A PUBLICATION OF THE WARREN GROUP Since 1872 Real Estate & Financial Information

BANKER & TRADESMAN Online
ESTABLISHED 1872
THE REAL ESTATE, BANKING AND COMMERCIAL WEEKLY FOR MASSACHUSETTS

Issue of November 5, 2007

STRUCTURES

Multiple Disciplines Are Beneficial at Firms

By Stephanie Horowitz

This hybrid home has been optimized for energy performance using techniques and features including passive solar design, high performance spray-in insulation, optimized day lighting, a geothermal heating system, on-demand hot water and energy-efficient appliances. The home's energy will come from the sun and the grid, using a process called net metering. The home's solar energy systems have been sized to produce nearly as much energy as will be used over the course of a year.

The advent of new software tools greatly increased the value of having non-architectural staff members at residential architecture firms. Staffs working with this software now generate designs with a huge impact on how buildings perform, which is a major shift in the design process when compared to just a few years ago.

Historically, building performance was measured only during research projects or by homeowners with a passion for analyzing their utility bills. Most architects made their best guess at the techniques that might improve building performance, only to hope that their theories would come to fruition as planned when put into practice. Feedback on the efficiency of design techniques was only available far down the road, well after construction was complete and time had passed.

With an engineer involved, one might run numerous calculations to improve building performance, adding an additional factor of logic to the theories and an increase to the possibility of success. But the additional time needed by the engineer to make the detailed calculations to improve on the architect's theory was costly, and no practical feedback could be gained until after a home was built.

Today there are new tools that, when combined with the skill sets of architects and engineers, become very powerful but also beg for a third component – a financial analyst. The three disciplines should be considered essential to all residential design projects: architecture, engineering and finance. Architecture is needed to design the residence, engineering to design all the mechanical and energy systems, and finance to present cost versus benefit analyses and justify recommendations at major decision points.

The new tools that empower all three of those roles are multiple forms of energy modeling software. They utilize a combination of material properties, building geometry, building orientation, climate data, HVAC specifications, air infiltration rates, lighting specifications, appliance specifications and consumption patterns of the inhabitants to predict the energy performance of one or more residences. Once only available in the realm of commercial work, energy modeling is becoming more accepted throughout residential design and construction.

The engine behind most of the software was developed from numerous research studies funded by the U.S. Department of Energy, with involvement from others such as the

Lawrence Berkeley National Laboratory, the NAHB Research Center, the National Renewable Energy Laboratory and the Partnership for Advanced Technology in Housing. That software engine offers third-party developers the opportunity to take advantage of its powerful features and create more user-friendly interfaces. Different evolutions of the software have been developed for the purposes of measuring the performance of single family homes, multifamily buildings and Energy Star performance.

What makes the software so helpful is the feedback it provides when used by a knowledgeable professional. It's no longer necessary to wait until a year after construction to see how a building will perform or use a "wait and see" approach to test a theory about how a small change in design will affect a home's performance. Now, the feedback can arrive quickly. Multiple scenarios can be run every day, allowing you to compare wall construction methods, insulation schemes, window placement and orientation, and generate accurate numbers.

This breakthrough empowers design teams with constant feedback during the design process, enabling informed decisions based upon hard data.

When the architect designs a home and the engineer specifies the systems, that design can be modeled as a set of attributes and assumptions to see how it performs. The financial analyst can use the model's outputs to determine a cost optimal package of specifications. For example, finding the diminishing point of returns for insulation would show the correct choice for a specific home between 4 inches, 6 inches, or 8 inches of insulation inside a wall cavity. Which choice would be the most cost effective and protect against overspending, leaving additional money in the budget for other improvements like better windows. In building, more is not necessarily better, and so the software plus the combination of skill sets forms a solution where the design improvements are redefined from "more" to "just right."

Of course, there are flaws in the system and the software is not perfect. It was designed and tested by humans, so that's a caveat. The known issues are the software accuracy, which is continually being refined; prediction limitations, such as the design of the way the software operates; and the challenge of human influence, often the biggest variable.

Human influence assumptions are the most unpredictable and largest variables. Architects must make assumptions about how people will live in a house and do their best to design for a family's lifestyle. A financial analyst makes assumptions about how long someone will live in a home and what kind of mortgage they will choose. Engineers make assumptions about the number of loads of laundry washed each week, the inside temperature set point for heat in the winter, and simple things like how much cooking a family averages each month. These and many more human choices have to be predicted as best as possible according to the lifestyle traits of a specific family.

Despite the challenges in establishing assumptions, the accuracy achieved by considering all of these factors (even with a margin of error) far outweighs using one's best guess or rule of thumb. The result is a whole house design that takes into account a myriad of factors rarely considered by a typical architecture firm. Decisions become clear and logical choices with supporting data. Benefits received by the homeowner include cost optimal choices and confidence in every major decision point in the design process.

The final design will have long lasting repercussions as the house survives well beyond the lifespan of the first owner, so consider designing your next residence with multiple disciplines involved, which are all empowered by energy modeling software.

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