Building Information Modeling for Sustainable Design

Building Information Modeling facilitates complex processes and analyses that were previously too laborious or expensive to perform. This white paper details how Revit® Architecture, Autodesk's purpose-built BIM solution, supports key aspects of sustainable design and "green" certification.

CONTENTS

Over the last 20 years information technology has revolutionized the design and production of movies and music, airplanes and toasters, machinery and holidays. The design of manufactured items in particular has benefited from design software that enables the engineering and analysis of every conceivable characteristic of an assembly, from physical and operating characteristics to thermal behavior and fabrication requirements. The adoption of digital prototypes in manufacturing has made products more efficient and suitable to their purpose, less costly, and more stylish.

Architects and engineers are now applying similar tools to building design. The most sophisticated of these tools deliver continuous and immediate feedback on a far greater range of characteristics than conventional design tools. Material quantities and properties, energy performance, lighting quality, site disturbance, and what-if comparisons between new construction and renovation are some types of information that are easily available from these tools. This approach to building design is so different from using conventional CAD software that the industry has a new name for it: *building information modeling* (BIM).

As building growth intersects with environmental concerns and the rising cost of energy, a growing field within building design has emerged - *sustainable design,* the practice of designing, constructing, and operating buildings in a manner that minimizes their environmental impact.

Green Architecture

For most people, the environmental impact of buildings is startling. In the United States, commercial and residential buildings consume close to 40% f our total energy, 70% of our electricity, 40% of our raw materials and 12% of fresh water supplies. They account for 30% of greenhouse gas emissions and generate 136 million tons of construction and demolition waste (approx. 2.8 lbs/person/day).[1]

[1] U.S. Department of Energy, Energy Efficiency and Renewable Energy Network (EREN). Center of Excellence for Sustainable Development, 2003

Autodesk®

Sustainable design seeks to mitigate this negative impact through the use of environmentally sensitive design and construction practices. The goal of sustainable design is to produce green buildings that are "environmentally responsible, profitable and healthy places to live and work."[2]

The concept of sustainable design is not new. For instance, NYC's Rockefeller Center, built during the 1930s, used roof top gardens and operable windows - design aspects that we now term as "green." But the energy crisis of the 70s coupled with an emerging environmental movement launched the modern era of eco-friendly design.

Standards for Sustainable Design

Conservation efforts and sustainable design gained momentum during the 80s and 90s, as focus shifted from point strategies like solar heating to a holistic approach to green design. A national sustainable design organization, the U.S. Green Building Council (USGBC), was created in 1993 - formed by a group of leaders from the North American building industry.

Today they are the guiding force behind the voluntary LEED (Leadership in Energy and Environmental Design) Green Building Rating System®, widely accepted as the national standard for sustainable design. The LEED® rating system awards points for satisfying specified green building criteria in five major categories: site design, indoor environmental quality, and efficient use of energy, materials, and water.

In the United States, the LEED standard has been adopted nationwide by federal agencies, state and local governments, and interested private companies as the guideline for sustainable building. A high LEED rating (out of a 69 point theoretical maximum) recognizes the excellence of a green building design and qualifies the project for an array of financial and regulatory incentives from state and local governments, and even from privately funded organizations promoting sustainable design.

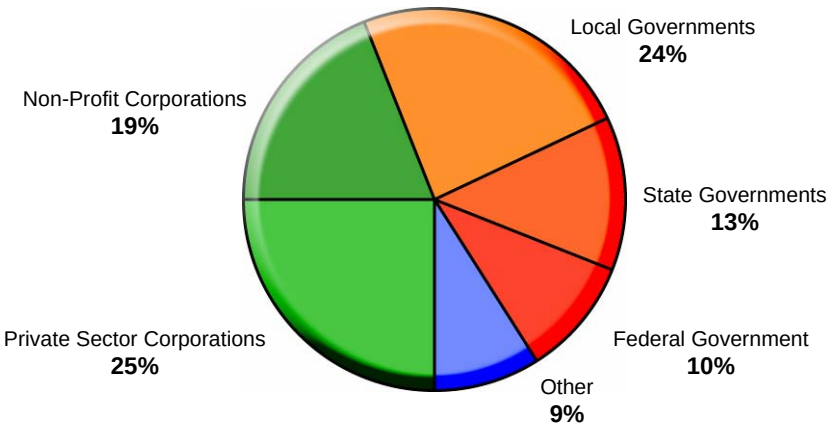


Figure 1

LEED certification is being pursued by a variety of building owners.

(Source: USGBC, Sept 2004)

Internationally, similar standards are emerging. Canada has joined the LEED program, and several European countries have their own green assessment programs, including U.K.'s BREEAM® (Building Research Environment Assessment Method), Holland's Eco-Quantum, and the Swiss ecoinvent life cycle analysis methodology.

Green Report Card

Although the majority of today's building projects are still designed and built with little regard for environmental impact, the recent surge of interest in sustainable design is

[2] U.S. Green Building Council, Mission Statement, 2004

undeniable. The USGBC reports that the number of LEED-certified projects doubled between 2002 and 2003. And in a 2003 survey of the building industry[3], nearly half the firms surveyed had initiated at least one project based on green-building principles.

But what is the cost of sustainable design? Depending on the building project and the "green" measures selected, the net change in construction and operating costs can range from a savings to unaffordably expensive. Long-range lifecycle assessments may paint a rosier picture but in today's tight economy, building developers and owners are especially sensitive to the value that their design and construction dollar buys.

Complicating the cost analysis, the design process can require more resources as many of the engineering and analysis tasks that used to be conducted later in the design process are shifted towards earlier phases to assist in evaluating sustainable design options, and others that may never have been done at all (such as daylighting studies) become routine.

BIM, supported by appropriate technology, has the potential to reduce the cost of sustainable design by making the information required for sustainable design, analysis and certification routinely available simply as a byproduct of the standard design process.

What is BIM?

Building information modeling is an innovative new approach to building design, construction, and management that was introduced by Autodesk in 2002. It is characterized by the continuous and immediate availability of project design scope, schedule, and cost information that is high- quality, consistent and reliable.

The Revit building information model has changed the way industry professionals think about how technology can be applied to building design, construction and management.

While many technologies can be used to support BIM, Revit Architecture is purpose-built for BIM and delivers its highest benefits because it is based on parametric building modeling technology, which uses a relational database together with a behavioral model to capture and present building information dynamically.

Just as a spreadsheet is a tool for thinking about numbers, software built on parametric building modeling technology is a tool for thinking about buildings. And just as a change made anywhere in a spreadsheet is expected to update everywhere with no further intervention from the user, so a change made anywhere in a parametric building modeler is immediately reflected everywhere.

BIM and Sustainable Design

In current practice, many digital building models do not contain sufficient information for building performance analysis and evaluation — the building blocks of sustainable building design. As with traditional physical models and drawings, evaluating building performance based on the graphic representations of conventional CAD or object-CAD solutions requires a great deal of human intervention and interpretation, which renders the analyses too costly and/or time-consuming.

The Revit parametric building modeler represents the building as an integrated database of coordinated information. Beyond graphically depicting the design, much of the data needed for supporting sustainable design is captured naturally as design on the project proceeds. In addition, the integration of Revit Architecture with commercially available analysis tools greatly simplifies the often cumbersome and difficult analyses. By linking the building model directly to the analysis software, Revit Architecture gives architects easy

[3] *Building Design & Construction White Paper Survey*, 09/03, Source: Reed Research Group

access to tools that provide immediate feedback on design alternatives early on in the design process.

As such, Revit Architecture is particularly well suited to address the kinds of problems sustainable design professionals encounter every day – and may eventually open up new building characteristics such as embodied energy and complete lifecycle costing for evaluation and optimization. For projects pursuing LEED certification, many LEED credits require that drawings be submitted to support the qualification for the credit. Although most of these drawings can be prepared using conventional CAD software, Revit Architecture produces these drawings more efficiently as part of the building information model and has the added advantage of parametric change technology, which coordinates changes and maintains consistency at all times. The user does not have to intervene to update drawings or links. A LEED requirement documented in the Revit building information model is far less likely to fall out of synch or be overlooked (and inadvertently violated) during project design than a requirement documented in a conventional CAD or object-CAD-based application.

Today, Revit Architecture customers are using building information modeling for a variety of sustainable design activities including design optimization, visualization, daylighting, energy analysis, quantity takeoffs, and specifications management – to name a few.

The Revit model carries a wealth of information necessary for many other aspects of sustainable design and/or LEED certification. For instance, schedules of building components can be obtained directly from the model to determine percentages of material reuse, recycling, or salvage. Various design options for sustainability can be studied and tracked in the model. Advanced visualization techniques can convince an otherwise skeptical client that green design performs well and looks good.

Design Optimization

During any design process, the architectural team needs to track various design options until enough information is available to decide between them. For example, an open office scheme providing daylighting and views may need to be tracked with a more partitioned layout for programmatic and environmental comfort purposes well into the documentation phase. These two options could then be used for detailed daylighting design analysis.

Building information modeling with Revit Architecture supports design optimization by letting architects develop and study multiple design alternatives (green or not) simultaneously within a single model. Design options can be toggled on and off in the model for visualization, quantification, and analysis as needed, and can be maintained for as long as required (which sometimes can be quite late in the design process) and then incorporated, discarded or archived as key design decisions are made.

In this fashion, what-if analyses examining different sustainable design options for varying levels of LEED certification (or alternate ways of achieving the same level of certification) can be easily examined and thoroughly documented within the Revit building information model - keeping good ideas on the table as long as required for evaluation.

Design Optimization Case Study: Skyscraper Digital

Skyscraper Digital began in 1992 as the digital imaging studio for its parent company, Little Diversified Architectural Consulting, but quickly evolved to serve a wider audience seeking to use 3D technology and services as an effective business tool. Today Skyscraper's unique digital tools have applications spanning all industries including institutional, educational, corporate, government, resort and entertainment.

Skyscraper Digital (*www.skyscraper-digital.com*) has been using the Revit building information modeling solution for four years, and has recently made extensive use of its design options feature for a building rehab project.

One of Skyscraper's recent projects is the rehab of a 14 story headquarter building of a large financial services company located in Charlotte, North Carolina. To support daylighting analysis, Skyscraper developed a host of design options for the project, all of which were maintained in the building information model.

By keeping these various design options active as the design matured, Skyscraper was able to study several daylighting scenarios during the schematic, design development and construction document phases. Having multiple design options available within the same file allowed them to quickly go back and forth between the options as the design progressed. For example, they were able to toggle between very early, simple massing forms to more refined and detailed solutions as shown in Figure 2 below.

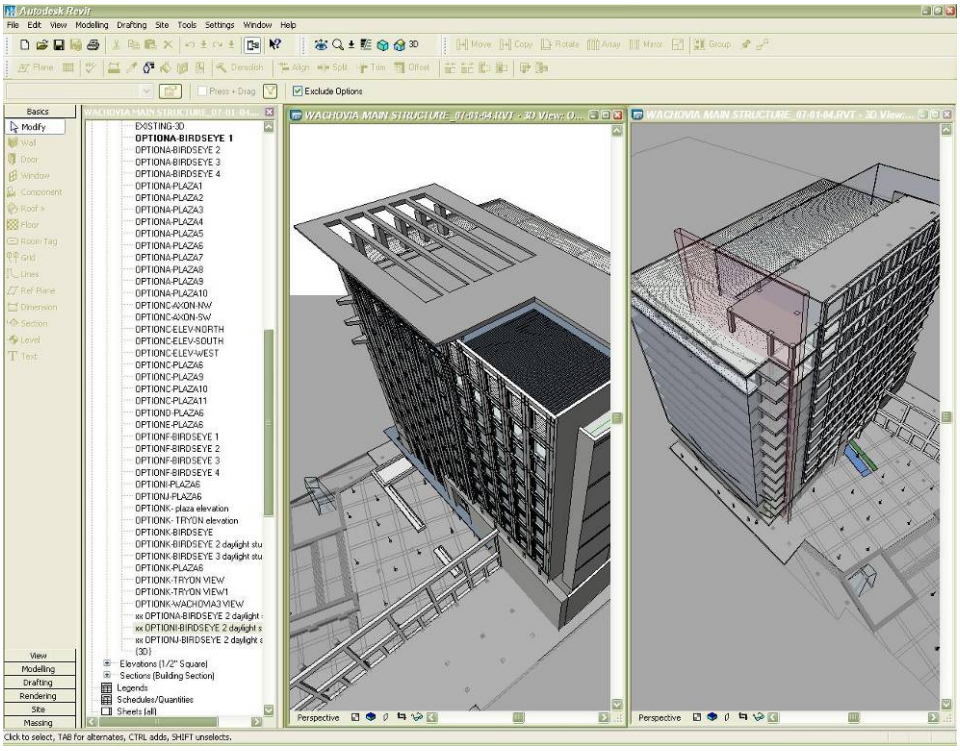


Figure 2

Skyscraper Digital made extensive use of design optimization for this building rehab project.

Taking advantage of the centralized database, Skyscraper's team was confident that they weren't repeating or duplicating themselves anywhere and were able to make informed decisions throughout the design process.

Visualization

During the Middle Ages and into the Renaissance, master builders designed and built their projects using on-site, life-size models (i.e., the actual built project). As the centuries passed, those processes that were used to create St. Peter's Basilica and Notre Dame Cathedral evolved into what we now think of as the design/construction process, where architects – separated from the construction process – uses two-dimensional drawings to visualize and document their design.

Some design professionals are seeing BIM as an opportunity for increasing their influence over the entire building project – perhaps bringing the architect closer to the "master builder" Renaissance ideal.

BIM allows architects and engineers to become "digital" master builders who are able to see the building, its materials, its structure, and its performance in real time as it's being designed, and (more importantly) before the design is converted to very expensive bricks and mortar – or more likely metal studs and gypsum board. At the same time, this model can very efficiently provide a fully coordinated set of conventional documents that is accurate and reliable.

This is the power of building information modeling with Revit Architecture, and is critical to many aspects of successful sustainable design. The building information model can be used in conjunction with software tools for energy analysis, lighting studies, and so forth, to *quantify* the green effects, while 3D visualization and walk-throughs allow the design team and the client to *see* the greener design.

Visualization Case Study: Little Diversified Architectural Consulting

Little Diversified Architectural Consulting (*http://www.littleonline.com*) recently used the visualization capability of Revit Architecture to communicate the merits of a reduced exterior light pollution design to their client, the University of North Carolina.

Headquartered in Charlotte, North Carolina, with offices across the United States, Little has expanded its core design services to include sustainable design analyses for work-place, retail, and community clients. They were commissioned by UNC to renovate a 1960s dormitory into an updated, high-end residence hall – improving interior comfort and energy use as well as updating and improving the exterior appearance. One green aspect of the project was how to minimize light pollution.

Lighting the night sky with extraneous light is both unnecessary and expensive, but it's done routinely in North America and elsewhere – partly through carelessness and partly due to lack of time and tools to deal with it effectively. Also, "light pollution" to one owner may be "security lighting" to another.

For the rehabilitation project, UNC required the use of the LEED rating system as a guide-line for this project, which is in the State of North Carolina's pilot program for greening state buildings.

Figure 3

Little Diversified Architectural Consulting used high-quality images from Revit to communicate the merits of this reduced exterior light pollution design.

Little's team used Revit Architecture for the project, and were able to visually analyze the effects of custom lighting fixtures on the facade, designed to reduce light pollution. They also used Revit Architecture to develop an effective light-shelf design to maximize bounced daylight to the windows on the walkway sides of the 10-story dorm. By using their standard design environment for these specialized functions, the decision-process became more efficient and informed. And by being able to literally "see" the building in advance and analyze lighting levels, UNC was able to rapidly approve this aspect of the project design.

Daylighting

Daylighting, the practice of using natural light to illuminate buildings, not only makes people more comfortable and productive, it can sharply reduce the electrical lighting load and subsequent heat and energy loads. A sustainable, high-performance design can derive much of its ultimate success from effective relationship to, and integration of, the sun's energy into the design of the building envelope and fenestration.

However, effective daylighting is rarely performed due to the complexity of formulas required to accurately analyze daylighting characteristics. There have been computer software programs available for years that can accomplish these tasks, but the cost to use them was prohibitive because of the cumbersome and difficult methods for entering the building design information.

Revit Architecture changes this by allowing the design team (rather than expensive lighting labs) to undertake the modeling, measurement, and documentation of complex interior daylighting designs *within their standard design environment*.

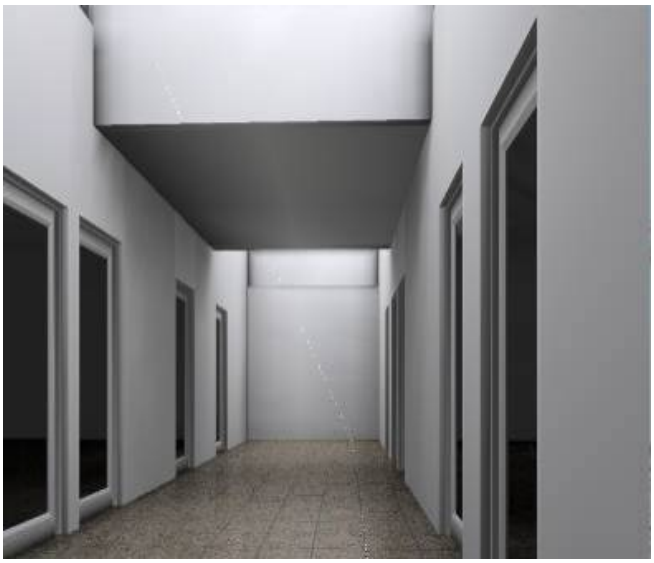
Daylighting Case Study: Little Diversified Architectural Consulting

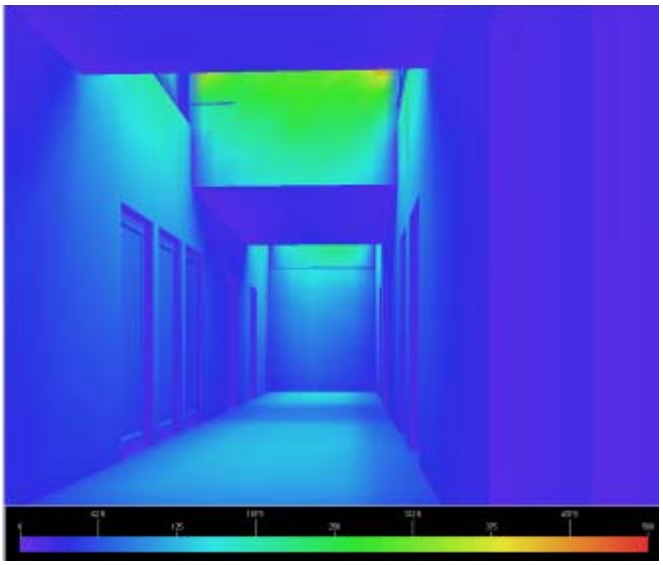
Turning again to an example from Little, they relied on Revit Architecture for an innovative green design of the new Living/Learning Center at the University of South Carolina in Columbia. The complex offers housing for 500 students, assembly space, classrooms, and offices. Incorporating state-of-the-art sustainable design strategies, the Learning Center is partially underground and features a turf roof that helps to absorb rainwater and becomes an integral part of the existing campus landscape.

In the past, Little sent projects like this out to a laboratory for daylighting analyses, but with Revit Architecture they can now perform them in-house. During planning, the firm combined Revit Architecture and AutoCAD® software to select the best site and orientation to maximize solar access for balanced natural lighting and energy conservation. During design, Little used Revit Architecture for interior daylighting design and exterior bouncelight between buildings. And Revit Architecture was essential to Little for calculating points for the building's targeted gold LEED rating.

Figure 4

Little used models from Revit to produce high quality realistic renderings for daylighting analysis (left) and numerically quantifiable pseudo-color intensity radiosity models (right).





Construction of the Living/Learning center has recently been completed, and the project delivers the promises made to USC for a high-quality sustainable structure that uses 45%

less energy and 20% less water than typical construction, that has virtually no water run-off, and that costs no more to build than a conventional building.

Energy Analysis

According to the Department of Energy, there are more than 76 million residential buildings and nearly 5 million commercial buildings in the United States today. The beginning of this white paper contained a remarkable figure relating to those structures that bears repeating: buildings consume close to 40 percent of all energy used in the United States.

Contrast that figure with the amount of energy consumed by SUVs, mini-vans and light-duty trucks on the road (approximately 7 percent) and one can see that scolding SUV owners for depleting our oil supplies might be considered a tempest in a teapot.[4]

Reducing our dependence on fossil fuel is not a battle cry commonly associated with architects. But in fact, it's one area that sustainable design (and therefore architects) can directly impact.

Sophisticated energy analysis is critical to a building design strategy for reduced energy consumption. And like software for daylighting analysis, energy analysis programs have been available for years, but rarely used by the design firm. Many firms outsource energy analysis (due to time and cost), and as a result building energy performance information is available only at fixed points in the project, usually later than needed for supporting the best decision-making about the project.

But now, Revit Architecture provides robust design information with the necessary level of detail and reliability to complete these analyses earlier in the design cycle, and makes possible routine analysis done directly by designers for their own baseline energy analysis.

Revit Architecture is linked directly to the Green Building Studio™ (GBS) service from GeoPraxis (*www.geopraxis.com*), an industry leader in the development and implementation of building energy analysis tools and web-based solutions. The GBS service creates a geometrically correct thermal model of the building, applies local building code assumptions, creates a DOE-2 input, runs the analysis, and returns summary results to the designer's browser.

In this fashion, energy analysis can be performed throughout the design process. In early design phases, massing studies can be used with resulting energy analyses to make decisions about how the building is placed on the site. As the design progresses, various daylighting options can be evaluated for energy savings. When appropriate, the DOE-2 model input files can be used with engineering analysis systems such as eQUEST®, EnergyPlus™, or Trane® Trace® 700 for detailed analysis. This automated input of geometric coordinates can save hundreds of hours of manual labor.

Energy Analysis Case Study: Architectural Resources

Architectural Resources (*www.archres.com*) is a 27 person architecture, interiors and planning firm with offices in Buffalo and New York City. Since 1991 Architectural Resources (A|r) has provided high quality, personal design and project management services to owners and individuals throughout New York State.

They are using Revit Architecture on a new project for the State of New York - the Queens Psychiatric Center Community Services, a 45,000 square foot educational/health facility designed to meet the requirements of a LEED building without increasing the original budget. Part of the strategy to reach this goal is to reduce the total energy consumption in dollars (Energy Cost Budget or ECB) by twenty percent.

A|r's traditional method of estimating a building's performance is to work with consulting engineers who redraw the entire building in engineering software, then analyze the build-

[4] Mazria, E. It's the Architecture, Stupid! *Solar Today,* May/June 2003

ing at a base case (code minimum) and then at higher efficiency levels to produce a percent difference in savings. This process usually takes weeks to complete, often with additional services charged to the client.

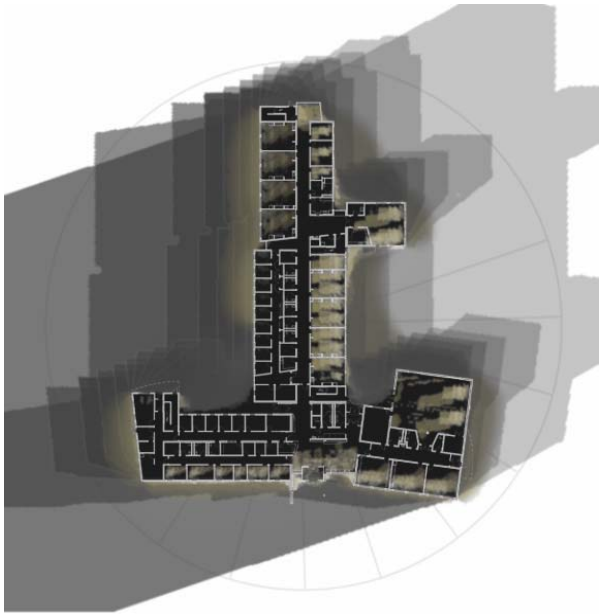


Figure 5

Architectural Resources use Revit for a variety of energy analyses, such as this solar/sun study.

With the use of Revit Architecture and GBS, A|r designers easily export the model of the building in a format compatible with major engineering software applications, and run a base case study within ten minutes. This process can be repeated as desired to compare prior results to reconfigurations of spaces and features. The consulting engineers can then use the base case information, edit the HVAC system, modify building R-values and produce an ECB. The total time takes less than a week with no additional services required and gives A|r the confidence that the spaces being analyzed by the engineers match their design intent.

Computation of Material Quantities and LEED Documentation

Repeating another statistic from the beginning of this white paper, buildings account for 60% of the raw materials used in the United States. So the selection of building materials is crucial to sustainable design. Specification and procurement of green building materials rely on the accurate computation of a project's material quantities. This is one of the underlying strengths of Revit technology – its ability to provide information effortlessly.

Figure 6

Skyscraper Digital used Revit to create these phased images of a hospital project in Charlotte, North Carolina.

Other technologies scatter building information across multiple CAD files or require user intervention to make sure that all of the building information is internally consistent. This sets the stage for unreliable information retrieval. In Revit Architecture, every drawing, every view,

every schedule is a direct presentation of information from the same underlying database. Schedules and quantities of building components that are live views of the building database, and therefore always accurate, deliver an enor- mous benefit for any design.

For sustainable design there are many LEED points that require calculating areas, volumes, or costs of building assemblies or materials for credit. The submittal requirements for these credits in- volve listing each material or product used to meet various credits – demonstrating that the project incorporates the required percentage of reused, recycled, locally sourced, rapidly renewable, or certified wood products based on percentage of cost.

Quantification of a project for cost estimating is especially easy using Revit Architecture, as is associating quantities with properties such as “reused material.”

The calculations for these LEED credits can be embedded in a schedule directly in the building information model and will be maintained dynamically as the project moves forward through design, including any design options that are being considered. In addition, quantities can be exported to third party databases or cost-estimating packages via ODBC.

The capability of Revit Architecture to track information about the development of a project in time (sometimes referred to as “4D” analysis, the fourth dimension being time) allows existing conditions to be stored directly in the building information model. This “phasing” information is the foundation for calculations that assess the extent of demolition and new construction on a project, critical for green design and LEED certification.

As portions of the project to be demolished are identified, calculation of quantities based on volume (for structural reuse) and area (for shell and interior reuse) can be calculated. Demolition and renovation drawings can be produced using time-specific views of the building information model, reflecting the evolution of the project from phase to phase.

Specification Management

The environmental impact of extracting, processing, and transporting building materials makes their careful selection an important aspect of sustainable design. But communicating the materials needed for a green project is often a stumbling block for sustainable design projects because material specifications are usually created in isolation from the design model, so their development and upkeep are time-consuming and error-prone.

To remedy this disconnect, Revit Architecture is integrated with a popular specification management software solution called e-SPECS® from InterSpec, a provider of construction document management solutions and services. Using e-SPECS For Revit, the development, editing, and (most importantly) coordination of the project specifications can be highly automated. e-SPECS is linked directly to the Revit building information model via ODBC, a robust and well-established standard for database interoperability. As a result, e-SPECS For Revit extracts product and material requirements directly from Revit Architecture, ensuring that the building model and project specifications remain coordinated as the design progresses. For instance, when a new building component such as a type of window or roof is added to the Revit Architecture model, the e-SPECS project specification manual is automatically refreshed, to reflect the current materials and properties in the building model.

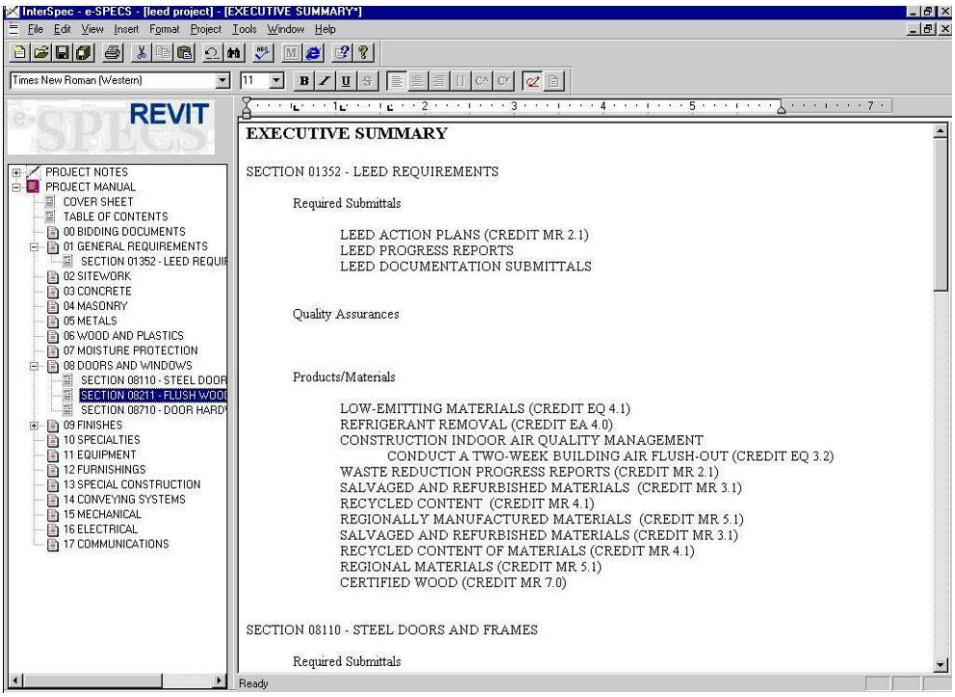


Figure 7

Material specifications produced automatically by e-SPECS For Revit also contain cross-references to LEED requirements.

The LEED rating system encourages the use of green products and materials, and projects pursuing LEED certification need to identify LEED-compliant materials and track submittal requirements related to those materials. e-SPECS references MASTERSPEC® (AIA's licensed master specification system), which includes hundreds of references to LEED requirements for material selection. As a result, specifications produced automatically by e-SPECS from a building information model also contain these cross-references to LEED requirements, an enormous coordination benefit and time savings.

Furthermore, for specific products and materials identified in Revit Architecture as applicable for LEED credit, the corresponding specification language will be inserted into the appropriate specifications by e-SPECS. If a firm has created a green-version of its master specification, e-SPECS can also link to existing office masters, to encourage greener choices wherever possible.

Reducing Waste and Inefficiency

Waste and inefficiency is a huge problem in the building construction industry, and is fundamentally unsustainable in environmental terms as well as economic terms. The Economist reported[5] in 2000 that inefficiencies, mistakes, and delays account for $200 billion of the $650 billion spent on construction in America every year; almost one third of the total spending is lost to waste. The IT Construction Best Practice service notes that in the United Kingdom the annual cost of rectifying construction defects caused by poorly detailed drawings and incorrect instructions has been put at £1 billion (about US $1.66 billion).

A large source of this waste and inefficiency is on-site rework required by poorly coordinated drawing sets[6]. Every change order that costs the owner or builder money but doesn't

[5] *New Wiring*, The Economist, January 13th, 2000

[6] *Botched Plans*, Engineering News Record, May 2000

add to the value of the building is wasted resources. Every wasted move and effort on a construction site is wasted energy and materials, potentially contributing to the waste stream, consuming fossil fuels, and so on.

Revit Architecture strikes at the heart of that waste by eliminating the source – construction documents that aren't consistent or coordinated, and don't accurately reflect the design. Parametric change technology ensures that the Revit building information model – including the documentation – is, at all times, coordinated, consistent, and complete.

As the design team works in familiar drawing and schedule views, Revit Architecture coordinates their design information across all other representations of the project – in model views or drawing sheets, schedules, sections, plan, and so on. As the design progresses, Revit Architecture preserves all information from beginning to end. The same model that is rendered in design is used to prepare construction documents and generates specifications.

Capturing more value in the building itself by reducing squandered effort and resources during construction is fundamentally green and a direct product of Revit Architecture.

Summary

The Revit Architecture design and documentation system is ideally suited for delivering the kind of information that can be used to improve design and building performance. Much of the data needed for supporting green design is captured naturally during the design process and is extracted from the building information model as needed.

Revit Architecture facilitates the very complex processes of sustainable design like daylighting and solar access, and automates the drudgery of activities like material takeoffs – all the while capturing and coordinating information in the documentation set.

The partner products it leverages such as Green Building Studio and e-SPECS (available separately) expand its natural capacities to provide specialized functions like bouncelight calculations, energy analysis and specification management. Linking these products to Revit Architecture makes this technology far more accessible than before, giving architects easy access to tools that provide quick feedback on green design alternatives.

For LEED certification, up to 20 points can be facilitated through state-of-the-art building information modeling using Revit Architecture. Its proven ability to deliver cost-effective sustainable designs gives firms the assurance they need to pursue an aggressive LEED ranking for their projects and market their sustainable services competitively.

In a 2002 sustainable design briefing[7] of the U.S. Senate Green Building Roundtable, the USGBC reported that "Continuing advances in technologies, integrated design practices, and growing industry awareness will no doubt continue to transform a building industry characterized by relatively slow rates of innovation." Building information modeling and Revit Architecture are playing a key role in that transformation, delivering significant innovation to an industry on the brink of change.

To find out more about Autodesk's building information modeling solutions, visit *www.autodesk.com/bim*.

[7] *Building Momentum, National Trends and Prospects for High-Performance Green Buildings,* USGBC, April 2002

About Revit

The Revit platform is Autodesk's purpose-built solution for building information modeling. Applications such as Revit Architecture, Revit® Structure, and Revit® MEP built on the Revit platform are complete, discipline-specific building design and documentation systems supporting all phases of design and construction documentation. From conceptual studies through the most detailed construction drawings and schedules, applications built on Revit help provide immediate competitive advantage, better coordination and quality, and can contribute to higher profitability for architects and the rest of the building team.

At the heart of the Revit platform is the Revit parametric change engine, which automatically coordinates changes made anywhere — in model views or drawing sheets, schedules, sections, plans… you name it.

For more information about building information modeling please visit us at *http://www.autodesk.com/bim*. For more information about Revit and the discipline-specific applications built on Revit please visit us at *http://www.autodesk.com/revit*.

Autodesk®