GREEN *edge*

METRICS GET RESULTS

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As the saying goes, "If you don't measure it, you can't manage it." Metrics are the language of assessing buildings' functionality with precision, accuracy and high predictability. They allow owners and designers to specify operational efficiency, model expected performance with computer simulation, and measure actual results to ensure that they got what they paid for. Performance metrics provide fixed references that anchor the design intention in reality for all parties to building's service life. This helps harmonize the often-fragmented design-build-operate process, and produces better buildings.

Yet performance metrics are often overlooked, except to make sure that the structure meets code. It is time for the design and construction industry to take a more rigorous approach to understand the true environmental and cost impacts of their decisions. If you don't know how your project compares to leading designs, how can you know that your building is really green? If you don't specify high performance, how can you be sure you'll get it?

The Leadership in Energy and Environmental Design (LEED) Green Building Rating System provides the best measure of overall environmental performance. Before LEED, designers could call their buildings green based on a few symbolic features, which usually didn't reflect the project's total environmental impact. Many LEED credits require detailed evaluation of various building systems. The act of measurement itself is valuable and helps boost performance, as is reflected in the LEED measurement and verification credit. Performance metrics and standards enable practitioners to compare projects objectively.

We have found a number of metrics extremely useful in green building design. Performance can be quantified for the entire facility and at the level of specific devices. Here we discuss whole-building performance. Every architect and engineer should understand and utilize these metrics, even for non-LEED projects.

HOW MANY WATTS PER SQUARE FOOT (WATTS/SF) DOES YOUR BUILDING USE FOR LIGHTING AND PLUG LOADS?

Too often, mechanical system design is governed by overly-conservative assumptions for lighting and plug loads. It is not uncommon for large buildings' HVAC systems to be sized based on loads two to four times their actual usage. This results in expensive overcapacity and inefficient operation at partial loads, increasing capital and operating costs. Calculating actual (or expected) energy intensity helps avoid these mistakes.

IT IS TIME FOR THE DESIGN AND CONSTRUCTION INDUSTRY TO TAKE A MORE RIGOROUS APPROACH TO UNDERSTAND THE TRUE ENVIRONMENTAL AND COST IMPACTS OF THEIR DECISIONS.

A detailed study of a large sample of office buildings reported in the ASHRAE journal found that the average plug load was 0.75 Watts/sf. A typical office uses 1.2 Watts/SF for lighting, but best-practice designs with daylighting have achieved operating levels of 0.4 Watts/SF and less. Lighting and HVAC designers should work together to achieve these goals.

HOW MANY GALLONS OF WATER ARE CONSUMED PER OCCUPANT?

This is rarely calculated and is a good way to assess how sensitive the design is to water conservation issues. By understanding where in the building the most water is being consumed, you can be smarter about which conservation efforts to prioritize. Many types of water-using fixtures meet or exceed EPACT92 and BOCA National Plumbing Code standards without compromising performance. This helps earn LEED water efficiency credits. Best practice designs for large commercial buildings should aim for no more than three or four gallons per occupant per day for personal use. This does not include water efficiency in other building systems such as storm water reuse, drip irrigation and optimal cooling tower operation.

HOW MANY SQUARE FEET PER REFRIGERATIVE TON OF COOLING DOES THE BUILDING USE?

Many architects do not understand this metric, which is unfortunate because many of their mechanical engineers use it to size their HVAC systems regardless of how much energy it might use in the future. The old rule of thumb that office buildings need about one ton of cooling for every 250 square feet of floor area is grossly conservative and results in inefficient, oversized systems. Depending on the climate and building use, efficient designs can easily achieve 500 to 750 SF/ton. In milder climates where passive cooling strategies are used, compressor-based cooling can be fully eliminated some or all of the time. Nevertheless, when compressor cooling is used the design team should set a goal for a high SF/ton.

HOW MANY THOUSAND BTU PER SQUARE FOOT PER YEAR DOES THE BUILDING CONSUME?

This allows us to compare the relative energy performance of different building types with combustion heating in comparable climates. If someone says their building is efficient yet it uses 80 kbtu/sf/yr or more in a four-season locale, they are confused! If it uses 30 kbtu/sf/yr or less it is looking good.

The U.S. Green Building Council or the AIA Committee on the Environment should compile a database of case studies of projects in all climates and building types that compares their performance based on these and other metrics, and make this information available online. Showing that it is possible to achieve high levels of objective performance in any situation will do a great deal to push the movement forward.

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