physics, mathematics, computer science, etc.) are often required to take these classes with no credit towards their master's degree, increasing their time commitment and debt. Similar professional degrees, including medical, legal, business, and architecture, offer more flexibility as they are accredited at the masters level and can be entered through a variety of undergraduate fields.

Furthermore, those without undergraduate degrees in engineering, who later achieve a master's degree in structural engineering, continue to face adversity professionally. Many state licensing boards base experience requirements on an ABET accredited bachelor of engineering degree. This basis is likely due to the dearth of ABET accredited master of civil engineering degrees. Although the penalty varies by state, those without the equivalent bachelor's degree may require eight years of experience prior to licensure rather than the typical four years. This additional experience requirement further sets late entrants in structural engineering behind their peers. Engineers who were educated abroad face similar extended experience requirements. As younger generations seek non-traditional career paths, more flexibility in education and at the workplace is required to attract talent to structural engineering.

#### Action Items:

- *Restructuring of engineering education.* ASCE and the National Academy of Engineering are both exploring making the master's degree in structural engineering a professional degree. Additionally, internship or co-op programs can expose students to the profession.
- *Post-Baccalaureate programs for structural engineering.* Post-baccalaureate programs could provide the additional coursework necessary to confer a general engineering bachelor's

degree. Such programs are commonly used for pre-medicine studies, serving as a conduit both for those who take a late interest, and for educationally disadvantaged students (including underrepresented minorities) who enter college with insufficient math and science backgrounds to begin a science or engineering degree. Prospective hosts for such a program could be the universities that provide the latter portion of a 3-2 program. In 3-2 programs, students take three years of fundamental math and science at a liberal arts college and then two years of study in an engineering discipline at a research university. A similarly structured one to two year “post-bac” approach could be utilized for late entrants.

- *Pursuit of online master’s degrees for reentry into the profession.* Graduates of civil engineering bachelor’s programs, who chose to pursue careers in other professions, could enroll in part-time online master’s programs to refresh and advance their engineering skills. Care must be taken that online degree programs are developed to incorporate all of the requirements, accreditation or otherwise, to meet the needs of the profession.
- *Reevaluate experience requirements for professional engineering licensure.* State licensing boards should set similar experience requirements for graduates of structural engineering master’s programs as for their colleagues who possess undergraduate engineering degrees. This could be rectified through the accreditation of master’s programs or the acceptance of master’s degrees from schools with accredited undergraduate engineering programs. The accreditation of more colleges abroad, or reciprocity between foreign accreditation bodies and ABET, should also be pursued.

## Challenges Facing Young Professionals in Academia

### Lack of Sources of Research Funding

As more universities express interest in growing into top tier research institutions, there is increased demand for research resources that are not growing at the same pace. The National Science Foundation and Department of Defense provide funding for research in the area of structural engineering.

However, funding from these agencies for structural engineering related projects tends to lag behind other more prominent fields. The goals of these projects are not necessarily focused on the direct current needs of the structural engineering profession, but on transformative topics that can have high impact in the future. Also, the increasing number of overall faculty seeking out funding from these agencies, which have seen only a limited increase in available funds, has made it difficult for both young and established faculty to obtain funding.

Funding is also available from other agencies such as the Federal Highway Administration, State Departments of Transportation, American Institute of Steel Construction, and American Concrete Institute. These agencies fill a critical need and are a great resource for researchers, but they typically focus on a particular need relative to their mission. Available funds are often smaller than those from federal agencies. The need to obtain supplemental funds requires contacts that young faculty may not have and takes time away from other areas, such as publishing, necessary for tenure.

One of the main problems within the structural engineering field is the lack of other sources for significant funding. In 2011, 5,400 civil engineering graduate students at doctorate-granting institutions were supported through institutional funds and 2,301 through Federal grant money. Meanwhile, only 1,078 students were funded through non-federal domestic or foreign support. As a result, the total amount of money for structural engineering research is limited and the lack of industry involvement limits the ability for research to have an immediate impact.

### Action Items:

- *Concerted effort from industry to fund research.* Young professionals would benefit from more engagement of industry in structural engineering research. Funding is critical, but even in-kind professional support and donation of materials or services can result in significant future partnerships that can be beneficial to both parties.
- *Increased effort from industry to adopt new technology and methods.* Faster adoption of new technologies and methods coming out of research will increase the impact of research and the public perception of the need for research in structural engineering. By increasing the impact of current research, it will provide incentive for increased funding from government and private agencies.

## Challenges Facing All Young Professionals

### Fostering Collaboration between Practitioners and Academics

There is a need for better collaboration between structural engineering professionals in practice and those in academia, as is often done in Europe and Japan. Collaboration between practitioners and academics can lead to quicker adoption of new technology and methods developed through research, as well as research motivated by the immediate needs of the structural engineering profession. These opportunities could take the form of industry funding as outlined above or more simply, the creation of conduits for the exchange of information. However, young structural engineering professionals in practice and academics often find it difficult to make these types of connections due to a focus on establishing their career, limited interaction with those on the other side, and lack of knowledge of where to look or who to talk to about developing such collaborations.

Part of what inhibits collaboration is a lack of knowledge of the research being conducted and how it might benefit those in practice. While universities often subscribe to a variety of academic journals, structural engineering firms often do not. As students, academic publications provide a resource to help solve problems; however, these resources are not widely available to young professionals after graduation. Although articles are available online for a fee, it is difficult to know from the abstract whether the content will be useful to a practicing engineer, leading to potentially costly searches. Collaboration is one way to keep both parties informed of the state-of-the-art and the needs within structural engineering, setting a precedent for young professionals to follow.

### Action Items:

- *Provide a forum for those in academics and practice who have interest in*

collaborate  
experience  
develop  
attend  
learn  
share  
meet  
join



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*collaboration.* A location that provides information on the interests of those willing to collaborate across the academic-industry boundary is necessary, particularly for young professionals. The forum would provide a means of introduction to people across the profession.

- *Broader availability of academic journals to the engineering community at large.* Many journals can be obtained for free from local libraries through inter-library loan programs, but these often take time that may not be available. Journal publishers should want their publications to be available to the engineering community and should develop platforms for practitioners to explore journals without prohibitive costs. Papers could also be published in more colloquial forms highlighting the potential for future incorporation by industry. A model of converting research into practice is seen in the Applied Technology Council (ATC).
- *Professional interaction between academics and practitioners.* Practitioners should be willing to seek out Academics when situations arise where their background and research capabilities will be helpful. Likewise, Academics should make a more concerted effort to reach out to practitioners to determine the research needs of the structural engineering profession. This research could be similar to wind tunnel studies conducted at universities or include the testing of engineering materials, assemblies, dampers, vibration studies, etc.
- *Better communication of current practice and the structural engineering industries' needs.* Practitioners should openly share technical presentations

and blog posts online to increase knowledge within the structural engineering community.

### *Lack of Public Awareness/ Acknowledgment of the Structural Engineering Profession*

In order to attract the best and the brightest young professionals to the structural engineering profession, whether it is in practice or academia, a stronger effort is needed to make the public aware of the importance of the profession. Far too often, structural engineering makes headlines only when something catastrophic occurs, and far too little recognition is given to some of the greatest accomplishments of structural engineers in the public domain. Often the work of structural engineers is taken for granted or hidden behind an extravagant architect. A more concerted effort is needed to promote the extraordinary things that structural engineers accomplish on a daily basis. Bringing the structural engineering profession to the forefront of society in a positive light will help to attract the next generation of structural engineers, who will lead the profession in the future.

The United States lacks political leaders in Congress with engineering backgrounds. There is a need for increased advocacy on national issues such as aging infrastructure and the work that structural engineers are doing to draw attention to and solve these problems. Young structural engineering professionals will be driving this profession forward and need to be mindful of the need for better public awareness.

### **Action Items:**

- *Take advantage of political interest at the undergraduate level.* Extend ASCE's annual Legislative Fly-In and government outreach programs to members of ASCE student chapters. Starting political interest early will help motivate engineers to shed light on the needs of society and show the structural engineering profession as the solvers of these problems, not the creators.
- *Increase public understanding of the importance of structural systems.* Make the ASCE Infrastructure Report Card more personal by including letter grades for particular sites that people use on a daily basis. Assign letter grades to Philadelphia's rail network, New York City's subway lines, California's bridges. People may respond more to the report card if a structure in their own locality receives a poor grade. We also need to

highlight what structural engineers are doing to rectify the problem.

- *Further outreach to the public.* Although magazines like STRUCTURE® are great for disseminating information within the profession, articles need to be more accessible to the public to increase awareness of structural engineering. Structural engineers need to take up roles as public servants/public informers and communicate to the public on a level that will affect them.
- *Open up Structure's Congress or high profile projects to the public.* Create a day at the Structure's Congress with presentations geared towards the general public, with reduced registration fees, to serve as a conduit for interested members of society, government, and high schools to learn about structural engineering. For example, the American Astronomical Society had two public days for the first time at their conference in 2013.
- *Promote structural art.* Incorporate coursework in aesthetics in engineering education so engineers become greater contributors to design.

## Conclusions

If we are to meet the ASCE Vision 2025 goal that civil engineers will be master builders, stewards of the environment, innovators, managers of risk, and leaders in the community, we will need young engineers on board, tackling these issues. ■

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A more extensive report will be published by the SEI Young Professional's Committee in the future.

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- SELCE the “Structural Engineering Licensure Coalition” represents a unified voice of the top Structural Engineering Societies dedicated to establishing and promoting a common position on structural engineering licensure and working towards implementation in all jurisdictions. SELCE is comprised of the Structural Engineering Institute (SEI) of the American Society of Civil Engineers (ASCE), the National Council of Structural Engineers Associations (NCSEA), the Structural Engineering Certification Board (SECB), and the Council of American Structural Engineers (CASE) of the American Council of Engineering Companies (ACEC).
- Currently only one school, the University of Louisville, is accredited at the Master’s level., Available at ABET’s website, Last updated October 01, 2013. Available at <http://main.abet.org/aps/Accreditedprogramsearch.aspx>
- New York: Education/Experience Credit Toward New York State Licensure in Professional Engineering. Available at [www.op.nysed.gov/prof/pels/peexpchart.pdf](http://www.op.nysed.gov/prof/pels/peexpchart.pdf)
- Illinois: Joint Committee on Administrative Rules, Administrative Code. Title 68 Professions and Occupations Chapter VII: Department of Financial and Professional Regulation Subchapter b: Professions and Occupations Part 1380 The Professional Engineering Practice Act of 1989 Section 1380.230 Approved Experience. Available at: [www.ilga.gov/commission/jcar/admincode/068/068013800002300R.html](http://www.ilga.gov/commission/jcar/admincode/068/068013800002300R.html)
- Some existing post-baccalaureate programs in engineering include:
- Boston University LEAP program (Late Entry Accelerated Program)  
(Not specifically Civil/Structural, no B.S. degree given).  
[www.bu.edu/eng/academics/special-programs/leap/](http://www.bu.edu/eng/academics/special-programs/leap/)
- University of Washington.  
[www.ce.washington.edu/prospective/undergrads/postbac.html](http://www.ce.washington.edu/prospective/undergrads/postbac.html)
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