

A New Paradigm For Building Design

By Jason F. McLennan and Peter Rumsey, PE, CEM

As buildings became more complex over the last century, the divide between architects and engineers widened so far that sometimes it's a wonder buildings work at all. Familiar horror stories include falling glass and sick building syndrome. Vast, often hidden environmental impacts also reflect dysfunctional design. Is there a new paradigm? As collaborators on several projects, we often muse on a better world where architects and engineers truly understand and appreciate each other's work, occupants enjoy the built environment, ecological impacts are lowered, and ultimately buildings become restorative to nature.



Architects and engineers worked together to design ducts (center left) for the atrium of the MSU EPICenter Pilot Building. The low-pressure-drop ducts combine energy-efficient function and pleasing aesthetic form spanning three floors in a vertical public space.

Why do we face this challenge? The increasing sophistication and complication of building systems has reshaped our industry. The "masterbuilder" of old was both architect and engineer, but the complex building process makes it difficult or impossible to be such a person anymore. One job has splintered off into subfields: architecture, interior design, landscape architecture, and electrical, mechanical, structural and civil engineers. These professions make up the design team, but know relatively little about each other's specialties.

Architects provide conceptual design and detailing that helps pull the disciplines together. Engineers focus on specific aspects and subsystems. Architects mandate the engineering objectives and constraints, yet speak a different lan-

guage. Engineers themselves are not all on the same page. The engineering generalist is extinct. One of Peter's professors at U.C. Berkeley told his class (to their amazement) that he received his degree in simply "engineering." Today students have to choose one branch of engineering. Is it any surprise that Berkeley's engineering school is at opposite ends of the campus from the architecture school?

Compounding these challenges, the design process is usually a linear sequence in which the differing disciplines each do their piece of the work in isolation and then hand the design on to the next specialist. This compartmentalization is hard to overcome, and undermines both design integration and building performance. Education and in-service training for design professionals should include more exposure to the key concepts and approaches of the other related disciplines. We require a paradigm where the team acts in unison like a masterbuilder in a weather-tight working structure, not just as a group of separated disciplines passing a baton.

A fundamental barrier to better, greener design is the "fee for equipment" rather than "fee for value" model. Amory Lovins of Rocky Mountain Institute says: "Basing design fees on a percentage of project costs compensates architects and engineers for what they *spend*, not what they *save* on total cost of ownership." Yet building owners often use a percentage of construction costs to gauge design team expenditures. Architects still apportion design budgets to subconsultants (including engineers) based on percentages.

We have worked on several public sector projects where this perspective prevails. In one case we designed a more energy-efficient building and thus downsized the mechanical systems. It took more time to do energy modeling and high-performance engineering design. It took the usual time to lay out the ducting, fans, *etc.*, but because they were smaller, the mechanical construction cost dropped by over 30 percent. Should our fees be dropped accordingly? Obviously not. The owner got a simpler system that cost less to build and run. These results should be the design imperative. The small increase in design cost will be far outweighed by the potential construction and energy cost savings, not to mention lower environmental impacts.

Cutting design/build budgets to the bone without considering the effect on building performance or O&M costs is stan-

standard practice, but it will never produce good design. Nor will higher fees alone guarantee better design. We have also seen big-budget projects result in dis-integrated, non-sustainable design. Design budgets typically lack incentives for engineers to add value. One remedy is to reward designers in part with shared cost savings from better design, such as smaller mechanical systems or improved energy efficiency.

Electrical and mechanical engineers often fall into the trap of repeating standard designs and relying on rules of thumb to save time. We have seen many projects where the engineer asks not to be involved until the middle or end of the design development stage (when the architectural design is 50 percent to 75 percent complete). Integrated design, energy efficiency, daylighting, natural ventilation and many other sustainable strategies are nearly impossible to integrate into a building at such late stages of design. Green design is difficult without early involvement by the whole design team, including the engineers.

Building owners, architects and engineers need to rethink the design process. Integration and collaboration should be key features of building design, ideally from the earliest phases. Integrated design exercises or "charrettes" bring together key participants in the design-build-operate process at the beginning, providing huge leverage for project improvements. Also, we observe that communication

between design team members has been greatly enhanced in Leadership in Energy and Environmental Design (LEED) projects, because it provides project participants with a common framework and goals that transcend construction cost myopia.

Better designs are generally easier to build, use less energy, and provide better indoor and outdoor environments. Greater collaboration and coordination can reduce design conflicts and simplify construction requirements throughout the project, and downsize artificial lighting and utilities. This benefits building owners and occupants, and can reinvigorate the design process and make it more exciting and fun. **ED+C**

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