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The Official Publication of Autodesk User Group International

March 2012

Tips, Tricks and Techniques

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- 10 Time Savers for AutoCAD Architecture
- MText Tricks: Beyond the Basics
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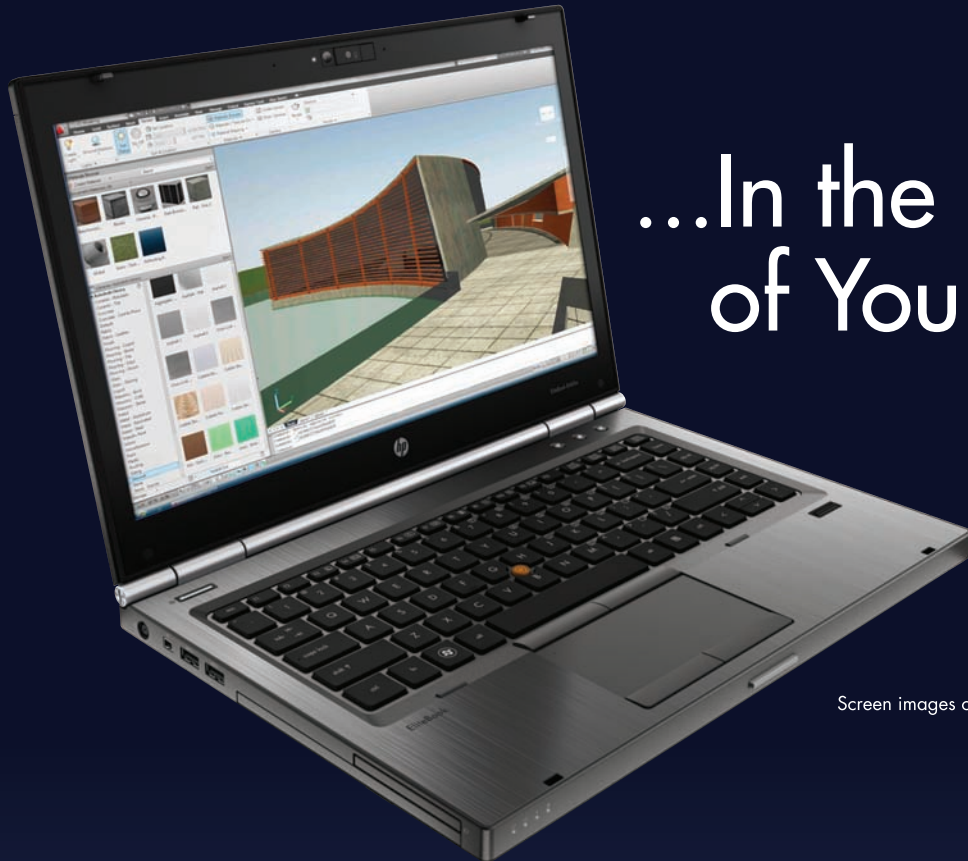
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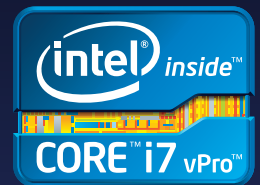


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reetings, *AUGIWorld* Reader!

One of the primary reasons this fine publication exists are the questions that pop up each and every day when using Autodesk software. In the early days of AutoCAD, the questions centered around how to make the program faster. We would buy overly expensive RAM expansion cards with 2mb of memory! Then we created virtual RAM drives and put the program overlay files onto that drive. Instant performance boost!

We have come a long way since then. Now we try to focus on functions and how to trick the software into doing what we need it to do. Tips and tricks is our theme for the month. Our cover image is a trick of pure engineering, architectural form, and functional design—quite fitting if you ask me. Okay, let's get ready to shine a light on the some great software techniques!

We begin with Murray Clack, who has a series of tricks for AutoCAD MText. His list is way beyond the basics! Then Melinda Heavrin runs down her top 10 time savers for AutoCAD Architecture. Many of these items are shared among all AutoCAD flavors, so be sure to check for yours!

Next we have Christopher Fugitt, who offers us a bed of roses and entices us to smell his tricks when using AutoCAD Civil 3D. Then Bill Campbell takes us on a short trip to gain some ground in the AEC Industry when using AutoCAD MEP.

You will sharpen your Inventor skills with everyday tips and tricks from John Evans. If you have ever thought Inventor was limited in customization, you are surely mistaken. And I've looked around and bring to you all the latest updates and service packs from Autodesk in the Heads Up column.

Now into the Revit world. Jay Zallan brings a world of tips, tricks, techniques, and work-arounds for Revit Architecture. Get a pad and pencil and takes some notes! Then Mark Kiker has laid out a whole bunch of Mac-compatible products in this month's Inside Track.

Next Emy McGann looks to leverage data efficiently with Revit MEP as she brings a whole bunch of tips for RMEP. Our Autodesk Insider of the month is Ananda Arasu, Product Marketing Manager for the manufacturing industry. Did you know that he is a qualified military medic? And then James Salmon runs down the best IPM and BIM solutions in this month's BUILT column.

And that's what we have waiting for you. Tips and tricks and more, just a few pages from here...

Take care,

David Harrington

AUGIWorld

www.augiworld.com

Editors

Editor-in-Chief

David Harrington - david.harrington@augi.com

Copy Editor

Marilyn Law - marilyn.law@augi.com

Layout Editor

Debby Gwaltney - debby.gwaltney@augi.com

Content Managers

AutoCAD - Curt Moreno

AutoCAD Architecture - Melinda Heavrin

AutoCAD Civil 3D - Christopher Fugitt

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AutoCAD Tricks for MText: Beyond the Basics



As an AutoCAD® user for nearly 25 years, I still get a sense of excitement—and dare I say I become “giddy”—whenever I discover a new AutoCAD trick. When I discover those hidden gems, I instantly realize that, at least when it comes to creating AutoCAD drawings, my life just became a little easier.

The only real problem when discovering new tricks is that you can actually go years before you come across a real gem that has a major impact on how you do things.

That’s why I am presenting as many helpful tricks as possible on a particular topic to make things easier for future reference. In this article, I will share a series of tips and tricks for creating MText objects. If you take away just one trick from this article, I will have done my job.

Multi-line text (MText) objects were introduced way back in AutoCAD Release 13 (1994), and had some very basic features such as word wrapping and “By-Entity” formatting. Since then, it has become an intuitive and intelligent in-place document editor. The purpose of this article is to go beyond the basics.

MTEXT TRICKS – NUMBERING AND SUB-LISTS

As you probably know, MText has the ability to create number lists of selected paragraphs within the editor. But did you know that you can create sub-listings?

Take a look at the example in Figure 1. It is a listing of some general notes, numbered 1 through 5, that you would see on a design drawing.

1. ALL ELEVATIONS ARE IN METRES TO CANADIAN GEODETIC DATUM. BENCHMARK FOR SURVEY IS NSCM 205631, WITH A PUBLISHED ELEVATION OF 76.630m.
2. TOPOGRAPHIC INFORMATION IS FROM DIGITAL MAPPING.
3. PROPERTY LINE INFORMATION PROVIDED BY THE MUNICIPALITY AND IS APPROXIMATE ONLY.
4. UTILITY INFORMATION IS APPROXIMATE ONLY. EXACT LOCATION IF REQUIRED SHALL BE DETERMINED IN FIELD BY THE CONTRACTOR.
5. ALL WORK TO BE DONE IN ACCORDANCE WITH MUNICIPALITY STANDARDS AND TO THE PROJECT SPECIFICATIONS.

Figure 1

With a simple keyboard function, we can easily change items 2 and 3 to become sub-items 1.1 and 1.2, and in turn, items 4 and 5 will automatically renumber themselves as items 2 and 3. Then, you can simply change the new item 3 to restart as a separate item 1 (see Figure 2).

1. ALL ELEVATIONS ARE IN METRES TO CANADIAN GEODETIC DATUM. BENCHMARK FOR SURVEY IS NSCM 205631, WITH A PUBLISHED ELEVATION OF 76.630m.
 - 1.1. TOPOGRAPHIC INFORMATION IS FROM DIGITAL MAPPING.
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Figure 2

While in the text editor, place your cursor at the beginning of item 2 and press the Tab key on your keyboard. Do this for item 3 as well, and you will see how items 2 and 3 become sub-set items 1.1 and 1.2, respectively.

Note: If you no longer wish for an item to be indented as a sub-list, simply put your cursor at the beginning of the text and hold down the Shift key on your keyboard followed by pressing the Tab key.

While in the text editor, to restart a numbering sequence, place your cursor at the beginning of the text to be renumbered, click on the pull-down button for Numbering Lists and Bullets; and select Restart.

MTEXT TRICKS – TAB STOPS

You can control the location and width of text within documents with indents and tab stops just as you can in any word processor. To control which text is to have indents and tab stops, simply highlight the desired text, and then drag the indents (i.e., top line left indent, second line left indent, and paragraph right indent) on the ruler bar to the desired location. To insert a tab-stop, simply click your cursor where you need a tab stop.

Take a look at Figure 3.

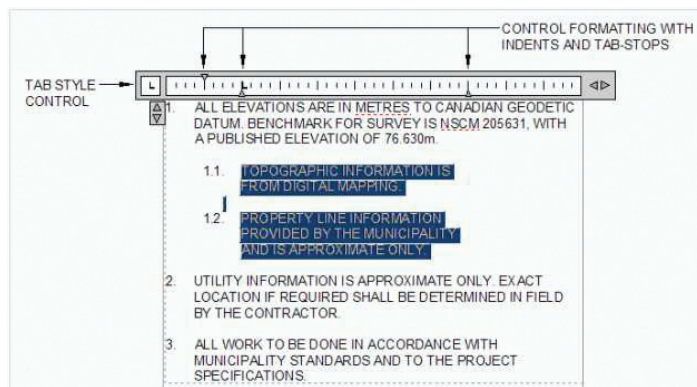


Figure 3

Refer to the notes in Figure 4. It is a materials list for a typical road cross-section (note the values listed are in millimeters).

40mm TYPE C-HF ASPHALT (SURFACE LIST)
60mm TYPE B-HF ASPHALT (BASE LIFT)
150mm GRAVEL BASE - TYPE 1
450mm GRAVEL BASE - TYPE 2

Figure 4

Instead of having the text within the list all left-justified, or pressing the spacebar to get the justification to look “good enough,” we can use indents and tab stops to make the format more appealing and easier to read. We can even use a tab stop style that allows all the numbers to be right-justified.

To insert and set up different tab stops while in the MText Editor, simply click repeatedly on the tab-style box until you get the desired tab stop style, and then click on the ruler bar where you want the tab style to be located. Then it is only a matter of placing your cursor in front of the text, and pressing the Tab key on your keyboard to shift the text accordingly.

You can then add bullets to the list the same way you can add a number list.

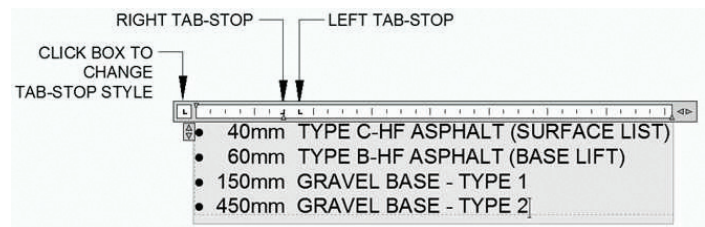


Figure 5

In addition to manually assigning tab stops, you can predefine them within an MText object as well simply by right-clicking on the ruler and selecting Paragraph from the pop-up menu.

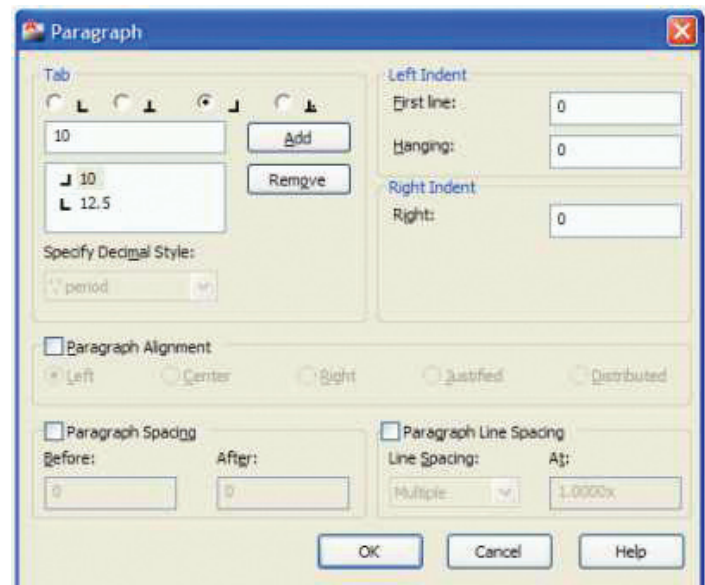


Figure 6

As you can see in Figure 6, there are four different types of tab stops. Looking at the radio buttons from left to right, they are:

Left Tab – All text entered appears AFTER the tab stop.

Center Tab – All text entered appears CENTERED from the tab stop.

Right Tab – All text entered appears BEFORE the tab stop.

Decimal Tab – All numerical text with a decimal value (e.g., 500.00) appears from the tab stop centered from the decimal point. This way, all the decimal points will line up vertically in the list. In addition to decimal separators, you can also use a comma or space as a separator.

Figure 7 is an example using the decimal tab stop. Notice how the decimal points line up perfectly regardless of how wide or narrow the numbers are (i.e., 5 versus 1). If a right tab stop were used, the decimals would be vertically misaligned because the width of the character would dictate the decimal point's position.

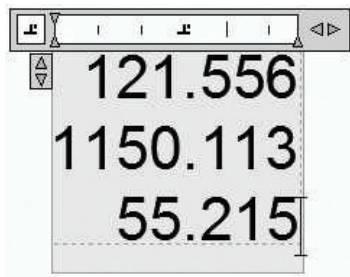


Figure 7

MTEXT PRODUCTIVITY TRICKS AND TECHNIQUES

As if the previous tricks weren't cool enough, below is a series of tricks and techniques that make editing MText easier.

Many of these tricks can be classified as "undocumented" (meaning you may not find them in any AutoCAD book) and are not part of the MText Editing Toolbar.

Controlling MText Boundary Box Limits

All MText objects have a "boundary box," which aids in controlling word wrapping and column height. Sometimes these limits exceed what the MText object needs (especially if a large portion of text was modified/deleted). There is no real "danger" associated with a large boundary box, but it is always best to keep things neat and tidy (especially if there is a background masking assigned).

To quickly adjust the boundary box so that it confines itself to the perimeter limits of the MText object, simply double-click on the width adjustment arrow that is next to the ruler bar. This method saves you the effort of having to manually drag the boundary box until it "looks good," and you run the risk of misaligning the word wrapping. See Figures 8 and 9.

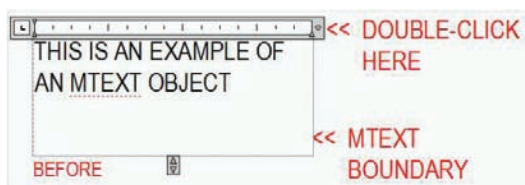


Figure 8

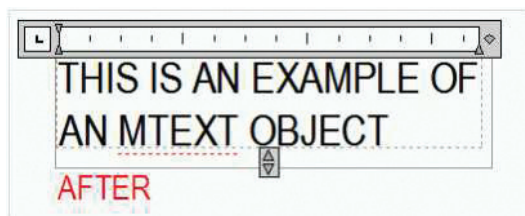


Figure 9

Navigate and Edit Words with Keystrokes

While in the MText Editor, you may have to navigate to, or edit, certain words while typing. The traditional method is to use your mouse, but that means you have to pause while typing and then focus on using the mouse.

Below are some tricks you can apply using your keyboard in order to save time and keep typing.

Navigating

To jump the cursor quickly from one word to the next: Simply hold down the Ctrl key on your keyboard and then press either the left or right arrow keys. If you press just the arrow keys, the cursor will move only one character at a time.

To jump the cursor quickly from one paragraph to the next, hold down the Ctrl key and then press either the up or down arrow keys. If you press just the arrow keys, the cursor will move only one line at a time.

Deleting

To quickly delete entire words, hold down the Ctrl key and then press the Delete key which will delete all words right of the cursor. To delete whole words to the left of the cursor, hold down the Ctrl key and press the Backspace key.

Highlighting

To highlight a group of words, hold down the Ctrl and Shift keys at the same time, and then use the left or right arrow keys which will highlight an entire word each time you press an arrow key.

Relocating Text

To relocate text with the keyboard, highlight the desired text, press Ctrl+X on the keyboard, place the cursor where you want the text to be relocated, and then press Ctrl+V on the keyboard. To relocate text with the mouse, highlight the desired text, hold down the left mouse button, drag where you want the text to be relocated, and then release the mouse button.

I hope you enjoyed this AutoCAD Tips and Tricks feature. In future articles, I will focus on tricks for other specific features.



Murray Clack is the CAD Systems Coordinator for CBCL Limited, a consulting engineering firm in Halifax, Nova Scotia, Canada, and has been using AutoCAD for nearly 25 years. He has had articles published in Autodesk's 'a' magazine; submitted tips and routines to CADalyst magazine's "Hot Tip Harry", and recently provided consultation to Autograph Technical Services for the metric version of their CadCard Slide Chart.

10 Time Savers



There are lots of tips and tricks that allow AutoCAD® Architecture to run smoother than ever. In this article, I'll touch on a handful of the many that are available. And, because each of these could be an article in itself, I've just hit the highlights. Now, sit back and enjoy!

SELECT SIMILAR

Select Similar is a tool that allows you to quickly select objects of the same type and properties. I have found this tool to be much faster than Quick Select. Select the object that you want to use as the template object to select similar objects. Once the objects are selected, right-click in the drawing area and click Select Similar.

You can also use the command `SELECTSIMILAR` in the command line. When you do this, you are asked to select objects or settings. If you choose settings, the Settings option displays the Select Similar Settings dialog box (see Figure 1). The following options are displayed:

- ♦ **Color** – Considers objects with matching colors to be similar.
- ♦ **Layer** – Considers objects on matching layers to be similar.
- ♦ **Linetype** – Considers objects with matching linetypes to be similar.
- ♦ **Linetype scale** – Considers objects with matching linetype scales to be similar.
- ♦ **Lineweight** – Considers objects with matching lineweights to be similar.
- ♦ **Plot style** – Considers objects with matching plot styles to be similar.
- ♦ **Object style** – Considers objects with matching styles (such as text styles, dimension styles and table styles) to be similar.
- ♦ **Name** – Considers referenced objects (such as blocks, xrefs, and images) with matching names to be similar.

Select the options you wish to use and select OK. Similar objects based on the criteria chosen are selected.

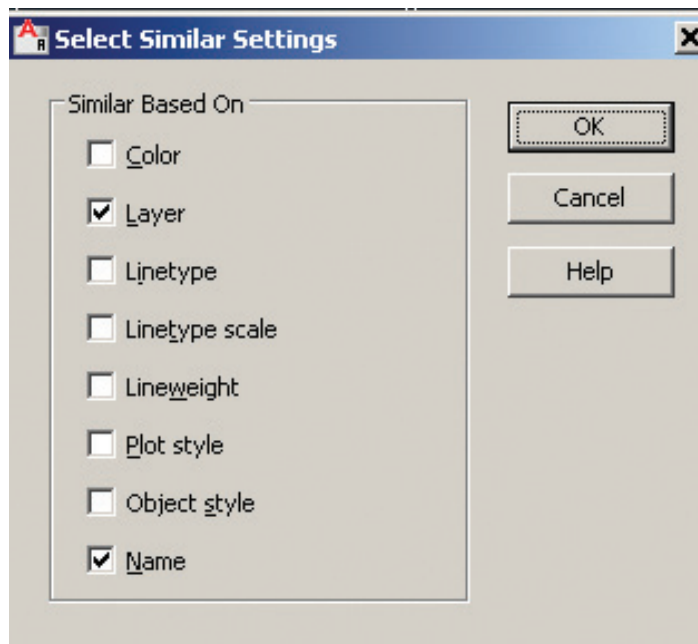


Figure 1: Select Similar settings dialog box

ADD SELECTED

If you need to draw an object with the same type and properties of an existing object, you can use the Add Selected tool. This tool differs from the `COPY` command by duplicating only the general properties of an object. For example, creating an object based on a selected circle adopts the general properties of the circle, such as its color and layer, but prompts you for the new circle's center point and radius. For another example, you can select a polyline then right-click and click Add Selected. Now AutoCAD Architecture is ready to create another polyline with the same properties. How quick is that?

AUTOCOMplete

AutoComplete is the ultimate time-saver for those who like to key in commands. As commands are keyed in, AutoCAD Architecture will automatically complete the entries. If you pause while entering in the command, a list of all possible commands and system variables will display, allowing for easy selection. By entering the command AUTOCOMplete, you can customize which of the following features are turned on.

- ♦ **Append** – Controls whether commands and system variables are automatically completed as you type.
- ♦ **List** – Controls whether a list of valid commands and system variables is displayed as you type.
- ♦ **Icon** – Controls whether the corresponding icon for a command is displayed in the list. The same icon is used for all system variables.
- ♦ **System variables** – Controls whether system variables are also included with the Append and List features.
- ♦ **Delay** – Sets a time delay in seconds before the Append and List features take effect.
- ♦ **On** – Enables the operation of the AUTOCOMplete features that are currently turned on.
- ♦ **Off** – Suppresses the operation of AUTOCOMplete features without changing their settings.

At this point, you will notice that the history is now displayed with a gray background color, which can be modified in Options. To obtain the above list of options, you can also right-click on the command line and the AutoComplete list is present (see Figure 2).

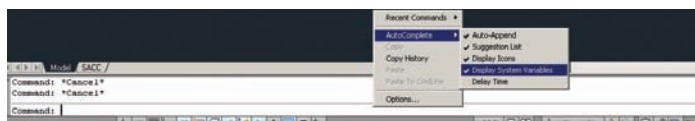


Figure 2: AutoComplete customization

MULTIFUNCTIONAL GRIPS

In AutoCAD Architecture 2012, multifunctional grips have been added to many objects. Polylines, for example, have extra grips to make editing much easier. Secondary grips are located at the midpoint of each segment. Using the secondary grips to move a segment is much easier than editing each vertex.

Multifunctional grips can also be found in dimensions, lines, arc 3D faces, and many more. When you use multifunctional grips with dynamic input turned on, you can edit the object via relevant dimensional values. When you hover the cursor over a quadrant grip with dynamic input enabled, the distances from the center to the quadrants are displayed along the major and minor axes. If you click on the grip, you can edit the values.

TRANSPARENCY

Transparency controls whether background pixels are transparent or opaque. Transparency can now be assigned to objects and layers in the same way that color, plot style, linetype, and lineweight have been applied. Transparency can be set to a value between 0 and 90, where 0 indicates no transparency and 90 indicates high transparency. Transparency can also be set to ByLayer or ByBlock (see Figure 3). When Transparency is set per object, the layer transparency settings are overridden.

Transparency can be found on the Properties Palette as well as the Home tab of the ribbon. The application status bar also contains a toggle button that allows you to toggle transparency on and off. You will notice that the Plot and Page Setup dialog boxes contain a checkbox for Plot Transparency. Note that checking “plot transparency” will increase plotting time. It is a good idea to leave this unchecked when not using transparency.

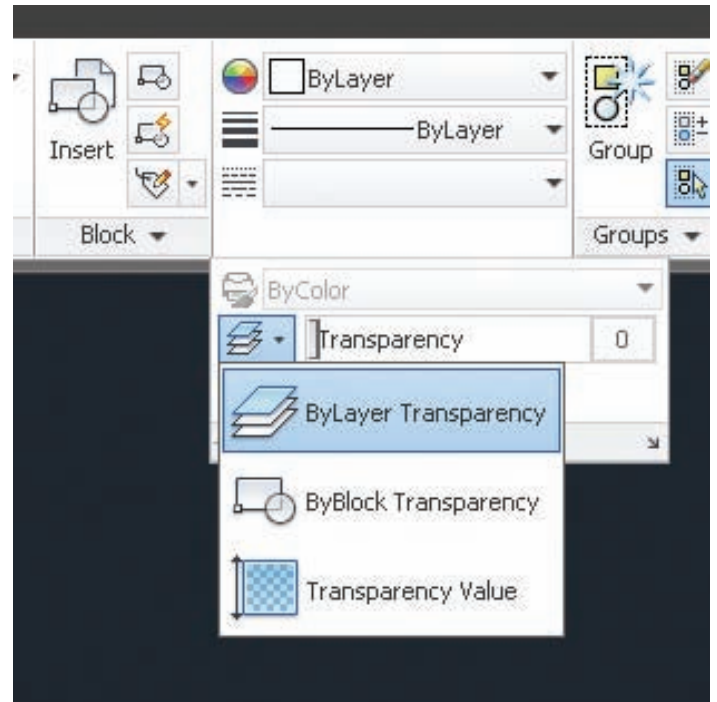


Figure 3: Transparency

ASSOCIATIVE ARRAY

In AutoCAD Architecture 2012, the ARRAY command has been greatly improved and is now creating a new array object that is associative by default. An associative array treats the entire array as a single array object. This makes editing the properties of an array much easier. Editing can be done using multifunctional grips, which is quick and easy. You can edit individual items within the array by using the Ctrl key. If you find that you have made errors in your edit, the Reset tool returns the items to their default size and position and you can begin again.

Associative arrays can be 2D or 3D. 3D associative arrays are very powerful in AutoCAD Architecture. You can indicate the number

of items needed in the Z direction and specify the distance between levels, and presto—you are done! It is important to note that the distance of 0 between levels would create each row at the same elevation.

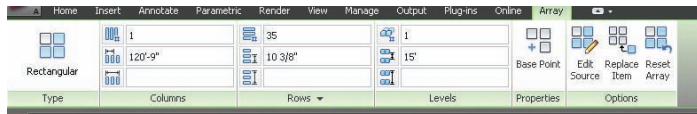


Figure 4: Array toolbar

3D UCS

In AutoCAD Architecture 2012, the UCS icon can be directly manipulated using multifunctional grips. You can now easily move and align the origin with objects, including solids and curved surfaces. Begin by selecting the UCS icon. As you hover over the grips, various menus appear. If you right-click on the UCS icon, additional controls appear. In the UCS command, the UCS icon displays a dynamic preview.

RENOVATION

The Renovation tool is intended to make completion of renovation projects easier for the user. You can easily identify objects and associate them with different phases of a renovation project. In one drawing, you can show existing, demolished, and new construction! This allows you to avoid errors that are typically caused by editing multiple drawings.

When you begin Renovation mode, the existing category is assigned to existing objects. If objects are deleted, they are assigned to the demo category. For example, moving a door will create both a new door as well as a demo door along with the corresponding wall openings.

In the display configuration for Renovation, objects are displayed according to their display representation. Within this display configuration, Existing, New object, and Demolished categories are specified. They can be viewed in plan, elevation, and section displays.

The first time Renovation mode is activated, a specific Renovation display configuration is created. To do this, click the Manage tab of the ribbon, Style & Display panel, Renovation Mode. This brings up a dialog box that allows you to give a name to the new display configuration. You can select the Options button to change settings using the Display, Layers, and Styles, Blocks and Materials tabs. Click OK and you are now working in Renovation mode.

POINT CLOUD

Point clouds created from 3D scanning devices can be attached and displayed. Point clouds are great for streamlining time-consuming restoration and renovation projects. They are attached similar to other reference files and support up to two billion points. You can quickly visualize and snap to the surface of your scanned objects directly within your modeling workspace. It is a good idea to lock down the point clouds so the points don't move. AutoCAD Architecture 2012 has an improved indexing algorithm. This allows for optimized viewing when changing zoom levels and keeps you from waiting as long for

the drawing to refresh. The point density can be adjusted using the Density slider bar for better performance (see Figure 5).

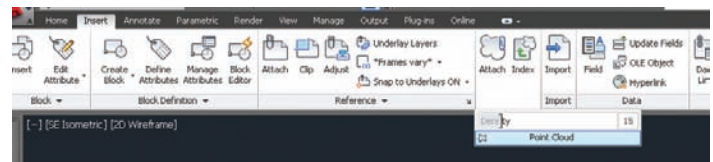


Figure 5: Point Cloud Density

CUSTOM GRIDS

Creating Custom Grids allows you to define several aspects that were not previously user defined. With this tool, you can define different numbers of grid lines for each side of the grid. This means that you can create column grids where one or more column lines are not required to be across the entire building as a single object.

While labeling the grid, you may use primary and secondary numbering. This allows you to add grid lines with a secondary numbering sequence during the grid creation. You can also add them later, if you desire. This feature reduces the need for you to convert linework and also eliminates the need to tag each of your column lines individually.

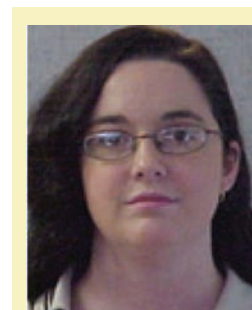
Several properties can be controlled with the Custom Grid tool. Some of these properties are:

- + Number of grid lines
- + Inner grid radius
- + Prefixes for grid labels
- + Grid label numbering/lettering scheme
- + Clockwise and counter-clockwise grid direction
- + Orthogonal or radial grid shape

With the Custom Grid tool, there are many more possibilities for time saving. What a great productivity tool!

CONCLUSION

This article discusses just a few of the many tips and tricks for AutoCAD Architecture. Begin by practicing with these, then dig deeper to discover what they can do beyond what I have written. The greatest way to learn is to delve into the software and play around. (Remember, there is always the Escape button!) Now, on your mark, get set, explore!

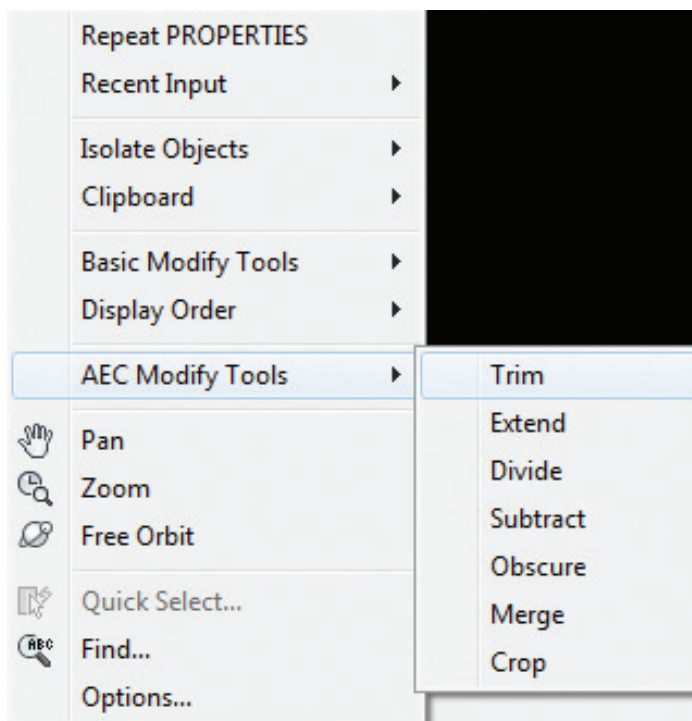


Melinda Heavrin is a CAD Coordinator & Facility Planner for Norton Healthcare in Louisville, Kentucky. She has been using AutoCAD Architecture since release 2000. Melinda can be reached for comments and questions at melinda.heavrin@nortonhealthcare.org.

Stop and Smell the Tricks!

Often we get so engrossed in outputting work we forget to stop and smell the tricks. The tricks are functions we use in AutoCAD® Civil 3D® and other products that may not be obvious at first, but that ultimately make our lives easier. Tricks might be using expressions to get rid of the manual movement of labels or finding a quick and easy way to trim blocks. What that, let's get to it.

AEC TRICKS



One of the earliest tricks I learned about were the AEC Modify Tools located on the right-click menu in Civil 3D. Using the commands, we can get enhanced capabilities in using Trim, Extend, Divide, and other commands. I find the Trim command especially helpful in trimming blocks and linework. The command lets you select what you want to trim and then either select points on the screen or pick a line on the screen. Then you select which side to trim. This works extremely well on blocks. It trims all of the items contained within the block and makes it an anonymous block.

The Extend command is great for extending linework without having a line to extend to in the drawing. It works by selecting a boundary edge on the screen. I find this especially helpful when I need to extend to a profile. Normally Civil 3D has trouble extending to some Civil 3D objects, but with this command we can extend to some of those objects without creating temporary linework.

Now that you know that trick is there, take the time to smell the tricks and learn others that can help in your day-to-day work.

UNDOCUMENTED TRICKS

Have you ever wanted a flexible mask object, one where you can grip edit the edges to new places? Well, there is a command within Civil 3D that does just that. Unfortunately, it's undocumented in Civil 3D, but it is documented in AutoCAD® Architecture. Since it is not in the help file I'll go through one way to create it. The first step is to draw a polyline around the area you want masked. Then type AECPOLYLGON at the command line. Type C for Convert, then PL for Plines, and then select the polyline that you created. Once created, the style of the AECPOLYGON needs to be created for the mask. To do this, type S for Style to bring up the Style Manager (see Figure 1).

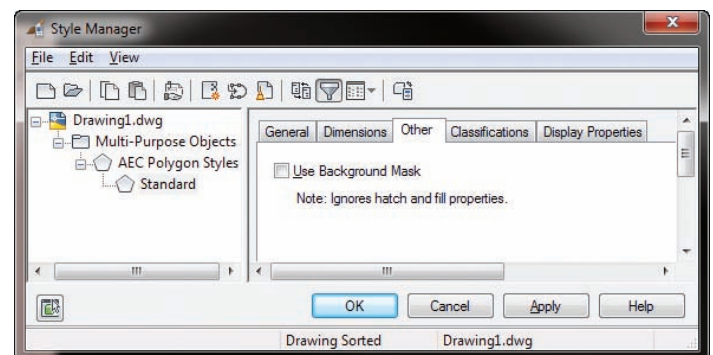


Figure 1: Style Manager

Then select the Standard Style and choose Use Background Mask under the Other tab. Pressing OK will make the Standard AEC Polygon Style be a mask. Now we have a mask object, but we probably want the edges to be hidden. To do that, select the

AECPOLYGON and then right-click and choose Hide Edge from the menu. Then go around and select the edges to hide. The edges will go from green to red once hidden. This makes it easy to hide building pad areas from a surface.

A colorful, undocumented tool is the LineWorkShrinkWrap command. This command makes it easy to create a polyline of a batch of linework. And it's a snap to create a line encompassing numerous extracted surface boundaries. For instance, I was working on a levee project. Since Civil 3D isn't really a BIM product with actual real-world objects, I had to come back later and add ramps from the bottom of the levee to the top to a corridor surface. This left me with about 32 ramp surfaces and a corridor surface object. To make sure I didn't have any errant triangulation in my overall surface, I needed a boundary that encompassed all 33 surfaces. To do this I extracted the surface boundaries, converted them to 2D polylines with the same elevation, and then used the LineWorkShrinkWrap command to create an outer polyline of the surfaces. I then used this polyline as the outer boundary of my composite surface. It's important to use 2D objects since the command doesn't like 3D lines.

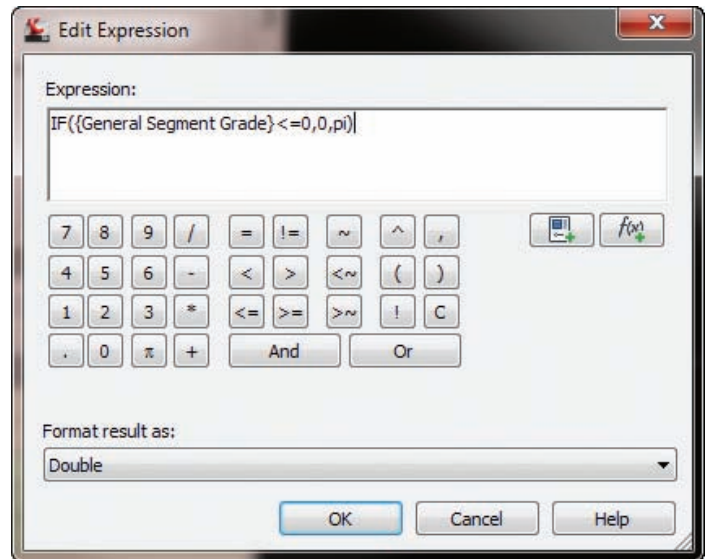
THE OBSCURE

About once a year Autodesk® releases Subscription Advantage Packs. The packs extend the functionality of Civil 3D with new features before the next release. Often they are features that would normally be introduced in the next release, but come out a bit early. This year's version was the Volumes Dashboard Extension for AutoCAD Civil 3D 2012. Unfortunately, it doesn't magically appear within Civil 3D when it is released. You must go to the Subscription website, download it and then install it. While you are there getting the download, make sure you check out the other extensions available. If you work with other data formats such as GENIO and 12d you will also find tools for your use. If you're stuck using an older version, check to see if there is a Subscription Advantage Pack for your product.

The Subassembly Composer was released as a tool for use in furthering the abilities of subassembly. The tool makes it easy to create subassemblies that do exactly what you want (or close to it) without a lot of programming. I've used it to create subassemblies that contained all of CALTRAN's curb types. That way I won't have to swap out a subassembly if the design changes. All I have to do is select the curb type I want to use from a drop-down list. I also know that the dimensions are correct. Other custom subassemblies I've created are for retaining walls that look up standard values of standard plans, so I don't have to continuously look up the values.

Autodesk Labs also has some limited-release products to help make our lives easier. For instance the Corridor Solids Technology provides a way to get quasi objects from a corridor. While the solids are not exactly smart objects, they are objects that better model asphalt pavement. When was the last time you saw asphalt pavement made of lines and points?

EXPRESSIONS



Expressions are my "go to" trick. If I don't see a way to label a Civil 3D object within the program, expressions are the first things I consider. My list of expressions is quite vast. I've created vertical curve labels that label every 50 feet along the curve. That way I don't have to place numerous labels that an agency may require. I've created pipe labels that are anchored to the invert of the pipe at the outside edge of a structure, reducing the amount of time required to label a pipe network.


Expressions may also help do calculations. We can create an expression to calculate the flow of a pipe. Sure it's a long equation, but it is possible. Another expression is for calculating stopping sight distance for use in vertical curve labels. This way we can check in the label if the stopping sight distance is exceeded. There are some great resources out there on how to create and use expressions.

Hopefully you can take the time to investigate how tricks might help make you more productive. Also take the time to look for other tricks that are out there. Here's one place to start: Peter Funk usually has an Autodesk University class on tips of tricks in Civil 3D.



Christopher Fugitt is a Civil Engineer and has spent the last eight years designing government projects as well as residential subdivisions. Before working as a Civil Engineer, Christopher worked for a General Engineering Contractor on subdivision and mining projects. Christopher earned his B.S. degree in Civil Engineering from California Polytechnic State University, San Luis Obispo. Christopher maintains and authors the Civil 3D Reminders blog at <http://blog.civil3dreminders.com/>

Gaining Ground in AEC

 AutoCAD® MEP is becoming more prevalent in the BIM world, from *all* sides of the AEC industry. Though some groups, depending on their background, specific needs, or training, prefer the use of Autodesk® Revit® or other software, there are a lot of reasons to use AutoCAD MEP 2012 instead. This article will outline some little-known (or not so little-known) facts about this software and why it is rapidly becoming more accepted in the industry as an intelligent, parametric-based design tool for BIM industry leaders. This notion is replacing the rather dated attitude that AutoCAD MEP is a simple add-on to the infamous “vanilla AutoCAD” base function that placed Autodesk on the map in the first place. Some are even naïve enough to put it in the same category as Express Tools when explaining its functionality in terms of how it sits on top of AutoCAD.

Because of Revit’s growing database-driven file collaboration process, many architects and structural firms have been moving toward using Revit for their process design needs. Revit Structure and Revit Architecture prove to be very useful (and very powerful) when working on a “stand-alone facet” type system. This means that architects and structural engineers typically will not need any other trades to complete their design documents and drawing sets, particularly for 3D models. The only things they must share is a coordinate system and a common grid.

These two trades are not typical in relation to others, as you could model the architectural end around only the structural model and the structural model either by itself or with the assistance of the Civil aspect. This is why there are Autodesk software packages aimed directly at these trades—AutoCAD Architecture, Revit Structure, and Revit Architecture, for example.

These trades notwithstanding, there is no doubt that Revit MEP is powerful enough to take on multiple tasks within the MEP construction industry as it relates to BIM.

Granted, some industries are more suited to AutoCAD-driven software packages because of many factors. A lot of MEP, GC, and General Construction AEC Contracting firms like using AutoCAD MEP because it is powerful enough to take on the hard-hitting and fast-paced role of the project while using intelligent parametrics with a massive growing library of information and models.

The newer releases (2010 and above) have been focusing more and more around BIM and 3D. These releases take cost, material, scheduling and many other factors to the next level by automating processes such as bills of material, panel and board schedules, quantity take-offs, and more. This, in collaboration with the aesthetically pleasing and not-too-detailed qualities of the 3D models from the stock libraries, are enough to make even the most old-school engineer want to learn AutoCAD MEP. Oh, and the learning curve is not as intense as others, either.

EASE OF USE AND LIMITED TRAINING NEEDED

AutoCAD MEP is easily integrated into a team of engineers who most likely have been using vanilla AutoCAD for some time, since R14 or later. Because these engineers and designers are already accustomed to the AutoCAD platform and base commands, learning MEP is not as hefty as learning an entirely new piece of software such as Autodesk Inventor or Revit.

Not to say it is seamless, because it will take some time to adjust to the “mechanisms” that make this program tick. The Style Manager, for instance, is not as easy as, say, AutoCAD Architecture’s tool. And the Tool Palette, though fundamentally easy to view and navigate through, will take some getting used to. Once you understand the Workspaces, the Display Manager, Routing Preferences, Systems and others, you will know more than enough to be dangerous.

The standard AutoCAD commands are used for the basics. The more intense features that will move you from a basic user to an advanced user—adding custom parts to the library, creating MVParts to be used in collaboration with the stock catalog, using the content builder/editor to change the way that objects interact with each other, or the rules to which they abide—will all be achieved in time. At the very least, most users can begin to populate areas of a project with a very limited learning curve.

PROGRESS MAKES PERFECT

In the past (pre-2008) AutoCAD MEP was called Autodesk Building Systems or ABS. ABS, though well ahead of its time in relation to other design software, didn’t appeal to certain people,

most likely the decision makers who pushed other products to be their group's standard modeling software for BIM.

In the past three years, though, AutoCAD MEP has made massive leaps to integrate the "information" aspect of BIM into this design software, rather than using their 3D library as just an add-on tool to vanilla AutoCAD. And, to be honest, it was little more than that in previous versions. There were a few "extras" that would compute air flow studies or turn-radius sketches, but at that time, MEP was a program that really could have been run in AutoCAD using the "apload" command.

But time has passed and anyone who stuck with ABS and onward to AutoCAD MEP post 2007 would see that the growing software package was no longer a chunk of models and a few extras, but an entire catalog of mechanical, electrical, piping and plumbing parts that you could pull from a visual library, tweak how they react to other connected parts, adjust the rules and standards set forth in the style manager's OSHA safety standards and trade-specific rules, and create your own parts for super-fast production of an assembly of parts that make up your entire drawing. Even the least experienced, entry-level drafter could 3D model a run of process plumbing without worrying about making an "illegal turn." The software wouldn't even let you draw it if it weren't allowed in the installation world (for the most part).

CUSTO-FRIENDLY

Another great reason people choose AutoCAD MEP is because of its open-source "feel." If your company uses non-traditional objects or tools that simply are not included in the "out-of-the-box" stock MEP Catalog, compile your own objects to add to it. You can even create an entire group of assemblies and MVParts to add to the tool palette and send it out to your entire team for use. They will then be able to see that group as an option in their now custom tool palette. This helps not only non-traditional and little-known trades, but also traditional trades, which get more realistic space-claim, population, and cost analysis from their models. This is sure to make your company look great when Company Y is showing an extruded rectangle for cable tray and yours is showing the actual channels with rung ladders without bogging down the system as 3D solids.

PLAYS WELL WITH OTHERS

Many times you will see AEC construction firms opting for AutoCAD MEP (or another AutoCAD-based product) versus other comparable applications because of its interoperability with the project's standards and guidelines set in place by the project's general contractor or owner. Most of the time, the whole group—structural engineers included—must use software that is able to share information *easily* with the project team. Though Autodesk has been vigorously working on this angle for all of its software packages, such as Revit to AutoCAD, Inventor to Revit, AutoCAD to Navisworks, and so on, not every piece of software speaks fluently to the other just yet.

If the structural and architectural firms are using Revit, and the MEP trades are using AutoCAD-based platforms, the Revit us-

ers must conform to the AutoCAD users, rather than vice versa. Because of the popularity of AutoCAD applications, it is no doubt that the majority will be working to AutoCAD applications most of the time based on the "familiarity" compound outlined above.

When this happens, it doesn't matter that their Revit model counterparts were so trim and small in size within Revit's database-driven world, for when they export to an AutoCAD .dwg, the size quadruples (at the very least). This is because AutoCAD is turning intelligent objects into 3D solids on a very large scale. The larger and more complex the project, the more the file size multiplies. This is because each object is no longer an intelligent, stretchable parametric with many grips and object information, but rather a dumb, solid "3D chunk" that can be read in the AutoCAD world. One day, based on the rate that Autodesk has been working on interoperability between its own software applications, they will all speak to each other seamlessly by simply saving a Revit model as a .dwg, while maintaining object intelligence. But until then, this is the way that we must operate.

With all of this being said, Revit MEP is by no means the "wrong" choice for subcontractors. Revit has proven itself to be a lone rider that can handle the strain of thousands upon thousands of components that make up a building.

I think most people would agree that Revit MEP is of great help internally and if the entire project's subcontractors are using it globally. Otherwise, in order to send your 3D model out to the other subs who are using AutoCAD-based products for coordination and collision detection, you must "dumb it down" and increase its file size. If all members of the team were using AutoCAD MEP, you would easily be able to identify other trades' objects, keep their intelligence, keep the file size down on an overall compiled model, and impress the GC with how well each model interacts with another from the get-go.

AutoCAD MEP will continue to evolve just as Revit does. Until they can all get along perfectly, I will continue to choose AutoCAD MEP because of its ease of use, small learning curve for previous vanilla AutoCAD users, ease of interoperability with other Autodesk products, and open-source, customizable interface.



Bill Campbell lives in the San Francisco Bay Area, is an AutoCAD 2012 Certified Professional and works for a top engineering firm in San Jose, California, as 'BIM Lead'. He enjoys surfing and jogging the beach with his wife and dogs, snowboarding, and traveling abroad. He is also adept at customizing and tweaking AutoCAD MEP and other Autodesk products, and enjoys beta testing Autodesk's upcoming BIM-based software. He is constantly looking for new ways to customize and make operations easier within Autodesk products.

Everyday Tips and Tricks



Autodesk Inventor® 2012 is arguably one of the easiest software packages to learn, and possibly the easiest operating CAD platform I have ever seen. Ease of use aside, there are numerous shortcuts and new ideas that some folks just haven't run across yet. The following is a collection of tips and tricks that I use daily, and that I hope will benefit everyone.

ASSEMBLY ENVIRONMENT

Productivity Panel

This panel on the Assembly tab of the ribbon is a collection of powerful assembly tools, which reduce numerous steps down to almost nothing. Here are a few of my favorites.

Ground and Root

This tool is one of the most sensible and productive tools introduced in the latter revisions. It can be found in the Assembly tab of the ribbon, under the Productivity tool panel.

When placing the initial component into the assembly environment, it is placed at the assembly origin and then grounded. Subsequent component insertions are placed freely in space.

Use *Ground and Root Component* to pick any ungrounded component that is already in the assembly, and have it grounded at the parent assembly's point of origin (0,0,0), with the axes aligned similarly.

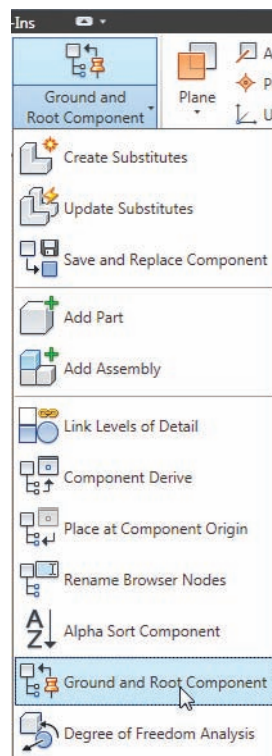


Figure 1: The Productivity panel.

For those who utilize a lot of skeletal modeling techniques, this tool is quite useful.

Place at Component Origin

This tool uses the Place command to insert a component at the origin point of any selected component in the assembly.

After the components are inserted, they are constrained with three mate constraints on the three origin planes. This works great for anything that has been designed with a common origin point.

Level of Detail

It can't be said enough how powerful a custom Level of Detail (LOD) can be. The best example of its use is for reducing the complexity of an assembly. LOD works by allowing you to suppress various components in an assembly, and saving the state as a LOD with whatever name you choose.

Very often when one assembly is fitted to another, minor details such as pins, some bearings, and interior components add nothing to the benefit of the user. In fact, the greater the number of components Inventor is trying to display, the poorer the performance. So why not get rid of them until you need to see them in a more detailed view?

These named LOD are passed with a placed assembly, and are available to be switched back and forth, without having to open or edit the subassembly. Additionally, you can save a LOD in the main assembly, which captures the LOD in sub-assemblies and triggers them back and forth as needed. This is referred to as a nested LOD. A good example of this is a working "Low LOD." If you don't want much complexity in the main assembly, then you probably don't want complexity in the sub-assemblies either. Create a Low LOD that includes the Low LOD state in all the sub-assemblies. Then you can minimize the entire group of components from one location.

Create Substitutes

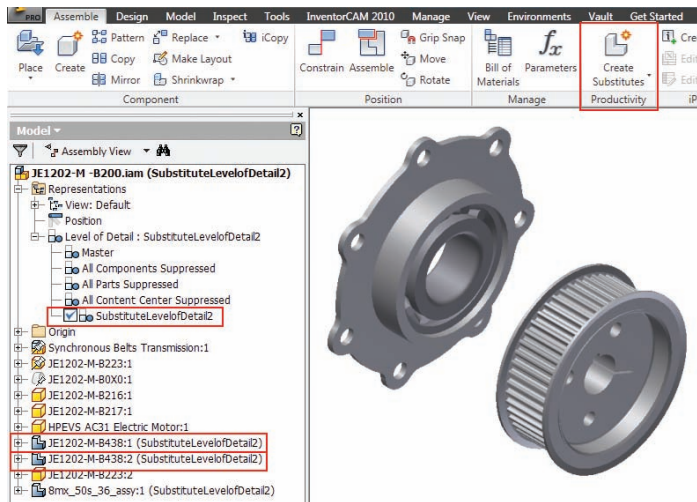


Figure 2: The Create Substitutes tool. Notice the nested LOD.

Create Substitutes takes the large number of steps to reduce the complexity of an existing assembly and reduces them to a push of a button.

In Figure 2, I have two small sub-assemblies in an overall assembly file. Let's say we needed to reduce the weight of the overall assembly, and need to create new Substitute (LOD) for each, and replace the existing components with part files that look like the original assemblies, but with substantially reduced features. That's a lot of file manipulation developed into one step. Here's how to use it:

- Open every top level component assembly that is in the parent (current) assembly, and create a new LOD in each file called 'SubstituteLevelOfDetail1'.
- Create the new LOD substitute part for each component assembly file.
- Place the substitute part into each component assembly under the substitute LOD.
- Create a new LOD in the parent assembly with the same name that was created in each sub-assembly file (Nested LOD).

At this point, every top-level sub-assembly currently active has been replaced by substitute part files, corresponding to the LOD named 'SubstituteLevelOfDetail1'. When the Master LOD is activated, the Master LOD is activated in each of the replaced components, bringing the complete complex assembly back into existence. Returning to the reduced complexity model is as simple as activating the 'SubstituteLevelOfDetail1' LOD.

Reduced Component Colors in Nested View Representations

Along with various techniques to reduce the complexity of models and speed up response time in Inventor, the colors and textures of components play a role. Component colors must be calculated in order to display them as directed.

It is recommended that those who use realistic and complex colors on their Inventor components should use two sets of colors. One set has a reduced complexity and one represents the realistic color with which they wish to render. Then you can apply a separate View Representation that captures the two different color schemes in each part. Like LOD, View Representations can be nested. From the assembly, all components in all sub-assemblies can be colored realistic, or basic (or whatever you desire) from one easy location as well.

Shortcut Keys

No list would be complete without some hotkey definitions. With my AutoCAD® background, I'm a hotkey nut. Here are a few for the assembly environment that I use often:

- G – Rotate
- V – Move
- P – Place
- C – Constrain
- Tab – Demote

Gestures

Inventor 2012 brought with it gestured commands. Just right-click and drag to do things such as create welds, open sub-assemblies, and turn on and off visibility of planes. They can be quite powerful, as I demonstrated at Autodesk University using Publisher, which had gestures before Inventor.



Figure 3: The Open Gesture.

The only trick is to learn them all. Each section of Inventor has a different marking menu, and so different gestures are available. While it can seem overwhelming, it's a great thing to master.

BILL OF MATERIAL

You can do numerous things with the Bill of Material (BOM) in Autodesk Inventor. I think that often it is overlooked, or at least under-valued, in many training circles.

Add a Property Column

This is a simple function, but bears mentioning, especially for those who do not get formal training. You can add any property as a column in the BOM. Simply right-click on the BOM header and a Customization dialog will appear with all the properties that can be added. Find the item that you want display and drag it to any position on the column header.

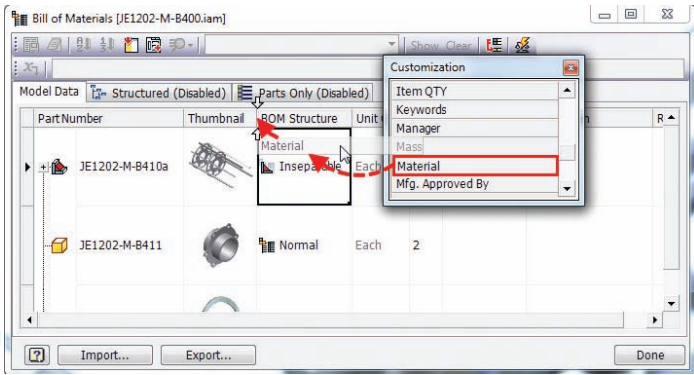


Figure 4: Dragging a new property column into place in BOM.

Modify Part Properties Remote

While you are in BOM, you can modify the properties of one of more parts without having to open them all. Simply Select them in the BOM, and pick the property field you wish to alter. The changes will be sent back to each part file automatically.

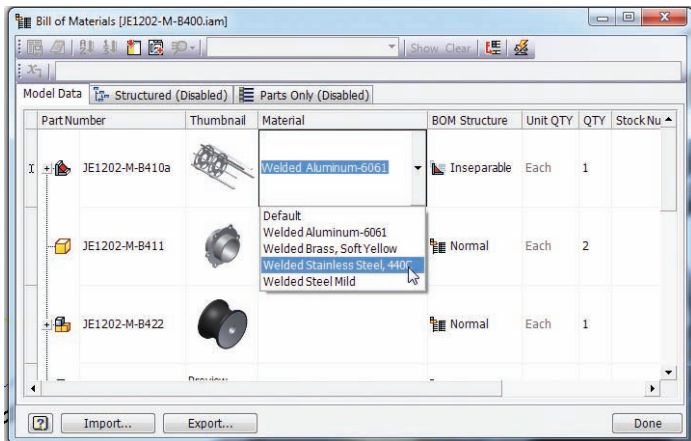


Figure 5: Changing the material properties for components through the BOM. Notice the mass properties to the left.

Mass Properties of Sub-Assemblies

Review the Mass Properties of sub-assemblies easily without having to navigate to each through the Assembly Browser. Just add the Mass column to the BOM. Don't forget the 'Update Mass Properties' button at the top right of the BOM dialog, if any changes are made.

PART ENVIRONMENT

Multibody Solid Creation

I have found the *New Solid* in the part modeling environment to be one of the most useful tools for developing mating components. Since all the solids are together in one location, references are easier to create, manage, and are less prone to failure. Give it a try if you are not yet using the functionality; just pick the *New Solid* button when adding solid features to the part environment.

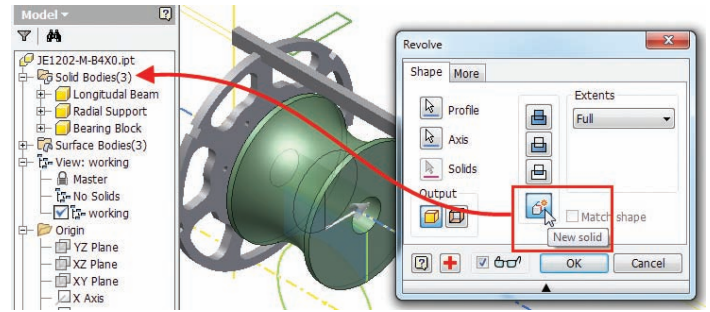


Figure 6: Create New Solid button in the multibody solid operation.

Derive

I use this functionality continuously throughout my work. *Derive* creates a feature definition in the part environment from a feature in another file. This is super useful when developing objects in the multibody solid part environment, as mentioned above.

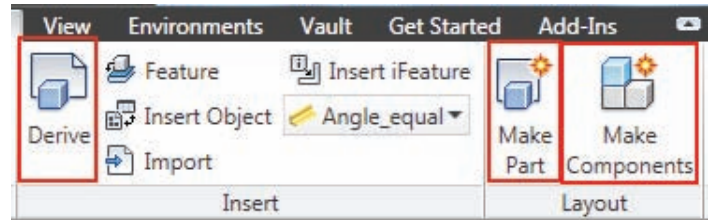


Figure 7: The Derive, Make Part, and Make Component Commands.

Once the derived features are added to the part file, any form of continued improvements can be made. You can develop unique variations easily by creating a base shape with the standard features common to all parts, and then derive it into each part file for the remaining modifications. Solids can be derived as well as numerous other features including work features and parameter, to name a few.

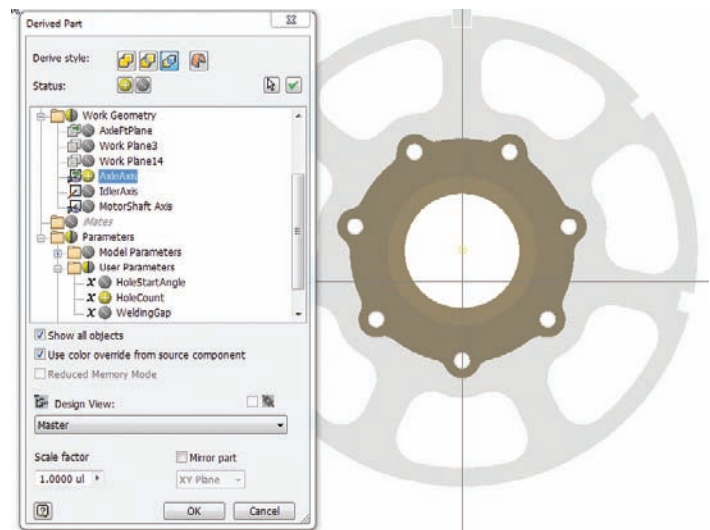


Figure 8: Options in the Edit Derived Parts dialog.

These update perfectly when changes to the original file are made, which makes it the best way to transfer design information in the top-down modeling strategy.

Derive a Surface

Another thing that should be noted is that solids can be derived into a part file as one of four different definitions.

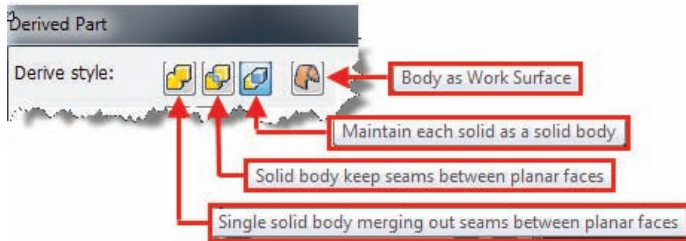


Figure 9: The Derive Style Options

- As a single solid, with seams merged out.
- As a single solid, with the seams intact.
- As separate solids.
- As a representative surface.

The latter is especially useful when you need geometry in another file, but don't want the mass.

Make Part and Component

These two commands automate the creation of derived components by packing all the options into a convenient location. *Derive* is used while working from within the resulting (often empty) part environment. Think of it as a wide receiver.

Make Part and Component employs the *Derive* command to create the derived part from within the parent (often multibody solid) part file. You might see this as the quarterback. The benefit of *Make Component* is that it will create an assembly file on the fly, and *Ground and Root* the individual new components in their correct relationship before it's done.

This is a beautiful tool for creating most of an assembly from the comfort of your multibody solid environment, and then farming the entire component assembly out with the push of one button. Each file can be named how you see fit, and individual template and parameter options are available.

Direct Manipulation

For any who have not upgraded recently, you are missing out on a whole lot of smooth operation. Great tools such as direct feature manipulation are proven and really cut down on some of the frustration that comes from repetitive workflows such as *Fillet* and *Chamfer* of edges. Just pick the edge and choose from the command glyphs that appear.

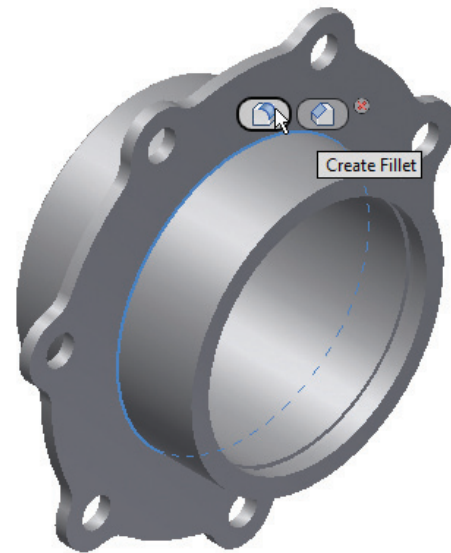


Figure 10: Direct manipulation glyphs.

Numerous commands have been added to this functionality, such as picking a face and selecting the *Create Sketch* glyph; very fast and convenient.

Reference Work Features Whenever Possible

One of the things I can't stand is when I reference a new sketch or component from a feature face and the feature is removed by a later edit. What happens? The references collapse.

Whenever possible, when you don't have the luxury of multibody modeling, use work features, origin planes, and derived parameters to establish the mating surfaces and geometry of joining components

"But it's so easy to pick a face and go!" Too bad. Don't do it. If you take the extra time to develop solid work plane and work axis-oriented geometry, your assembly updates will run smoother and you will have more confidence in a greater complexity of designs.

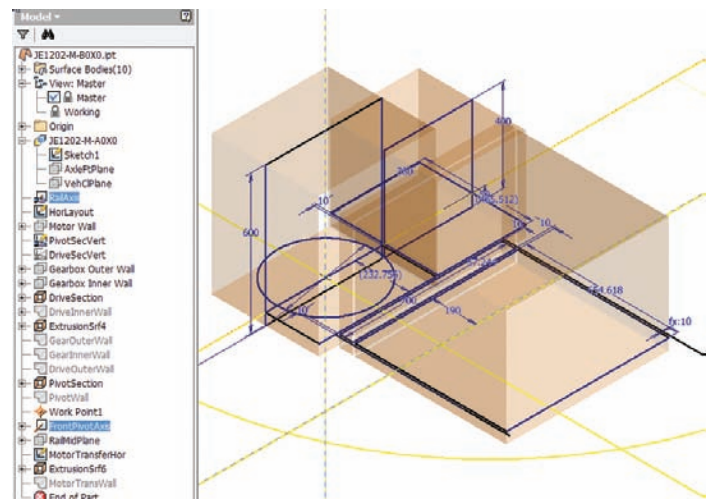


Figure 11: Skeleton part file controlling four major sub-assembly regions. Notice that it is controlled through a derived link to a master skeleton part.

We rely heavily on skeletal models. These basic sketches drive constrained work features that are derived throughout the entire design. Even if the constraints fail, you can easily re-constrain the work feature and get back on track. This is not so with failed projected geometry.

More Shortcut Keys

In the part environment, additional shortcut keys are available. Here are the ones I use often:

- ♦ F7 – Slice Graphics
- ♦ C – Circle
- ♦ D – Dimension
- ♦ E – Extrude
- ♦ F – Fillet
- ♦ H – Hole
- ♦ R – Revolve
- ♦ X – Trim
- ♦ = – Equal length constraint

Sunith Babu has a great list on the CAD Professor site if you'd like to see them all. <http://goo.gl/ieaLz>

Tolerance Referenced Parameters

Many companies prefer to tolerance at the paper level only, allowing technicians to keep all dimensions basic and engineers to manage these details on paper. For those who want to use tolerancing, here's one method I use to manage my toleranced features globally.

Reference-in key parameters from a central location using the *Derive* command. An alternate method, and in the case of the image shown in Figure 12, is to model key mating features right inside the master skeleton file, using multibody solids that are derived out.

Then apply that key parameter directly to all related features, such as both the shaft and sleeve. Once the parameter is applied, it's quite easy to tolerance the shafts and sleeves as needed, using one common overall basic dimension for all common features.

When the shaft diameter needs to be revised, all that has to be done is to change the one key parameter in the master skeleton part file. Changes are handed down evenly and automatically to all toleranced components.

Vault Professional

I want to mention Autodesk® Vault Professional as a tip. I know it isn't Inventor, but it is an amazing tool for organizing your work. One thing that I love is how easy it is to move a component file that has been referenced in an assembly and saved with the wrong

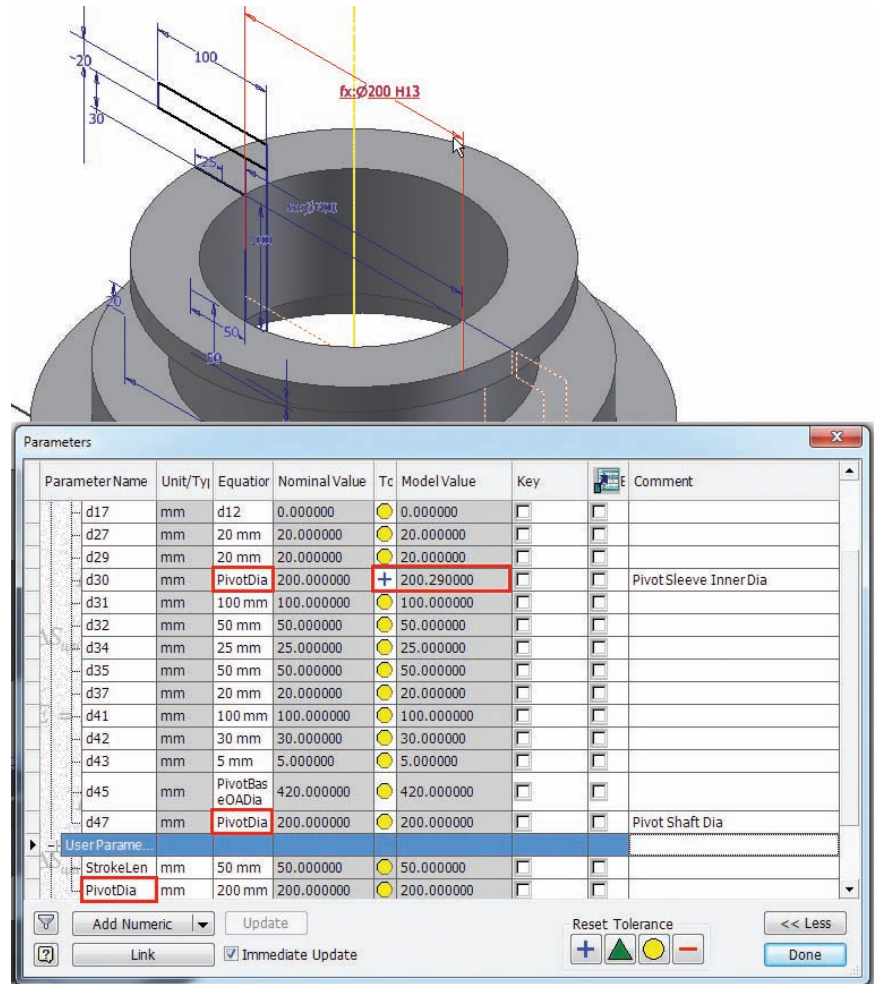
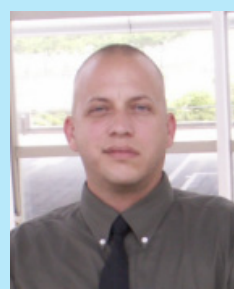


Figure 12: Toleranced mating components that make use of the same parameter.

path. We simply move the file to the correct location in Vault, and the new referencing is all taken care of seamlessly (and without prompts and warnings) when the assembly is reopened. I honestly don't want to work on a project without it.

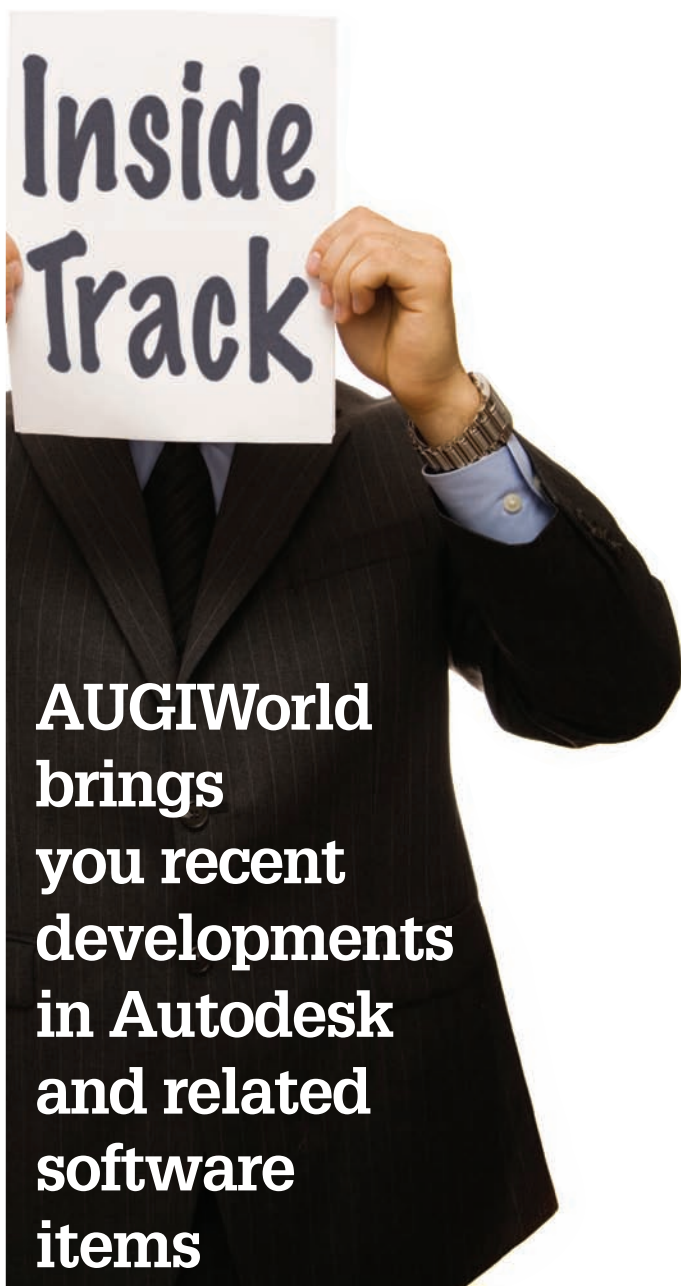


John Evans is an Autodesk Certified Inventor Professional living in the Florida Panhandle, where he provides technical troubleshooting at Gustin, Cothorn, and Tucker, Inc. His career through the Aerospace Design, manufacturing, and maintenance spans 24 years and includes a tour in the USAF. John now works as a design consultant and author from his company John Evans Design and manages the blog "Design and Motion", where he combines his passions: Autodesk Inventor, simulation, and motion control. He is a regular attendee of Autodesk University and has recently joined Tekni Consulting as a contributing author for the Creative Inventor training series. He can be reached at john@johnnevansdesign.net.

AUTODESK MAC-COMPATIBLE PRODUCTS

For those of you that are on Apple hardware, finding native Mac tools can be long process. If you have moved from a PC environment to the Mac OS, then you want the tools you have used in your past life. Autodesk provides several native Mac products for 3D modeling, rendering, and animation, visual effects, and digital imagery.

Let's look at a few familiar ones. The following products natively support Mac OS® X:



AUTOCAD FOR MAC



Design and shape the world around you with AutoCAD® for Mac® software. Explore your ideas and share data seamlessly while working in a native Mac environment.

AUTOCAD LT FOR MAC

AutoCAD LT® for Mac® software brings powerhouse drafting tools to the Mac®. With native support for DWG™ technology, it's easier than ever to document and share designs on your platform of choice.

AUTODESK STITCHER UNLIMITED

Easily create professional wide-angle and panoramic images from photographs with Autodesk® Stitcher® Unlimited software.

AUTODESK SKETCHBOOK DESIGNER



Autodesk® SketchBook® Designer software provides a hybrid paint and geometry workflow for design illustration and graphic communication.

AUTODESK SKETCHBOOK PRO

Autodesk® SketchBook® Pro painting and drawing software enables you to transform your computer, laptop, or tablet PC into the ultimate sketchbook.

For those not so CAD products for your Mac – try some of these...

**(PROVIDED BY BILL ADAMS)
FREE (OR LOW COST) APPS FOR MAC
OS X YOU MAY NOT BE USING...**

DROPBOX



Everyone knows Dropbox for their amazing file-sharing service. Drag any file into the Dropbox folder and it automatically gets shared.

Sign up for a free account and you automatically get 2GB to share with your friends. Set up shared folders and anything you drop will be instantly downloaded by others.

Need mobile access to your files? There's an iPhone app just for that.

THE UNARCHIVER



Emphasis on the "The". This little app – that comes without a user interface – can probably unpack just about any file you throw at it. Once installed, it will replace Mac's native unarchiving utility, BOMArchiveHelper.

To mention a few, it supports and unarchives RAR, ZIP, Tar, 7-Zip, Stuffit, CAB, MSI and even EXE files. The only format it cannot unpack is ACE. But that's hardly a worry.

Besides being clever, The Unarchiver is also efficient. You can click on as many RAR or ZIP files for it to unpack but it will never overwork your system. Instead, it will queue the files and unpacks them individually.

BEAN

Bean is lean, fast, and uncluttered. If you get depressed at the thought of firing up MS Word or OpenOffice, try Bean.

(Note: According to their site, "Bean has not yet been tested on OS X 10.7 Lion")

TEXT WRANGLER



I use TextWrangler for different purposes, mainly for what lacks in TextEdit — a word counter. It also supports coding and HTML, which is helpful on occasion.

TUXERA NTFS FOR MAC (LOW COST)



Tuxera NTFS for Mac is a commercial NTFS driver developed from the popular open source NTFS-3G driver, which is a natural part of all major Linux distributions, and also has lots of users on Mac OS X, FreeBSD, Solaris and NetBSD.

GIMP



GIMP is an image editor (raster), which is a free alternative to Adobe Photoshop and Paint Shop Pro. It has tons of cool features, and is a great free alternative to other software

(Note: According to Roaringapps website, "Gimp has some problems on OS X 10.7 Lion")

INKSCAPE



Inkscape is an Open Source vector graphics editor, with capabilities similar to Illustrator, Freehand, CorelDraw, or Xara X using the W3C standard Scalable Vector Graphics (SVG) file format. Inkscape also supports Creative Commons meta-data, node editing, layers, complex path operations, bitmap tracing, text-on-path, flowed text, direct XML editing, and more. It imports formats such as JPEG, PNG, TIFF, and others and exports PNG as well as multiple vector-based formats.

PHOTOSHOP ELEMENTS 10 (LOW COST)



Simply awesome! Adobe Photoshop Elements 10 photo-editing software delivers powerful options that make it easy to create extraordinary photos, quickly share your memories in Online Albums and unique print creations.

Professional CAD/CAE Workstations



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@Xi[®] Computer has been building the most performing AutoCAD[®] Workstations for over 20 years. The new Intel[®]Core™ i7 & XEON[®] based, MTower™ & PowerGo™ are no exception. As NVIDIA[®] TPP, we offer the newest C2075 and M2090 for top performing Desktop Supercomputers and HPC Clusters. Proudly Custom Built in the USA, sided by a superior domestic technical support, our Workstations, Servers and HPC Clusters are designed to excel and reliably deliver in the most demanding computational environment.



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PowerGo XT

MTower 2P64X

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- Xi[®]MTower Silent Liquid Cooled
- MS Windows[®] 7 Pro[®] -Linux[®]

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- 8GB DDR3 1333MHz to 32GB
- NVIDIA[®]GTX580M 2GB DDR5
- 750GB SATA6Gb w/8GB SSD
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- Speakers, Camera, 1394+ Mike
- MS Windows[®] 7 Professional[®]

- Intel Xeon[®]Processor, 5600 Ser.
- 12MB L3Cache,SR-2 Class. MB
- 12GB DDR3-1333MHz ECC to72G
- NVIDIA[®]Quadro[®] 2000 1024MB
- 750GB SATA6Gb w/8GB SSD
- 27.5" 1920x1200 Hanns-G[®] LCD
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- MS Windows[®] 7 Pro[®] -Linux[®]

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1x6-Core E5645 2.40GHz \$2,699

Quad Core i7 2700K 4.5 Ghz \$2,219

6-Core i7 3930k 3.9GHz TB \$2,999

2x6-Core E5645 2.40GHz \$3,349



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The Ultimate Revit Hand: Every Revit Tip, Trick, Technique & Workaround (Known & Unknown)



In this article, I will provide EVERY known Autodesk® Revit® tip, trick, technique, and workaround known—and as yet unknown. I'll do this by sharing tips, tricks, and techniques for getting tips, tricks, and techniques!



By the time you finish this article, you'll possess extremely valuable tools for working with Revit, as well as assuring your personal and professional growth.

So do you want or need Revit tips, tricks, and techniques? How about Revit workarounds and workflows? Or are you simply looking for ways to produce your work (more) correctly? Well, so am I, so read on.

There is so much out there already, so I'll focus on ways to get tips, tricks, techniques, and workarounds that for some are obvious, yet are un-used or under-used by far too many Revit users.

Let's begin with "where." The best places to get answers, tips, tricks, techniques, and workarounds:

- You and your brain
- Your computer (aka others' archived brains)
- Revit mentors (aka others' live brains)

TIP #1: SELF HELP: GET IT/GIVE IT!!!

Do not ask someone before you try, re-try, then re-try differently

That is a rule for everyone who needs an answer to a question, whether in Revit or elsewhere.

This is not tongue-in-cheek; this is perhaps the best way to learn. There is no magic wand out there—answers come from creative thinking and perseverance—trying repeatedly, failing, and ultimately succeeding.

- Approach obstacles as opportunities and you will better yourself and others.
- Give yourself a chance to figure it out; you can come up with the answer yourself most of the time and that is what life is all about.
- Take a new approach and lose pre-conceived notions of what you believe to be the possibilities.
- Look at the Properties dialogs :-). The answer may be right in front of you.

TIP 1A

Create Answers Yourself (and grow your knowledge in meaningful, fulfilling ways).

Follow three simple concepts and eight potential steps and you will most assuredly create or find the answers you are looking for.

1. Change Your Perspective

Get up, do 10 cleansing breaths, rethink, try again

No hippy/zen joke here: this is great for your brain and outlook at the very least.

Take a break, walk around, rethink, try again

A few-minute break can clear your head, allowing an answer to formulate, as well as give you a good stretch.

Describe your issue to someone who knows nothing about it

Ask one who knows nothing of the software or process that has you stumped.

Doing this will require you to explain it in a new way and that reframing will allow you to hear it anew and should open you up to a realization of the solution(s). *This works for me most of the time!*

2. F1

The F1/HELP button is your first line of defense. That said, the answer is not always there, but try this first!

3. Internet Search

Someone has most likely already had and solved an issue just like yours and the Internet will provide you with myriad answers. Don't forget to check different viewpoints!

Did someone say Google? (Or any other good search engine?)

Describe your question specifically and briefly with 'Revit' in it

RevitForum: <http://revitforum.org/>

AUGI Forums: <http://forums.augi.com/>

The Blogosphere

There are so many Revit/BIM blogs out there your head may spin. Most of us who write provide links to others' blogs. This will allow you to easily create a list that meets your needs.

A good place to start: <http://c3consulting.com.au/links/bim-blogs.html>

I have no professional attachment with these folks; I am just spreading some love.

Even though my blog is at the end of their list :-), it's a good start for you!

Now, with the three concepts above, you will get the answer you need 99 percent of the time. For the remaining 1 percent, keeping going.

TIP 1B

Ask a colleague or expert

Ultimately, there are no bad questions; just be sure you have exhausted the three concepts above and have tried to help yourself before asking others. After all, they are busy as well and initiative is usually rewarded.

Be a problem solver to whatever degree you can. Even though there are no bad questions, there are numerous, repetitive questions that are easy to figure out without involving others. Avoid the appearance of laziness.

TIP #2: LEVERAGE SOCIAL MEDIA

LinkedIn, Twitter, Foursquare are three of the sites that every Revit, BIM person needs to exploit. If you do not have an account for LinkedIn, Twitter, and Foursquare yet, you desperately need to get on-board. If you have them, use them.

For instance, at Autodesk University this past December, Four-square combined with Twitter was the overwhelming reason that people from around the world were able to meet easier and more frequently than ever before. By simply checking into a location on FS and then engaging on Twitter, we became immediately visible to all of our friends and followers, making meetings happen... a lot!

This was important, not simply for the socializing aspect, but for spontaneous working and brainstorming. Sessions sprouted up, providing value well beyond the standard fare and many a Revit and BIM workflow were shared and then brought back to our individual corners of the world, helping beyond any of our expectations.

TIP 2A

Follow those I follow:

You can get a decent list by hitting those who follow me by starting at: <https://twitter.com/#!/JayZallan/following>, which should catapult you into their followers, and so on. Then all you need do is interact.

TIP 2B

Post only good content

You can get a lot of support by sharing some of your own expertise, but understand that information overload is always looming. Many people "unfollow" twit-spammers or over-posters and over-personal-posters. I suggest keeping it mostly on-point.



Here is a partial list of folks worth following on Twitter, to get a headstart (in no particular order):

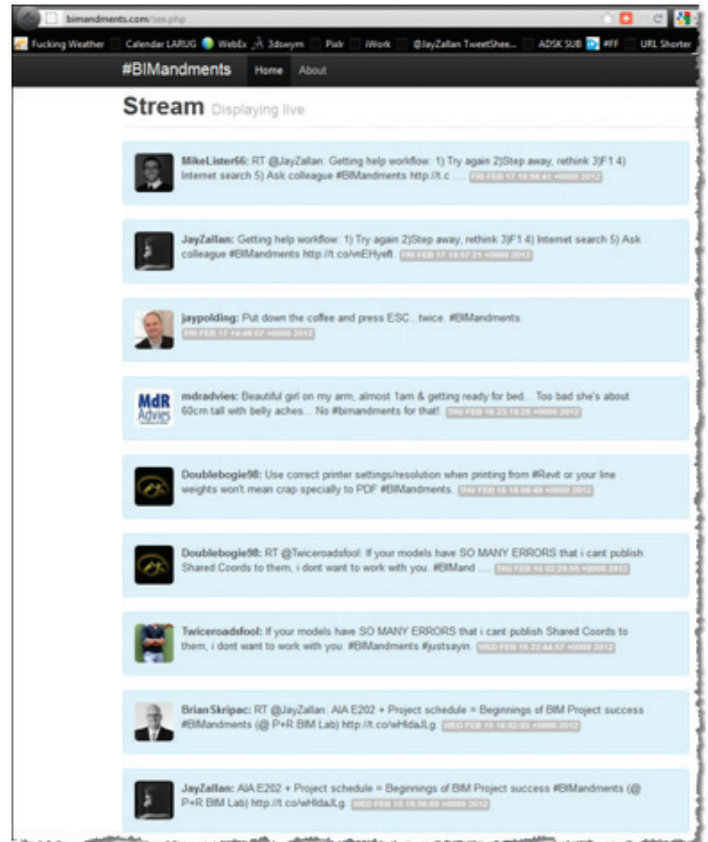
- | | |
|----------------------|------------------|
| @JayZallan (Duh :-)) | @virtuarch |
| @leftyinvalid | @JonLanderos |
| @TroyGates | @KnowledgeSmart |
| @davewlight | @projectvasari |
| @davidfano | @AutodeskSupport |
| @AYBABTM | @robincapper |
| @alnjxn | @lukeyjohnson |
| @becausewecan | @revit3d |
| @PhilRead | @brucegow |
| @DesignReform | @mradvies |
| @case_inc | @Steve_Stafford |
| @randydeutsch | @RevitFactCheck |
| @jvandezande | @BIMandments |
| @seandburke | @MattRumbelow |
| @simonwhitbread | @jobcaptain |
| @Revitspace | @JasonGrantArch |
| @scottsh115 | @SteveDeadman |
| @dourevit | @ShaunF1969 |

- | | |
|----------------|------------------|
| @bauskas | @CSIConstruction |
| @GeorgeMokhtar | @jrostar |
| @MSIXVEO | @davidkingham |
| @ZachKron | @scottddavis |
| @jeremytammik | @JWurcher |
| @ikeough | @pauldohertyaia |
| @revitking | @ElrondBurrell |
| @TanjaDzambaz | @cjrider |
| @WesleyBenn | @BrianSkripac |
| @DesignByMany | @Twiceroadsfool |
| @RTCAUS | @apertedesign |
| @RTCUSA | @paulfaubin |
| @zoog | @blads |
| @fedenegro | @HarlanBrumm |
| @djivey | @LEEDing_Lady |
| @revitall | @masteringrevit |
| @StewartGH1970 | @BIMstore |
| @kirklyncox | @caddhelp |

#BIMANDMENTS

#BIMandments is, in my opinion, the best and most useful AEC, BIM, Revit Twitter hashtag used. They are actually helpful tips (even the ones I write).

Created by @AYBABTM the #BIMandments are added by putting that hashtag in a Tweet.



@AYBABTM is actually Don Rudder, Director Software Development for CASE Inc. <http://www.case-inc.com/>)

REVIT RTC TECHNOLOGY CONFERENCE

RTC is hosting three events this year!

RTC AUSTRALASIA

Novotel Wollongong
NSW, Australia
24 - 26 May 2012

www.revitconference.com/rtc2012au

RTC VISDAY

Novotel Wollongong
NSW, Australia
23 May 2012

www.revitconference.com/rtc2012auvis

RTC NORTH AMERICA

Evergreen Marriott
Georgia, USA
28 - 30 June 2012

www.revitconference.com/rtc2012us

What makes RTC special is not just the opportunity for learning, it's the interaction between you and your peers and fostering your goals and dreams. RTC is an event, a movement for sharing and encouraging your passion. Consider that the most valuable thing people usually take away from their college life are their interactions with great minds (great professors or fellow students) and things apart from class that help define them as people.

RTC will recharge your batteries if you are feeling drained. RTC will assure you that you are indeed on the right path. RTC will give you a platform to help reach your goals. RTC will invigorate you and your firm.

RTC is a user event - "by users, for users"

- Learn from some of the world's top instructors and industry experts.
- Share ideas and insights with an international community of your peers.
- Explore the latest trends and technologies
- Cultivate important business and professional relationships

Register now to attend!



<http://www.event.com/d/jcq86b/4W>



<http://www.event.com/d/tcqlyz/4W>



<http://www.event.com/d/wcqk4z/4W>



www.RevitConference.com



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Background Image: RTC 2011 Australasia Innovation Winner - Gianni Zandel, Woodhead

Don tells me that the #BIMandments has its own website (officially launching before this article goes to print perhaps).

As Don tells it, “This site is already capturing in a MongoDB database tweets hashed as such so they will live forever. Once we launch it, twitter users will be able to vote on their favs.”

TIP 2C

Create a saved Twitter search for #BIMandments

TIP 2D

Follow @BIMandments

Then read each post from these two places, from the beginning, and your Revit seas will provide smoother sailing.

Here are a few examples (actual #BIMandments) illustrating what I believe to be the beauty of ‘140 characters or less’ from #BIMandments... enjoy.

The First of the #BIMandments, by “The Creator” Jan 12th, 2012, 2:27 PM

- I don’t normally tweet Revit tips... but I will be posting some Essential Tips that we’ll soon all begin to know as #BIMandments

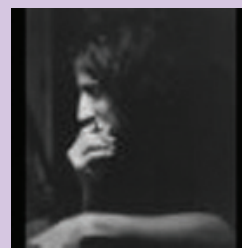
Other #BIMandments:

- If you find yourself doing a task repetitively, create a keyboard shortcut if one does not exist. Then use it!!!
- Thou shall Be proactive not reactive when clash detecting.
- Modeling screw threads in thy family will result in a sinful visit from a disrobed Justin Bieber.
- Know a lot about creating families? Toss most of it when you start working on adaptive components and conceptual massing tools.
- My shameless link sharing: Know Your (Worksharing & Central Model) Rights <http://bit.ly/x3PZyv> & <http://bit.ly/ywQ6a4>

You get the idea now... the Revit community is active, sharing, and giving. Your job is to take advantage and join in, so new users can grow and you can get *and give* tips.

OK, so now you know the process to become a Revit Master: **Try>Try Again>Try Again Differently>Bounce it off ‘lay-people’>Hunt down the Digital Answer>Ask a Mentor.**

You now have at your disposal every Revit tip, trick, technique, and workaround known—and as yet unknown. I’ll bet you didn’t think that was possible when you read the first line of this article, did you?



Currently the VDC Director of BIM at Perkowitz+Ruth Architects & Studio-111, Jay Zallan brings unique and qualified insights into the business and creative processes of architecture with proven strategies for production and growth. He has more than 20 years of architectural experience and enjoys a varied and diverse portfolio of architecture and art. Jay is currently president of the Los Angeles Revit Users Group, AUGIWorld Revit Architecture Content Manager, BIM Advisory Board member for Graphic Standards, and he is a frequent lecturer on Creativity, BIM and Virtual Design & Construction. He can also be found presenting at Autodesk University, Revit Technology Conference, and as a guest lecturer at the University of Southern California, LACMA, as well as many other industry and AIA events.

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-Apr-01	Autodesk 2012 Content Explorer Service Hotfix http://goo.gl/6zU76
2011-Dec-08	Autodesk 2012 Content Explorer Service Hotfix 2 http://goo.gl/RVIw6	2011-Mar-23	Autodesk Material Library Medium Resolution Image Library 2012 http://goo.gl/cHnq3
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		

AUTOCAD LT® 2012

2011-Dec-13	AutoCAD and AutoCAD LT 2012 SP1 Ribbon Hotfix http://goo.gl/1Fj8a
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2011-Dec-08	Autodesk 2012 Content Explorer Service Hotfix 2 http://goo.gl/5WXMh	2011-Dec-13	AutoCAD and AutoCAD LT 2012 SP1 Ribbon Hotfix http://goo.gl/6mfcE
2011-Sep-27	AutoCAD LT 2012 Service Pack 1 http://goo.gl/WuDx4	2011-Dec-08	Autodesk 2012 Content Explorer Service Hotfix 2 http://goo.gl/IHfzF
AUTODESK® REVIT® ARCHITECTURE 2012		2011-Nov-14	AutoCAD 2012 Performance Slowdown Hotfix (32/64 bit) http://goo.gl/HlZTY
2012-Feb-21	Hotfix – Autodesk Revit 2012 – Improves stability when working with large datasets (64-bit only) http://goo.gl/2G4sl	2011-Sep-29	AutoCAD Architecture 2012 Service Pack 1 http://goo.gl/Qf2zm
2011-Dec-13	Hotfix - Autodesk Revit Server 2012 - Improve stability when uploading to Revit Server http://goo.gl/dCJCS	2011-Aug-30	AutoCAD Architecture 2012 & AutoCAD MEP 2012 - Localization Hotfix: Corner Windows http://goo.gl/cJmEU
2011-Oct-11	Hotfix – Autodesk Revit 2012 – Apply material family parameters using the Paint tool http://goo.gl/SNOeD	AUTOCAD® CIVIL 3D® 2012	
2011-Jul-13	Revit Architecture 2012 Deployment Utility http://goo.gl/4UBPQ	2011-Dec-13	AutoCAD and AutoCAD LT 2012 SP1 Ribbon Hotfix http://goo.gl/GWuoS
2011-Jul-13	Hotfix - Incorrect Ribbon Icons http://goo.gl/eR6IK	2011-Dec-08	Autodesk 2012 Content Explorer Service Hotfix 2 http://goo.gl/N7hj5
AUTODESK® INVENTOR® PROFESSIONAL 2012		2011-Dec-08	AutoCAD Civil 3D 2012 Update 1 http://goo.gl/AkgDX
2011-Dec-12	Hotfix - Multiple Issues Addressed (see Summary and readme file) http://goo.gl/z33ow	2011-Nov-14	AutoCAD 2012 Performance Slowdown Hotfix (32/64 bit) http://goo.gl/Ebi47
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-Sep-07	Hotfix - Prospector Lock-up http://goo.gl/T2mTx
2011-Nov-18	Hotfix - Projected edge will not select as a closed loop for offset http://goo.gl/G6fk0	2011-Jul-13	AutoCAD 2012 Block Editor Save Corruption Hotfix http://goo.gl/G6hpz
2011-Nov-29	Hotfix - Multiple Issues (see Summary and readme file) http://goo.gl/O6BT7	2011-Jun-23	Autodesk Infrastructure Design Suite Network License Hotfix http://goo.gl/yJ54v
AUTOCAD® ARCHITECTURE 2012		AUTOCAD® MAP 3D 2012	
2012-Feb-06	AutoCAD Architecture 2012 AEC Dimension Hotfix http://goo.gl/VMQeM	2011-Dec-13	AutoCAD and AutoCAD LT 2012 SP1 Ribbon Hotfix http://goo.gl/Md4tj
2012-Jan-23	Service Pack 1 Silent Installation (Nordic Version Only) http://goo.gl/GoeQd	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>

2011-Aug-10 Autodesk® Infrastructure Administrator 2012
 Feature Rule "Check Perimeter" Hotfix (for
 AutoCAD Map 3D 2012)
<http://goo.gl/2QIRN>

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>

2011-May-11 Localization Hotfix for AutoCAD Mechanical
 2012 Chinese Simplified, Chinese Traditional
 and Korean 32bit - Side-by-Side with
 AutoCAD Mechanical 2011
<http://goo.gl/tZ1HH>

AUTODESK® VAULT 2012

2012-Feb-22 Multi Issue Hotfix
<http://goo.gl/f0owT>

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/1jfp>

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Tips to Leverage Data



Efficiently

➔ **T**he key to operating Autodesk® Revit® MEP efficiently is to utilize the data associated with the elements in the model. Revit provides tools to manage the information of the design, and you can fully leverage data and eliminate the redundancy of tasks by being creative with these tools. Querying the data through the use of schedules, tags, filters, and view templates goes a long way in ensuring that the drawings are accurate and consistent. The illustrated techniques in this article are discoveries I have made over the years that are helpful in using Revit MEP to its full potential.

TIP: USE IF/THEN STATEMENTS TO COMBINE INFORMATION FROM MULTIPLE COLUMNS

Those who are fluent with the software would agree that the schedules in Revit are not pretty. It is not uncommon for users to struggle with consistency and accuracy when transitioning from traditional schedules to smart schedules. Combining information from multiple columns will limit input errors while reducing the overall width, thus making the schedules more legible. This commonly occurs when displaying dimensional information from a part.

To display the WIDTH and HEIGHT in a “12x12” format, for example, a nested if/then statement is required. In the example below, the common sizes are accounted for in the formula; if a part does not match a specified size “REFER TO PLANS” is displayed in the MODULE SIZE column.

GRILLE AND DIFFUSER SCHEDULE		
Width	Height	MODULE SIZE
2' - 0"	2' - 0"	24x24
1' - 0"	1' - 0"	12x12
2' - 0"	2' - 0"	24x24
1' - 4"	0' - 8"	REFER TO PLANS

MODULE SIZE = if(and(Width = 2', Height = 2'), "24x24", (if(and(Width = 2', Height = 1'), "24x12", (if(and(Width = 1', Height = 1'), "12x12", "REFER TO PLANS")))))

A similar scenario can be exemplified with the Light Fixture Schedule. The voltage is displayed, but the fixture may have a universal ballast in which “UNIV” is shown. Adding a hidden column with a yes/no parameter allows the user to override the VOLTAGE column to display UNIV instead of the Actual Voltage.

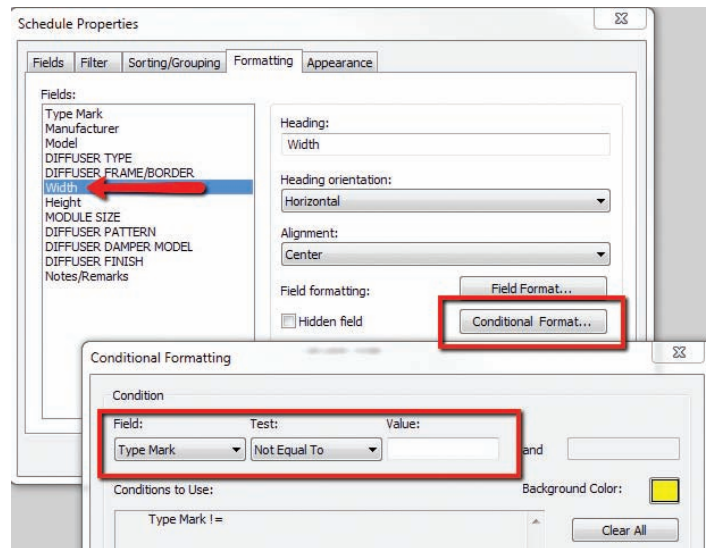
LIGHTING FIXTURE SCHEDULE				
FIXTURE WATTAGE	Actual Voltage	FIXTURE VOLTAGE	Universal	
35 W	120 V	120 V	<input type="checkbox"/>	FLUORE
75 W	120 V	UNIV	<input checked="" type="checkbox"/>	FLUORE
60 W	120 V	120 V	<input type="checkbox"/>	FLUORE

FIXTURE VOLTAGE = if(Universal, "UNIV", if(Voltage = 120 V, "120 V", if(Voltage = 277 V, "277 V", "Other")))

TIP: USE CONDITIONAL FORMATTING TO HIGHLIGHT HIDDEN COLUMNS

Both of the above examples utilize hidden columns. The columns need to be part of the schedule so the data can be used in the if/then statement, but their presence in the final schedule is unnecessary. Users are required to manually hide columns in a schedule so they do not print. Highlighting an entire column is an ideal way for the user to visually identify which columns should be hidden prior to plotting.

To highlight an entire column, use conditional formatting with a condition that will always be met. In the example below, the WIDTH column has the conditional statement **Type Mark is Not Equal To “blank”**. This statement will always be true (every row must contain a Type Mark value) which ensures that every row in the width column will highlight yellow.



TIP: CREATE SCHEDULE VIEW TEMPLATES AND PRESET COLUMN WIDTHS

The two examples above deal with managing the information in the schedule. This tip will provide visual consistency among the schedules. Addressing common cosmetic problems makes your smart schedules look less robotic and your sheets look more professional.

The appearance of the schedule is controlled by the Appearance tab of the Schedule Properties dialog box. The information on this tab can be captured in a view template and applied to all other schedules in a project. To create the view template, right-click over the schedule name in Project Browser and choose Create View Template From View... Applying the view template to all schedules will ensure every schedule has consistent graphical properties.

The Appearance tab in the Schedule Properties dialog box does not give the user authority to preset the width of the columns. The user must manually adjust each column when the schedule is placed on the sheet, and this can be very cumbersome when manipulating a larger schedule such as an Air Handling Unit Schedule.

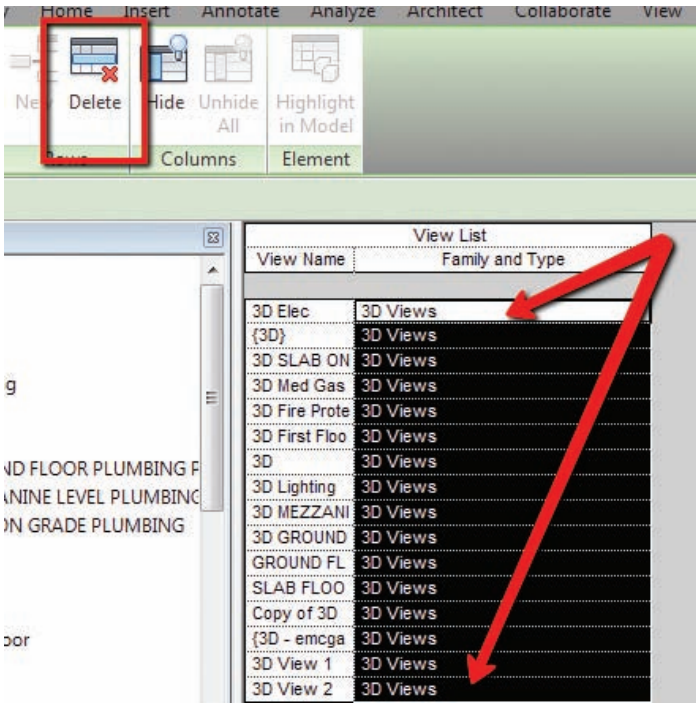
The column widths can be preset in the project template to provide all subsequent projects with consistent schedule column widths. In the project template, place the schedules on a sheet, use the grips to adjust the columns to the desired widths, and then delete the schedule from the sheet. When the schedule is placed on a sheet within the project, the preset widths of the columns will remain. This same method can be applied to schedules that are stored in an external file and loaded into the project as needed.

TIP: LOAD PREDEFINED SCHEDULES INTO THE CONSULTANT'S PROJECT

In addition to supplementing construction documents, schedules are often used as design or maintenance tools. Best practice dictates that when linking models from outside consultants, the received model

should be purged and compressed, and unnecessary views should be deleted to reduce the file size. Some users may justifiably argue that deleting the views and sheets can be time consuming, especially when receiving a new model from the consultant on a weekly basis.

Predefined schedules can be loaded into the consultant's project to help automate the task of removing unnecessary views and sheets. The loaded schedules will display all the views and sheets in the model and the user can quickly delete the views through the schedule, rather than deleting in Project Browser. The schedules can be saved on the network and loaded into the project using the Insert from File command on the Insert tab of the ribbon.



TIP: CREATE 3D AND SECTION VIEW TEMPLATES TO ORGANIZE THE PROJECT BROWSER

While schedules display the information from the model, view templates and filters can be used to help visually clarify and validate the information during the design and modeling process.

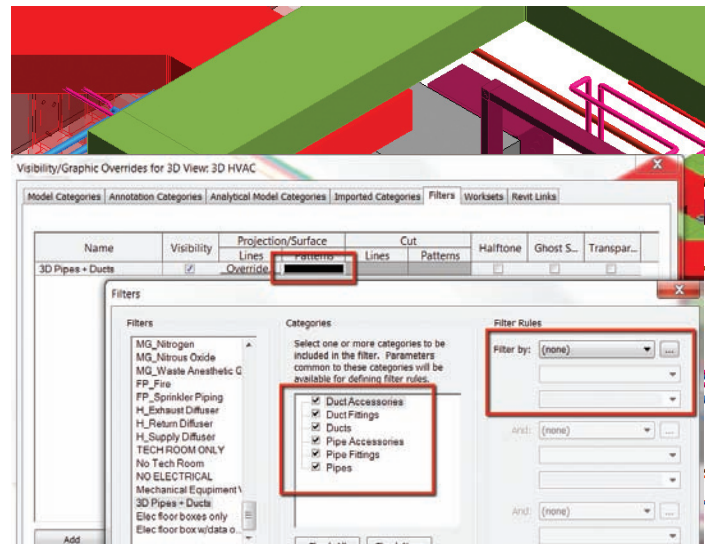
When a section is cut from the model or a new 3D view is created, they are strategically hidden under the "???" sub-discipline of Project Browser. These views are out of sight and often remain in the project when their function is no longer needed. Also, when creating these views, every element is displayed regardless of discipline. Turning off unneeded elements can become redundant and frustrating for the user.

View templates store common properties for a specific type of view such as visibility graphics, discipline, sub-discipline, and filters. Adding discipline specific view templates for 3D and section views to the project template will help with the coordination and organization of the Project Browser. They will also provide a streamlined approach to quickly toggle the irrelevant categories off and add any filters to the view.

TIP: ADD A FILTER WITH A SOLID FILL OVERRIDE TO THE 3D VIEW TEMPLATES

3D views are essential when modeling in Revit. They are useful for many reasons including verifying the connectivity of systems and visualizing spatial relationships. The views often become congested, and it can be difficult to decipher the many systems.

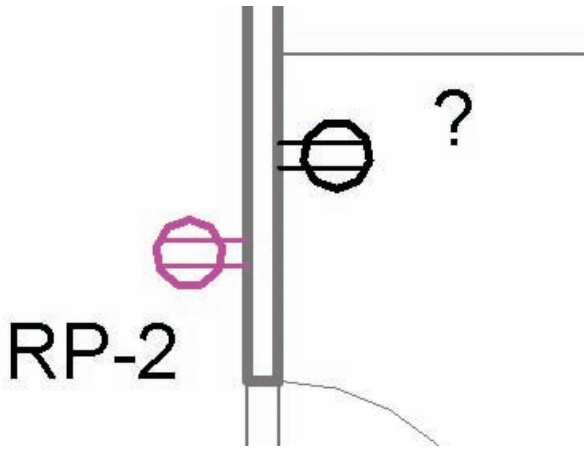
Differentiating the duct, pipe, and their associated systems is simplified if they are colored with a solid fill in a 3D view. This can be accomplished by creating a filter within the 3D view template. The filter is applied to duct and pipe, and their fittings and accessories with the Filter Rule set to *Filter by: (none)*. Having a filter with the filter rule set to (none) will group all the objects in the category regardless of their properties or system. After creating the filter, set the pattern override of the filter in Visibility Graphics to Solid Fill. The solid fill will assume the color that is defined in the system definition.



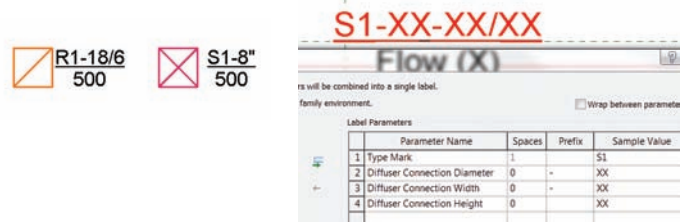
TIP: ADD A FILTER TO CHANGE THE COLOR OF CIRCUITED DEVICES

There are tools available within Revit to notify the user if something has not been assigned to a system, such as Show Disconnects and System Browser. These are two valuable tools, but they may not be the most efficient for verifying that all devices have been assigned to a circuit during the design process. The Show Disconnects exclamation mark disappears immediately after the Power button has been applied to the device, it does not notify the user if the panel has not been selected. The System Browser is a great tool, but it can be time consuming to find the unassigned object in the project.

To visually differentiate between circuited and un-circuited elements, create a filter to change the color of the device after a panel and circuit have been assigned to the system. To accomplish this, create a new filter with the filter rule set to **Panel does not equal "blank"**. In Visibility Graphics, select a color for the line graphics override of the filter to highlight the device after the condition has been met.



The same tag can be used on both air terminals. If the diffuser does not have the “Diffuser Connection Diameter” parameter in the family, it will not display any information for that field.



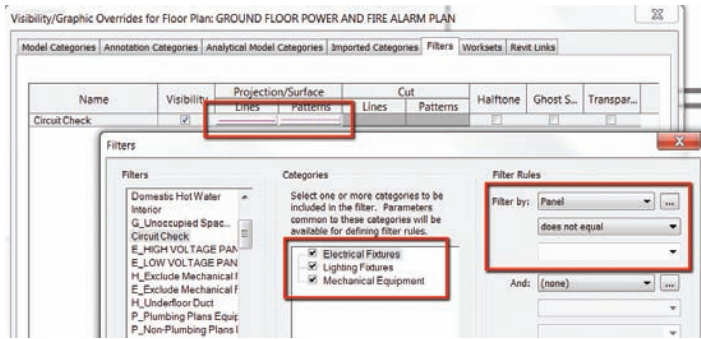
TIP: CREATE CUSTOM FAMILY TEMPLATES

To capitalize the data as explained in the earlier examples, all families must be created consistently with the same shared parameters. Shared parameters are stored in an external text file and can contain an excessive number of parameters. Determining which shared parameters to add so the family works with the schedules and tags can be discouraging and time consuming for the user.

Having custom family templates preset with the shared parameters will ensure that all families are created equal. To create a custom family template, start a new family using a template that installs with the software. Add the shared parameters that are needed for the schedules and tags and save the family. After closing the family, use Windows Explorer to change the file extension from .rfa to .rft.

Note: This tip ensures that all families created by the user have the correct shared parameters. However, it does not mention what to do if content is used directly from a manufacturer. Currently, the user must manually add each parameter or modify the existing parameters to point to their shared parameter file.

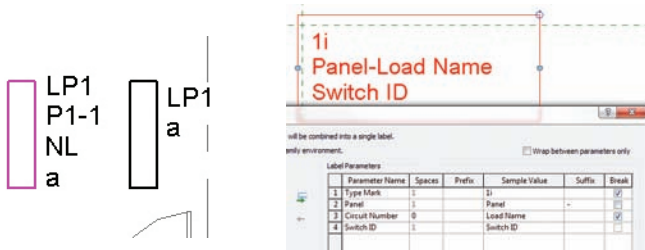
Revit provides the user with a variety of powerful tools to extract data from the model. Using these tools to their full capabilities will streamline the design process, reduce redundant tasks, and ultimately maximize efficiency. Leveraging the data efficiently in Revit MEP allows designers and engineers to focus on the quality of their designs.



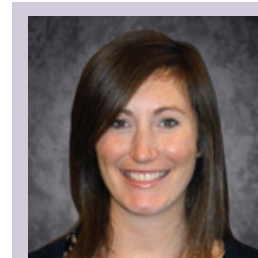
TIP: CREATE TAGS THAT DISPLAY MULTIPLE PROPERTIES IN ONE LABEL

Filters are used to visually highlight design information while tags display the information for construction documentation. One object may often need to be denoted with multiple parameters on the drawings. For example, one light fixture may need to display the Type Mark, Panel, Circuit Number, Night Light, Emergency, and a Switch ID. Adding all of these parameters in one tag will eliminate the need to place multiple tags on one object. One tag containing all the data also ensures that all parameters will be accounted for on the drawings.

Create a tag with the properties in one label and use the Spaces and Break options in the Edit Label dialog box to control positioning. If a property does not contain a value, the parameter will not display. In the example below, both light fixtures have the same tag. The light fixture on the right does not have a value assigned to the two middle parameters, so the last parameter moves up to be under the first. After the light is added to a circuit, the bottom parameter will move down to display the circuit number.



A similar example can be seen with an air terminal tag. One air terminal has a rectangular neck while the other has a round neck.



Emy McGann is a BIM Manager for Karpinski Engineering, a multi-disciplined consulting engineering firm based in Cleveland, Ohio. She is responsible for implementing and supporting Revit MEP across the firm. Her previous experience as a Revit MEP Technical Specialist has helped Karpinski Engineering stay on the cutting edge of BIM technology. Emy is a Revit Architecture 2010 Certified Professional and an AutoCAD 2010 Certified Professional & Certified Associate.



11 Questions with Ananda Arasu, Product Marketing Manager Manufacturing Industry



What is your role at Autodesk?

I'm a Product Marketing Manager (PMM) in Manufacturing for AutoCAD Electrical and AutoCAD Mechanical. As a PMM, I'm responsible for the go to market strategy and execution of those products.

How long have you been with Autodesk and doing this?

I started with the company in late August 2011 so my tenure at Autodesk is short. I'm excited to be working for Autodesk and with this group of people. Being the "new guy" at any company can be a bit harrowing. Fortunately, the Autodesk culture makes it much more manageable.

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

I have a degree in Electrical and Electronics Engineering from Oregon State University (Go Beavers!). One of my first jobs after college was in support at an electronic design automation company that built software for computer chip designers. It was a very electrical engineering-centric industry and my education prepared me well to understand users' perspectives and needs. For the better portion of the next decade, I worked in a technical marketing position at Men-

tor Graphics. That's when I decided to focus more on product marketing. I went back to school, earned an MBA, and then joined the product marketing team at Tripwire in Portland, OR.

I've gone through a handful of *significant* industry changes in my career. Perhaps the largest was when I became a product manager for a biologic product in the orthopedic medical device industry. My product was a synthetic chemical compound that is inserted into the bone. In the span of a couple of weeks, I went from talking the language of IT security to talking the language of orthopedic surgery; from visiting an engineer at a desktop computer to visiting a surgeon in the operating room. I've always gravitated toward computer-aided design. It was comforting to learn that, even in the orthopedic industry, there is a strong demand for Autodesk design tools for creating products such as anatomically shaped plates and screws that help heal fractured bones.

Eventually I returned to the world of software and found my current role at Autodesk.

What does a "typical" day look like?

I work on many different projects at the same time. Generally speaking, e-mail gets my attention in the early morning and then I transition to meetings with teams, my own tasks and deadlines, and putting out the proverbial fire. Most recently, I've launched a new Systems Design blog where I can connect directly with users and prospects in my industries.



What are some of the challenges that you face as a new employee at Autodesk?

One of the challenges is getting used to a new industry. I spent more than 10 years working in the Electronic Design Automation Industry and now I'm new to the Industrial Machinery/Mechanical Engineering Industry. So I need to slow down and acquire a deeper understanding of what and how our customers do what they do. Fortunately, there's a culture at Autodesk that makes it easier to manage the transition. One of the benefits of Autodesk's matrix-like organization is that everyone has a deeper understanding and support for the shared goals and objectives. It makes it easy to contact a colleague and get something done because everyone's marching in the same direction (more or less).

Do you have a role at Autodesk University or other events?

At this past year's AU, I was most involved with supporting the Autodesk Manufacturing Suites. I helped the Electrical team to staff the various presentations around AU. AU is such a great opportunity to see and speak directly with our customers. I was pleasantly surprised by the amount of excitement that AU generates. It was an awesome experience. I was also part of the support staff at the Rockwell Automation Fair, which is the largest show for AutoCAD Electrical. It's a great event for Autodesk.

What do you like most about Product Marketing?

I like being able to work with other people and teams to take a product to market. The tools that we have in the Autodesk portfolio are truly top notch. It's exciting to see a customer use our tools to produce something tangible.

How do you split the work among your team?

There are seven people on my team. We tend to split the work based on a set of products. I work with AutoCAD Electrical and AutoCAD Mechanical. Other Managers focus on Inventor, Vault, etc. However, Suites blur those lines. We spend more time working together than we do apart.

You've recently started the Systems Design blog. What's that all about?

More and more of our users are taking advantage of the direct access to Autodesk via mechanisms like blogs. My new blog gives us an opportunity to connect the developers, designers, and managers who make Autodesk products with those who use them. It has a lot to do with engagement and getting the word out. I also like that the blog is a little less formal than other material that we produce like whitepapers, presentations, and videos. autodesk.ty-pepad.com/SystemsDesign

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

My kids. They're my hobby, distraction, and a few other things, too.

My kids are coming of the age when they are playing organized sports. I've always enjoyed soccer so I jumped at the opportunity to coach one of the teams. Another one of my pleasures is taking my car out for a cruise and listening to some good music. I fit in a good book now and then. Recently, I've been enjoying a Jeffrey Archer book.

What would we be most surprised to know about you?

I was born and raised in Singapore, where military service is mandatory for men. After basic and Combat Medic School, I served as a combat medic for two years. Prior to my service, I had no medical training. The army taught me everything that I needed to know about being a combat medic in three months!

Wicked IPD Procurement Programs:

IPD & BIM Solutions Unleashed



This is the latest article in the Wicked Series. Here we explore the challenge of procuring building information modeling (BIM) enabled infrastructure—in both the public and private sectors—from integrated BIM-enabled teams capable of operating in an integrated project delivery (IPD) environment and delivering BIM-enabled infrastructure.

INTRODUCTION

Stewards of public infrastructure and their counterparts in large private enterprises know Design-Bid-Build is broken; they just aren't sure how to replace it or with what. CM at Risk, Design-Build, and Public Private Partnerships (P3), all currently in vogue, offer different paths forward. Integrated Project Delivery (IPD) offers another. This article explores adoption of IPD by large institutional owners—public and private—that own, operate, and maintain large infrastructure portfolios and consume planning, design, and construction services in volume.

Integrated Project Delivery (IPD) is characterized by:

- Early engagement of key project stakeholders
- A pain share gain share approach to compensation and risk
- Collaborative control of the project
- ADR processes that support private adjustment of legal relationships
- Collaborative development and validation of targets / goals

THE OWNERS' CHALLENGE

Governments around the world mandate high-performance buildings, increased energy efficiency, reduced water usage, and so on—all in hopes of achieving sustainable infrastructure with a small carbon footprint. Those same governments insist such infrastructure perform flawlessly, at lower costs, and they want it all now. In short, public owners want better sustainable infrastructure faster and cheaper than ever. Private owners make similar demands. These timeless demands—better, faster, cheaper—have historically been viewed as mutually exclusive, with one or more being

sacrificed to achieve another. While laudable, especially when tied to the concept of sustainable infrastructure and smaller carbon footprints, these goals are very difficult to achieve.

A constant lament from governmental agencies tasked with procuring sustainable and green infrastructure involves their inability to procure planning, design, and construction services from integrated teams. Antiquated procurement laws and regulations are viewed, rightly, as thwarting any effort to procure services from integrated teams. Large institutional owners in the private sector often feel bound by similarly restrictive procurement procedures, though they too want high-performance buildings faster better and cheaper. Only integrated, BIM-enabled teams have a realistic chance of delivering BIM-enabled infrastructure that is sustainable and green. Traditional teams operating in silos simply lack the tools necessary to plan, design, and deliver such infrastructure. It's very, very hard to pound a round green peg through a square brown hole.¹



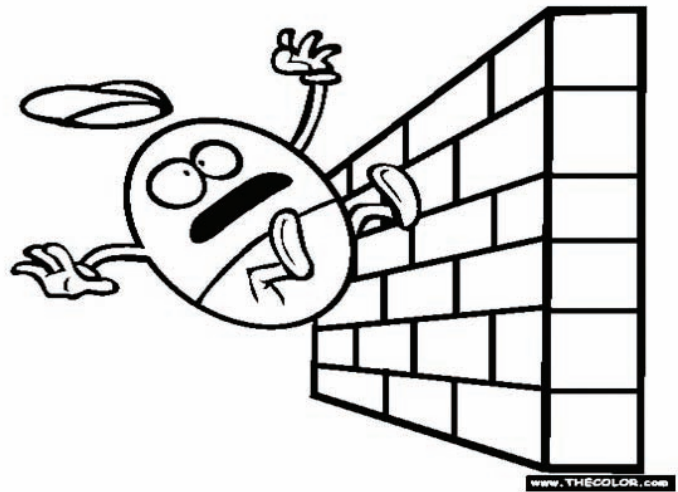
Frustrated procurement officers, in charge of acquiring sustainable infrastructure with a tiny carbon footprint, see BIM as a potential solution. However, BIM deployed under a Design-Bid-Build procurement model never reaches its full potential. In fact, few in the industry operate under any illusion that sustainable green infrastructure can be achieved under a Design-Bid-Build model of procurement.

BIM—at least good BIM in a BUILT environment—captures information authoritatively from the moment the project is a gleam in the owner's eye through demolition, displaying digital representations of physical characteristics, serving as a shared knowledge resource, and enabling intelligent and effective decisions regarding operations, maintenance, and other activities related to the BUILT environment.

THE DESIGNERS' AND CONSTRUCTORS' CHALLENGE

Design professionals, slow to embrace BIM, now recognize its value. General contractors, who embraced BIM as a means of reducing their own costs, recognize the value, too. But designers and contractors view BIM differently and leverage BIM differently within the context of their own business models. Designers initially adopted BIM to increase efficiency, but now realize BIM is emerging as the new standard of care in the design profession. Contractors, initially enamored with clash detection and visualization, now exploit BIM's capacity to deliver quantity take-offs, material lists, virtual first-run constructability analysis, and a variety of other lean business processes crucial to success in the competitive world of construction. Owners, who sat on the sidelines for several years, now see the potential in BIM and many want designers and contractors to hand over critical data that will empower owners to operate and maintain infrastructure more efficiently.

The challenge is to hand over useful BIM and not just a box of jumbled BIM ala Katy's Castle² or Humpty Dumpty BIM.³ Designers and contractors who toss BIM over the wall to owners are delivering Humpty Dumpty BIM. And we know owners—the King—don't have enough men or horses to put Humpty together again. Owners don't want or need Humpty Dumpty BIM. They want BIM-enabled infrastructure they can operate, manage, and maintain intelligently over time.



As hard as it is to deliver BIM-enabled infrastructure, owners, contractors, and designers are beginning to figure it out on a project-to-project basis. IPD procurement programs represent the next logical step. Excitement among this group of hands-on stakeholders, at an all-time high and rising, contrasts sharply with the "know-nothing" attitude towards BIM that prevails among institutional stakeholders of a financial bent. Stakeholders in the financial sector control business processes critical to successful deployment of an IPD procurement program, and must join the conversation.

WHERE IS THE FINANCIAL SECTOR?

Lenders, insurers, sureties, government bonding agencies—and the professionals who advise them—have enormous financial interests, along with the core team of owner, contractor, and designer in successful project delivery. Unfortunately, the average financial stakeholder knows little about BIM, less about IPD, and appears uninterested in either process.

In many instances these tangential but critical stakeholders, and their professional advisors, instinctively recoil from the perceived complexity of BIM and IPD, with many counseling against adoption of IPD as a novel and unknown risk magnifier, while reluctantly conceding to the use of BIM, provided BIM is kept in silos. Unaware of the need to tie BIM to an integrated procurement process to fully leverage BIM, the professional advisors—with vested interests in the outdated legal, lending, and insuring instruments—resist change. Sure to be targeted for revision and or replacement under an IPD Procurement Program, existing legal, lending, and insuring instruments are perceived and touted by their champions as insurmountable barriers to an effective IPD Procurement Program. Nothing could be further from the truth.



This ignorance reeks of opportunity. Just get your head out of the sand! Lenders, insurers, sureties, and others with a financial stake in complex construction projects who learn to leverage BIM stand to reduce risks exponentially, increase profit margins, and may help launch a revolution in the delivery of BIM-enabled infrastructure globally. Owners—both public and private—planners, designers, constructors, lenders, insurers, sureties, and other stakeholders on complex infrastructure projects need solutions to myriad problems associated with the procurement, operation, and maintenance of infrastructure. An effective IPD procurement program—on a BIM backbone—can be a first step to deliver solutions to those problems.

WICKED IPD PROCUREMENT PROGRAMS

Enter Wicked IPD Procurement Programs, a procurement model featuring fully integrated IPD and BIM solutions. To date, IPD has typically been project centric. Project-specific IPD ensures the owner, contractor, designer—and ultimately an entire integrated, BIM-enabled team—operates on a common legal platform that facilitates the use of BIM on a specific project. While a vast improvement over Design-Bid-Build and other procurement models, project-centric IPD ignores the real potential of IPD and BIM.

Wicked Procurement Programs, which envisions the use of IPD and BIM solutions across an entire portfolio of facilities and infrastructure and legions of integrated, BIM-enabled teams, throws open the IPD door to the entire universe of stakeholders and includes owners' entire portfolios. Public sector clients—who consume vast quantities of planning, design, and construction services annually and often take on the burden of operating and managing that infrastructure over time—stand to gain the most from a Wicked IPD Procurement Program.

In search of increased efficiency in procuring, operating, and maintaining public infrastructure, public sector consumers now demand BIM. Of course, few making such demands know exactly what BIM is, how to leverage it, or what kind of BIM they want, need, or can handle. Further, few bother to determine what kind of BIM, if any, their partners in the BUILT industry can deliver. Fewer still acknowledge the need to sidestep the morass of antiquated procurement laws and regulations in a way that enables them to demand planning, design, and construction services from integrated BIM-enabled teams in a BIM-enabled IPD environment.

Regardless of the barriers—which actually represent opportunities—keen interest exists among owners in procuring planning, design, and construction services more efficiently. Further, public owners routinely express the desire to retain a seat at the decision-making table throughout the design and construction process. This is ironic, given the willingness of public entities to adopt Design-Build and P3 as procurement methods, as neither of those procurement models typically reserve the owner's seat at the design table and leave the lion's share of value accumulated from increased efficiency to the contractor or other private entities. Substantive, solution-oriented conversations eventually turn to the merits of IPD as a procurement method and BIM as a process for managing infrastructure-related information. Public owners, intrigued by the possibility of an effective public IPD procurement model, see many billions of dollars in annual savings on procurement, operations, and maintenance costs. Green advocates and fiscal conservatives alike see value in IPD and BIM solutions.

THE NUMBERS DON'T LIE

Public owners, keenly aware that operations and maintenance costs consume 85 cents of every dollar budgeted for infrastructure, desperately seek to control those costs. Those costs, which rise dramatically in the later stages of the life cycle of most infrastructure—i.e., when infrastructure procured under the P3 model is typically turned back over to the government—represent a long-term burden.

Government projects account for almost half of the \$4.6 trillion spent in the construction industry annually. The \$4.6 trillion, however, represents only the 15 cents on every dollar allocated to procurement of design and construction services. Ignored are the accumulating costs—85 cents of every dollar—required to operate and maintain an ever-growing portfolio of global public infrastructure. If governments accumulate \$2 trillion in new public infrastructure annually for the next 20 years, those entities will be responsible for existing, and aging, infrastructure plus \$40 trillion in new infrastructure.

If governmental entities reduce the cost of procuring planning, design, and construction services by 10 percent—a modest goal given inefficiencies known to permeate the Design-Bid-Build model—then \$4.0 trillion would be freed for other purposes over a 20-year span. Those savings would have to be achieved globally, of course, to see such results, but even modest success would entail significant gains. Pushing the savings rate to 20 percent would net close to \$8 trillion.

While impressive, savings on procurement costs pale in comparison to the savings achievable if owners leveraged IPD, BIM, and lean business processes to wring inefficiencies out of operations and maintenance over time.

Lean experts contend 30 to 50 percent of the monies spent to procure planning, design, and construction services are wasted. Reducing waste in the arena by 10 to 20 percent is entirely reasonable. Of course, a wide array of individuals and businesses make a living off the \$1.2 to \$2.3 trillion in waste embedded in the system. Those with a vested interest in waste resist IPD and BIM with a vengeance. Similar levels of waste associated with the trillions of dollars spent annually on operation and maintenance costs related to existing and future infrastructure represent even more low-hanging fruit available to owners of BIM-enabled infrastructure.

Typically, operations and maintenance costs for infrastructure average 2 percent of current value. That number is much lower early in the life cycle—often .5 percent or less—but inevitably climbs north of 3 percent and may be close to 5 percent near life cycle end. Government infrastructure typically has a longer life cycle than private infrastructure, with much government infrastructure in place 60 to 100 years after construction.

These numbers are significant for two reasons. First, knowledge of this information enables one to estimate potential savings associated with reductions in operation and maintenance costs. Second, such calculations provide insights regarding the use of P3 and other procurement models.

With respect to potential savings, the calculation can be simple. The cost of maintaining \$40 trillion in public infrastructure, at 2 percent, is approximately \$800 billion annually or \$16 trillion over 20 years. The cost jumps to at least \$48 trillion—if not higher due to aging—over 60 years. Knocking 10 percent off those numbers at the 20- and 60-year mark, respectively, could save governments \$1.6 trillion and \$4.8 trillion respectively. If 50 percent could be saved, the numbers jump to \$8 trillion and \$24 trillion. Savings of this magnitude would enable governments to return vast sums to taxpayers which, in turn, would spur entrepreneurial endeavors of all kinds around the globe.

The foregoing figures apply with equal force to private sector infrastructure which represents the other half of the \$4.6 trillion spent annually around the globe to procure planning, design, and construction services.

In short, IPD, when deployed in conjunction with integrated BIM processes, has the potential to save governments trillions and trillions of dollars in reduced costs when procuring, operating, and maintaining infrastructure projects. The value of “Googlizing” our infrastructure that is tying an information-rich data stream to the design of the infrastructure, has the potential to add even more value and improve the lives of users and citizens in ways we cannot even fathom at this time.

By contrast, Design-Bid-Build, Design-Build, and P3 fail to increase efficiency and are ill-suited to enabling owners to obtain and leverage fully functional digital assets that result in truly BIM-enabled infrastructure. P3, touted by many governmental entities as the best procurement method available, achieves little in the way of savings during procurement and even less in the operations and maintenance phase as the private entity that leases the infrastructure enjoys use of the facility during the prime of its life. Governments resume ownership obligations during the infrastructure's later years. Accordingly, the infrastructure projects being procured under the P3 models today have the potential to be returned as spent shells with high operations and maintenance costs and little or no useful data.

In short, IPD as a procurement method and BIM as an information management process offers public and private consumers of planning, design, and construction services better results and will enable those owners to operate and maintain BIM-enabled infrastructure more intelligently over time.

WHAT'S AN OWNER TO DO?

Features of an effective IPD Procurement Program appear in the following sidebar. While drafted for both public and private owners the program has drawn the most attention from public owners shackled by antiquated procurement laws and regulations. Flexibility is the watch word in the public sector. As public entities adopt IPD and BIM, we will find better ways to use those tools. Meanwhile, it's important we start using the tools!

ELEMENTS OF AN EFFECTIVE IPD PROCUREMENT PROGRAM

- 1. Align Interests.** Align the business purpose of your IPD procurement program with the business purpose of the infrastructure you intend to procure. Align your interests with the interests of your partners in the BUILT industry. Align their interests when and where you can.
- 2. State Your Business Purpose.** Public entities, which procure planning, design, and construction services, need to ensure the infrastructure being procured has a viable business purpose.
- 3. Seek Sustainable Infrastructure.** Infrastructure that is sustainable—both environmentally and economically—empowers government and its citizens to achieve great things. Unsustainable infrastructure becomes an albatross around their collective necks.
- 4. Exploit the Loopholes.** Restrictive regulatory and statutory procurement rules need not be a barrier. Treat the laws, rules, and regulations as an opportunity to innovate. Loopholes exist. Find them. Exploit them. Use them to the taxpayers' advantage for once!
- 5. Create Target Cost Templates.** Develop a template for assessing the cost of procuring, operating, and maintaining sustainable infrastructure. In-house staff and trusted designers create similar templates already. Tap and use those resources.
- 6. Know Your BIM.** Owners need fully functional digital assets to operate and maintain sustainable infrastructure. Quiz your operations personnel. Pick the brains of experienced maintenance staff. Know what you need to operate and maintain sustainable, BIM-enabled infrastructure.
- 7. Communicate Your BIM Needs.** Tell your partners in the BUILT industry what you want and why you want it. Don't demand BIM in a vacuum.
- 8. Know Your Partners' Capacities.** Know what kind of BIM your partners in the BUILT industry produce; know what they can deliver; know what they cannot deliver; know what they will deliver; know who they will deliver it to; and know whether it is compatible with your FM system.
- 9. Demand Integrated BIM.** Don't be bamboozled by BUILT industry partners who insist integrated BIM is impossible. Learn together. Those "not ready for prime time" need to get ready.
- 10. Encourage Innovation.** Host a series of workshops for your industry partners at which you communicate your needs, explore their capacity to deliver, and agree on a path forward.
- 11. Wicked Procurement Guidelines.** Announce your intention to adopt IPD and to require integrated BIM. Publish Wicked Procurement guidelines that lay out the business case for procuring, operating, and maintaining sustainable, BIM-enabled infrastructure from integrated BIM-enabled teams capable of delivering in a BIM-enabled IPD environment.
- 12. Craft an RFP for IPD.** Once you know what you want and what your industry partners can deliver vis-a-vis IPD and BIM, work with those partners to craft an RFP that enables your organization to call for bids from integrated, BIM-enabled teams.
- 13. Craft an RFQ for IPD.** The new RFP for IPD should be accompanied by an RFQ that details the skills required to be a member of an integrated, BIM-enabled team capable of delivering sustainable, BIM-enabled infrastructure in a BIM-enabled IPD environment.
- 14. Analyze the Metrics.** Leverage the vast river of information-rich data flowing through your existing procurement, operations and maintenance processes and compare IPD, Design-Build, Design-Bid-Build, with P3 and other procurement models to identify the best mechanisms for delivering the best value in light of the business purpose of the sustainable, BIM-enabled infrastructure you procure.

Based on the foregoing figures and analysis, IPD, especially if combined with BIM and certain lean business processes, deserves careful consideration in the public arena. The BUILT industry, which prides itself on a can-do spirit of innovation, enjoys a challenge. Green buildings, bridges, skyscrapers, giant ships, and complex infrastructure of all kinds exist around the globe as a result of the BUILT industry's commitment to getting the job done. Inclement weather, maddening government regulations and red tape, recalcitrant teammates, and a wide range of similar obstacles are overcome every year to bring new infrastructure online. Convincing planners, designers, and constructors to adopt and implement IPD and BIM will be easy if those procuring their services insist on doing things better. But old habits die hard and there are some processes and tools that need to be set aside or modified to move forward.

Design-Bid-Build tops the list. It is practically useless as a procurement tool and is the most outdated, antiquated, and inefficient procurement model in existence. Governmental entities interested in improving the efficiency with which they procure, operate, and maintain infrastructure—whether sustainable and BIM-enabled or not—should abandon Design-Bid-Build as quickly as possible. If that requires legislation, so be it. Meanwhile, those really interested in IPD and BIM seem to find ways around the restrictions imposed by antiquated procurement laws and regulations every year.

Design-Build works well for public owners with zero appetite for risk and those with no interests in participating in the planning or design process. P3, while initially effective and easy on the budget, likely entails significant long-term risks and costs. But neither of these methods offers the flexibility and ownership advantages of IPD and neither leverages BIM on behalf of the owner the way IPD can.

For all the excitement and hubris displayed toward IPD and BIM in this article, public entities interested in procuring planning, design and construction services under an IPD model must not get too far ahead of their industry partners in the adoption process. IPD is an integrated team process

that cannot succeed without the support of key stakeholders. Thus, public owners must involve the BUILT industry in the effort to deploy IPD as a procurement model. In addition, it is critical that BIM be utilized throughout the process and that a fully functional digital asset (aka, an integrated BIM) be delivered to the public owner at the end of the project.

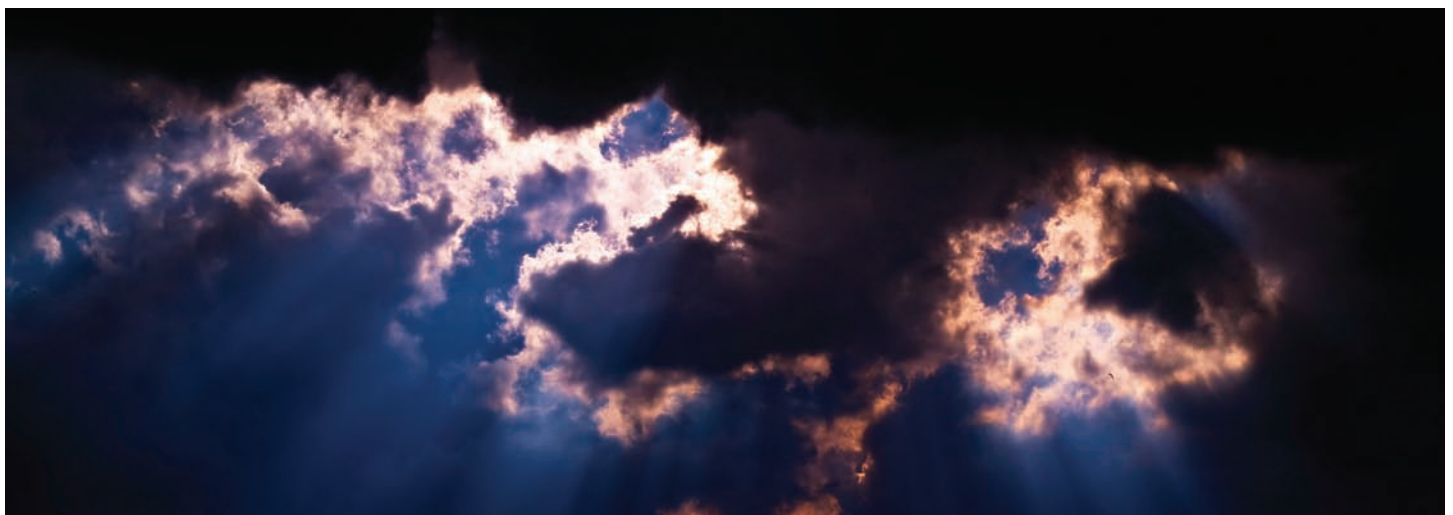
CONCLUSION

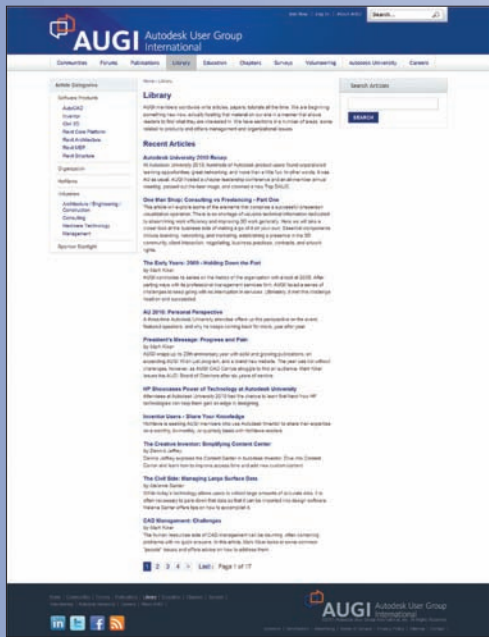
There is nothing simple about adopting a new procurement model, especially one as revolutionary as IPD. Combining IPD with BIM, while necessary, does complicate the process. The value to be derived from these innovative new processes is so high though, only the most timid will shy away. Leaders in the BUILT industry stand ready to pursue IPD and BIM on behalf of owners—public and private—that demand it. Let's roll!

- 1 <http://collaborativeconstruction.blogspot.com/2012/02/round-green-peg-in-square-brown-hole.html>
- 2 <http://collaborativeconstruction.blogspot.com/2010/03/bim-as-digital-asset.html>
- 3 <http://collaborativeconstruction.blogspot.com/2012/02/humpty-dumpty-information.html>



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.





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