John Gervais (MNSEA)
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What is the greatest challenge facing structural engineers and/or the structural engineering profession in the next five years? Please identify how your local SEA and/or NCSEA can address this issue.

The structural engineering industry, as well as the construction industry at large, is constantly seeking new innovations to help improve efficiencies in both our work effort and our delivered products, the structural drawings that become our client's building. We have developed cutting edge tools that, on one hand, simplify and accelerate the analysis and design process, while at the same time, are capable of optimizing and streamlining our structures in a way that would not be possible even 20 years ago. Yet, even with these advancements and technological leaps, structural engineering, much like the construction industry, is not necessarily known for being openly receptive when it comes to new, progressive ideas. Afterall, the premise that "this is how we've always done it" is a safe and familiar sentiment for many experienced contractors and conservative structural engineers. However, given the exponential growth of technological evolution and the increasing use of automated decision making, this line of thinking must be replaced with one that embraces progressive ideas. One of the greatest challenges facing the structural engineering industry in the next five years, and really the next decade, will be the ability to adopt new technology and effectively integrate it with established systems.

I have been involved in the structural engineering industry, both academically and professionally, for the last 8 years. In that time, I have been constantly reinforced with the basic fundamentals of structural engineering: the design of steel, concrete, masonry, and wood structures; gravity and lateral analysis; load path, load path, load path, and so on. Like any good budding engineer, I made a habit of writing out my calculations as neatly ordered formulations. I would start by writing out my assumptions, followed by code references and equations, and eventually work out the answer. However, I quickly learned the real engineering world is not so orderly. Architects change their minds and construction teams make mistakes. My calculations soon became ravaged battlefields of lead scribbles, eraser marks, and ink smears, with volumes of paper that each required their own stacks on my desk. I thought there had to be a better way, but I was unsympathetically informed that this was the standard. Not to be deterred, I worked to find a better way to formulate my calculations in a way that did not involve paper cuts or stacks of filing cabinets. Since then, I have moved to completely paperless calculations using various computer programs. By doing so, I have dramatically decreased my calculation times, made my calculations both repeatable and easy to follow, and allowed myself to take on bigger and more complex projects as the sole lead engineer. Although this may seem like a simple and straight-forward anecdote in solving one's workflow problems, I would propose that this is actually a much larger problem, analogous to the issues faced by the structural industry.

Structural engineers, mostly by education but likely by nature, tend to question the validity of new information and new ideas, which to say is not a bad thing, as critical thinking is a key asset to being a successful engineer. Structural engineers also tend to be creatures of habit, whether good or bad, and those habits are hard to change. However, the technology that is being created and developed to assist in structural engineering is constantly providing new information and new methods to perform our work. If structural engineers are going to keep pace with the rest of the ever-evolving technological landscape, we need to be capable of vetting these new technologies and adopting them into our workflows. New technologies like real-time cloud-based BIM coordination, 3D field imaging and documentation, and artificial intelligence based decision-making programs are some of the next big developments for the design and building industries, all of which are already being utilized to some capacity. As architects and construction teams continue to evolve their workflows to adopt these technologies, so too must structural engineers. Problems arising from coordination issues or miscommunication between teams are often the biggest hurdles for any project. If structural engineers can help develop and implement new systems to remedy these issues, we can position ourselves as leaders on these project teams, as well as provide a more valuable service to our clients.

Although many structural engineers would agree that utilizing these new technologies to provide more efficient cross-discipline coordination can only be a good thing, there are fears that increased reliance on advanced technologies like artificial intelligence and machine-learning will eventually lead to the replacement of humans by computers as the main structural engineers. While this scenario is still decades away from becoming possible, it is important for the structural engineering industry to begin understanding the potential benefits and issues of implementing automated decision-making programs into our workflows. On one hand, we stand to gain a monumental increase in analysis and design efficiency, but on the other hand, risk the possibility of losing our entire profession. This same situation has already been played out over multiple industries, mostly for manual labor jobs such as in the automotive industry, where assembly lines of people have been replaced by rows of automated robots. However, unlike many industries where automation means less human involvement, employing the use of artificial intelligence would likely lead to the increased demand for structural engineering oversight. For as much as the science of structural engineering relies on the principles of mathematics and physics, there is a significant part of the profession that really relies more on the creativeness and artistry of the structural engineers themselves. The finesse that is required to find creative and unique solutions is not a skill that is readily adapted by a computer program. In the same vein, automated decision-making is still predicated on the premise that accurate results rely on the accurate input of appropriate data. Without the proper oversight of human engineers, these cutting-edge computer programs would be reduced to nothing more than clunky black boxes of meaningless results, corresponding to the familiar phenomenon of “garbage in, garage out”.

In order to prepare for the adaptation of evolving technologies, there needs to be a pointed effort by academic and industry leaders to begin training structural engineers on the proper utilization of these next-level technologies. Engineering schools and organizations, like NCSEA, need to push for technological literacy training as a requirement for both structural engineering students and professionals. This is not to say we should move away from hammering our young engineers with the fundamentals of structural engineering, because without them, we ourselves act as black box computers, unable to truly understand the nature of our work or differentiate between good and bad decisions. However, the sooner the structural engineering industry can adapt and implement these new technologies, the better chance we have in shaping the future for how our profession leads the design and construction industry into the next era.