How Code Complexity Harms Our Profession

Part 2

By Craig M. DeFriez, P.E., S.E.

In Part 1 of this article (July 2014), I examined the wind load provisions in ASCE 7-10 to illustrate how the ever-increasing complexity of code provisions has negatively impacted our profession. In this second and final installment, I would like to take a look at where we have been as a profession in recent decades, and perhaps extrapolate where we are heading if current trends continue.

When I began my career in the early 1980s, the building code was a single volume. It included most of the provisions, equations, and methodologies needed to design a building of any material type. A few other reference books were necessary, such as the AISC *Steel Construction Manual*, which itself was only 1 inch thick rather than rivaling the size of the Las Vegas phone book. Per the 1988 *Uniform Building Code*, determining the wind pressures on a building was a very straightforward and understandable process, completely described in less than 3 pages and a few simple tables, as opposed to 113 pages in 6 chapters of ASCE 7-10. The same could be said for the seismic provisions, contained in less than 20 pages and a few tables, compared to 134 pages in ASCE 7-10. Loads were developed at service levels, there were only five basic load combinations, and most design was done using allowable stresses – a method still preferred by many engineers today when given the choice.

We were able to develop design forces quickly, using a few easily understood equations. We acquired an intuitive feel for structural behavior, because the methodology for developing loads and applying them to the design of systems and components was comprehensible to the human mind. This is no longer the case, considering the dozens of codes, commentaries, guides, and manuals to which structural engineers must now refer. Unfortunately, we have allowed academia, code committees, and regulatory agencies to seduce us with the idea that – for the sake of (alleged) accuracy in analysis, refinement in design, and greater building safety – we must sacrifice intimacy with our craft.

Reasonable accuracy in analysis and design is important, but we must maintain some perspective and balance between theory and practice. The mandates of local building departments, actual field conditions, and varying construction practices often conflict with the level of analysis and design refinement to which we now routinely subject ourselves. A lot of buildings were designed using the simpler methods of the past, and most are still in service. Computers have become valuable tools in modern engineering practice, allowing us to design more complex structures than would have been possible even a few decades ago. No one disputes the value of such technology, but when the codes and standards become so complex and the design methodologies so intricate that we become almost totally dependent on computer software – not as a tool, but as a crutch – we are a step removed from truly comprehending what we are doing.

Several years ago, my son was enrolled in a civil engineering degree program and asked my advice about specializing in structural engineering. I told him that it is a demanding profession. The volume of knowledge that he will be expected to master is extensive. The professional license to practice is difficult to obtain. It is a constant struggle to adapt to new and sometimes unintelligible changes in code provisions and design methods every few years. Occasionally, we find out that previously adopted code provisions are flawed, only to be replaced by new and even more complex provisions, with the assurance that they are now "correct." And, sometimes they are still wrong and are again modified in the very next code cycle.

I explained to my son that he would have to become nearly totally dependent on computer software to do his job. Designing a building has become more a matter of how adept you are at using a particular vendor's program – each with its own peculiar idiosyncrasies and nuances – than any real understanding about the behavior of the structure or what constitutes good design practice. Much of structural design has become a black box activity; most engineers today are unwilling or unable to wade through complex and confusing equations and methodologies to do basic design work, when they can simply input a few parameters into software developed by others and get an answer. It may not always be the right answer or the best answer, but it is an answer.

The undeniable evolution of complexity in code provisions and design methodologies increases the likelihood for misinterpretation and error, which may actually diminish the accuracy in design and safety for which we are striving. Structural engineering has often been characterized as both art and science, but it is not quantum physics, and we should not behave like it is. It is the application of fundamental principles of statics and mechanics of materials combined with experience and judgment to produce buildable and reasonably safe structures.

Can we honestly say that we can still wrap our brains around all of the provisions and methodologies contained in the current building code and referenced standards? We may soon be at a tipping point, if we are not already there. Will the structural engineers of the future practice the art and science of structural design with understanding, good judgment, and competence? Or will they be relegated to serving as technicians who simply use software to design buildings without having any real understanding of what the software is doing.

My son ultimately decided to specialize in water resources and environmental engineering, and is happily employed in that field. I cannot say that I blame him.▪

*Craig M. DeFriez, P.E., S.E. (**cmdefriez@yahoo.com**), is a consulting structural engineer living in Carson City, Nevada. During his career he has had extensive experience in plan checking, peer reviews, and code interpretation and enforcement.*