BIM for Interior Design

Discussions about BIM (building information modeling) typically focus on the design of the *outside* of the building and the many benefits BIM brings to that aspect of architectural design. We read about massing models and curtain walls, expressive roof forms, and detailed wall sections. But how is BIM being applied to the design of the *inside* of the building - the finishes, the fixtures, the area requirements, the furniture schedules? This paper examines the use of Revit® Architecture software for the interior design of a building.

Interior Advantages

Regardless of the specialization of the interior design group - corporate, hospitality, retail, etc. - interior designers cite several key advantages of BIM:

- The speed and ease of creating an interior design model, coupled with the ability to visualize that design.

- The ability to capture and manage the design as multiple options within a single model - options that may vary anything from space layout to material selections.

- The richness and reliability of the data embodied within the building information model. This is fundamental for early tasks such as schematic space planning and master scheduling, the accuracy of detailed design activities like quantification and costing, and finally for the production of well-coordinated documentation.

Creating the Design Model

Architects and designers working on the interiors of a building sometimes start with the building shell CAD files from their own firm or another firm. But in many cases, the building shell might pre-date the interiors project by many years with only paper documentation to rely on. Because it's so easy to create a 3D model with a BIM solution like Revit Architecture, these designers will sometimes quickly model the relevant portions of the building exterior off the 2D or paper floor plans as a way of starting their project.

As the interior design progresses (spaces defined, walls created, fixtures added, finishes selected) a parametric building modeler like Revit Architecture preserves design intent, coordinates changes and maintains consistency within the project design. If the designer changes the plan layout, the related ceiling plan and other documentation adjusts automatically. If a wall is deleted, the lighting sconce is deleted too, and the schedule of fixtures is instantly synchronized.

Autodesk

The Revit Architecture library (http://revit.autodesk.com/library/html) features families of equipment and components. The parametric nature of the library elements means users have a vast selection to choose from. Manufacturers and vendors, industry groups such as the Woodwork Institute (formerly the Woodwork Institute of California, www.wicnet.org) and user communities such as revitcity.com or AUGI® forums; all provide content as well. Revit Architecture also includes an easy-to-use family editor to create custom content - a task some firms assign to a junior team member to build their familiarity with BIM.

Seeing Is Believing

As the design evolves, Revit Architecture allows designers (and clients) to easily visualize their design in whatever form suits their needs - from straightforward perspective and axonometric views to the most sophisticated rendered images, 360° panoramic views, and animated walkthroughs.

Most architectural modeling tools support hidden-line views. Most solutions also have some sort of shading capability. Purpose-built BIM solutions such as Revit Architecture take this several giant steps further. Views - whether they're elevation or plan or perspective, wireframe or hidden-line or shaded - are direct presentations of the underlying interior design information, including the spatial configuration, finishes, materials, etc.

When the designer changes the information (in any view), all views update automatically. In fact, the same is also true for drawings (which are actually "live" views of the underlying information model), schedules, material take-offs, and so on. The building information across all representations of the project is reliable, coordinated, and internally consistent - the signature characteristic of BIM.

Because visually rich 3D views are direct presentations of the underlying building information, Revit Architecture allows designers to produce visualizations within their own design environment (with the same user interface they're already accustomed to), as a natural part of the design process. This ability to easily visualize their design in 3D without using specialized tools and the effortless model/image coordination is a driving force behind BIM's adoption by interior designers.

Figure 1:

Designers at The Stubbins Associates use Revit Architecture to visualize their developing interior design.

Jeff Millett, AIA, director of information and communications technologies for The Stubbins Associates (www.stubbins.us), used the example of their interior designers wrestling with the height of workstations in a recent tenant fit-out project. The workstation walls formed

an interior corridor, but the designers were worried that the planned 6' height was too severe, producing the wrong look and feel for the space.

They "dropped a camera into the corridor" (see steps below) and created a few quick shaded images. The images validated their concern, and they modified the workstation height throughout the area. "Without Revit Architecture, we wouldn't have had the time or budget to do this type of design investigation," reports Millett.

To create a camera view in Revit Architecture:

- Select pull-down menu *View >> New >> Camera*.
- Click a location (in any view) to place the camera.
- Click again in the same view to indicate direction and range of the new camera view, and the view automatically updates.
- To change to a shaded view, select *View >> Shading with Edges*.

Getting Down to Details

Creating images for interior design must be quick, easy, and expressive. Lighting, materials, finishes, fixtures all play a role in the visualization process. BIM allows for this level of detail - even in the early conceptual modeling stages.

The traditional process of creating quality rendered images is to export a CAD hidden-line view to a graphics design package, color it, and manually add finishes - with lots of graphic tweaks along the way to get presentation-quality renderings. It's a complex, costly process - limiting the amount of renderings a firm can produce during the design cycle. Using Revit Architecture, designers can produce rendered views with realistic lighting conditions and accurate finish/material representations directly from the building information model, leading to better design decisions earlier in the process.

Revit Architecture includes tools for shaded views with vectorial shadows, capped section boxes and silhouette edges. Photorealistic renderings can be generated using either raytracing or high-end radiosity techniques (which produce the most subtle and accurate lighting possible).
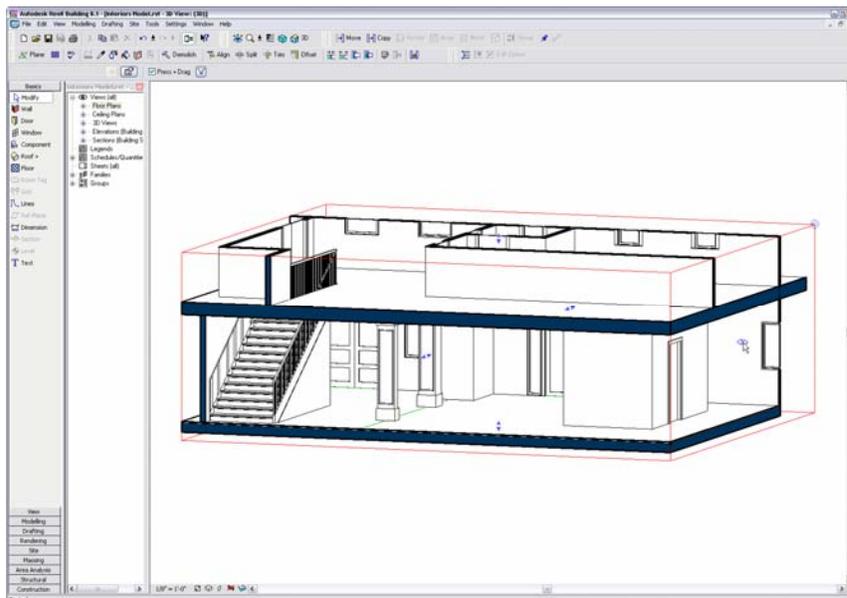

Figure 2:

Revit Architecture includes a variety of tools to enhance presentation views such as the use of highlighted section boxes.
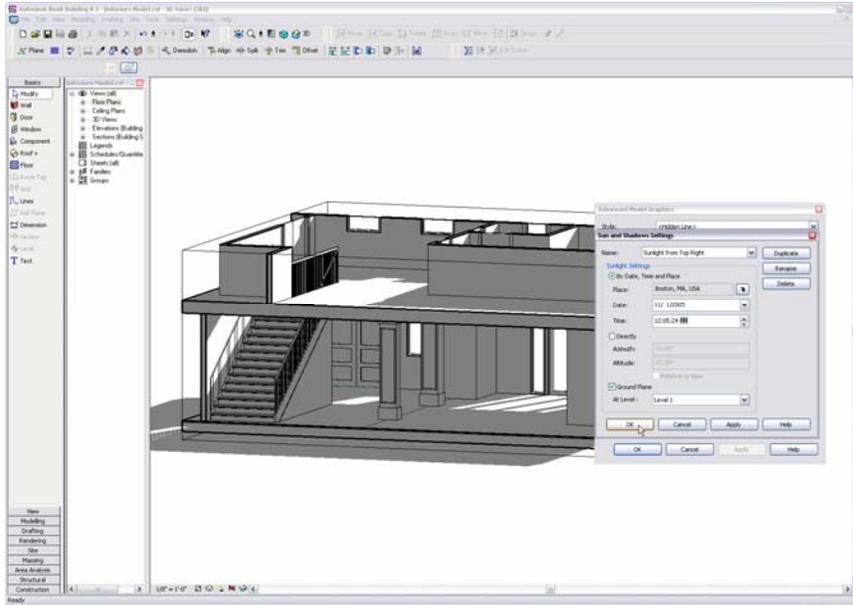
Figure 3:

Shaded views featuring vectorial shadow casting can be created specifying date, time, and location.

Designers can also use libraries of real-world materials to create detailed representations and renderings. Firms can even scan actual products (a hardwood flooring sample, for example) on a flatbed scanner, then use the scanned image to create a custom finish, giving it a slight bump factor to produce very realistic renderings.
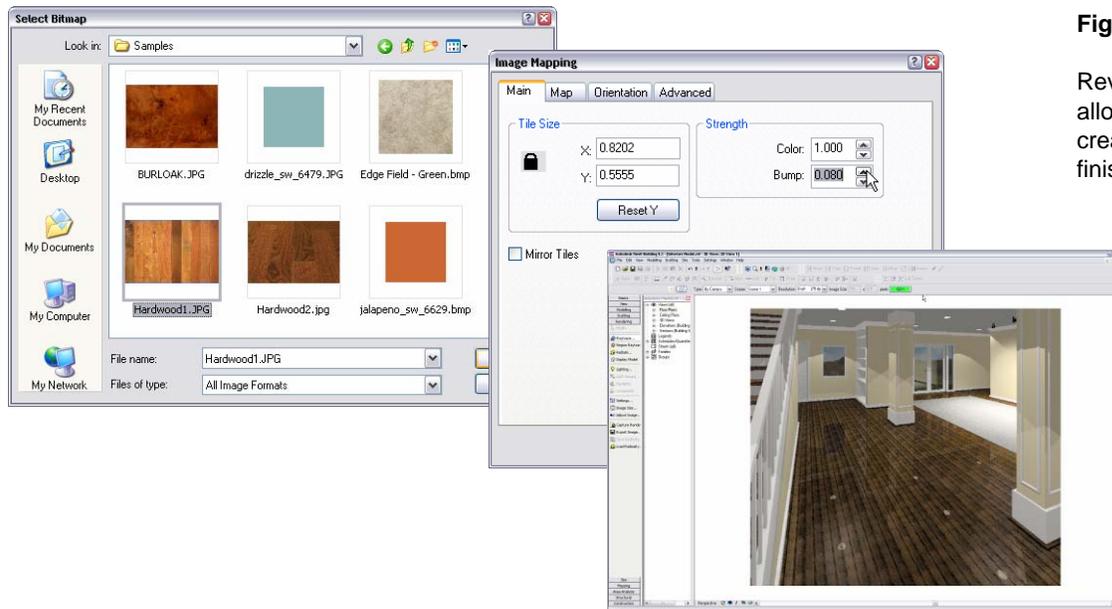

Figure 4:

Revit Architecture allows users to easily create custom material finishes.

To create a custom material finish in Revit Architecture:
- Scan a material sample and save the image file.
- Select *Settings >> Materials* from the Revit Architecture toolbar.
- Open the *Materials Library* and create a new material.
- In the *Materials Editor*, select the saved image file. Manipulate the image as desired (e.g., strengthen the color or give it a bump effect).
- Save the new material, then apply it to a component.

BIM for Interior Design Options

A designer often needs to keep multiple design alternatives open until enough information is available to decide between them. For example, a designer may need to track and compare an open office scheme providing daylighting and views with a more enclosed layout for programmatic and environmental comfort purposes.

A purpose-built BIM solution like Revit Architecture supports design investigation by enabling designers to develop and study multiple design alternatives simultaneously within a single model. Design options can vary in their complexity, from additional floors in an office building to simply different carpeting in a lobby.

Figure 5:

Revit Architecture supports design investigation by letting designers study multiple design alternatives simultaneously within a single model.

Design options can be toggled on and off in the model for visualization, quantification, and analysis as needed. They can be maintained for as long as required (which sometimes can be right through construction documents, for bidding as "alternates") and then incorporated, discarded, or archived as key design decisions are made. Multiple sets of design options can be created to address specific design issues. For example, one set of design options may focus on a floor layout while another set focuses on options for the lobby area.

Design options are all contained in a single Revit building information model. Users don't have to create separate models for the various options; they don't have to "save as LOBBY_OPTION1" and "save as LOBBY_OPTION2" as they would using CAD or Object CAD solutions that rely on separate files or layers to store and manage data.

Revit Architecture coordinates the design information across all representations of the project and across all the design options for the project. All the views, schedules, material take-offs, drawings, and so forth are direct presentations of the underlying building model. Thus, the design options are accurately reflected in any and all related views, schedules, and drawings.

Interior Design Options

To better understand how Revit Architecture uses design options, let's look at a typical commercial interior design job: a tenant fit-out project. The shell and core of the building is fixed, and the interior design team needs to define the interior space. The client has asked the designers to create three preliminary layouts: one featuring offices, a second with cubicles, and a third open-plan with low/high partition walls.

Once the initial design options are developed, the client and architect meet to decide which proposal to pursue. Their decision may be based on a variety of factors: space

utilization, area requirements, aesthetics, material cost, daylighting analysis, etc. Supporting project material - drawings, schedules, initial cost summaries based on material quantities, etc. - are all used in the decision-making process. With Revit Architecture, this information is always available as live views of the building model, and so the three design options in our example are consistently reflected and coordinated in all related presentations. If an interior wall is deleted in a particular design option, the lighting sconce in that option is deleted as well, and the schedule of fixtures relating to that option is instantly synchronized.

As the design progresses, the client and design team selects the open-plan option and all the other options can be discarded. New options are then created to iterate on a more granular design. The material selection in the lobby area of our tenant fit-out example may be of particular interest to the client, who wants to explore in greater detail various design options for that space - using a mixture of material selections and finishes as well as several different furniture layouts.
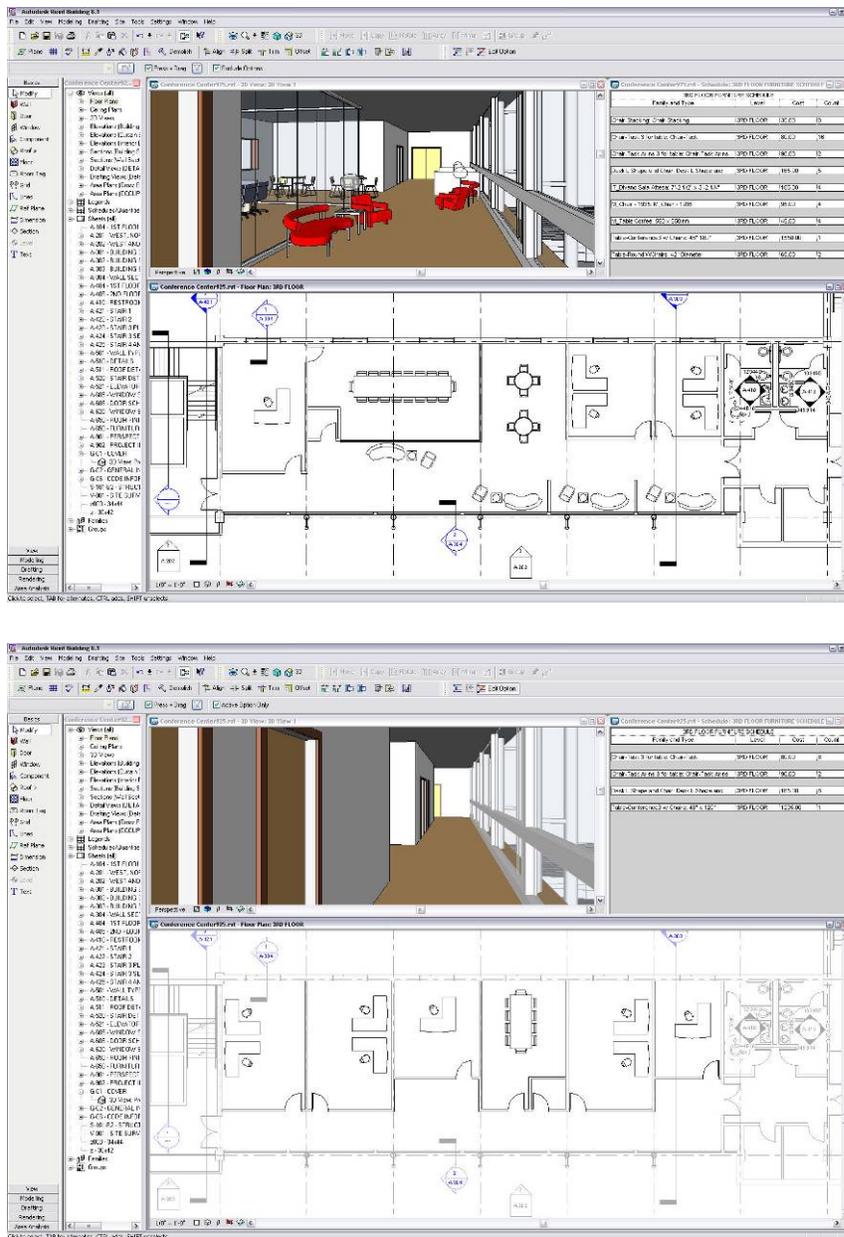

Figure 6:

Alternate design options (such as the two shown here) are accurately reflected in all related schedules, views, and drawings.

Working With Design Options

The main Revit Architecture model encompasses all those features of the design that are *not* optional - for example the shell and core of our tenant fit-out project. The "favorite" design alternative is designated as the primary design option. By default, views display both the main model and the primary option. The design team on the tenant fit-out project had an inkling that the client would ultimately go with the open-plan concept. So as they began their work, they designated that option as the primary design and the other two options, traditional offices and cubicles, were designated as secondary options.

Users can control the visibility of design options in any model view - plan, elevation, 3D, schedule, etc. - using the *Design Options* tab of the *Visibility/Graphic Overrides* dialog box. If there are no options being edited, a view displays the main model and the primary option by default. When a designer is editing an option, the view displays the main model and the option being edited. Users can also dedicate a view to a specific option within an option set by choosing the option name. Thus, Revit can display multiple design options side by side for reviews and client presentations and the alternate design schemes are accurately reflected in related schedules, views, and drawings.

Users specify which design option they want to work on by opening the *Design Options* dialog box, clicking *Edit Option*, and then highlighting the desired option. The *Edit Option* button stays selected while the user is editing the option and when the cursor is placed over the button, a ToolTip reminds the user which option they are editing.
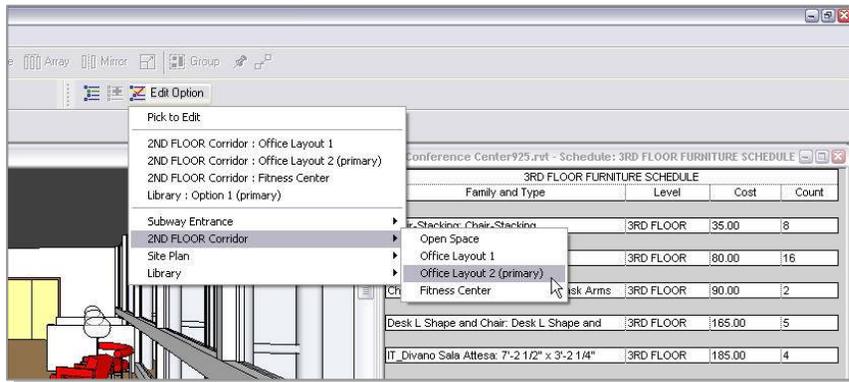

Figure 7:

For quick access, the user can browse and switch to any design option directly from the Revit Architecture toolbar using the *Edit Option* menu.

In our tenant fit-out example, the design team models the three specific floor layout options. They reference common elements of the main model (load-bearing and core interior walls for example) and create option-specific elements (office walls for the office option for example) that are visualized in option-specific views. By modifying the visibility properties of different views and schedules, the designer can toggle between the design options for day-to-day design tasks as well as client reviews.

A specific option is selected to move forward or the team can "cherry pick" design pieces from several options to create the final proposal or proposals. Abandoned options can be deleted or archived. New design iterations (such as the lobby area in our example) can be created and explored as the design progresses.

Building Consensus

The ability of BIM to capture and reflect design thinking enables interior architects and designers to evaluate, with their clients, multiple interior design schemes in the context of the rest of the building. As a result, less time is needed to achieve consensus on a particular design - and the clarity and transparency of the process minimizes the number of change-orders, the amount of rework, and the impact of delays.

BIM for Interior Design Information

The data embodied by the building information model is fundamental for tasks throughout the interior design process: early design activities such as schematic space planning and master scheduling; the accuracy of detailed design activities like quantification and costing; and finally for the production of well-coordinated documentation.

Information Foundation

BIM systems allow users to add non-graphic properties such as product name, finishes, cost, and so forth, to building components. Some Object CAD systems store non-graphical data about a building in a logical structure with the 3D building graphics. Users extract this data to provide information about quantities and attributes, just as they extract the 2D drawings from the 3D graphics. But additional tools and effort are required to keep the graphical and non-graphical data synchronized. The larger the project, the greater the effort required to keep the data coordinated and the greater the risk of inconsistencies.

Revit Architecture, which is purpose-built for BIM, combines a design model (3D building geometry and non-graphic properties) with a behavioral model (change management) into an integrated parametric building model. The entire model, including the design documents, is an integrated database where everything is coordinated and internally consistent.

Some non-graphic interior design information is visible in project drawings - a room number or name on a plan drawing for instance. Other information may ultimately be called out only in schedules - the door hardware set in a door schedule for instance. But regardless of where the information is ultimately displayed, the single source is the building information model and Revit Architecture stores and manages all the interior design information and coordinates the information across all representations of the project.
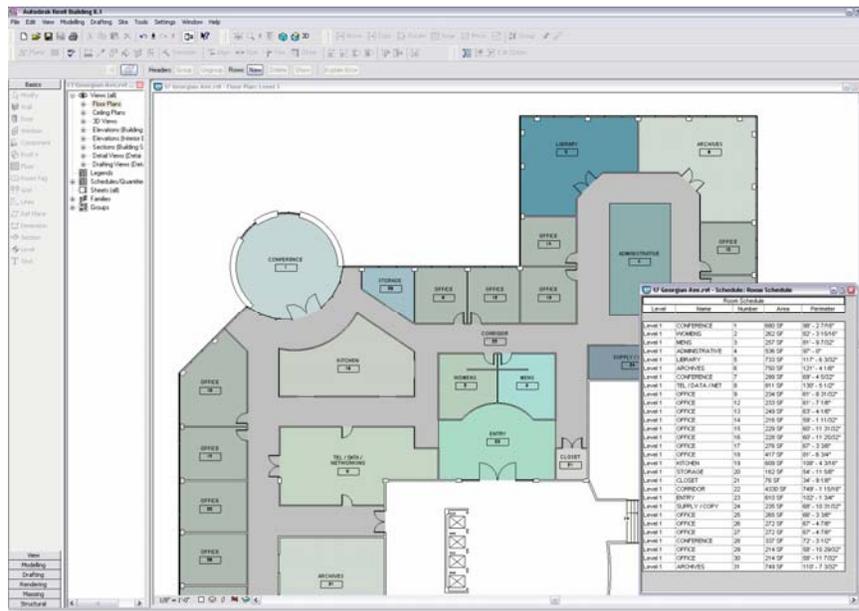

Figure 8:

With Revit Architecture, drawings and schedules of building components are "live" views of the building database.

Schematic Design

Prior to detailed design, firms can create a master schedule for interior spaces - a working database view of a project - that includes a large amount of non-graphic data regarding areas and room types. In this fashion, Revit Architecture users can employ table-based schedules as the input medium for many interior design components.

Clayton Starr, Sr. Applications Administrator for RTKL (www.rtkl.com), explains how their interior design group used this master schedule approach to pre-define spaces for a recent hospital project. Their designers "loaded up" the Revit building information model with a host of non-graphic information such as room type (examination, patient, surgical, etc.), area requirements, furniture and equipment requirements, planned finishes and materials - down to the type of material used for a window sill. "By adding this level of detail so early in the design, we can produce remarkably accurate preliminary estimates," remarked Starr.

As design progresses and actual spaces are modeled, Revit Architecture allows designers to check their design model against their design requirements. For instance, a room area can be automatically calculated and compared to an area requirement schedule to flag rooms that are too small.
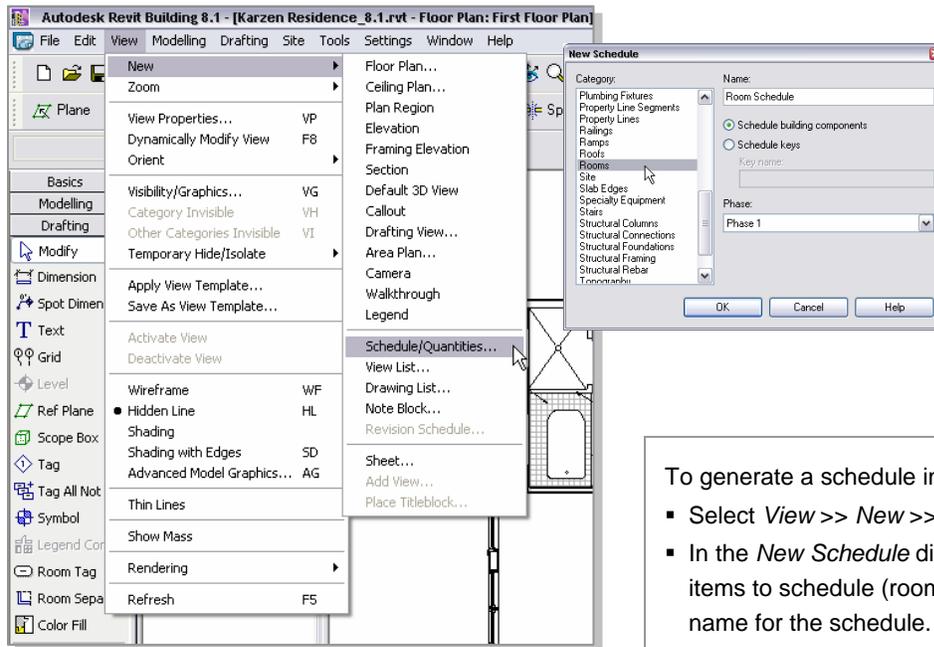

Figure 9:

Interior designers can easily generate a room area schedule.

To generate a schedule in Revit Architecture:

- Select *View >> New >> Schedule/Quantities*.
- In the *New Schedule* dialog box select the category of items to schedule (rooms in this example), and type in a name for the schedule.
- Using the *Schedule Properties* dialog box, select the fields, filters, and any sorts that may be necessary.
- Click OK to display the new schedule (below).
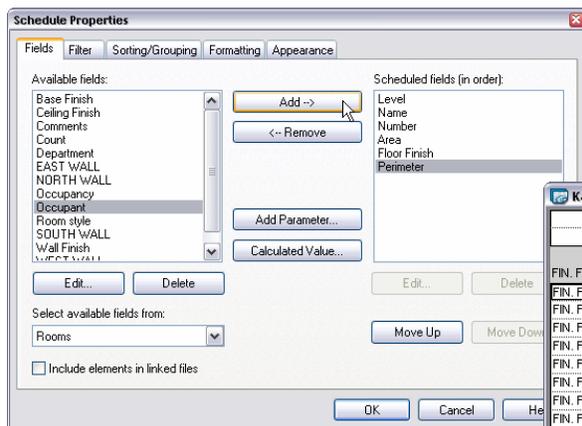
Room Schedule

Level	Name	Number	Area	Floor Finish	Perimeter
FIN. FLOOR					
FIN. FLOOR	Entry	200	201 SF	HARDWOOD	69' - 0 5/16"
FIN. FLOOR	Great Room	201	464 SF	HARDWOOD	139' - 3 3/8"
FIN. FLOOR	Kitchen	202	259 SF	TILE (12x12)	90' - 11 1/16"
FIN. FLOOR	Library	203	221 SF	HARDWOOD	59' - 8 3/4"
FIN. FLOOR	Dining Room	204	206 SF	HARDWOOD	57' - 9 1/8"
FIN. FLOOR	Master Bedroom	205	285 SF	CARPET	69' - 0 3/16"
FIN. FLOOR	Master Bath	206	172 SF	TILE (8x8)	76' - 8"
FIN. FLOOR	Toilet 2	207	30 SF	TILE (8x8)	22' - 0"
FIN. FLOOR	Closet	208	46 SF	TILE (8x8)	27' - 8"
FIN. FLOOR	Closet	209	47 SF	TILE (8x8)	27' - 11 3/16"
FIN. FLOOR	Toilet	210	26 SF	TILE (8x8)	21' - 3"
FIN. FLOOR	Coat Closet	211	20 SF	HARDWOOD	18' - 0"
FIN. FLOOR	Closet	212	36 SF	TILE (12x12)	24' - 0"
FIN. FLOOR	Laundry	213	88 SF	TILE (12x12)	41' - 10 1/4"
FIN. FLOOR	Pantry	214	21 SF	TILE (12x12)	19' - 0"
FIN. FLOOR	Powder room	215	44 SF	TILE (12x12)	29' - 11"
FIN. FLOOR	GARAGE	216	714 SF	CEMENT	114' - 0 3/16"

Calculating Quantities

The ability of Revit Architecture to store, manage, and coordinate design information is essential for the precise tracking and reliable quantification of building materials, supplies, and equipment. Other design technologies scatter building information across multiple CAD files or require user intervention to make sure that all of the building information is internally consistent - resulting in less reliable information retrieval. In contrast, schedules and quantities of building components in Revit Architecture are live views of the building database, and are therefore accurate.

Revit Architecture allows users to calculate area and quantify materials effortlessly and reliably - reducing overall project cost by producing accurate estimates and minimizing the ordering of excess or unnecessary materials. Accurate area measurements lead to accurate finish budgeting for items such as carpet, wall coverings, ceiling tile, or finishes. Accurate furniture and equipment counts leads to accurate schedules for those items.

Returning to RTKL's hospital project example, hospital spaces contain very specialized, expensive equipment that require long lead times for ordering. By involving the interior design group early in the overall project (during the start of detailed design in this case), and relating detailed equipment schedules to emerging design spaces, RTKL was able to produce a better overall design, with minimal late changes and precise equipment counts.

Interior design modeled in Revit Architecture, rendered using 3Ds MAX® software

Figure 10:

RTKL uses Revit Architecture to produce very accurate preliminary estimates for interior designs by relating detailed equipment schedules to emerging design spaces (such as this hospital patient room).

The accuracy and level of detail of the Revit building information model can also be a segue to more effective ways of managing and operating the resulting facility. The ability to track occupancy, space allocation, and assets is prompting some firms to contemplate how to leverage the building information model for future service offerings.

Interior Documentation

With Revit Architecture, all the construction documents relating to the interior design are direct presentations of the underlying building model - including schedules, material take-offs and other "informational views" of the building. The Revit parametric building modeler coordinates any and all changes to the interior building model. If an interior wall is deleted, the lighting sconce on that wall is deleted as well and all related documentation is updated. The plan and elevations drawings that contained the wall and sconce, the electrical plans that contained the sconce, and the related schedule of lighting fixtures - all are instantly updated.

Summary

Revit Architecture software provides interior designers with a unified environment for conceptual design, design development, visualization, rendering, and documentation without requiring duplication of effort or replication of model information. The Revit parametric building modeler coordinates this information across all representations and design options of the project - giving designers, and their clients, confidence in the accuracy and reliability of their interior design documentation and information.

For interior designers, as for architects and other building design professionals, building information modeling is a powerful tool for thinking and communicating about design and is a strong competitive advantage for interior design businesses.

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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