

Thinking Green

Live \ Learn \ Work \ Sustain

A PUBLICATION OF
BOVIS LEND LEASE BOSTON
2009

Building Value into Buildings

Building Information Modeling
Path to Sustainability

Sustainable Design in the
Life Science Industry

Green Retail
Instead of selling green, leading retailers
are greening the sell

A New Stream of Thought
A Sustainable Approach to
Construction Waste Stream Management

Green Marketing 101
Educate, Don't Manipulate

Productivity Gains
The Hidden Benefit of Green Office Space

Hospitals Find
It's Not Easy Being Green

You Have Worms In Your Office?



Building Information Modeling Path to Sustainability

By **Julie Paquette**, PE LEED AP
and **Chad Wisler**, PE LEED AP

Vanderweil Engineers

Building Information Modeling represents the future of the design and construction industry, promising to transform the way buildings are created. Advocates assert that use of BIM technology will lead to unprecedented construction efficiency with fewer errors, lower costs, less time, and also improve the ultimate building performance in many ways. Greenbuilding advocates are equally enthusiastic that BIM tools will help create the most sustainable buildings and systems. While seemingly far from fruition, it is important to understand what leading companies are doing today to advance both BIM and green building simultaneously.

WHAT IS BIM?

Building information modeling is the process by which a digital, three-dimensional, object-oriented software package is used to create an information-rich central database that will follow the project from design inception to operation. Designers do not simply draw walls; they define and link a 7-5/8" CMU wall object that can be parameterized with such data as R-Value, fire-rating, paint color, cost, and procurement time. In this way, BIM may be used not only to design and document a project, but also to track materials, coordinate construction, analyze future performance, and manage the building when occupied. Further, the embedded information of an object is not replicated anywhere in the model. The user may view this centralized information through many lenses including the 3D model, floor plans, elevations, section cuts, schedule, and drawing sheets. This means that when a user makes a change through any lens or view, they are changing

the central embedded information and all lenses reflect that change. This integrated framework alone sells many on the power of BIM technology – but that's just the beginning.

HOW WILL BIM HELP CREATE HIGH PERFORMANCE GREEN BUILDINGS?

Green building advocates have long recognized that BIM technology could be used to create high performance buildings and systems. In fact, the US Green Building Council announced a strategic partnership with Autodesk two years ago to jointly develop tools and curriculum focused on BIM applications. Although software and processes are far from fully realized, there are several reasons why BIM is important for green building.

Integrated Project Delivery

Aggressive green building goals, including significant energy and carbon reductions, are best achieved through collaborative processes that integrate design disciplines and construction teams. BIM is a tool to facilitate such processes. BIM enables information to be exchanged and analyses to be performed quickly so that green building decisions are better-informed and easier to make. BIM also provides a single platform through which all members of the project team engage – not only fostering integrated project delivery, but requiring it.

Analysis

Computer analysis tools, such as energy modeling and computational

fluid dynamics, have been around for decades. However, use of these tools is often limited by time, cost, and lack of expertise across disciplines. For example, at Vanderweil energy modelers trained in specialized software such as eQUEST create a virtual model of a building to predict energy demand in a particular climate. Setting up the

“ BIM enables information to be exchanged and analyses to be performed quickly so that green building decisions are better-informed and easier to make. ”

model takes many hours, iterations are slow, and the accuracy of the results depends on the accuracy of the inputs. These challenges limit the use of energy modeling as an effective tool early in the project. Further, there are few software packages that allow multiple studies to be effectively based on one model. An advanced team may build three separate models to analyze energy use with eQUEST, simulate day-lighting with ECOTECT, and assess airflow with Fluent Airpak. The question is: what does BIM offer instead?

1. Translating Geometry

BIM tools, such as Autodesk's Revit, translate the building's geometry directly from a design drawing. This capability alone dramatically reduces the time and effort that goes into setting up models for analyses. Because BIM

information is interconnected, changes to design are reflected throughout the “drawing set,” allowing much faster iterations.

2. Incorporating energy modeling capability

Because energy modeling requires information that isn’t typically defined even in BIM models, Revit incorporates a protocol for translating data from drawings to energy simulation inputs. Essentially, the protocol assists users in defining HVAC zones, fills in model gaps with many default assumptions, and generates a gbxml file to be used in a DOE-2 energy simulation engine. The process isn’t perfect; trained engineers still need to be involved to validate the assumptions and vet the results.

3. Offering additional performance modeling capability

In early 2007, Autodesk partnered with IES to expand Revit’s analysis capabilities. IES developed Virtual Environment, a software package that models energy use, day-lighting, thermal loads, and computational fluid dynamics based on one shared model. Currently, Revit MEP uses an IES engine to calculate heating and cooling loads directly.

Materials

The ability to easily and effectively track material volumes, cost, and attributes offers significant green building benefits. Using BIM tools, designers can select building elements from a “library” of materials and assemblies which may be linked to all sorts of useful information: cost, lead times, and green data like recycled content, VOC levels, and embodied energy. The ability to use this information more easily ought to encourage manufacturers to actually provide it. In addition, if the model is set up properly by the designer, it may be used to estimate material quantities without the error and tedium associated with hand take-offs. Accurate measurements inherently reduce waste.

Certification

While no rating system is flawless, LEED and other green building certification programs level playing fields in the industry by defining green building holistically. While the use of certification should increase, the time, effort, and cost that go into documentation should really decrease. BIM tools may be used to aggregate building information and streamline the different types of analyses that are typically required for

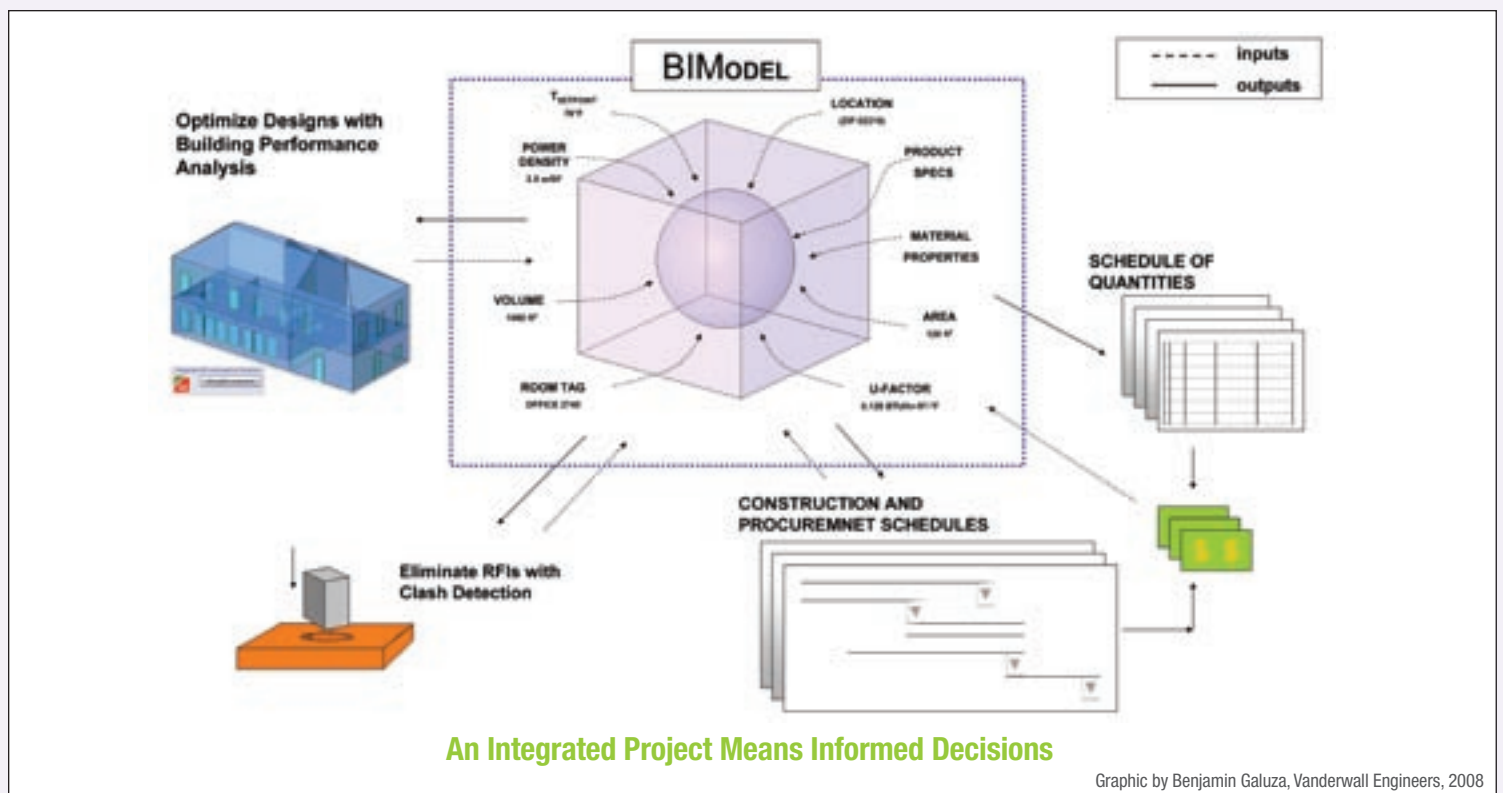
documentation. In late 2007, the USGBC demonstrated such a process under development.

WHAT ARE LEADING FIRMS DOING TODAY?

Since BIM is an evolving technology, we ask what leading firms are doing to promote its use for green building. At Vanderweil, we have been piloting Revit for several years on select projects with clients at various stages of technology adoption. We have experienced the complexity firsthand with a range of project challenges and successes. We feel that today, time and effort must be invested in the following four areas:

Production

Some firms are using BIM tools to create small projects or small portions of larger projects initially to train designers in production, build their assembly libraries, and troubleshoot as they go. Because software like Revit MEP is currently less sophisticated than its counterpart Revit Architecture, design teams may produce 3-D architectural drawings which are then “flattened” to allow conventional 2-D drawings from consultants. These are early, but critical steps. As the ability to draw, embed information, and share models increases, so does the ability to



Graphic by Benjamin Galuzo, Vanderwall Engineers, 2008

use these models effectively for green building.

Software

Given the speed at which technology changes, selecting BIM software and modeling tools can be a gamble. The most popular software packages include ArchiCAD from Graphisoft, Microstation suite from Bentley Systems, and Revit from Autodesk - mentioned throughout this piece. These players continue to purchase other software packages to expand their green building capabilities. In 2008 alone, Autodesk acquired Green Building Studio (creator of the gbxml format) and EcoTect to enhance Revit. Leading firms must stay flexible and up-to-date on such changes.

Validation

As new building performance tools are developed and incorporated in BIM software packages, it is important to

validate the results against those from older, more established tools. We need answers to questions like: how do thermal load calculations from Revit MEP compare to Trace 700? How do CFD results from IES Virtual Environment compare to Fluent Airpak? Validation is a critical step not only towards building confidence in new software in-house, but also towards gaining its acceptance by standard-setting and certification entities like ASHRAE and the USGBC.

Partners

The ability to go directly from a design model to an energy or lighting simulation is promising for green building, but it is not automatic like a “push of a button.” Any type of performance analysis requires many inputs and simplifying assumptions, and firms need to partner to make it happen with BIM tools. Models can be

derailed by lack of information, wrong information, and too much information. Engineers need architects to build models correctly with the necessary information for analysis, and architects need engineers to define appropriate levels of information, make meaningful assumptions, and interpret the results.

CONCLUSION

Moving forward, BIM technology will continue to advance as more users develop skills and successful projects. At the same time, the global mandate for green building will continue to grow stronger. The steps that are being taken today are critical as a foundation for the future. A future that no doubt requires buildings with less embodied energy, fewer carbon emissions, lower operating costs, at a cost less than yesterday’s going rate. The firms who are making the leap today while there is still a gap to be bridged will see the greatest reward.

VANDERWEIL
vanderweil.com

WGBH, Corporate Headquarters, Boston, MA

Who we are...
Founded in 1950, I.G. Vanderweil Engineers, LLP is a 400-person multi-disciplinary consulting engineering firm specializing in mechanical, electrical, and plumbing systems. We are a company which values its clients, employees and the environment and we have built our practice accordingly. Our commitment to developing innovative solutions and working partnerships with our clients has earned us a 90% repeat business ratio.

What we do...
Vanderweil specializes in the following engineering services for buildings, central heating and chiller plants, power generation, and transmission and distribution (T&D) design:

Mechanical	Electrical	Sustainable Design
Fire Protection	Commissioning	Telecom/Data
Energy Modeling	Plumbing	Utilities

BOSTON • LAS VEGAS • NEW YORK • PHILADELPHIA • PRINCETON • WASHINGTON, DC

ABOUT THE AUTHOR

Julie Paquette leads the Green Initiatives Group at Vanderweil Engineers. She provides green building and LEED consulting for a wide range of corporate, industrial, and academic buildings. Expertise includes process, plumbing, and water management systems, technical training, and design delivery. Julie is a registered professional engineer, LEED accredited professional, and holds engineering degrees from Brown University and MIT. Reach her by email at jpaquette@vanderweil.com.

Chad Wisler is responsible for the firm’s Life Science group operations as well as the firm’s Green Initiatives Group corporate direction. He specializes in the design of HVAC systems for laboratory & process facilities as well modeling systems for true informed design. Chad is a registered mechanical engineer as well as LEED accredited professional. Reach him by email at cwisler@vanderweil.com.