# How Code Complexity Harms Our Profession

## Part 1

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

In a recent Structural Forum column, *A Remarkable Profession!*, September 2013, Stan Caldwell pointed out some of the negative aspects of structural engineering that often prompt complaints from its practitioners. Those comments resonated with me and, I suspect, many of the more seasoned engineers who have witnessed significant changes in the profession over the past few decades. I contend that our most serious threat is not low fees, bid shopping, or lack of respect, but something self-inflicted: It is the unreasonable and unnecessary degree of complexity in building code provisions and design methodologies that poses the greatest danger to the future vitality and survival of our profession. In Part 1 of this article, I will illustrate that point by specifically examining the new ASCE 7-10 wind load provisions.

One of the significant changes is the adoption of so-called "ultimate" wind speeds similar to strength-level earthquake loads incorporated into the building code some time ago. Strength design was first introduced as a method of proportioning structural components such that no applicable limit state is exceeded when the structure is subjected to all appropriate load combinations. As originally conceived, strength design involved developing service loads that were increased by various load factors and then compared with a material-dependent limit state such as flexure or shear. We have now taken a concept related to design properties for materials, and invented pseudo design forces that do not actually exist in nature. Wind speed, a term commonly understood even by non-engineers, has now been transformed into a set of contrived velocities that have no intuitive or actual relationship with how hard the wind actually blows.

For example, under earlier codes we designed for an 85-mph maximum wind speed in my area. This seemed sensible because we often have wind gusts of 60 mph or more during severe storms. There was an intuitive and rational relationship between actual wind velocities and the design-level wind speed that we used in our calculations. Under ASCE 7-10, we now design for ultimate wind speeds ranging from 105 to 120 mph in this area, depending on the building classification. A Risk Category II building is now designed for a 115-mph ultimate wind speed based on the new maps, which incorporate a load factor and a building risk factor. Wind speed is no longer an atmospheric phenomenon that has a real-world practical meaning, but is somehow oddly coupled to a material limit state as well as the building type. What do these parameters have to do with how fast the wind blows? The whole concept can only be rationalized through a series of mathematical gyrations – try explaining that to your contractor or owner!

ASCE has acknowledged for years that the wind load provisions are difficult to understand and apply. Even the new so-called "simplified method" is neither simple nor even coherent, since it generates pseudo-pressure coefficients mysteriously correlated to member forces in buildings rather than actual design pressures (whatever that may mean). Hence, if you compare the analytical (or Directional) method with the simplified method, ASCE tells us up-front that you will get different results. Is that supposed to give us confidence? ASCE seminar instructors admit that the simplified method for Components & Cladding is more difficult to use than the analytical method, so in code-speak, I guess that "simplified" in no way means easier to understand.

They also acknowledge that previous versions of the code got some things wrong – such as ASCE 7-05 wind loads being 20% conservative compared to the new ASCE 7-10 provisions. While recently watching an ASCE webinar on the new wind load provisions, the instructor made a mistake in applying the new provisions in an example that he was presenting. Even as he acknowledged his error, he jokingly warned the class how easy it is to make such mistakes – exactly my point! Given that kind of admitted fallibility, does anyone doubt there will be significant changes to the next version of ASCE 7? The point is that when the code provisions are so transitional and complex that even the experts cannot adequately explain them, there is definitely a problem. ASCE claims that they have "improved" the wind load provisions in ASCE 7-10, but in truth, it remains a befuddling mess. If you disagree, try explaining how to use Figure 28-4.1 to someone. The ASCE webinar instructor could not do it.

To help compensate for this complexity, ASCE 7-10 provides a series of step-by-step procedures for designers to follow. This prompts the question, "Why is that necessary?" The answer is because there is nothing straightforward, intuitive, or even rational about the wind load provisions. It would seem to confirm the observation from Mr. Caldwell's article that structural engineers are becoming "little more than math technicians who meticulously follow precise recipes to produce adequate designs." You know who (or what) is really good at that? Computers. Structural engineers must now heavily rely on sophisticated and expensive software to handle the bewildering maze of code-required load generation, load combinations, analysis procedures, and design methodologies. Given this current trend, it is not unreasonable to predict that computer software will soon take analysis and design out of the hands of engineers and turn it over to technicians and programmers.

In the second installment of this article, which will appear in a future issue, I will take a broader look at how design practices have changed over the past several decades and offer some additional thoughts about current trends that may affect the sustainability of our profession.▪

*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.*