Error Checking and the Black Box

Part 3

By Scott N. Jones, S.E.

This is the final installment of a three-part series (STRUCTURE, April 2020 and May 2020), wherein we discussed the Black Box, why it is critical to our work, and how to control it to make sure we are getting correct and accurate results. This segment takes a high-level look at strategies for the successful use of engineering software.

Avoid the Temptation to Duck Your Head

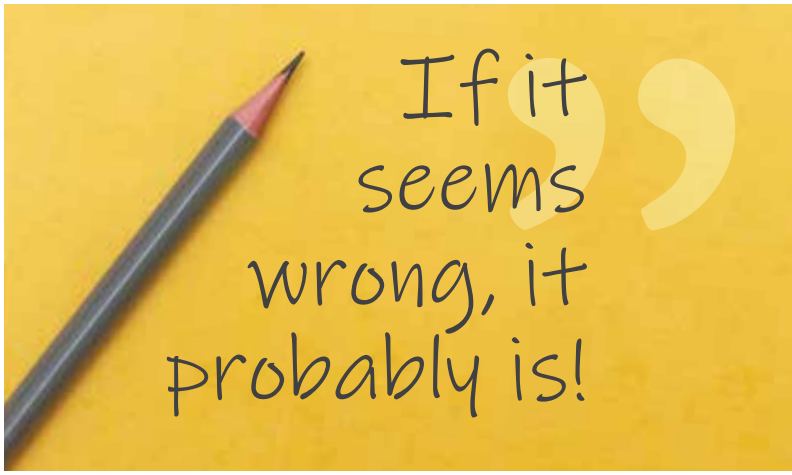
We are engineers, not technicians! Take some time to look at the big picture. Create a plan. Establish a vision. Great processes and habits are among the best ways to guarantee quality work. Before you start that next project – before you excitedly import that model from Revit (a building information modeling software) into your favorite design software – take a minute to step back and form a strategy. In what ways is this building like others that you have successfully engineered? How can you efficiently and correctly replicate the processes you have used before? And in what ways is it different? What challenges does this building pose that no other building that you have previously designed did? What makes your stomach tighten just a little because you are not sure you understand (at least not yet) how to handle it? What code provisions need to be applied that make you cringe to think you will have to read, decipher, understand, and apply? Now STOP! Take the parts you do not understand and research or ask someone until you do understand. Establish a plan. Create a vision. Create a process. Then, and only then, can you move forward with an excellent design!

How Deep Does the Software Go?

Make sure you understand very clearly where the design of the black box ends and your "hand calcs" start. Did that moment frame get checked for strong-column, weak-beam ratio by the program? Or do you need to do that? Did the program assume the cantilevered beam was braced on both the top and bottom flange? Did the model actually design the perimeter beams for their drag and chord forces – or is that on you? Please, please, please resist the temptation to "assume" the software did the check. If you have not seen the output with your own two eyes for proof that the check was made, you have to assume it was not!

Create Standards

As engineers, we create standards for many things – CAD standards, redlining standards, calculation packet standards, etc. But does your firm have modeling standards? A clear and concise recipe for creating frequently used model-types can be a godsend, especially for the less experienced engineer. Maybe a typical single-bay moment frame. A multi-span beam. A truss. A recipe that lays out how to create the proper boundary conditions at supports, end conditions, load cases, etc. Why not take the guesswork out of the process and guarantee more predictable results? It is a lot easier to prevent the error by the use of standards than by finding the error through quality control!



Check Your Assumed Conservatism at the Door

Are my "conservative assumptions" really conservative? We have all had a good laugh ourselves when contractors try to justify what they did *without* the blessing of the engineer by saying they "way overbuilt it." And the reason we laugh is that, almost always, the parts that were "overbuilt" and the parts that will experience high structural demand are almost *never* the same. Unfortunately, this Achilles Heel also seems to apply significantly to less experienced engineers. The author's stand is that you cannot say that you are covered by "being conservative" on an element (that you did not calculate) unless you have analyzed it in that exact same condition before and have found it to be, by your own experience, conservative. Yes, it is challenging work being a structural engineer with so many calculations! But the lesson that has to be learned is that if you do not know from actual first-hand experience that it is conservative, buckle down and do the extra calculation and prove it. You may be surprised to find how often you were not as conservative as you thought.

Parting Thoughts

Adopting these strategies will help you become a better, wiser, and more accurate engineer. One last thought in parting. A simple but powerful phrase the author often uses around the office is this: "If it seems wrong, it probably is!" This phrase has been coined as a statement to give our engineers permission – even inspiration – to do a double check when things seem just a little off. Its desired effect is to plant the seed of skepticism in the mind of the otherwise confident engineer who has studiously completed the calculations. Does the size of the beam just "feel" too small? Do the wind loads on the parapet seem less than you would expect? Does the depth of the beam and the width of the column look out of proportion now that you see them in the detail, drawn to scale? If it seems wrong, if it feels wrong, it probably is! Give it another look with fresh eyes. Ask a colleague to do a double-check. You will not regret it! Happy error checking!▪

*Scott N. Jones is a Partner at Wright Engineers in Orange County, California. (**sjones@wrightengineers.com**)*