# Technology is not a Substitute for Experience

*By Brent L. White, P.E., S.E.*

Our firm is fortunate to be celebrating our 50th anniversary this year. We have grown from a one-person firm to a dedicated staff of over 30. That growth has not been exponential, but it has been steady and consistent. Recently, while preparing a presentation for our employees about our 50-year history, I had the chance to reminisce about some of the successes and challenges since 1969. I have been around for 36 of those 50 years, so I have some knowledge of our history, but I was reminded of some of the work our firm did in those earlier years. The founder of our firm still visits with us occasionally and attends company social functions, so we still have a connection to our founding, and it is great to have that connection.


As I have reviewed files and photos dating back to our founding, I am amazed by the projects that were undertaken and completed from that very first year. From the perspective of a structural engineer today, some of those projects are even more amazing considering the tools that an engineer today takes for granted and expects to be available. 50 years is insignificant when considering engineering projects accomplished throughout history. The tools available today have grown exponentially in sophistication, reasonable availability, and actual use by today's engineer. From that perspective, knowing that projects completed 50 years ago in the average engineering office were completed using slide rules, pencil and calculation pad, and hand drafting is a bit awe-inspiring. I have never used a slide rule. As a college freshman, I entered school the first year that students were required to have a scientific calculator. By the way – those calculators cost a fortune when compared to the much more sophisticated versions available today.

My brief historical review reminded me of the concerns I have regarding engineering design in today's environment. In a competitive, capitalist environment, the efficient use of available tools is essential. It would be impossible to compete and provide the expected engineering services if we were all still using slide rules and drafting tables. However, I am concerned that we are losing, or may have lost, something along the way. Using those early tools required an engineer to develop a rapid understanding of not only the necessary engineering principles but a feel for how things really worked. Not only having a general feel for if the calculation is correct, but is the solution reasonable? The founder of our firm, acting as a mentor, always reminded me and others to "put on your contractor's hat" as we designed structural systems and elements, especially as we prepared construction documents and details.

With the prevalence of useful engineering programs, computers, BIM, and other tools, do the engineers of today develop the same sense of what is correct and what is actually doable as was the case with our predecessors? The likely answer to this question causes me serious concern. We can and should develop a sense that the calculations and designs we complete are correct and right using all of these modern tools.

Precision does not guarantee accuracy. While attending university, I had a professor that confused many students when he said the only digit after a decimal when completing a calculation is 7. This was his way of helping us understand that there is always a certain level of inaccuracy or unknown in calculations. When we begin calculations with established live loads that may or may not be actual, and dead loads that are determined to the best of our knowledge and then add a little extra, completing calculations to three decimals does not make sense. Computers do not understand this situation. Therefore, it is easy to assume that precision guarantees accuracy and that accuracy is actual knowledge to be utilized without question. I have reviewed structural elements and systems designs with less experienced engineers and within a few seconds point out that something isn't correct. "How do you know? You didn't do the calculation." My response is, I just know; experience tells me something is out of place. Developing this experience base is essential. We must not allow technology to prevent the development of this essential experience.

Just because you can does not mean you should. The engineers in our office have heard me say this many times. Considering the tools mentioned previously and the presumed ease of using those tools, it is easy to fall into a trap assuming they must be used for everything. There are times when $wl^2/8$ or $wl^2/2$ and the steel manual is all you need – and faster. Culturally it seems that, as engineers, we tend to be developing the idea that everything needs to be "modeled." For complex and sophisticated analysis, this is the case; but in my opinion, it is used more than necessary and may be preventing the development of the "feel" for correct answers. Just because the computer is sitting there, and software is available, does not mean it should be used in every instance.

Know when it is good enough. Related to the accuracy discussion above, understanding when solutions are adequate based on our understanding, as well as schedule and budget constraints, is essential. Almost any problem can be refined indefinitely without providing additional value. Obviously, there are complex solutions to complex problems that require iterative design processes. Complexity, however, is not generally true. This also ties into the idea of complicating the analysis and design more than necessary.

The technology available to us today as structural engineers is wonderful and exciting. I do not want to be misunderstood that I may think it is not important, necessary, and essential. However, just as essential is developing our experience base and understanding so that we are not entirely dependent on a computer program as engineering professionals.

With all that said, I shared this not because it is precise or accurate. I did it because I can, and it is good enough.▪

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