

# PROFESSIONAL ISSUES

issues affecting the structural engineering profession

## Forward Thinking Engineers Are Automating Calculations, Are You?

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Increasingly, the design and construction industry is relying on Building Information Modeling (BIM) to conceptualize, plan, detail, create, and guide the building of structures. As a result, the industry as a whole is moving toward more efficient processes. Surprisingly, structural calculations have not evolved in the same way. Over the years, almost without planning, engineers have settled into the practice of using a combination of hand-written calculations and spreadsheets in design. However, why do engineers continue to rely on time-consuming hand calculations and cumbersome spreadsheets?

### *How Did We Get Here?*

The use of spreadsheets was born out of a desire for greater efficiency. Spreadsheets are often created on a very ad-hoc basis with little or no planning from higher management and tend to start as small “scratchpad” applications that develop into much larger design tools over time. While spreadsheets might work just fine for the finance side of business, they were not built for the complex calculations that engineers must perform and communicate.

In some parts of the world, all calculations are required to be submitted to the local government for checking. There’s a greater emphasis on calculations. In many countries, such as the UK, this has driven the adoption of technology and the desire to move away from scribbled hand calculations and spreadsheets. Some might say that the lack of a similar requirement to backup designs with calculations in many parts of the U.S. has stifled progress.

### *The Problems with Spreadsheets*

The ease with which even an inexperienced user can enter data and calculations into a spreadsheet, and very quickly produce results, can lead to the belief that spreadsheets are inherently easy to use. However, as the requirements of a spreadsheet increase so does the complexity.

### *Well-Intentioned but Erroneous*

While spreadsheets can be useful when implemented and used correctly, a study by Professor Ray Panko of the University of Hawaii ([www.marketwatch.com/story/88-of-spreadsheets-have-errors-2013-04-17](http://www.marketwatch.com/story/88-of-spreadsheets-have-errors-2013-04-17)) showed that close to 90 percent of spreadsheets contained errors.

### *Quality Assurance*

Completed spreadsheets often include many pages containing hundreds or even thousands of calculations. The problem with spreadsheets is that all those calculations are hidden in the

formulae and cross-referenced within the cells of the spreadsheet. While it is possible to examine the formula in each cell one at a time, understanding how an entire spreadsheet works is often a monumental task. This makes full quality assurance tough to achieve – something that is essential in the design environment.

### *Collaboration and Knowledge Sharing*

As spreadsheets are written by different staff members for their personal use, they are often difficult for others to use. It would seem reasonable that if someone has written a useful spreadsheet that there are likely to be others within the same organization who would benefit from it too, but that is not typically the case.

### *The Solution*

Fortunately, technology is available today that can automate repetitive structural and civil calculations to increase productivity and minimize errors. Engineers in other countries and some in the U.S. are already utilizing technology to drive efficiency either by developing their own small scale software to assist with repetitive calculations or by using programs developed by others. This is revolutionizing their processes for creating easy to use, high quality and accurate calculations that they can share with others.

Civil engineering firms can take advantage of automated calculations to improve workflow, increase business efficiency and expand the scale of projects, making a company more competitive. Replacing a combination of hand calculations, spreadsheets and various computer software programs with an all-inclusive, commercially available software package places all data in a consistent editable format. With these programs, firms can spend far less time making revisions and engineers can write their own unique calculations. Calculations are saved for multiple uses, on regular projects, and by any team member.

Because design codes are constantly changing, using a comprehensive software solution also ensures engineers can leverage the detailed output to learn how to use the most recent edition of a particular design code.

### *Taking the leap*

Engineers looking to move into the 21<sup>st</sup> century with calculation production should look for a single solution that provides the capabilities to automate component design, electronically create calculations, and produce output in a way that is very transparent. With this kind of solution, anyone checking those calculations can understand and follow them.

There has never been a better time to consider adopting technology to automate structural calculations. The initial investment is likely negligible compared to the potential return so the business case is usually transparent. Why would you want to delay improving processes to save time and reduce costs? ■