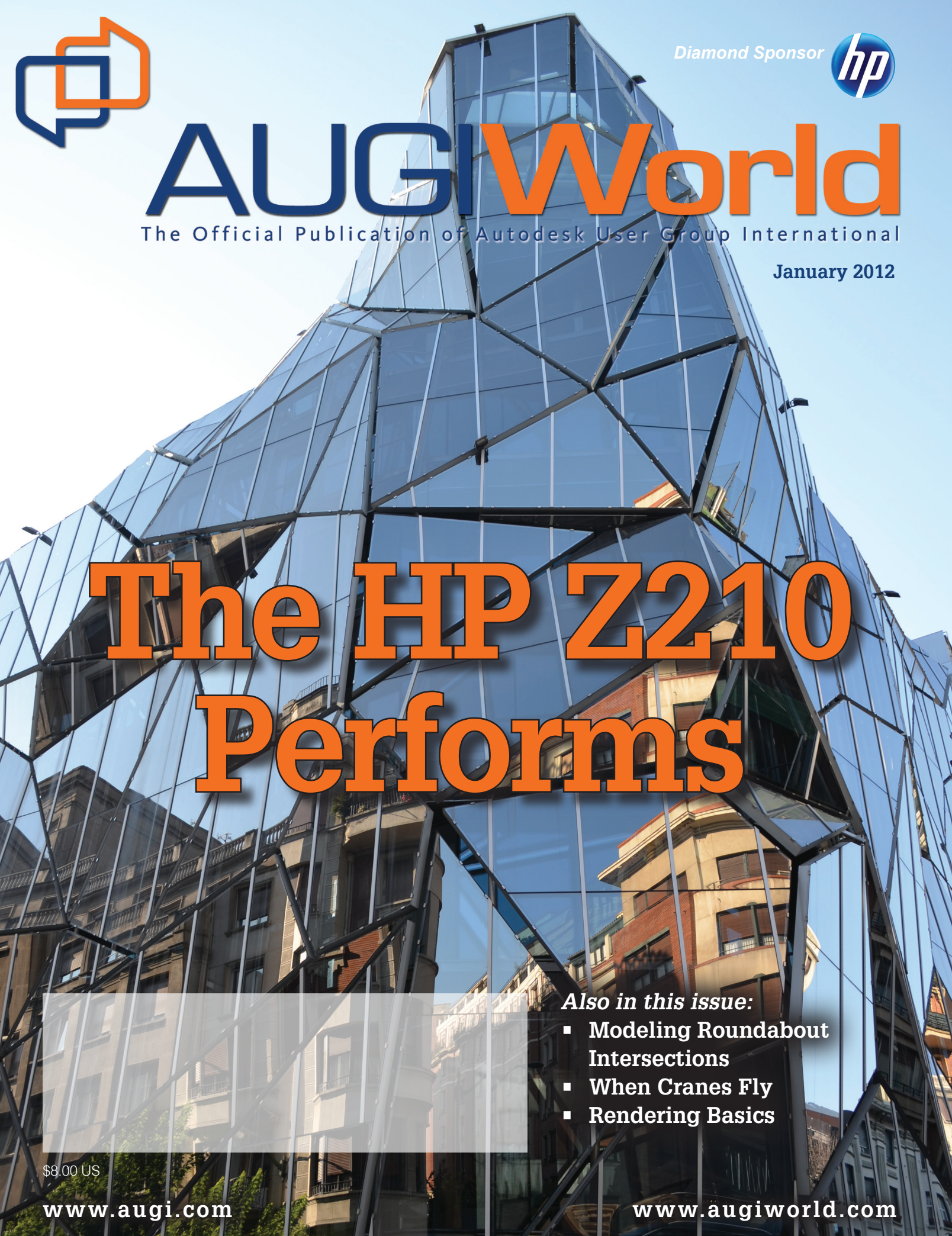

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# AUGI World

The Official Publication of Autodesk User Group International

January 2012

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# contents



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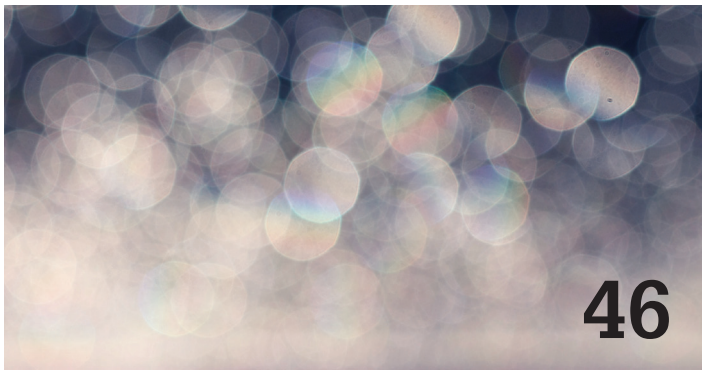


## columns



## product review



## industry focus

Happy New Year, Dear Reader! We start off the New Year with high hopes and plenty to wet your reading whistle! Our theme this month is advancement, advanced topics, and trying to blow your sockets off and hurt your brain just a little. Our cover picture is one of my favorites—I took it myself while visiting Bilboa, Spain, with friends. I don't think anyone could argue that building cladding system looks advanced! If you ever have the pleasure of visiting the area, that building is a small taste of the awesome architecture and engineering in the city. So, let's get started!

We roll out the first issue of the year with Louisa Holland exposing her AutoCAD system variables superstars. These sysvars in AutoCAD can make your day! Then we circle around with Bryan Tanner so he can show us how to model roundabout intersections in AutoCAD Civil 3D. Following this, our intrepid BUILT columnist James Salmon shows us where to find some wicked solutions! Next we have Mark Flayer who brings us up to speed with the Inventor Moldflow Adviser Design plug-in. This tool is pretty impressive if you do casting work. Then Steve Bennett gets personal with customization of your Revit.ini or outie file.

2012 brings something new to these pages in the form of *AUGIWorld* Product Reviews. Occasionally during the year we will provide software and hardware reviews on non-Autodesk products (first time ever). We begin this new topic with a review by Bill Debevc and Lonnie Cumpton on the HP Z210 workstation. Our reviews will focus on the product itself and its appropriateness for the products we use. Look for the official AUGI ranking seal for the final grade in this evaluation.

Next we have James Clifton, who explains why large networks can be green and efficient at the same time. Then Michael Smith goes vertical in Navisworks Manage putting cranes to work in his project models. Next, Joel Londenberg describes well-documented flows when using Revit MEP. And then Glenn Jowett gets advanced by going basic in scheduling beyond your expectations in using Revit Structure. Following is the monthly red-alert column "Heads Up!" that breaks down the various patches and upgrades from Autodesk. I've temporary taken on this column—let me know if you want to help!

Then we have our monthly Autodesk Insider column: this month it is Brian Haines, the industry marketing manager for the AEC division. Quick tidbit… he wants to see kiwis! Next Melinda Heavrin also gets advanced by going basic first as she explains rendering in AutoCAD Architecture. Then Erik Lewis brings the latest and greatest news from the industry in this month's Inside Track.

This issue marks the return to paper print for AUGIWorld magazine! At the moment it is in limited distribution with only a few hundred members. Look for more information later on subscribing to receive AUGIWorld in print. Until next month…

*David Harrington*


# AUGIWorld

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**Sean, 32 years old**

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Product: Bluebeam PDF Revu CAD

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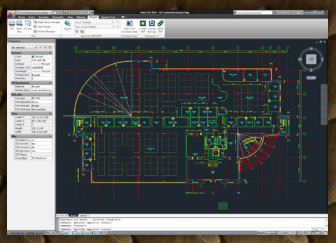

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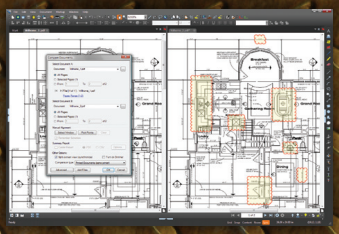

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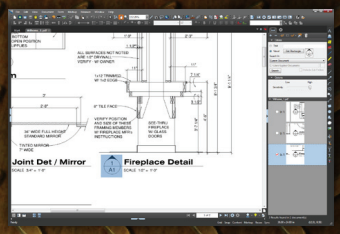


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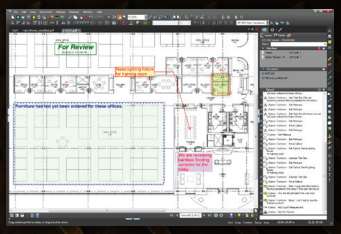


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by: Louisa Holland

# AutoCAD System Variable Superstars

In AutoCAD® there's a hidden treasure trove of options that many users do not realize exist. System variables are values that control command settings, interface behavior, and user options. Some system variables are stored with the DWG file, while others are stored to your computer's registry.

Most system variables can be controlled through a user-friendly front-end, such as the Options dialog box. Others can be found in drawing-specific areas such as the Units dialog or the status bar. A few system variables are key-in only. No matter where the front end is, they can be controlled through command-line input.

The following is an alphabetical list of some that I consider to be the most useful.

## FILEDIA

Most users who have worked with AutoCAD for any amount of time have needed to reset this registry-stored variable. When this variable is set to 0, or "off," the dialog box display is suppressed for the Open and Save As commands. A script or LISP routine will frequently set this variable to the off position while it runs its course, but will reset it back to on at the end of the process. If AutoCAD happens to close unexpectedly during the running of the script, the variable does not get reset to the proper position.

## GRIDSTYLE

Many people like to work with the AutoCAD grid on, but find the new engineering paper look makes the polar tracking guidelines difficult to see. The default value is 0, but changing the GRIDSTYLE to 1 will take the model space grid back to the pre-2011 dotted appearance. GRIDSTYLE can also be set to 2 through 7,

which affects in which drawing environments the classic grid will appear. GRIDSTYLE set to 7 means that you will see dotted grid in model space, the block editor, and layout tabs. Whether the grid is on or not is saved with the drawing, but whether you are seeing the classic or new type of grid is saved in your computer's registry.

## GRIPMULTIFUNCTIONAL

AutoCAD 2012 has raised the bar for drafting productivity with multifunctional grips on everything from polylines to dimensions. However, if you are working with a large-scale drawing, the pop-up menus that appear as you move your cursor over grips can be distracting. GRIPMULTIFUNCTIONAL can be set to values between 0 and 3, defined below.

0 – will turn off multi-functional grips altogether.

1 – will allow you to access the grip goodies by holding down the control key as you click.

2 – gives you hover-only grip menus.

3 – the default setting; gives you grip menus with or without using the CTRL key.

## PEDITACCEPT

In AutoCAD 2012, joining arcs and lines into a polyline is easier than ever. The JOIN command on the Modify panel now works on lines even if they are not co-linear. However, if you need to specify a fuzz distance between objects you will still need the PEDIT command. By default, PEDITACCEPT is set to 0, but most users prefer to set this to 1. Setting this to 1 will skip over the prompt where AutoCAD asks you if you wish to convert lines, arcs, and splines to polylines. The objects will automatically convert to a polyline and save you the confirmation step.

## PICKADD

In most cases, the PICKADD variable is changed accidentally, either by a crash or when a user inadvertently changes it by clicking on its icon in the Properties dialog. By default, PICKADD is set to 2, which means that as you click items the selection set continues to grow. To release items from a selection set, users can hold down shift while they click. The only difference between PICKADD set to 2 and PICKADD set to 1 is how the command behaves during the SELECT command. When PICKADD is set to 1, items are released from selection after the command is completed, which seems to defeat the purpose. If PICKADD is set to 0, AutoCAD will release the last picked object from your selection set. In other words, for every new item you select, AutoCAD "lets go" of the previous item or items. An example of a situation where I deliberately set my PICKADD to 0 was when I was manually manipulating a group of polylines and using AutoCAD properties to set individual elevations. With PICKADD off, it saved me the step of hitting ESC after each edit.

## SELECTIONANNODISPLAY

Annotative objects are a time saver and can facilitate clean-looking drawings. However, when you select an annotative object such as annotative text, you will see a "shadow" view of the text at its different sizes and positions. Many users find this distracting and wish to turn off the display. Set your SELECTIONANNODISPLAY to 0 and only the current scale will be displayed, much like a non-annotative object.

## WHIPTHREAD

Most new workstation-grade computers come with more than one processor, which is great for multi-taskers who are drafting, listening to music, and jumping in and out of email or word processors all day. AutoCAD can utilize multiple processors through setting the WHIPTHREAD variable. By default this is set to 1, where only REGEN tasks are sent to a secondary processor. I recommend setting this to 3 to maximize AutoCAD's performance on panning and zooming tasks. WHIPTHREAD set to 3 will offload regen and redraw tasks to a secondary processor. If you are on an older computer with only one processor, this setting will not affect anything.

## ZOOMFACTOR

Hopefully, you are using your middle mouse wheel to do the majority of your panning and zooming. It does not take long for this to become second nature for most users. The ZOOMFACTOR system variable determines the amount of change to the zoom level that takes place with every notch of rotation. The lowest possible value for this is 3, which results in very small increments of zoom. The largest ZOOMFACTOR value is 100, which results in dramatic zooming with each roll. If you ever find the zoom getting "stuck" and AutoCAD reporting that you are already zoomed in or as far out as possible, use the REGEN command to refresh your screen.

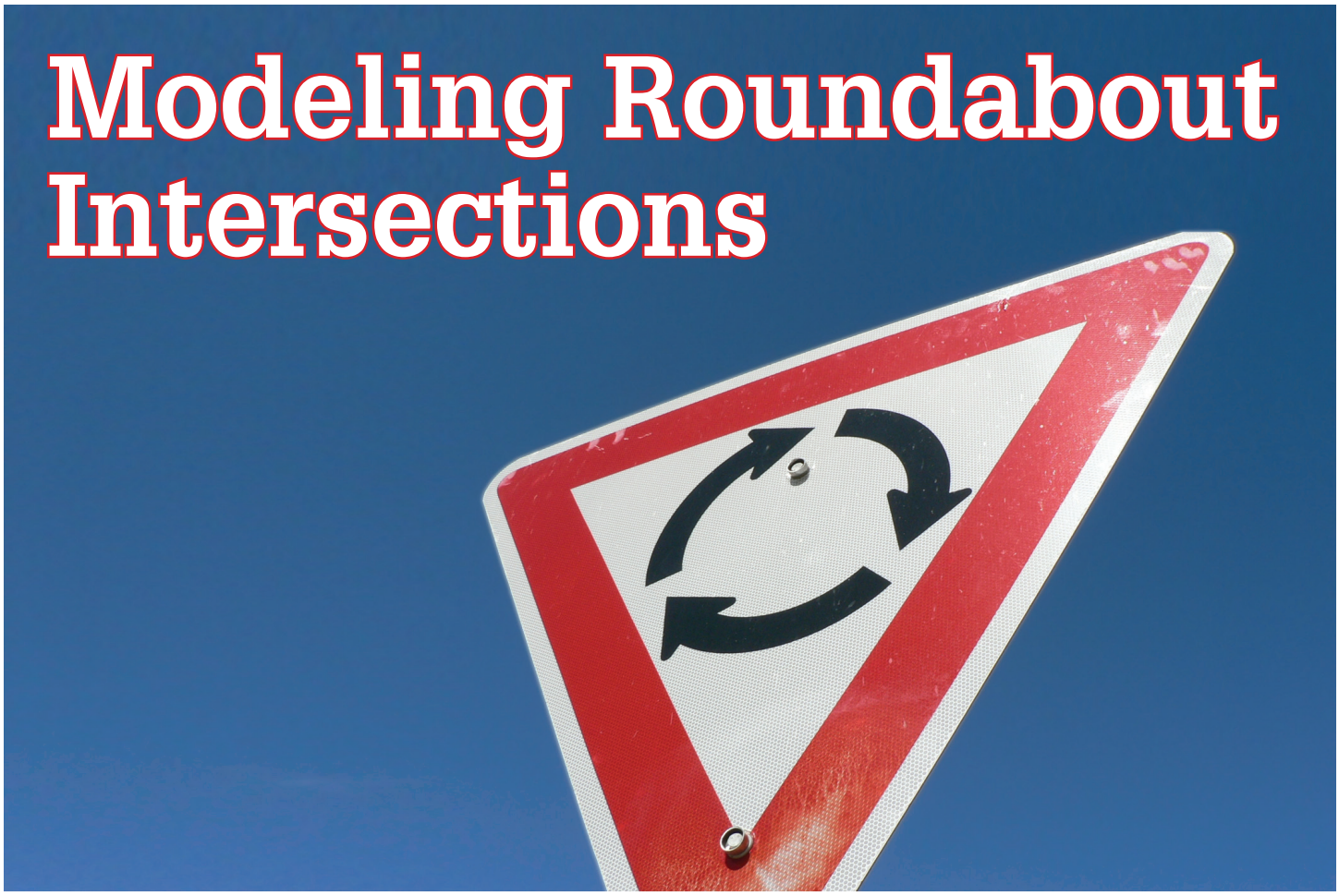
## ZOOMWHEEL

AutoCAD and Google map users tend to agree that rolling forward is an intuitive motion for zooming in. Autodesk Inventor® users might disagree. The default setting for this variable is 0. Setting it to 1 will make the middle mouse wheel zoom out as you roll forward and zoom in as you roll toward yourself.

This list is just the tip of the iceberg in terms of the options available to customize AutoCAD behavior. I encourage you to explore the options available by perusing the system variable list from the Express Tools tab. You may accidentally discover the solution to a years-old AutoCAD behavior mystery!

*Louisa "Lou" Holland is a civil engineer and application engineer for MasterGraphics Inc, located in Milwaukee, WI. She has been teaching and consulting on AutoCAD and related products for more than 10 years. Check out her most recent book,* Mastering Civil 3D 2012, *by Sybex publishing. You can find Lou on Twitter @LouisaHolland or by emailing louisa.holand@mastergraphics.com*

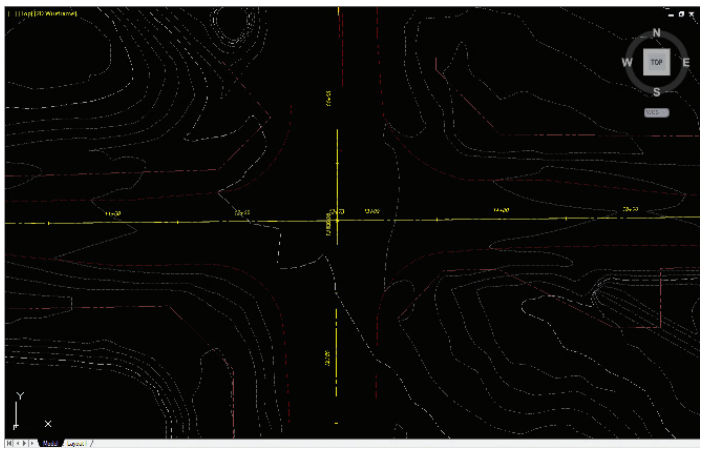
# Modeling Roundabout Intersections



The release of AutoCAD® Civil 3D® 2010 included a very desirable feature—a toolset for roundabout design. Although everything was included for creating two-dimensional geometry— including alignments, pavement marking, and signage—corridor modeling of the roundabouts seemed to be missing. Join me for a little discovery of how to utilize the Intersection Design wizard for developing intelligent, 3D roundabout corridor models (though the roundabout shown below might be a little aspirational).

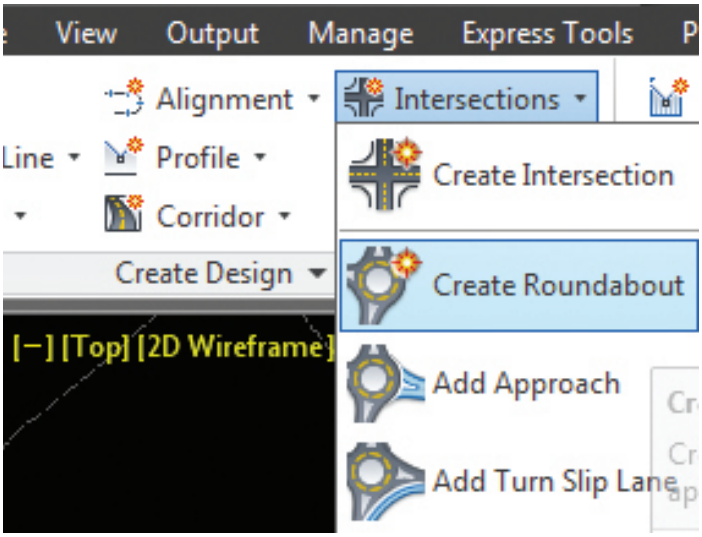
## GETTING STARTED

First things first: You must start out with alignments. The suggested route to minimize the number of times you must add additional approaches is to utilize four separate alignments at the point of intersection. Use station control to modify labels if you must, or just take extra time later adding additional approaches.



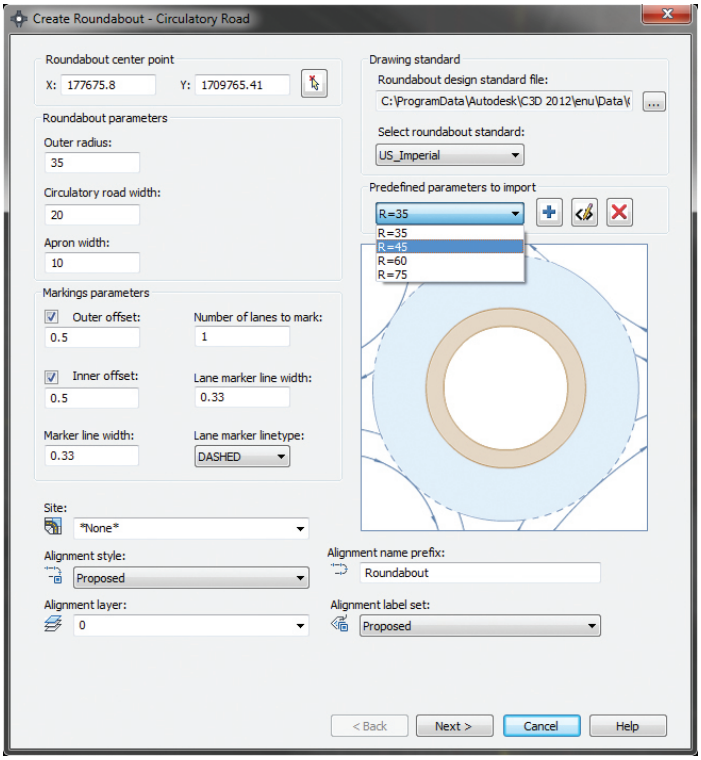
For the purposes of this article, we'll work with a simple 4-way intersection. Whether or not your specific application of the roundabout tools requires a more complex configuration, the point is to explore the transition of it to a Civil 3D corridor.

## CREATING THE ROUNDABOUT GEOMETRY

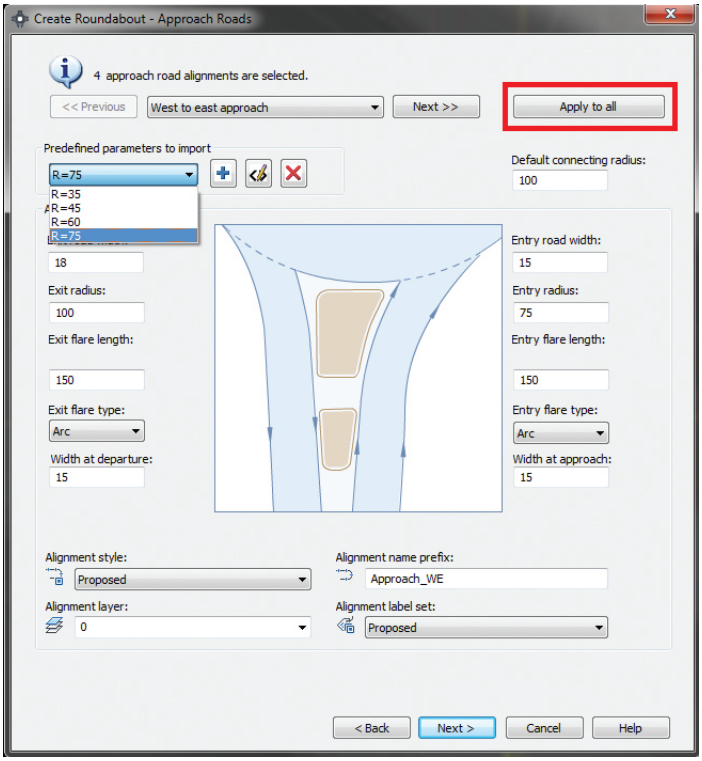



The roundabout tools are located on the Home tab of the ribbon, on the Create Design panel, under the Intersection command drop-down. Select the Create Roundabout option. From there, you will be prompted to select the center of the roundabout, which should be the same as your alignment intersection.

You'll then be prompted to select the approach(es). Pick each alignment. This is where using four separate alignments simplifies the process; otherwise, you'll be limited to two approaches. Select the Enter key when done and you'll be brought into the create roundabout wizard.



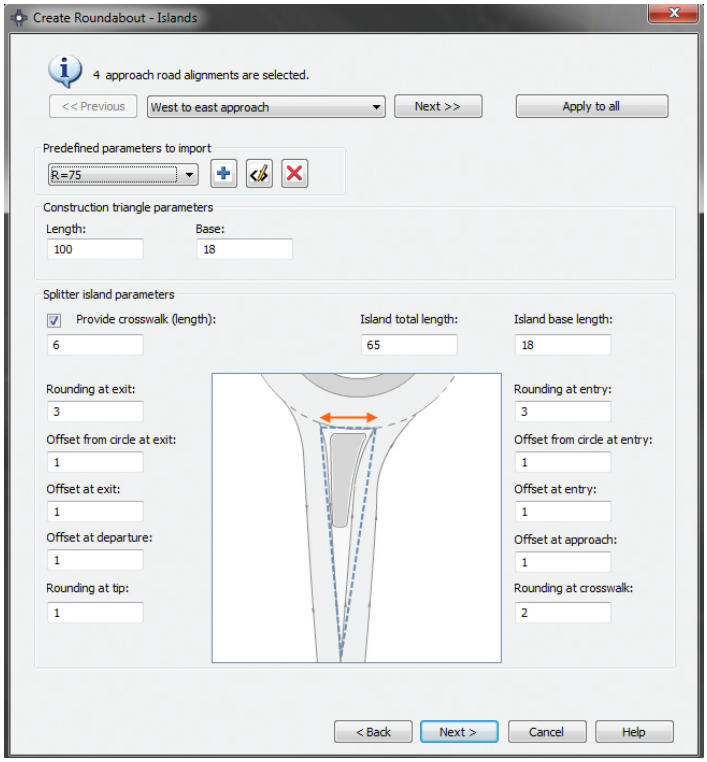

There are several pages within the wizard that will step you through each component of its construction. The first page allows you to select an .xml file with predefined design parameters for standard roundabout radii. This .xml file can be customized to your heart's content to match national or regional codes. This initial page is where you may also modify drive widths, inner and outer pavement markings, and alignment styles/names. Select Next once you have completed these fields.




The second page of the wizard involves setting the dimensional values and styles for entering and exiting approach lanes. You need to be sure these values do not exceed the overall radius of the roundabout; otherwise you will receive an error and incomplete design once completing the wizard. Use the predefined radius values as a guide for what should work under these circumstances. There are separate settings that can be defined for each approach alignment, or you can simplify the process, should your design permit it, by applying the settings across all approaches. Select Next once you're done.

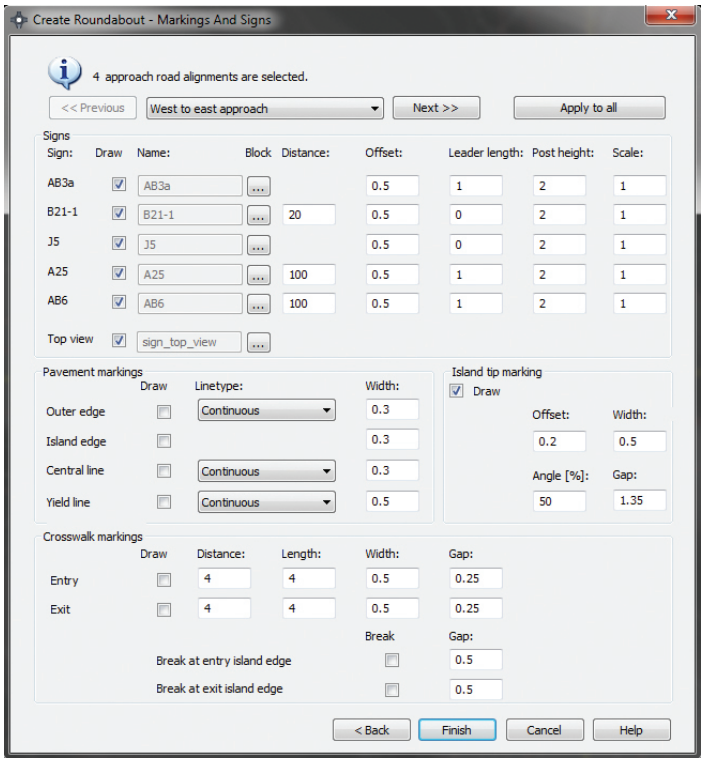
Continuing on with the wizard (and don't worry, though this dialog may seem intimidating, every aspect of it is broken down into individual components) define the settings for approach islands. The same rules apply to this page of the roundabout wizard as the approach lane parameters—use predefined roundabout radius information to help in defining the exact geometry you want to apply.

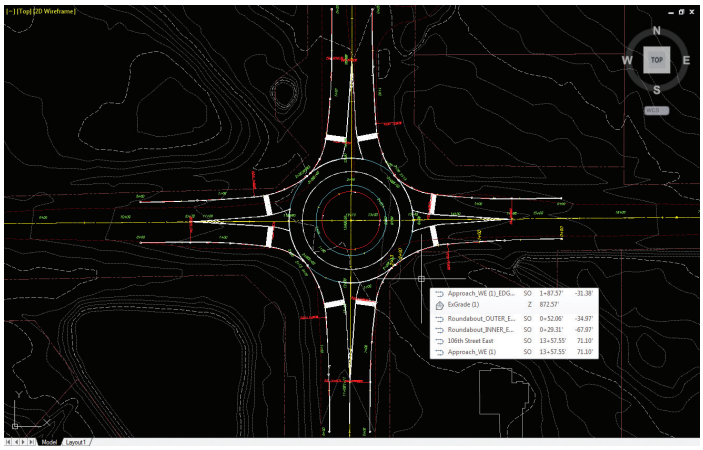
It's worth noting that when going through this process, you can save the changes you make in the fields back into the .xml file you have been working with or create an entirely new one, customized to your specific design needs. You can also go back into the wizard to edit settings after the roundabout has been completed.




The last roundabout wizard page is dedicated to the additional pavement marking and signage you want automatically applied to your design. The blocks used for the signage are multi-view and will display properly when viewed in plan, section, and perspective views for rendering purposes. You can substitute your own blocks to meet local codes and change their placement within the roundabout area.

Although you've likely already noticed this on previous pages of the wizard, you can define minute details—even down to the paint striping widths used. Select the Finish button when done.

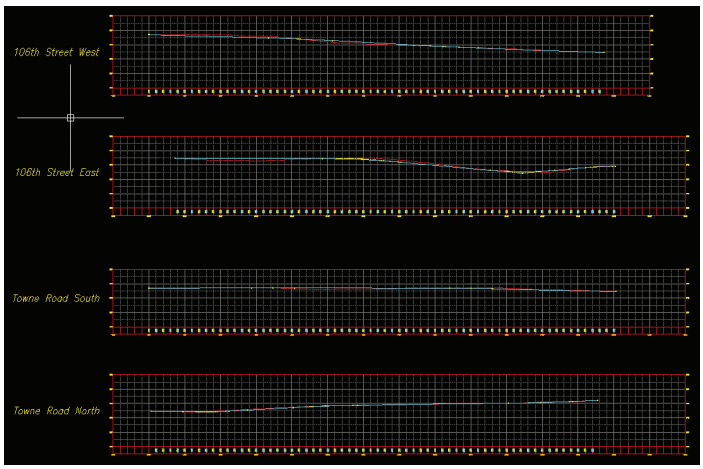


You should now have a finished, two-dimensional roundabout complete with pavement marking and signage (if you chose to include them) in your drawing. The image above should give you a pretty good idea of what this looks like. Feel free to select any portion of the roundabout and select the Edit Roundabout option from the Civil 3D Contextual ribbon at any time to make changes that may be necessary along the course of your project or if you ran into any problems with the resulting output. This may also include adding more approaches (if you had only two alignments instead of splitting them at the intersection) or a slip lane for uninterrupted travel for drivers making a "traditional" right-hand turn (or left turn for designs in the UK, Australia, India, parts of Africa, et al). These options are also available within the roundabout Contextual ribbon or the intersection command drop-down on the Create Design panel of the Home ribbon tab.

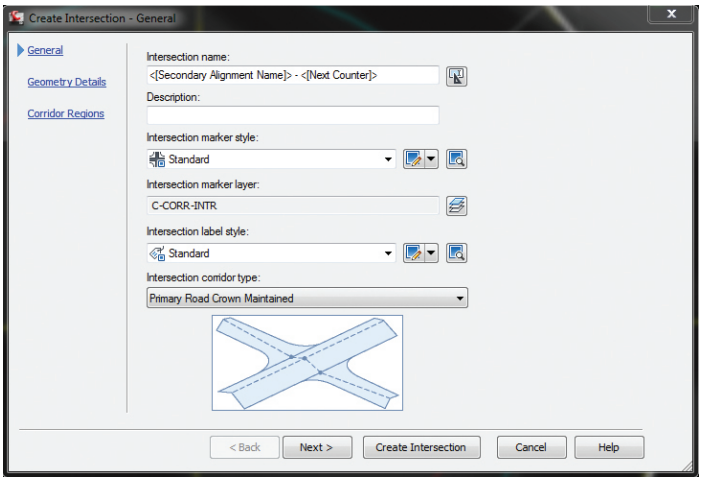
## BUILDING A CORRIDOR (NOT SO FAST...)

We now want to utilize the alignments and other geometry to design the corridor. However, don't get too far ahead of yourself—remember that the roundabout wizard created only two-dimensional geometry. Before jumping into the intersection design wizard, you'll first need to create design profiles for the approach lane alignments, as well as the roundabout centerline.



## BUILDING A CORRIDOR (FOR REAL THIS TIME)

With our horizontal and vertical geometry defined and in place, it's time to jump right into the intersection design wizard. It, too, is also located on the intersection command drop-down. After picking the intersection tool, you'll be prompted to select the intersection point in the drawing. It sounds pretty simple, but cluttered labels and overlapping linework can make this frustrating. Use layer isolation, zooming, and object snapping to avoid some of the hassle associated with missing the exact point of intersection of the roundabout and approach alignments. Just remember, Civil 3D is doing exactly what you tell it to do, and where.

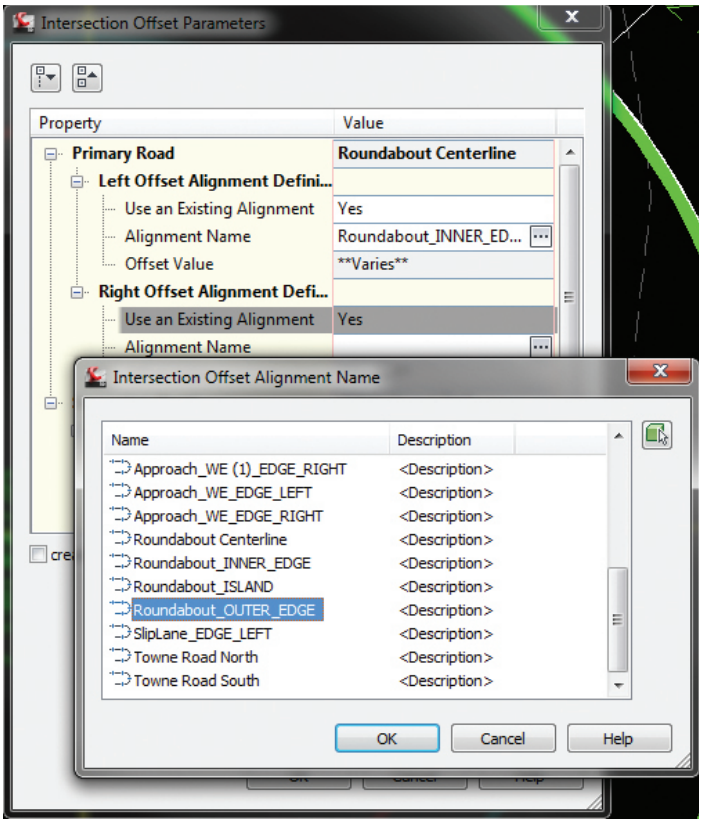



You'll need to go through this process for each approach in your roundabout design. I'll explain the process once, assuming the same or similar methods will be used for each additional approach intersection.

**Civil 3D Pro Tip:** *Be descriptive in the naming of your entities. These designs can start getting very complex in a short amount of time and the last thing you want to do is go on a goose chase trying to figure out what "Alignment – (1) (Copy) and Alignment – (2) Intersection (4)" actually represents in your drawing. Good styles and settings can assist in avoiding a scenario such as this, but you should be diligent in ensuring elements are easy to understand for someone who hasn't seen this project before.*

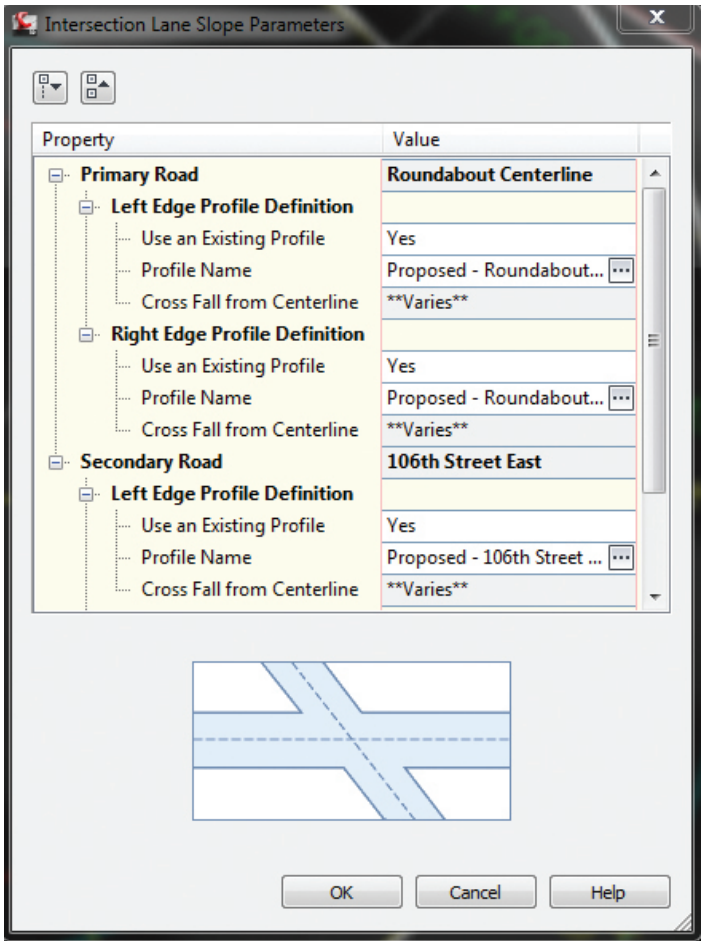
With that in mind, on the first page of the intersection design wizard, name each intersection you go through by the roundabout alignment name + the approach. Alignment name should offer more than enough information to pinpoint its location and purpose. Make certain you maintain the crown for the primary road as it would make for a pretty bumpy drive on the roundabout otherwise. With those, and the label/style settings defined, select the Next button.

In the next page of the intersection wizard, you'll be prompted with several options for changing which alignment is the primary, setting offset parameters for each lane in the intersection, curb return horizontal parameters, lane slope parameters, and curb return profile parameters. Let me break that down a bit for you.




Here you can set exact widths for left and right lanes for both the roundabout and approach alignments. You can also optionally define the lane widths on offset alignments (which you already have from the roundabout creation wizard). I sometimes like to use predefined offset alignments, but there are two things to be cautious of when doing so. First, the corridor generated is perpendicular to the baseline alignment and linework such as curbs and gutters don't generate smoothly through curved or variable offset widths. Second, for you to actually generate a corridor from these offset alignments you must have profiles defined for them already. If either of these criteria puts a cramp in your process, use a set width for the lanes and go back later for targeting in your corridor options dialog.

In the curb return parameters dialog, you can set up the radius, chamfer, or three-point arc dimensions to be utilized on your roundabout at each quadrant of the intersection. Although you already set offset alignments or lane widths (with targeting later), the curb return parameters are important for setting a vertical profile for corridor regions where targeting must be applied from the edge of pavement back to the approach centerline and edge of roundabout travel way for an accurate and smooth surface. Set the radii just as your roundabout wizard had generated them and it should make for some easy cleanup work later with corridor grip editing and redefining targets.




The lane slope parameters dialog is another important aspect in how your roundabout intersection will be constructed. If you utilized offset alignments for your lane widths, you must use the corresponding profiles within this dialog box in order to build the intersection corridor. However, if you opted for offset widths to be refined later, only simple grade % values are needed here. Keep in mind your roundabout centerline likely requires a positive slope on the inside lane and a negative slope on the outside lane and it should be defined as such here.

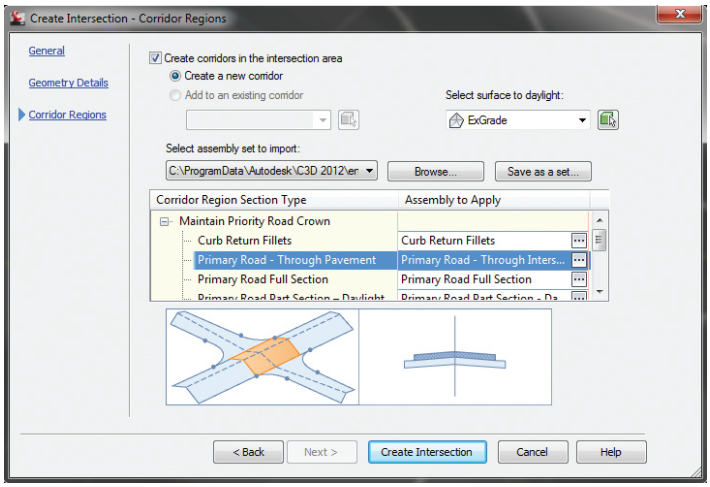
**It's also always good practice to add a surface to your corridor and check for any irregularities or design problems with the Civil 3D object viewer.**

The last dialog to be concerned with on the second page of the intersection design wizard is the curb return profile parameters. This dialog determines how far, if at all, your corridor region is extended beyond the curb return radii for the quadrants of your intersection. It is advisable that whichever end of the curb return radius is on the roundabout portion of the intersection, which could be the incoming or outgoing end depending on which quadrant is current, should have the option to extend the curb return profile as "no." The end of the curb return radius, which is part of the approach alignment, could and likely should be extended along the entire length of the taper for the approach.

Apply these settings for the curb return profiles to all quadrants of the intersection. Also note if your approach alignment extended beyond the roundabout centerline, you have been working with a four-way intersection and only two of the quadrants actually apply. The others will be an easy fix later by simply deleting the baselines and regions from the corridor properties dialog box after the intersection has already been built.

When done with the curb, return to the profile dialog box, select OK, and click the Next button on the intersection design wizard to proceed to the final page.

With this third and final page of the intersection design wizard you can generate a new corridor or add a region to an existing corridor, name the region, select assemblies that should be applied to each region of the intersection corridor, and/or import assembly group settings used in previous designs.



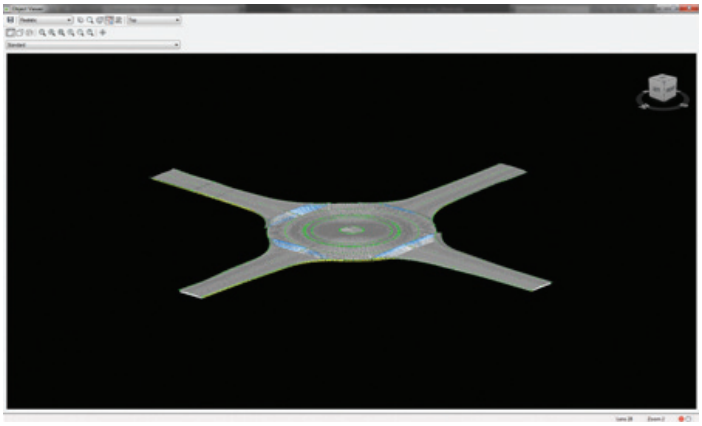

If you didn't already have an assembly set to import or available in your current drawing file, they can easily be modified later to update the corridor or be swapped out in the corridor options dialog for entirely new, more applicable assemblies. Click the create intersection button once you are done adjusting these settings to complete the first approach intersection.

Repeat this same process for any additional approaches you have within your roundabout design. Similar settings, dimensional values, and assembly sets make the process go faster each time.

## THE FINAL PRODUCT

Now that you have your approach intersection built from the roundabout alignments and target geometry, you should end up with a corridor resembling the following image.

It's also always good practice to add a surface to your corridor and check for any irregularities or design problems with the Civil 3D object viewer. Just select the surface and/or corridor entities in your drawing space and select the object viewer option from the Contextual ribbon or from the right-click shortcut menu. The corridor and surface should look similar to the image below. Targeting, profile, and assembly adjustments may be necessary to develop an accurate model.



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# Wicked Solutions

## INTRODUCTION

This article presents a vision for Wicked Solutions in the BUILT industry. The initial article in the series served as a Wicked Primer, the second identified Wicked Problems in Construction, while the last article discussed Wicked Tools. This article tackles Wicked Solutions.

The Wicked Series, read alongside the Digital Assets Series from *AUGIWorld* May, June, and July 2011, analyzes the Wicked Problems faced by BUILT industry professionals seeking to deliver Building Information Modeling (BIM) services as members of integrated teams in an Integrated Project Delivery (IPD) environment.

Wicked problems require Wicked Solutions and there are no easy answers. A single article hardly qualifies as substantive analysis and the following should be viewed by readers as a jumping off point, not an end point, in the quest for Wicked Solutions to the Wicked Problems plaguing the BUILT industry.

## WICKED PROBLEMS AS KNOWLEDGE PROBLEMS

Because Wicked Problems are inherently difficult to define, identifying Wicked Solutions to those problems is exponentially more difficult. Thinking outside the box, drawing on analysis, insight from other disciplines, observing success in other sectors of the economy, and generally thinking deeply about these issues is critical. Doing so leads some to believe economic theory may be one useful prism through which to view Wicked Problems and Wicked Solutions in the BUILT industry.

In fact, Wicked Problems look a lot like the Knowledge Problem used by F. A. Hayek in his essay "The Use of Knowledge in Society" to argue central planning of an economy was doomed to failure.[1] According to Hayek, individualized plans, in large and small enterprises, enable efficient use of scarce labor and capital resources.[2] Hayek argued that efficient planning entails formation of plans containing relevant data generated by others forming similar plans where data acquisition and analysis depends on a price system. The price system, as envisioned by Hayek, provides

a framework for communication and plan coordination among entrepreneurs in a capitalist market system. Fluctuation of prices conveys critical knowledge to entrepreneurs regarding the broader economy, within which individualized business plans unfold. Wicked Problems in Construction (*AUGIWorld*, December 2011) represent project size "knowledge problems" that lend themselves to similar solutions. Pain share/gain share protocols that incentivize collaborative and cooperative solutions drive "market-based solutions" on construction projects in much the way prices drive market-based solutions in the broader economy.

## THE MARKET AS A WICKED SOLUTION

Unfettered markets, in which intelligent actors procure and deliver services and supplies in accordance with their own self-interests, resolve little "knowledge problems" as they arise, especially when there are shared and vested interests in the outcome. Actors in such circumstances address Wicked Problems more effectively when they have timely access to critical data. With a finger on the pulse of discrete aspects of the Wicked Problems they face—and the authority and motivation to solve them—such actors find themselves well positioned to deploy creative solutions, exercise good judgment, and resolve issues as they arise. These actions short circuit much of the paralysis by analysis caused by Wicked Problems with their evolving definitions, looping decision cycles, and other unique features.

Unfortunately, as with the larger economy, the financial reality of a complex construction project is anything but "unfettered." Myriad government regulations and private sectors demands provide a variety of constraints with which stakeholders must grapple. Fragmented and sclerotic decision chains, lack of authority downstream, blame allocation (aka, finger pointing), fear of litigation, myopic vision, and flawed incentive mechanisms, among other defects, combine to limit the ability of project-level stakeholders to effectively deploy market-based solutions.

These challenges, viewed as the opportunities they are, provide integrated teams and owners who deploy such teams the chance to revolutionize the delivery of planning, design, construction, operations, and maintenance services throughout the BUILT industry. Creating real market-based incentives throughout the life cycle of a facility, or a portfolio of facilities, requires typical project delivery methods, and the contracts upon which those methods are based, to be rethought.

## INTEGRATED LEGAL FRAMEWORKS AS WICKED SOLUTIONS

Owners seeking delivery of fully functional digital assets from BIM-enabled firms currently procure services from a disparate and fragmented team of BUILT industry professionals. Very few of those owners, however, consider requesting—much less demanding—fully functional digital assets be delivered by providers throughout the life cycle of the facility. Even less attention is paid to the scope and nature of the legal instruments pursuant to which such assets would be delivered.

Instead, owners typically sign a series of traditional transactional agreements with each provider. For example, one firm might be hired to identify potential building sites while another is retained to complete environmental assessments. Paper copies of reports completed by the site selection firm/committee are filed along with the environmental studies, or digital copies are digitally "round filed" in a windows folder that no one in the organization can locate the next year. Civil engineers, architects, structural engineers, mechanical engineers, general contractors, construction managers, trade contractors, commissioning agents, property management firms, facility management companies, and other providers in the BUILT industry similarly fumble the hand off of critical digital assets. The problem is compounded by the failure of owners and their lawyers to include digital assets as a deliverable and the failure, when they do, to accurately describe the scope and format of the digital assets requested.

Once providers are under contract, they retreat to a bunker, complete the scope of work as assigned, then toss their work product over the wall to the next provider. Owners, conflating price with value and too often mistaking one for the other, lean on the bid crutch that prop up the tired and discredited design-bid-build procurement model to procure these services.

Antiquated procurement laws, regulations, and mechanisms represent significant constraints on BUILT industry stakeholders, especially in the public sector. The transactional contracts that flow from the design-bid-build method of procuring projects expressly pit stakeholders against one another and shackle them to outdated business models and processes that limit their ability to operate as members of integrated teams. More importantly, the outdated legal framework within which these services are procured fails to address delivery of functional digital assets, depriving most owners of the most valuable component of BIM, the *information*.

The BUILT industry needs an integrated legal framework designed to enable owners to procure planning, design, and construction services from integrated teams of BIM-enabled professionals. Procuring services from integrated teams capable of delivering fully functional digital assets will empower owners to achieve BIM to FM on a portfolio-wide basis. As more owners recognize the value of BIM and demand fully functional digital assets, new legal instruments, indeed a new legal framework, will be required to achieve and sustain success.

The economic interests of the key stakeholders in the BUILT industry align on a macro scale and would be well served by a legal framework that encouraged collaborative and cooperative behaviors among integrated team members. The familiar features of effective project specific agreements, adapted for use on a cross-disciplinary and cross-sector basis, provide a viable starting point for such a framework.

Ironically, creation of such a framework presents itself, simultaneously, as both a Wicked Problem and a Wicked Solution. Useful as a solution to the myriad Wicked Problems confronted by the BUILT industry, the creation of a sufficiently robust integrated legal framework bears the earmarks of a classic Wicked Problem. The disparate and fragmented nature of the interests of the stakeholders required to begin the conversation deters many from moving forward. Analysis of a new legal framework as a Wicked Solution gives rise to another conundrum: When, where, and how can BUILT industry stakeholders craft, negotiate, and implement new legal agreements and a new legal framework?

## COLLABORATIVE WORKSHOPS AS WICKED SOLUTIONS

Collaborative workshops help answer the question. Of course, critical analysis of the BUILT industry's wicked problems occurs everyday. Unfortunately, much of the analysis occurs within the same bunkers or silos to which many BUILT industry stakeholders retreat upon receipt of a contract to provide services on a specific project. Well intentioned, a plethora of associations and industry groups busily promote such analysis.

Among the more prominent of the national organizations are the AIA, AGC, CURT, BOMA, and NASFM to name a few. In addition to private organizations, numerous governmental entities participate in the process. These include the federal entities such as the GSA, DOD, DOE, USACE, and the VA, state actors in Wisconsin, California, Texas, and elsewhere, as well as quasi public-private entities such as NIBS and the BuildingSMARTalliance, among others.

These organizations have a history of working together to achieve laudable goals for the BUILT industry as a whole, especially regarding standardization of specifications and, more recently, the introduction of project-specific integrated or collaborative agreements. A broad cross section of industry organizations endorsed the new generation of legal agreements published by ConsensusDOCS, LLC. AIA responded with a set of so-called transitional IPD documents that were designed to facilitate the use of BIM in an integrated environment. Private entities such as Sutter Health, HansonBridgett, and Collaborative Construction offer customized instruments as well. All of these instruments support and enable the use of IPD and BIM on a project-by-project basis. The legal framework concept contemplates a broader reach for these instruments and those who support IPD and BIM.

Collaborative workshops, whether project centric or industry wide, provide an excellent forum in which to discuss the Wicked Problems faced by the BUILT industry. Open and honest communication, along with cross-pollination of ideas, drives innovation in such workshops. Further, such workshops help stakeholders know where their interests converge, diverge, and conflict—knowledge that is critical to formulating effective long-term strategies on an industry-wide basis. Wider use of collaborative workshops, both project specific and industry wide, benefits individual and industry-level stakeholders.

## ENTERPRISE LEVEL BIM OR BIMXML AS A WICKED SOLUTION

Analysis of the complex, intertwined, and interdependent social and economic interests of the stakeholders in the BUILT industry cry out for technology-based solutions. Software providers and technology companies—from IBM and Microsoft to Autodesk and Dessault Systems—continue to improve the hardware and software available to conduct such analysis. But the knowledge problem discussed at the beginning of this article provides a cautionary tale regarding the use of such tools to "solve" the entire problem set. That said, technological innovation is a critical component to the solution and cannot be ignored.

Enterprise-level software solutions exist today in the manufacturing world and are used to virtually design, construct, and test a wide range of products. Weapons systems and similarly complex facilities delivered by the likes of Boeing, Lockheed Martin, Bechtel, and similar entities, are planned, designed, manufactured, and deployed using enterprise-level software tools on a regular basis. The vast majority of the facilities and infrastructure projects delivered by the BUILT industry? Not so much.

Frankly, the BUILT industry has an opportunity to leap-frog over 20 to 30 years of antiquated technologies and business processes, landing firmly in the 21st Century. Leveraging these virtual design tools, and the business processes and new-generation legal instruments required to deploy them throughout the life cycle of a facility, allows BIM-enabled firms to deliver fully functional digital assets to owners. In other words, BIM-enabled firms that operate in an IPD environment can deliver BIM to FM.

As more and more owners, especially sophisticated institutional owners including the U.S. Government agencies listed above, the U.K. Government (which is demanding second-level BIM as a deliverable by 2016), and innovative private companies demand BIM as a deliverable, it will become more and more important for BUILT industry professionals to deliver BIM to FM.

## WICKED CONCLUSIONS

Is your organization prepared to compete in an integrated environment? Is your organization BIM enabled? Is your organization prepared to create, utilize, and share fully functional digital assets in an IPD environment? Economies of scale, cultural differences, localized workforces, supply chains, and other factors combine to inhibit adoption of IPD, BIM, and lean business processes in the BUILT industry. As with other aspects of the Wicked Problems faced by the industry, these challenges actually represent tremendous opportunities.

Accordingly, the questions raised in this series of articles should be viewed as opportunities and not as hurdles. The BUILT industry needs to seize the opportunity and run with it. Innovative firms, organizations, and governmental entities can join forces immediately to begin charting a path forward.

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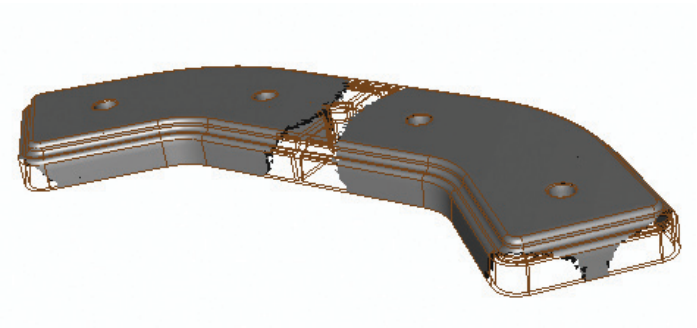
1 Hayek, F.A. 1945 The Use of Knowledge in Society *The American Economic Review.*

2 Hayek F.A. 1937 Economics and Knowledge *Economica* V4 N13 33-54

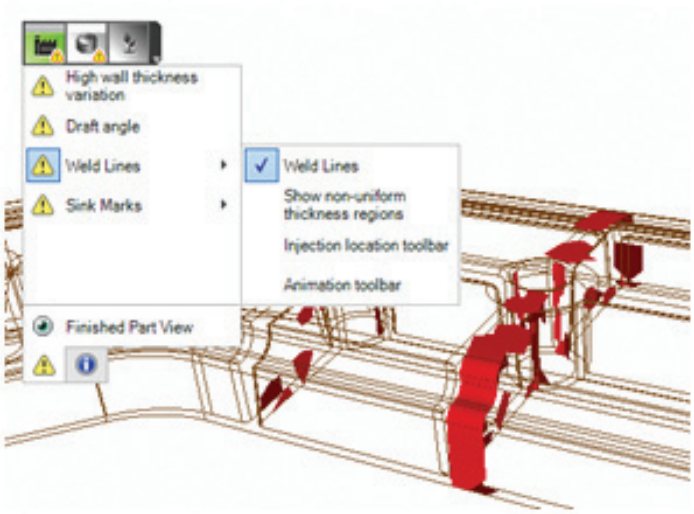
*James L. Salmon, Esq. President, Collaborative Construction Resources, LLC is a collaborative consultant and the creator of these IPD in 3D™ concepts. Salmon advocates the use of advanced BIM technologies, Lean Construction methods, Collaborative Agreements and other IPD in 3D™ processes. His Collaborative BIM Advocates group provides free membership, national networking opportunities, custom symposiums and online webinars.*

# Autodesk Inventor Moldflow Adviser Design Plug-in

Part designers using Autodesk Inventor® or Autodesk Inventor® LT software have the option to use the new Autodesk® Moldflow® Adviser Design plug-in (formally Project Krypton from Autodesk Labs) to evaluate their plastic part designs directly within the native CAD environment. Part designers can evaluate manufacturing feasibility, cost efficiency and environmental impact concurrently with product development as the design evolves.



This plug-in highlights potential design problems directly on the CAD model and provides immediate feedback on design manufacturability, cost efficiency, and the environmental impact of the plastic material. Fill patterns, undercuts, poor draft angles, weld lines, and sink marks are represented on the model, and these are updated almost instantly as design parameters are altered in the model.




These capabilities allow designers to react quickly to address identified issues and optimize their designs.

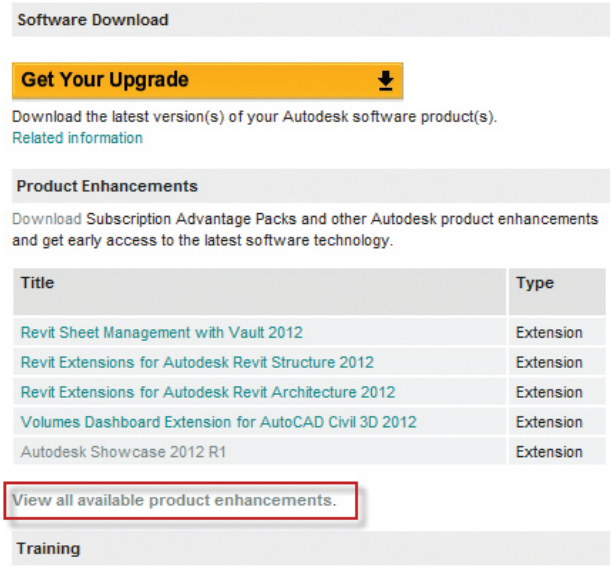
You may not be the Moldflow user in your company, but you can still use this utility to perform some preliminary checks in Inventor before the Moldflow users get their hands on the model.

## AVAILABILITY

In order the install the Moldflow Adviser Design add-in for Autodesk Inventor, the following criteria are assumed.

1. You are on subscription
2. You have a Network License of Autodesk Moldflow available
3. You have one of the following CAD packages
   - Inventor 2012 – 32 and 64 bit
   - Inventor 2012 LT – 32 and 64 bit
   - Pro/E Wildfire 3.0 – 5.0 32 and 64 bit

To access the installer for the utility, visit the Autodesk Subscription site and locate the product enhancements section. You may need your contract manager to perform this download in order to obtain the files.



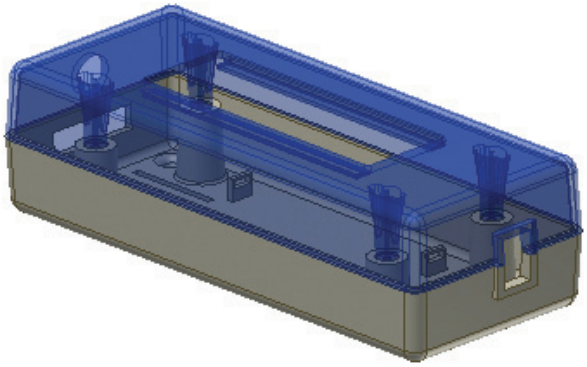

During the installation process, Autodesk will ask about the network license manager and server locations. If you cannot locate a Moldflow license server, the installation will not continue.

Shown below are the available FlexLM feature codes allowed for the Adviser utility.

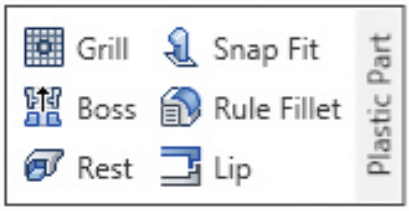
| | |
|---|---|
| Autodesk Moldflow Adviser Advanced 2012 | 85816MFAA_2012_0F |
| Autodesk Moldflow Adviser Design 2012 | 85818MFAD_2012_0F |
| Autodesk Moldflow Adviser Manufacturing 2012 | 85819MFAM_2012_0F |

## PART MODELING

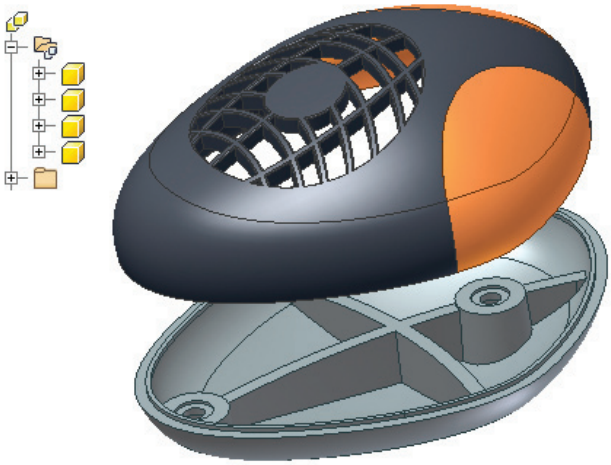
There are several modeling features and techniques in Autodesk Inventor just for plastic part modeling.



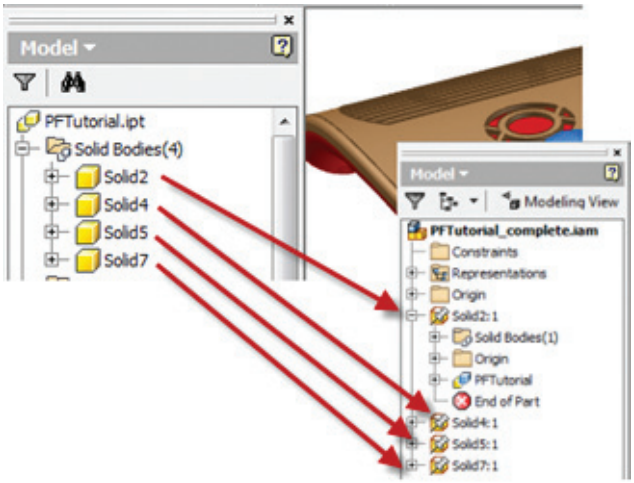
A couple years ago, specially designed modeling tools known as the Plastic Features were added. These features include such gems as Lip, Boss, Rest, Grill, Snap Fit, and Rule Fillet. The Rib command was also recently overhauled to better work with plastic features.




Perhaps the largest increase in capability for plastics over the last couple years has been the inclusion of the Multi-Body Part commands, which allow a user to build a single part is if it were an assembly.



After modeling is completed in this file, the individual solid bodies can be broken out into their own respective parts with use of the Make Components or Make Part commands. Autodesk Moldflow Adviser Design does not support multi-bodied parts so this step has to take place before part analysis can begin.



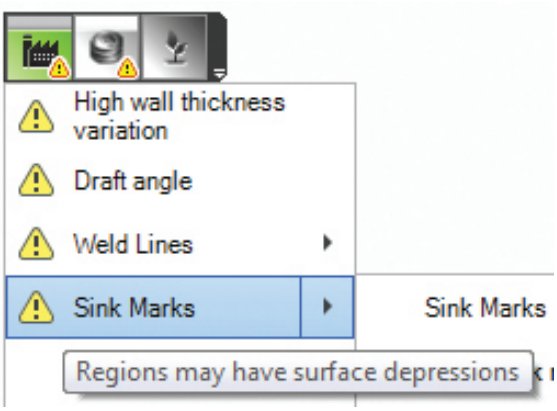

Material Selection is also quite important for the Adviser to work. If no material is preselected (default) the Adviser will use polypropylene. If a non-plastic material such as aluminum is chosen, then the Adviser will automatically disable itself.

## MOLDFLOW DESIGN WIDGET

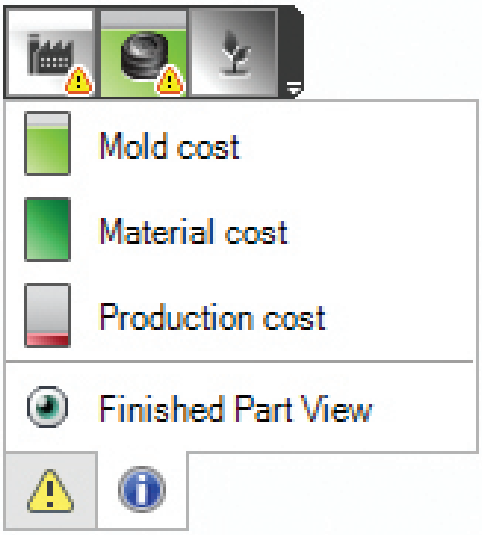
The on-screen advisor tool requires some interface and customization adjustments in order to fully utilize the utility. These adjustments include turning on additional menus and configuring the settings for each of the plastic indicators.


For information about an indicator, click on the icon and a pop-up dialog with two tabs is displayed. The Alert pop-up tab outlines any parameters that need attention. Several individual parameters have sub-menus that help visualize or rectify the problem.

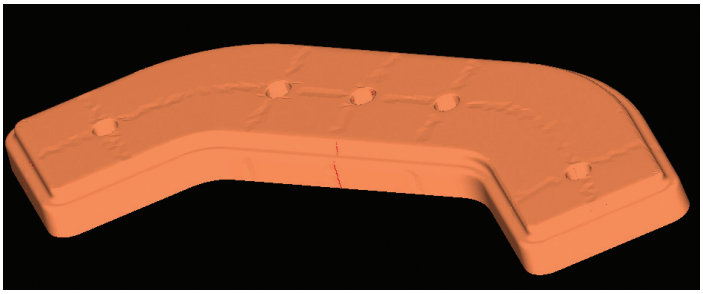
The Information pop-up tab shows how each parameter contributes to the indicator value.




The warning alerts can also be switched to view the individual indicator element graphs by selecting the blue information button in the indicator flyout.



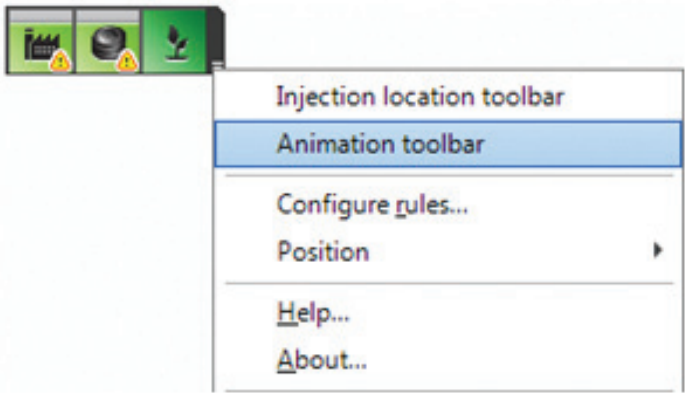

In order to see what the resultant calculators predicted for the part, use the Finished Part View in any of the indicators to launch a previewed render of the part, including potential sink marks in the material.



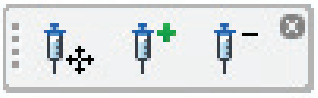
This preview dramatically improves visual understanding, conveying potential changes to the design criteria, or showcasing potential flaws in manufacturing of the part.

### Menu

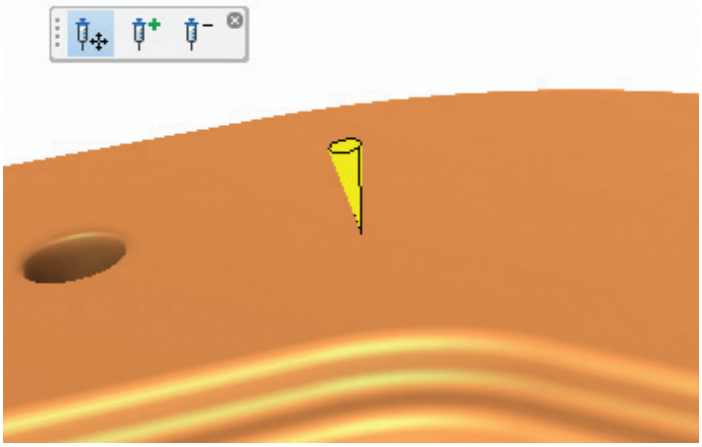
The menu for the advisor add-in allows for the user to activate two on-screen toolbars as well as configure the rules for cost efficiency, manufacturability, and plastic material impact.




### Injector Toolbar



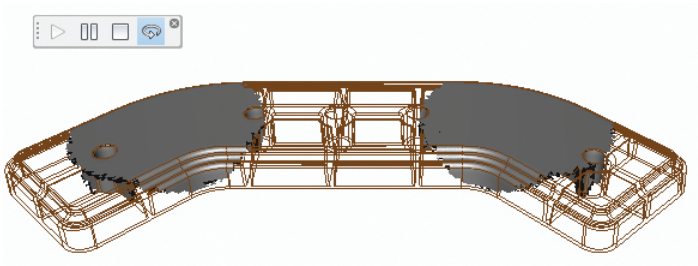
The Injector toolbar allows the user to move the initial injector for a part and either add or remove additional plastic injectors for the material. The addition of the injectors will change the animation of the fill.



## Animation Toolbar

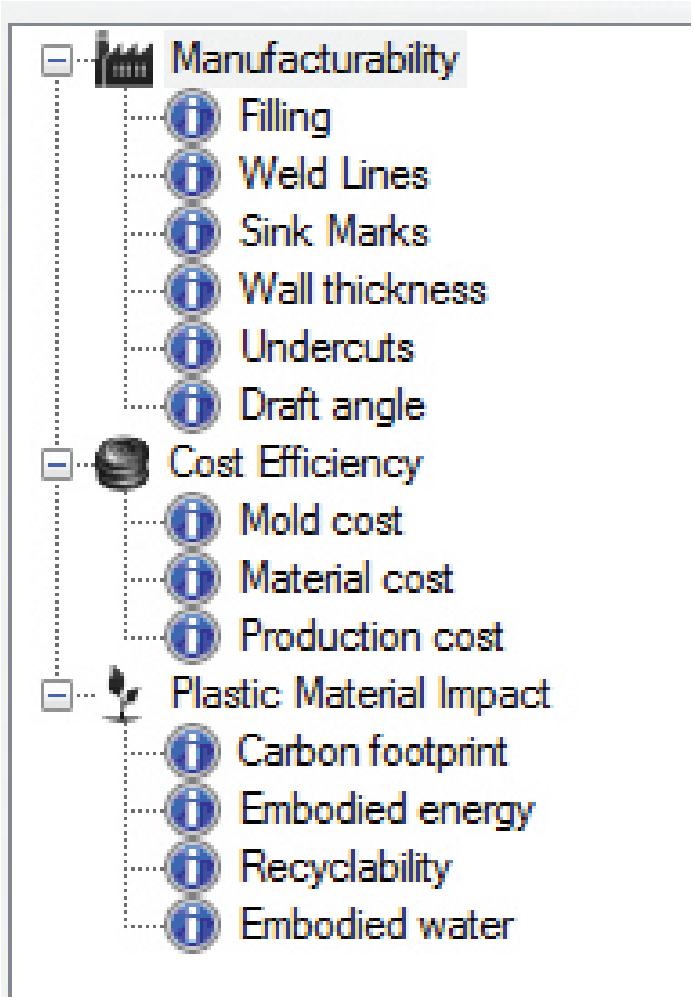
The animation toolbar controls the on-screen animation of the plastic filling preview process. This process actually uses the multi-threading capabilities of your system to increase the speed and analysis of the preview.

The loop option allows the animation to play repeatedly during visible inspection. The elapsed time of the animation below is approximately three seconds.



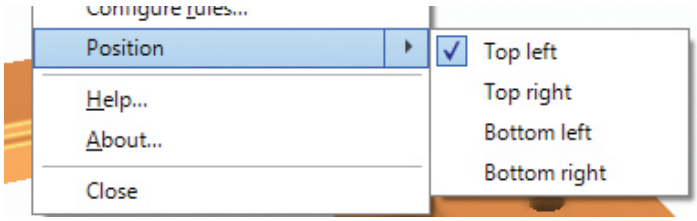
## Configure Rules

Each setting for the three indicators can be controlled here. Rule inclusion can also be selected for each heading. For instance, if draft angle was not a concern to the user, the calculations and subsequent warnings can be disabled from the widget.




## Position

Simple selection for which portion of the screen the indicators will reside.




## MANUFACTURABILITY

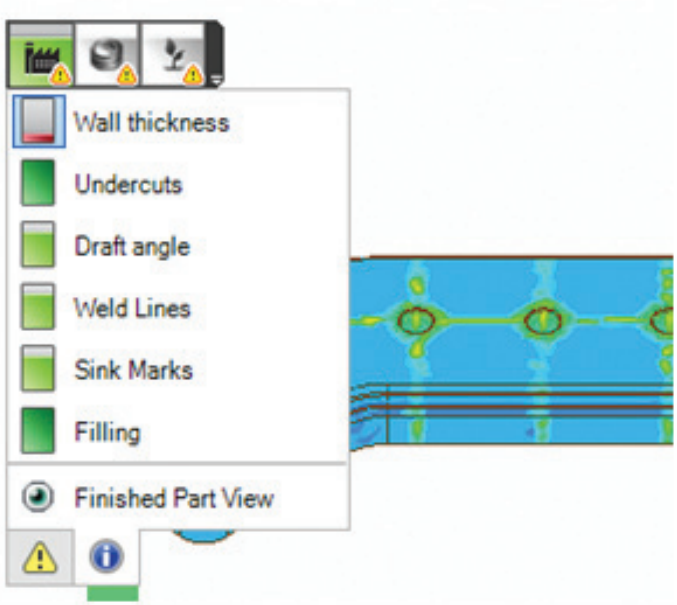
Manufacturability is the combination of wall thickness, undercuts, draft angle, weld lines, sink marks, and filling of the part. A weighted combination of these factors results in the rating in the indicator.

Remember that the settings for all of these factors can be adjusted in the advisor rules.

## Wall Thickness

Ideally, a plastic part should have an even wall thickness across the entire part. Otherwise, quality problems can occur.

Molten plastic will prefer to flow through thick sections of the mold. Excessively thin areas could have problems filling or may fill at a slower rate than thicker areas. Problems of short shots, underflow, and possibly weld lines can result from variation in part wall thickness.

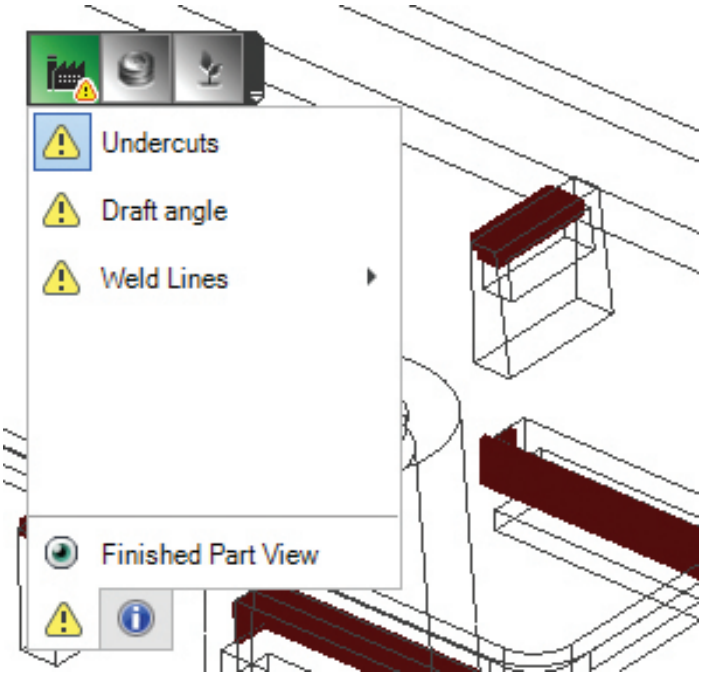


Excessively thick areas will take longer to cool, which can lead to the part deforming as the molten plastic solidifies as well as longer manufacturing cycle times. Excessively thin areas require a higher injection pressure to fill the mold cavity, increasing the possibility of unfilled sections of the part.

The wall thickness element examines the part thickness and its variation to highlight regions that could cause molding problems.

## Undercuts

An undercut is a design feature that interferes with the ejection of a molded part from the mold. An undercut can include features such as holes or bosses that are not aligned with the direction of ejection, threaded sections, and snap fingers.

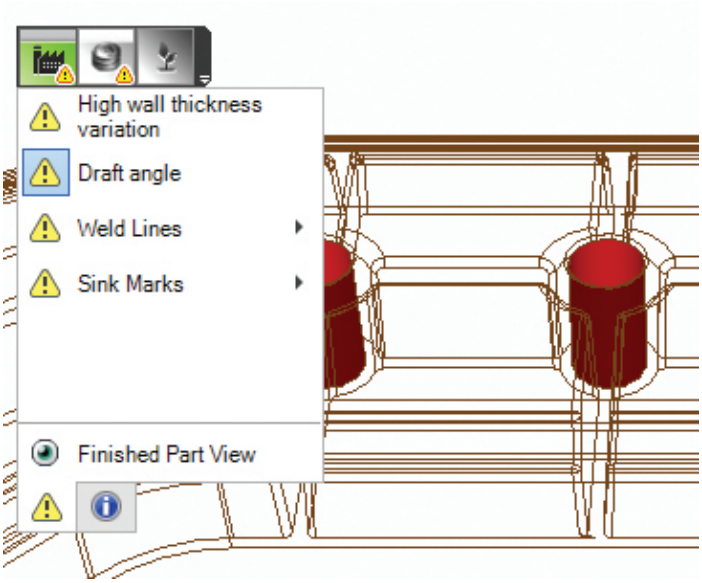



The snap finger shown above has an undercut surface highlighted in red.

This part could not be produced without the inclusion of moving parts within the mold to ensure the part could be ejected. This will add to the cost of the mold.

## Draft Angle

A draft angle is a slight taper added to assist in the ejection of the molded part from the mold. Surfaces that lie parallel to the direction of the part ejection will cause difficulties in production.



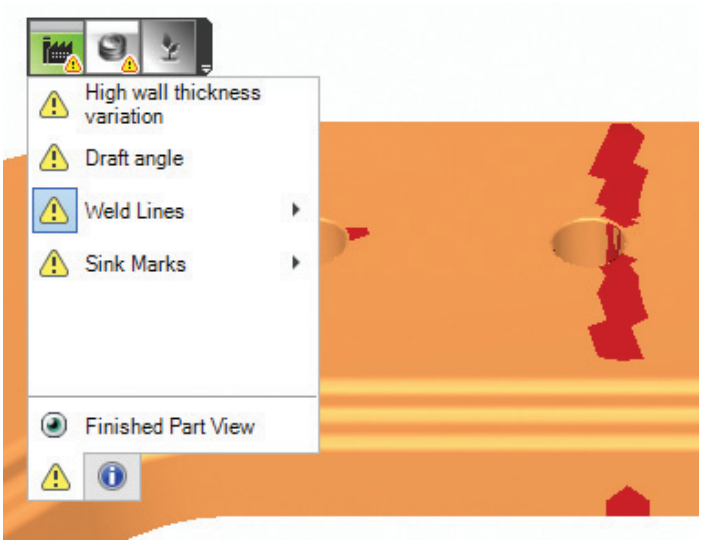

The amount of draft added will depend on the material to be used and the surface finish of the part.

Highly polished surfaces often have a draft angle of 1.5° while heavily textured leather-like surfaces can require a draft of 6° to 8°.

## Weld Lines

A weld line on plastic parts can cause structural problems and/or be visually unacceptable.

A weld line is created when two or more flow paths meet during the filling process. Weld lines can be caused by material flowing around holes or part inserts, multiple injection gates, or variable wall thicknesses, where different localized fill rates can cause separate flow fronts. If the different flow fronts have cooled before meeting, they will not interfuse well and can cause a weakness in the molded part. A line, notch, and/or color change can appear. This is undesirable in highly visual areas of the part.



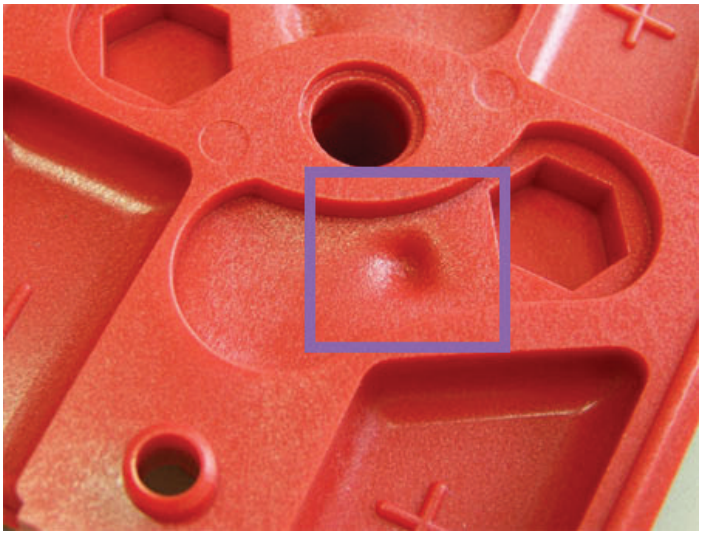
It may not be possible to remove weld lines from the part. Changing the injection location, modifying local part thickness, changing the selected material, and/or modifying processing parameters such as injector speed and mold temperature could move the location or minimize visual impact of the weld line.

## Sink Marks

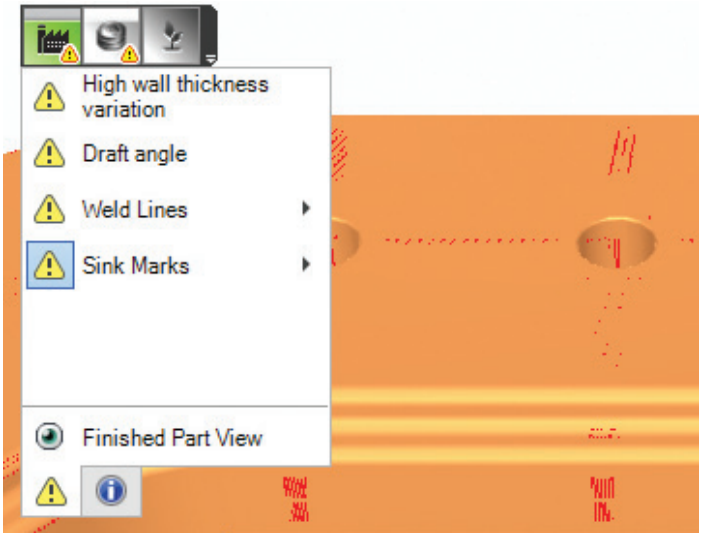
Sink marks result from localized shrinkage of the material at thick sections of the part.

A plastic part solidifies from the outside surface to the center of the part. On cooling, sections of the part that are thicker than the surrounding area can have a small reservoir of molten material in the center of the part. As this reservoir solidifies, it shrinks, drawing the surface inwards to form a sink mark.

Sink marks appear as depressions on the surface of an injection molded part. These depressions are typically very small; however, they are often highly visible because they reflect light in different directions to the rest of the part. The visibility of a sink mark is dependent on the color and surface texture of the part.



Where possible, change the part design to minimize thick sections. Manufacturing parameters can be adjusted to reduce or possibly eliminate sink marks.




## Filling

The Filling result can be used as an indicator of the probability of plastic filling a region within the cavity under conventional injection molding conditions.

## COST EFFICIENCY

Manufacturability is the combination of mold cost, material cost, and production cost. A weighted combination of these factors results in the rating in the indicator.

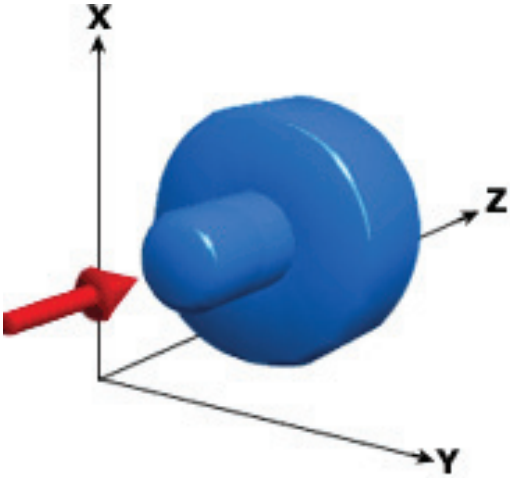
The costing efficiency indicator is based on a single-cavity mold. The proper assessment of a multi-cavity mold should be done with specialized software such as the full Autodesk Moldflow Adviser product.

## Material Cost

The size of the part and the relative cost of the selected material combine to determine the material cost.

## Mold Cost

The mold cost is determined by the size and complexity of a part along with the number and position of injection locations.



### Part's height

The size of the part when measured in the Z direction.

### Part's projected area

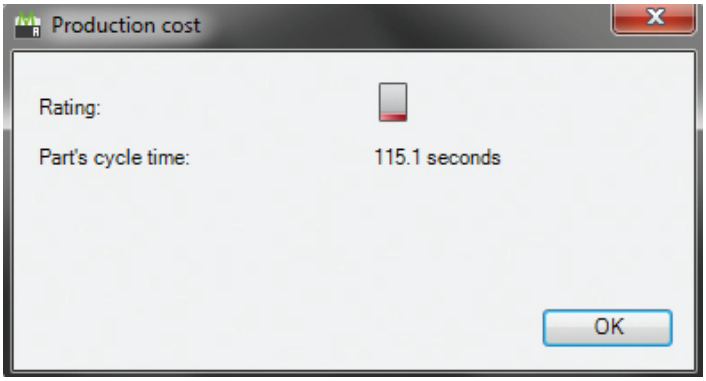
The area of the part when projected onto the X-Y plane.

### Part's complexity

Geometric features of the plastic part such as the extent of undercuts and the number and location of injection locations contribute to the cost of manufacturing the metal mold.

### Production Cost

The time it takes to manufacture a part and the associated costs are represented in the Production Cost element. Because plastic injection molded parts can have a large range of size and complexity, the Production Cost indicator is based on a single-cavity mold of average size and complexity.




## PLASTIC MATERIAL IMPACT

Manufacturability is the combination of carbon footprint, recyclability, embodied water, and embodied energy. A weighted combination of these factors results in the rating in the indicator.

Publicly available data is the basis for the Plastic Material Impact indicator result. Autodesk's prime data source is Plastics Europe (http://www.plasticseurope.org).

### Carbon Footprint

The amount of carbon dioxide produced when making the raw material needed to manufacture this part, multiplied by the weight of the part.

### Recyclability

The recyclability of a material is a measure of the percentage of the material that is recovered as scrap and subsequently reprocessed into useful products.

### Embodied Energy

The embodied energy is the total energy required in the making of a part. Typically 70-90 percent of this energy is associated with manufacturing the raw material. Value is multiplied by weight.

### Embodied Water

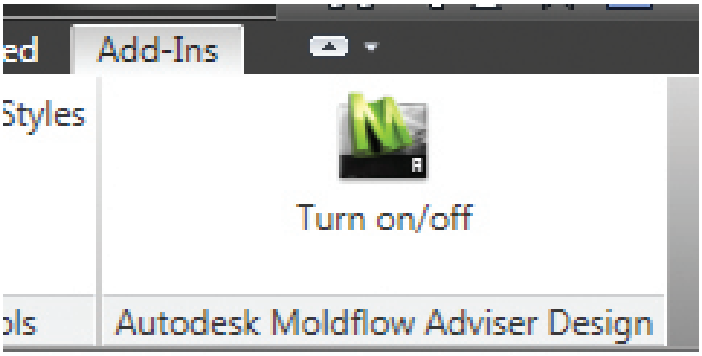
Embodied water is a measure of the amount of water required to produce the selected material. Value is multiplied by weight.

## SUSTAINABLE ENGINEERING

The use of this tool can aid in the process of creating not only cost-effective parts, but also parts that are more sustainable in design. Even if your company only pays lip service to these ideas, they do become an increasing important part of design choice and public awareness for your products.

By starting the selection process early on, the lead time due to rework and failed prototypes is reduced in your process making your work more cost effective and sustainable as well.

Just remember to turn it off when not in use to save on computational time in Inventor.




*Mark Flayler is an application engineer with IMAGINiT Technologies, specializing in manufacturing environments. He has implemented Autodesk® manufacturing products within several industries including the blow/injection molding, automotive, and custom machinery markets.*
*Mark has extensive experience and a comprehensive understanding of the technical, practical business, and human dimensions of implementation. When not providing training, support and implementation, he writes the IMAGINiT Manufacturing Blog and takes an active role in the manufacturing community. Mark is an ATC certified instructor, and is PSE and ATC certified in AutoCAD®, AutoCAD® Mechanical, AutoCAD® Electrical, Autodesk® Data Management, and Autodesk® Inventor®.*

by: Steve Bennett

# Ini or outie? Advancing Your Customization of the Revit ini File

I really don't want to know if you have an "innie" or an "outie," unless it pertains to Autodesk® Revit®! Do you use an out-of-the-box initialization file with no changes (outie) or do you customize it (ini) to help users in your company have a more pleasant time opening and using Revit? Have you been avoiding customization with Revit 2012 due to the change in how ini files are created? If so, have no fear—this article will help you out.

The Revit ini (short for initialization) file is used by Revit when a user launches the program for the first time. Revit can be told by this ini file that certain plug-ins are installed, certain settings are turned on/off, and preferences can be set in advance. By default, Autodesk provides an ini file for Revit with very basic settings. Many people, however, want to control the settings from a company-wide standpoint, thereby entering the arena of why you would want to customize it.

Before we jump right into customizing, we need to find a few paths and a couple of tools. Please keep in mind the following information is based on running Revit 2012 on a Window's 7 64-bit OS (that's really what you should be using anyway). First, go download the Revit 2012 Deployment Utility & Notepad++

Revit 2012 Deployment Utility http://tinyurl.com/RevitDU1

Notepad++ http://tinyurl.com/NPplusplusDL

Next, be sure you can find the following files/locations on your hard drive:

C:\Program Files\Autodesk\Revit Architecture 2012\Program\UserDataCache

C:\Users\sbennett\AppData\Roaming\Autodesk\Revit\Autodesk Revit Architecture 2012

If you haven't already created a network deployment image, go start it now. You'll need that completed prior to looking for the inifile.xml (this assumes you have a good understanding of how to build that image). Now, find the following files/locations in the network deployment image you created on your network:

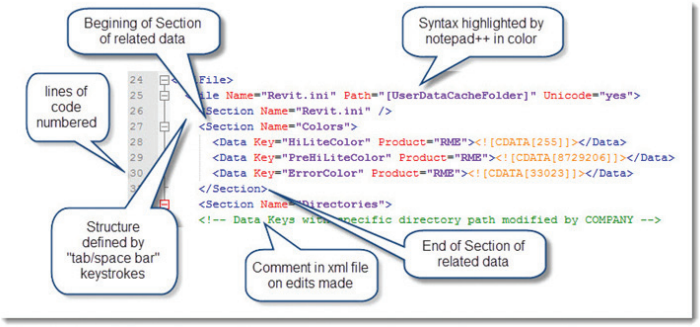
\x64\RAC2012\inifile.xml

\x64\RAC2012\Program Files\Autodesk\Root\Program\Setup\Cache\inifile.xml

At this point, you can choose from two separate routes. You can use the automated tool from Autodesk to make some simple changes to the ini file, which can combine a previous custom Revit ini file with the xml file. The other route is to edit the inifile.xml file using notepad++. Using a tool to build a custom ini file is no fun, though!

We will cover going the route of notepad++ to edit the xml file directly. You will want to copy the inifile.xml to your desktop from the network. After installing notepad++, right click this copied xml file and choose to edit with notepad++.

The great thing about notepad++ is that it will color code everything automatically, which helps those who are new to xml coding decipher what they are looking at (see Figure 1). It also allows you to collapse/expand sections which helps minimize scrolling on long files. There are two main things you will want to keep in mind when editing the file: Structure and Syntax.



The Structure can be maintained by entering after the same line where new a new code line is added or by using the tab/space bar key to match indents. Another part of the Structure is the Sections, which group data together. The start of a section will look like **<Section>** and the end will look like **</Section>**. Data inside the Section is structured using a repeatable flow like this: **File->Section->Data**. In past versions of Revit, the ini file contained what I call Sections too, inside brackets (e.g., [**Directories**]). Things that controlled messages upon opening Revit, options and other user interface choices were grouped into appropriate sections.

Here is what sections looked like in past versions of the Revit.ini file (items in bold) and the commands are grouped below:

[**Messages**]
SuppressNewFeaturesWorkshop=1
SuppressHardwareFullySupportUnknownCardWarning=1

[**Graphics**]
UseGraphicsHardware=0

Here is an example of some added Sections to the inifile.xml (items in bold) and the commands are grouped below:

```
<!-- Company Added Section Begin -->
<Section Name="Selection">
  <Data Key="AllowPressAndDrag"><![CDATA[0]]></Data>
</Section>
<Section Name="Windows">
  <Data Key="Maximized"><![CDATA[1]]></Data>
</Section>
<Section Name="Messages">
<Data Key="SuppressHardwareFullySupportUnknownCard
  Warning"><![CDATA[1]]></Data>
<Data Key="SuppressGraphicsHardwareWarning"><![CDA
  TA[1]]></Data>
<Data Key="SuppressHardwareFullySupportNewDriverWar
  ning"><![CDATA[1]]></Data>
<Data Key="SuppressHardwareFullySupportOldDriverWarn
  ing"><![CDATA[1]]></Data>
</Section>
<!-- Company Added Section End -->
```

The syntax deals with the special characters and spacing for each line of code (including, but not limited to < [ / ! - ) Color coding is automatically applied to text depending on the syntax used. Be sure to match syntax so things are color coded correctly. You can add notes to the xml file with something like the following: **<!-- NOTE TEXT -->** This is a great idea so that others who look at the file can easily identify changes made and what they entailed.

A command that deals with a yes/no option can be set via a 1 or a 0, hence the <![CDATA[1]]> (yes or active) or <![CDATA[0]]> (no or inactive). Library locations can be set inside of a CDATA item too, using a second set of brackets. It would look something like this: <Data Key="ProjectPath"><![CDATA[C:\Revit Local Files]]></Data> I placed the extra set of brackets in bold to help them stand out.

Another thing I've found useful when looking through an xml file in Notepad++ is if you double-click a word, it will highlight any other duplicate instances found. This is great for finding similar lines of data. Using the double-click to find similar items, space bar/enter/tab key to control syntax and copy/paste, you can start modifying the ini file.

Once you've finished editing the ini file, it's probably a good idea to have someone who is familiar with what you are doing review your work. Then backup the inifile.xml file from the network deployment on the network to somewhere safe and unforgettable. Copy the modified inifile.xml into the two paths on the network shown near the beginning. Next, install Revit from the network deployment image on a test machine and see how your ini file looks (it will be found in your roaming folder shown above. If it looks like it did in past releases of Revit you are in good shape). Launch Revit and see if your changes took hold. If not, you may need to go back and adjust a few lines of code. Otherwise, if everything worked you can now enjoy the benefits of your custom ini file!

References:

http://tinyurl.com/RevitClinic1
http://tinyurl.com/RevitClinic2
http://tinyurl.com/RevitClinic3
http://tinyurl.com/RevitClinic4

Further changes one can make to the ini file:

http://tinyurl.com/RevitClinic5

*Steve Bennett is currently the firm-wide CAD manager for HMC Architects. He works with teams in the daily use, support, and application of Revit Architecture and Vasari along with AutoCAD Architecture, 3ds Max Design, and Navisworks. Prior to joining HMC, Steve was the technical manager for the AEC and Design Visualization industries for U.S. CAD and brings more than 16 years of industry experience. During his time with U.S. CAD, he regularly conducted seminars on the use of Autodesk technology in Architecture and Design Visualization and provided implementation services, customization, training, and support to AEC design professionals. Prior to joining the Autodesk reseller channel, he worked as a drafter, designer and CAD manager for an engineered lumber products company where he worked on a variety of commercial and residential projects. Steve is an Autodesk Certified Professional for AutoCAD, Revit Architecture, and 3ds Max Design and is an Administrator for the AUGI forums.*

by: Bill Debevc and Lonnie Cumpton

# The HP Z210 Performs

Hardware reviews are always an interesting proposition because the point of view of the reviewer is subjective. This review is a bit unusual in that is contains two points of view. The first is from Bill Debevc, an IT professional. For 20 years, Bill has worked in IT for a variety of organizations—all dealing with various Autodesk-related products. Weighing in from a design technology perspective is Lonnie Cumpton, who brings more than 20 years experience working with various software technologies related to the building design industry.

When you see the HP Z210 box come to your door, your first thought is, "Yup, there's a computer in there." It isn't nearly as fun looking as the old cow boxes that Gateway used to ship nor nearly as sleek as Apple packaging, but it is clearly professional and very HP. Also worth noting is that the box itself is an environmental effort from HP—the simple brown box with limited black text and images reduces the resources used for packaging. Considering all of the efforts in the building design space to reduce the environmental impact of our designs, it's nice to see a computer company making an effort as well.

*The HP Z210 is ranked a 7 out of 10 stars by AUGI authors Bill Debevc and Lonnie Cumpton.*

Box aesthetics aside, opening the box was a pleasant experience. The system comes out of the box easily and presents a clean functional design. It is a typical mid-tower design, small enough to fit either on a desk or under it. Not that you'll be putting it on display, but you also won't be embarrassed to have it be seen.

On the front of the unit is a DVD writer, memory card reader with all the standard ports, standard audio ports and three USB2 ports. On the back are the typical mouse and keyboard ports, audio jacks, six additional USB2 ports, one DisplayPort, and one DVI connector, which utilize the onboard graphics provided by the Intel Xeon processor.

The system we tested also included an Nvidia Quadro 2000 graphics card with two DisplayPorts and one DVI connector on the card itself. One of the expansion slots was also filled with a USB3 card providing two USB3 ports.

One important note is that the onboard graphics cannot run at the same time as the Nvidia card. To run dual monitors you will use the Nvidia card, plugging one monitor into the DVI connector and the second into one of the DisplayPorts using the provided DVI adapter. Our power supply was 400 watts, which could lead to power issues if you wanted to add a second video card.

Right out of the box, everything ran perfectly with the exception of the DVD drive. The serial ATA port on the drive was not plugged in. We can only assume that this was an oversight and not a standard feature. Once it was plugged in, all ran fine.

On the inside, we have an Intel Xeon E31245 processor running at 3.30GHz, a 1 TB 7200 RPM Samsung hard drive and 32GB of RAM. A quick note on the RAM—we asked that the system be shipped with 32GBs of RAM even though the price point was a bit high at the time of the test. We did this hoping the price point for RAM will be dropping greatly at the first of the year.

After getting the system booted, the first step was to visit the "Windows Experience Index." Although not the most comprehensive test, it is available on all Windows 7 computers. The HP z210 scored a 7.5 on processor speed, 7.6 on memory speed, 7.0 on graphics, 7.0 on gaming graphics, and a 5.9 on hard drive speed.

The second step was to install our Autodesk applications. The new Autodesk Building Suite makes this process simple. With a single click we installed Revit Architecture, MEP, and Structure, as well as Showcase and AutoCAD in about 15 minutes with no errors.

In general, the performance of all Autodesk products was great. The AUBench test in Revit produced a score of 165. Like most benchmark tests the AUBench is great for comparing system performance but does little to score user experience. Our testing showed the speed of the HP z210 to be strong and comparable to most high-end workstation systems. The only area in which this system seemed to have performance issues is with the hard drive. With most Autodesk products, especially Autodesk® Revit®, hard drive speed can play a big role in performance, especially as it relates to the user experience. If you order one of these, we recommend going with 10,000 RPM or SSD drives.

In our testing we loaded several small files and a number of large files maxing out the processor and RAM. Even though the four cores are not 100 percent utilized by Autodesk products, the process was very fast and handled the load well—even loading a massive 500MB Revit file with three 200MB links. The 32GBs of RAM made this task simple, never using more than 12GBs of RAM until we ran multiple sessions of Revit at the same time. In Revit 2012, load times do take advantage of the four cores as that process is now multi-threaded. The graphic card was very responsive in all tests, with panning, zooming, and screen response very snappy.

We went one step further and converted the HP z210 into a private BIM cloud. This process turned the one HP z210 into five virtual BIM workstations. Once configured, we ran the same performance tests on all five users at the same time with no noticeable drop in performance. Overall, the HP z210 is a great candidate for both individual workstations as well as a private BIM cloud.

Once again HP has delivered another strong workstation at an attractive price point. We really hammered this system, and other than the hard drive, cannot find much negative to say. The retail price for the system as configured came in just under $5,500, with the 32GBs of RAM. With 16GBs of RAM the same system retails for about $3,000. As the RAM becomes more readily available in this configuration we would expect the 32GB version to drop in price.

*Bill Debevc and Lonnie Cumpton are currently using their expertise to help companies develop and deploy private BIM clouds at BIM9. You can find them on LinkedIn and at www.bim9.com.*

by: James Clifton

# Green Networks: A Solution

Running a building or campus network is a major cost area of building or campus operation (voice, data, and video). We have learned that we cannot live or work without it. However most facility personnel treat it as hands off and refer it to the IT guys for "their requirements." Isn't it time the tail stopped wagging the dog?

What if you could decrease or eliminate the space requirements, the need for "freezing" HVAC (ever been in a server room?), and mitigate maintenance and vulnerabilities for business continuity and security? It is time to reel in the energy-eating monster and slay it. Are you interested in reducing total cost of ownership (TCO) by as much as 65 percent and see a decrease in power consumption by as much as 50 percent (source: Motorola POL white paper, 2010)?

## HOW CAN THIS BE?

The move to providing greener buildings and attaining LEED certification has made many steps in the right direction and technology has provided the opportunity to achieve that goal. Likewise technology is one of the most important systems in our buildings (sensors, controls, software, and so on) and one of the largest consumers of power, HVAC, and space (see Figure 1). It is also one of the most vulnerable systems in day-to-day operations and largely misunderstood by most architects, construction companies, and facility management personnel.

Most server rooms are full of routers, switches, panels, and miles of patch cables for voice, data, and media that stifle the imagination of most professionals and, quite frankly, scares many of them. Between the noise, cold temperatures, and apparent cable chaos, who can blame them?

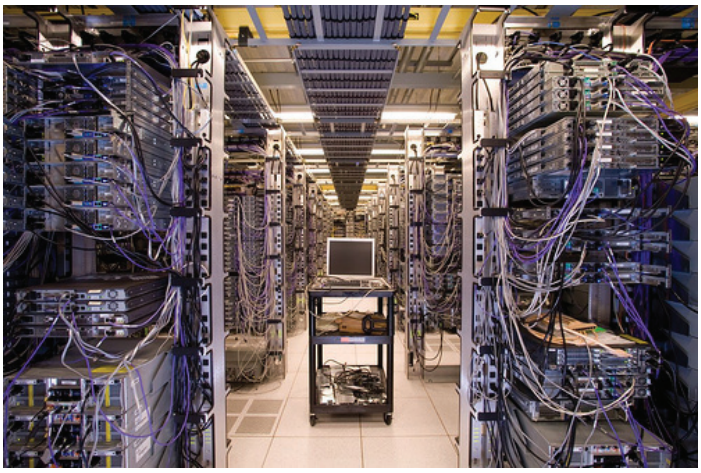


*Figure 1: Current Technology – A Corporate Server Room*

Architects have been restricted in building design by the distance and space needs of the copper-based LAN. They have also been forced to include unwanted extra non-renewable plastics and copper for these traditional LANs in their building designs.

Some engineers have begun to turn to optical fiber instead of copper transport systems; however, they still require the same type of electrical switches as the copper. There is a better way.

## PASSIVE OPTICAL LAN

An alternative LAN solution to copper-based systems is a new system known as Passive Optical LAN (POL). POL is based on proven Passive Optical Networking (PON) technology currently deployed by leading service providers around the world and provides triple play services to subscribers. It provides enterprises with fiber optic connectivity to any Ethernet end point such as end-user devices, access points, and wireless controllers, application servers, and printers. POL greatly simplifies the enterprise LAN by replacing copper-based cables and devices in the traditional LAN setting with fiber optic equipment.

## NOT SMOKE AND MIRRORS

The POL network consists of a high-density aggregation device in the main telecommunication room that delivers converged services over a Gigabit Passive Optical Network (GPON) that extends to the desktop or cubicle and terminates at a Work Group Terminal (WGT). The WGT provides 10/100/1000BaseT Ethernet connectivity to desktop equipment such as desktop computers, laptops, voice-over-IP phones, and video phones using regular copper patch cords.

POL uses small, passive fiber optic splitters that are placed in enclosures in a building, usually at every floor, although theoretically they could be anywhere or just at the main room. These splitters and their enclosures, typically 2 to 4 cubic feet in size, require no power, produce no heat, and can be installed in electric closets, in their own dedicated closets, or behind access doors in walls or ceilings.

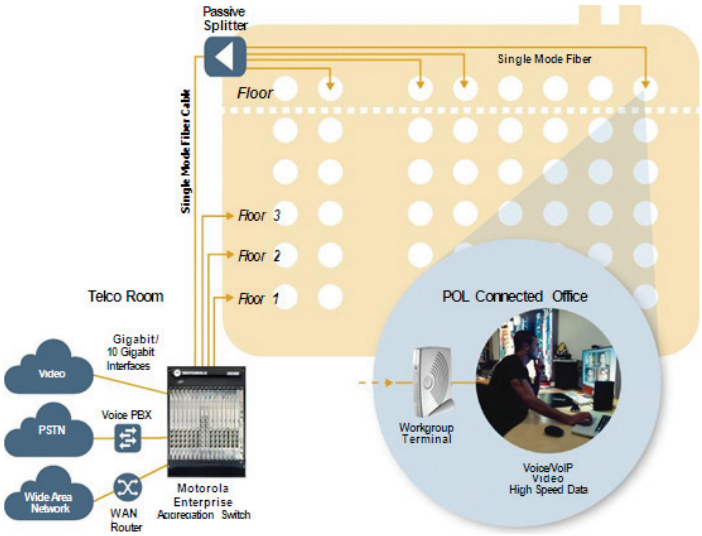



*Figure 2: Passive Optical LAN (POL)*

The POL system reduces overall power and cooling requirements, and reduces the need for construction materials that are not environmentally friendly. This allows the architect to deliver a structure and interior, with extra advantages to the customer and the environment, at a significantly reduced cost.

## A COMPARISON

Take the following example structure to compare a POL with the traditional copper-based LAN in a building. The example is a theoretical six-story research and office facility built for a hospital or university. In this building, there is one main distribution frame (MDF) communications closet and 12 intermediate closets (two per floor, stacked at each end). The structure is 320 feet by 120 feet, with about 250 feet between north and south IDF closets. There are 2,000 faceplates and 4,000 Ethernet jacks/outlets, about 350 feet from each IDF closet. The building also includes 100 wireless LAN units.

## INFRASTRUCTURE

An analysis of cable infrastructure requirements for copper-based traditional LAN and POL shows that the POL needs much less cable. One third to one half as many horizontal distribution cables are needed to provide the same or an even greater number of user work area ports (Ethernet outlets). The fiber optic cables for POL are a fraction of the size of the Category 5, 6, and 6A cables used for copper LAN.

Most of the weight of copper LAN cables is from plastic and some is from copper. The fiber optic POL cables are composed mostly of plastic and some glass. Category 6 cables are about 24 pounds per 1,000 feet, Category 6A cables are about 49 pounds per 1,000 feet, and fiber optic POL cables are less than 12 pounds per 1,000 feet. Assuming that the same number of outlets is required, POL infrastructure uses two to seven pounds less plastic and an additional two pounds less copper per outlet than a traditional copper LAN (a reduction of up to 28,000 pounds less plastic and 8,000 pounds less copper).

## CONSTRUCTION COSTS

The fiber cable infrastructure of POL costs substantially less to install than a copper-based LAN system for the following reasons: 1) There are fewer cables to install, as a traditional LAN setting would require four home-run copper cables to the IDF, whereas only one fiber cable is required in POL; 2) Fiber cables are less expensive than copper cables; 3) Fiber optic cables are thinner and lighter resulting in further reduction of labor costs; 4) There is less cost for closet fit-outs, cable trays, racks, cabinets, and fire stop penetrations due to the nature of fiber optic cables; and 5) The costs for grounding/bonding backbones are also reduced because fiber optic cable is non-conductive.

Overall construction costs are reduced by the lower material costs and reduced installation labor costs. These calculations are based on typical material, tax, and labor costs in a major city in the Northeast region of the United States. The cost difference is even higher for areas with higher labor costs. In areas with much lower labor costs the cost savings are still present primarily due to lower material costs.

## POWER CONSUMPTION

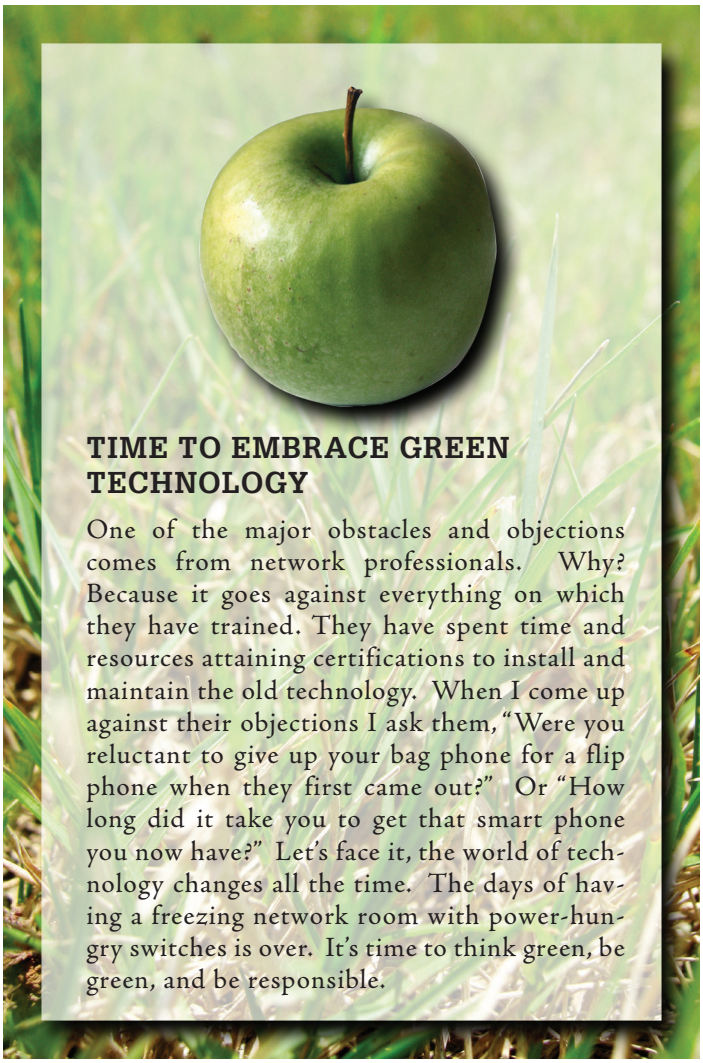
Due to the elimination of electronic switches in intermediate closets, designers and architects do not have to worry about the power and cooling requirements for IDF closets. Architects don't have to design the extra power circuits to supply power to power-hungry workgroup switches and can realize tremendous cost savings by eliminating these components with the use of POL. In addition, they don't have to design the cooling requirements for IDF closets, resulting in additional power savings from the reduced HVAC equipment. We have observed that total cooling need for network electronics reduced by more than 50 percent because of these efficiencies in POL network.

Aside from the energy savings due to minimal cooling requirements, POL equipment is inherently energy efficient. The aggregation switch situated in the main telecommunication room can support more than 7,000 Ethernet end points and requires much less power than a comparable traditional distribution switch. Similarly, the workgroup terminals near the faceplates can support four Ethernet end points and consume much less power per Ethernet port than a comparable intermediate workgroup switch. We have observed that POL electronics requires 50 percent less power than a comparable traditional copper-based network.

Many new networks also have devices that use Power over Ethernet (PoE), which is a method of safely delivering small amounts of power directly to a device over the same cable as is used for the Ethernet signals. Typically some Wireless Access Points and some IP telephones are powered in this manner. This method sends low-voltage power over the small diameter 23 or 24 gauge wires in the Category 6 and Category 6A cables, which means that some of the power is lost in the cable itself due to the resistance of copper. With POL, the PoE devices are supplied with power from the WGT, which is physically very close to the telephone or other PoE device.

Consequently, less power is lost in cabling than it would be in a traditional copper-based LAN design. For the example facility, this savings is about 4,600 kilowatt-hours per year, over 2 kilowatt-hours per worker (assuming PoE phones are used).

In the example research facility, the total energy savings are 50 percent less electricity and 50 percent less cooling than a traditional copper LAN. This is a reduction of 140,000 kilowatt hours per year, which is about 70 kilowatt hours per worker. Much of this information is contained in the Motorola POL white paper from 2010, and is available at www.pearlnet.com/GPON.



### TIME TO EMBRACE GREEN TECHNOLOGY

One of the major obstacles and objections comes from network professionals. Why? Because it goes against everything on which they have trained. They have spent time and resources attaining certifications to install and maintain the old technology. When I come up against their objections I ask them, "Were you reluctant to give up your bag phone for a flip phone when they first came out?" Or "How long did it take you to get that smart phone you now have?" Let's face it, the world of technology changes all the time. The days of having a freezing network room with power-hungry switches is over. It's time to think green, be green, and be responsible.

*James Clifton, MS, CBCP, is the Director of Operations with PearlNet, LLC in Atlanta, GA, and can be reached at jclifton@pearlnet.com*

# When Cranes Fly

One of the little-known modules in Autodesk® Navisworks is Animator, that friendly tool that allows you to create a scene with model objects. The scenes in Animator can be complex or simple. For instance, a scene can be as simple as having a crane rotate or as complex as having cars moving in a parking lot with a camera following an avatar into a revolving door. Regardless of the complexity, Animator is there to help you design a scene that brings your imagination to life.

## INTERPOLATION IS YOUR FRIEND

The Animator module works by using keyframes. Keyframes capture the animation set—a group of objects in the animation scene—at a given point and interpolate the steps necessary to connect to the following keyframe. For instance, if a car moves from point A, the first keyframe, to point B, the second keyframe, Animator will fill in all the missing frames to connect points.

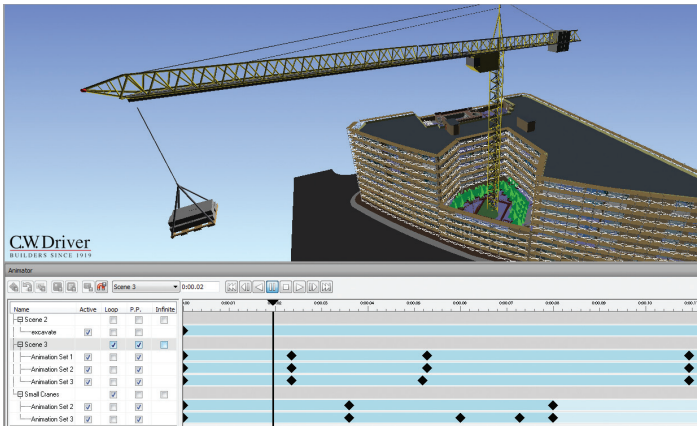



*Figure 1: Interpolation*

To make an animation scene, open Animator from the Home tab of the ribbon and click the Animator icon. In the Animator window, right-click in the left pane and select *add animation scene*. Then in the selection tree or the model scene, select the model components you wish to animate. Right-click the animation scene and select *add animation set*. You can add many animation sets to one animation. For instance, you might add multiple cars to the same scene to animate a cross street or to demonstrate the ingress/egress of a parking lot.

## ANIMATOR TOOLS

The Animator module has many different tools. The first group of tools includes translate, rotate, and scale. These Animator tools act exactly as the item tools do, but they do not affect the model objects; they affect the animation set objects' keyframe settings. Put plainly, the animation tools will only help change the settings for an Animator keyframe, whereas item tools change the settings in the model scene. A good practice is to never open the Item Tools tab in Navisworks while working with Animator because you might use the item tool instead of the Animator tool.

To create a simple animation such as a car moving down the street, select the car animation set in an animation scene, and create a keyframe by clicking the keyframe animation tool. Drag the time slider on the timeline to the point in time where you want the car to be located next. Click the translate Animator tool and move the car to the desired location, and capture the new keyframe. Click the play button on the Animator window to watch the car move from point A to point B in time.

The rotate Animator tool is a little more tricky than the translate tool. In order to harness the true power of this tool it is paramount that you understand the location of the pivot point of the object you wish to rotate. Going back to the car example, you would need to set a point on the car between the front two tires in order to

properly simulate the rotation of the car. The problem with the rotation tool default pivot point is that Navisworks uses calculation in order to determine the default center of a group of objects. Because a car is made up of multiple parts, chassis, tires, headlights, etc., and some of the component or layers used to make up the car have floating objects, the center of the object might be 10 feet away from the car. This means that in order to properly simulate the turning of a car, you will need to adjust the pivot point of the gizmo to the center tires of the car in keyframe A and capture the keyframe with the proper center in keyframe B. Only by having both the start and end keyframes with the same pivot point location will the car properly rotate.

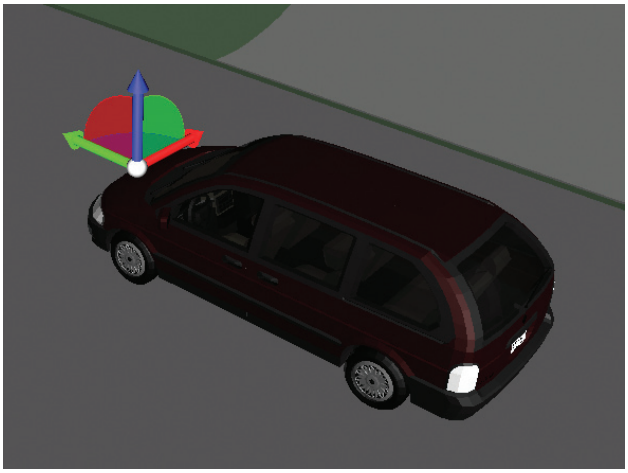


*Figure 2: Pivot points*

To simulate a true rotation of a car you will have to alternate between the translate and rotate tool. You do not have to capture a keyframe every time you switch tools. You only have to capture keyframes at critical points. These points might include the starting spot of the car, the starting spot of a turn, the middle of the turn, the end of the turn, then the end of a street.

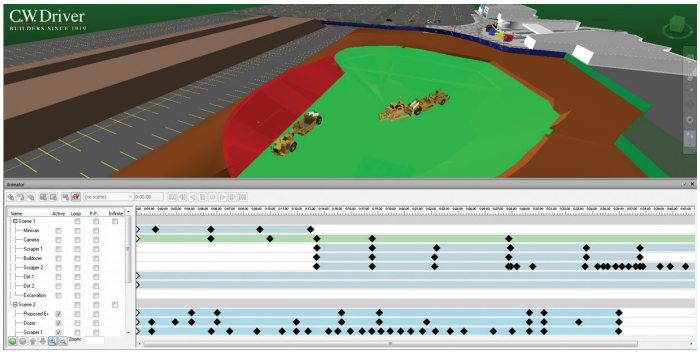



*Figure 3: Complex animation*

Another powerful tool, though commonly forgotten, is the scale tool. This amazing tool allows you to simulate growth/reduction patterns in the x,y,z planes independently of one another for an animation set. This means you could simulate the growth of plants over time. You would simply select the plants you wish to grow/reduce, add them as an animation set to the animation scene and use the scale tool to show the change from keyframe to keyframe. Another example of using this tool could be showing the hauling away of demolished material from a jobsite to better show owners how LEED standards are being followed.

## ANIMATING FOR ATTENTION

Besides animating changes to geometry locations, Animator can be used to help draw attention to special details during a virtual demonstration of the project. Animator allows you to tell your construction story by utilizing color overrides, transparency overrides, camera sets, and section sets.

Color overrides and transparency overrides do not interpolate from keyframe to keyframe; however, they are paramount in showing the story of your project. The color override can highlight any object at a specific time in your animation simulation by drawing attention and detail to that object at the precise time you need it. When a predefined time has passed, it will return to its original color and another object can be highlighted.

The transparency tool is similar to the Animator color tool. The transparency tool can make objects semi-transparent exactly when you need to show objects behind objects. For instance, when you are walking through the finished virtual project you may wish to talk about overhead MEP systems. In the animation scene, you could set the ceiling to go transparent at the exact time you start talking about the overhead MEP systems.

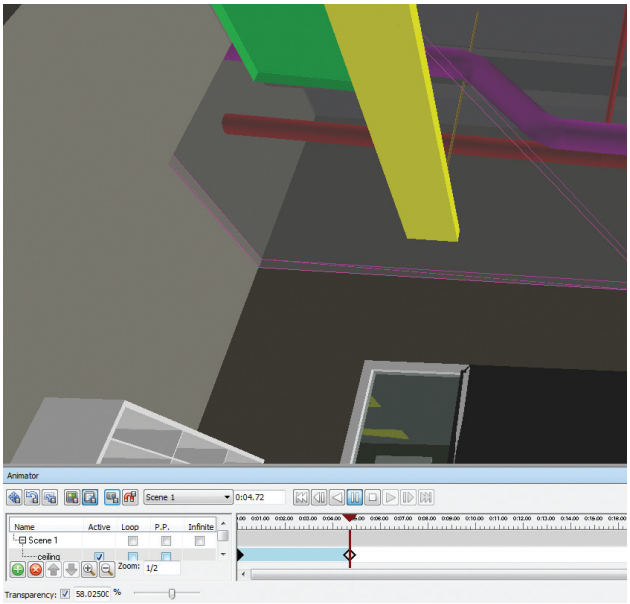



*Figure 4: Animated transparency*

The camera set is a key piece of an animation scene. This set allows you to guide the animation to pre-defined locations. You can create a camera set from an existing saved viewpoint animation, or you can create specific camera points with keyframes. Either way, Navisworks interpolates the frames between keyframes to simulate a perfect, smooth walkthrough. You can have only one camera set per scene.

The section set is another feature that is useful to call attention to key features of a project. The section set allows you to create section planes or section boxes and animate their behavior. For example, you could create a section set that uses a section box to cut through a project while a camera set follows the section box, and both pause as key elements are highlighted from the color keyframes. When multiple features of Animator are connected together, a full animation story can be created.

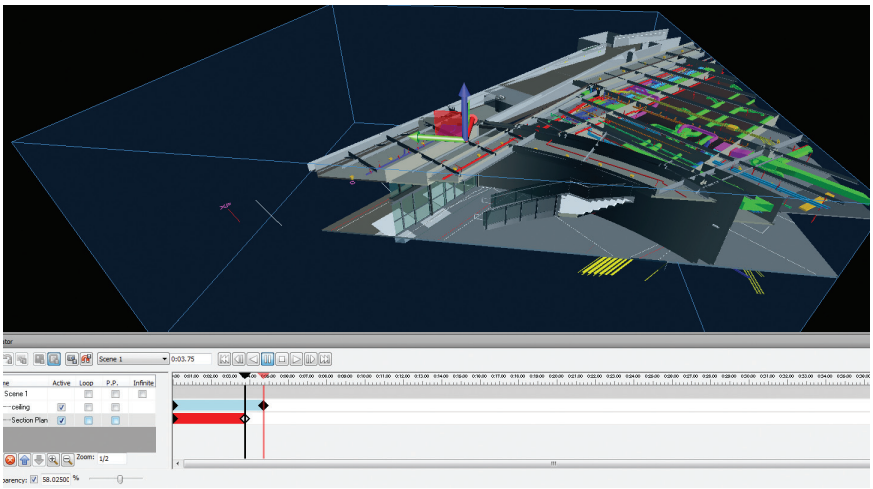


*Figure 5: Section set and coloration of a school*

## ANIMATING THE 4TH DIMENSION

Besides being used to tell a story about key parts of a building, Animator also allows you to add animation sequences to a 4D simulation. For instance, if you wish to animate construction equipment during the grading portion of the project schedule, you would simply use the translate and rotate tools on the grading equipment and save them as an animation set. You would then select the animation in the Timeliner window.

There are three animation options: Scale, Match Start, and Match end. Scale will adjust the animation to match the start and stop points of the schedule. This is very useful because you might create an animation that is 15 seconds long, but has to cover three months of time in the construction schedule. By using scale, the 15 seconds will be scaled to fit the three-month schedule duration during the 4D simulation playback.

The other two animation settings are match start and match end. Match start begins the animation as soon as the scheduled item starts and ends exactly as the animation is set to end, which may be long before the scheduled item's duration ends. This means if the animation lasts five seconds, Timeliner will start the animation as soon as the scheduled item starts, but the animation will stop after five seconds as it will be complete. Match end simply makes the animation stop at the end of the scheduled item and starts the animation just in time to ensure the end animation matches the end of the schedule item's duration.

An example of how this is useful is to create a crane boom swing in Animator and set it to ping pong, which means as soon as it hits the end of the animation it will reverse and do the animation backwards. When combined with loop, the crane can continue simulated operation throughout the duration of the project when attached to a crane activity and set to scale.

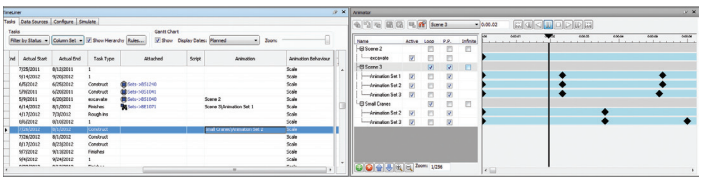


*Figure 6: Animations in Timeliner*

An added benefit to animating the Timeliner sequence is that it can be integrated into clash detection. Remember, you can clash items in time. This becomes critical for some jobs such as medical facilities. For instance, think of a large piece of machinery such as an MRI machine. In the 4D simulation, an activity would be scheduled for it to be lifted into place. Animator will allow the machine to actually be lifted through its proper routing with the proper construction equipment while other objects are moving in at the same time. This allows all of these animated objects to be clashed in time.

## ANIMATOR LIMITATIONS AND FIXES

Unfortunately, Animator does have some drawbacks. The biggest problem is its inability to select multiple keyframes and move them all at the same time. You are forced to move each individual keyframe if you wish to change the animation's duration. Fortunately, if you are creating the animation for the sake of a 4D simulation, you can just rely on the scale setting to properly extend or shrink the length of your animation.

Another problem with Animator is the tendency to use the item tools instead of the Animator tools. This is a problem because the item tools are in such a familiar location for Navisworks users that they tend to be used instead of the Animator tools. For this reason, it is highly recommended that you do not even open the Item Tools tab when working with Animator.

Animator is not Autodesk® 3ds Max, but it does allow you to make useful walkthroughs that can tell an important story. You can export animations to keyframe pictures or to an avi file.

To sum up, the animator module is an often forgotten tool in Navisworks. It allows you to tell a story and have the model assist you in highlighting key attributes of your project and telling your project's story in the digital world.

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By: Joel Londenberg

# Plumbing Systems for Well-Documented Flow

Plumbing in Autodesk® Revit® MEP has often received a bad rap, and some of it is deserved. When you are new to this platform, plumbing can be very daunting. You have to tackle several new tasks all at once in order to be productive. The tasks, printing, modeling, annotating, and engineering are all very different then previous AutoCAD®-based workflows. This article is intended to help with some of those last two tasks, annotating and engineering.

All of the plumbing tutorials offered for Revit MEP by Autodesk cover the basics of modeling and defining logical systems. These cover most of what you need for documenting flow for domestic water supply and sanitary sewer. The basic process is to place your plumbing fixtures, assign them to a logical system, pipe and tag as needed. The flow in the pipe is specified in your family and tracked in the pipe (see Figure 1). There are a few basic requirements for allowing this flow tracking to function.

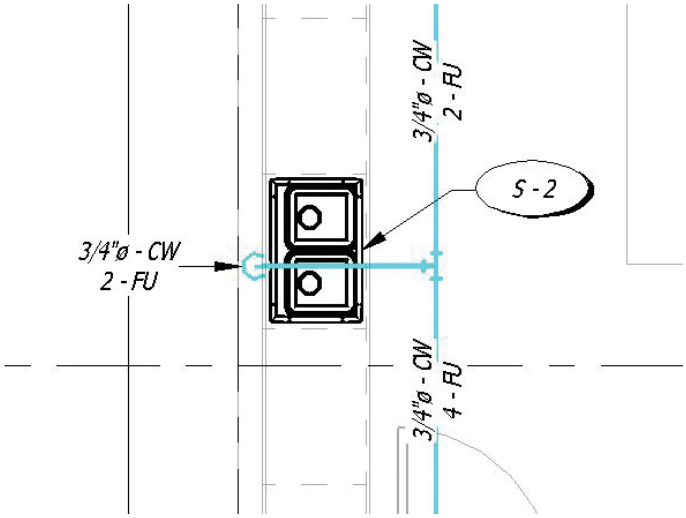


*Figure 1*

First, all the connected families must be consistent in the way they define flow. The connectors must have the same Flow Configuration and System Classification (see Figure 2)—in this case, Fixture Units and Domestic Cold Water. They must also be consistent in defining the direction of flow (this is not related to the direction the pipe connector arrow points). Think of this in the sense of fresh water flowing *IN* to the fixture from the pipe, and sanitary drain water flowing *OUT* of the fixture to the pipe. If you mixed fixtures with some flowing *IN* and some flowing *OUT*, you would not be able to properly collect flow in your pipes.

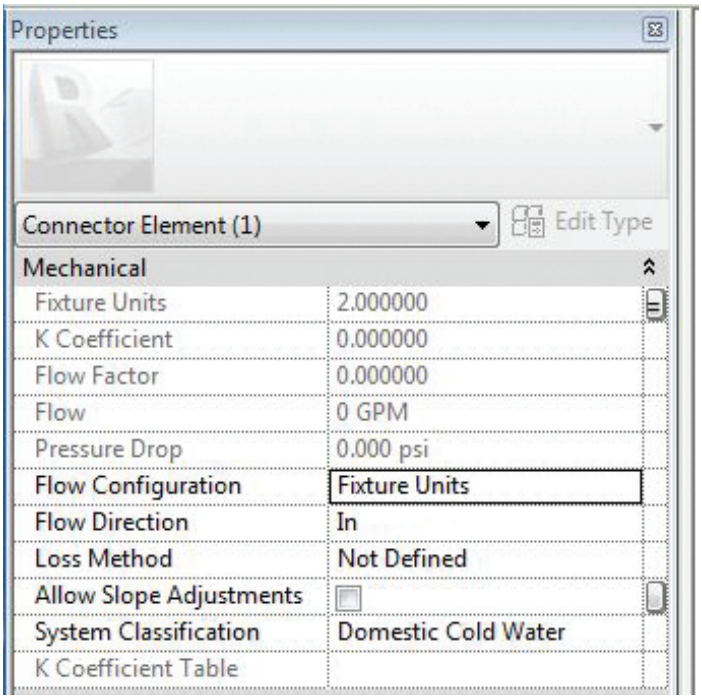


*Figure 2*

Second, there can be only one possible path for water to flow. This is different from real life. For instance, it is perfectly acceptable in plumbing construction to loop the domestic cold water supply around a building floor with periodic taps out to fixtures. However, Revit does not understand how to calculate this.

So long as you have these two items, Revit can track your flow. Now let's look at what is needed to apply this to the more difficult piping options.

## SANITARY VENT

Beginning with Revit MEP 2012, there is increased control over systems, as well as some additional System Classifications, including Vent. We also have the ability to connect pipe of different classifications and have them retain that classification setting.

However, connecting pipe of different classifications doesn't suit our need because it gives us two separate possible paths for flow, which means that Revit fails to track our flow past one of these junctions. The Vent classification doesn't work in any case, because it doesn't track flow at all (see Figure 3).

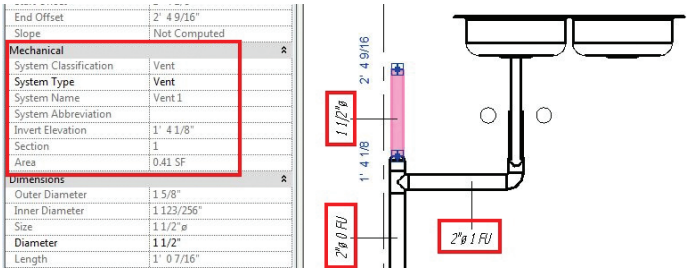


*Figure 3: Flow (1 FU) is tracked in the first pipe segment, but not after the tee (0 FU); the properties of Vent pipe does not include flow.*

The best option for tracking flow in both sanitary drains and sanitary vents is to separate the two at the fixture family. Create enough model geometry in your family to host both connectors. Classify them both as Sanitary with the Flow Configuration set to Fixture Units (and don't forget to give the Fixture Units a value). The flow direction is only important in the sense that all of your families must match.

Once your families are set up to separate your drain and vent and you pipe them accordingly, you can use pipe tags to parametrically track and document flow. This will make pipe size easier to calculate (see Figure 4).

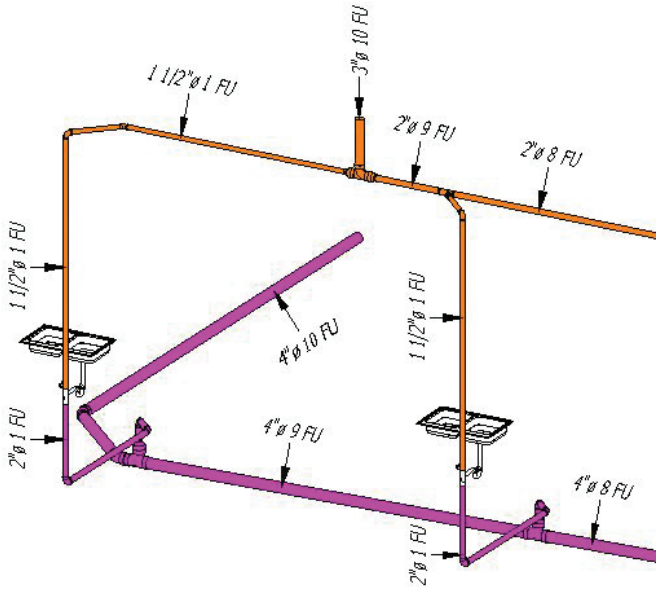


*Figure 4*

Note that you do not need to explicitly define any logical systems for this to work. Even if all the pieces are left on whatever default system Revit chooses to give them, you still have full documentation for flow.

One missing piece is the ability to use View Filters to change your color, as seen in Figure 4, or line type to visually distinguish between drain and vent pipes. The most flexible and robust method for filtering your views is to use System Name. This requires that you set up user-defined systems. The name that you select can be used for filtering, and will be displayed in the pipe tags.

Since systems do not affect flow collecting in pipes, you do not need to have a separate System Name for each pipe tree. For example, most single-story buildings have a single sanitary drain outlet to which every fixture is connected, but many vents through the roof.

Just because the vent pipe tree in the North wing of the building is not connected to the vents in the South wing does not mean that they have to have unique logical systems. I generally assign only one logical system with a name that is convenient to display for each of these pipe systems; Domestic Cold Water (CW), Sanitary drain (WASTE), Sanitary vent (VENT), and Sanitary condensate drain (COND). If there are multiple domestic hot water heaters in a building and you wish to document them separately, then you can append the heater callout to the system name, Domestic Hot Water (HW-1).

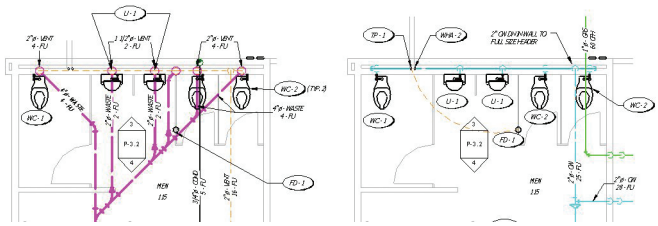

*Figure 5: Once both the System Name and flow are well-defined, you can use tags and view filters to demonstrate both in your plans.*

## NATURAL GAS

Tracking and documenting flow for natural gas piping (fuel gas) adds a few complications to our strategy. We still need exactly one possible path for Revit to track flow, and it's still best to use System Name to drive view filters and tags. But what flow are we tracking?

Gas pipe size calculations (in my part of the world) are based on cubic feet per hour or CFH. Revit does not have CFH as an available unit, so we will need to choose a placeholder. The simplest answer is to use gallons per minute (GPM). We also need to choose a System Classification that will allow us to specify flow in GPM. You can use one of several options; in this example I used Hydronic Supply. You should plan this choice carefully—you will have to keep your classification consistent across your families and projects.

Next, we need to specify the demand. Gas is usually specified in mechanical equipment and in water heaters as BTUH under heating input. If you trust your equipment specifier to enter the BTUH correctly, then the most flexible option is to use a formula to calculate CFH directly from BTUH. This is not quite as simple as it may seem. You will need to edit the family and add a shared parameter (we will be scheduling this later). Title it descriptively, for example, my parameter is ACH (for my company's name) CFH as GPM, all condensed to ACH CFHasGPM, the Discipline is Piping, Type is Flow. The rough formula is 1,000 BTUH per CFH. Since the parameter specifying BTUH is likely formatted in Revit to use that unit type, you will have to not only calculate the number, but also convert the units from BTUH to GPM.

Revit makes this complicated. The formula shown in Figure 6 should reasonably work; however, when you press OK, Revit internally converts the units of energy from BTUH to VA, and units of flow from GPM to CFM. Because of rounding settings, we end up with 0 GPM as our value instead of 120 GPM (see Figure 7).

| | | |
|---|---|---|
| Input Heat | 120000.00 Btu/h | = |
| ACH CFHasGPM (default) | 120 GPM | = Input Heat / (1000btu/h) * (1gpm) |

*Figure 6*

| | | |
|---|---|---|
| Input Heat | 120000.00 Btu/h | = |
| ACH CFHasGPM (default) | 0 GPM | = Input Heat / (293.07 VA) * (0 CFM) |

*Figure 7*

| | | |
|---|---|---|
| Input Heat | 120000.00 Btu/h | = |
| ACH CFHasGPM (default) | 0 GPM | = Input Heat / (1000000btu/h) * (1000gpm) |

*Figure 8*

To fix our rounding issue we can arbitrarily enlarge both the divisor and multiplier (see Figure 8), and now we have correct calculated flow (see Figure 9).

| | | |
|---|---|---|
| Input Heat | 120000.00 Btu/h | = |
| ACH CFHasGPM (default) | 120 GPM | = Input Heat / (293071.07 VA) * (134 CFM) |

*Figure 9*

Now assign this calculated flow to the pipe connector in the family and it's ready for use in your project. Your gas flow CFH (substituted with GPM) will properly calculate in the pipe in your project. The next complication comes from your pipe tag that shows the flow. If you add the text "CFH" to your tag family, in the project it will still show GPM as well (see Figure 10).

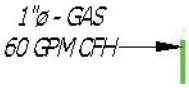


*Figure 10*

To fix this, go to the project units settings and set the Unit Symbol for piping flow to None (see Figure 11).

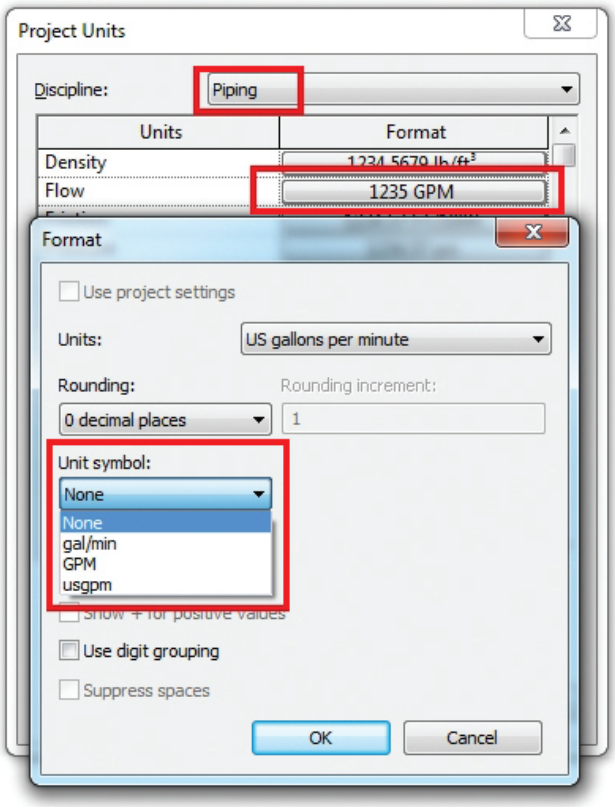


*Figure 11*

Finally, because we used a shared parameter to calculate CFH in our families, we can schedule this value and document our total building gas load as well (see Figure 12).

**GAS LOAD SCHEDULE**

*GAS LINE SIZED AT TOTAL DEVELOPED LENGTH LESS THAN 400ft*

| TAG | MARK | CFH | QTY | TotalCFH |
|---|---|---|---|---|
| OVEN | 1 | 65 | 2 | 130 |
| PAC | 1 | 250 | 1 | 250 |
| PAC | 2 | 250 | 1 | 250 |
| PAC | 3 | 60 | 1 | 60 |
| PAC | 4 | 150 | 1 | 150 |
| PAC | 5 | 60 | 1 | 60 |
| PAC | 6 | 60 | 1 | 60 |
| PAC | 7 | 60 | 1 | 60 |
| PAC | 8 | 60 | 1 | 60 |
| WH | 1 | 120 | 1 | 120 |
| Grand total | | | | 1200 |

*Figure 12*

## COST / BENEFIT

There is significant effort required to set up these methods for use in your office. Plumbing and mechanical equipment families, pipe tag families, project unit settings, and view filters will all need to be adjusted. However, this effort can be paid back when you make full use of the parametric capabilities in Revit MEP. This method allows you to change the heating input value on one water heater and be 100 percent confident that every pipe tag and schedule on every sheet in your set will remain up to date.

Like most things in life, what you put into this process is what you will get out.

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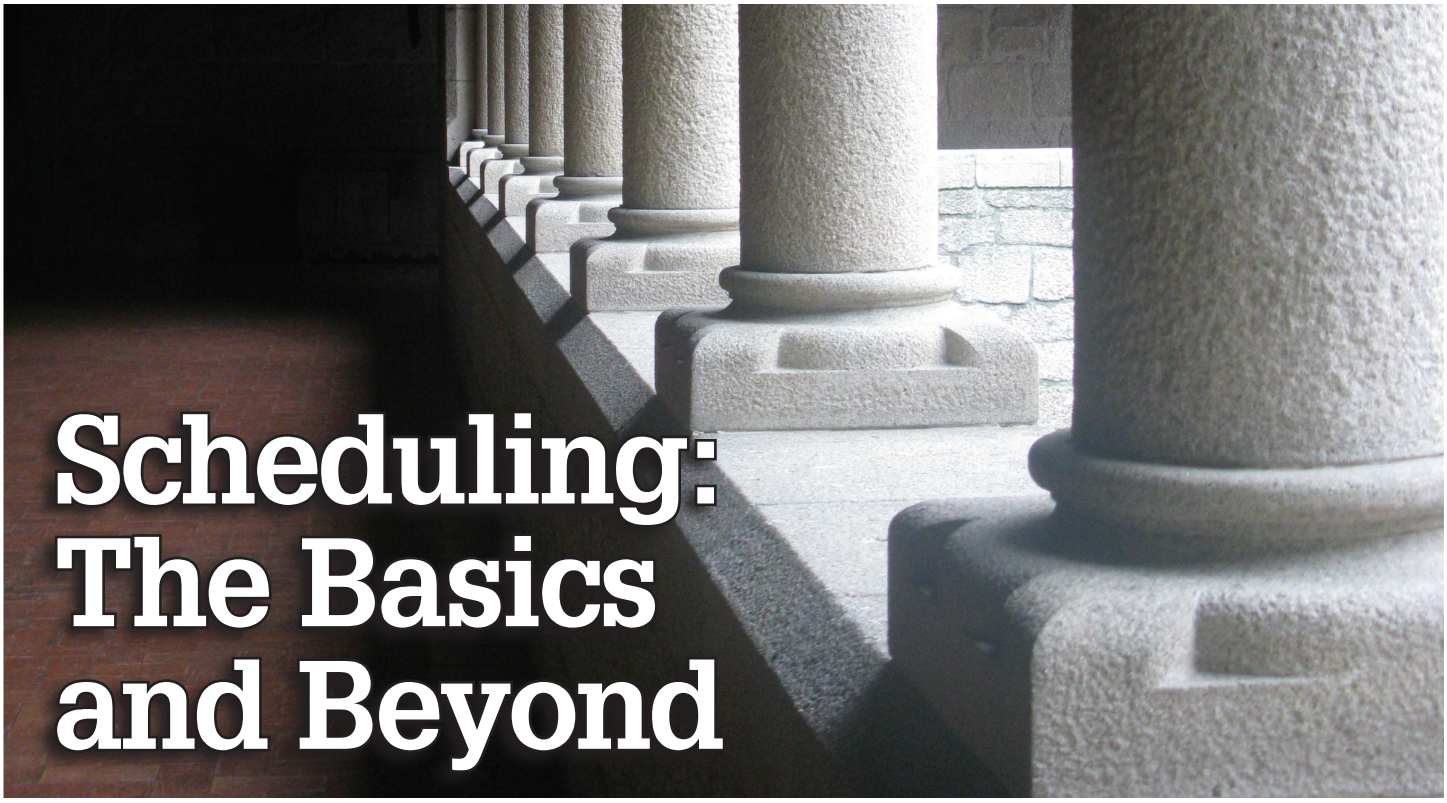


# Scheduling: The Basics and Beyond

## THE BASICS

Most Autodesk® Revit® users reading this article will by now be familiar with the basic scheduling tools within the software. The ability to automate the scheduling process for elements such as columns, beams, and foundations; tagging the elements and scheduling the mark, type, count, and so on, considerably speeds up the traditional draughting process.

| BEAM SCHEDULE | | | |
|---|---|---|---|
| MARK | SIZE | BEAM DEPTH | TOTAL No |
| B4 | PFC200x90x30 | 200 | 1 |
| B5 | RHS100x50x6.3 | 100.0 | 1 |
| B7 | UB203x102x23 | 203.2 | 23 |
| B8 | UB203x133x25 | 203.2 | 611 |
| B9 | UB203x133x30 | 206.8 | 32 |
| B10 | UB254x146x31 | 251.4 | 38 |
| B11 | UB254x146x37 | 256.0 | 4 |
| B12 | UB254x146x43 | 259.6 | 1 |
| B13 | UB305x127x37 | 304.4 | 1 |
| B14 | UB305x165x40 | 303.4 | 12 |

Using the parameters that are already embedded in the system, additional information can be added to schedules to further add value to your documents (when using Revit for information production). Concrete volumes can be added to foundation, column, beam, and floor schedules.

This information can be further broken down within the schedule using the Sorting/Grouping tab of the Schedule properties, enabling the user to easily schedule concrete volumes by floor level within a building, for example, or the concrete volume of columns by storey, rather than providing just an overall total.

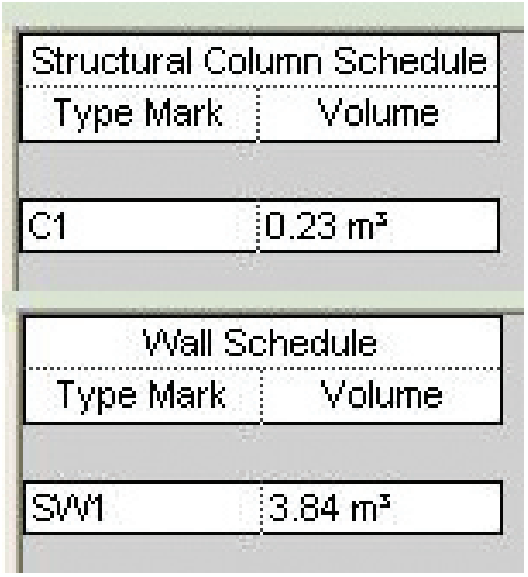
| *CONCRETE COLUMN TOTAL VOLUME PER FLOOR | |
|---|---|
| COLUMN MARK | TOTAL CONCRETE VOLUME |
| 0 (FOUNDATIONS) TO 1st FLOOR | |
| | 52.87 m³ |
| 1st TO 2nd FLOOR | |
| | 16.76 m³ |
| 2nd TO 3rd FLOOR | |
| | 16.30 m³ |
| 3rd TO 4th FLOOR | |
| | |
| 4th TO 5th FLOOR | |
| | |
| 5th FLOOR TO ROO | |
| | |

| _STRUCTURAL SLAB CONCRETE V | |
|---|---|
| TYPE | CONCRETE VOLUME |
| -0 FOUNDATION SLAB | |
| 400 R.C SLAB | 471.05 m³ |
| | 471.05 m³ |
| 0 GROUND FLOOR | |
| 275 R.C SLAB | 230.30 m³ |
| | 230.30 m³ |
| 1st FLOOR | |
| 300 R.C SLAB | 487.19 m³ |
| | 487.19 m³ |

## CONCRETE VOLUME SCHEDULE CAUTIONS

There are some basic modeling principles that users need to be aware of when scheduling concrete volumes within Revit. It is easy for the inexperienced to model elements in a "lazy" manner that causes them to intersect each other as opposed to forming neat geometric joints.

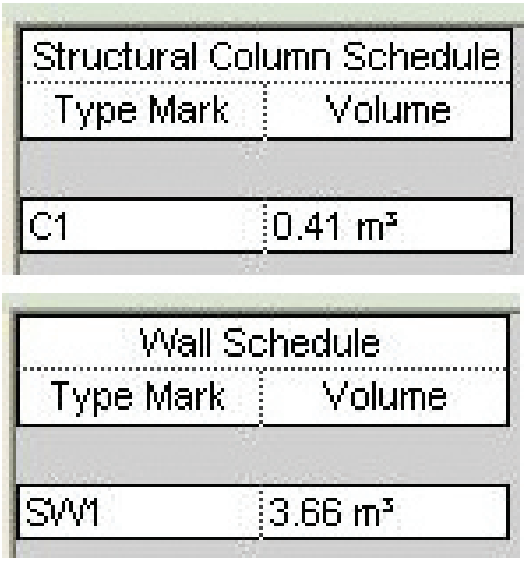
On paper, this method of assembly may appear to be satisfactory; however, when you start to interrogate the reported volumes within the schedule, discrepancies are found if the model has been constructed in this manner. The concrete volumes reported in Figure 4 are incorrect, and should actually be showing the values displayed in Figure 5.



| Structural Column Schedule | |
|---|---|
| Type Mark | Volume |
| C1 | 0.23 m³ |

| Wall Schedule | |
|---|---|
| Type Mark | Volume |
| SW1 | 3.84 m³ |

*Figure 4*



| Structural Column Schedule | |
|---|---|
| Type Mark | Volume |
| C1 | 0.41 m³ |

| Wall Schedule | |
|---|---|
| Type Mark | Volume |
| SW1 | 3.66 m³ |

*Figure 5*

The reason for this is because the concrete wall is intersecting the column and the geometry has automatically joined. This has resulted in a miscalculation of concrete volume for the individual elements. Whilst the reported overall concrete volume of the structure will be the same, the breakdown of the various elements to show different grades of concrete is where the problem will arise. The solution sounds simple: model each element correctly! However, in practice this might prove to be harder than it seems.

## BEYOND THE BASICS - PARAMETERS

There are two types of parameters that can be added to schedules. Project parameters can be added within the project environment and appear in schedules but cannot be tagged, and shared parameters are built into the families and can be scheduled and tagged.

In the example below, project parameters have been added to the family allowing the column schedule to show the various loads on each column: Dead, Imposed, Wind, Shear Major and Shear Minor. Using an external plug-in programme, Microsoft Excel files can be imported and exported. This enables the user to easily update the loads in the Revit schedule, using values exported from the analysis package, resulting in all the information being stored within the Revit database.

| COLUMN LOAD SCHEDULE | | | | | | |
|---|---|---|---|---|---|---|
| MARK | DEAD LOAD | IMPOSED LO | WIND LOAD | SHEAR MAJ | SHEAR MINO | COLUMN LOCATION |
| CL1 | 575 | 215 | ±275 | ±15 | ±110 | AA(1265)-24 |
| CL2 | 300 | 110 | ±275 | ±15 | ±110 | AA(1265)-23 |
| CL3 | 2350 | 1400 | ±130 | ±30 | ±15 | AA(1415)-21 |
| CL4 | 300 | 250 | ±30 | ±30 | ±15 | AA(1415)-19 |
| CL5 | 3550 | 2100 | ±175 | ±55 | ±15 | AA-17 |
| CL6 | 2450 | 1450 | ±130 | ±275 | ±15 | AA(-2770)-14 |
| CL7 | 1250 | 800 | ±100 | ±100 | ±15 | AA(-3285)-13 |
| CL8 | 1650 | 950 | ±115 | ±20 | ±15 | BB(2865)-9a |
| CL9 | 850 | 400 | ±710 | ±90 | ±340 | AA(-1340)-24 |
| CL10 | 575 | 280 | ±710 | ±90 | ±340 | AA(-3610)-24 |
| CL11 | 1850 | 1150 | ±100 | ±30 | ±20 | BB-24 |
| CL12 | 1200 | 1150 | ±100 | ±15 | ±15 | BB-20 |

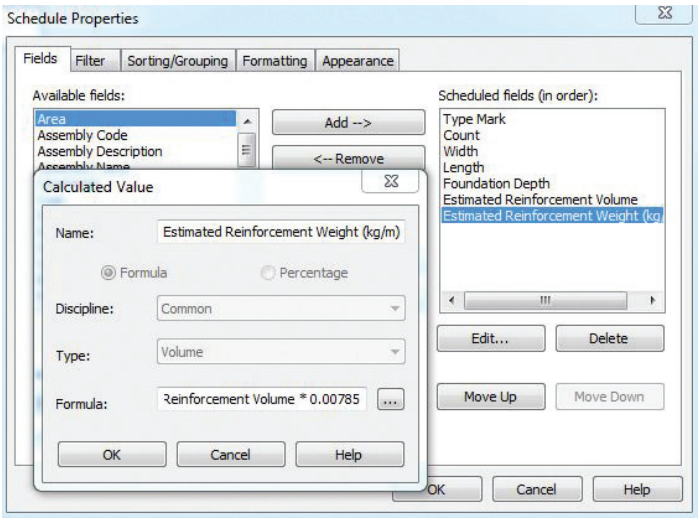
Shared parameters could be considered to be the backbone of the Revit platform and the key to producing data-rich Building Information Models. Shared parameters are stored independent of the family or project environment, and can be used in all families (standardizing the naming of parameters within your library). Once added to families, these can be called up in tags and schedules (speeding up the information production process).

In the example below, shared parameters have been built into a parametric base plate family. These parameters have been scheduled to call out the base plate dimensions, number of bolts, bolt size, and dry pack thickness. Additional parameters could be added to the bolt family and shared to the base plate family to include additional data such as bolt lengths.

| BASEPLATE SCHEDULE | | | | | | | |
|---|---|---|---|---|---|---|---|
| MARK | COUNT | LENGTH (mm) | WIDTH (mm) | THICKNESS (mm) | No OF BOLTS (mm) | BOLT SIZE (mm) | DRYPACK THICKNESS (mm) |
| BP1 | 8 | 250 | 150 | 10 | 2 | 12 | 25 |
| BP2 | 5 | 250 | 150 | 10 | 4 | 12 | 25 |
| BP3 | 6 | 125 | 200 | 10 | 2 | 12 | 25 |
| BP4 | 6 | 400 | 250 | 12 | 4 | 16 | 25 |
| Grand total: 25 | | | | | | | |

## BEYOND THE BASICS – REINFORCEMENT ESTIMATES

The default fields available within the Revit schedules (for concrete) allow for the scheduling of estimated reinforcement volumes, assuming the reinforcement has been modeled in the project. This figure can be converted into an estimated reinforcement weight by using a calculated value in the schedule.




The idea of using Revit to provide accurate reinforcement estimates could be viewed by the user as quite a labor-intensive process, requiring all elements within the model to have the reinforcement modeled to suit the preliminary reinforcement design.

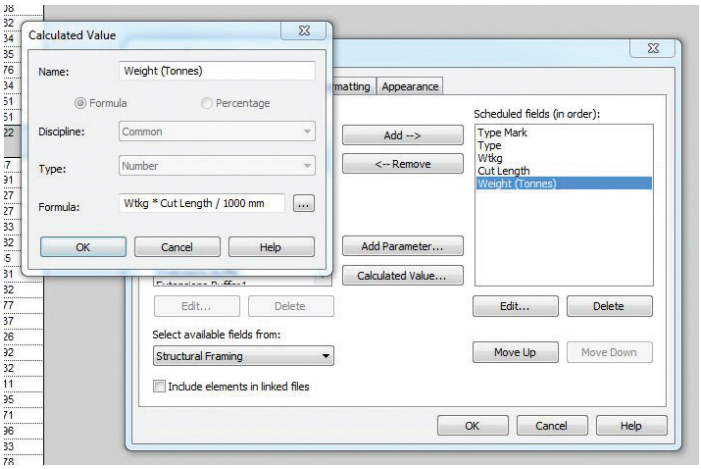
However, the use of the reinforcement extensions provided by Autodesk as part of the Subscription Advantage Pack will speed up this whole process. Using this extension, columns, beams, foundations, and walls can be quickly and accurately detailed with the designed reinforcement, producing accurate schedules to assist with pricing.

| FOUNDATION SCHEDULE | | | | | |
|---|---|---|---|---|---|
| TYPE | COUNT | WIDTH | LENGTH | THICKNESS | ESTIMATED REINFORCEMENT WEIGHT (kg/m) |
| F1 | 5 | 1200 | 1800 | 450 | 77.17 |
| F2 | 8 | 1800 | 2400 | 450 | 205.70 |

## BEYOND THE BASICS – STEEL TONNAGE

The ability to calculate steel tonnages from a Building Information Model not only assists the tender process, but in such a competitive market can prove invaluable when undertaking value engineering on a scheme.

By adding a shared parameter into the steelwork families to allow the W value (Mass per metre kg/m) to be scheduled, the member's tonnage can be easily calculated using the basic formula: Mass per metre * Cut Length / 1000 (for metric tonnes)




This method is applicable to all steelwork, although it is worth noting with column schedules there is no "cut length" field, so the parameter to use in this instance is length.

Tonnage schedules can be broken down by element, by floor level, and so on, using the Sorting/Grouping tab in the Schedules dialogue box. It is often worth sorting the elements by type mark and having this field set as a hidden field under the Formatting tab of the Schedule properties.

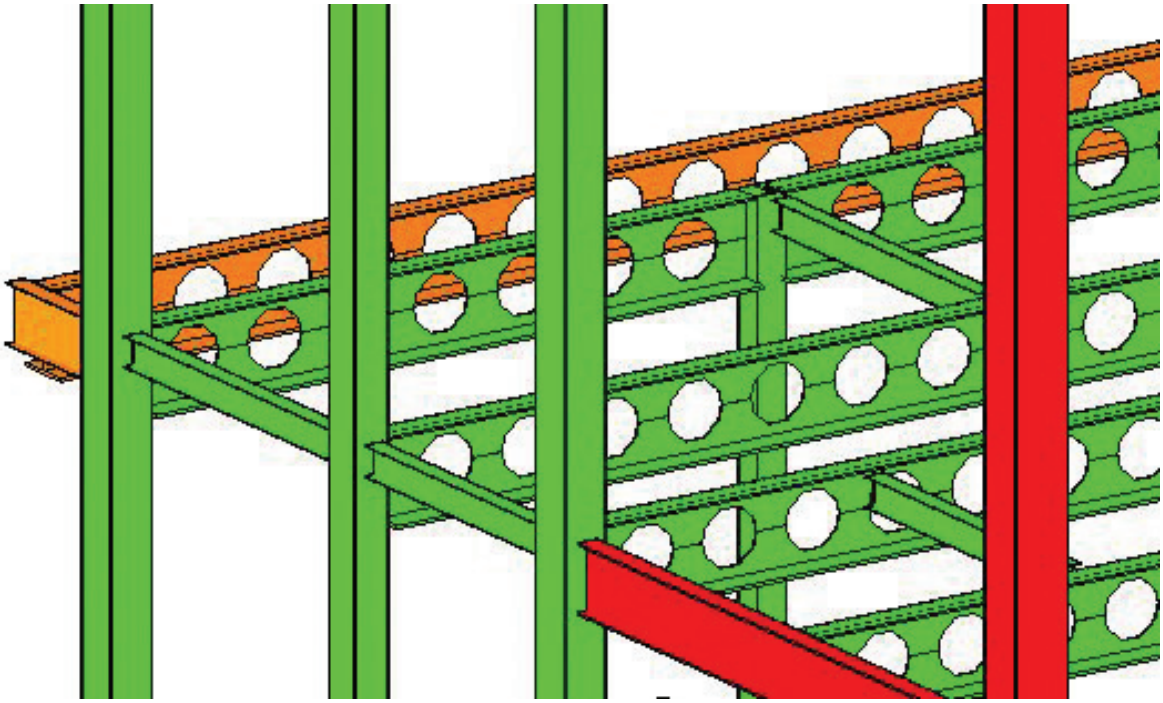
| | | | |
|---|---|---|---|
| UC356x406x634 | | | |
| UC356x406x634 | 0.6339 | 10727 | 6.800066 |
| | | 10727 | 6.800066 |
| UKB533x210x138 | | | |
| UKB533x210x138 | 0.1383 | 11733 | 1.622625 |
| | | 11733 | 1.622625 |
| UKB533x312x150 | | | |
| UKB533x312x150 | 0.1506 | 10023 | 1.509473 |
| | | 10023 | 1.509473 |
| Grand total: 1042 | | 3865235 | 237.855364 |

Custom framing members such as cell beams with different top and bottom web and flange sizes can also be scheduled, providing you have the relevant information relating to its mass and add that information into the family as a shared parameter.

Being able to accurately schedule the steel weights alongside the member utilisation ratios can help to identify inefficiencies in the frame design and provide an opportunity to refine the design and make savings. In today's highly competitive market, innovative use of the software in this manner may just provide the cutting edge that results in a winning tender for the team.

**In today's highly competitive market, innovative use of the software in this manner may just provide the cutting edge that results in a winning tender for the team.**

## MOVING FORWARD



Structural analysis and design packages have the ability to export plans, elevations, sections, and 3D views showing the utilization of members such as framing. Traditionally, any members with a utilisation ratio greater than 1.0 would be shown red. Members with utilisations less than or equal to 1.0 would be coloured according to their actual utilisation based on a graduated color chart typically turning deeper shades of blue as the members become increasingly redundant. These colours are usually set within the program and cannot be changed.

In order to promote efficiency in design, clients are beginning to request graphical confirmation of the structural utilisation of the design detailed on the construction issue drawings. Through the application of colours to the individual members (based on their level of structural usage), any areas of excessive structural redundancy in the frame will be apparent and allow clients to consider design modifications to improve efficiency of use.

Through the intelligent use of schedules and filters within Revit, structural members can be highlighted using any chosen colour scheme based on their levels of utilisation stored as parameters within the families.

Using an external plug-in program to manipulate data transfer between the design package and Revit, utilisation parameters in the member families can be populated at the click of a button based on the results of the structural design. Thus, construction drawings can be easily and quickly "converted" into structural efficiency drawings following each design revision, until such time as the client is satisfied and the design frozen.

This method provides clients with a means of checking that they are not paying for an inefficient design, and because they are able to visualize this in a 3D environment, they can gain a better understanding compared with traditional 2D.

## SUMMARY

In summary, schedules should be considered as:

- an extremely valuable and powerful feature of Revit.
- a way of providing additional (quantitative) information with little extra effort.
- an opportunity to gain a competitive advantage to tendering and value engineering.

To gain most benefit from scheduling, careful consideration needs to be given to:

- the information required and parameters added to families accordingly.
- sorting / grouping data in a logical way.
- the way your Revit model is constructed

Finally, not only are schedules useful for quantification purposes, they provide a powerful way of linking Revit to external software packages.

*Glenn Jowett is the UK Revit Structure Leader for Opus International Consultants, based in Manchester, England. Glenn's role is to facilitate the growth and development of Revit Structure and BIM in the UK, as well as the global business.*
*Opus is a leading international multidisciplinary consultancy, with a network of offices in Australia, Canada, New Zealand, the UK, and the USA. Before returning to the UK, Glenn spent over three years working in the New Zealand business, Glenn can be contacted at Glenn.Jowett@opusinternational.co.uk, and also authors a Revit blog: Revit ST. http://revitst.blogspot.com*

by: David Harrington

# HEADS UP!

## Updates, Service Packs and Top Known Issues obtained from product pages at Autodesk.com

### AUTOCAD® 2012

2011-Dec-13 AutoCAD and AutoCAD LT 2012 SP1 Ribbon Hotfix
http://goo.gl/OK7jQ

2011-Dec-08 Autodesk 2012 Content Explorer Service Hotfix 2
http://goo.gl/RVIw6

2011-Sep-27 AutoCAD 2012 Service Pack 1
http://goo.gl/jM8kC

2011-Jul-13 AutoCAD 2012 Block Editor Save Corruption Hotfix
http://goo.gl/U47H5

2011-Apr-01 Autodesk 2012 Content Explorer Service Hotfix
http://goo.gl/6zU76

### AUTOCAD LT® 2012

2011-Dec-13 AutoCAD and AutoCAD LT 2012 SP1 Ribbon Hotfix
http://goo.gl/1Fj8a

2011-Dec-08 Autodesk 2012 Content Explorer Service Hotfix 2
http://goo.gl/5WXMh

### AUTODESK® REVIT® ARCHITECTURE 2012

2011-Dec-13 Hotfix - Autodesk Revit Server 2012 - Improve stability when uploading to Revit Server
http://goo.gl/dCJCS

2011-Oct-11 Hotfix – Autodesk Revit 2012 – Apply material family parameters using the Paint tool
http://goo.gl/SNOeD

2011-Jul-13 Revit Architecture 2012 Deployment Utility
http://goo.gl/4UBPQ

2011-Jul-13 Hotfix - Incorrect Ribbon Icons
http://goo.gl/eR6IK

## AUTODESK® INVENTOR® PROFESSIONAL 2012

2011-Dec-12 Hotfix - Multiple Issues Addressed (see Summary and readme file)
http://goo.gl/z33ow

2011-Nov-23 Hotfix - Task Scheduler Check-In corrupts BOM/Error 1200 on Item Assign & Cannot use the iLogic Add Rule
http://goo.gl/44F3b

2011-Nov-18 Hotfix - Projected edge will not select as a closed loop for offset
http://goo.gl/G6fk0

2011-Nov-29 Hotfix - Multiple Issues (see Summary and readme file)
http://goo.gl/O6BT7

## AUTOCAD® ARCHITECTURE 2012

2011-Dec-13 AutoCAD and AutoCAD LT 2012 SP1 Ribbon Hotfix
http://goo.gl/6mfcE

2011-Dec-08 Autodesk 2012 Content Explorer Service Hotfix 2
http://goo.gl/IHfzF

2011-Nov-14 AutoCAD 2012 Performance Slowdown Hotfix (32/64 bit)
http://goo.gl/HlZTY

2011-Sep-29 AutoCAD Architecture 2012 Service Pack 1
http://goo.gl/Qf2zm

## AUTOCAD® CIVIL 3D® 2012

2011-Dec-13 AutoCAD and AutoCAD LT 2012 SP1 Ribbon Hotfix
http://goo.gl/GWuoS

2011-Dec-08 Autodesk 2012 Content Explorer Service Hotfix 2
http://goo.gl/N7hj5

2011-Dec-08 AutoCAD Civil 3D 2012 Update 1
http://goo.gl/AkgDX

2011-Nov-14 AutoCAD 2012 Performance Slowdown Hotfix (32/64 bit)
http://goo.gl/Ebi47

2011-Sep-07 Hotfix - Prospector Lock-up
http://goo.gl/T2mTx

2011-Jul-13 AutoCAD 2012 Block Editor Save Corruption Hotfix
http://goo.gl/G6hpz

## AUTOCAD® MAP 3D 2012

2011-Dec-13 AutoCAD and AutoCAD LT 2012 SP1 Ribbon Hotfix
http://goo.gl/Md4tj

2011-Dec-08 Autodesk 2012 Content Explorer Service Hotfix 2
http://goo.gl/QyS0E

2011-Nov-09 AutoCAD Map 3D 2012 Service Pack 1
http://goo.gl/ya0w4

2011-Sep-14 Localized UI Hotfix
http://goo.gl/ER6Ek

## AUTOCAD® MECHANICAL 2012

2011-Oct-27 AutoCAD Mechanical 2012 Service Pack 1
http://goo.gl/P8nQu

2011-Dec-08 Autodesk 2012 Content Explorer Service Hotfix 2
http://goo.gl/kRUzk

## AUTODESK® 3DS MAX® 2012

2011-Oct-25 Autodesk 3ds Max 2012 Service Pack 2
http://goo.gl/FxPNm

2011-Sep-29 Backburner 2012.1
http://goo.gl/yTVIV

2011-Sep-23 Hotfix 1 – Autodesk® 3ds Max® 2012
http://goo.gl/nzMVl

2011-Sep-23 Hotfix 2 – Autodesk® 3ds Max® 2012
http://goo.gl/HVJkx

## AUTODESK® ALIAS® 2012

2011-Aug-09 Alias 2012 SP1
http://goo.gl/Q7cWK

2011-Aug-03 Hotfix - Unable to open CATIA V5 R20 files with DirectConnect 2012
http://goo.gl/9Cssc

2011-Jul-08 Hotfix - Import shrink option not functioning properly with DirectConnect 2012
http://goo.gl/0FsRS

2011-Jun-17 Hotfix - Imported B-Spline surfaces from CATIA V5 are over extended with DirectConnect 2012
http://goo.gl/x9zCR

## AUTODESK® MAYA® 2012

2011-Oct-11 Autodesk Maya 2012 Service Pack 1
http://goo.gl/DarDG

2011-Aug-12 Composite 2012 Hotfix
http://goo.gl/HTBfc

2011-Aug-03 Hotfix - Unable to open CATIA V5 R20 files with DirectConnect 2012
http://goo.gl/o4YFy

2011-Aug-01 Autodesk Maya 2012 Hotfix 4
http://goo.gl/eKtZT

## AUTODESK® NAVISWORKS® MANAGE 2012

2011-Dec-19 Clash HTML Tabular Report Hotfix
http://goo.gl/5kP4E

2011-Sep-12 Autodesk® Navisworks® 2012 Service Pack 1
http://goo.gl/IEEwN

## AUTODESK® VAULT 2012

2011-Nov-30 Suites Update
http://goo.gl/WgRnX

2011-Nov-17 Update 1
http://goo.gl/tmp8L

2011-Sep-30 Autoloader Update
http://goo.gl/vIteu

2011-Sep-30 DWG UDP Update
http://goo.gl/1ljfP

by: David Mills

# 14 Questions with Brian Haines Industry Marketing Manager Architecture, Engineering, and Construction

**Q what is your role at Autodesk®, Brian?**

I'm an Industry Marketing Manager in the AEC Group. Specifically, I work on the Building side of the group. I'm tasked with overseeing Marketing Programs related to helping our customers understand the value of the Building Design Suite as it relates to the Autodesk portfolio.

**How long have you been with Autodesk and doing this? Any other roles?**

I've been with Autodesk for (almost) seven years. In the past, I was both a Product and a Technical Marketing Manager for FM Desktop. After that I worked in Product Marketing for Autodesk Quantity TakeOff and later the Product Marketing Manager for the Autodesk structural engineering portfolio including Revit Structure, AutoCAD Structural Detailing, and Autodesk Robot Structural Analysis.

**Tell us a little about your background and how you came to be doing what you do now?**

I have a Bachelor's of Architecture from the University of Arizona. I went to work for an architecture firm in Portsmouth, NH, which was funding an Internet start-up in the project collaboration space. I was their first employee! They hired me out of college because I had a background in information systems as it related to managing large portfolios of property and I was a CAD manager for the University of Arizona. Given that opportunity, I went immediately into the software side of the industry. After eight years at the firm, I was hired by Autodesk in 2005.

**What does a typical day look like at your desk?**

Typical? Ha – I suppose atypical could be construed as typical, right? We all work on multiple projects. Given the global focus of my work, the day can start with a conversation with the Sales/Marketing team in Germany, progress to include catching-up on launch deliverables, and finish with a coordination call between our East and West Coast teams. It varies…a lot.

The majority of our communication is done via phone and net meetings so I make a point to split time in the Manchester, NH and Waltham, MA offices. When I'm not in the home offices, I try to find opportunities to go on the road which can help me to maintain relationships with customers, channel partners, and other Autodesk colleagues at events like Autodesk University.

**What kind of challenges do you and those you work with deal with?**

Some of the challenges are making sure that our customers clearly understand the value of what we provide. The need for a broader set of software tools increases as our customers and their workflows get more sophisticated and the need for collaboration increases. We need to make sure they understand the

value of the entire Autodesk portfolio of products (not just one product). At Autodesk we take a lot of pride in speaking directly to our customers and understanding their unique industry needs and then providing the best solution we can provide for them.

### How many coworkers are on your team and how do you share the work?

There are seven people on our team. There are three Technical Marketing and four Industry Marketing Managers. The work is divided by Industries: Architecture, MEP Engineering, and Structural Engineering.

### Do you or your team get involved in planning for future releases of the software?

As part of the Marketing team, I'm less involved in scoping features for future releases and more involved on the Autodesk go-to market plan for Architecture and Engineering in the Building space. From a very early stage, we begin working with product management as well as sales and field marketing teams to help deliver our products to existing customers and new prospects.

### Do you get to do any planning for Autodesk University or other events?

Oh, yes. Prior to AU, I'm one of the course reviewers/selectors for the Building Track. At AU, I work to support customers who have speaking engagements during the week. These days, those opportunities focus around areas such as Building Information Modeling, Sustainability, and customers who have adopted the Autodesk Building Design Suite.

### Do you check out the activity of other forums like ours at AUGI? How much time do you get to do external research apart from responding to users directly?

Yes, on different levels. Our social monitoring tools deliver news from the AUGI forums on a periodic basis. The AUGI forums are a tremendous store of information and always provide useful insights into our customers trending topics. I also maintain a close relationship with several AUGI volunteers. I often speak with them to validate a line of thinking or gain perspective.

### Up until recently, you blogged for BIM & Beam, the Autodesk blog geared towards the Structural Engineering industry. How did you get started?

At that point in time, the blog had several authors who were writing about product tips and tricks. We realized that the there was a demand for Autodesk news as it related to Structural Engineers. I started writing about the various news, trends, and events that were available to our audience and, thankfully, they embraced it! As any blogger will tell you, it's a surprisingly rewarding activity. I always appreciated a reader who took the time to add a comment to my posts. Many Autodesk customers don't get direct access to Autodesk, so I also enjoyed the opportunity to speak with them.

### What sort of things do you do for distraction, hobbies, travel?

I am an avid bicyclist. I like to bike as much as I can. Currently, the largest hobby/distraction in my life is the MBA that I'm pursuing at the University of New Hampshire. It cuts into my cycling time more than I care to admit. We've had a very mild winter in New England so I was fortunate on New Year's Day—I did an 18-mile ride on the sea coast of New Hampshire with a handful of other cycling 'enthusiasts.' When it does get too cold outside, I usually head indoors for the training bike.

My 16-year-old son is a competitive swimmer and we spend a lot of time travelling to attend his meets.

### What was the last book you read?

*Landscape Turned Red: The Battle of Antietam* by Stephen W. Sears. I used to live in the vicinity of Washington County, Maryland. The Civil War era and history has captivated me for as long as I can remember.

### If money were no issue, where would you go on vacation?

I really want to visit New Zealand because of the landscapes (and *Lord of the Rings*). My next sabbatical is in a year and half. We're making plans for New Zealand now!

### What would we be most surprised to know about you?

My hair, mustache, and goatee are misleading. Even though I might not look like it, I'm a veteran. I spent eight years in the military and am very proud of that service.

# Rendering Basics

In the previous issue, we discussed working with materials within AutoCAD® Architecture. Now it's time to look at using those materials to render a drawing. First, what is rendering? In a nutshell, rendering creates a 2D image based on your 3D scene. It shades the scene's geometry by using the lighting you've set up, the materials you've applied, and environmental settings such as fog and background.

The renderer in AutoCAD Architecture is a general-purpose renderer that generates physically correct simulations of lighting effects. A range of standard rendering presets are available. Some of the presets are tailored for relatively quick preview renderings while others are for higher quality renderings. While the final goal is to create a photorealistic, presentation-quality image that illustrates your vision, you may need to create many renderings before you reach that goal. At a basic level, you can use the Render command to render your model without applying any materials, adding lights, and so on. When you render a new model, the renderer automatically uses a virtual "over-the-shoulder" distant light. This light cannot be moved or adjusted.

## SET THE RENDER DESTINATION

When you render a scene, the image can be displayed in either the viewport or the render window. This is called the render destination. The render destination is set in the Advanced Render Settings palette in the Render Context section (see Figure 1). The default setting is Window. To set the render destination, enter RPREF at the command prompt. This will open the Advanced Render Settings palette. Open the Destination list and select Window or Viewport. Render the scene.

When the render destination is set to Window, the renderer will automatically open the render window and the image is then processed. Upon completion, the image is displayed and a history entry is created. As more renderings occur, they are added to the render history so you can quickly look at previous images and compare to see which have the desired results. Images that you wish to keep can be saved from the Render Window.

If you choose to set the render destination to viewport, the generated image is rendered and displayed directly within the

active viewport. This is basically a one-time rendering because there is no render history entry that you can compare with later images. If you want to keep the image you rendered to the viewport, the SAVEIMG command can be used to save the images. It is important to note that rendering to a viewport always renders against the background color you set for the drawing area.

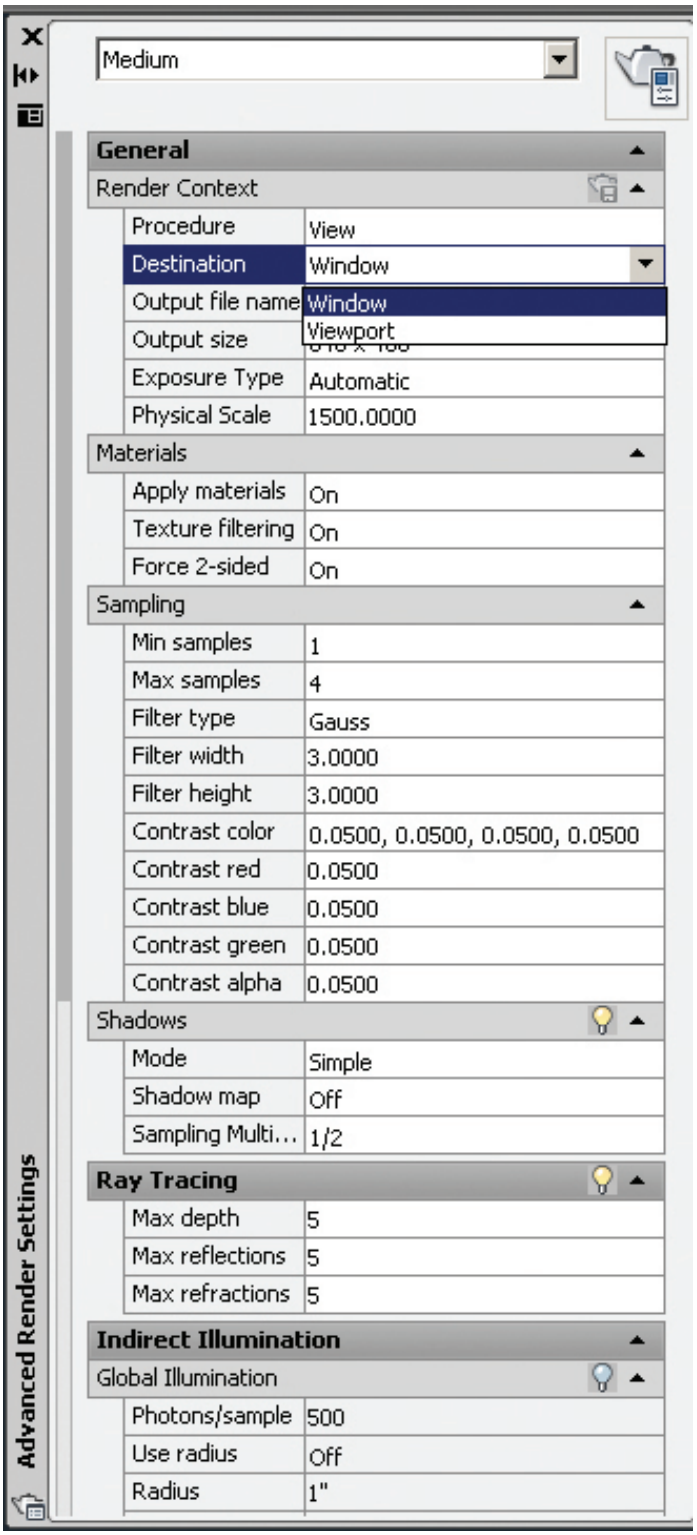



*Figure 1: Render destination*

**By rendering a selected object, you can quickly verify how the material looks and if its texture coordinates must be altered.**

## RENDERING VIEWS, SELECTED OBJECTS, OR CROPPED CONTENT

You can render an entire view, a set of selected objects, or a portion of what you see in the viewport (see Figure 2). Let's look at each one.

The default is to render all objects in the current view in the drawing. If you haven't opened a named view or camera view, the current view is rendered. While the rendering process is faster when you render key objects or smaller portions of a view, rendering the entire view lets you see how all objects are oriented to one another. Depending on the rendering destination you've chosen, the rendered view is displayed in the render window or directly in the viewport. To render a view, begin by displaying a 3D view of the model. Next, select the Render tab on the Render panel of the ribbon. Select Advanced Render Settings. Choose a render preset to control the quality and speed of the rendered output. Now, set the Destination to Window or Viewport to specify where you want the rendered image to be displayed. Render the scene.

If you're adding detail to specific objects, you don't want to waste time rendering an entire viewport. By changing the rendering procedure to Selected, you are prompted to pick the objects that you want rendered. Rendering a selection set of objects is very efficient when testing different materials, especially when the materials include texture mapping. By rendering a selected object, you can quickly verify how the material looks and if its texture coordinates must be altered. To render a selection of objects, select the Render tab on the Render panel of the Ribbon. Select Advanced Render Settings. Choose a render preset to control the quality and speed of the rendered output. Now, set the render procedure to Selected and select the objects in the model that you want to render. Render the scene.

Sometimes you need to render only a portion of what is displayed in the viewport, but you still want to see some of the surrounding environment. By setting the rendering procedure to Crop, you can specify a smaller region of the viewport to be rendered. Similar to selecting objects by window, you can set a rectangular region in the viewport. Any objects that appear in the region are rendered. Everything outside the region is ignored by the renderer. Note that a cropped rendering only displays in the viewport. To render a cropped view, enter RENDERCROP at the command prompt. Specify a window in the viewport that you want to render. Render the scene.

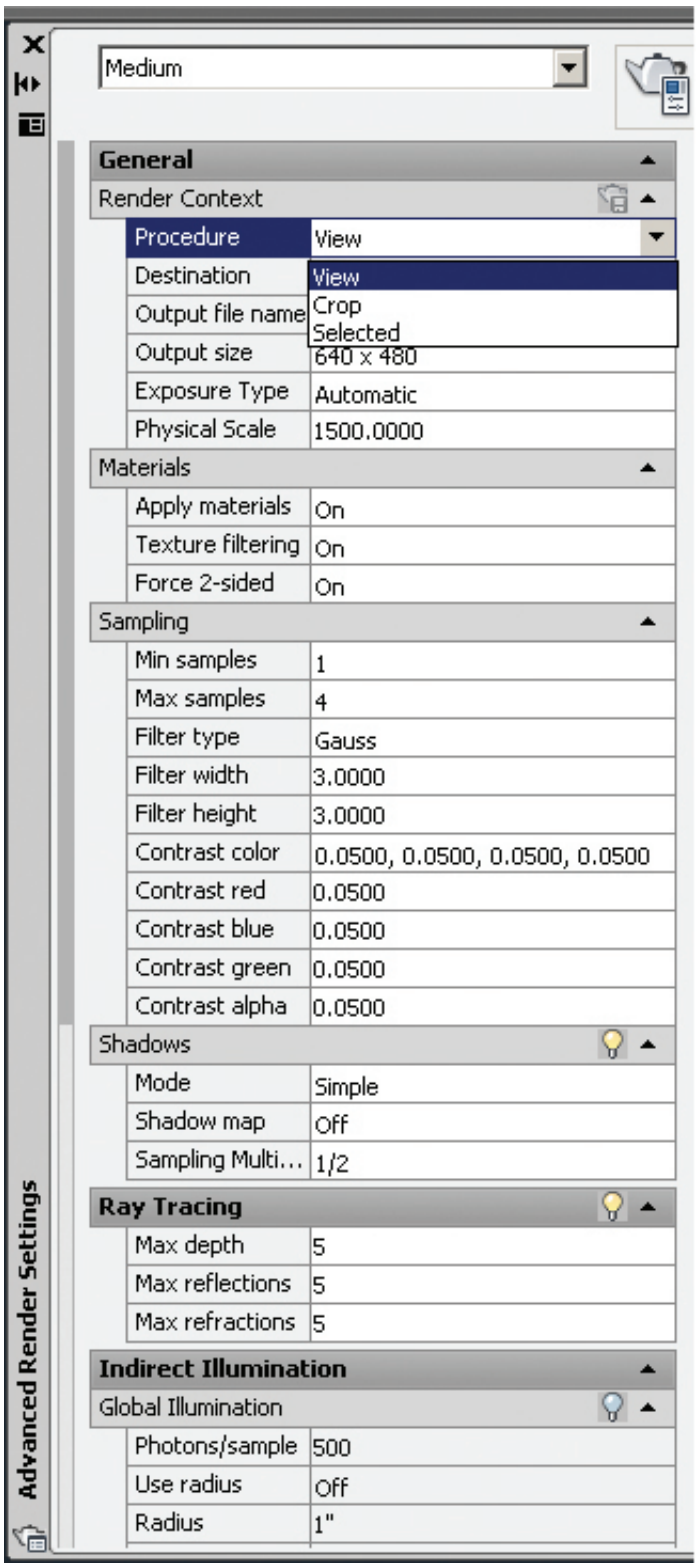



*Figure 2: Rendering procedure*

## SET OUTPUT RESOLUTION

You can set the resolution of the rendered image by specifying the width and the height of the image, in pixels. There are three resolution settings that control how a rendered image appears: the width, the height, and the image aspect ratio. The width and height settings control the size of the rendered image, measured in pixels. The default output resolution is 640 x 480 and can be set as high as 4,096 x 4,096. Higher resolution settings result in smaller pixels and finer detail. It is important to note, however, that high-resolution images take longer to render.

Output resolutions are set from the Output Size dialog box (see Figure 3). When you set an output resolution, it gets stored with the current drawing and is added to the output resolution list found in the Render panel of the ribbon. Most often, as you test how objects look in the model, you will find yourself using lower resolution settings, around 320 x 200 or lower. As you add more detail and materials, you'll shift to mid-range settings, such as 640 x 480. The final rendering will always use the highest resolution required by the project, 1024 x 768 or greater, because this is the image that is presented to the customer or submitted for print.

Aspect ratio describes the proportions of a still image or the frames in an animation, expressed as the ratio of width to height, regardless of the image's resolution. The aspect ratio of an image is controlled by the Image Aspect setting. Aspect ratio is usually expressed either as a ratio of width over height (for example, 4:3) or as a multiplier (such as 1.333). Changing this value changes the height value to maintain the correct dimensions for the output resolution. If you choose to lock the image aspect, the width and height are tied together; changing one automatically changes the other while maintaining the aspect ratio.

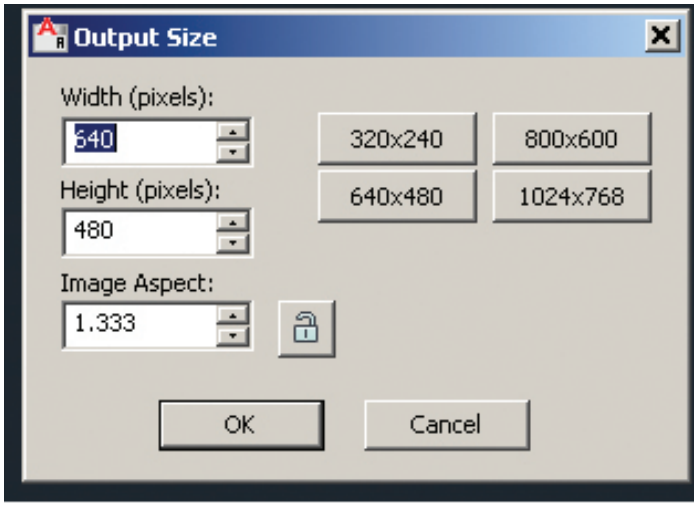



*Figure 3 – Output Size dialog box*

## MATERIAL ADJUSTMENTS

Adding materials to objects greatly increases the realism of a model. In the context of rendering, materials describe how an object reflects or transmits light. Within a material, maps can simulate textures, bump effects, reflections, or refractions.

From the Advanced Render Settings palette, you can turn materials on or off, turn material filtering on or off, and affect how the surfaces of an object are rendered. Materials that you've created and attached to objects in the model are normally turned on when you start the rendering process. If you

turn them off, all the objects in the model assume the characteristics of the GLOBAL material.

## USING LIGHTING IN RENDERING

When there are no lights in a scene, the scene is shaded with default lighting. Default lighting is derived from two distant sources that follow the viewpoint as you move around the model. All faces in the model are illuminated so that they are visually discernible. You can control brightness and contrast, but you do not need to create or place lights yourself. When you insert custom lights or add sunlight, you can disable the default lighting. You can apply default lighting to the viewport only.

You add lights to give the scene a realistic appearance. Lighting enhances the clarity and three-dimensionality of a scene. You can create point lights, spotlights, and distant lights to achieve the effects you want (see Figure 4). You can move or rotate them with grip tools, turn them on and off, and change properties such as color and attenuation. The effects of changes are visible in the viewport in real time. Spotlights and point lights are each represented by a different light glyph. Distant lights and the sun are not represented by glyphs in the drawing because they do not have a discrete position and affect the entire scene. You can turn the display of light glyphs on or off while you work. By default, light glyphs are not plotted.

For more precise control over lighting, you can use photometric lights to illuminate your model. Photometric lights are physically correct lights that use photometric values, which enable you to define lights more accurately—as they would be in the real world. You can create lights with various distribution and color characteristics or import specific photometric files available from lighting manufacturers. Photometric lights can use manufacturers' IES standard file format. By using manufacturers' lighting data, you can visualize commercially available lighting in your model. Then you can experiment with different fixtures and, by varying the light intensity and color temperature, you can design a lighting system that produces the results you want.

The sun is a special light similar to a distant light. The angle of the sun is defined by the geographic location that you specify for the model and by the date and time of day that you specify. You can change the intensity of the sun and the color of its light. The sun and sky are the primary sources of natural illumination. With the sun and sky simulation, you can adjust their properties. In the photometric workflow, the sun follows a more physically accurate lighting model in both the viewport and the rendered output. In the photometric workflow, you can also enable sky illumination, which adds soft, subtle lighting effects caused by the lighting interactions between the sun and the atmosphere.

Light fixtures can be represented by embedding photometric lights in blocks that also contain geometry. A luminary assembles a set of light objects into a light fixture.

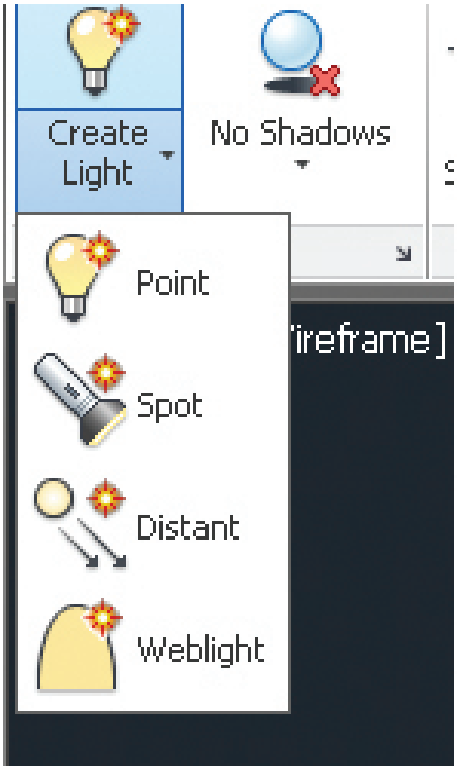



*Figure 4: Light types*

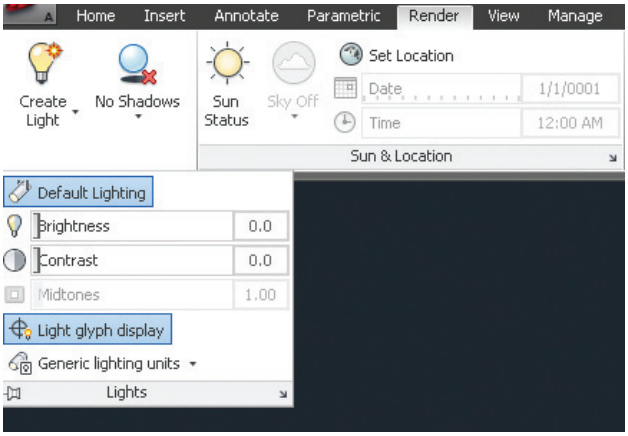



*Figure 5: Light adjustments*

## USING SHADOWS IN RENDERING

Shadows allow you to create rendered images that have greater depth and realism. The renderer can generate shadows by either shadow mapping or by ray tracing. Shadow-mapped shadows rely on a bitmap that the renderer generates during a pre-rendering pass of the scene. Shadow mapping provides softer edges and can require less calculation time than ray-traced shadows, but can be less accurate. Ray tracing traces the path of rays sampled from the light source. Shadows appear where rays have been blocked by objects. Ray-traced shadows have more accurate, hard edges, but do require more calculation time.

Shadow maps are the only way to generate soft-edged shadows; however, they do not show the color cast by transparent or translucent objects. Shadow-mapped shadows are calculated faster than ray-traced shadows. During a pre-rendering pass, a shadow map bitmap is created. Shadow quality can be controlled by increasing or decreasing the

size of the shadow map. The default shadow map size is 256 x 256 pixels. If the shadow appears to be too grainy, increasing the map size will give you better quality. Shadow-mapped shadows should not be used if you have a light shining through a transparent surface.

To generate shadow-mapped shadows in a rendered image, begin by clicking the Render tab on the Render panel of the ribbon. Select Advanced Render Settings. In the Advanced Render Settings palette, make sure that Shadows is turned on. Now, select the shadow mode you wish to use. Turn on the shadow map and render the model.

Ray-traced shadows are generated by tracing the path of light beams or rays sampled from a light source. Ray-traced shadows are more accurate than shadow-mapped shadows. Ray-traced shadows have hard edges and accurate outlines. They also transmit color from transparent and translucent objects. Because ray-traced shadows are calculated without a map, you don't have to adjust resolution as you do for shadow-mapped shadows.

To generate ray-traced shadows in a rendered image, begin by clicking the Render tab on the Render panel of the ribbon. Select Advanced Render Settings. In the Advanced Render Settings palette, make sure Shadows is turned on. Select the shadow mode you want to use and then turn off Shadow Map. Render the model.

One of three shadow mode settings can be selected when shadows are turned on. The shadow mode can be set to Simple, Sort, or Segment (see Figure 7).

- Simple – The renderer calls shadow shaders in a random order. This is the default mode state for shadows.
- Sorted – The renderer calls shadow shaders in order, from the object to the light.
- Segment – The renderer calls shadow shaders in order along the light ray from the volume shaders to the segments of the light ray between the object and the light.

In order for shadows to be cast in a model, lighting must be established. A light source needs to be added to the scene and you need to specify if that light source will cast shadows. For shadows to display in the viewport as you set up the scene, you need to turn on shadows for the visual style. If you want shadows to appear in the rendered image, you need to turn on shadows and choose the type of shadows to render on the Advanced Render Settings palette.

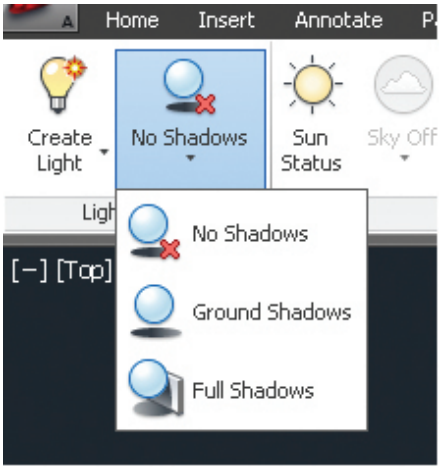



*Figure 6: Shadow options*

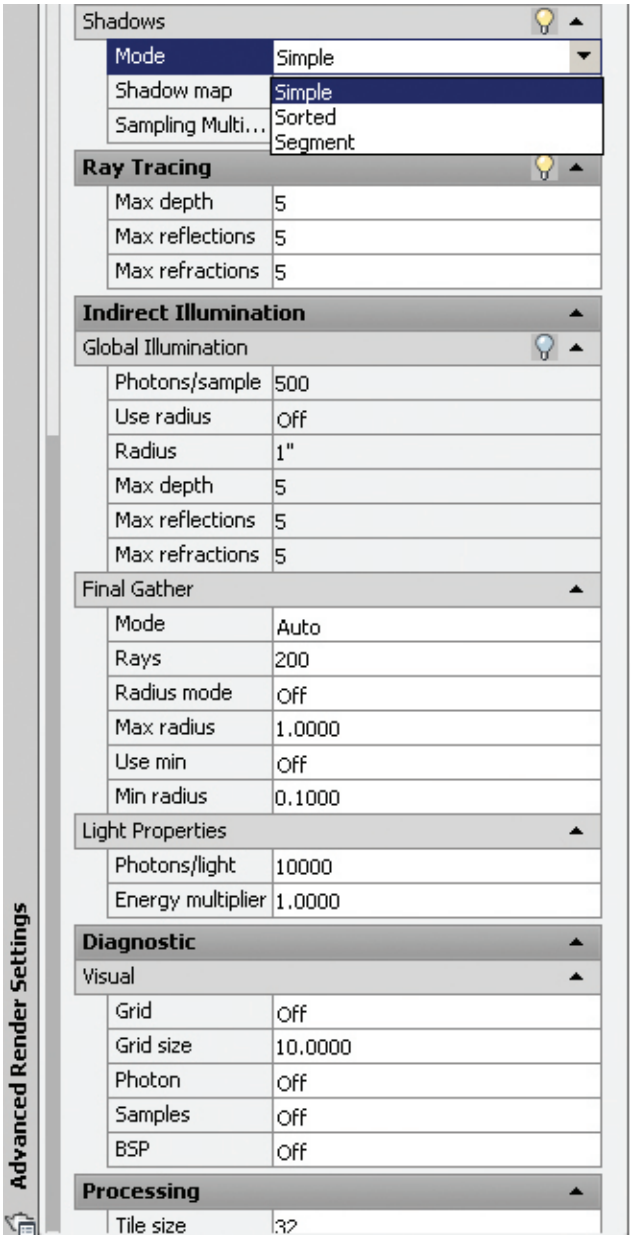



*Figure 7: Shadow mode settings*

## CONCLUSION

AutoCAD Architecture contains vast rendering possibilities. There are so many capabilities with the software that it's difficult to learn everything quickly. I always say that the best way to learn something is to dive in and see what the software can do.

*Melinda Heavrin is a CAD Coordinator & Facility Planner for Norton Healthcare in Louisville, Kentucky. She has been using AutoCAD Architecture since release 2000. Melinda can be reached for comments and questions at melinda.heavrin@nortonhealthcare.org.*

## SHAREWARE VISUAL PROGRAMMING INTERFACE FOR REVIT

Ian Keough is offering a visual programming interface *Dynamo* for Revit and Vasari on github

Keough writes:

*The intent of this project is to provide a code playground for building interesting parametric functionality on top of that already offered by Revit, and to do so with a graphical interface that allows you to share your work with others less inclined to write code themselves.*

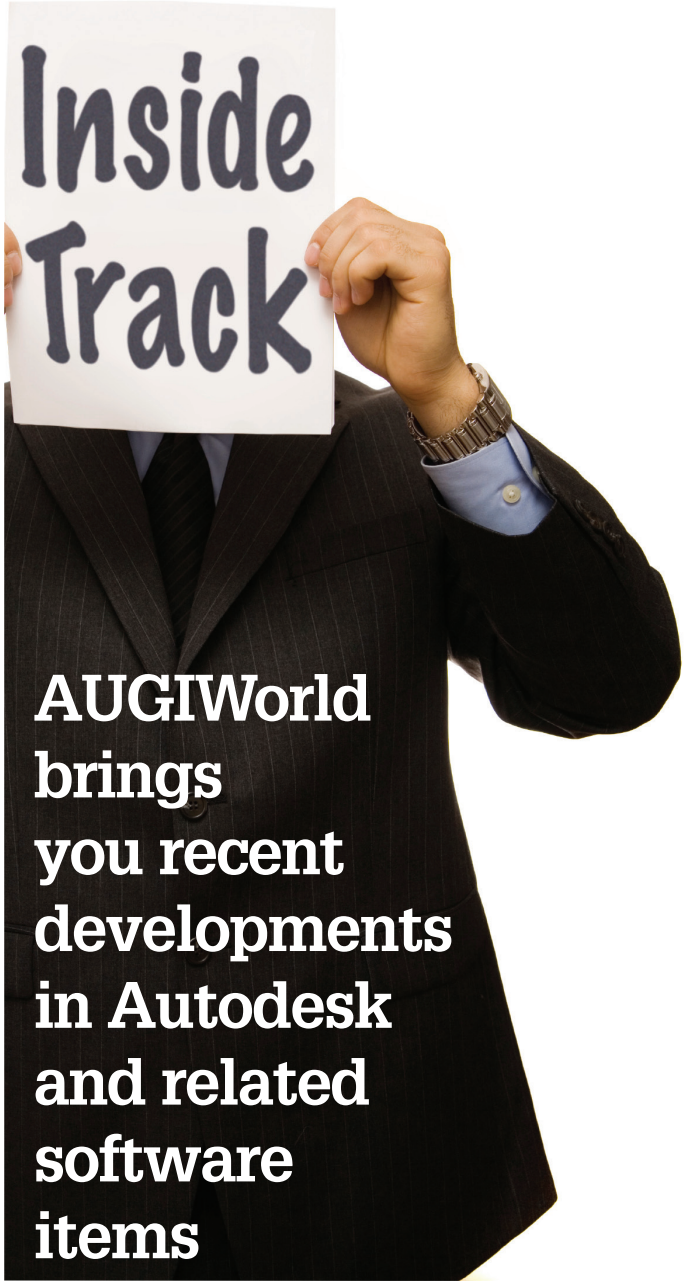
Find out more at https://github.com/ikeough/dynamo

## ETRANSMIT UPDATE FOR REVIT NOW ON AUTODESK LABS

Autodesk Labs offers an update for eTransmit with the following fixes:

- eTransmit will no longer crash when you try to create a transmittal on a network drive.
- The progress bar now updates correctly when there are errors and warnings. Previously it gave the impression that the transmittal had failed when there were only warnings.
- And a new function as well: In version 1.1, you can use eTransmit even if you have one or more models open.

Head over to Autodesk Labs' blog *Inside the Factory* to read more and links to the current version. http://goo.gl/xGkDg




**AUGIWorld brings you recent developments in Autodesk and related software items**

## AUTOCAD WS AVAILABLE ON KINDLE FIRE

Autodesk announces that AutoCAD WS now operates on Kindle Fire.

*The Kindle Fire is now joining the huge family of Android and iOS devices running AutoCAD WS and allowing you to take your designs with you anywhere you go. Use your Kindle Fire to view your drawings, edit them, and share them with your colleagues.*

Download AutoCAD WS for Kindle Fire at the Amazon App Store http://aucad.ws/uqkar3

## ENERGYPLUS VERSION 7.0 AVAILABLE

The U.S. Department of Energy (DOE) has released an updated version of EnergyPlus simulation software for modeling heating, cooling, lighting, ventilating, and other building energy flows.

EnergyPlus has a long list of new features that include enhancements to:

- Datasets
- Input
- Windows and daylighting
- Zone and surface models
- Natural and mechanical ventilation
- HVAC and refrigeration
- Electrical systems
- Controls and user functions
- Output
- Utilities
- Documentation and guides

Go to www.energyplus.gov to learn more

## CASE-INC OFFERS FREE REVIT ADD-INS

Case-Inc announces plans to offer one free Revit App per month on its website: apps.case-inc.com

Posted thus far:

- Change and Replace Linestyles
- Revision Cloud Data Export to .txt file
- Door Mark Updater

## BIMLIST, THE NEXT GENERATION OF REVIT FAMILY BROWSERS

BIMlist

A content management tool for finding, organizing, and using Revit families, BIMlist is an advanced, yet easy to use, Revit family browser. Users can locate and preview Revit families quickly before inserting them into a project. BIMlist allows users to search by parameter values and names, and create logical groupings of families. No more fumbling through network directories to locate content. Administrators have robust controls within BIMlist. Now you can ensure company standards are being followed and control access to content for the end users. BIMlist is a Revit family browser that makes organizing, locating, and inserting Revit families fast and easy. http://goo.gl/O9xrM


# Been to the Library?

If you've visited www.AUGI.com recently, then you've seen a highly visible improvement in AUGI's member interface. But one of the most exciting features is still flying under the radar and that is the Library. The Library is the home for articles and whitepapers that the membership contribute to the organization. There is a tremendous amount of material generated by members and until now that content 'shelf life' was pretty short. Since magazines come out monthly, an article's time in the spotlight is brief. Well, no longer! As issues of *AUGIWorld, AUGI | AEC EDGE* are replaced by new ones, the staff at AUGI will be posting article content on the website in HTML. The magazine PDFs will stay, of course. Consider the AUGI Library a new area to read some great content. Finding articles from past issues is a breeze, because searching and categorization can now be applied to these articles. In addition, the Library is the real home for *AUGI HotNews,* an email-based monthly publication.

# Are you ready to write?

AUGI, through the contributions of members, produces monthly magazines such as *AUGIWorld*. Well the articles in these magazines don't grow on trees! The content comes from members willing to contribute. If you are an AUGI member, you probably use an Autodesk product. Do you know your product pretty well? Have you ever sat down with someone else to explain how Paper Space works, or how to explode polylines, or customize the CUI? These messages you share casually with others are the same messages that others outside of your area need to hear. Just imagine… even though you have been using AutoCAD since R9, today, somewhere in the world, someone started using AutoCAD for the first time. And that expert level change you made to your CUI to work better with your PGP today? Tomorrow someone else will begin that exercise as well and you could save them some time with your insight. So, get out there and join the fun – contribute to your magazines and your fellow members. Share your knowledge and expertise with beginners and advanced users alike. People are ready to hear what you have to say. For more details contact david.harrington@augi.com