An Industry Perspective on FEA in the ME Curriculum

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Considering the main methods of stress/structural analysis – hand calculation, experimental measurement, and Finite Element Analysis (FEA) – each has distinct advantages, but each is also subject to misuse. Introductory mechanics courses typically focus on teaching the methods of hand calculation, therefore giving less attention to modeling skills and the development of sound intuition. FEA is normally introduced later in the curriculum, in a course emphasizing the underlying theory rather than the skills needed to solve problems.

Now that inexpensive software permits automatically meshing and solving a problem in seconds, with abundant visual feedback, I argue that future engineers will be best served by employing FEA as a tool whenever possible in the curriculum. If introduced in Statics, FEA could then enhance the teaching of Strength of Materials and Machine Design, and solidify the engineering of Design Projects. Some may argue that this early exposure is problematic, due to the students' lack of background in FE theory; however, is this any different than computer science students programming microcomputers without a background in IC theory? Students can learn much of the behavior of mechanical systems from FEA, without getting mired in the inner workings of the FE foundations and algorithms. Courses in FE theory can still be provided to students desiring further knowledge of theory, such as those who envision research careers. In fact, they may learn the theory even better, having already developed an appreciation for typical issues and results.

Beyond the development of FEA facility through practice, users most need to acquire the skills of *modeling* (i.e., specifying and validating) and *interpreting* (applying discretized linear results to real materials and geometries). Such skills are needed just as much with the other analysis approaches, but are often overshadowed by emphasis on the techniques of carrying them out. The use of software to transparently handle problem - solving bookkeeping will enhance basic engineering pedagogy. Furthermore, graduates will command a powerful technique for their future careers, permitting them to skillfully address problems of considerable complexity.

The toughest pedagogical issue is: Can we afford to de-emphasize student skills in symbolic manipulation? Workplace observations suggest that my non-academic colleagues rarely if ever use such techniques, so it may be worth shifting them somewhat to upper-division electives.