

Courtroom FEA: But my expert has hand calculations

Hand calculations are good. It is very important that design engineers do hand calculations. It is very important that engineering expert witnesses do hand calculations. For everything but the simplest of part geometries, hand calculations of stress are generally rough estimates. Often they are only in the ballpark of the true maximum stress levels. Sometimes they are only in the ballpark of the average stress levels, and miss the highest stresses entirely. In the span of 50 years, finite element analysis has gone from esoteric research topic to widely available, widely applied mature technology. In the 1980's, FEA required extremely expensive mainframe computers, very expensive FEA codes and highly trained analysts, and was still implemented at many large corporations. In the 1990's, Unix workstations provided distributed FEA processing and FEA packages went mainstream, lowering entry costs. A seat of hardware and software still cost many tens of thousands of dollars, and highly trained analysts were still required, and still FEA spread to thousands of companies. In the 2000's, lower priced FEA packages run well on medium to high-end personal computers, and FEA usage continues to grow. Highly trained analysts are still needed to consistently obtain accurate results, a fact unfortunately ignored by too many in the industry. Why does FEA usage continue to grow when all of these companies already have hand calculations? Because, when applied correctly, FEA works. It delivers accurate stress estimates for parts with geometry too complicated for hand calculations alone, which describes most of [r. paola vargas daly lawyer](#) today's parts. Accuracy means that localized stress concentrations can be removed. Accuracy means one less uncertainty, meaning that a lower factor of safety can be considered—resulting in lower weight, lower cost parts that are still stronger and have longer life cycles. Accuracy means that an expert witness can pinpoint areas of concern, and can often nail down the why's and how's of a part failure. As discussed in previous issues of Courtroom FEA, this will often point the finger at the responsible party, be it designer, manufacturer or end user. Accuracy can mean reduced lab testing by concentrating the investigation on the suspect areas. Accuracy means credibility.



FEA has internal checks that a good analyst needs to apply to verify the results. Hand calculations provide a rough estimate of the results, and the hand calculations and FEA had better match within their accuracies. If not, something is wrong with one or both of them, and the analyst had better correct that. Once they do match, hand calculations are an external check of the detailed FEA results. Hand calculations are good. But they aren't good enough in a high stakes courtroom battle.