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Heuristics and Judgment

By Jon A. Schmidt, P.E., SECB

I used this space in the March issue of STRUCTURE® magazine to discuss Dr. Billy Vaughn Koen's definition of the engineering method, as stated in his book, *Discussion of the Method: Conducting the Engineer's Approach to Problem Solving* (New York: Oxford University Press, 2003):

> *The engineering method is the use of heuristics to cause the best change in a poorly understood situation within the available resources.*
>
> *A heuristic is anything that provides a plausible aid or direction in the solution of a problem but is in the final analysis unjustified, incapable of justification, and potentially fallible.*

Familiar examples of engineering heuristics include rules of thumb and factors of safety. These tools allow us to solve problems, not because they are grounded in the indelible truths of nature, but because the collective experience of our predecessors and contemporaries suggests that they are "good enough" to get the job done while still protecting the safety, health, and welfare of the public.

In fact, experience is probably the key ingredient in the development and implementation of a successful heuristic. That is why there are significant limitations on the range of problems that an entry-level engineer realistically can be expected to handle. An engineering degree signifies that someone has absorbed a certain amount of necessary - but insufficient - background information. Only by actually applying this knowledge in the "real world" can an individual gain the proficiency that is necessary for professional practice.

The word that most of us probably associate with this aspect of engineering is *judgment*. I have often said that the most important thing for any engineer to know is how much he or she does not know. This awareness drives us to talk to other engineers, conduct extensive research, and otherwise give careful thought to how we are going to proceed when a client or supervisor presents us with a challenge that deviates significantly from anything that we have confronted in the past. The retired former CEO of my firm, Dave Ruf, had a favorite saying that remains an integral part of our corporate culture and a key aspect of our quality control program: "There are no dumb questions; if you don't know, ask."

The best and most successful engineers are the ones who have developed the most comprehensive and effective sets of heuristics – including "meta-heuristics" that help them quickly determine which specific heuristics to apply when a particular situation arises. Here is another one of Mr. Ruf's favorite sayings: "Do it right the first time." This is only possible if you choose the proper approach from the very beginning. What codes and standards are applicable? What design aids do I have in my file that deal with this? What assumptions or simplifications can I reasonably make? What software should I use? And especially: Where is that excellent and timely article about this that I read in STRUCTURE a few months ago?

Some would probably argue that you cannot teach judgment. This may be true to a certain extent, but at the same time, there is a reason why licensing boards require new graduates to spend several years working under the supervision of experienced professionals. Those of us who now qualify for the latter category should do everything that we can to help those who are just embarking on an engineering career to overcome the limitations of textbooks and examinations. Let me conclude with a few basic heuristics that I personally like to pass on to new employees right away:

- "Soft" skills are at least as important as technical skills. Communication, responsiveness, and timeliness can go a long way with colleagues, management, and clients.
- Least weight does not equal least cost. Labor is often more expensive than materials, so incorporate simplicity and repetition as much as possible.
- Always use computers with caution. Verify modeling assumptions with veterans and perform a "reality check" of the results.
- Three significant figures are sufficient. More than this gives an unwarranted impression of precision, considering the semi-empirical nature of many code provisions and realistic construction tolerances.
- Be involved in projects from concept to completion. Structural input can be critical for some early design decisions, and (unfortunately) many contractors need careful oversight to ensure quality.
- Take pride in your profession. Be active in relevant organizations, including your local Structural Engineers Association, and pursue licensure and certification.
- Read and write for STRUCTURE magazine. All of us can learn a lot from each other! ▪

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