Use the File Menu from your browser to Save, Print or E-Mail this document

---

7/25/03

Discussion 7-03
The Design Process

In engineering design philosophy there are two distinctly different approaches to design. For discussion purposes they will be referred to as (1) *The Products of the Market Place* and (2) the *Laws of Physics.*

THE PRODUCTS OF THE MARKET PLACE APPROACH

This process is one in which the design engineer develops a knowledge of numerous products that can be employed in some integrated manner to comprise the "system". As the designer gains more experience he/she builds up a larger and larger inventory (knowledge) of products and can thereby achieve much improved designs - that is, the success of his/her design is directly proportional to his/her knowledge of the available products. Another way of thinking of it is that the success of the design is constrained by his/her knowledge of the available products.

The vast majority of design engineers employ the products of the market place technique. Even some of our Universities reputed for "practical design engineering programs" teach this approach. The characteristics related to this design include:

- Engineers specializing in a single type of building;
- Applying the same system and components repetitively;
- Changing the otherwise repetitive design only when a manufacturer(s) presents a new product.
- Utilizing the then current system of choice (or following the fads).

THE LAWS OF PHYSICS APPROACH

The laws of physics approach to design is the approach employed by few engineers, but always by engineers of excellence. In the Laws of Physics approach, the engineer starts with a thorough knowledge of the physical laws that relate in any way to the task at hand. Then, given a design challenge he/she first defines the objectives of the design in terms of the design parameters. After having done so, the designer applies his/her knowledge of the laws of physics in the development of a system concept that satisfies all of the design parameters.

If there are conflicting parameters that cannot be successfully resolved (for example cost and maintainability) the designer revisits the parameters with the owner and redefines them to resolve the conflict before continuing with the process. Having gone through this process to the extent necessary, ultimately a design concept is achieved that satisfies all of the parameters. In this approach to design it can be said that a

successful design is one that optimizes or achieves all of the design parameters. Note that this is contrary to the statement often heard, particularly in the architectural profession that "the design process is a process of compromise."

Then, having idealized the optimum design the designer goes about seeking the products necessary to implement this ideal design. In this manner he/she goes about the process of learning about available products in a systematic and organized manner. A side benefit in employing this design technique is that when a product is needed and it is found to not be available the result is often *innovation.* This is how new products are usually developed and the state of the art is continually advanced.

There are numerous examples of this design philosophy resulting in innovation in the HVAC industry. Probably one of the most evident examples was Willis H. Carrier who was an outstanding systems designer. When he needed a large capacity water chiller to achieve one of his designs and none were available, his solution was to innovate. He then conceived, designed and perfected the centrifugal chiller!

Another benefit of the *laws of physics* approach to design is ironic. That is that those who practice it tend to develop a broader knowledge of available products faster than those who must rely on that knowledge to base their designs.

IN SUMMARY

In summary, of the two different design philosophies discussed, the *laws of physics* approach is used by engineers of excellence and is strongly encouraged for those who desire to provide superior designs. It does require a strong base in the fundamental physical sciences employed in the designs. This is a good reason for engineers to try to revisit the fundamentals continually. In forensic engineering analyses if a machine or system has failed to produce the desired performance (i.e., meet the design parameters) it is usually found to be caused by an oversight of a fundamental principle in the development of the design.

Given a firm understanding of the fundamentals, the success of the design using the *laws of physics* approach is related to the success of establishing the proper design parameters. The topic of the next discussion will be "Design Parameters".