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Building information modeling (BMI): A sustainable design tool for the AEC industry

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Recent popular interest in environmental sustainability and green design, as evident in increased market demand for LEED certified buildings, challenges building owners, tenants, designers, and builders. We know that we need more creativity in delivering higher-performing, healthier buildings and spaces. We see new building technologies, but we need demonstrable evidence that these innovative ideas will actually work as promised and reliable analysis to convince us that they are cost-effective.

For many years now, designers relied on powerful digital simulation tools to test and evaluate innovative design ideas. For example, energy modeling software can compare energy efficiency options and predict anticipated energy consumption, computational fluid dynamics (CFD) modeling can demonstrate air flow in naturally-ventilated buildings, and daylight simulation tools can test sun shading and internal daylight penetration. However, in practice these tools have proven expensive and often cannot provide output quickly enough to inform a fast-moving design process.

The LEED Green Building Rating System increased awareness of the potential for these simulation tools. LEED points are awarded for quantifiable performance measures, and these tools provide quantifiable demonstration of that performance. Despite the overwhelming success of LEED, critics charge that the LEED certification process is cumbersome, and they have been right - until now.

While digital simulation tools are not new, recent advances is building information modeling (BIM) software now provide architects and engineers with access to powerful analytical and performance simulation tools that quickly produce usable results. In the past, these simulation tools required designers to re-model proposed options in each individual software tool. Now, design teams can connect BIM data directly to each software tool, eliminating time required for remodeling. In addition, the output from these simulation tools can be depicted graphically rather than just numerically, resulting in an understandable explanation of the results.

BIM is a relatively new term to describe a radical transformation from the paper-based process with which building design has been traditionally created to a process utilizing a digital 3-D model. The transition to BIM over the next few years will be even more revolutionary than the transition from hand-drafting to CAD. The information captured by BIM can be simultaneously viewed as conventional architectural plans and elevations, as lists of vital figures and statistics, and as photorealistic, 3-D renderings, and other formats of real-time data.

BIM will help the AEC industry better optimize design, construction implementation, and long-term building performance. As examples, we are already seeing the following sustainable design applications of BIM:

Visualization: BIM output helps owners and builders to easily visualize opportunities proposed by the design team. The design team can quickly study and optimally resolve design problems in 3-D and

that same design data can be communicated through perspective views. Similarly, quantitative building performance data, such as natural day lighting levels, can be displayed in readily understandable graphics that can help decision makers understand the environmental benefits of one option over another.

Quantification: BIM database easily quantifies measurements and components for quantity surveys and cost estimating. This data can both streamline analytical LEED calculations and can also depict decision-ready information, for example comparing two options.

Simulation: The BIM database connects to building performance simulation tools for real-time computational analysis providing the most effective means to study and evaluate optimum performance characteristics.

Systems coordination: 3-D descriptions of the physical relationship between various building systems provides a thorough and accurate means of detecting and correcting collisions and conflicts in complicated building systems, optimizing the space required for building systems and reducing unnecessary re-work and waste.

Fabrication: The accuracy and thoroughness of the BIM database provides design and construction teams with the confidence to employ digital connections between the design model and fabrication. Direct from digital fabrication allows more efficient use of raw materials, increases precision, and reduces field work.

In summary, BIM offers a very powerful new sustainable design tool. This tool will not only help to produce better coordinated conventional construction documents but will help design teams to confidently design higher-performing buildings, and to communicate the potential quantifiable benefits of innovative new building technologies. In doing so, design teams will be able to make the best use of digital simulation tools and efficiently produce the demonstrably quantifiable documentation required for LEED certification.

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