Editorial

Sustainable Design

New Opportunities for Innovation

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During the past decade, sustainability became one of the hottest buzzwords in the construction industry. By now, nearly every structural engineer has had some experience with the United States Green Building Council's LEED® rating system. It is common for owners, architects, and municipalities to either desire or require a LEED rating for many of their projects. During LEED's meteoric rise in popularity, the distinction between it and sustainability has blurred. Nearly all structural engineers who have been involved in a LEED project know that their opportunities to contribute to a LEED rating are essentially limited to four areas: accounting for high recycled content in structural steel and rebar; using fly ash or slag to reduce cement content in concrete; specifying wood from a sustainably-harvested forest; and, accounting for locally-extracted materials. Unfortunately, this limited impact leads many of us to think we can't play much of a role in sustainable design. However, this is far from the truth.

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Sustainability is frequently defined as "meeting the needs of the present without compromising the ability of future generations to meet their needs." As structural engineers, we help to provide one of humanity's most basic needs: shelter. However, do we understand the environmental impact of the choices we make as we design today's structures? To date, our design decisions have been based on providing safe, economical, and constructible structures without giving much attention to environmental impact. We must reexamine our past practices to determine if we will make the same decisions when we include environmental issues in our decision matrix. Are there ways that we can minimize environmental impact without compromising the quality of the structure we provide?

Broadening the criteria by which we evaluate our designs provides exciting opportunities for creativity and innovation. Consider examples from two common construction materials. First, structural steel: the high recycled content of most structural steel has been greatly publicized, and I by no means am downplaying the environmental benefit of recycling. However, what if we went one step further, and designed structures that enabled future generations to *reuse* that structural steel? What if we could eliminate the energy that goes into the recycling process, which involves collecting scrap, transporting it to the mill, melting it, reforming it into new shapes, and transporting it once again? If we design to facilitate disassembly, we can make such reuse more economical and likely to occur. Are there choices that we can make as we design buildings that will make their components have more value at the *end* of the building's life?

As mentioned above, cement replacement in concrete is one strategy implemented on nearly all "green" projects. The primary reason for this is, depending on where you get your statistics, cement production accounts for approximately 5% of global CO_2 emissions. Clearly this is an area where we can make a positive environmental impact. Consider if, in addition to specifying relatively high levels of fly ash replacement on projects seeking LEED ratings, and permitting modest levels of cement replacement for other projects, we were to specify project and element appropriate levels of cement replacement on all of our projects. It may not be appropriate in all cases, such as cold weather concreting, but in many cases it would likely provide both financial and environmental benefits. One of the biggest drawbacks to using cement replacement is the delayed strength gain of the concrete. However, we can encourage the use of such mixes by specifying 56 or 90-day compressive strengths for certain elements. It is common practice to specify three-day strengths for concrete in post-tensioned floors; why not specify 90-day strengths for foundation elements, columns, and shear walls?

Thus far, most discussions about sustainability and structure have focused on the materials that comprise the structural frame. However, little attention has been paid to the many other products we specify. As we move forward, we need to better understand the environmental impacts of structural admixtures, adhesives, and coatings. We need to understand the chemicals that make up these products, determine if the benefit they provide is worth the cost, and specify the products that minimize environmental impact.

Clearly, adding sustainability to the design criteria raises new questions, many of which cannot be easily answered at this time. SEI's Sustainability Committee, a two-year-old group of 30 dedicated volunteers, is working to facilitate education and the exchange of knowledge. During the past Structures Congress, we organized both a technical session and a half day workshop devoted solely to sustainability. We are currently working on a number of tasks, including a committee report and future seminars that address the many ways structural engineers can enhance the sustainability of our built environment. As we continue to ask questions and educate ourselves and our clients on our capabilities with regard to sustainability, we will make great progress.▪

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