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Sustainability

SPECIAL REPORT: ENGINEERING SERVICE FY10 PROGRAMS

BIM for LEED

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Sustainability continues to be an important factor in design and construction at all levels of government. The growing need for sustainable design means innovation and new expertise must balance growing demand with increasing regulation. For the U.S. Army Corps of Engineers, sustainability standards were reemphasized in 2006 when the Assistant Secretary of the Army for Installations and Environment issued a memorandum announcing the formal transition from the Army's Sustainable Project Rating Tool to the U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) green building rating system for the FY08 construction program. Today's military construction projects target the sustainable standard equivalent to LEED Silver certification.

The movement towards sustainability was given an extra boost in February when the *American Recovery and Reinvestment Act of 2009* was signed into law. Among its numerous construction-related initiatives, the law's provisions include more than \$3 billion for the repair and modernization of defense facilities. Roughly \$600 million will be spent on energy alternatives and efficiency innovations. Other significant sums

will be allocated to the Department of Energy (DOE), the Environmental Protection Agency (EPA) and the General Services Administration to replace or upgrade water, transportation and other key systems for increased energy efficiency and sustainability.

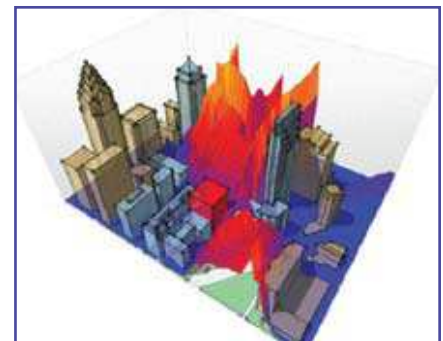
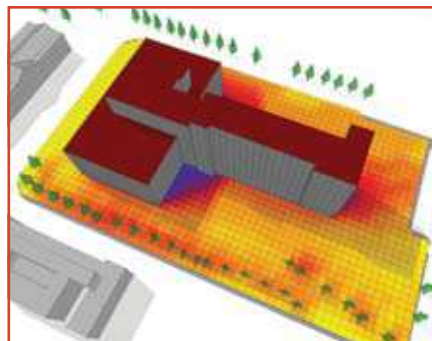
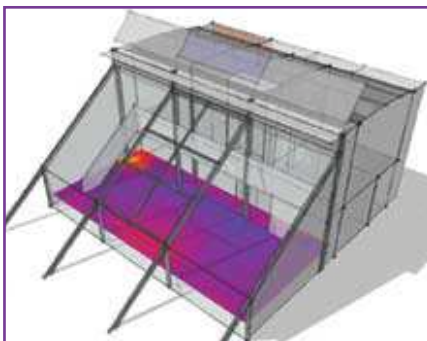
As our nation's goals for a sustainable environment converge with opportunities to launch construction projects connected to energy reduction, the innovation of building information modeling (BIM) can help make this vision a reality.

Sustaining the Future

Although there is no explicit requirement for Department of Defense (DOD) projects to officially certify LEED Silver, there is a solid commitment to this standard on the part of military agencies. The principles of LEED are firmly in the minds of design, engineering and construction teams, focusing on characteristics inherent to LEED certification such as sustainable sites, water efficiency, energy, materials and resources, indoor environmental quality, and innovation and design. Military designers and engineers striving to create and assess designs based on these criteria can be assisted by BIM technology. BIM authoring tools are software packages

Building information modeling enables engineers to analyze and predict the sustainable performance of proposed designs.

BIM software can assist designers analyze sustainable design elements including daylighting (left), solar radiation (center) and overall project visualization (right).



Images courtesy Autodesk

capable of describing a building or infrastructure project in 3-D, defining actual building or infrastructure elements in terms of parametric relationships and linking spatial elements with data relevant to key aspects of the project.

The U.S. Army Engineer Research and Development Center has launched research projects and initiatives to improve the sustainability of military design and construction. The Center for the Advancement of Sustainability Innovations, a research facility integrated with the Army's Construction Engineering Research Laboratory and the University of Illinois, has a project to understand how BIM can contribute to goals for sustainability. The Fort Bragg (N.C.) Community Emergency Service Station project is being designed and built utilizing BIM with a goal of achieving a design equivalent to LEED Platinum. A model and analysis tools helped the team determine the most effective configuration and systems to achieve sustainable goals for the building.

The adoption of BIM in practice among military engineers, architects and contractors continues to increase. Clark-Nexsen, an architecture and engineering firm headquartered in Norfolk, Va., has made commitments to both BIM and LEED.

According to Willie Cooper, AIA, a Senior Associate Architect who heads up Clark-Nexsen's BIM implementation efforts, "BIM is a different way of looking at design. Sustainable design is happening in the same way. We are evolving our process to incorporate both BIM and LEED—a direction that fits where the industry is going."

Cooper points out the value in these approaches for Clark-Nexsen's prototype projects, such as for Navy Federal Credit Unions, and for DOD schools. The BIM-based design allowed the firm to conduct analysis earlier in the design process. The firm now targets LEED Silver based on client demand.

Tools for Sustainability

BIM and sustainable design are connected by utilizing the capabilities of the model to provide useful data to analysis tools that report on a design's predicted performance on key sustain-

able characteristics. For example, BIM authoring tools can convert the model into a non-proprietary format for sustainable design information, such as Green Building xml, or gbxml. This format is supported by many vendors of BIM products and sustainable analysis products. Practitioners use the capabilities of gbxml to transfer and analyze models using a variety of sustainability analysis tools, helping accelerate the design of projects for LEED compliance.

Questions design teams can answer with the assistance of BIM include:

- How will solar patterns and climate interact with building forms to produce heat gain and interior illumination?
- How will the design's glazing patterns and specific materials impact the project's ability to manage thermal gains?
- How will design elements impact interior illumination, glare and heat gain?
- How will interior partitions impact air flow throughout the space?

Web services such as Autodesk Green Building Studio accept models and produce graphs and numerical assessments of building projects. The analysis includes projections of carbon emissions and EPA's ENERGY STAR scoring. This Web service provides whole-building energy analysis and includes reports on the qualification for LEED daylighting and water-efficiency credits. Other tools, such as DOE's EnergyPlus, can provide additional insight.

Construction and design-build firms are realizing benefits in combining BIM with sustainable design in government projects. Mortenson Construction, a design-build firm, is using an entirely new BIM workflow to approach construction difficulties, particularly with sustainable design.

"Our more LEED-sophisticated design partners are able to consider the environment and building systems in the proposal design phase with our Revit model, and import the model to eQUEST or IES VE to study the energy model," said Patrick Burns, P.E., F.SAME, Vice President at Mortenson.

"We can study sustainability tradeoffs in the model, understand quickly where we are achieving energy reductions and get to the right decisions in the proposal stage, then improve on that in the

actual design," said Burns.

This approach has been used successfully on Mortenson's recent hangar project at Naval Air Station Jacksonville, Fla. The approach helped enable Mortenson and project architect HNTB to meet the U.S. Navy's requirements for clear spans—nearly three football fields long—well within schedule.

Sustainability and Beyond

Other benefits in the BIM workflow are applicable to sustainable projects. Quantity take-offs can be done in schematic design and throughout the design process for cost modeling. The use of BIM can increase procurement efficiency, schedule and phasing, which helps address sustainability requirements for efficiency in the use of materials and on-site waste reduction during construction. Additionally, the detection of clashes, errors and fabrication inefficiencies pre-construction provides sustainability benefits as well as cost savings to project.

Post-construction, there is an awareness of the importance of sustainable facilities management, which is represented by USGBC's LEED Existing Buildings program. AutoCAD Civil 3D software, an engineering and design tool, helps with site-level decisions that are important to LEED ND, USGBC's program for neighborhood development, and for LEED NC, for new construction.

Government contractors and agencies have gained tremendous expertise in BIM and sustainable design. Approaching A/E/C firms with requirements for sustainability and investigating BIM as a means to achieve goals is a good first step in government construction projects. Given DOD's commitment to urgent action on sustainable improvements, the opportunities afforded by programs like the *American Recovery and Reinvestment Act*, and the increasing attention paid to this issue in all levels of government, the link between sustainable design and BIM is growing. TME

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