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Design of sustainable buildings requires increased collaboration between architect, engineer & client

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Close collaboration among the architect, engineer, and client has long been an important marker of a successful project. In today's climate of high energy prices and a heightened focus on sustainability, collaboration needs to be taken to a new level in the design process. Clients expect architects to lead them through a process that aligns program, budget, scope and schedule with optimal energy performance and sustainable practices. They expect detailed energy budget and payback analyses. Everyone's goal is to optimize building performance with respect to energy use while creating a beautiful, functional and cost-effective design.

Way it was. In the past, the building envelope often reflected the architect's functional and aesthetic response to the programmatic needs of a project. The thermal performance of the envelope was considered but it did not drive the building's design. Mechanical systems to heat and cool the building were determined after the design emerged and were usually based on a carbon fuel source. Engineers sized mechanical systems with additional capacity to ensure the heating and cooling loads could be met under the most extreme environmental conditions. This approach yielded reliable performance but did not optimize energy performance.

Over the last two decades, starting with the design of our own building in Auburn with its sophisticated energy saving and indoor quality systems -- that if designed today might well achieve LEED certification -- Harriman's architects and engineers have worked closely together to design efficient buildings.

New tools. Today computer-aided design allows engineers to quickly analyze a building envelope's thermal properties. We use this analysis to establish parameters for building skin, such as the amount of glazing we can incorporate into the design. We analyze solar orientation. We take into account systems used to heat, cool and illuminate the building, such as fuel cells, ground-source heat pumps or solar and photovoltaic systems. Using 3D modeling software, we explore aesthetic concepts that address the programmatic needs of the building while simultaneously analyzing the energy impact of various design alternatives.

New approach. Technology has ratcheted up the need for the closer, earlier, and more explorative involvement of all project team members. In the past, the architect led the design process and the engineer followed in a supporting role. Today the architect and engineer collaborate from the beginning, well before design begins. We identify performance characteristics required for the building and define systems needed to achieve energy goals. The building design then emerges as an optimized integrated system where the art of architecture is fused with the science of engineering.

This paradigm for the design process is used in our office. We are currently designing a $42-million office building and parking structure. Working with the client and a construction manager, we

identified sustainability goals and performance criteria for the project. The LEED rating system was reviewed to identify the project's certification potential to achieve the highest sustainability performance. Through this collaborative approach, we are evaluating building exposures, glazing quantities, and product options. We are also evaluating building envelope and building HVAC options for an end result of an energy budget that targets a performance of 40% below ASHRAE 90.1 requirements for energy use. We are creating a computer-generated energy model for the building envelope to identify performance criteria for each exposure of the building. This data will drive the design of the exterior fenestration. We are also evaluating which technology or combinations of technologies offer the optimum energy performance; i.e., geothermal heating and cooling, solar heating with thermal storage, fuel cell technology, raised floor air supply, and photovoltaics.

Results speak volumes. Each building type and site offers a different set of opportunities for this integrated approach to design. The success of this approach has resulted in Harriman being selected to design a 200-bed higher education student housing project in southern New Hampshire that has set a net zero carbon impact. The architectural program included green technologies and sustainable practices to be incorporated into the design. We also recently installed a 250-kW fuel cell at a retail client's store in Connecticut that has an overall efficiency of 85% in producing electricity and heat for building uses, compared to 30%+ efficiency power from the grid and perhaps 80% efficient systems for heating. The heat that is a byproduct of the fuel cell is being used to meet the facility's operational needs. We performed load profiles on this building, which identified the return on investment of this technology. This information assisted the client in evaluating its benefit before incorporating it into the design.

We see the sustainable energy focus being explored worldwide. Recently, we were engaged by a high technology client with facilities worldwide who wants us to help them reduce their $1 million per month utility bill by integrating sustainable energy alternatives into their processes and facilities. We are using energy modeling to analyze the cost/benefit ratio for different systems such as cogeneration, wind turbine, fuel cell, geothermal, thermal storage, photovoltaics, and solar heating technologies in their United States and Malaysia facilities.

The merging of art and science to design beautiful, high performing sustainable buildings challenges all of us to think differently. As a multidisciplinary firm, Harriman is energized by this more integrated design approach. Buildings are more complex, clients have higher expectations and technology is more advanced than in the past. But the urgency of rising energy costs means close collaboration between architects and engineers is more important than ever.

Patrick Costin, AIA, LEED AP, is the chairman of the board for Harriman, Portland, ME.