BIM and Visualization

This white paper explores how building information modeling using the Revit platform with Autodesk® 3ds Max® can be used to explore, validate and convey architectural designs.

Predicting how occupants, visitors, or neighbors will react to and interact with a building is a crucial part of the design process. “Will this building cast shadows on the neighboring park?” “Will this brick façade fit in with the other buildings around it?” “Will this lobby area get too congested?” “Will this light monitor provide enough daylight to the hallway below it?” These types of questions are best answered by “seeing” the design - experiencing the design before it’s real.

A computable building information modeling platform such as the Revit platform brings with it the ability to predict the performance of a building before it’s built. One aspect of a building’s performance is how people will experience a building, and physically accurate design visualization is fundamental to predicting the effect the building will have. This white paper focuses on how BIM improves the design visualization process.

Visualizing an Architectural Design

Visualizing an architectural design often relies on envisioning the building based on orthogonal drawings or a small-scale physical model or an artist’s sketch or watercolor. Visualizations such as these can be hampered by the viewer’s ability to mentally interpret 2D drawings, the static nature of medium, and in the case of models or artist’s renderings, the cost to produce them.

The advent of CAD and 3D modeling technology ushered in computer-based visualizations, which complement the traditional visualizations described above. Shaded 3D views, photo-like renderings, animated walkthroughs - these types of design visualizations are much more effective for communicating a 3D design and are now widely used to explore, validate and convey architectural design concepts.

Most architectural authoring tools (including Revit-based applications) have some sort of built-in or in-line visualization capabilities for quick feedback during the design process. Purpose-built visualization tools (such as Autodesk 3ds Max software) are then used to deliver the extra realism and special animation effects that characterize today’s visualizations: renderings worthy of an art gallery, animated walk-throughs and fly-bys that

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resemble movie trailers. For commercial projects (and even high-end residential projects), these are the norm instead of the exception - expanding the visual context of a design concept for more effective validation and communication.

If a designer is already using a BIM solution to design the building, the obvious most efficient visualization workflow is the reuse that data - avoiding the waste of time and cost to recreate the building model in the visualization application. In addition, the redundant models (the architectural design model and the visualization model) would have to be kept in sync - increasing the time, the cost and the potential for error.

Similar building applications - structural analysis or energy analysis for example - are susceptible to the same malady; but some have avoided the use of redundant models by using the building information model for related building analysis. Similarly, state-of-the-art design visualization tools (such as 3ds Max) are now taking advantage of building information models for visual analysis.

Visualizing a Building Information Model

BIM produces amazingly accurate and detailed building models. So it's natural to expect that those models can also be used for advanced visualizations such as a rendering of an urban building project with the existing structures surrounding it or a lighting study that shows precisely how a new light shelf design will impact indoor lighting at all times of the day and throughout the seasons.

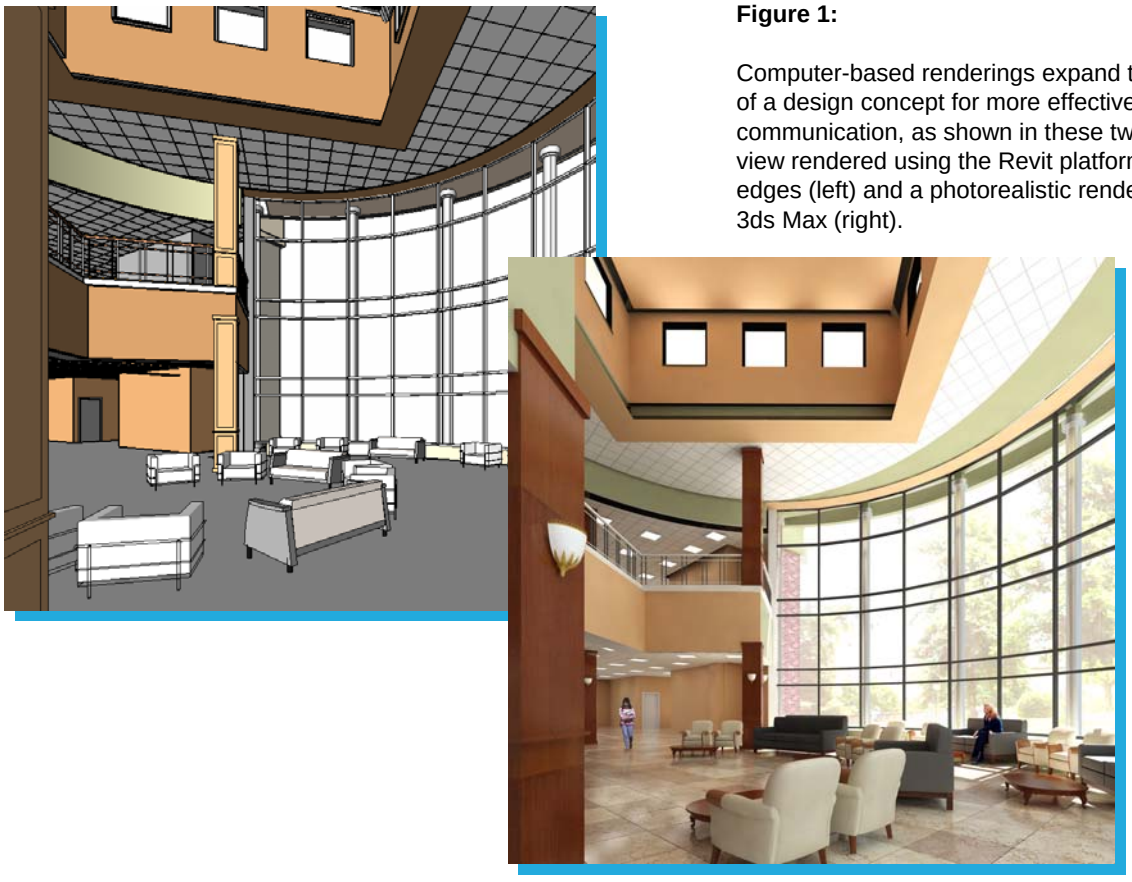


Figure 1:

Computer-based renderings expand the visual context of a design concept for more effective validation and communication, as shown in these two images: a 3D view rendered using the Revit platform, shaded with edges (left) and a photorealistic rendered view using 3ds Max (right).

How does all that detail get into the visualization application without having to recreate the model? Revit platform users can save their building information model in a 3D DWG format, which is then linked directly into 3ds Max software. 3ds Max can maintain a live

data link to a Revit model, so when the Revit building model changes the Revit user saves it out to 3D DWG again and the 3ds Max user just refreshes to update the visualization model.

The DWG export and import capabilities within both the Revit platform and 3ds Max software enable the seamless transfer of model data and interoperability between the applications. The most complex building geometry - like the curvilinear forms that seem to characterize so many new high-profile projects - is supported by the DWG format. In addition to geometry, critical visual information such as materials and camera locations are all encapsulated in the DWG file. Even geographic coordinate information is shared between the Revit platform and 3ds Max, enabling sun studies based on a building's actual location. And by linking the DWG into 3ds Max, all that preset Revit information such as materials, camera positions, etc and all the 3ds Max visualization settings are preserved when the DWG file is refreshed.

The modeling features of 3ds Max software can then be used to enhance the existing building information model; to create surrounding buildings and landscape details like trees and grass for example, or to add supplementary detail like furniture or even accessories like flower arrangements and drapes - adding realism and breathing life into the design. 3ds Max can also be used to quickly revise a design and evaluate the visual impact. For example, 3ds Max can automatically identify and select all imported building objects that have similar attributes; all exterior brick walls for example. A user can quickly change the material of those walls to stucco and create a new rendering to be used during a design review session with the owner. In addition, 3ds Max can also act as an 'aggregation hub' to bring in GIS and landscape data, site photography, and other forms of pre-made geometry - to build a context for a building information model.

[Note: If the 3D modeling features of 3ds Max software have been used for early conceptual design, a 3D DWG can be used to transfer data in the opposite direction, from 3ds Max to the Revit platform, where Building Maker can then be used to transform the massing model into building elements such as walls, floors, roofs, etc.]

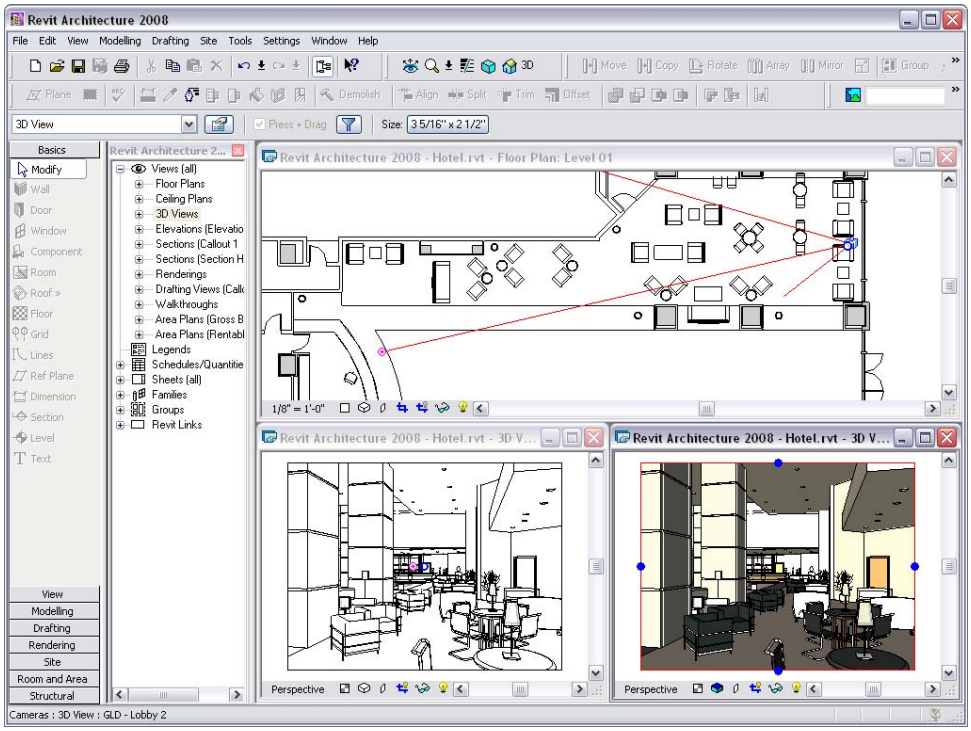


Figure 2:

The Revit platform contains several automatic visualization modes. Note the camera angles and locations in the top view that become encapsulated in the 3D DWG format when the building information model is transferred to 3ds Max.

Extending a Building Information Model for Advanced Visualization

To better understand how 3ds Max software can be used to visualize a Revit-based building information model, let's step through the design visualization workflow.

1. The Revit platform contains several automatic modes for visualizations, including Hidden Line and Shaded with Edges, shown in the screen capture and close-ups in Figures 2 and 3.

Figure 3:

Close-ups of the Hidden Line mode and Shaded with Edges mode in Revit-based applications are shown in these images (left and below, respectively).

Figure 4:

The Revit platform contains an internal renderer for quick visualizations.

2. The Revit platform also contains an internal rendering engine for quick visualizations, such as the one shown below in Figure 4.

3. For higher quality images, the Revit platform user transfers the building information model to 3ds Max by exporting the model to a 3D DWG format.

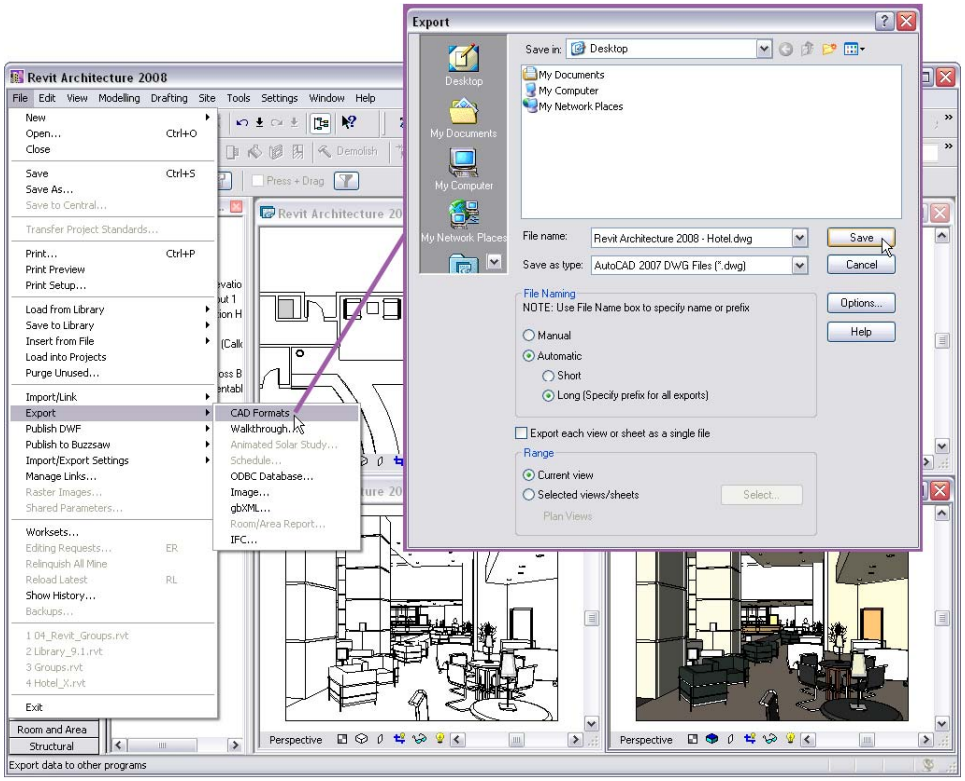


Figure 5:

The Revit platform building information model is transferred to 3ds Max by exporting it to a 3D DWG format.

4. The 3ds Max user then imports and links the 3D DWG file, as shown below. By linking the file, design changes that occur in the Revit platform are reflected in 3ds Max.

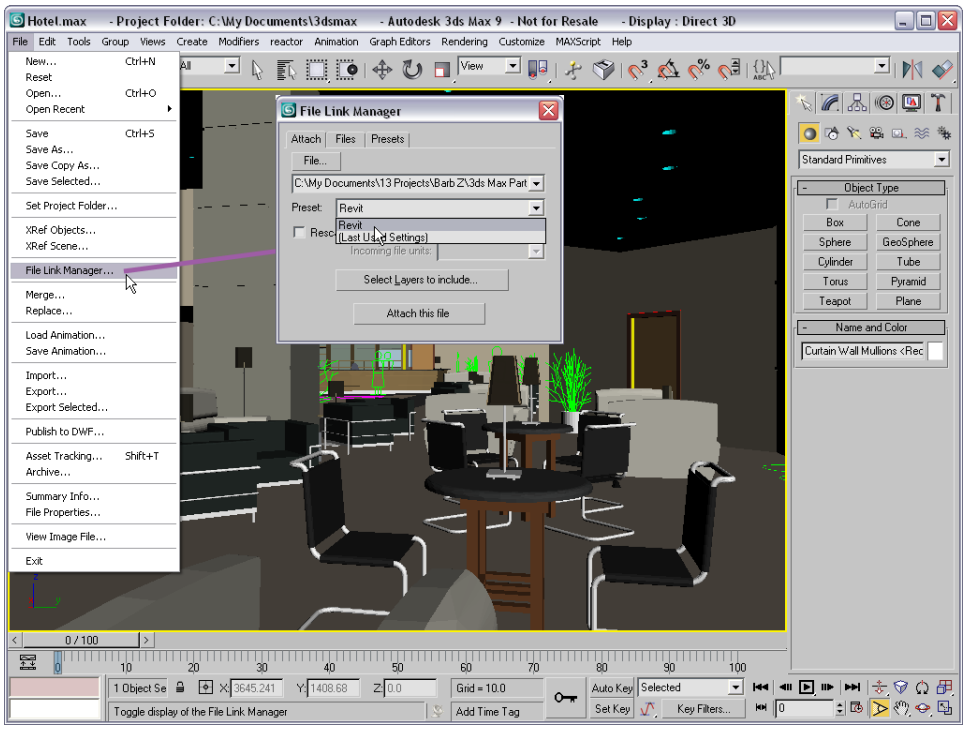


Figure 6:

Revit platform models exported to a 3D DWG format are then imported and linked in 3ds Max.

5. In addition to geometry, the 3D DWG format conveys other information such as camera positions and materiality information, which can be refined in 3ds Max as required.

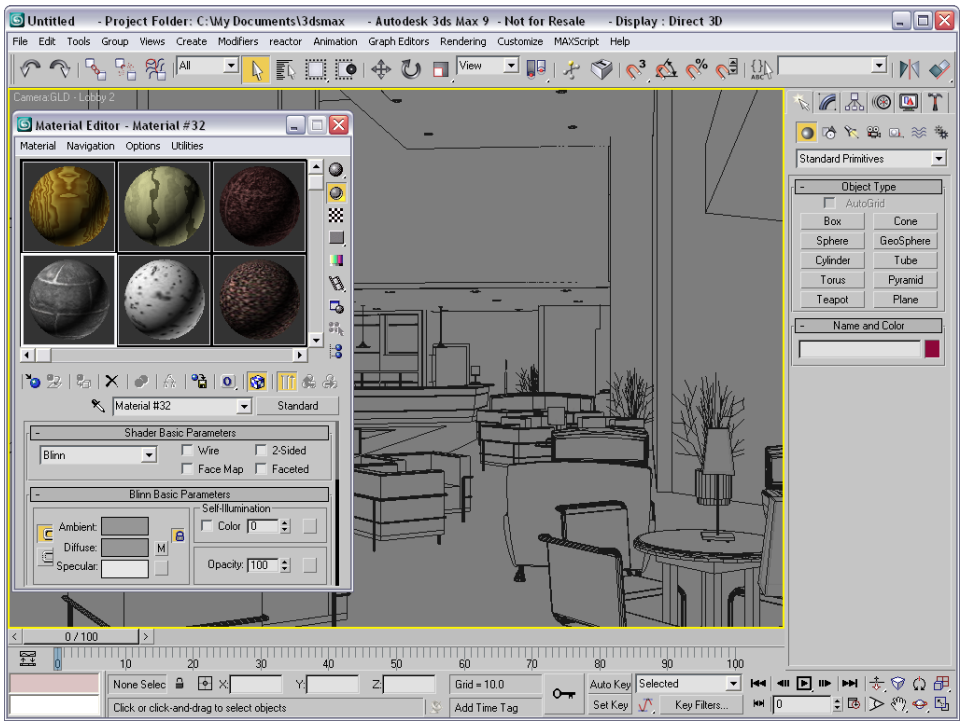


Figure 7:

Camera positions and material information are transferred from Revit-based applications to 3ds Max in the 3D DWG format.

6. Photorealistic renderings (such as the one shown below) can then be created with 3ds Max.

Figure 8:

The building information model created in the Revit platform can be rendered in 3ds Max to produce photorealistic images.

Now let's examine two firms - Ayers/Saint/Gross and RTKL - both using 3ds Max in conjunction with Revit platform building information models to experience their building designs before they're built.

Revit and 3ds Max in Action: RTKL

Founded in 1946, RTKL (*www.rtkl.com*) is a global architecture, engineering, and planning firm with more than 1,000 professionals in the U.S. and around the world. Several years ago, RTKL made the strategic decision to move to BIM in order to build better buildings and are currently using Revit-based applications on a variety of large-scale projects for a wide range of institutional, commercial, cultural and governmental clients. They began implementing Revit® Architecture software in late 2003, followed by Revit® Structure and Revit® MEP software.

RTKL's Dallas office has been using 3ds Max software for visualization for many years, implementing it several years before Revit-based applications. Colin Davis, a lead 3D artist in their internal visualization studio recalls, "We would start the visualization process by using AutoCAD® software to create a 3D model of the architect's design, usually based on their 2D drawings. When the architects began using Revit Architecture, we eliminated that whole step and began using 3D DWGs exported from the Revit platform." Now they just import those files into 3ds Max, and get to work producing the visualization itself.

"Since we don't have to model the building anymore we use the extra time to improve the realism of the visualization," explains Davis. "We can spend the time fine-tuning the materials, the textures, the lighting, and adding extra details like furniture and accessories, surrounding structures and landscape, even animated 3D people and cars."

In addition, RTKL's architects are making good use of the visualization capabilities within Revit Architecture for quick renderings and "plain old" hidden-line views and color sections - particularly in the early stages of design, leaving the visualization studio to focus on the high-quality presentation material needed for reviews, approvals and marketing. In fact, Davis feels that one of the major benefits of using the Revit platform building model in 3ds Max is that their designers are spending more time fleshing out their ideas in the building information model. "The time saved by not having to create, develop or coordinate the model means we can produce higher quality visualizations that accurately portray the

Figure 9:

RTKL uses 3ds Max to produce high quality visualizations such as this image of a hospital room interior.

architect's design."

Figure 10:

RTKL used both Revit-based applications and 3ds Max on this recent healthcare project: The Heart Hospital, a 198,000 square-foot specialty hospital located in Plano, Texas.

Revit and 3ds Max in Action: Ayers/Saint/Gross

Ayers/Saint/Gross or ASG (*www.asg-architects.com*) specializes in design and planning for non-profit institutions, with a specific focus on higher education. With offices in Baltimore, Phoenix, and Washington, D.C., ASG's 125-member staff includes architects, planners, urban designers, landscape architects, interior designers, graphic designers - and 3D visualization experts.

ASG began using 3ds Max software in 2003, when they formed their own in-house imaging studio by acquiring an architectural visualization company already using 3ds Max for their visualizations. Initially, this new group also used 3ds Max to recreate the architect's design (typically based on 2D AutoCAD drawings). As the 3D DWG format emerged as a high-fidelity vehicle to transfer model data, this in-house imaging studio purchased Revit Architecture [?] for its modeling capabilities and began using it, rather than 3ds Max, to build their visualization models.

In parallel, the firm also began investigating BIM and BIM solutions; eager to use a common 3D building model throughout the design process - to visualize and communicate building design solutions from early concept through construction administration without redundant modeling efforts. The success of Revit Architecture within the imaging studio influenced the firm's decision to pilot the software for their architectural design needs as well and they launched a pilot project in early 2004. It was so successful that within a year the firm decided that all new projects would start in Revit Architecture.

"The architects now send us 3D DWG files exported from their Revit Architecture building information models, which we can import and link directly into 3ds Max," explains Brian Russell, an Integrated Practice Manager in ASG's visual imaging studio. "Visualization technology has dramatically improved in the last few years, reducing rendering times and

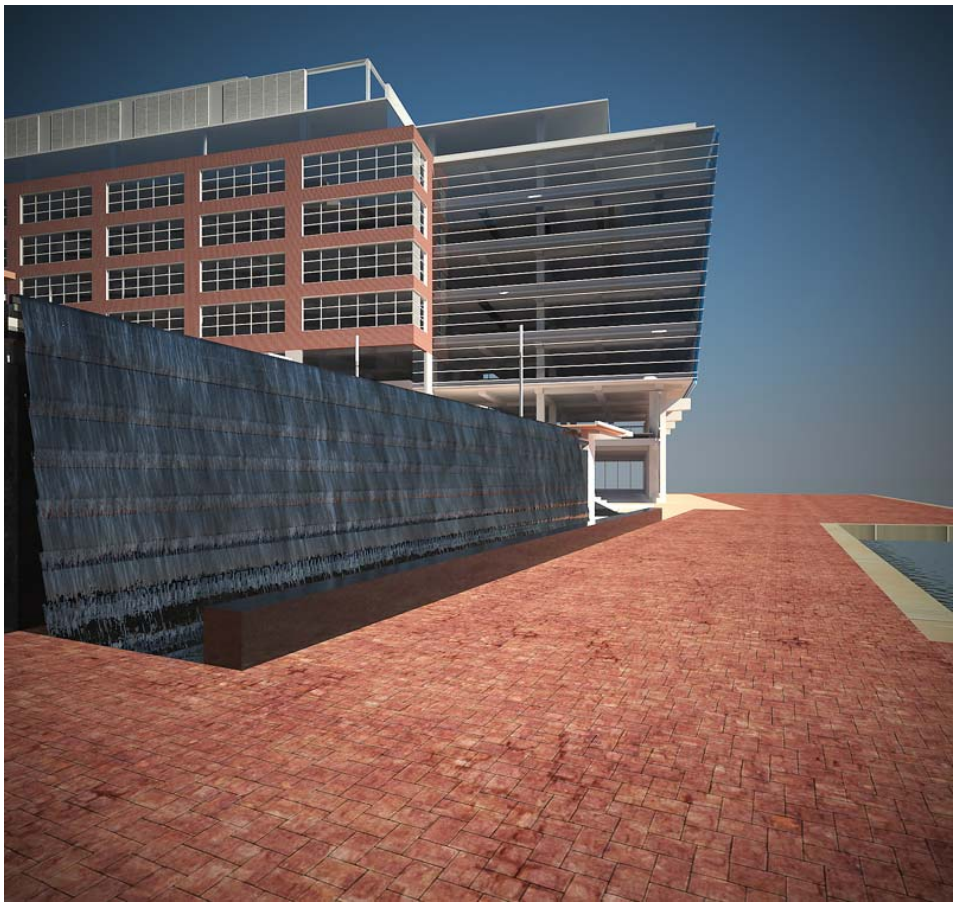
increasing the quality of the output. Now we can save even more time by not recreating the architectural model." This has led to more visualizations (and higher quality ones) throughout their design process. For example, they used to produce only 1 or 2 renderings for a project, typically after the building design was complete, just prior to construction. Now for most projects they produce at least one per design phase, and often many more.

In addition, visualizations were generally reserved for marketing purposes, or for milestone events like client presentations and approval processes. But now they're also used for design investigation. "An architect will sit with me and we'll try on different finishes or change the lighting scheme," explains Russell. "We perform sun studies or lighting simulations, create renderings or animations - whatever the design team needs."

3ds Max has also helped ASG to increase the amount and quality of animations they produce, using its advanced visualization capabilities such as character and crowd animation to study how a building information model will function with people - humanizing the design for presentation purposes. They also use Revit-based applications and 3ds Max to model and aggregate surrounding landscape or structures, another critical ingredient for convincing visualizations. In fact, using a combination of Revit applications, AutoCAD, 3ds Max and SketchUp software, they recently modeled a good chunk of downtown Baltimore to produce a 30-minute animation sequence for a combination of waterfront redevelopment projects. "We used Revit-based applications to model the proposed construction, as well as several nearby (existing) buildings for optimal building detail - so when we dropped a camera in at street level the results were very realistic," Russell explains. Initially the assignment was just to produce a series of still images, but the real estate developer was so impressed he commissioned the animation to "sell" the project - literally.

Figure 11:

Ayers/Saint/Gross used Revit-based applications and 3ds Max to create images like this one for comparative design studies of the Thames Street Wharf project in Baltimore, currently under development.



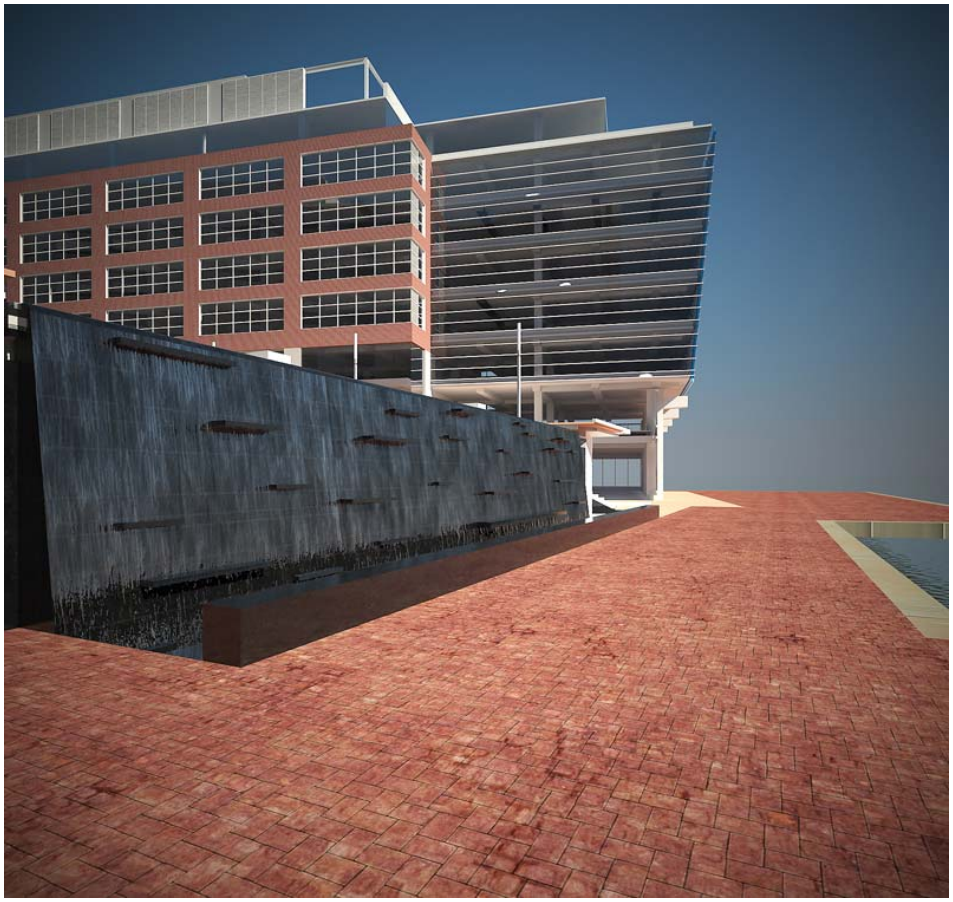


Figure 12:

Ayers/Saint/Gross used these images to visualize the subtle design differences of the water feature in the foreground of the images.

Summary

Do a web search on Freedom Tower and you'll get hundreds of thousands of image hits - photoreal images of a building that hasn't been built. This is testimony to the power of today's design visualization applications and their ability to accurately visualize, thoroughly study, and effectively communicate building designs. Whether they're used to create images for in-process design reviews, lighting simulations, or highly polished marketing material, design visualization tools like 3ds Max software that take advantage of an existing building information model extend the value of BIM and the make the creation of visualizations more efficient.

The ease and fidelity of transferring the Revit platform building information model to 3ds Max significantly reduces the time and cost to produce the visualization. Linking the Revit platform building information model to 3ds Max further minimizes the time required to coordinate the architectural design and the visualization. But ultimately, it is the detail embodied in the building information model that ensures that the resulting visualization is a true reflection of the architect's vision.

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*.

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