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January 2013

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HP recommends Windows.

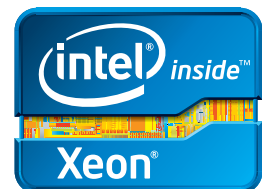


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contents

product focus



- 6 Revit Architecture 2013: Myth Buster: Revit & IFC, Part 2 The Saga Continues**
- 10 AutoCAD Architecture 2013: Display Themes and You**
- 14 Revit MEP 2013: Plumb It, Don't Plummet**
- 20 AutoCAD 2013: Do More with Fewer AutoCAD Tools**
- 26 Revit Structure 2013: Post-Tensioned Concrete Slabs**



- 20 AutoCAD Civil 3D 2013: BIM and Civil 3D – Fact or Fiction?**
- 37 Navisworks Manage 2013: Thousands of Clashes in a Thousand Seconds**
- 40 Autodesk Showcase 2013: Communicating Simulation with Showcase Rendering**



columns

- 4 Editor's Note**
- 19 Inside Track**
- 35 BUILT: (SMART)^x Game Changers**

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Editor's Note



Hello, *AUGIWorld* readers!

Welcome to the first edition of our magazine for 2013! We have a wonderful year of technical insight and other editorial content planned for the new year. That said, if you have the writing itch to share something from your own world of Autodesk software, we may just have an opening for your article. Just contact me and join the fun!

Onward to the issue! For the month of January many of the authors look forward in terms of technical application to show some of the most advanced topics around. Autodesk products are not generally considered simple to use (in spite of some of the marketing spin out there). As such, you can always use that extra bit of help, the nudge in the right direction, and, of course, the step-by-step instruction, to get the job done.

In other AUGI news (I don't need to talk about *AUGIWorld* because you can just read the magazine ☺), the organization's members recently elected three well-qualified volunteers to join the Board of Directors for 2013-2015. Returning members are R. Robert (Bob) Bell and Scott Wilcox. AUGI has been doing well these past years, so seeing Board members reelected by the membership shows a generally high approval rating. And we have a new director joining—Michael Smith—who hails from the management staff of *AUGIWorld*. He is young and ambitious and represents a new class of Board director, which is needed to help keep the organization on the leading edge of the user base.

Lastly, we have begun to see members joining (or upgrading) from the basic free membership to one of the paid membership plans. This is wonderful to see after nearly a year of planning and development to put it in place. One recently added benefit that many will be "wowed" by is the opportunity to join the ADN in 2013 for free. As a benefit of an AUGI Professional membership, you can get access to all that the standard ADN program has to offer (a \$1,400 value). Curious about what ADN is? Check it out (<http://goo.gl/nzX9O>). Want to join/upgrade your membership in AUGI? Check out (<https://www.augi.com/account/register>).

And lastly, I want to thank my good friend and photographer Daniel Hurbise, who in a pinch always seems to have some great imagery for the cover of *AUGIWorld* magazine. But, hey, you are welcome to submit something as well. ;)

Have a great year—see you next month!

David Harrington

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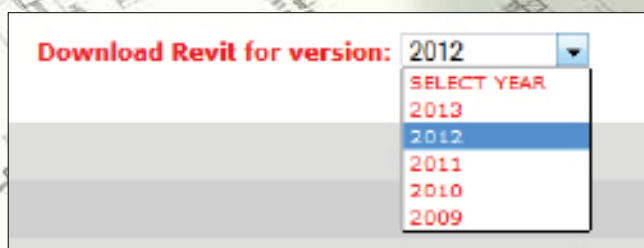
Revit Architecture
Revit MEP
Revit Structure

Versions:

2009
2010
2011
2012
2013



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WHERE ARE WE NOW?

After my first article on Autodesk® Revit® and IFC (*AUGIWorld*, September 2012), I got a lot of responses and feedback—from all sorts of different people and companies. I’m currently collaborating with IFC programmers from Autodesk® (yes, they actually have those), a technical consultant from Tekla, and several architectural firms using ArchiCAD such as BondBryant Architects and Zeep Architecten to document and investigate IFC handling with Revit. As it most surprisingly turns out, we all just want to do our jobs as well as possible and IFC is a part of it. This article is an update of that collaboration.

ROADS

Let’s start with a challenge: How do you create an element in Revit of the category Roads? Yes, the main category Roads, not a Site or Topography subcategory. Check it—it’s there... now use it.

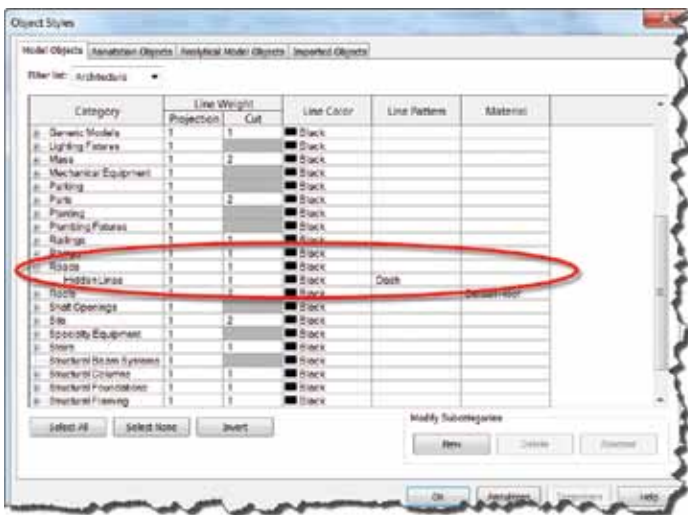


Figure 1

Okay, spoiler alert—you can’t. There is no way to natively create a road element within Revit. Basically the category is a leftover from an attempt to bring proper site tools to Revit back in the day. Development was an epic failure so it all got cancelled. After the smoke cleared, all that remained was the obsolete category Roads. That, and Site Tools.

But you can create roads using IFC with the mapping functionality. Model Road elements as masses, (in-place) walls/floors, generic components... heck, use railings based upon adaptive components. Just make sure they’re identifiable as roads.

There are a few things you need to remember when choosing the Category as you create these elements:

System Families cannot be overridden by the export mapping table. In other words, a floor will always be mapped to IfcSlab. There are currently two exceptions of which I am aware:

- a. In-Place components categorized as System Families. These too will respond to the settings for the appropriate category in the mapping table.
- b. Setting the Revit (sub)category to “Not Exported” will not visibly export the element. The element will be exported, but not visible in an IFC viewer, nor will it be re-imported when opening the file in Revit.

In the import mapping table, some hard-coded IFC counterparts for the Revit System Families are simply not there, which means you cannot use these to override IFC classes upon import. Examples are IfcRamp, IfcSite, IfcSlab, IfcSpace. System Families you *can* remap are IfcCurtainWall, IfcWall, IfcRoof, and IfcStair (which makes no sense since it’s basically the same as a Ramp in Revit).

1. Create a 3D view with only the components visible you need as roads. I used the following Revit categories to create roads (see Figure 2):
 - In Place Floor
 - Floor
 - Topography



Figure 2

Option A will let me put them in any given IFC class based upon the settings in the mapping table.

Options B and C will always be exported as an IfcSlab and IfcSite. Upon import I will not be able to remap this to roads because the IFC class IfcSlab and IfcSite are not supported in the import mapping table.

2. Create a custom export mapping table. How to do this? Open the standard AIA export mapping file you get upon import. Don't know where it is? Go to R > Export > Options > IFC Options (see Figure 3).

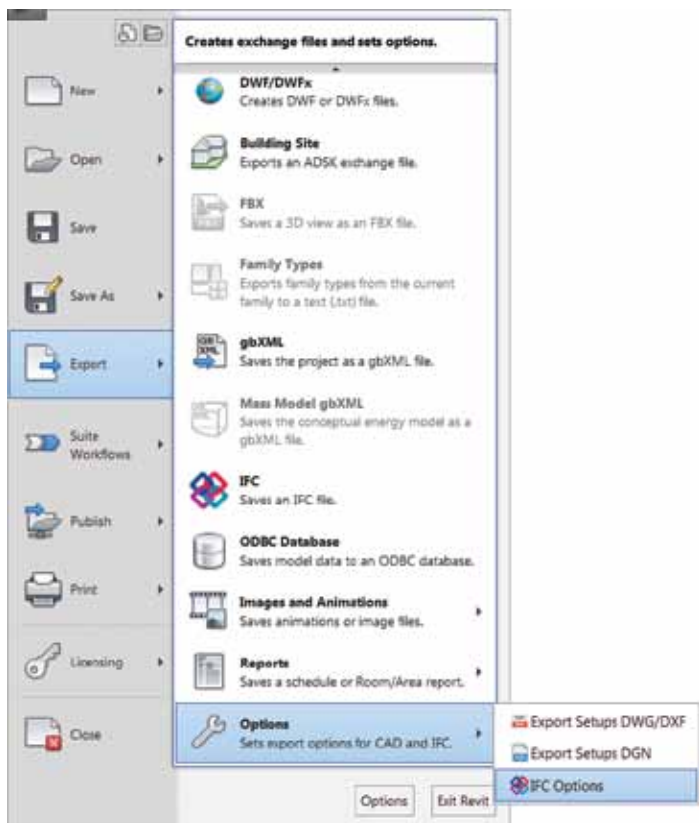


Figure 3

In the menu, choose Save As and save the txt-file somewhere. Rename it "IFC_Not_exported.txt" or something similar. Exit the command then open the txt-file in Notepad and place everything

beginning with "Ifc" with Not Exported. Save it again. You now have an "empty" IFC Exporter file to use as desired.

You'll get something like Figure 4. Keep in mind that the syntax is:

<Revit Category> <Tab> <Revit Subcategory> <Tab> <IfcClass>.

If you don't need to specify a Revit Subcategory, leave this one blank, just put in two <Tabs>. Currently IFC subclasses are not supported.

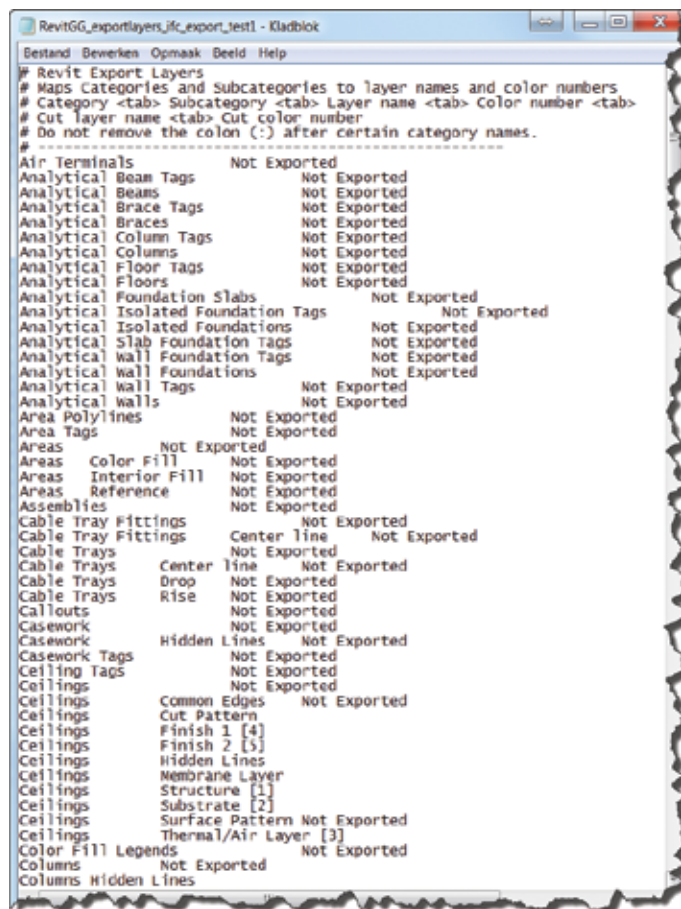


Figure 4

Now for the final step. In Notepad, find the categories you DO want to convert, and rename "Not Exported" into "IfcBuilding-ElementProxy." In this example we need to map the following Revit categories:

- Floors (for the In Place Floor component and to export the Floor to the IFC file).

- Topography (to export the Topography to IfcSite). It doesn't matter which class you put in here, just as long as it's not the "Not Exported" value.

Revit Architecture 2013

- Go back to Revit, IFC Export options, and hit Load. Now find the file you just created and apply it. Then Export your file to IFC. Use the standard 2x3 settings upon export.
- Upon import, create a mapping table that converts all elements in `IfcBuildingElementProxy` to the category Roads and presto, you're done (see Figure 5). Notice that you cannot apply an override for the IFC classes associated with Revit System Families (see Figure 6).

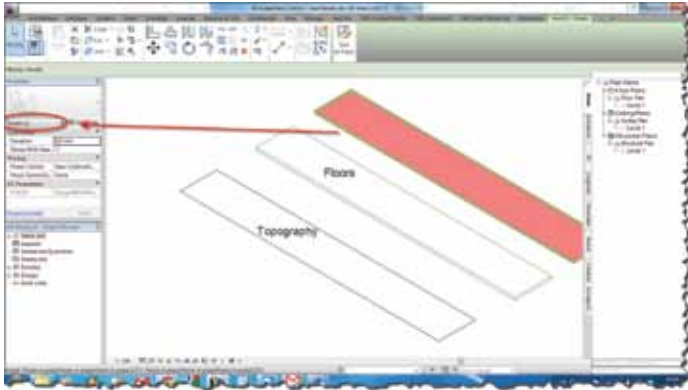


Figure 5

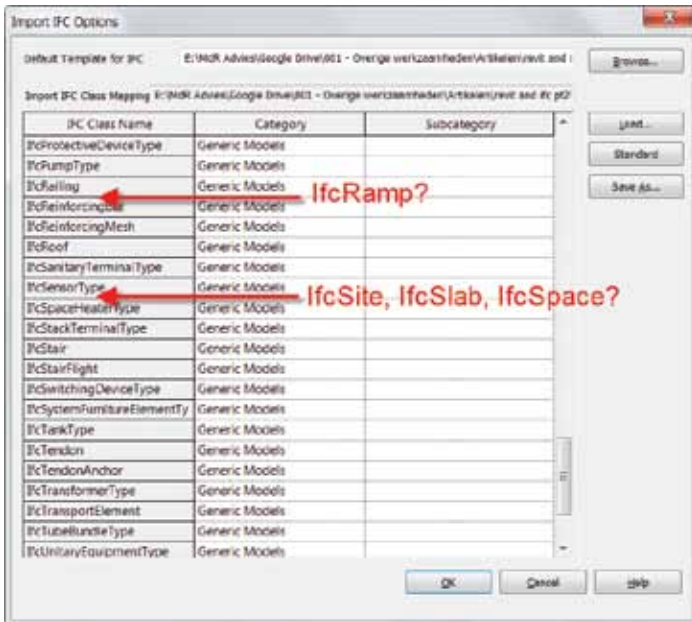


Figure 6

Why would you want to do that? I don't really know... But it doesn't just end here. When thinking about practical uses, it occurred to me there are several:

Use masses to model sites and convert them to a topography.

Model complex windows as curtain walls and re-import them as a native window.

Ever have a mass that wouldn't let you create a Wall/Floor/Roof from Surface? Select the surface, extrude it to the desired thickness, export to the proper IFC class, and re-import.

Use Generic Model Adaptive Components to create all sorts of shapes you cannot manage in the "regular" family editor and then export and re-import in the desired category.

And so on...

Granted, there are limitations. Imported IFC objects usually are dumb, non-parametric objects, which limits the usability. And I've not had the time to test performance hits, stability, and that sort of thing. So use at your own risk. But still, this is an intriguing workflow.

IFC BY LAYER

Have you ever had to use an IFC file from other software such as ArchiCAD? Notice how they could sort IFCs according to layers with a custom naming convention?

That can also be done and customized in Revit. By default it will use some American format. To customize it, you need to add a setting in your Revit.ini file. Add these lines:

In [Directories], add: `ExportLayersNameDGN=xxx.txt` (with "xxx" being the full file- and pathname of your layer mapping file. In this article I basically used my dwg mapping file.

In [Export] add: `UseVersion2012DGN=1`

You will now have the custom layer settings in the IFC file (see Figure 7).

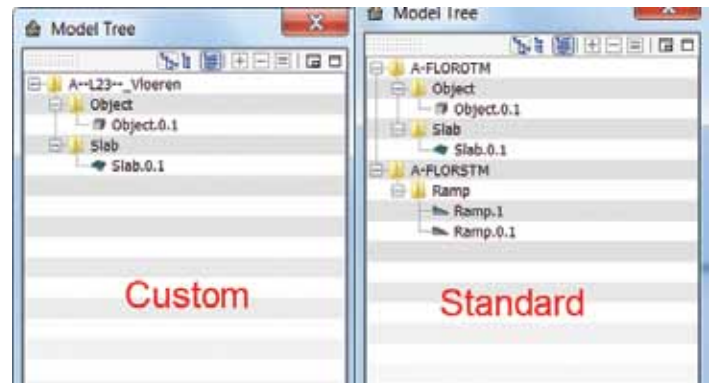


Figure 7

EXPORTING CUSTOM IFC PARAMETERS

Have you ever tried to create and export IFC parameters that were not in the Autodesk IFC Shared Parameters file? Did it work? I'm guessing it didn't and that's probably because you tried to do it the logical way and put your custom parameters in the IFC Parameter group. That's not possible—you can basically use any group but this one.

KNOWN LIMITATION: FAMILY INSTANCES

One of the most frustrating issues pertaining to IFC imports in Revit is the fact that Family Types and Instances are not recognized. In other words, import 20 similar Windows or Doors and there will be 20 different families in Revit.

This, however, is a limitation within the IFC file format and not a Revit-related problem. IFC knows only individual objects and does not have the intelligence to group similar objects into families and/or family types.

Both Autodesk and other software developers such as Tekla are working on ways around that. In fact, the latest importer/exporter for Revit in Tekla 19 should be able to identify different instances of beams and group them in families. The Revit importer explores these possibilities for columns.

However, there are some difficulties. How does one define which elements should belong to one family? For structural elements, which are for the most limited in variation, it is relatively easy to base it on geometry. For doors or windows that's virtually impossible. Maybe somewhere in the future there will be a smart way to do this, but I highly doubt it. And to be frank, there are bigger problems.

USER INPUT: VARYING RESULTS UPON IMPORT

If you work with IFC regularly you might experience varying results upon importing them in Revit. Usually this is not your (or Revit's) fault.

Take, for instance, a roof in ArchiCAD. This can be modeled in various ways: With the Roof tool, Shell tool, Morph tool, and Slab tool, after which it is "told" to be a roof.

The last one creates an error in the IFC output. Yes, it's really a bug—verified and all. You can check this by creating a slab in ArchiCAD and tell it to act like a roof. In the properties it will remain in the IfcSlabType class, which creates an error when importing in Revit where it is ported to the Generic Model Category.

This example is a bug. But there are others where the way things are modeled in one software affects the way it's exported and imported in another.

IN CONCLUSION

To be honest, I would have stopped this quest after the first article if it wasn't for all the feedback I received from people also working on this. Some just provided me with tips and tricks; with others I am collaborating on a daily basis to get this entire IFC thing properly documented.

I am not a particularly big fan of the format. It has its place, but use is limited to a carrier of the most basic information (at least, in my humble opinion). However, getting through this and gaining more knowledge, I am beginning to see that 99 percent of the opinions "out there" are expressed by people who have absolutely no clue of what they are talking about.

And to figure it out is a bigger challenge than anything I've faced with Revit in the past year. And I do like my challenges every now and then...


So, this is a shout out to all of you who have tricks and tips on IFC not included in this article or the previous one; for those who are trying to figure this out too and want to help and/or collaborate on this; or anybody who just wants to pick my brain. Contact me on Twitter (at mdradvies) or by email (martijnderiet@mdr-advies.nl) and hopefully we can get this thing sorted once and for all.

And maybe there's a Part 3 in this, too.



Martijn de Riet is a self-employed BIM Consultant from the Netherlands, working with Revit since version 5.1. Martijn has a bachelor degree in Building Science. After his study he started his own engineering firm working for contractors, architects and private clients. Starting 2007 his company transformed into a full-time BIM consultancy service. At the moment, Martijn's clients vary from mid-sized architectural firms to the largest Dutch general contractor and MEP engineering firms, with a focus on specific corporate solutions, design, and implementations of Revit and BIM workflows. Martijn is a member of the Dutch Revit User Group and currently working on creating a Master Template and library. He provides lectures for companies, technical universities, seminars and such on a regular basis.

Display Themes and You

 **T**he Display Themes tool has been around since AutoCAD® Architecture release 2006, but it is not widely used and therefore under-appreciated by many. Display themes will work with any ACA object. Manual properties of an object—such as a wall's fire rating or a door's manufacturer—are not typically visible in a drawing. The display themes tool lets you incorporate such non-graphic data in your drawing (both 2D and 3D) by using certain colors, fills, or hatches to highlight objects that meet the criteria or theme rules that you have established in a display theme style. For example, you could

define a property named Function for room objects and then set up a theme rule that specifies that rooms with a Function value equal to "storage" will be displayed with a solid cyan fill. A display theme can be activated in a drawing by using a display theme tool to insert a display theme legend, which explains the meaning of color, fills, or hatches specified in the theme.

It is important to note that if you use a display theme style that is provided with AutoCAD Architecture 2013, the property set definitions and property data formats for the style are already created for you.

CREATING DISPLAY THEMES

Display themes are an effective way to present information during the conceptual design phase of a project or when working with construction documents. With display themes, you can identify changes to a project that are not in the contract, identify the staging of a project, and identify objects that meet or do not meet specific standards. If you use the drawing as an external reference (xref) in a project, the display theme is imported into the host drawing by default. If the host drawing already contains a display theme, then the display theme in the host drawing overrides the display theme in the xref. A marker appears over the disabled display theme legend.

Below is a simple, five-step process that you can follow to create a display theme.

1. Create property data formats to use in your theme. The formats you create will determine how your data is displayed in the display theme legend.
2. Create property set definitions for objects in your drawing. Here you will incorporate formats from step 1.
3. Create a display theme style. This will specify the format for the legend of your display theme as well as what objects will be highlighted in your drawing. The legend is a key that will incorporate property set definitions from step 2. It will specify which visual indicator will be applied to which objects in a drawing and what the content will be.
4. Attach property set data to the objects for inclusion in your display theme.
5. Activate the display theme by adding the legend to the drawing.

Now, let's look at each of these steps in a little more detail.

PROPERTY DATA FORMATS

The criteria for the display theme are based on the property data attached to the objects or object styles. The property data overrides the display properties to produce the visual effects produced by inserting a display theme. Property data formats are created and edited in the Style Manager under the Manage tab of the ribbon, Style & Display panel. You can also enter the command AECSTYLEMANAGER. To create a new format, expand Documentation Objects, right-click Property Data Formats, and click new. Enter a name for the new format and click enter. If you wish, you can also select an existing Property Data Format, right-click and copy, then paste and rename.

Now, click on the Formatting tab (see Figure 1). Here, you will need to specify how you want the formatting to appear. For example, if you want the text to appear in all capital letters, you would select "Upper" under the Case drop-down. Fill in all information pertinent to the format you are creating. Click Apply and then OK when you are finished.

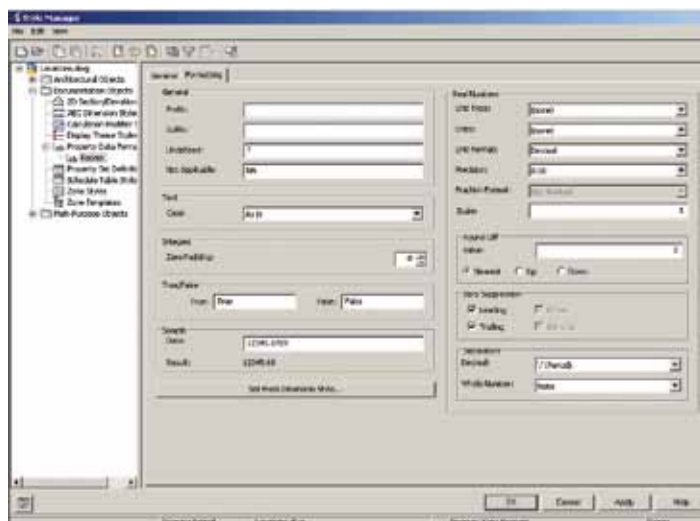


Figure 1: Property Data Format

PROPERTY SET DEFINITIONS

Property set definitions are created and edited in the Style Manager under the Manage tab of the ribbon, Style & Display panel. You can also enter the command AECSTYLEMANAGER. To create a new definition, expand Documentation Objects, right-click Property Set Definitions, and click new. Enter a name for the new definition and click enter. If you wish, you can also select an existing Property Set Definition, right-click and copy, then paste and rename.

Select the Applies To tab and check the box next to each Object or Style and Definition that this Property Set Definition will apply to in the drawing. Now you will want to click on the Definition tab (see Figure 2) and add Property definitions as needed. Using the buttons along the right side of the dialog box, you can choose to add manual definitions, formula definitions, automatic definitions, and so on. The Automatic Property Definitions button is unique in that it brings up a dialog box of preset definitions. The values for each of these properties are obtained directly from an object or its style. The properties available to select are dependent upon objects or styles selected on the Applies To tab (see Figure 3).

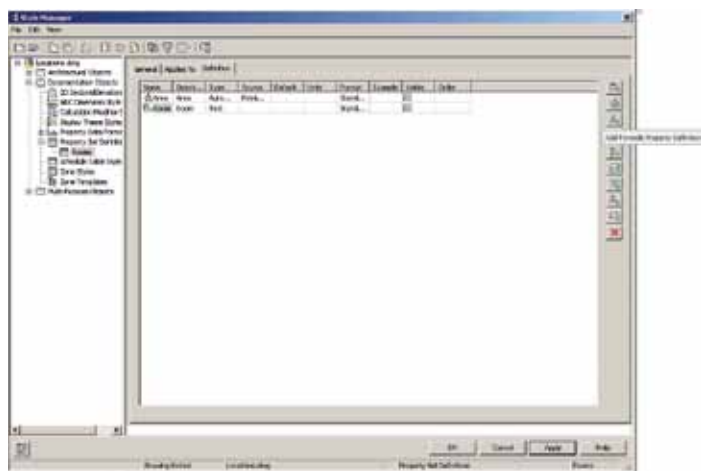


Figure 2: Property Set Definition

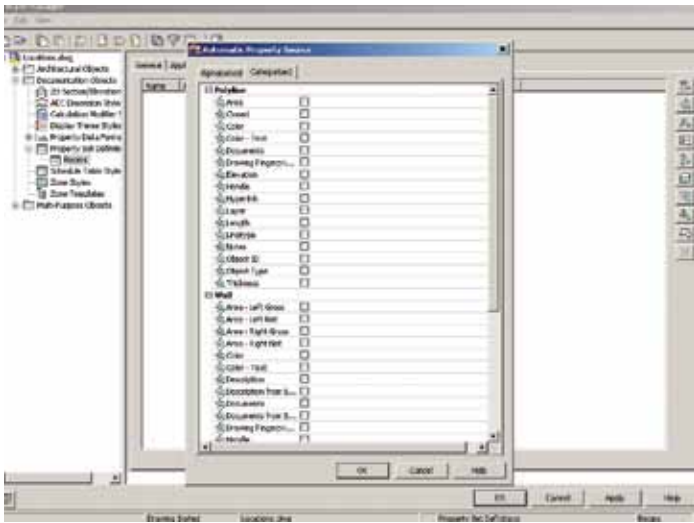


Figure 3: Automatic Property Definition

DISPLAY THEME STYLES

Display theme styles control the visual change to the objects as well as the content and appearance of the display theme legend in the drawing. A drawing must contain a display theme style to effect the visual changes or to add a display theme legend. When you copy a display theme style into a drawing, property set definitions and data formats specified in the style are also copied. Display theme styles are created and edited in the Style Manager under the Manage tab of the ribbon, Style & Display panel. You can also enter the command AECSTYLEMANAGER. To create a new style, expand Documentation Objects, right-click Display Theme Styles, and click new. Enter a name for the new definition and click enter. Enter a description for the Display Theme Style. If you wish, you can also select an existing Display Theme Style, right-click and copy, then paste and rename.

Next, click on the Design Rules tab (see Figure 4) and click the Add Component button on the right side of the dialog box to create a new theme setting. This will create an unnamed theme setting with an index number of one. Now you can create the settings for the display theme, which will control the type of highlighting in the style.

Next, you can create theme rules for each theme setting, which will determine specifically which objects will be highlighted using each setting. When you create a theme rule, you will see an index number, which corresponds with the theme setting. If you wish, you can create multiple rules for each theme setting. For each theme rule you create, you can select a property set definition, a property that is contingent upon the property set definition you selected, and a condition that is contingent upon the property set definition and property you selected. Then you will enter a value appropriate to the condition you selected and select an operator appropriate to the formula you are creating for the theme rules.

Next, you will specify the format for the design theme legend by clicking on the Legend Format tab. Enter in the information that is pertinent to your style.

Last, you will specify the display properties for the display theme legend by clicking on the Legend Display Properties tab. You will then select the display representation on which to display the changes and select the Style Override. The display representation in bold is the current display representation. Click the Layer/Color/Linetype tab, select the component to change (if any), and select a different setting for the property. Once everything is finished, click OK twice.

Once your display theme style is created, you can drag and drop it onto the tool palette for future use. Doing this creates a display theme tool. Once it is placed on the tool palette, you can right-click on it and click on Properties to add a description, change the scale of the legend, and more.

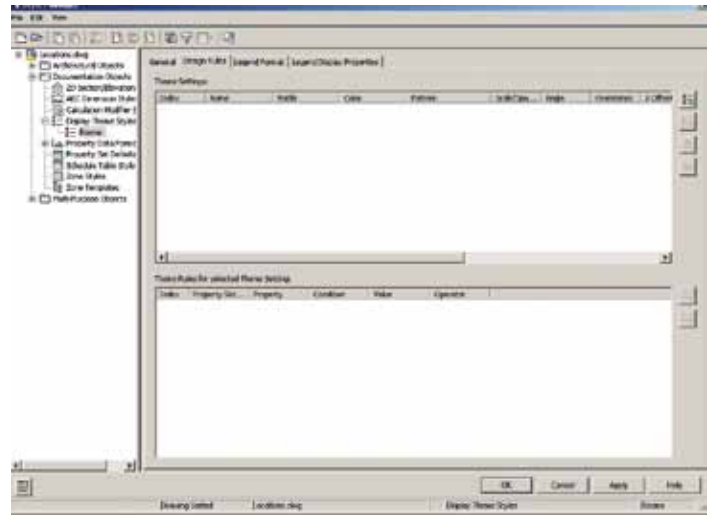


Figure 4: Display Theme Style Design Rules tab

ATTACH PROPERTY SET DATA

Now that you have created everything you need for your display theme, you will need to attach property set data to objects in your drawing. Select the objects to which you will be attaching property set data, right-click, and select Properties. On the Properties Palette, click the Extended Data tab (see Figure 5). Next, click the button at the bottom of the palette to add property sets. Select the property sets to attach to the object and click OK.

The property set is now attached. You will find that the values for automatic properties are already filled in. At this point, you can enter data for manual properties for each object.

It is important to note that if you select more than one type of object, you can attach only the property set definitions that apply to all the selected objects. For example, if you select doors and windows, you can attach only those property sets that apply to both doors and windows.

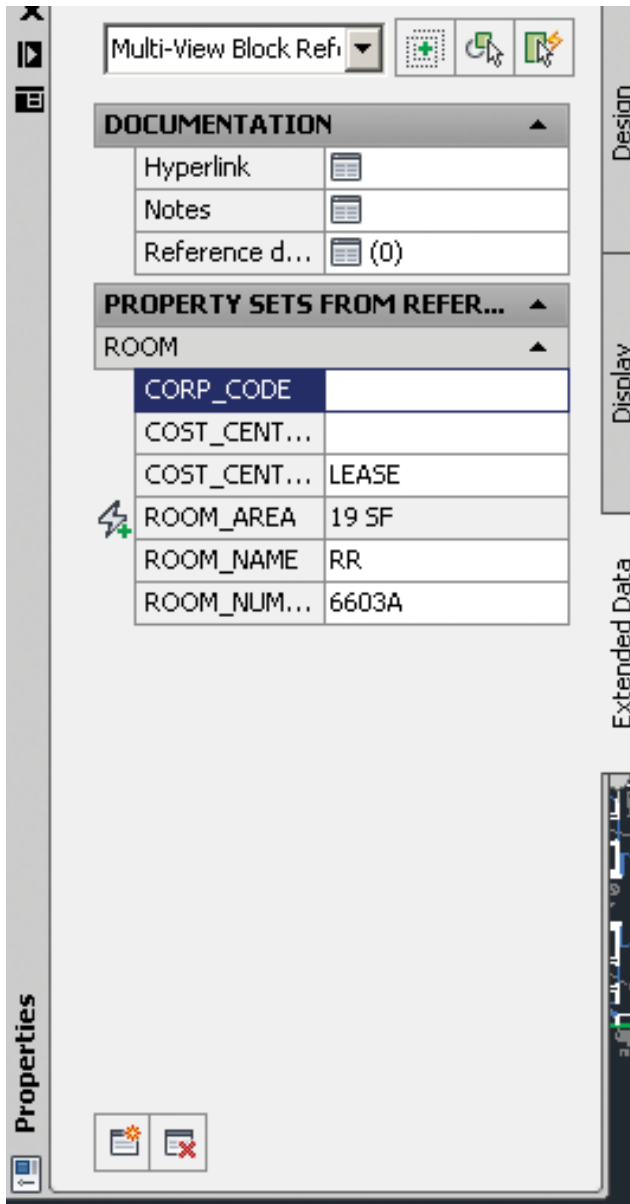


Figure 5: Properties Extended Data

DISPLAY THEME LEGEND

A display theme legend provides a key to the display theme, mapping specific colors, fills, or hatches to properties of objects in a drawing. You insert a display theme legend into a drawing to activate a display theme and visually change the appearance of objects by overriding the current display properties.

The tools provided let you quickly place display theme legends by selecting a display theme tool with a specific display theme style and other predefined properties. When you place display theme legends using display theme tools, you can use the default settings of the tool or you can change settings for the display theme properties. You can also use display theme tools to apply the settings of a display theme tool to existing display themes.

The default Scheduling palette in the Tool palette set contains three sample display theme tools that you can use and customize as needed. Custom palettes created by your CAD manager or other users may also contain display theme tools with display theme styles and properties that are customized for your projects or office standards.

ACTIVATE DISPLAY THEME

The display theme legend activates the display theme in the viewport and identifies the meaning of the different colors, fills, or hatches used in the theme. The data for the display theme legend is collected from the property set data attached to the objects or object styles, as specified in the display theme style. When you add new objects to a drawing, data is added to the legend if it meets the criteria you specified in the display theme style.

At this point, you are ready to add the theme you created into your drawing. The display theme is added to the drawing through either the scheduling tool palette or the command `DisplayThemeAdd`.

Open the tool palette that contains the display theme tool you want to use and select the tool. In the drawing area, specify the insertion point for the upper-left corner of the display theme legend. Then specify the lower-right corner of the legend or press enter to scale the display theme legend to the current drawing scale. The display theme is now activated. At this point, you will notice that the objects affected by the display theme visually change in the drawing as indicated by the legend.

You can add more than one display theme to your drawing; however, only one theme at a time can be active. If you add a display theme to a drawing that already contains a display theme, the older theme will automatically be disabled when you add the new one. If new data is added to your drawing that meets the criteria of your display theme style, it will be added to the legend.

CONCLUSION

After creating your first display theme, you will notice at each use that inserting a display theme style in a drawing is a lot quicker than inserting hatches and color fills separately for each object in a large drawing. This is a great way to get presentation style drawings quickly and efficiently!



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Plumb It, Don't Plummet



It starts with a basic question: “Who owns the plumbing fixtures?” The architect places the fixtures, but the engineer/designer specifies and plumbs the fixtures. In a multi-model workflow process, should the fixtures be located in the plumbing model, the architectural model, or both? If they are in both models, is the project fixture count accurate? Is there a chance of the fixture count being doubled? If the plumbing fixtures

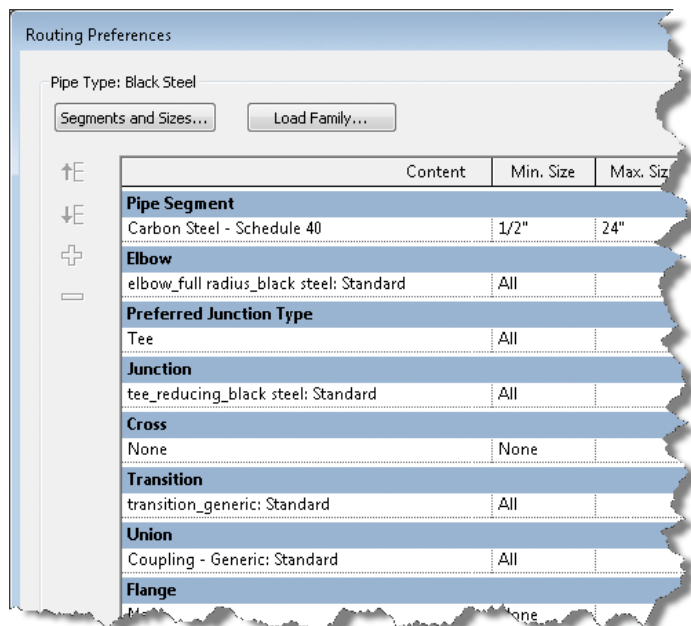
are copied into the plumbing model, what happens when there are background changes? Can the architect rely on the plumber to maintain fixture locations, ADA clearances, and so on?

After reading the first paragraph, many might think that the software’s Copy/Monitor functionality is the solution. Copy/monitor is very useful with levels and gridlines, but maybe not so much with plumbing fixtures. Copy/monitor will inform you of objects

being changed and you will have the option to update them, but the occurrence of broken piping systems connected to those objects will not be revealed until the changes are accepted.

This article is intended to present an option for creating plumbing systems in Autodesk® Revit® MEP in a multi-model workflow process without disrupting that process between the architect and the plumbing engineer/designer while maintaining the functionality of Revit MEP, BIM, and accuracy within the plumbing model.

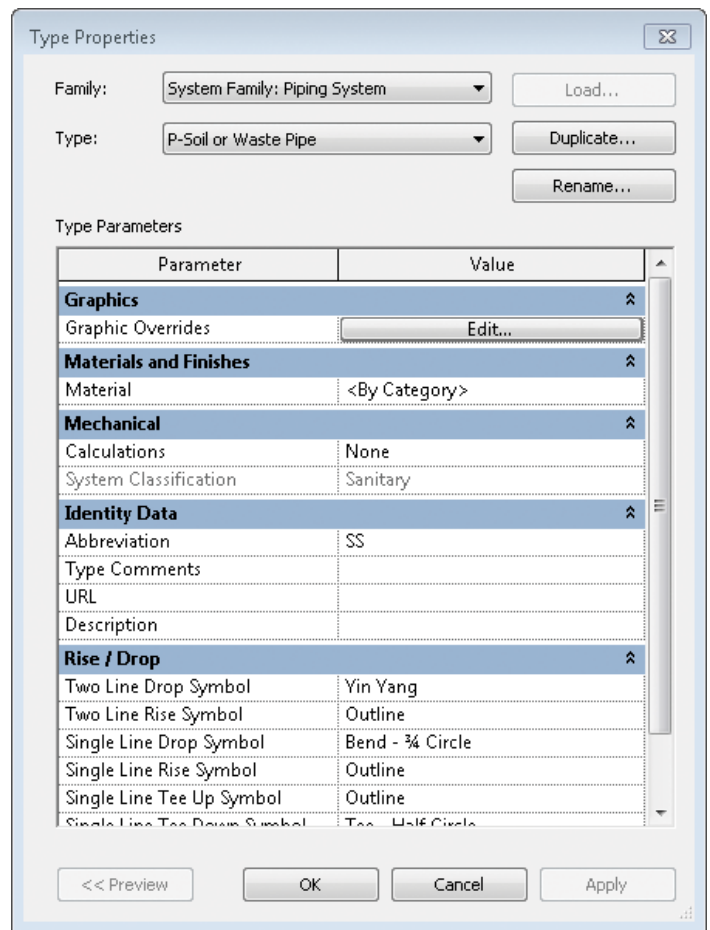
Before designing plumbing systems in a Revit model, a few plumbing basics need to be set up in the template. Start by defining the pipe types: Black steel, Cast iron, Copper, PVC, and Standard are the basics. Pipe fitting defaults are set at the pipe type (Type Properties in Revit MEP 2012 and Routing Preferences in Revit MEP 2013). Set a preferred junction type (tee or tap) and then set the default fittings and pipe segment type.



There are basic fitting types delivered with the software; however, additional pipe fitting types may need to be created or purchased. Experience dictates that custom pipe fitting creation is best left to experienced individuals.

Tip: It is beneficial to have an understanding of how to edit lookup tables (csv files) that are associated to the fittings to add various pipe size requirements. As you model your plumbing systems and “custom fittings” are being created by Revit accompanied with a “Warning,” be sure to address these warnings or the performance of your model will suffer. Revit is telling you that the lookup table does not contain the fitting size being inserted into the pipe. You need to decide if the lookup table needs to be edited—or perhaps hooking a 1/4” pipe directly into a 12” pipe might not be the best routing solution.

Pipe systems need to be set up as well. Create your pipe systems as needed if a different graphic representation is required (system color, line weight, and line pattern are set at the system level). Edit the Graphics Override and save them.



Tip: Revit contains default piping systems: Hydronic Return, Hydronic Supply, Sanitary, Vent, Domestic Hot Water, Domestic Cold Water, four different Fire Protection systems, and Other. If you create new piping systems, make sure you duplicate the correct default system. For example, don’t duplicate Hydronic Supply to create a Hot Water Recirc system. The default systems have an associated classification that can be used to set up filters to control what is displayed in your views.

Tip: The “Other” classification will not calculate fixture units and should be used for systems such as fuel oil, medical gas, or natural gas. For some reason, the “Vent” classification also will not calculate fixture units.

View templates need to be created for the graphic display of working views and views for sheets. Consider creating filters associated with classifications as mentioned above to control the on/off display (turn off fire protection in a domestic water view). The Medium or Coarse display setting will display pipe as single line and hidden line will display the rise/drop symbols correctly. The Fine display setting will display piping as double line. Foundation plans look nice when displayed as double line.

Tip: For linked models, it is beneficial to work with other disciplines and have them create views in their models for linked views needed in your model. This saves a lot of time during model setup. Return the favor by setting up views for others in your model. You will be a hero!

Revit MEP 2013

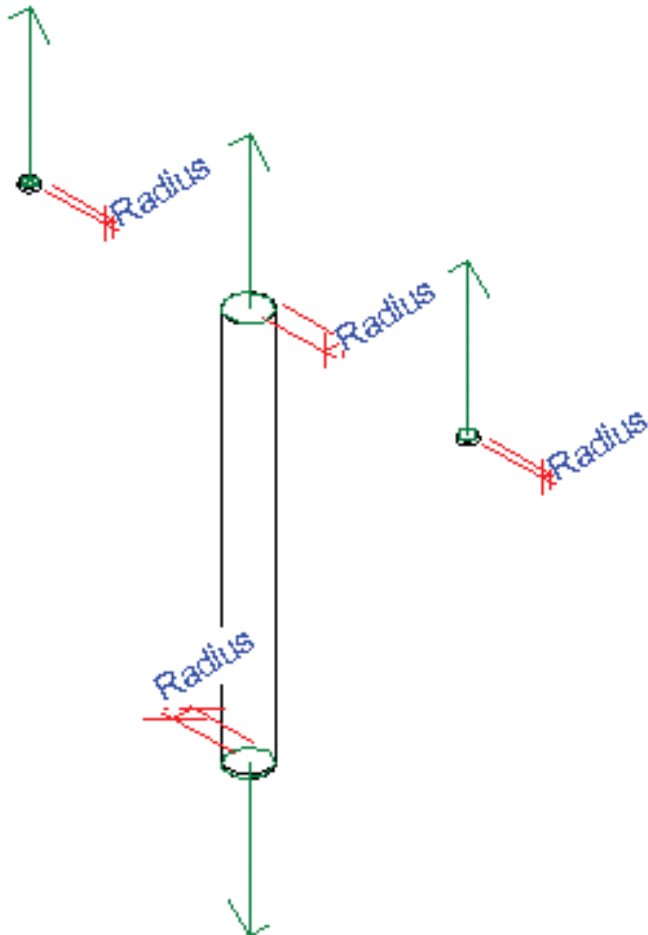
Once the template basics are set up, it's time to decide what to do with the plumbing fixtures (finally!). My approach to this issue is to create families that will be located in the plumbing model and will sit right behind the plumbing fixtures displayed in the linked architectural model. In actuality, these families represent the fixture carriers.

Family creation can become very complex and frustrating. The families for this solution contain very few graphics and require only a basic knowledge of family creation. However, these families do contain multiple parameters that demonstrate the capabilities of BIM and can be created with minimal effort.

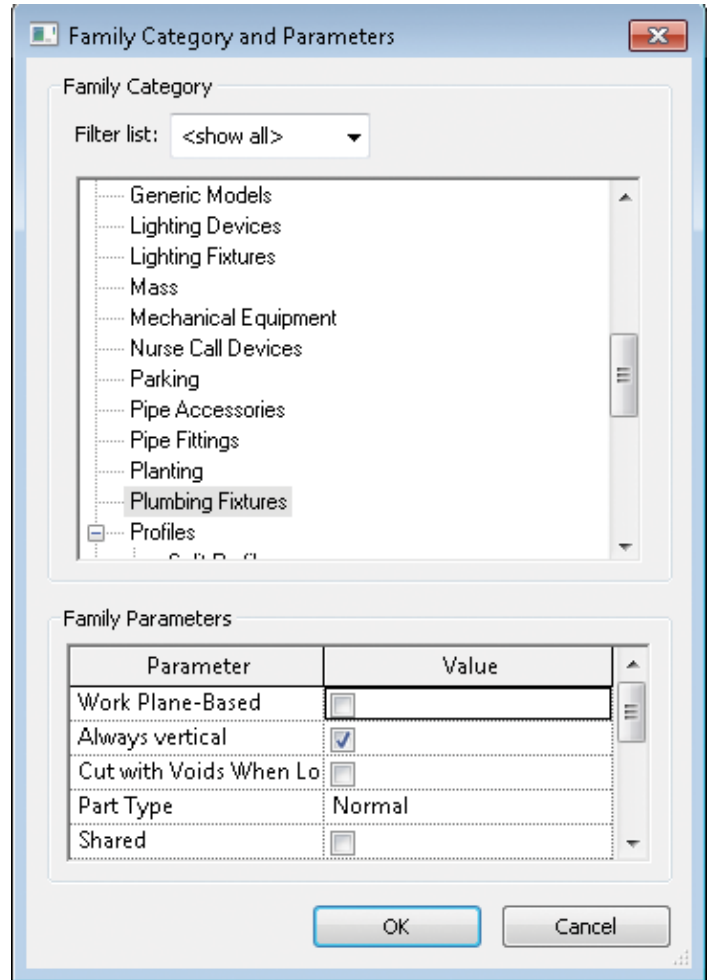
I'll use a custom lavatory family as an example. It contains only two extrusions for the hot water and cold water connections and a longer extrusion for the vent and waste connections.

Tip: A spacing of 7" between the extrusions will allow the rise/drop symbols enough room without overlapping in the medium and course view settings. A parameter to adjust the height above finished floor after it is placed in the model should be considered as well (good for 3D views).

After the graphics are finished, attach pipe connectors to the ends of the extrusions, making sure they attach to the correct face of the extrusion.



After the connectors have been placed, create parameters and assign to each connector. Step one is to open the Family Category and Parameters dialog box and select Plumbing Fixtures.



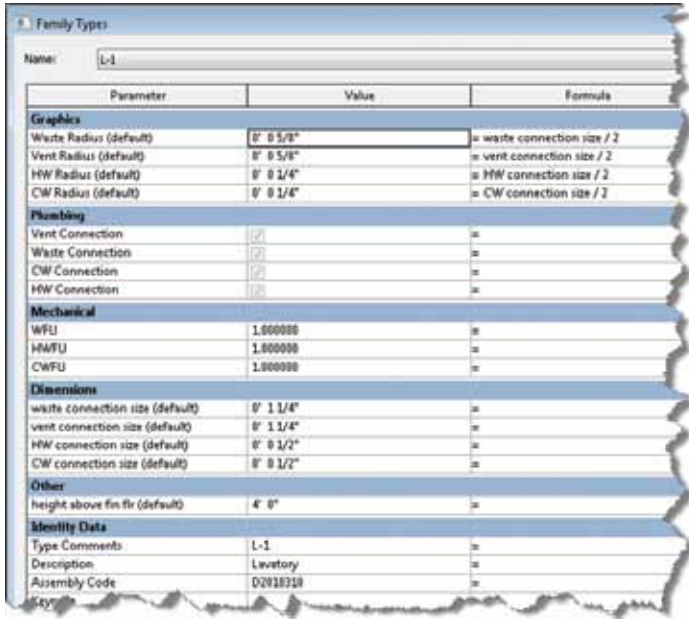
Open the Family Types dialog box. There are three parameters under the Mechanical group that are used to assign fixture units to the family. As mentioned above, there is not one for vent piping.

There are shared parameters available for the four connection sizes used in this family (waste, vent, HW, and CW). Insert them into the family from the Shared Parameter text file in the Family Types dialog box. Select Add on the right-hand side of the dialog, then select and insert the parameters. You may need to browse to the shared parameter text file.

Going back to the Family Types dialog box, notice the four parameters under the Graphics group. These are parameters that help control the size of the connectors. Connector sizes are determined by their radius while pipe sizes are identified by their diameters. Set the radius parameters to half the size of the associated connection size parameter in the formula column. Use the radius parameter to control the connection size and extrusion size so they flex together. This makes editing the family easier (if needed) by thinking in pipe diameter and letting the formulas do the math for you.

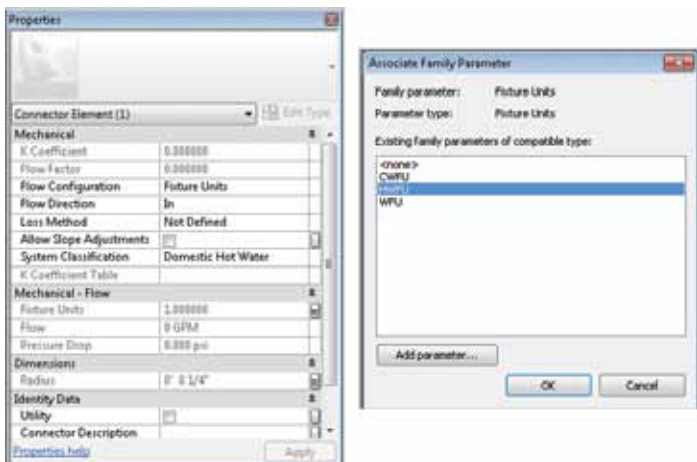
For the waste/vent extrusion, control the size by using the Waste Radius parameter. The vent connection will typically be smaller than the waste connection, so just assign the Vent Radius parameter to the vent connector.

Once those are added, the Family Types dialog box should start to look like the following figure.



Fill in the Identity Data fields as needed. These will be useful in schedules. I use Type Comments for Fixture Mark Numbers in my plumbing fixture tags. Assembly Code is used for COBie requirements (if needed) and can be associated with specifications. All of these parameters can be scheduled.

Back to the families....Select a connector and start assigning the attributes in the Properties dialog box. Select the pull down for Flow Configuration and set it to Fixture Units. Select the box to the right of the Fixture Unit field and assign the appropriate fixture unit type to it. Set the Flow Direction to In for water and Out for waste. Select a Loss Method and then System Classification.



Once this is all set up, changing connection sizes in the Family Types dialog box should change the radius of the connectors and extrusions. Fixture unit values are set in the Family Types dialog box as well.

Tip: For scheduling in Revit, consider creating a Total CW Demand Load parameter to help with sizing the water service to the building. A parameter for assigning fixtures to stacks might be useful as well.

One final consideration is to create several types in the family for each fixture type in your specifications. Select the New button in the Family Types dialog box and create as many as you need.

Tip: Name the type with the mark number that will be assigned to it. Also, fill in the description and the parameter that will be used to tag the family once it is inserted into the project. Experience indicates that the Type Comments parameter works well for tags (as mentioned above).

Once the basics are understood and a successful fixture has been created, start building all the fixtures you will need.

Tip: Copy the lavatory fixture and rename it "Sink," then edit the family, rename the types, edit the description, and save it. Copy the lavatory fixture and rename it "Water Closet," then edit the family and remove the HW connection.

For fixtures such as mop sinks and showers, add a dimension parameter that controls the offset of the waste connection from the wall and remove the vent connection.

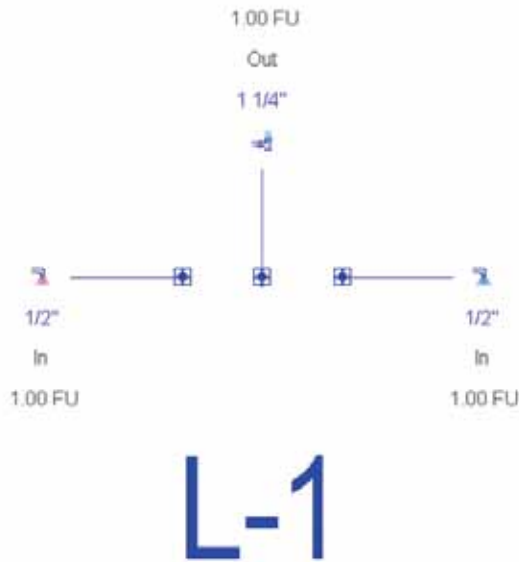


Create a family that contains only the waste and vent connections and extrusion. Use this family for venting the waste up a wall from the mop sinks and showers. Set the waste fixture units to "0" so the fixture unit count in the system still calculates correctly.

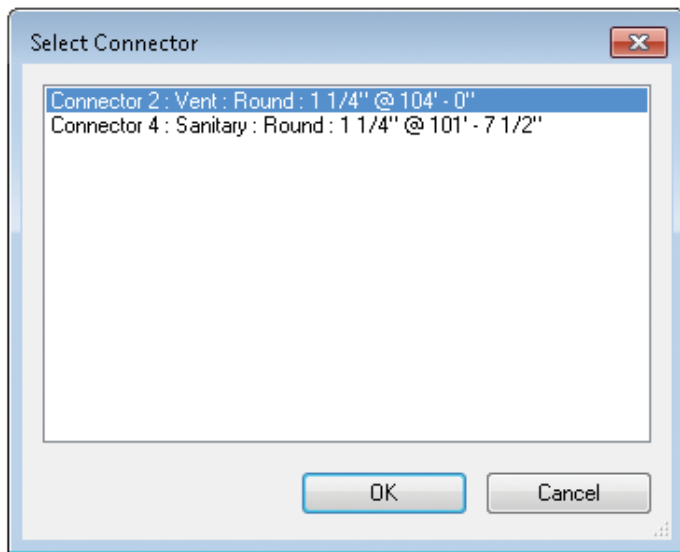
Tip: Use a section view to connect the waste piping to the connectors.

Place the families behind the architectural fixtures. The space bar will rotate the family to the correct orientation (CW connection on the right). Piping can now be routed and connected to the plumbing fixtures. By selecting the family, icons will appear that show each connection and the associated classification.

Revit MEP 2013



If the waste or vent connection is selected for the first time, Revit will ask you what connection you want to hook to since the connections are stacked.



After several fixtures are connected together, select a pipe and check the fixture unit count for a total. If the total reads "0", there is more than one open end somewhere in the system. Check the pipe to the connectors or make sure the fixture units in the families aren't set to "0".

Other Tips

- Open-end pipes will cause the fixture unit counts through the system to be "0". Cap the ends.
- For loop systems, break the pipe and add caps to each side of the break. Nudge them close together so the gap is not noticeable. For single line plotting, create a pipe cap and remove the lines creating the schematic cap symbol from the family. The result will look like a continuous line in the model.

- Use caps when hot water lines turn into hot water recirculating lines. Put a cap on the end of the hot water line so the fixture unit count calculates correctly. Start the hot water recirculating line next to the cap and model the system. This will allow the line patterns identifying HW and HWC to display correctly.

One final topic: Schedules. Use them! The automatic schedules in Revit MEP are very powerful if you know how to use them. Revit has a default plumbing schedule category. Select it and start dragging parameters into the schedule. All of the shared parameters mentioned above can be scheduled. Figuring out how to filter and sort the fields in the schedule is challenging yet very rewarding once you have the final result achieved. Schedules can calculate quantities and totals. By simply placing our new plumbing carriers behind the fixtures displayed in the linked architectural mode, a total count of each fixture type and total fixture unit count can be calculated without even modeling a single pipe. By adjusting the settings of the schedule, these totals can be calculated per floor, by waste stack, by fixture type, or the entire building.

Mark Number	CVFU	HM/FU	VW/FU	Total Demand Load
L-2	7.5	7.5	5	10
L-8	3	3	2	4
WC-2	80	64	80	
WVC-4	108	0	144	108
WH-1	0.5	0	0	0.5
Grand total:	196	375.75	161.25	386

In closing, remember these three things:

- Communication is still the key to a successful project.
- It flows downhill.
- Payday is on Friday.

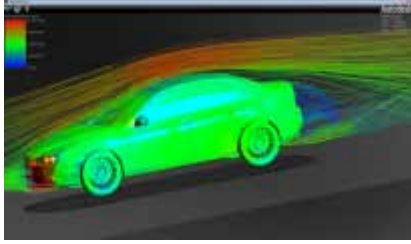
Happy plumbing!



Dave Bencoter graduated from Northwest Missouri State University with a bachelor's degree in Industrial Technology in 1988. He has been employed at HDR for nearly 25 years. During this time, Dave has worked for the Mechanical Department designing HVAC, Mechanical Piping and Plumbing systems using multiple CAD packages (Revit MEP being the latest). He has also been involved with the development, implementation, support and content creation for these CAD packages while serving on the Best Practices team. You can contact him at dave.bencoter@hdrinc.com

PROJECT FALCON

<http://labs.autodesk.com/utilities/falcon>



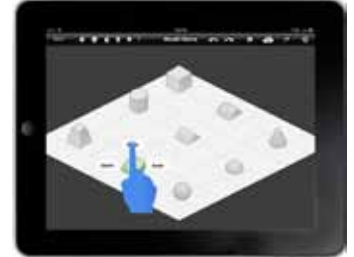
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Project Falcon is a free technology preview that simulates air flow around vehicles, buildings, outdoor equipment, consumer products, or other objects of your choosing in a virtual wind tunnel.

Project Falcon uses a revolutionary automatic meshing technology that can handle flow around any geometry at any stage of design. This technology is coupled with a transient, incompressible fluid flow solver and LES turbulence model in a way that delivers quick results and requires very little setup on behalf of the user.

AUTODESK FORMIT

<http://autodeskformit.com/>



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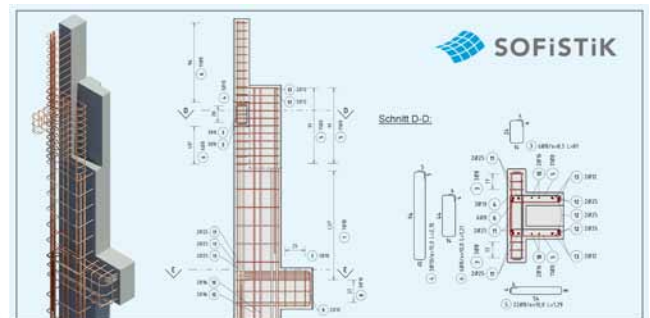
Check out the videos at the website noted above.

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SOFISTIK REINFORCEMENT FOR AUTODESK REVIT 2013

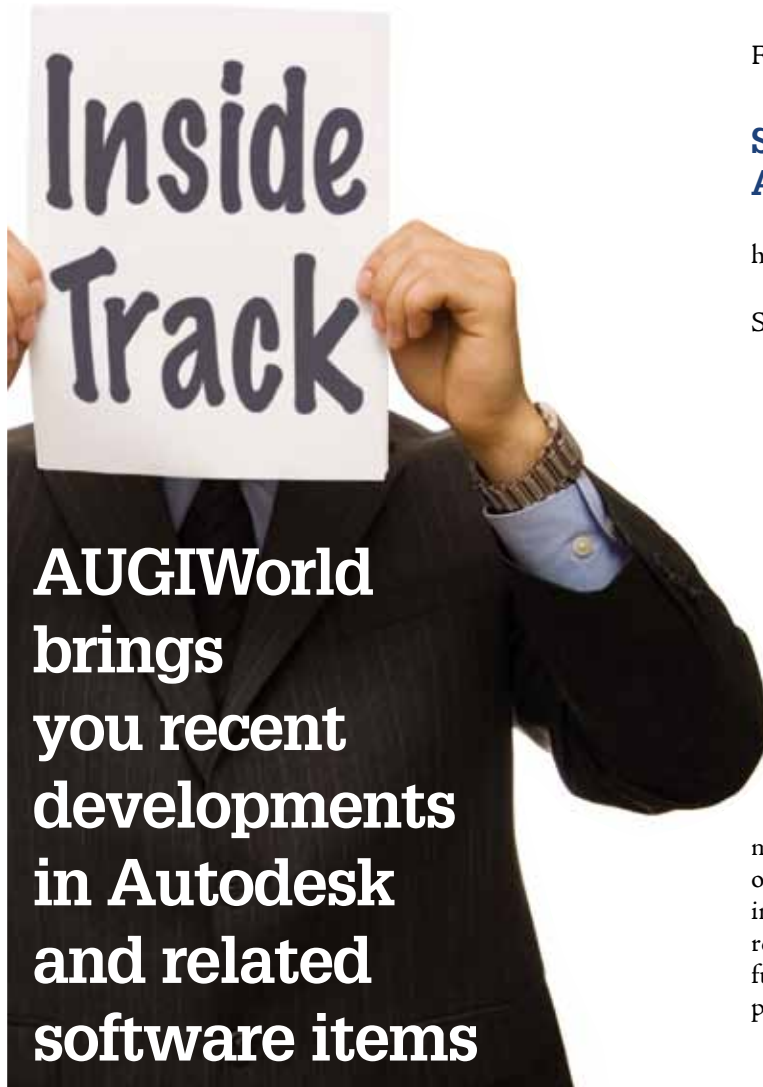
<http://www.sofistik.com/en/solutions/soficad/labsreinforcement/>

SOFiSTiK



A technology preview for creating and documenting reinforcement in Revit.

The goal of this Preview Version of SOFiSTiK Reinforcement for Autodesk® Revit® is to enable the productive design of 3D reinforcement with Autodesk Revit. This particularly includes the creation of 2D plans and steel schedules. The current program version offers, at this time, around 80 percent functionality. SOFiSTiK continues to work with Autodesk on product improvement.



Do More with Fewer AutoCAD Tools



Most Windows applications have common interface and workflow traits. This consistency helps to eliminate steep learning curves and enables users to quickly adapt to other software. Today, we expect to use software in the way we operate other software. It stands to reason that as Windows-compliant software, AutoCAD® has a similar look and feel to other Windows applications.

Imagine if you had never used AutoCAD before. When someone asks you to modify an object, what do you do?

Here are some possibilities:

1. You will try to select it and see what will come next. You would try to see if there are grips available.
2. You will try to double-click on the object.
3. You will right-click and see what options are available in the contextual menu. Most of us will try to find the edit options or properties-related tool on the list.

Many AutoCAD users would love to do as described on the list above. We will try to use AutoCAD like other software packages we know. Many beginners are not familiar with a wide range of AutoCAD tools and people who use AutoCAD just a few hours a week would not bother to learn many of the tools.

In this article, we will see how some of these methods work in AutoCAD, but not only for beginners. These methods can be useful for experienced users, too.

GRIPS

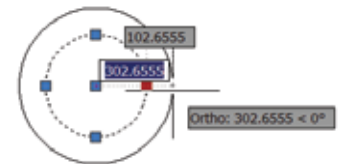
Grips will automatically appear when you select an object. There are several types of grips and each type represents a different function.

The most basic function of grip is to stretch an object. If you stretch a grip on a line, it will change the line length.

If the grip defines object base point, it will move the object. For example, this type of grip appears at the center of a circle and will move the circle. However, the grips located at the circle's quadrant will change the circle diameter.



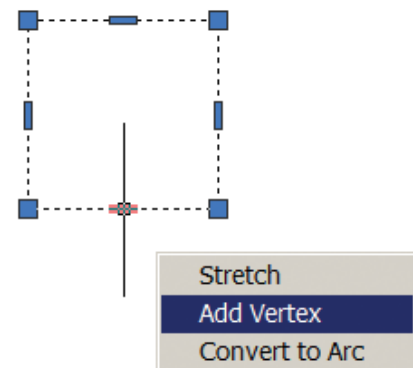
Moving grip at the circle's center



Moving grip at the circle's quadrant

MULTIFUNCTIONAL GRIPS

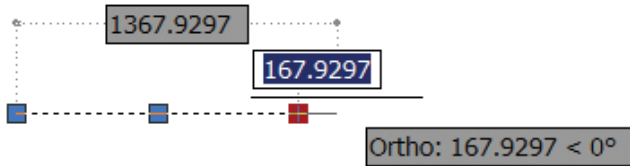
You can do several more things with grips. Since AutoCAD 2011, Autodesk has introduced multifunctional grips. This feature was later enhanced in AutoCAD 2012. With multifunctional grips, you can choose what modification you would like to perform. You need only select an object, then move your cursor above a grip.



Grips not only allow you to use fewer tools, they also provide quicker and easier methods. Previously, it was not easy to add a vertex to a complex polyline. Multifunctional grips now allow you to click a grip and quickly add vertex on that location.

DYNAMIC INPUT

AutoCAD is an engineering tool, so your drawing needs to be precise. When you select a grip, you can use dynamic input to modify the object and give precise input.



In the example above, you can either change the line's total length or the length change. You can easily switch between fields by pressing the Tab key. Once the desired field is active, you can type a new value and then press Enter.

There are options to change angles, also. You can change this behavior in the drafting settings. If you are not familiar with how to access the drafting settings dialog box, type DSETTINGS and press Enter. Go to the Dynamic Input tab and click Settings below the Dimension Input group.

You can choose the third option and activate what fields you would like to see.

DOUBLE-CLICKING OBJECTS

Double-clicking on an object is another common method to modify AutoCAD objects. When you do not know what to do, double-clicking an object will activate related tools to modify the object. For example, when you double-click on a piece of text it will activate the Edit Text tool.

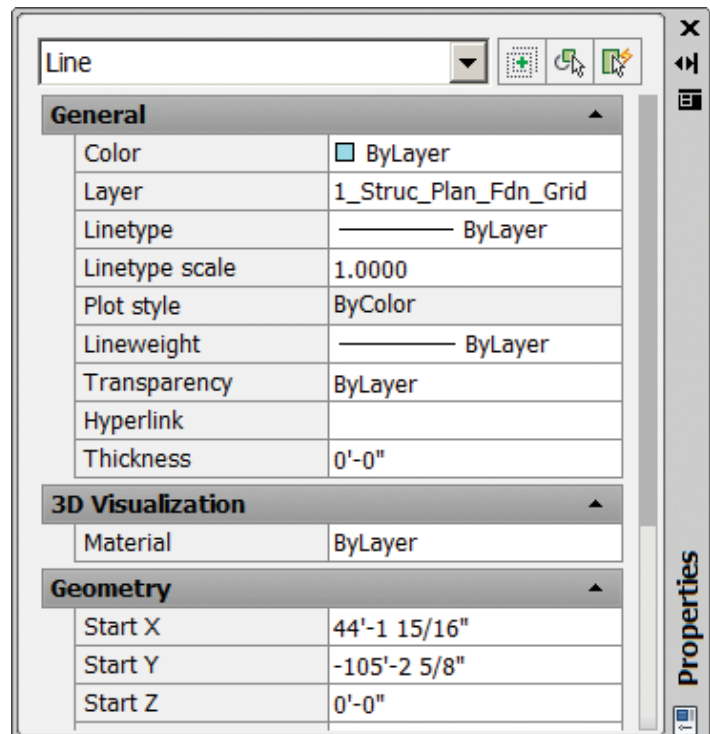
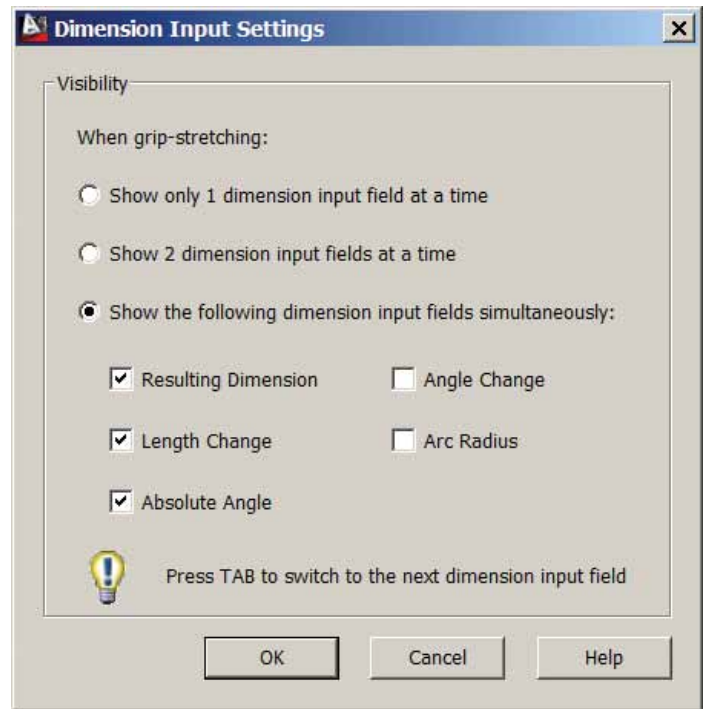
Most object types will open a Quick Properties palette. We will cover this later in the article.

PROPERTIES PALETTE

Changing properties is a popular editing method in many Autodesk applications. In AutoCAD, whether you just want to inspect the properties of an object or try to modify the objects, the Properties palette comes in very handy. Let's see what we can do with Properties palette. You can activate it by pressing CTRL + 1 on your keyboard.

CHANGE OBJECT PROPERTIES

The most common use of the Properties palette is to change object properties. An AutoCAD object can contain so many properties and each may require a different tool to modify it. This single tool enables users to modify all information in one place without having to memorize many tools.



While general properties are common for many users, you can also change specific object properties in this palette.

IF YOU DON'T USE THE RIBBON

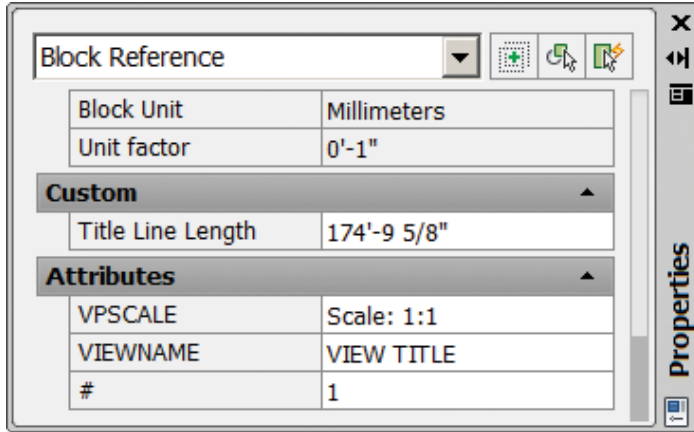
AutoCAD has contextual ribbon tabs that work great to modify object properties. However, not everybody loves the ribbon. If you prefer the classic interface, don't worry—you can achieve the same thing from the Properties palette.

AutoCAD 2013

Of course, you can only change properties. The contextual ribbon has more options and also shows common tools related to the selected object.

EXAMPLE: CHANGING BLOCK ATTRIBUTES

An experienced AutoCAD user would change block attributes by using the Edit Attribute tool. You can activate it by double clicking on a block that contains attributes. However, if you do not like double clicking, you can select the block and change the value from the Properties palette.



EXAMPLE: ALIGN MULTIPLE OBJECTS AT ONCE

This is a popular tip among AutoCAD users, even for advanced users.

Object Coordinates are a property that you can access here, too. Of course, moving objects using the Properties palette is not a recommended practice. However, this allows you to modify multiple objects at once.

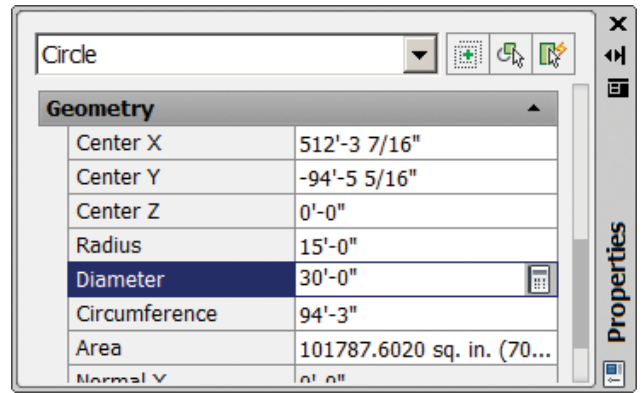
In the example below, you can see we have several text objects. You can align all of them by simply selecting them and then modifying the position X value.



After we change the position X value, it will align all the text objects vertically.

INSPECTING OBJECT PROPERTIES

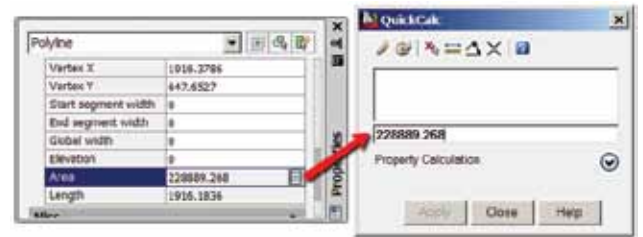
Do you know how to get a line's length, a circle's circumference, or a closed polygon's area? Yes, you can use the MEASUREGEOM tool, but the Properties palette provides this information as well.



Remember, you can also change these values. Sometimes this provides an easier way to modify an object. Sometimes, it provides the *only* way to modify an object! For example, you can change a circle's circumference in the Properties palette, but it is the only way to create a circle by defining the circumference length.

QUICK CALCULATOR

When you select a value in the Properties palette, you will see a small calculator button on the right side of the value. If you click the button, it will copy the value to the Quick Calculator.



Then you can calculate the value as necessary. You can calculate perimeter, length, or area from objects in your drawing.

How can we sum it with another area? You can use the calculator's history to copy the area value you want to calculate with the Quick Calculator. Press Enter to move the value to history. Repeat the procedure until you have all area values in history. After you have them all, you can conveniently calculate them by picking the values.

FILTER OBJECT SELECTION BY TYPE

When you work with complex drawings, selecting objects can be very tedious. The Properties palette offers a handy tool—filter object by type. When you select multiple objects of different types, you can click the drop-down list and choose a specific object type. This will isolate and display the properties of only the objects of that type.

This will not remove other objects from selection. It will affect only properties changed for the selected object type.

For example, say you receive a drawing and want to move all dimensions to a dimension layer. Begin by selecting all objects. Then you can filter your selection by choosing "Dimension" from the pull-down list. Now that all of the dimensions have been isolated, you can change layer from the Properties palette.

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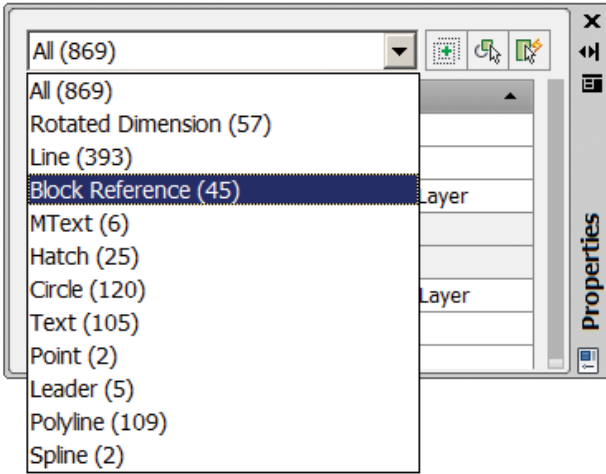


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ARRANGING PROPERTIES PALETTE

While the Properties palette is useful, some feel that it takes too much valuable screen real estate. After we use it, many of us would immediately close the Properties palette without giving it a chance and exploring it further. You can dock the Properties palette to the left or right side of the AutoCAD window. You can also easily resize the column and palette width as necessary.

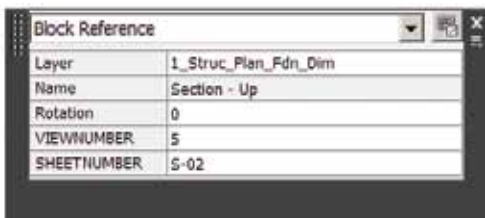
If you still feel the Properties panel is taking too much of your screen, you can minimize it. When you need to use it, you just need to move your mouse pointer above the palette tab and it will expand for use.

QUICK PROPERTIES PALETTE

Autodesk introduced the Quick Properties palette in AutoCAD 2009. With it you can activate the Quick Properties palette from the Drafting Settings or by pressing CTRL + SHIFT + P. When you select an object while Quick Properties is active, a small palette appears near the cursor.

The Quick Properties palette works in much the same way as the Properties palette. The difference is it will open automatically when you select an object. Instead of showing all properties, however, it shows only common properties. This offers convenient access to the most common properties to modify AutoCAD objects.

As you can see in the example below, when you select a block with attributes, the Quick Properties will show only common properties that can be changed. If you were to try to select another object type, you would see different properties.



CHANGING COMMON PROPERTIES

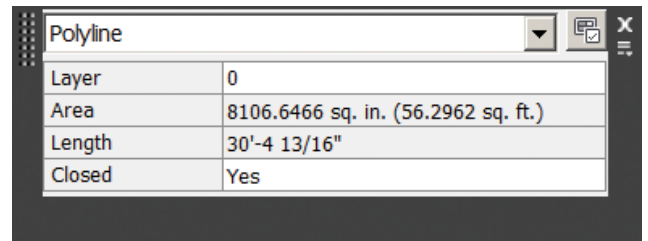
But what is common for me might not be common for you. It depends on your workflow and what you would like to achieve.



You can customize the properties shown in the Quick Properties with the AutoCAD Customize User Interface (CUI). You can quickly open the CUI dialog box by clicking the customize button on the Quick Properties dialog window.

You can customize the properties shown in the Quick Properties with the AutoCAD Customize User Interface (CUI). You can quickly open the CUI dialog box by clicking the customize button on the Quick Properties dialog window.

In this example, only layer, area, length, and closed have been selected. This will allow me to quickly change a polyline's layer or make it a closed polyline. In addition, this will allow me to quickly inspect the polyline's area and length.

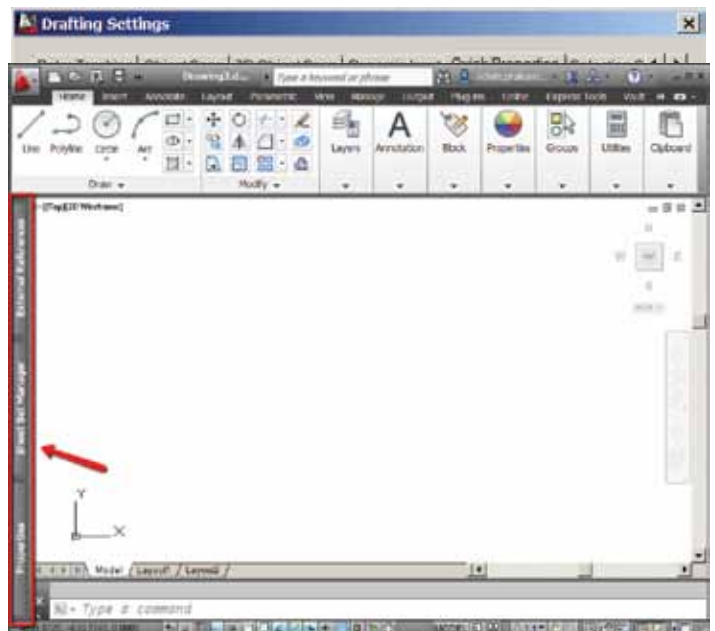


QUICK PROPERTIES PALETTE SETTINGS

Now that you know about the Quick Properties palette, let's explore how you can optimize it further. You can change the Quick Properties settings in the Drafting Settings dialog box by right-clicking above the Quick Properties button, then choosing Settings. Alternatively, you can type DSETTINGS then Enter.

On the Quick Properties tab, you can disable or enable the Quick Properties tool.

There is also an option to set the palette location to appear near the cursor or in a static location.



The idea of Quick Properties is to help you work with properties quickly. However, it should not interfere with our work.

Let's explore more settings that allow you to work comfortably.

COLLAPSING PALETTES

You can set any palette to collapse so it will only show a minimum number of rows. When you move your pointer above the palette, it will expand automatically.

Unfortunately, we cannot arrange the order of the rows. It would be great if we could easily move our most frequently used fields to the top. However, this feature is still useful when we activate the Quick Properties tool and want it to appear at minimal size when we are not using it.

EDITING OBJECT LIST

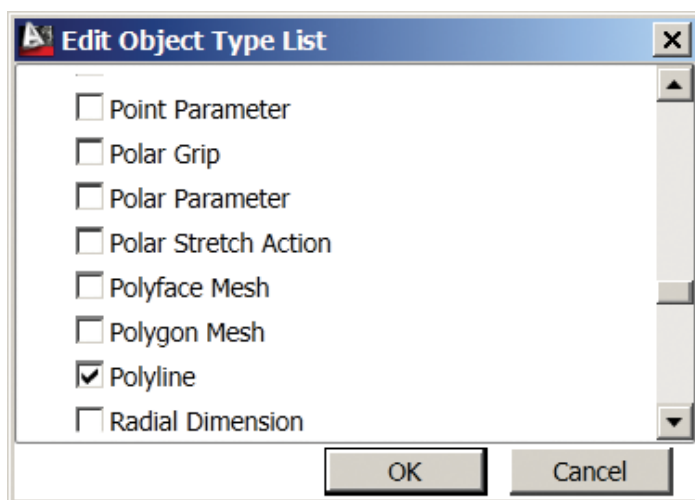
In the Palette Display section of the Drafting Settings dialog box, you can set palettes to display themselves only when you select objects with specific properties or all objects.

Now how we can determine which object to show quick properties? First, open the CUI again.



In the CUI dialog box, above the object type list, click the "Edit Object Type List" button.

Now you can edit which objects will be shown. Uncheck everything you do not need.



Now you will see only objects that belong to the object types that you selected for use with Quick Properties.



Close the CUI dialog box. Try selecting some AutoCAD objects. The Quick Properties dialog box will not be displayed unless you choose an object type that is on the list. In the example above, it will only appear when you select a line or polyline object.

CONCLUSION

The features discussed here are Windows-compliant methods and concepts and are easily understood by most Windows users. The good thing about Windows-compliant features is they are similar across different software. If you are already familiar with one software package, it should be easy to learn and use others.

While these tools are very useful when you only have basic knowledge, experienced users can still benefit from them daily. These tools allow the user to do many more things with fewer tools. And that type of working habit can often make you more productive.



Edwin Prakoso has used AutoCAD since R14. Currently he works for PT Nusantara Secom InfoTech, an Autodesk reseller in Indonesia. When he's not having a training class or presentation, he shares his experiences on his blog "CAD notes." On his blog, his focus is to help other users to be more productive. You can reach him at cad-notes.com or follow him on Twitter at [@CADnotes](https://twitter.com/CADnotes).

Post-Tensioned Concrete Slabs

As we all know, Autodesk® Revit® doesn't provide post-tensioned concrete modeling. Inserting tendons in the concrete is a very tedious and time-consuming procedure, even if we do it just as 2D annotation.

I have worked out an easier procedure for adding and modifying tendons (2D) by creating a number of new families we can use over and over.

MODELING THE SLAB

We start by modeling a cast-in-place concrete slab. For most large PT slabs, we also have to model the drop panels at the column supports. First model a flat slab for the entire area, then model the drop panels as separate slabs from the bottom of the flat slab. Merge the flat slab and drop panels into one slab.

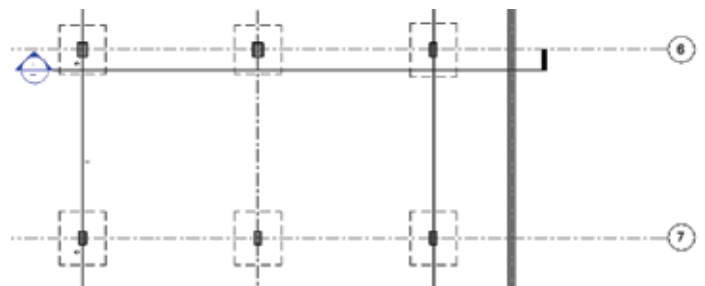


Figure 1

MODELING MILD STEEL IN THE SLAB

After modeling the slab, the drop panels, and openings, we can begin modeling the mild steel.

Above each column (even if we don't have drop panels) is a pocket of top bars. We model these bars as Area Reinforcement.

In the Properties dialog box, do the following.

- Change the layout rule from Maximum Spacing to Fixed Number.
- Turn off the bottom bars and change the number of Major and Minor Direction rebar as needed.
- Add the reinforcing.
- Remove the Area System.
- Change the length of the resulting bar sets to the required length by dragging the ends or changing the "B" dimension in the properties dialog box.
- Tag the reinforcing with the Rebar tag and the Quantity and Type tag.

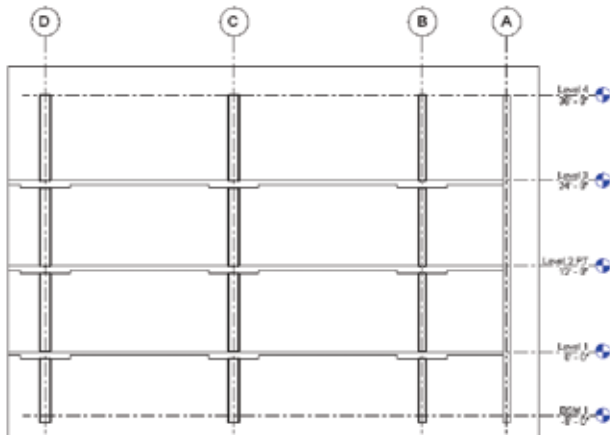


Figure 2

When we have finished modeling the slab itself, we duplicate the plan view (DO NOT use Duplicate with Detailing). This way we have one view for the Mild Steel reinforcement and another for the Post-Tension tendons. Having two views will make the drawings easier to read and less crowded with information.

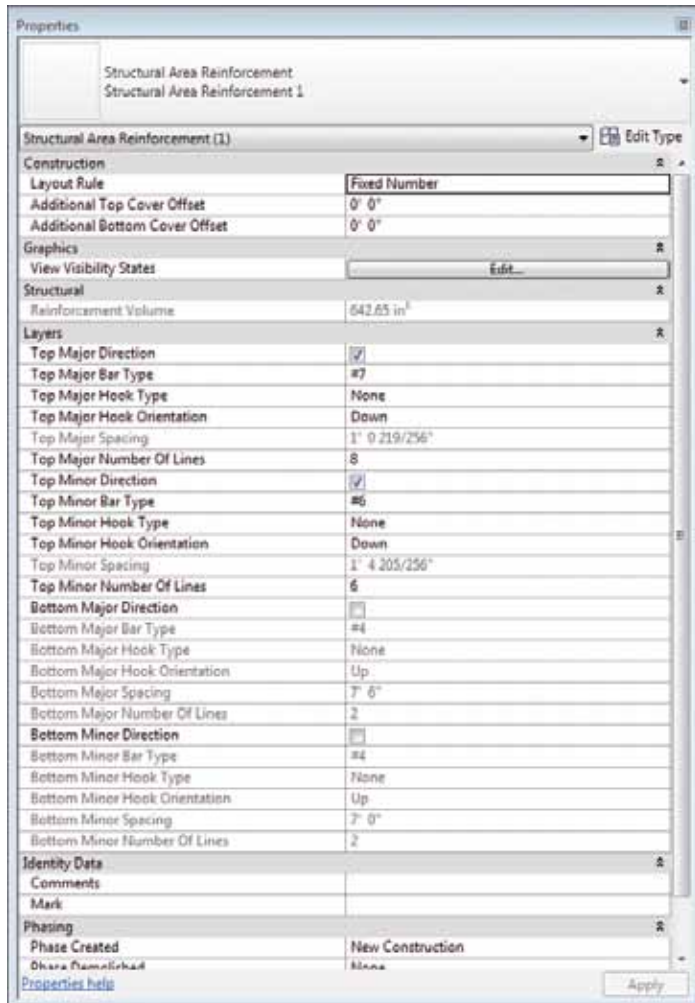


Figure 2a

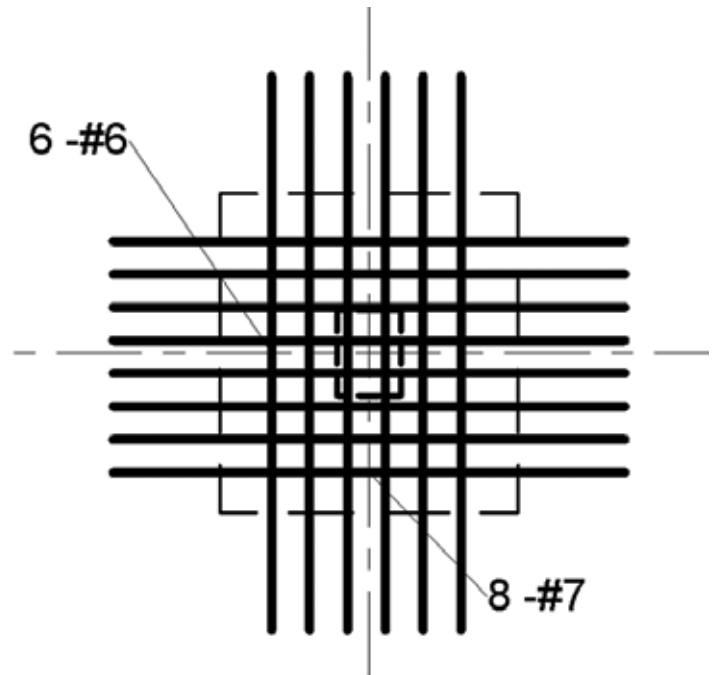


Figure 3

On the slab edge at walls or other supports where there is reinforcing in only one direction, we use Path Reinforcing. For Path Reinforcing we can either leave the system intact or we can remove the system to see all the reinforcing detail. In the Properties dialog box, change the spacing, length, and diameter as required. If the system is removed, the reinforcing set needs to be tagged as before.

Revit Structure 2013

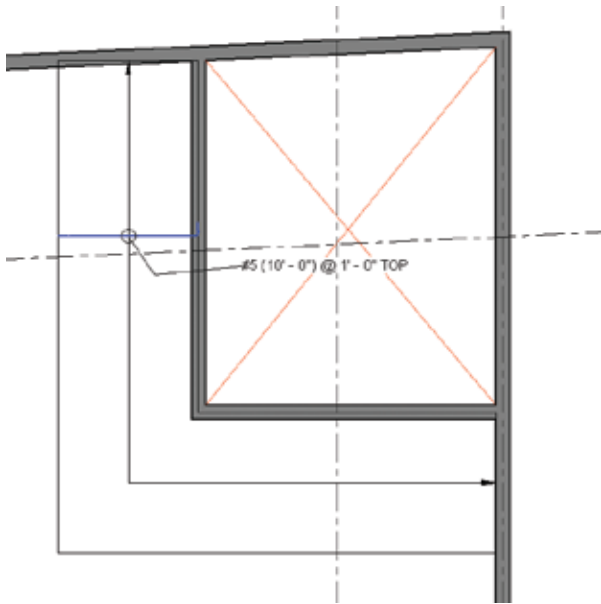


Figure 4

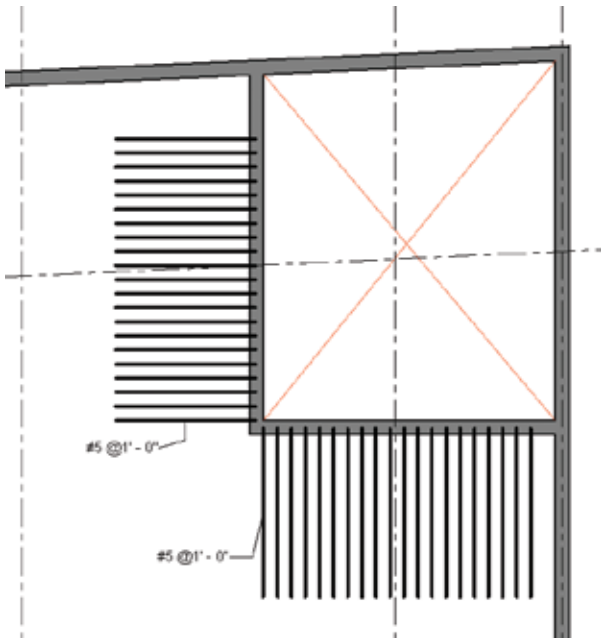


Figure 5

ANNOTATING THE MILD STEEL

If the company's preference is to annotate with 2D elements the mild steel and not to model the reinforcing, one additional family needs to be created for the rebar shapes.

Family Creation

90 and 180 Hooks

- Start a new Detail Component family.
- Create a 180hook component.
- Save.

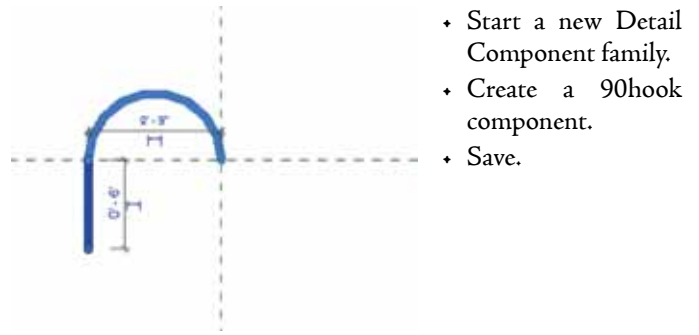


Figure 6

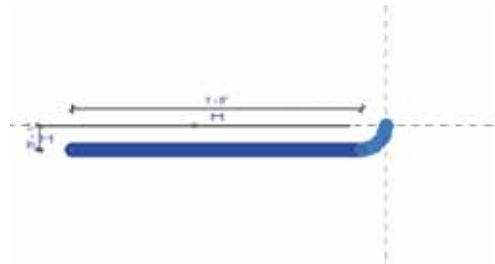


Figure 7

Reinforcing

- Start a new family using the Detail Component Line-Based template.
- Load the 90 and 180 Hook families.
- Add a reference plane about 3'-0" from the base.
- Dimension the plane location.
- Insert the two detail components at the origin.
- Add a line between the base and reference planes.
- Mirror the two detail components about the center of the line you just added.
- Separately dimension the line and the two detail components at the reference plane.
- Create the same label for all the dimensions.
- Create Instance Parameters for all the detail components.
- Add controls in both directions for flipping.
- Save.

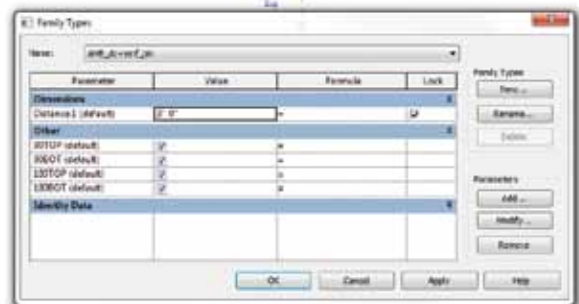
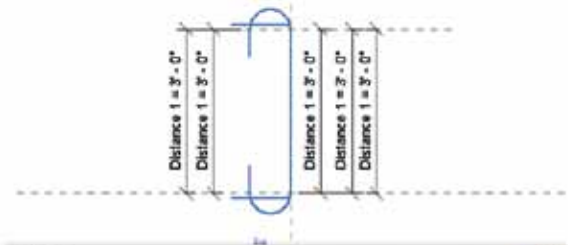


Figure 8

The call-out on the reinforcing is simple text, and the extent is a special dimension style defined for this purpose. In the dimension, just change the real number to the letter "o" and move it to the intersection of the reinforcing and dimension line.

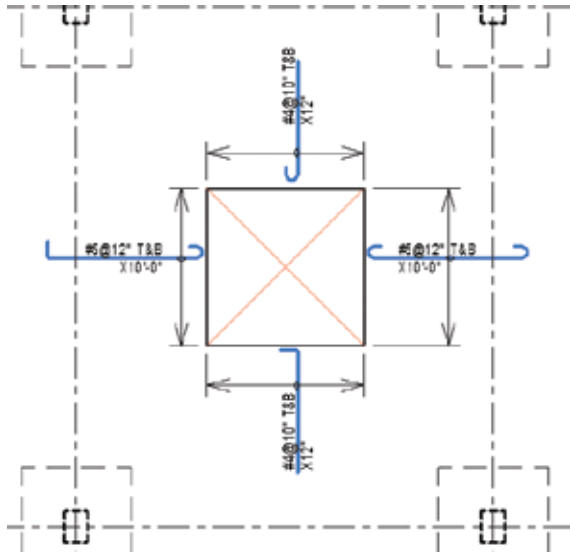


Figure 9

In Figure 9 each reinforcing is the same family with the hooks turned on and off as required. The bars also can be stretched to the desired length.

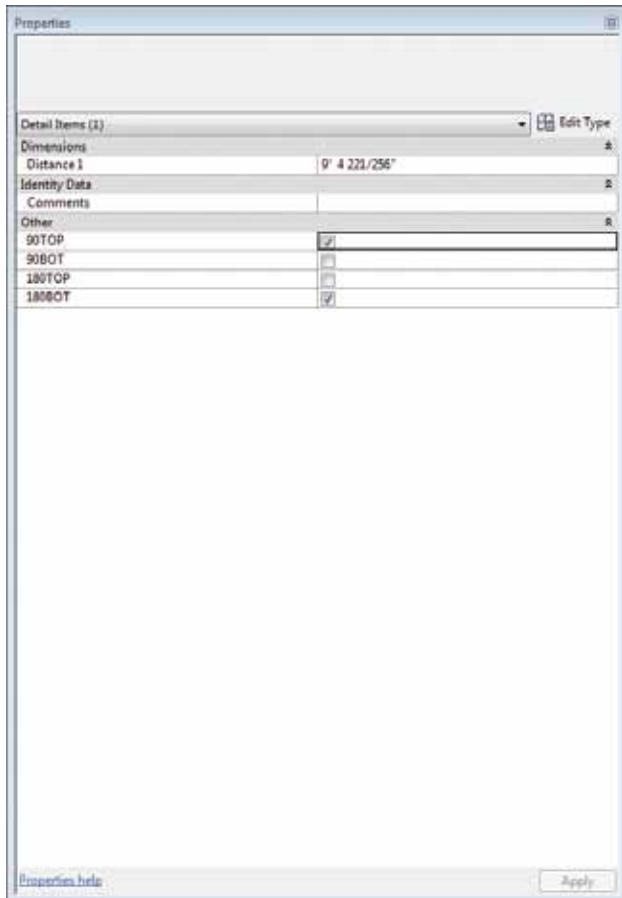


Figure 10

POST-TENSIONED REINFORCING

At first I tried to model the sections of PT tendons as a straight bar and then edited the sketch and added the curves. This ended up being extremely time consuming and cumbersome, and most of the tendons would have to be individually modeled. This would not be an advantage because you still would have to add all the necessary text for tendon height and pulling force. After a lot of debate, I decided that for now the only way is to just draw 2D annotation.

Reaching this conclusion required me to take an inventory of the symbols and detail components I would need to make this task easier.

My list for the families is not too long: Special Arrow, Terminator, Curved Tail, Curved Head, and a Straight Tendon with Arrow and Terminator. The Arrow and Terminator will be Annotation families and the rest Detail Components.

Family Creation

Arrow symbol

- Start a new Family with the Generic Annotation family template.
- Create a triangular filler region.
- Add lines around the filled region. The lines should be the same line weight you choose for the PT symbols, below.
- Save the Family as your Arrow symbol.

Terminator symbol

- Start another new Family with the Generic Annotation family template.
- Draw a short line for the tail (make the length match your AutoCAD® standard).
- Save the Family as your Terminator symbol.

PT Head and PT Tail symbols

- Start a new Family with the Generic Annotation family template.
- Add an arc about ¾ to 1" long from the origin tangent to the horizontal reference plan.
- At the end of the arc add the Arrow symbol perpendicular to the arc.
- Save as your PT Head symbol.
- Repeat using the Terminator symbol to create your PT Tail symbol.

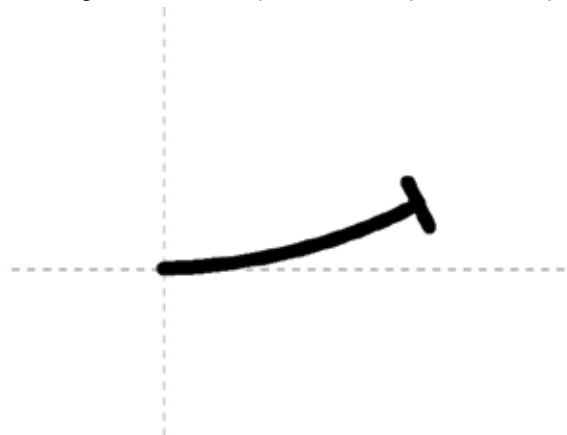


Figure 11

Revit Structure 2013

PT Head and PT Terminator Detail Components

- Open a new Family using the Detail Items family template.
- Load the PT Head symbol you created and add vertical and horizontal controls for flipping.
- Save as **PT Head** Detail Components.
- Open another new Family using the Detail Items family template and repeat the above using your PT Terminator symbol.
- Save as **PT Terminator** Detail Component
- Load both families into the project.

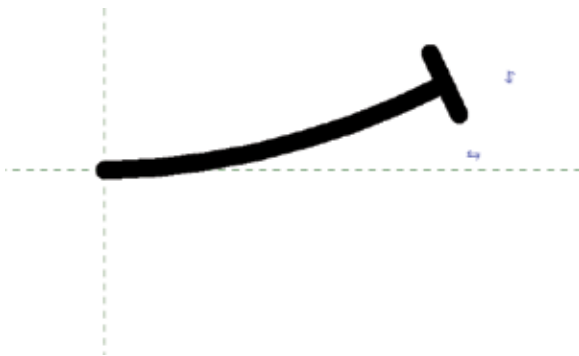


Figure 12

Tendon

To make a tendon we will use the new Arrow and Terminator symbols.

- Open a new family with the Detail Item Line-Based family template.
- Load the families Arrow and Terminator.
- Insert these two at the origin.
- Add a line from the origin to the reference plane.
- At the other of this line again insert an Arrow and a Terminator symbol.
- Dimension the end of the Arrow and the Terminator separately.
- Create the same label for all dimensions (this way they will move together when you stretch).

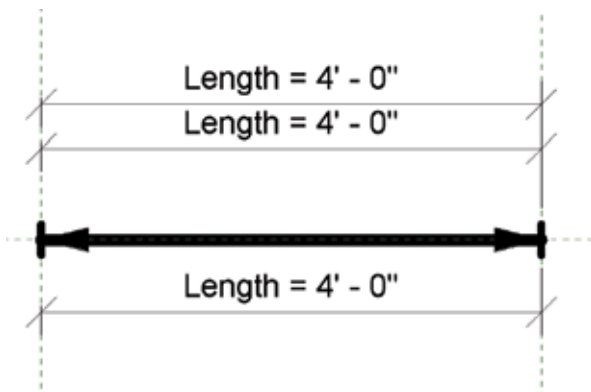


Figure 13

- Select the Right Arrow and at the label create an Instance parameter.

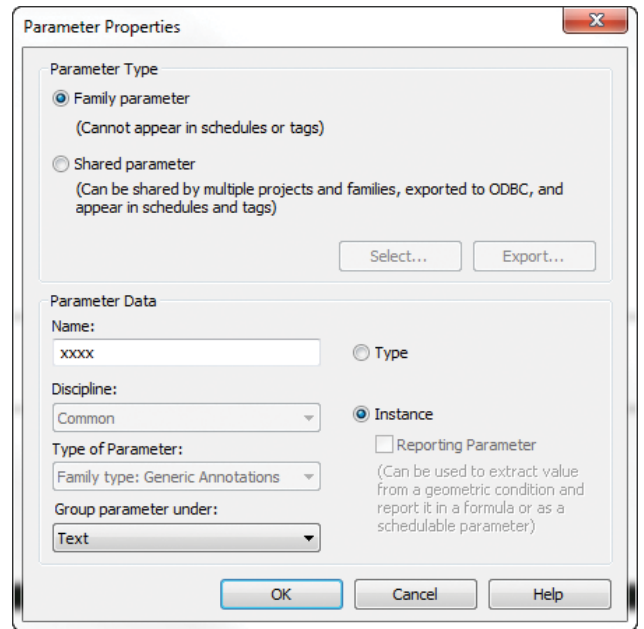


Figure 14

- Select the Right Terminator and at the label create an Instance parameter.
- Do the same for the Left Arrow and Terminator. You will now have four Instance parameters.

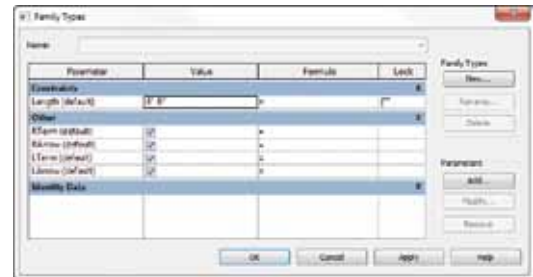


Figure 15

- Save as your Tendon Family.
- Load the Tendon Family into the project.

The detail components will be stretchable, and you can turn the arrows and terminators on or off at each end. This Tendon Family will be used for the majority of the PT representations in your model.

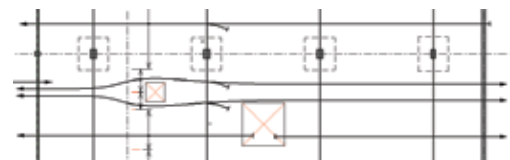


Figure 16

When you have a curved portion between the straight lines, just add a spline line between the tendon detail components. When you have intermediate fix points, just add the tail family as shown in Figure 17.

The extent of the tendons can be defined with the same special dimension style used for the mild steel.

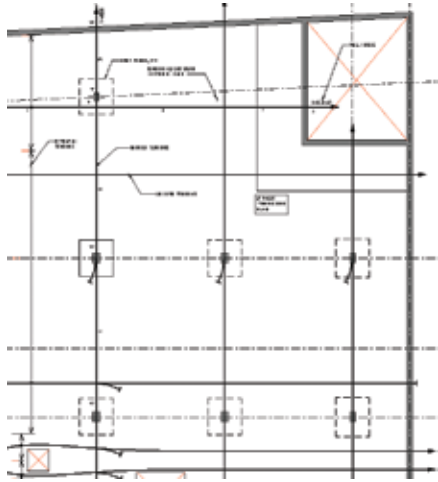


Figure 17

The tendon Height and Pull Force is simple text added as needed.

CONCLUSION

Setting up all these families, symbols, and detail components will seem like a lot of work at first, but using them instead of drawing each 2D tendon individually will save you an enormous amount

of time and frustration as you create the initial project model and make the many inevitable modifications.



Anamaria Brown is the owner of AMB Structural CAD, an AutoCAD and Revit consulting firm that specializes in drafting complex AutoCAD projects and Revit modeling. A structural engineer in her native Romania, she escaped to the United States in 1985, and almost immediately began working as a drafter for Skidmore Owings Merrill at the beginning of the CAD revolution. Deeply involved with Draft, Microstation, and the development of SOM's AES, she quickly became the major projects CAD team leader for SOM, and later for Epstein and Sons and Thornton Thomasetti. As a member of the National CAD Standards Committee she was involved with the creation of Version 3 of the NCS. Most recently she worked for TRC Worldwide in Sarasota, Florida. You may contact Anamaria through her website, AMBStructuralCAD.com You can reach her at AMBrown@ambstructuralcad.com or at phone 941.735.6186



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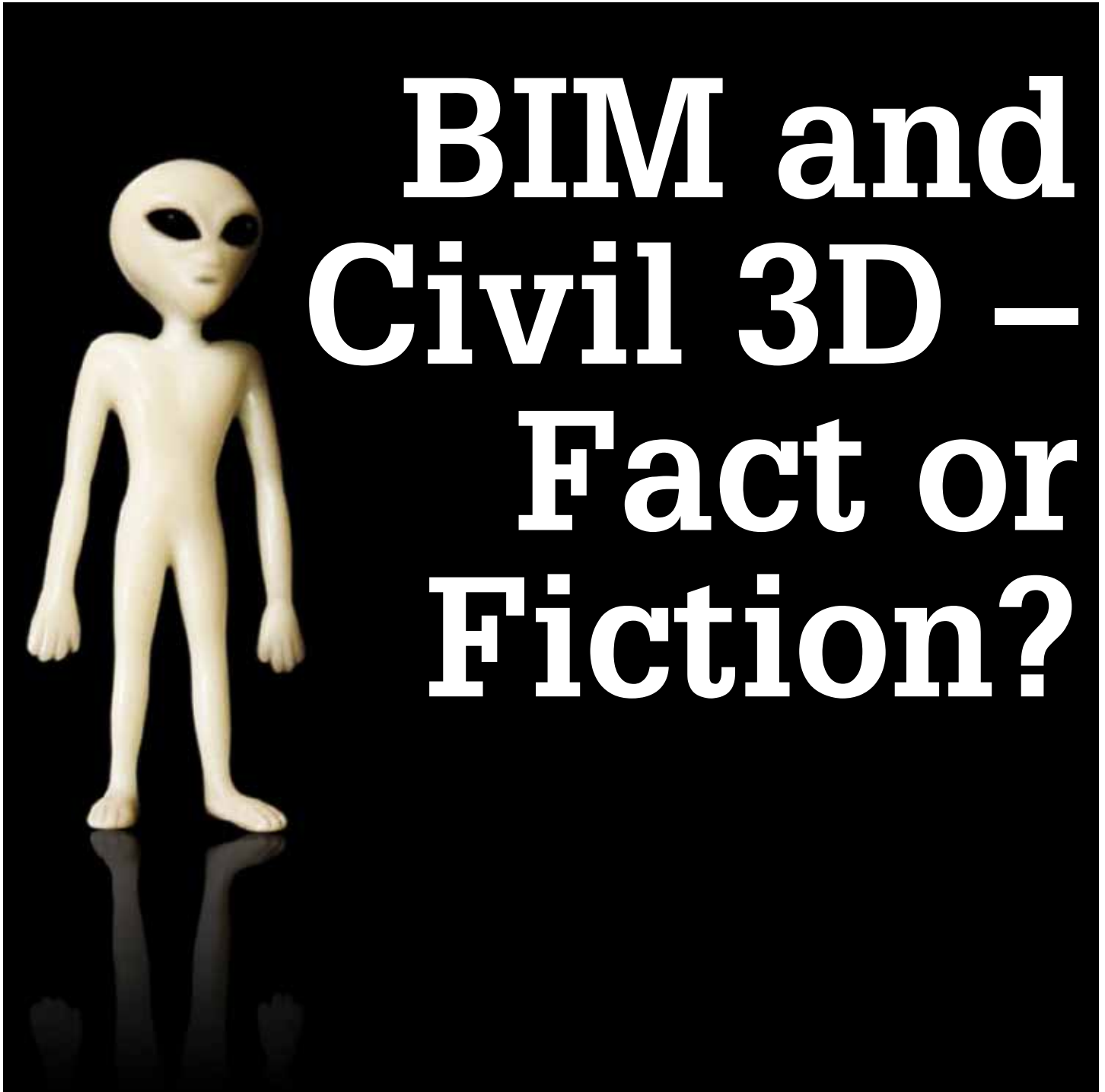


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BIM and Civil 3D – Fact or Fiction?

When Christopher Fugitt asked me to write an article for *AUGIWorld* on AutoCAD® Civil 3D®, it was with utmost enthusiasm that I accepted this gracious offer. Over the years I've been asked, time and time again, "What is the difference between Civil 3D and BIM?" This question is evidence that the infrastructure and land development industry has struggled with a Civil 3D/BIM identity complex. An Autodesk executive recently reflected to me, "...that train has already left the station." It is my intent with this article to shed some much-needed light on AutoCAD Civil 3D and its relationship to BIM.

BIM FOR THE INFRASTRUCTURE PROFESSIONAL

There have been countless articles published relating to BIM for architects and building professionals. This is not going to be another one of those articles. Sourcing Wikipedia, "Building Information Modeling is a process involving the generation and management of digital representations of physical and functional characteristics of a facility. The resulting *building information models* become shared knowledge resources to support decision making about a facility from earliest conceptual stages, through design and construction, through its operational life and eventual demolition."

In other words, when you create a life-size scale building model using Autodesk® Revit, for example, practitioners *sharing* that model with others can easily design their components to eliminate potential conflicts. This is currently the most common application of BIM concepts, and the industry still has a long way to go. In many instances, opportunities still exist for quantity takeoffs, tender documentation, construction records, and ongoing facility lifecycle management.

These BIM concepts are reasonably straightforward as they apply to buildings. They also apply to the infrastructure and land development industry, but in a different way. Infrastructure practitioners, when describing BIM, sometimes prefer to change the “B” in BIM from a noun to a verb, which implies that we are “building” *information modeling* into our processes. Fair enough—it is important that we improve our data management practices, but this is still not truly capturing the essence of BIM. This is the root of the problem—the term BIM does no justice to the land development and infrastructure industries, and hence the widespread confusion!

The term Model-Based Design is one that is used quite often when applying BIM principles to the fields of infrastructure and land development engineering. Regardless of what you call it, the terms are applicable to infrastructure within the following contexts:

- Leveraging data throughout infrastructure procurement phases.
- Leveraging data within an individual project phase.
- The Local Government asset data repository.

The concepts of BIM, as they are applied to the engineering project lifecycle, data leveraging within a specific phase, and the government asset data repository, are discussed in the following sections.

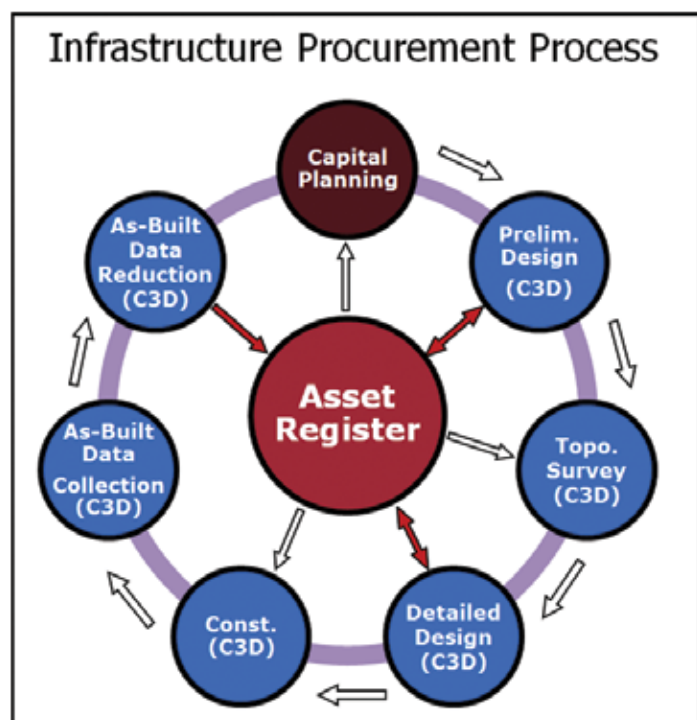


Figure 1: Infrastructure procurement process

INFRASTRUCTURE PROCUREMENT PROCESS

As with buildings, infrastructure components—sanitary, storm, water main and roads—have a lifecycle. At the municipal level, the *procurement* part of lifecycle usually begins with capital planning and ends with capture of “as-built” data and the transfer of this data to the municipal asset register, which in most instances is the geodatabase in their GIS.

A typical infrastructure procurement for a municipal project is illustrated in Figure 1.

The municipal infrastructure procurement process begins by analyzing data residing in an asset register or GIS to identify and choose the projects to be completed as part of the annual capital planning process. From there, individual projects typically move through the preliminary design, topographic survey, detailed design, construction, as-built data collection, and as-built data reduction (record drawing submission) phases. AutoCAD Civil 3D can be used in all of these infrastructure project procurement phases.

The planning phase is where designers have the greatest ability to affect the outcome, and hence the total cost of the project. Civil 3D is an excellent planning tool as it allows designers to quickly generate and evaluate alternatives to the undertaking. During the topographic survey phase, surveyors can use Civil 3D to automatically reduce data collected in the field to pre-engineering base plans and existing ground surface models.

The next step is detailed design, where design and construction plans are prepared, quantities are calculated, and construction staking data is generated. Detailed design and construction drawings are then sourced for construction staking data—where the design is moved to the field. The final steps are the collection of as-constructed data, the reduction of that data, and the submission of that data to update the municipal asset register. All steps can be accomplished using functionality available in AutoCAD Civil 3D.

When you consider BIM, one of the key components is the efficient movement of data throughout the project phases—in this case, the phases associated with infrastructure procurement. As indicated, Civil 3D can be applied to these “process adjacent” phases for infrastructure and land development projects. It only makes sense that data can be reused (rather than recreated) during these process adjacent phases. For example, data generated during the project planning phase (sewer alignments, road features, and so on) can be reused and modified during the detailed design phase. Model data generated in detailed design can be used for both construction data extraction and the preparation of digital submissions required for updating local government asset registers. This data continuity is the key essence of BIM as it relates to the infrastructure procurement process.

AutoCAD Civil 3D 2013

INDIVIDUAL PROJECT PHASE

The individual project phase for infrastructure and land development projects is another candidate for the application of BIM principles, as data sharing can be done from a centralized model. As with buildings, infrastructure projects consist of many different components—sanitary, storm, water, roads, and electrical—all of which are designed in a modeling environment.

This modeling environment, in which data is shared and not duplicated, allows for the following:

- Natural propagation of design changes through dependent drawings and documents.
- Cross-discipline collaboration to eliminate design conflicts.

Just as the building designer needs to ensure the plumbing doesn't conflict with the electrical and HVAC, infrastructure designers must ensure utilities are designed based on depth requirements so they don't conflict with one another. Once again, this utility and road conflict resolution represents a key component of BIM being applied to infrastructure and land development projects.

The critical BIM component within an individual project phase is data sharing versus data duplication. The methods of data sharing that AutoCAD Civil 3D supports are summarized in the following bullets:

- AutoCAD External References – graphical data sharing
- Civil 3D Data Shortcuts and Reference Objects – sharing surface, alignment, profile, pipe network, and view frame data
- External References, Data Shortcuts, and Reference Objects – for creating cross sections in separate drawings
- External References – labeling Civil 3D data “through” an external reference
- Survey Database – sharing survey observation, point, and figure data
- Autodesk Vault – multifaceted data management and sharing for drawings, project objects, and project-related files

Your project may involve some or all of the above data sharing techniques. The key is to define those relationships prior to beginning a project so that all involved can clearly understand the data structures and standardized mechanisms for data sharing. The mechanism used for data sharing is referred to as the *drawing/data architecture*, or the structure of the data.

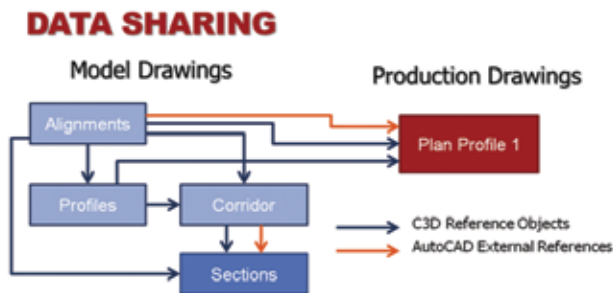


Figure 2: Data sharing in Civil 3D

An example of the drawing/data architecture for a simple project using AutoCAD External References, AutoCAD Civil 3D Data Shortcuts, and Reference Objects, is shown in Figure 2.

For projects with multi-disciplinary and multi-designer input, it is imperative that data is shared versus duplicated. This data sharing element is yet another important aspect of BIM that must be considered for infrastructure and land development projects.

INFRASTRUCTURE LIFECYCLE MANAGEMENT

As stated earlier, lifecycle management is yet another key component of the BIM concept. Where lifecycle management for infrastructure and land development projects differs from building/architecture is that the data is not stored in the CAD model, but in the asset register, which for many local governments is the GIS. It is in lifecycle management that the parallels between buildings and infrastructure begin to break down.

It is at the end of the infrastructure procurement process where the data representing the “as constructed” conditions are input into the asset register. The emerging problems within local governments is that these asset registers often take on several meanings—CAD, GIS, infrastructure maintenance management systems, financial systems—with the same data residing in multiple registers. Once the as-built data is in the asset register, then the process for continuing infrastructure lifecycle management can begin—basically making the decision as to whether is cheaper to replace or renew.

SUMMARY

As can be seen, the concepts of BIM, which were initially founded in the building industry, can readily be applied to infrastructure and land development projects. The key lies in understanding the processes and applying those concepts to the individual components of the process. Whether it's BIM or Model-Based Design, the concepts are the same and the technology allows designers to share and leverage data in certain areas. With Civil 3D, the true BIM components lie in: 1) moving data through the various phases of the infrastructure project procurement process; and 2) sharing data during individual project phases.



Andrew Walther is a professional engineer based in Comox, British Columbia, specializing in the application of AutoCAD Civil 3D to infrastructure and land development projects. He can be reached at andrew@apwengineering.com or 250-941-1422.

(SMART)^x Game Changers

INTRODUCTION

This article introduces the concept of (SMART)^x Game Changers for the built industry. Game changers associated with (BUILT)^x Solutions will be the focus of the (SMART)^x Game Changer series. Such solutions are used throughout the life cycle of facilities and infrastructure delivered by integrated teams capable of utilizing building information modeling (BIM) effectively in an integrated built environment. This article is the first in a year long series. (SMART)^x Game Changers and (BUILT)^x Solutions originated in the BUILT – BIM to FM Series published in *AUGIWorld* magazine in 2012.



The goal of the series is to open thought leaders' eyes regarding the value of IPD, BIM, and lean processes. The series will focus on intelligent and effective use of integrated project delivery (IPD), building information modeling/virtual design and construction (BIM), and other innovative business processes in mining, oil and gas, heavy infrastructure, and similarly capital intensive sectors of the built industry. IPD and BIM support innovation, saving billions in costs and generating billions more in new revenue. In short, when combined with (BUILT)^x Solutions they

are (SMART)^x Game Changers that reduce costs, increase profits, and bring more profitable work and projects online. These and other (SMART)^x Game Changers will be explored in this series.

Articles in the (SMART)^x Game Changers Series will be published in conjunction with an online series of monthly webinars offered by Collaborative Construction. Live seminars and workshops hosted by sponsors of the series will also correspond with the written articles and the online webinars. Seminars are scheduled throughout the U.S. and in Canada and Ireland. Specific seminars are scheduled for Vancouver – or possibly Seattle; Calgary, Edmonton, and Toronto in Canada; Dublin – and possibly Limerick – Ireland, and multiple cities in the U.S.

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- (BUILT)^x Solutions System™ – An Introductory Webinar
- (BUILT)^x Programs – Integrated Procurement Programs, IPP in 3DTM
- (BUILT)^x Projects – Integrated Project Delivery, IPD in 3DTM
- (BUILT)^x BIM to FM – Integrated Operations and Maintenance, IOM in 3DTM
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- (SMART)^x Risk Management – BIM and IPP, IPD and IOM for Insurers
- (SMART)^x Bonding – BIM and IPP, IPD and IOM for Sureties
- (SMART)^x BIM Technologies – (BIM)^x for the Built Industry
- (SMART)^x Cultural Change – (CM)^x as a Tool of Change for the Built Industry
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- (SMART)^x Industries – IOM in 3DTM

BUILT

Regular webinars begin in January with Series Sponsors and their invited guests attending online. Higher level sponsors and their invitees enjoy access to archived versions of the webinars and also host live seminars and workshops throughout the year. The list above reflects anticipated webinar topics and may change as the series progresses.

THE RATIONALE FOR THE (SMART)^x GAME CHANGER SERIES

Owners spend trillions on facilities and infrastructure annually, and trillions more on operations and maintenance. Yet market demands remain unmet and inefficiencies abound. Current planning, design, construction, operations, and maintenance methods routinely fail. To put it bluntly, this is (STUPID)^x.

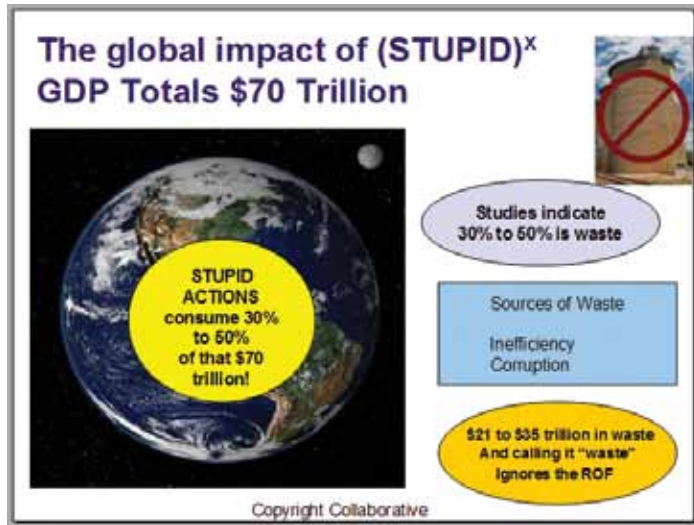
This series tackles these core problems, providing a vision for savings over the full life cycle of operations. Join Collaborative Construction for workshops throughout the U.S., Canada, and Ireland in 2013 to learn how these unique tools can save billions.

(BUILT)^x Solutions:

- Reduce waste
- Attack inefficiency
- Expand market share
- Increase revenue and profits

Virtual models enable visualization of:

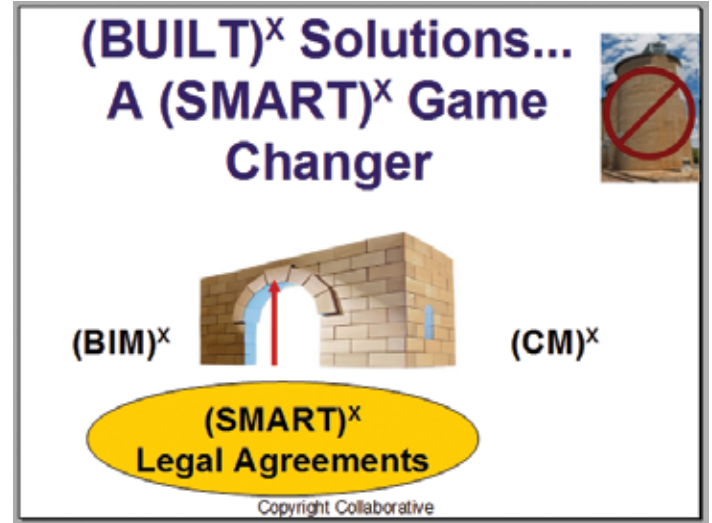
- Planning, design, construction, and ops
- Maintenance and reclamation processes
- Dynamic and interactive digital systems
- Collaborative workplace environments



(SMART)^x LEGAL AGREEMENTS

Strategic alliances, integrated agreements, and other collaborative legal tools and frameworks enable stakeholders to integrate IT, interact intelligently, and align economic and environmental goals over time. The (SMART)^x Game Changer Series explores

emerging business processes that leverage these innovative tools to reduce costs, expand revenue, mitigate risk and environmental issues, and increase market share.



Effective IPD, BIM, and lean process programs map and align the key interests of critical stakeholders, increase the efficiency of planning, design, and construction services, and reduce operations and maintenance costs for facilities and infrastructure. In short, (BUILT)^x Solutions drive value through the entire lifecycle, saving—and earning—billions.

CONCLUSION

This series of articles and the online (SMART)^x Game Changers Series provide built industry professionals access to thoughtful analysis of innovative tools and business processes. The webinars and seminars provide excellent forums in which to discuss emerging business processes and innovative tools and solutions that support those new business processes. The Information Age is upon us and individuals and companies must be prepared to compete in the emerging Knowledge Economy. The unprepared will be left behind. Don't be unprepared!



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.



Thousands of Clashes in a Thousand Seconds

Every BIM coordination will inevitably use different file types and have varying degrees of complexity for each trade. Often, clash tests between individual trades will produce thousands of clashes per floor that make a manager's task of organizing them seem daunting.

Autodesk® Navisworks® 2013 has added a few goodies to make coordinators' lives easier and allow them to manage thousands of clashes with fewer headaches.

A LITTLE HOUSEKEEPING

Wouldn't it be great if we could reduce the amount of clashes before even opening Navisworks? Well, with some trades, exporting DWG files through Autodesk® Revit® can reduce clashes. Most

trades ask for DWG files to Xref while they model. The trades modeling in Revit will export DWG files as a batch export with all their levels cut up, instead of having to export 30 different NWC files one view at a time. I know this article is about Navisworks and we'll get to that, but if you ever run into this issue you will be grateful you know a little Revit.

The default settings in Revit will export DWG files as polymesh solids, which separates all the solids into surfaces. This may not be terrible for use in AutoCAD®, but it will wreak havoc on a clash test—tripling the amount of clashes, or worse.

In Revit, if you click on the ellipses in the DWG export screen you will get a window with some tabs. Under the "Solids" tab you will have two options—check the "ACIS solids" box instead of the "Polymesh" box.

Navisworks Manage 2013

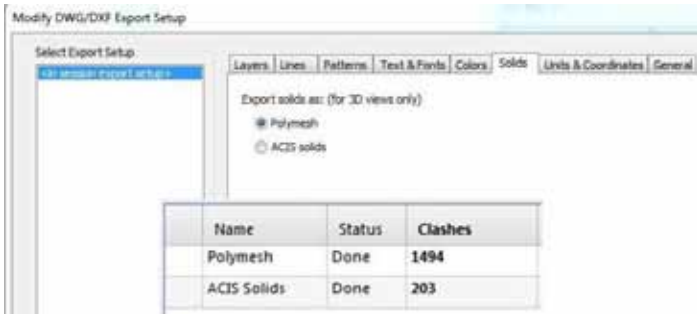


Figure 1: Same systems exported with one difference.

Figure 1 shows that a small setting will drastically change the number of clashes between two trades. I realize that anyone exporting NWC files will not have this issue, but those who run into don't have to worry.

THOUSANDS OF CLASHES

So what do you do when a project has thousands of clashes between individual trades on individual levels no matter what you try? And what if those thousands of clashes break down to hundreds of real issues? How can you quickly prepare your model for a coordination meeting and still have the confidence that you haven't missed any or created duplicates? Grouping clashes together is one of Navisworks' greatest strengths. There have been many articles devoted to grouping clashes, so I will not focus that much on the basics of grouping, but rather the workflow of handling thousands of clashes that has become easier, thanks to Autodesk.

Quick disclaimer: Everyone has their preferred methods of managing clashes. I am not here to tell you this is exactly how you should manage your clashes. Rather, I am simply offering my advice on how it can be done efficiently and accurately.

So after you have created and organized all your search sets and clash tests, and have created custom rules to eliminate as many false positives as possible, you are ready to jump head first into the ocean of clashes. The first thing I recommend doing is turning that ocean into a lake by grouping ALL your clashes into one group. You can do this by highlighting all clashes and selecting the group button located just above your clashes window (see Figure 2).

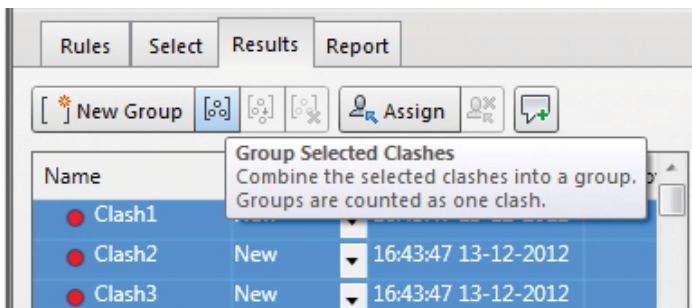


Figure 2

With a few thousand clashes, this process may take a few minutes per clash test. Be patient with Navisworks and remember that just because it seems to have crashed doesn't mean it really has. Navisworks enjoys working with thousands of clashes about as much as you do. If I had one wish it would be to have the option of Navisworks automatically grouping all new clashes—this would save a lot of waiting time. Maybe in 2014...

Now that all your clashes have been grouped, your patience will pay off. With your new group selected, the "Hide Other" isolation option will give you a holistic view of the issues. Whether you choose to focus on small clashes or just large constructability issues, this group will be your Main group.

Now I know some of you will say that you can get a holistic view just as easily by using the "Dim Other" and "Transparent dimming" without having to wait five minutes for Navisworks to make your group. This may be true, but try walking around a complex model with transparent dimming versus a hidden one. Your computers will thank you, and through this "Hide Other" workflow you won't be missing any issues or creating duplicates.

With the "Hide Other" on, you can begin to walk through your model looking for issues. Once you find your first issue you can use the Select Box to highlight all the pieces of geometry related to that issue (Shift + Select Box will select anything touching your box). The Filter by Selection tool has always been useful, but in Navisworks 2013, Autodesk has made a wonderful change to it. Now you can select filter clashes that are INSIDE a group! In 2012 you would have to explode the group for the selection filter to work, but not anymore.

After selecting your clashing geometry and turning on "Selection Filter," you will see all the clashes disappear except for the ones relating to your selection. If you highlight those clashes you can remove them from group or make them into their own group—either way you want to remove them from the "main" group.

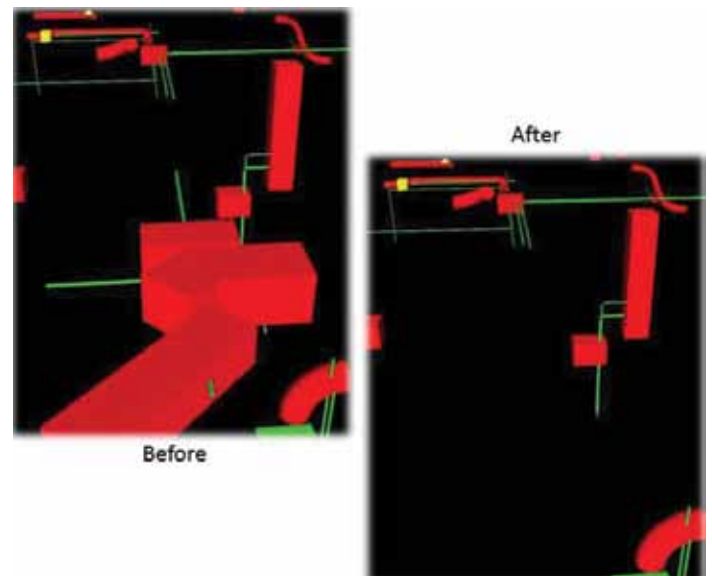


Figure 3: The clashes separated from our main group no longer clutter our view.

Once the clashes pertaining to our first issue are out of the main group, you will turn off the selection filter and select the Main group again with “Hide Other” on. You will now notice that you can’t see the issue you just focused on because it is no longer in your main group, but that’s great because you don’t want to see the same issue again—you’ve already marked it. With the first issue separate, you can move on to the next issue and never have to worry about duplicate clashes popping up in your coordination meetings.

The process is simple; we are taking our ocean of clashes and localizing it into a lake of clashes that we can view without dimmed objects slowing down our computers. Then we are taking individual pools of clashes and separating them out until we are left with the sludge of false positives that we can then discard.

REPORTING

Now we have all our clashes organized and we are ready for our coordination meeting. Because we have each issue separated, we can quickly move from issue to issue during the meeting, redlining and tagging along the way.

Because we have grouped our issues separately, when we write a report we can select “Group Headers Only.” This is telling Navisworks that we only want to see the grouped folders as viewpoints and not the thousands of clashes we have inside those folders. With the service packs installed, Navisworks will bring over redlines and tags into those new viewpoints.

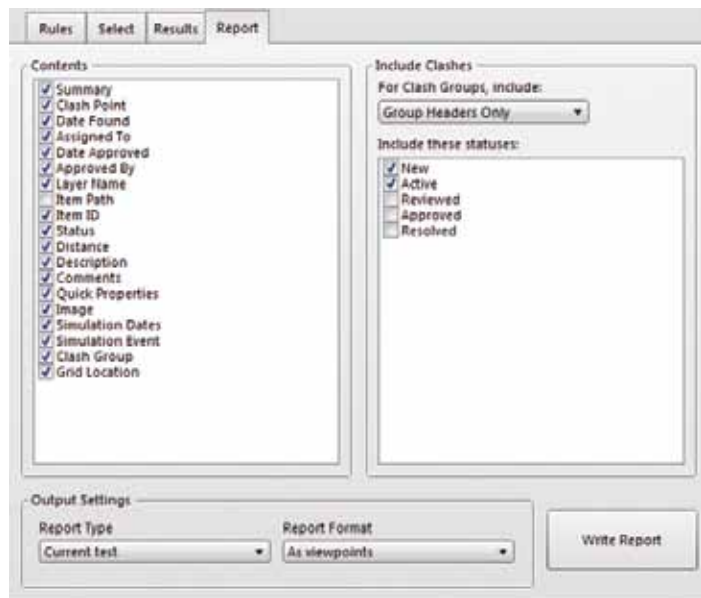


Figure 4: Writing a report as viewpoints.

Navisworks 2013 has given us a new feature with reporting, but you have to be careful when using it. You have always been able to create a report using viewpoints, but those viewpoints would be saved without any “Hide/Required” attributes. Not anymore. Autodesk has made us a little more dangerous—now when you

write a report you need to be very careful about your “Isolation” settings. Any isolation you have selected as well as any section cuts you have turned on will be applied to all the new viewpoints you write using reports.

After the viewpoints have been made, you get a folder with the clash test name and inside it a “Reset Appearance” view and then a folder with the grouped clashes. When you select the folder it will go to whatever view you had saved for your group in the clash detective and it will have any isolation settings you had.

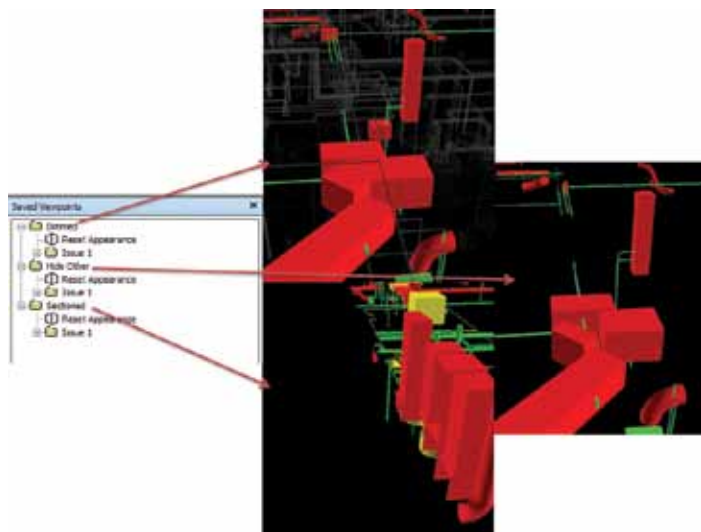


Figure 5: Viewpoints written as a report save their visibility attributes.

We write reports as viewpoints because they can be viewed in Navisworks Freedom. Being free, we expect all our trades to use it so they can go over everything that was covered in our coordination meetings and hopefully have those issues resolved in time for the next meeting.



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Communicating Simulation with Showcase Rendering

Earlier this year, Autodesk® released an add-on application that makes it possible to render a project in Autodesk® Showcase, and include the results from Simulation CFD and CFD 360. This application is available free, and using it will be the topic of this month's manufacturing process article, including:

- Why Render Analysis Results?
- Where Can You Get The Add-In?
- How does The Export Work?
- Importing into Showcase
- Strategies
- Results and Product Marketing

WHY RENDER ANALYSIS RESULTS?

After many discussions with clients, developers, and manufacturing teams, the simplest explanation I can offer is that adding analysis results to your product renderings allows teams to convey complex ideas to clients and team members that might otherwise be misunderstood or even dismissed. Additionally, some creativity applied to the environment in Showcase can create beautiful results that can be used to market your products in a new way.

WHERE CAN YOU GET THE ADD-IN?

The application is available from the Autodesk Exchange App store here:

Autodesk Exchange Simulation Section (<http://goo.gl/ibN9J>)

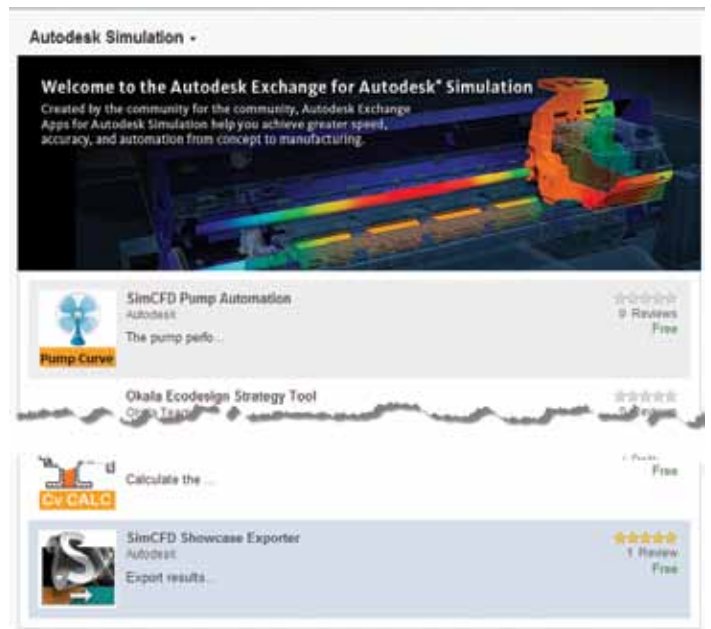


Figure 1: Simulation section of the Autodesk Exchange site.

Once installed, the add-in populates a new tab in the simulation software, titled Add-Ins.

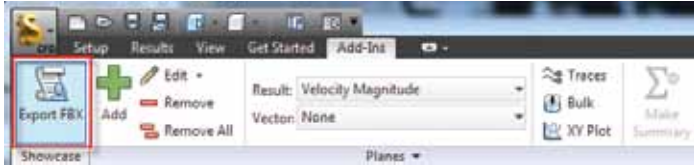


Figure 2: Add-Ins tab in Simulation CFD 2013.

Figure 2 shows how the Showcase Panel (and the Export FBX) is added to a portion of the Results tab contents in Simulation CFD. From this Add-Ins tab, most results visualizations can be added and adjusted prior to exporting your FBX file. This is kind of a handy feature—rather than simply adding an export button.

HOW DOES THE EXPORT WORK?

The Export FBX button creates objects that can be imported into Showcase, which can then be applied to the rendering project.

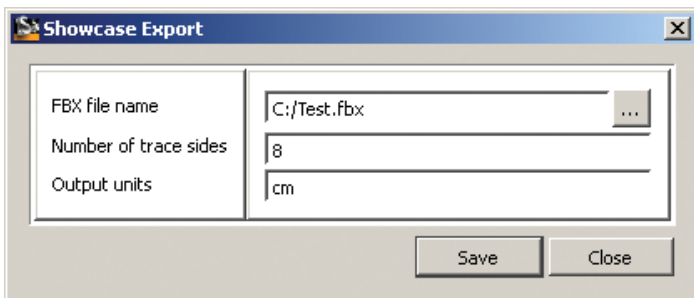


Figure 3: The Showcase Export dialog.

Once initiated, the Showcase Export dialog will appear with fields that permit users to change the storage location of the FBX file, the number of trace sides, and the output units. I usually store these files with the Showcase project.

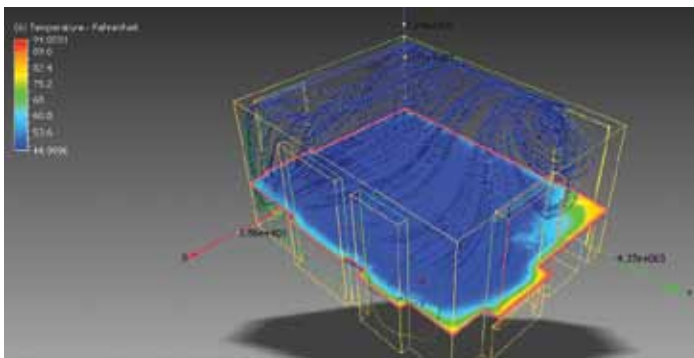


Figure 4: Simulation CFD results.

Each component (Traces, Planes, etc.) are packaged up in the single file, but will continue to be controlled separately in Showcase.

The Units are quite important. These act similarly to Fusion where, if not selected properly, will result in a coordinate and size mismatch that you will have to adjust in one manner or another (such as scale and translation).

The number of trace sides is still somewhat of a mystery, except that it will jack up the size of the file immensely. What it appears to do is create an overlay of data that has something to do with visualization. The default settings were routinely producing 20MB files (depending on the amount of trace data), so watch this carefully.

IMPORTING INTO SHOWCASE

Models can be imported into Showcase by the Import tool found in the Application menu. Once selected, Showcase will import and convert the data to a native format, and then add it to the environment.

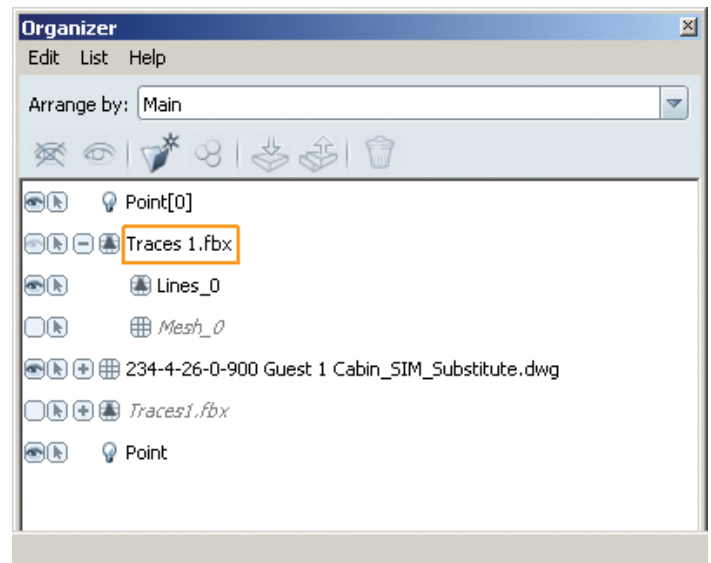


Figure 5: The Showcase Organizer.

Figure 4 shows the export I created called Traces1.fbx. Notice how the Mesh and Lines are separated—these represent the plane and traces results I created in Simulation CFD. I have suppressed the plane, but left the traces visible.

Note: Translating models in Showcase is not super user friendly. Typically we do not have much need to do so, as the information is transferred directly from the assembled products in Inventor and Fusion and straight into Showcase. However, should the units not match between the imported results and the Showcase environment, some translation and scaling will need to be applied. In my case, once I corrected the units on the export, some translation was still necessary. I simply used the dialog and drag arrows to maneuver the traces into the correct position.

Autodesk Showcase 2013

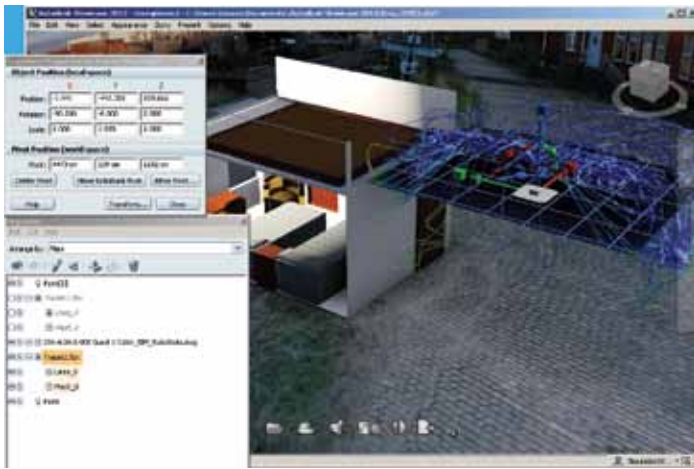


Figure 6: Translating the imported results model.

STRATEGIES

I'll focus on traces for the remainder of the article, but note that I have created some good overlays with the planes.

Thickness of the Traces

The thickness of the traces is applied in the Simulation CFD Trace List dialog. Once exported, there is nothing that can be done to adjust this in Showcase.

I found that 10mm or thinner traces produce better results in large environments, especially where geometry is more important than conditions. Generally, greater quantities of thinner traces produce better results. However, where very clear viewing of the results contours is necessary, 10mm to 20mm traces do better.

Trace Styles

Additional styles are available as well. The default style shown here is 'Cylinder.' Another useful one to try is ribbons. There are about 10 styles from which to choose. Try different styles and render them with different properties until you find the effect that works best for you.

Materials

The default material that comes in with the import is the one named 'Material.'



Figure 7: The adjusted material type. Note the original imported 'material' icon appearance that lies above and to the right of the dialog.

In some cases the imported material type is fine; however, in this example, I needed to adjust some parameters to get the effects desired.

Transparency

This truly requires a delicate balance. The more transparency that is applied, the more the result colorations are washed out.

Shadows

I thinned the shadows down a bit, and limited the distance that they would cast. Initially the walls were filled with shadows, but this is not the effect I needed.

Refraction

Refraction was a great blessing for the traces, and allowed the ray-tracing to work some magic (see Figure 8). I tried numerous methods before settling on that shown in Figure 10.



Figure 8: Heavy refraction applied to thicker traces. This was eventually discarded, but you can see the possibilities.

Reflection

I also came back and added a touch of reflection in order to give these an appearance of dimension.

The following images are the final result of the room render we developed at Design & Motion for the Autodesk University class.



Figure 9: Showcase hardware rendering.



Figure 10: Showcase ray-tracing with 15 iterations.

RESULTS AND PRODUCT MARKETING

In the previous example, it is very difficult to produce understandable results and render the image effectively. This is simply the nature of a large, spread-out frame attempting to view both the results and the environment from inside the stream. The only way to convey this scene with easily viewable trace contours (original simulation colors), is to render multiple frames from different angles. However, when looking at more concentrated traces against a smaller target, it is much easier to visualize the results in a rendered environment from a single view.



Figure 11: Turbocharger Velocity results in cutaway housing and glass styled impeller.

In Figure 11, the housing has been cut away and the impeller material property changed to glass. The results were left unchanged in order to relate the pertinent information contained in the colored contours. It is easy to understand the relative velocity changes as the airflow is accelerated across the impeller, but slows as it is compressed along the outer edges of the housing.

IMAGINATION

This is a powerful add-in, and is really only limited by your imagination. Varying trace styles and sizes along with various material and environment strategies can produce vastly different visual effects that can be tuned to the need or mood of the viewer.



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