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The Official Publication of Autodesk User Group International

December 2014

## Networking Nirvana: AUGI at Autodesk University

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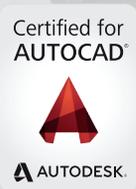
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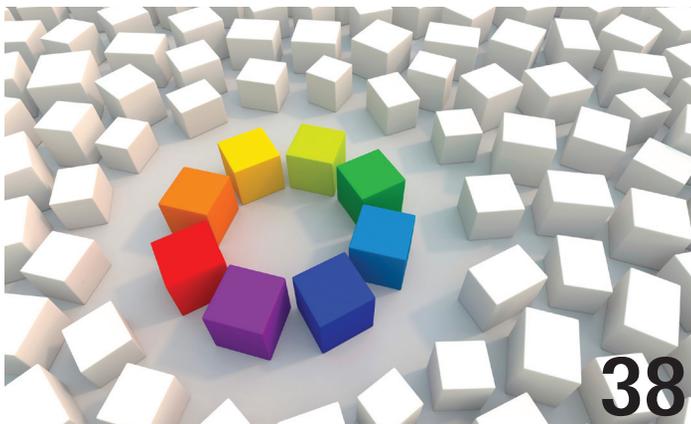
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# Letter from the President



# AUGI



## HELLO FROM IRELAND!

I have the pleasure of writing this letter to you from the incredible country of Ireland. I just attended the European Revit Technology Conference for 2014 in Dublin. I was there as a speaker, but also had the opportunity to represent AUGI while I was there.

I was joined by two other AUGI board members, Desirée Mackey and Shaun Bryant. Shaun Bryant, located in the UK, was AUGI's official representative at the event and did a great job of promoting AUGI while he was there. Desirée, from the US, was attending as a speaker but she also took the opportunity to promote AUGI to the attendees.

There was good representation of AUGI by the attendees themselves. When I queried folks attending sessions about how many were AUGI members, usually 25 to 40 percent raised their hands. The vast majority of those folks were either from the US or the UK.

This got me thinking.

Are there ways to promote AUGI to people who live outside the US, Canada, and the UK that we may be missing? The board welcomes your ideas so please feel free to provide those ideas to us at [board@augi.com](mailto:board@augi.com).

One way to promote AUGI to international people is to have AUGI board members attend more international events. There is one obvious disadvantage to that: the cost in time and money to send a board member to an international event. AUGI's Board of Directors is committed to making sure that AUGI's limited resources are spent in the best interests of all of AUGI's members. AUGI was able to have a strong presence at #RTCEUR only because of the close relationship between AUGI and RTC, which significantly reduced costs to AUGI.

Autodesk is now conducting Autodesk University Extensions in several countries around the globe, which can help AUGI reach a passionate group of folks who might not otherwise know of AUGI but who are looking for answers to their questions. Still, I don't feel that is enough.

AUGI needs to rely on members located in countries other than the US, Canada, and the UK to get the word out to folks in their own countries. If you are interested in doing more to promote AUGI in your own country, please contact myself ([robert.bell@augi.com](mailto:robert.bell@augi.com)) or Michael Smith ([michael.smith@augi.com](mailto:michael.smith@augi.com)) so that we can see what you can do to increase the number of AUGI members in your own country.

R. Robert Bell  
AUGI President

## AUGIWorld

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# Developing Leadership Insight



**T**he world is always looking for someone with insight. We pay high dollars to listen to those who are deemed pundits. We seek out bookworms, intellectuals, philosophers, and eggheads who might help us see through the avalanche of information and make sense of it all. We look for ideas on how to apply all of the data and features in software tools in a special way that eliminates our problems and exponentially energizes our design efforts. We look not only for understanding, but also for wisdom about how these perspectives might help us adapt, adopt, and achieve when others might not be able.

Insight as a CAD leader is needed, also. As a leader in a technology area, you will be called on to provide insight, vision, and planning for the future. Sometimes ideas just pop into your head. You do not know where they came from, but they transform the way you approach your use of CAD and BIM tools. You are viewed as an innovator and you enjoy the spotlight. But then you rack your brain for the next great insight and idea. The longer it takes, the more you feel like you are not ever going to find another insightful idea again.

So where do you go when the well runs dry? What do you do to uncover the next great concept that transforms your company's processes and invigorates the staff? How are you going to "make" an idea pop into your head?

As I was preparing this article for *AUGIWorld*, an article I read in *Harvard Business Review* called "Where to Look for Insight" by Mohanbir Sawhney and Sanjay Khosla (*Harvard Business Review* magazine, November 2014) gave some context to my thinking. It reinforced many of the concepts I have written and spoken on over the years. The authors pull it all together with seven areas where insight might be gleaned. With a tip of the hat to Sawhney and Khosla, I discuss their list with a focus on the CAD environment.

First, they define insight as: "an imaginative understanding of an internal or external opportunity that can be tapped to improve efficiency, generate revenue, or boost engagement." Taking that into a CAD environment, I have come up with the following under their seven headings (unless noted).

## ANOMALIES

Look for unique events or incidents that display improvements in process that might be used to generate wider advancements. You should be keenly aware of small items that make you think, "Huh, that's funny... not sure why that worked better." It might be that you notice one team that comes in with early deliveries on CAD efforts every time. You ask a few questions and find that they have created a Wiki to store tips, tricks, and areas of improvement. Other teams, while being just as good with technology, do not have this. These one-off situations can open the door to new ways of thinking and approaches that might change your efforts. Don't ignore them. Make a note to investigate and then go back and read that note.

## CONFLUENCE

Like two rivers blending together to make a combined dynamic flow, confluences can appear at any point in your workflow. For example, it might be how design brought in the BIM Leader earlier in the process than before. It might be how you found some time to generate CAD template files during some down time prior to the full project kickoff. By looking at intersecting events, teams, workflows, stakeholders, and management efforts, you may see a new project approach in the making.

## FRUSTRATIONS

An easy method for gaining insight is to look at the areas that frustrate people. Listen to what users or managers regularly complain about. Is plotting too slow? Does it take too long to get a project started? Do users have trouble finding the correct project families/components/blocks? Many times just addressing each item and asking how bad it is can release a great torrent of concerns that should lead to innovative process changes.

An example of this from way back is when one of the firms I worked with had a user who complained about the lack of space for laying out hardcopy contract drawings for reference. He created a half-size printed set and used that. Others started doing the same thing and soon everyone was using half-size sets to the point where the contractor and client started asking for half-size sets. This new approach saved time, money, and eliminated a space constraint.

## ORTHODOXIES

These are the things that have become the standard practice that no one challenges any longer. "That is the way we have always done it" is often heard. When something presents that level of historic use, it is either a great process or one that is just never thought about. In CAD it would be like the firm that created standard table layouts using a 4' x 4' square block. Everything was great until they needed a table layout using another size, based on client request. What they did was adjust the X or Y scale to make a 2' x 4' rectangle. That was just to get them through the first client request. When the new table size became a standard offering, they never went back and created a new block. They just kept on scaling the old one.

## EXTREMITIES

Your standards are not fully embraced by your teams at all times. Some standards are always followed and others are not. There are users who have pushed into new areas that are not covered by the standard and then there are laggards who seem to refuse to embrace any standard at all. Rather than write them off, ask them why. What are they doing that others might employ? What areas are defined in your standard that just really do not matter? Insightful thinkers will make adjustments as needed to reflect what is really needed and determine how to get everyone on board.

## VOYAGES

Sawhney and Khosla encourage you to talk to customers, clients, and suppliers. In the CAD world, there may be barriers to interacting with clients directly. Ask if you can sit in on a design review meeting. Not necessarily to interact, but to listen. I once sat in a meeting with a client just to hear the owner complain that the team spelled his name wrong on every file. It was a reference file and impacted every drawing. The PM was furious and justifiably so. We instituted a checklist for CAD quality that satisfied this client and many others. I suggest that you sit in with your subcontractors who provide portions of the CAD effort to see what their concerns are.

## ANALOGIES

Talk to and interact with others from differing firms (like at Autodesk University). Interact with those in different markets. Ask a ship builder how they use CAD. Talk to a manufacturing staffer about their process in CAD. Chat with an architect about creating buildings in BIM. Take their ideas, mold them into your environment, and define something new.

## CONCLUSION

By listening, watching, thinking, and acting, you can address these observations insightfully by making changes prior to problems. What sets aside someone with insight from someone who is just cleaning up a mess is that the insightful person is proactive in using the insights they uncover in a preemptive way. They can revolutionize your approach to CAD and move your firm forward.



*Mark Kiker has more than 25 years of hands-on experience with technology. He is fully versed in every area of management from deployment planning, installation, and configuration to training and strategic planning. As an internationally known speaker and writer, he is a returning speaker at Autodesk University since 1996. Mark is currently serving as Director of IT for SIATech, a non-profit public charter high school focused on dropout recovery. He maintains two blog sites, [www.caddmanager.com](http://www.caddmanager.com) and [www.bimmanager.com](http://www.bimmanager.com).*



# Make the most of Autodesk University 2014

**A**utodesk University is immense. Hosted in Las Vegas every year, the conference attracts thousands of BIM managers, vendors, press, and Autodesk staff. There are people everywhere. They are running between classes and lectures, going to parties, and learning about Autodesk's latest developments. This year the discussion will no doubt focus on Autodesk's computational design platform, Dynamo, as well as some of the most recent advances in 3d printing, reality capture, computer hardware, and BIM management.

Spread over four days, there are sometimes as many as forty events running concurrently at Autodesk University. There are so many interesting things happening that it can be overwhelming at times. But if you pick the right path, Autodesk University can be highly valuable. In this article we'll share a few tips for getting the most out of this year's Autodesk University.

## PLANNING FOR VEGAS

Before you go, make sure you register for classes at [au.autodesk.com](http://au.autodesk.com). There are 810 classes in the catalog this year, so picking which ones to go to can be difficult. One of the best strategies is to attend Autodesk University with a friend or colleague. That way you can split up and cover more ground.

Some classes fill up quickly. Inevitably these will be the ones you are most interested in. Don't despair, you can often get into classes by showing up early and offering to take the place of anyone that doesn't show up. There's always some. And if all else fails, Autodesk records most of the classes so you can always watch them later once you are back home.

There are classes you shouldn't miss:

**CM7959 - Get a Performance Boost: tune your hardware technology:** this class will help you understand how to optimize your hardware and make the right selections to get the best performance with Autodesk software. It includes many of the tips we've discussed in this column.

**CM7960 - Virtualization is real: what you need to know:** this class will teach you everything you need to know to get up and running with application and desktop virtualization, with a focus on Autodesk software.



## THE MOST EXCITING EVENTS

The Computational Design Symposium was one of the highlights of last year's Autodesk University. Every year the symposium takes a fairly provocative look at the cutting edge of computational design. This year the symposium runs from 8:30 - 11 am on December 3rd.

The exhibit hall is a part of Autodesk University that can sometimes get overlooked as you run between classes. It is definitely worth setting aside some time to take a wander through the all the booths. There's lots of free schwag to pick up and it is a great opportunity to tryout new hardware and software in the flesh. Also, don't forget the AUGI reception, which will be happening in the exhibit hall from 6:30 - 9:30 pm on December 3rd.

Also happening on December 3rd is the CASE / HP party. Every year the party manages to outdo itself. This year it is in Mix, which is at the top of the Delano hotel at Mandalay Bay with amazing views of the Vegas strip. The party is attended by many of the most innovative people in the AECO industry. Stop by for a drink and to pick up one of CASE's bldg=data t-shirts. Find out more at: [case-inc.com/au2014](http://case-inc.com/au2014)

HP is going to be out in full force at Autodesk University this year. Once again they are a platinum sponsor of the event. At the exhibit hall, HP will be showing off the new HP Z840 and Z440 Workstations. These are incredibly powerful workstations with the Z840 supporting two 18 core Intel® Xeon® processors. Since these processors come with hyper-threading, you can effectively use 72 processing cores with the Z840 Workstation. This is perfect for tackling computationally difficult tasks that can be done in parallel, such as rendering and point cloud processing.

The Z840 and Z440 Workstations also support the HP Z Turbo Drive. The HP Z Turbo Drive connects through the PCI Express slot, which more than doubles the read/write performance of the drive compared to standard SSD's connected through a SATA 6Gbs connection. With seven PCI Express slots, the Z840 can accommodate multiple high-speed HP Z Turbo Drives. The new HP ZBook 15 and ZBook 17 Mobile Workstations also support the Z Turbo Drive. See for yourself how fast these drives are when you visit the HP booth.

HP will also be demoing the latest HP Large-Format

Page Wide Technology. HP is about to release the third generation of Page Wide printer heads. These won't be out until 2015 but you can see a preview in the HP booth. Also on display will be the HP Designjet T2500 eMFP and the HP Designjet T520. Both of these printers are web enabled and designed to print 36 inch wide drawings.

One of the most exciting things happening at HP is the HP Multi Jet Fusion 3d printer. HP has recently announced they are going to enter the 3d printing market with a printer that works fast, produces better finishes, and prints in multiple colors and materials. You can get one of the first previews of this technology in the HP booth at Autodesk University this year.

## ABOUT HP

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## ABOUT CASE

CASE exists where building and technology intersect. We combine our experience as architects, engineers, project managers, software developers, and educators with a passion for technology to improve the way buildings are designed, realized, and operated. CASE is a building information modeling (BIM) and integrated-practice consultancy. We provide strategic advising to building design professionals, contractors, and owners seeking to supplant traditional project delivery methods through technology-driven process innovation.



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# MWF – Metal Wood Framing



**H**aving spent the last six years working strictly in the structural engineering field as Modeling Manager and Senior BIM Technician, I am always looking for ways to increase productivity and provide a better set of construction documents. There are many add-ons, but some aren't all they're cracked up to be, and others boast of things they can't actually do.

If you have ever spent any time working in Autodesk® Revit® you realize that when it comes to modeling wood and metal framing, it leaves a lot to be desired and that is where StrucSoft Solutions MWF software comes into action.

## WHAT IS MWF?

MWF stands for Metal Wood Framing. Pretty straightforward, right? The actual software package I tested contains three different major components: MWF Pro Wall, MWF Pro Floor, and MWF Pro Truss. Developer StrucSoft Solutions also has other packages available for residential home building as well as BIM coordination. For this review I tested just those three major components.

## MWF PRO WALL

The tasks that this module claims to do are quite impressive. Wall openings, doors, and windows are detected automatically and framed based on the templates. Abilities include modeling deflection tracks, kickers, connectors, bracing, nogging, straps, and equipment supports. Framing is enabled with user-defined or proprietary building components including CEMCO, Marino/WARE, and iSpan.

I was able to create complete walls easily right out of the box. There are so many options available that you will definitely want to receive some sort of training. For the purposes of this review, I utilized the templates that were already created and modified them as needed. I was able to very quickly take an existing wall and apply the framing to it. It automatically sees the openings and frames out according to the settings created in your template.

One feature I found very useful is that you can apply framing to grouped walls with just a click. If you have a building such as a hotel or apartments with the same room layout, you can frame out all the walls in just one unit and then apply it to all the other groups. That saves a lot of time and also makes modification easy because you only have to fix it in one place.

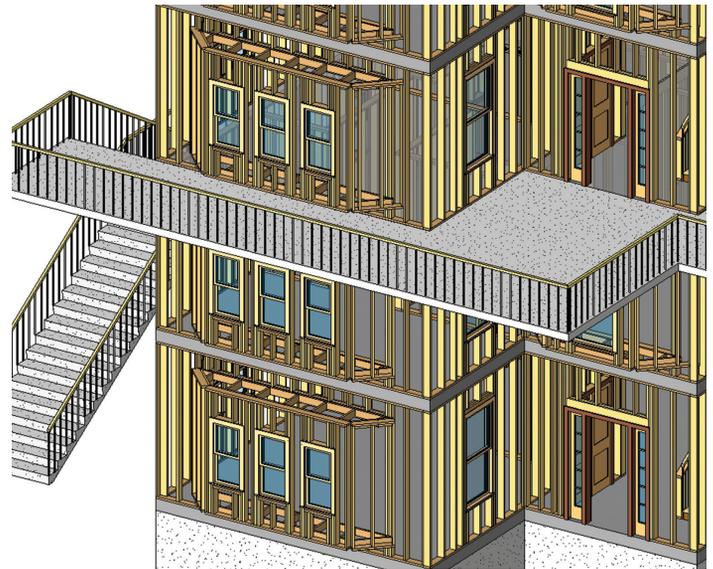


Figure 1: Wood framed walls

## MWF PRO FLOOR

This module is just as impressive as the MWF Pro Wall. It is able to auto-detect Revit floors, elements, and openings. The MWF Pro Wall Module also supports stick or panelized construction and user-defined end conditions including balloon, platform, or custom support conditions. It supports wood-canted roofs and rafters including bird's-mouth cuts, rafter tails, cut backs, and rafter alignment.

The floor module is one that the Autodesk Timber Framing Revit add-on does not have. The Revit add-on has walls, trusses, and

rafters. Both rafters and trusses require you to have a modeled roof to be able to use the tool and cannot be utilized with a floor. With MWF Pro Floor, you are actually modeling the framing for the floor. Just like walls, you need to have your templates set up to fully utilize the tool.

One feature I found very useful was the Opening tool. You can create an opening while working in the MWF Pro Floor tool and it will also create the opening in the Revit floor. Instead of having multiple steps to create that opening and getting everything to align, it becomes one seamless command.

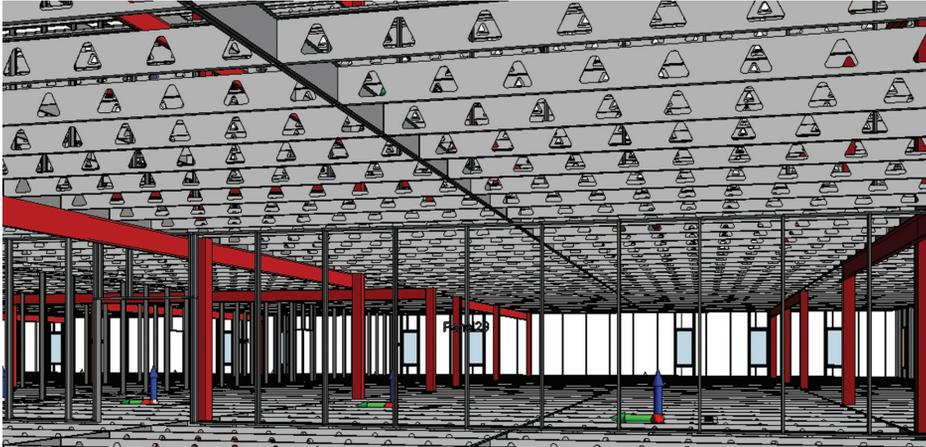


Figure 2: Floor framing

## MWF PRO TRUSS

MWF Pro Truss reads Revit roof elements and creates a customized truss layout based on user templates. Select your truss type, input reference points, and let MWF Pro Truss place your trusses. It offers automated creation of whole roof systems and user-controlled preferences and templates. It has multiple truss types including common, mono, scissors, flat top, mono scissors, and custom trusses.

Of all the tools provided by MWF, this is the one that most interested me. Using the regular Truss tool under the Structure tab OOTB is not the most efficient way to place trusses and can be very time consuming. This tool definitely saves time by consolidating the process, and gives many more options for type and shape of the truss.

One nice feature is the ability to customize trusses on the fly. I was able to adjust one side or the other or add additional vertical members very simply.

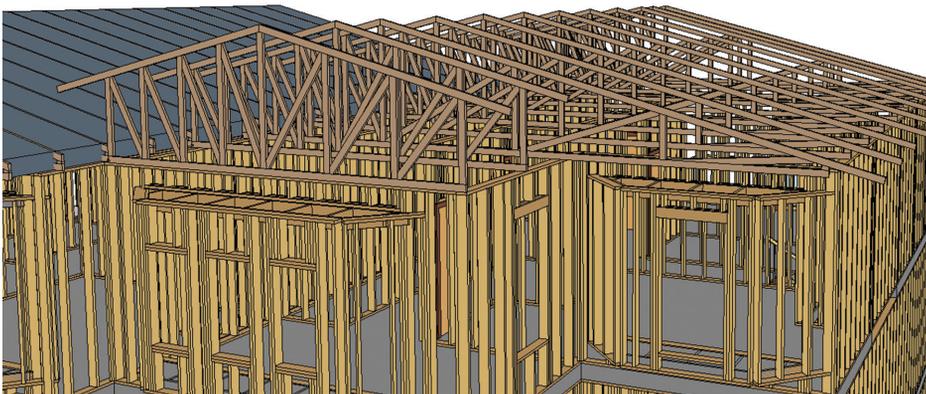


Figure 3: Roof trusses



# Merging the worlds of software and construction

**MWF** enables users to automatically frame Revit® projects, perform analysis, create dimensioned drawings & CNC output.



Visit us at Autodesk University Booth #136



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# Revit Structure 2015

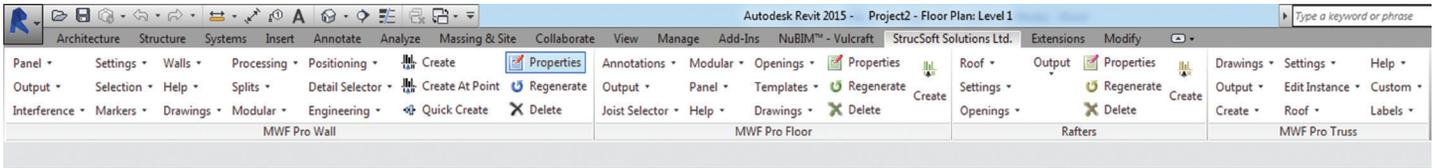


Figure 4: Screenshot of the MWF toolbar in Revit

## INSTALLATION AND TOOL PALETTE

The install is pretty straightforward. You will be directed to download the packages you have purchased as well as a license manager. Just follow the on-screen prompts and you will be ready to go. MWF uses the Autodesk Revit API and utilizes the families that are native to Revit. After install, you will have a new tab in Revit titled StrucSoft Solutions Ltd. What happens when you click on this tab, especially the very first time, can be quite overwhelming. There are many, many options available and is very important that you get proper training on how to fully utilize all the content that is available with this software. It is a template-driven add-on, which means you will want to have your templates created and ready to use to be able to capitalize on the options available in this software.

## IS IT A MODELING TOOL?

The short answer is yes, but it is much, much more. It is able to do things in the modeling environment that so many technicians wish were easy or did not have to create with a 2D elements.

If you spend any time looking at the StrucSoft Solutions website you will see everything else they have to offer. The company offers CNC modules, MEP clasher, modular configurator, and linear optimizer. They also work with a few leaders in the metal building industry and have content customized from those suppliers.

One feature that saves a lot of time is the option to detect an MEP file, recognize all the penetrations through walls and floors, and place framing around all those openings. Talk about a time saver!

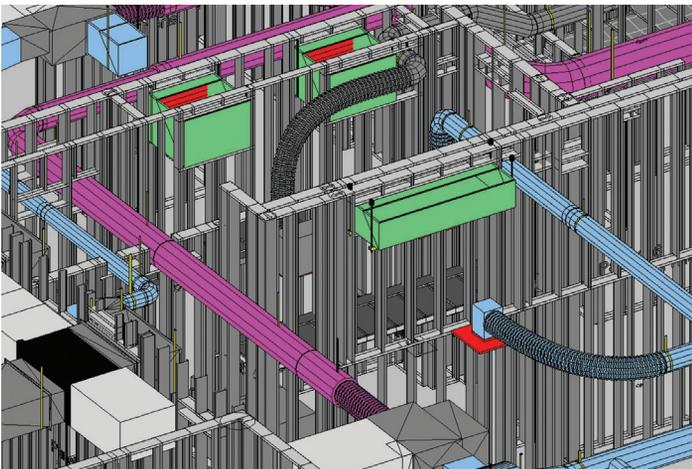


Figure 5: MEP coordination

## CUSTOMER SUPPORT AND TRAINING

The company's customer service and the training personnel I talked to are very friendly and knowledgeable. They have techs based in their Montreal office that are available 8 am – 6 pm Eastern Time,

in London, England 8 am – 6 pm British Summer Time. They also have authorized resellers in Scandinavia and Australia with trained technicians for customer service needs in those time zones. They have training available for MWF and will create customized training programs from the basics to the advanced depending on what your needs are.

## WHAT WILL IT COST AND WHERE CAN I GET IT?

The version I tested was the MWF Pro Suite. A standalone license costs \$5,985.00 plus a subscription cost of \$1,175.00, which is required at purchase. You also have the option of purchasing individual modules if you don't need the entire package. To purchase the software go directly to the StrucSoft Solutions website [www.strucsoftsolutions.com](http://www.strucsoftsolutions.com) or email them at [info@strucsoftsolutions.com](mailto:info@strucsoftsolutions.com).

## PROS & CONS

Pros:

- Ease of modeling completely framed buildings.
- Software is capable of producing shop drawings.
- Information can be exported to CNC machines and other databases for fabrication.

Cons:

- Fully modeling your metal or wood framed walls is going to add 20-30 percent to your overall file size. In an environment where files can already be large, this could be monumental, especially if you are sharing files over the Internet.
- Price. If you want to use it strictly as a modeling tool, then the price is huge. If you have plans for taking your drawings to shop level or are working directly with a fabricator, then the price isn't as steep and it will definitely save you time.

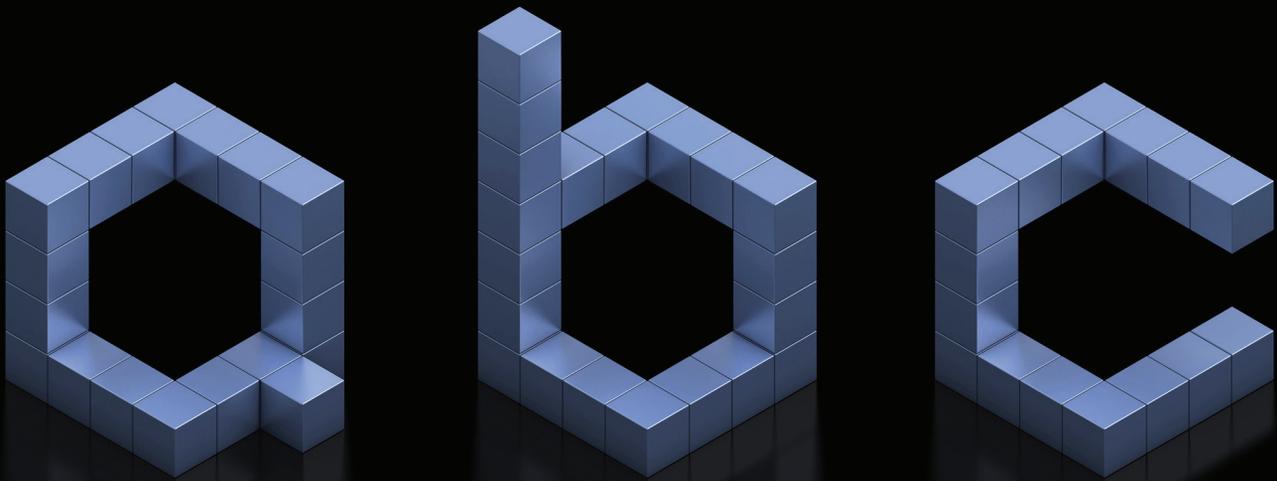
## FINAL THOUGHTS

The software performed very well and worked as advertised. I am giving it 8 out of 10 stars. It is very powerful software and has lots of potential for both modeling and fabrication. If the cost doesn't deter you and you do a lot of metal and wood framed modeling, then I recommend you go buy it.



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# The ABCs of MEP Construction Modeling, Part 2



**I**n Part 2 of this two-part series on MEP trade construction modeling we continue discussing shop drawings and submittals and focusing on how to best use Autodesk® Revit® MEP for trade construction modeling. For Part 1 of this article, please refer to the October 2014 issue of *AUGIWorld*.

## WHY USE REVIT FOR MEP TRADE MODELING?

Many MEP trade contractors are still using AutoCAD® or AutoCAD-based fabrication tools such as Autodesk's own CADmep+, so the question of why we would want to use Revit MEP for trade contractor modeling and shop drawing production is an important one.

First, it is important to understand where the industry is and in what direction it will be moving. It was clear from Autodesk's

acquisition of MAP Software in 2010 that they intended to fill the gaps in their building construction portfolio for MEP fabrication, a critical factor in the success of any building construction effort. Combined with Navisworks® and Quantity Takeoff, we now have all of the tools to leverage BIM for construction.

Sadly, the MAP Software acquisition was not without quite a bit of pain. The CADmep application is an AutoCAD-based add-on, and thus was a straightforward port to an Autodesk rebranding. However, their Revit-based product, FABmep+, came with a lot of legal strings attached, which caused Autodesk to discontinue the product in the 2014 release cycle (March of 2013).

However, Autodesk is clearly intent on making Revit a design to construction, end-to-end solution platform for BIM. They are actively working on the successor to FABmep+, which will bring fabrication-level Revit content and workflows to the MEP trades. This will dovetail with Autodesk's ESTmep

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application for estimation and Fabrication CAMduct for automated duct fabrication.

Given the rapid rate of BIM adoption by the design and construction industry, it is important for MEP trade contractors to consider adopting Revit and a BIM workflow as soon as possible, to eventually be able to take full advantage of this technology and not be left behind.

Secondly, even without the additional trade-specific Revit content provided by FABmep+, you would still see massive gains in productivity as you leverage the Revit platform using the provided toolsets for laying out and documenting duct, piping, conduit, and cable tray.

## BACKGROUND MODELS AND SHOP DRAWINGS

As we discussed in Part 1 of this article series, design models are usually not up to par for the purposes of MEP trade coordination, so the initial part of the MEP trade construction modeling process is to somehow acquire accurate architectural and structural construction models for use as backgrounds. Today this often comes under the purview of the construction manager (CM) in order to leverage BIM across all trades, so the CM will typically provide the background models to the rest of the construction team and perform coordination. This typically goes one of three ways for the MEP trade modeler.

Construction managers may subcontract out the creation of base architectural and structural models to hand over to the MEP trade contractors. This is often the case with non-BIM projects. However, the CM may not be experienced enough to properly specify the necessary requirements and protocols, so you may end up with inaccuracies or other issues. I've seen cases where they farm out the modeling to a company that, in turn, subcontracts the work to an offshore company, which then models all of the architectural and structural components in Metric instead of Imperial units or vice versa. In the delivered model, every length, component family member, and system family layer is an oddball dimension and this has radically compounded errors across the project.

If you are very lucky (or very unlucky, depending on your point of view), you may get the contract to model everything yourself. While not ideal from a sanity standpoint, it does afford you ultimate control over the modeling process and can provide a very clean coordination phase.

The ideal scenario is to receive models that directly incorporate or are a result of the fabricators' shop drawing process for structural and architectural components. Based on the construction documents, the concrete and steel detailers create the fabrication-level shop drawings. Once they have been reviewed and signed off by the structural engineer, the structural shop drawings have the final say in what is fabricated and installed, so any model based on these would be authoritative for your use. They contain precise framing spacing, slopes, and top of steel elevations, as well as all of the pertinent structural details used for fabrication.

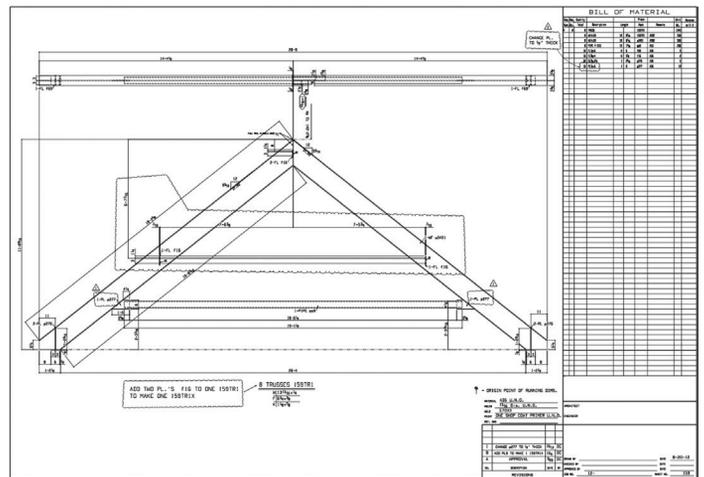


Figure 1: Typical structural steel shop drawing of a roof truss

Many of today's structural detailers use specialized, model-based software for their shop drawing production, so you may or may not get lucky and be able to obtain something that can be used directly in Revit. Revit 2015 now features IFC Linking, which should be a boon for construction modelers who need to repurpose foreign file formats. While the accuracy of IFC components has historically been a problem, the format is gaining steam and is actively being developed independently of Autodesk, which should help ameliorate these kinds of issues.



Figure 2: An IFC structural model

Architectural shop drawings also play a critical role in the overall modeling process. Detailed, approved shop drawings for exterior precast panels, curtain wall/storefront assemblies, and casework are all often necessary for properly coordinating with MEP.

## SUBMITTALS

A large part of the trade modeling process is to collect and review the approved submittals for all mechanical HVAC, piping, plumbing, and electrical components. This can be a long, drawn-out affair as contractors evaluate the cost, lead times, installation requirements, and cost (again) of each and every component they intend to supply for the project.

The submittal approval process may take longer than planned, and you will definitely not have everything in place on day one. The specifications dictate what manufacturers are approved, and the drawings may even provide model numbers as a basis of design, but contractors will often request substitutions, which may

take time to get answers. Just like structural shop drawings, the approved submittal ultimately dictates what is going to be installed and, thus, what is to be modeled.

Approved equipment submittals can have a huge impact on the coordination process. For example, I've seen the case where a design team uses a specific air handler and properly bases their HVAC designs on the unit's parameters for port sizes and locations, overall size, and so on. However, the unit's submittal that comes back from Johnson Controls is very different from the drawings. In reality the unit is about five feet longer, two feet wider, at least a foot taller, and has two new sections added for access. The supply and return air connections are larger, requiring modifications to the supply and return air ductwork. Additional ports for a glycol recovery loop between two coil units are included, but not shown in any drawings. Because of the increased size, it now requires careful placement in the mechanical room to avoid encroaching on nearby electrical panel clearances.

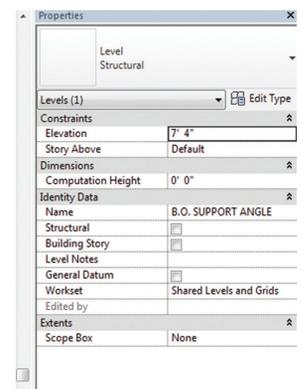
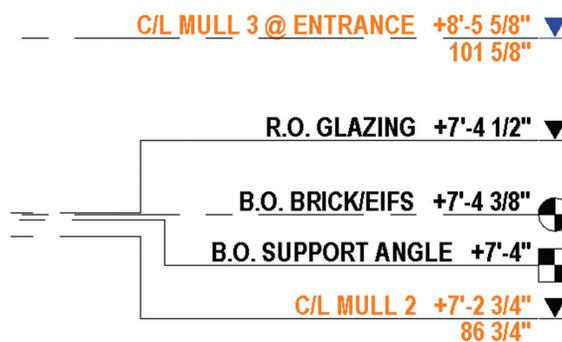
## COORDINATION TIMING

Probably the biggest problem with the BIM coordination modeling process is one of sequencing and timing. Typically, concrete and structural steel shop drawings are the first to be completed because the structure is the first thing to be built. However, the MEP contractor is already on site from day one, working in the field hand in hand with the concrete and steel trades, laying underground duct banks, piping, and placing sleeves. Things move very fast on site—as soon as the steel is up on one floor, the other trades descend on it to place hangers, ductwork, piping, and conduit. Thus, the MEP trade modeling efforts will need to be properly phased early enough into the coordination process as to not hold anyone up in the field. Be forewarned: MEP modeling is extremely labor intensive and even with simple buildings it can take a long time to model all the systems.

## INITIALIZING YOUR MEP CONSTRUCTION MODELS

Regardless of how you acquire the base background models, my typical MEP modeling workflow goes something like this:

I usually start by creating an authoritative datum model that establishes the overall shared and project coordinate systems, levels, grids, and any important reference planes. It's really a utility model; it has no real geometry, is very lightweight, and can be linked into other models and used to easily acquire/publish coordinates, copy over datum, and other useful tasks. Set the locations of the project base point, shared coordinate point, and true north from a linked civil model or CAD drawing. Set up all of the levels and grids, and be aware of the grids' 3D extents, ensuring the correct grids apply for each level. Place and name all of the important reference planes, such as the building's axes or centerlines. Incorporate scope boxes and propagate extents to set up views and datum graphics.



I also ensure all models have their units set to the highest level of precision available—1/256". This allows me to easily identify poorly located elements and quickly fix errors, which usually fix adjacent errors in the process. I like to keep my models honed. If I see weird x/256" dimensions, something is probably not located right. If it's an odd building with lots of odd dimensions, I'll use alternate units to display rounded values.

If I'm also modeling the architectural and structural backgrounds, I treat the set of linked models as a giant 3D jigsaw puzzle. I determine who owns what and model each element once and only once across the project. A concrete floor slab is typically structural, so it goes in the structural model only. Because of phasing during construction, you may opt to split up wall assemblies across models, putting the non-load-bearing portions that get built later (face brick, air space, insulation, sheathing, interior furring studs, and wallboard) in the architectural model, and the major load-bearing CMU portions in the structural model.

Leverage the use of parts in your structural and architectural models. Breaking up system family elements such as walls, floors, and roofs is required for some construction types and typically provides better accuracy for coordination, enhanced quantity takeoff (QTO), and advanced 4D sequencing.

Take advantage of all the available tools. Use split face and paint for zero-thickness finishes such as paint and wallcovering. For non-zero finishes, create thin floors, walls, and ceilings. And don't worry about modeling outside the box. I will often model railings as curtain walls and use in-place modeling of sweeps for casework and corrugated metal decking where necessary.

A certain amount of discipline-specific organization goes a long way. Each linked model gets its own set of project datum (levels and grids) and should be identifiable as such. Set up different discipline-specific head symbols and color-coded types for structural, architectural, and MEP datum, and apply them in all of your trade contractor models. Use instance-based project parameters and filters to turn them off in documentation views.

Figure 3: Structural, story, and general datum level types

Link the architectural and structural models into each other and into the MEP model, and copy the levels and grids as required. Don't make Revit work any harder than it needs to—at this stage

WORKSTATION



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### MSI WS60 MOBILE WORKSTATION

As an engineer, you need to take work home or to the clients occasionally. However, your system at home or your business laptop doesn't have enough juice to run the applications you need. This is where the WS60 Workstation comes into play. The slim form factor design and feather light system not only makes it ultra-portable, but it is also non-compromising in performance with its powerful NVIDIA Quadro K2100M graphics card and an Intel® Core™ i7 processor under the hood allowing you to take on even the most daunting of tasks wherever you go.



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## ATTENTION TO DETAIL

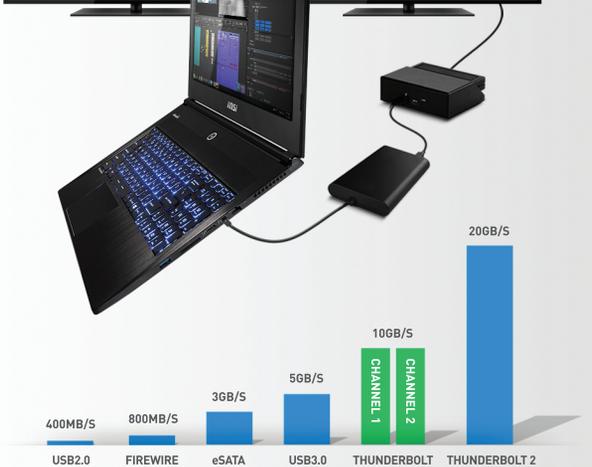
When you are trying to deliver high quality work either in the office or at the client site, you are going to need a high quality screen. MSI outfitted the WS60 with a 15.6" WQHD+ 3K (2880x1620) resolution screen to deliver images as sharp as ever along with colors that are true-to-life to make sure you get the job done right. Sometimes though, one screen might not be enough for people who require a lot of desktop real estate. With MSI's exclusive Matrix Display, you are able to connect up to 2 external monitors via HDMI and Thunderbolt™/Mini Display Port, transforming the ultra-portable WS60 into a desktop workstation allowing you to expand your workflow.

## CONNECTIVITY & SPEED

Connectivity plays a major part in a workstation and MSI did not falter here either. Big data requires a lot of bandwidth in order to transfer in a relatively short amount of time. The WS60 includes a Thunderbolt™ 2 port, offering engineers a great deal of flexibility, speed, and simplicity. It offers daisy chaining to multiple devices, doubles data transfer bandwidth to 20GB/s, and is capable of streaming to 4K monitors. Everything you could ask for right there in a single port.



The Thunderbolt™ 2 port isn't the only thing that is fast in the WS60. Moving data or loading programs and files in your workstation can take up a lot of time. To address this, the WS60 is configured with 2x m.2 SATA SSD's together in RAID 0 to provide over 1000 MB/s of read speed, including a high capacity hard drive as well to store large data files. With this setup, you can enjoy the best of both worlds.



## BUILT FOR PROFESSIONALS

Boasting in high-end components is one thing, but what is best about the WS60 Mobile Workstation is the ease of mind knowing that it is pre-certified by leading 3D software giants such as SolidWorks, ensuring compatibility, reliability, and stability for professionals like you.

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you won't need to monitor the datum between the models as they probably won't change (if they do, you have bigger problems).

You will want to turn off visibility of the linked datum elements easily, which you can do with a specialized view template. In any plan, elevation, or section view, modify the View/Graphics Overrides for a Revit link, setting it to custom and turning off the annotation, analytical, and import categories completely. Then create a special "Link Model Prep" view template from this view that has only the RVT Links section checked. Apply this template to all views, which will instantly switch off the linked model datum. Note: Remember that this template is specific to the RVT links you have loaded at creation time. If you rename a linked file or remove/reload it, the template will no longer function and will have to be rebuilt.

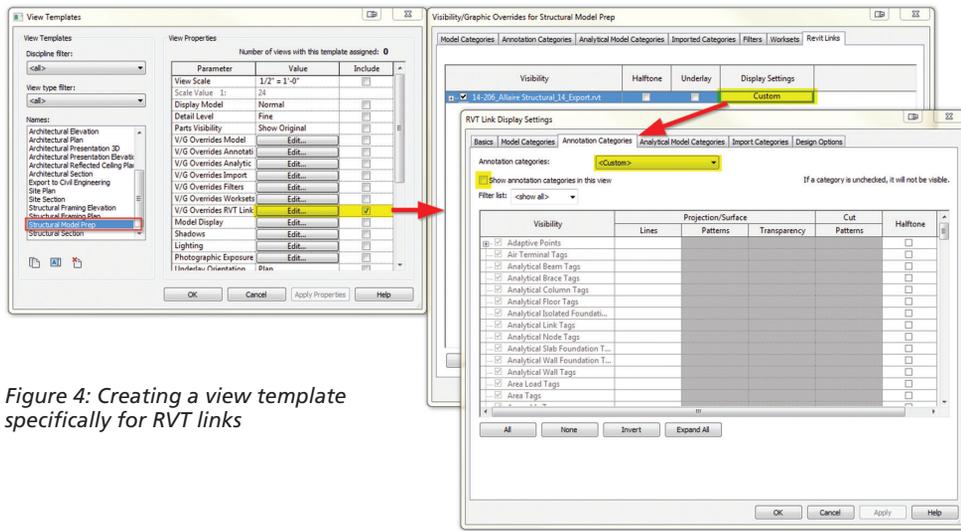


Figure 4: Creating a view template specifically for RVT links

To fully coordinate between the architectural, structural, and MEP models, you will necessarily bounce back and forth between all of them to make required changes generated from the MEP modeling process. These would include creating the required duct penetrations, pipe and conduit sleeves, electrical outlet poke-thrus, and so on.

Modifying the backgrounds to coordinate with MEP elements reduces the false positives during clash detection and allows all of the models to be used for locating these critical features in the



Figure 5: Pipe sleeves set in CMU walls

field. It's much less expensive to accurately form out a 12" hole for a steam pipe sleeve in a foundation wall when it is poured rather than have someone core drill it later on demand. Note that penetrations in structural walls may require modifications to the rebar, so these conflicts should be identified as early as possible and passed to the engineer for approval. If your structural model has the rebar modeled, so much the better.

If others are responsible for the architectural and structural models, be aware that these models may be updated after you start your MEP modeling, so you may need to refrain from making any MEP-driven changes yourself. Instead, coordinate the MEP-driven changes via frequent sketches back to the CM so they can have their modeler incorporate them and provide the updates.

## STARTING YOUR MEP MODELING

Now that you have the drawings reviewed and marked up, are familiar with all of the systems involved, and have solid architectural and structural models linked into your new, blank MEP model, it's time for the real fun to begin. And by "real fun" I of course mean endless tedium, long hours, lost weekends, and unhappy significant others.

Starting with a well-developed MEP template that has a lot of the typical settings and system/component family types is crucial. You need to get off the ground with basic duct, pipe, and conduit types that have most of the required

fittings and behave the way they should.

I typically start by creating all of my duct and piping system types as well as my duct and pipe types. This involves the following tasks: Modify/duplicate the duct and piping system types as required. These are first and foremost identified by the system classification, which is inherited by the system type that was duplicated. System classifications allow Revit to determine how systems and MEP family connectors work together. System types also determine what media it is carrying (air, water, gas, etc.), the conversion and calculation method used for sizing, and the graphics overrides that will automatically be applied in all views.

Review the specifications for the pipe and conduit materials, the systems in which they are to be used, and the sizes used for each material. Incorporate these materials into the mechanical and electrical settings as required for the various duct, pipe, and conduit types. Ensure that the proper true ID and OD sizes are input for each trade size. Remove anything not required in order to eliminate confusion.

When defining the pipe and duct types, take the time to flesh out the routing preferences. Ensure that the segments and sizes are properly enumerated. For example, the specifications may call for

## GENERAL MEP MODELING CONSIDERATIONS

While it's important to understand what to model, it's just as important to know what not to model. BIM Execution Plans (BEP) will often dictate this, but always confirm with the MEP coordinator about specifics. For example, the BEP may specify that all conduit 1" trade size and over is to be modeled. But there may be plenty of instances where 10 or more 3/4" conduits are ganged together and running through a space. Ensure that these are accounted for.

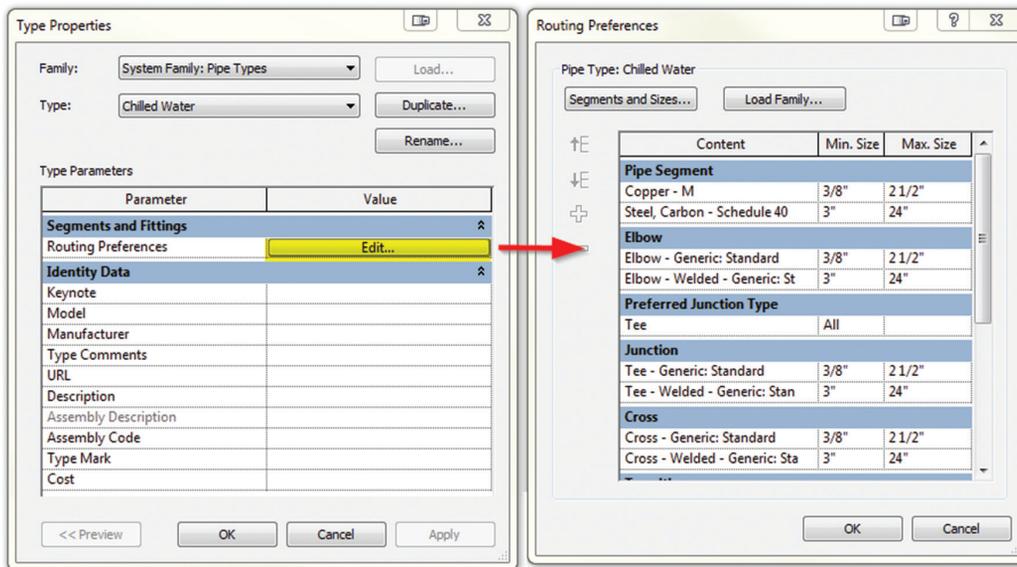


Figure 6: Adjusting a pipe type's routing preferences

copper Type M for pipes NPS 2 or smaller, and Schedule 40 steel pipe for NPS 2 1/2 and larger. Each requires different fittings and segment materials that can be set in the routing preferences.

Ensure that for each of these material types you create and/or load the proper component families for fittings and unions, and update the routing preferences accordingly. This is particularly important for larger drain pipe, as these elbow fittings have longer sweeps and take up much more room than the default elbow, which definitely will affect coordination. Note that in Revit 2015 there are new ductile iron and steel pipe fitting families based on AWWA standards.

For duct types, set up the routing preferences with fittings based on the contractor's shop standards. The contractor may call for TDC duct for anything 8"x8" and over, and use Slip & Drive for smaller duct. Or they may reserve TDC duct only for ducts 20" and larger. They may want transitions to be 18" typical, flat on one side if possible, elbows with 6" throats, with extended throat sizes in order to economize on cutting a piece of duct. Create fitting families for all of these items, including volume dampers as required. Do whatever you can to make the duct layout easier the first time around.

Review the specifications for duct elbow information. Are they angled or radiused? The drawings may indicate radiused elbows, but the duct subcontractor may prefer square 90-degree elbows with turning vanes, which are actually very efficient. If they are to be radiused, check the specifications to see what the radius ratio to duct size is required. Do not rely on the drawings, as they may have been drawn/modeled incorrectly. Having to increase the elbow radius from 1x duct width to 1.5x duct width across a tight plan can introduce all sorts of new clashes with other work.

Get a copy of the SMACNA "HVAC Duct Construction Standards, Metal and Flexible" manual and read it thoroughly. It documents and details many of the things you will need in the construction model.

One of the first things many modelers do is go on a Revit family treasure hunt, scouring manufacturer sites for equipment, light fixtures, and other content. Sometimes it is worth the effort, but just as often it is not. Just because a family comes from a manufacturer does not mean it works well. Often I see families that are way too geometrically expensive and complicated in how they were built, inconsistent from one model to another, and just difficult to use in the real world. In my view, the best families have few types and address project-specific conditions. Tip: the ENGworks BIMXchange add-in (<http://www.engworks.com/BIMXchange/bimxchange.html>) is a very good place to find well-modeled families from a number of popular equipment manufacturers.

No matter what family I am working with, I ensure all families include at a minimum the identity data for manufacturer, model number, assembly code, and other pertinent information that could be useful to the owner downstream. Work with the MEP coordinator to define what things can be added to the Revit content that will help him or her in Navisworks, such as links to submittal PDFs. I generally include type comments, but rarely tag from them, instead relying on more direct information for documentation purposes if required. Check with the BIM Execution Plan for any required parameters.

To ensure the family is as light as possible in plans, turn off 3D geometry for plan views and incorporate 2D symbolic linework instead. It's often easiest to use a nested 2D detail item family.

### SUBCATEGORIES

Because the "Mechanical Equipment" and "Electrical Equipment" categories are so all-encompassing, make use of subcategories for specific kinds of equipment, such as expansion tanks, air separators, heat exchangers, water heaters, and so on. Create and assign these to the geometry in the families, and they will come into the project environment and allow you to fine-tune their appearance in views.

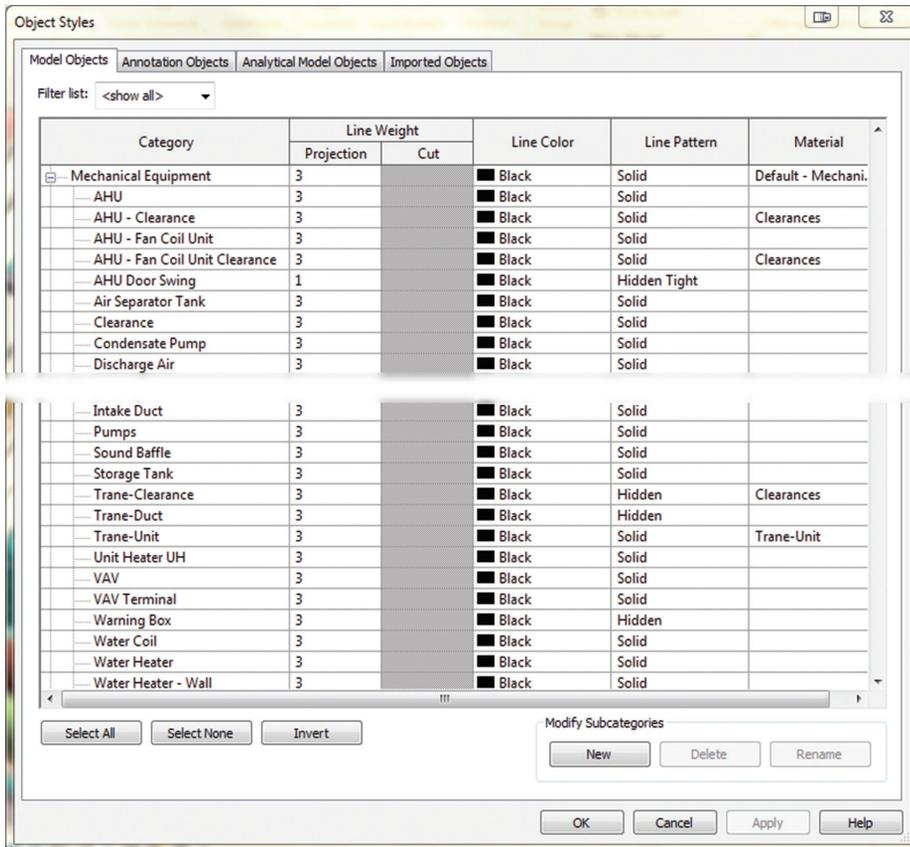


Figure 7: A partial list of mechanical category subcategories. Note the use of "Clearance" subcategories with assigned materials

## MEP CONNECTORS

MEP connectors are really what allow Revit MEP to function. You need to understand system classifications, flow direction, and controlling the flow and size using linked family parameters to make the connections to duct and pipe behave correctly. For air terminals, the connector needs to be set to Preset, which allows the user to define the CFM at the terminal. Additionally, the connector's flow parameter must be mapped to a flow family parameter. You can actually name the flow family parameter whatever you want,

and as long as the connector is set to preset and its flow parameter is mapped to the family parameter, it will schedule under the "Flow" field. Note that this connector must be the primary duct connector in the family.

For mechanical air-handling equipment, the connectors are set to "calculated" to calculate the total airflow to or from the air terminals and/or VAV boxes. Because we typically aren't actually designing the MEP systems for performance (that's what engineers are for), your connectors can be a little loose on defining loss methods, pressure drop, and other nerdy engineering considerations. However, I highly recommend you always provide a connector description, particularly on complex pieces of equipment, so that when you create systems you can readily assign them to the proper connectors on a multi-connector equipment family.

## SPECIFIC MEP MODELING CONSIDERATIONS

For electrical panelboards, I start with a prototypical panelboard family I created that has some typical standard sizes built in. I then create dedicated types named for each and every panel in the project, sized appropriately. This makes it easy to place panels and identify each one. It includes Unistrut supports that can be turned on or off based on the mounting condition.

I use the panel schedules to define some specifics in the panel type, but because electrical modeling is mostly about locating panels, equipment, and snaking conduit/cable tray through the building, I usually don't get hung up too much on the engineering aspects. I typically don't wire up any devices or worry about modeling flexible conduit, for example.

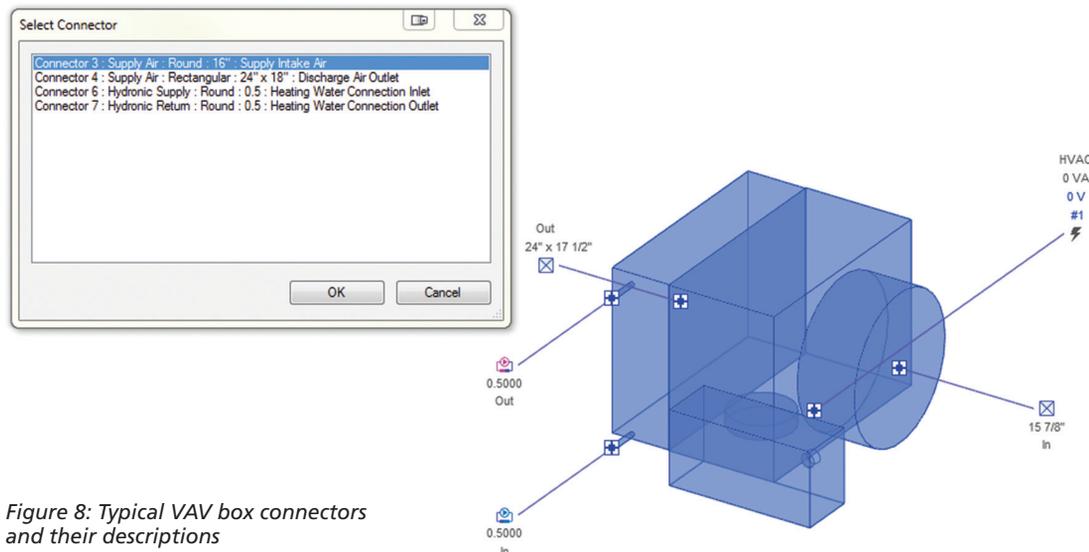


Figure 8: Typical VAV box connectors and their descriptions

However, included in all panel families are boxes that accurately show the required clearances for the dedicated electrical space above the panel, and the working space in front of the panel, as outlined in NEC 110.26. You would be surprised at the number of electrical designers who do not take this into account, and it can really affect coordination. Relocating a panel during construction because its

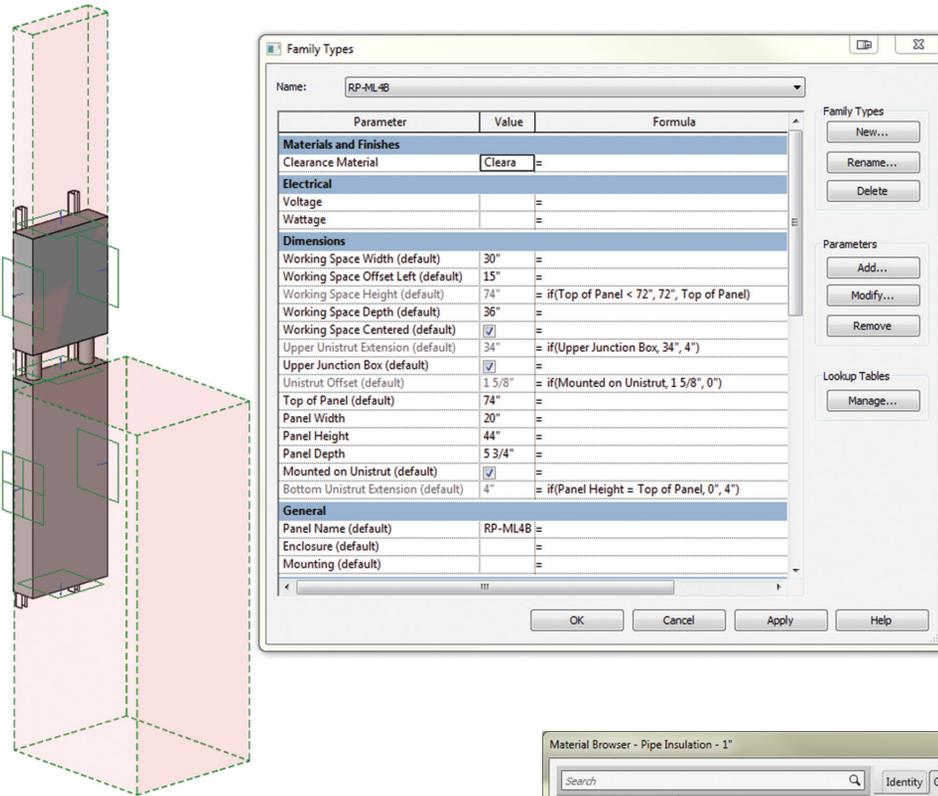


Figure 9: A typical panelboard family with code clearance geometry

clearances clash with nearby elements is always expensive, because it means more cable, conduit, and labor.

As a general rule I include clearance geometry (assigned to a subcategory) in almost all other mechanical and electrical equipment as well, using a standard “Clearances” material, which is a transparent pink color. These clearance boxes allow us to clash test for contractual and code compliance.

For suspended equipment, such as VAV boxes and unit heaters, I include simple hanger families with instance parameters for controlling the suspended height as well as the length to the underside of structure. I tend to model VAV boxes with the center of the duct at the reference level to make its offset value the same as that of the duct. For unit heaters I generally model the bottom at the reference level, making vertical placement above the floor (as well as tagging) easy in the project by specifying the offset instance parameter.

With air terminals—more appropriately termed grilles, registers, and diffusers or GRDs—I’ve found that some manufacturers have excellent families available and some manufacturers have none. Since most GRDs are the same or very close to what you need, grab some of that work and modify them as required. Note the neck sizes and shapes as well as the airflow pattern.

For mechanical piping systems, particularly steam systems, there are a lot of components to deal with. You have gate, globe, butterfly, and air-assisted pressure relief valves, strainers, thermometers, gauges, flexible connections to equipment, expansion tanks, air separators, pumps, heat exchangers, condensate traps... the list is endless and it all needs to be modeled to some degree. The submittal cut sheet will usually have good dimensional information to work with.

For duct and pipe I need to add insulation, but also always need to see the underlying geometry, so I create insulation types for each thickness that have a transparent material.

Plumbing fixtures and fixture supports (carriers) can be modeled as individual families and nested into a single fixture

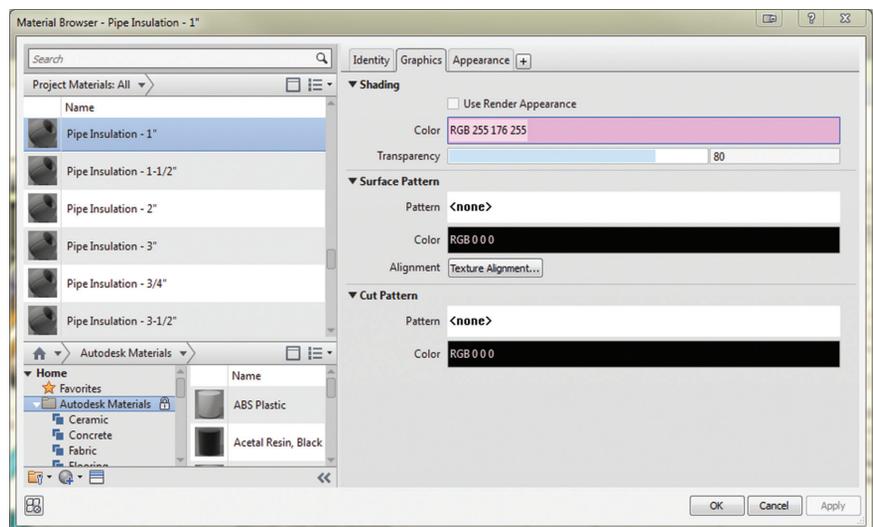


Figure 10: Transparent insulation materials

family with the proper connectors placed. For water closets I usually nest the carrier and the flush valves, linking parameters to the host family where required and remembering to make left- and right-handed versions. Mirroring plumbing fixtures is a “no-no”!

I will often model sinks complete with the faucet, p-trap and run horizontal “pipe” segments into the wall for sanitary/vent and hot/cold water supply, and include all of the necessary connectors there. That allows me to easily add the sink to the domestic cold water, domestic hot water, sanitary, and vent systems in one shot, and pipe up things easily.

Hangers and supports take up real space, conflict with real things, and need to be modeled. Providing these early helps the trade contractor mobilize people on the job site and better coordinate between trades in dense locations. These also contribute to

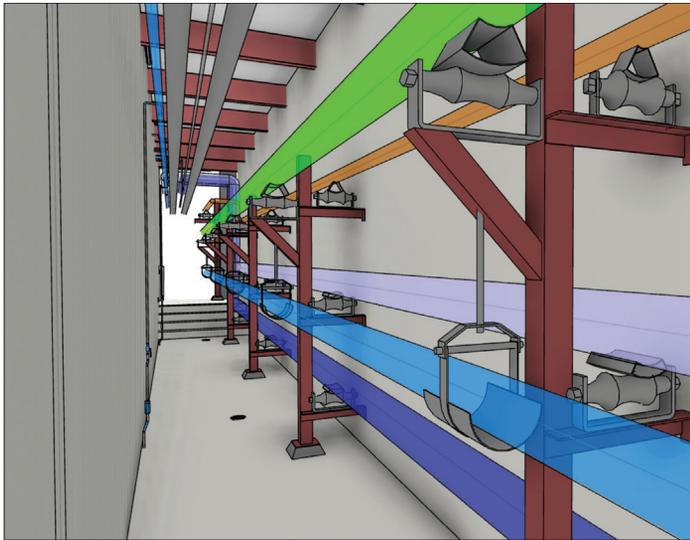


Figure 11: A typical service tunnel with pipes, supports, and hangers

prefabrication, which saves everyone time and money. Fully parametric unistrut racks and hangers for conduit and electrical equipment are pretty easy to make, as are saddles and clevis hangers. For strut-like hangers, I base the elevation on the underside of the things being supported. For pipe hangers I usually base it on the elevation of the center of the pipe.

## PLACING EQUIPMENT

After I gather up or model my equipment families, I try to locate as much of the mechanical equipment, lighting, plumbing fixtures, and GRDs at one time throughout the building. Don't try to pipe or duct anything up just yet—that requires coordination with structure and equipment and best comes later. Give the GRDs the proper CFM values per the HVAC drawings; I always tag them as well as run a schedule to double check.

For GRDs and light fixtures, special consideration has to be taken into account with regard to how you handle the ceiling. Ceilings are usually “owned” by the architect, but the MEP engineer needs to poke all sorts of holes in them, which leads to coordination breakdowns. For placing diffusers and lights in an MEP model, which may need to cut the ceiling plane, you have three options:

1. Put the ceiling in the MEP model and place ceiling- or face-hosted families that cut their host. Not always easy, especially when you do not control the architectural model.
2. Leave the ceiling in the architectural model. Place face hosted or unhosted families in the MEP model and don't worry about cutting the ceiling object.
3. Do option 2 with unhosted families, then place parallel “void only” families in the architectural model, which cut a hole in the ceiling that matches where the ceiling components are in the MEP model.

Of the three I typically prefer option 2, then if I can, move to option 3 using unhosted families. As the design is finished, we can use unhosted families and not worry too much about moving walls or ceilings. I'll prefer to have the ceiling in the architectural model as I don't want to have to deal with it specifically in the MEP, but also want the hole as well. I'll usually wait until the location of

the GRDs and lights is finalized, then quickly cut the holes in the architectural model to synchronize the two.

## TIE 'EM TOGETHER WITH SYSTEMS

Once all of your equipment and fixtures are placed, it's time to create the systems. It could be argued that construction modeling doesn't really need systems, since that is really under the purview of design. However, associating elements into systems can show significant performance gains rather than leaving them in the default system. Although I won't typically wire up the electrical devices, I will create circuits based on the electrical drawing panel schedules. Use the System Browser to view what elements belong to systems and which do not.

One of the best reason to use systems in construction modeling is that you can color code them with filters. By doing so you can easily cross check system integrity and identify components not in a system as well as get instant feedback when modeling out the duct and piping as to which system it belongs.

## DUCT DUCT PIPE

Once the systems are created, it is time to model the duct and piping. Some may start piping and duct first, which is a workable option; it's a personal preference. I like creating the formal systems first as it allows the connected duct and pipe to automatically inherit them. Otherwise you will end up with tons of systems that are created on the fly and at some point you will need to clean things up. This can be tedious and a real time waster.

When modeling duct, piping, and conduit, you need to understand how the contractor wants to install things. Talk to the job foremen for advice; they are usually more than happy to help anyone who can make their life easier. For piping, they usually like to run pairs of supply and return pipe side by side, both at the same elevation as much as possible, and rise/drop to each piece of equipment as required. Mechanical designers, on the other hand, will often run each pipe at different elevations so they can shoot off side to side easier. This takes up much more room above the ceiling, which is already at a premium.

When laying out the duct and piping, which can be tedious in and of itself, the secret is to make use of “working” sectional views and section boxes liberally through the project to isolate the condition you need to explore. I'll create a specific Working Sections view type complete with a view template that includes my typical color-coded filters and a section tag with custom head and tail that identify them as such. I try to create as few working sections as I can get away with, to keep the Project Browser tidy, and simply move them around as needed. It's also easy to ctrl+drag a section to make a temporary copy.

For section boxes, use the View Cube > Orient to a View to create a 3D section of a 2D working section. Additionally, use the COINS Auto-Section Box add-in, available for free from the Revit Apps store. This is super handy for creating sections by simply selecting objects: <https://www.youtube.com/watch?v=7rWdUsKyBOo>

## FILTERS

Because of the complex nature of MEP trade modeling, ensuring your views are easy to work with is essential. You will undoubtedly make use of shaded 3D sections more than any other view type. I've found that the biggest help in managing this voluminous amount of material is to take full advantage of Filters.

Pipes all look the same, so you need to be able to visually distinguish between steam condensate and domestic cold water. While you can use system types to provide the graphic override, it's tied to that one parameter. Filters allow you to key off of almost any MEP property. Apply them in the Filters tab of the View/Graphics Overrides dialog box and color code them by overriding the Projection/Surface Pattern with a colored solid fill. The additional use of transparency and cut pattern overrides for architectural elements also really helps view things easily in dense areas.

As suggested in Part I of this series, I highly recommend formulating a standard color scheme for all of your systems. Create a 3D view with all of the filters working. Then, just as with the RVT links, create a view template that only overrides the Filters tab, and apply the same template to all of your 3D views.

I tend to keep everything turned on in the Model tab in all views, then use Filters alone to selectively turn things on or off as required. Managing the bulk of your visibility requirement via Filters is often easier than in the Model tab as you can combine categories into a single filter—e.g., including pipes, pipe accessories, pipe fittings and pipe insulation—and it works across linked models.

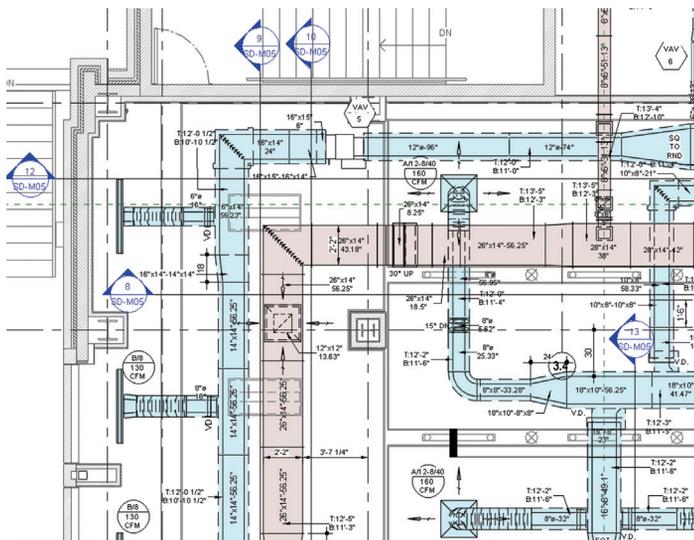


Figure 12: The service tunnel view's View Filters

## MODELING LEVEL OF DETAIL

Level of Development (LOD) is an AIA term that is supposed to govern how much is modeled for a specific purpose. In reality the use of LOD in construction is so vague I consider it useless. It certainly does not dictate how much effort you put into your modeling tasks.

Instead I go for the minimum level of detail I can get away with. Remember that you are modeling mostly to identify clashes, so

you won't need or want every nut and bolt. Follow the age-old aphorism that everything should be made as simple as possible, but no simpler. The best rule of thumb is to always start by under-modeling the family. It is expensive to model details that are unnecessary, and curved surfaces are tough using the anemic modeling tools in the Family Editor. Get the basic size correct with the connectors working; if you want more detail, add it later. Chances are, you won't.

## MEP SHOP DRAWINGS

Finally, you will need to create shop drawings for fabrication. This is where Revit really shines, even in its current form, because you can leverage all of that BIM data to easily tag and notate things. You will want to create multi-faceted tag families that can report different parameters, such as duct size, length, top and bottom elevation, and so on.

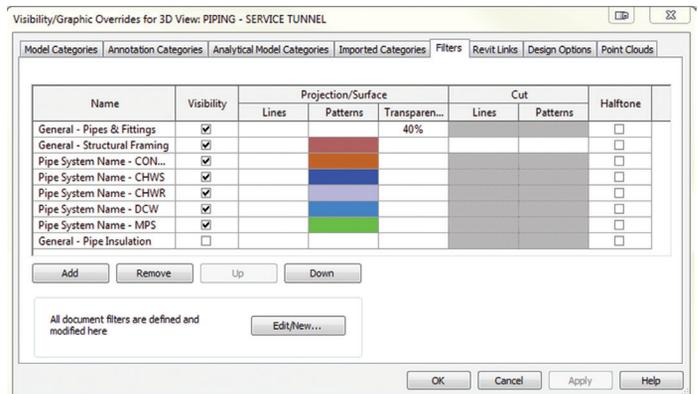


Figure 13: A partial HVAC duct shop drawing. All of the tags and text notes are intelligently reporting data from the model elements.

## CONCLUSION

The future of Revit for MEP coordination and fabrication is very bright. Even without any special add-ons, you can leverage the power of the Revit platform for MEP trade contractor modeling right now. With the promise of Autodesk's Fabrication suite of applications coming to the Revit platform, get ready for easier, more accurate MEP modeling, simpler cost estimating, and a direct model-to-shop floor fabrication workflow in the near future.



Matt Stachoni is the Senior AEC and BIM Applications Technical Specialist for CADapult Ltd, an Autodesk Silver Reseller in Newark, Delaware. He has been using Autodesk applications since 1987 and today actively participates in project construction modeling, coordination, and BIM training and implementation for architects, engineers, and construction professionals. He can be reached at [matt@stachoni.com](mailto:matt@stachoni.com).

# HAVE YOU SET UP YOUR LUG YET?

 As the LUG Director on the AUGI Board of Directors, I just wanted to ask you if you had set up your AUGI Local User Group (LUG) yet. If not, why not?

Maybe you already run a LUG?

If you do, do you have it listed on the AUGI website? You can become AUGI affiliated and get support from AUGI such as the LUG Handbook, which is full of great ideas and advice on how to set up and run your LUG.

Did you know there are three levels of AUGI membership?



**MEMBER**

**BASIC - FREE**



**MEMBER**

**PREMIER - \$25 PER YEAR**



**MEMBER**

**PROFESSIONAL - \$100 PER YEAR**

*(These costs may change over time)*

You can check out the levels of AUGI membership on the website, using this link:

[www.augi.com/about-augi/membership/membership-levels](http://www.augi.com/about-augi/membership/membership-levels)

As an AUGI Professional member, you also get access to the LUG back-end, too, and can edit your website details on the AUGI website, making sure your LUG entry is fully up to date.

You can schedule your LUG meetings, add a map to your meeting location, and provide your LUG members with all the information they need to get to your meetings on time!

I get some great benefits from AUGI as a Professional member. And as a Local User Group owner and organizer, AUGI provides me with great levels of support. Plus, if you are an Autodesk third-party developer, you get a year of free Autodesk Developer Network (ADN) membership, too! Not bad, huh?

## LOCATION, LOCATION, LOCATION

LUG's are a great way to meet other Autodesk users in your area. Meetings can be formal, informal, and can even be held in a local café or bar so that refreshments can be available. Maybe check out a local bar or café that might be able to accommodate your meetings and make it a regular thing. It gives the locally run business whose premises you are using extra business and it gives a great vibe to your meeting.

If you have a connection to a local college or university, maybe they can provide you with some space for meetings. You might even get a few students along who are interested in Autodesk products because they are using them in their courses. Better still, sign them up as AUGI Basic members. There is no cost to them at all, and they then get a load of AUGI benefits, including the legendary AUGI forums!



## MEETINGS

What sort of meetings should you have? Have you considered just having a social event—sitting down around some tables and just talking? Often, finding out what other people do is a great leveller. They might be doing something with Autodesk software that you have never even considered before, which in turn, allows you to take that knowledge back to the workplace with you.

Guest speakers are a great idea, too. But don't just tie yourself down to an Autodesk member of staff as a speaker. Talk to local business representatives who use Autodesk software. Find yourself a local success story. Maybe an academic institution has a professor or lecturer who is passionate about Autodesk software? Don't tie yourself down. It doesn't have to be ALL Autodesk, all the time! You might even want to link something to Autodesk software, such as an issue at work. Consider having a round table event where you all sit down and discuss a certain issue and how Autodesk software could assist in the solution. Be creative!

## SOCIAL MEDIA

Do you have a website set up for your LUG? Are you using Facebook, Twitter, and LinkedIn? Maybe set up a Meetup account so you can connect with other Autodesk users and promote your meetings. Social media is here to stay. Maybe create some online questionnaires about relevant topics using MailChimp, which is a great way to build up topics for speakers at your meetings. Post your next meeting as an event on Facebook and invite all your members and maybe some new ones. There are new social media tools popping up all the time and with today's smartphones and tablets, you can even set up the details of your next LUG meeting while you are on the move.

## RESOURCES

Have you considered discussing the Resources tab at the top of the AUGI website at one of your LUG meetings? Go to [AUGI.com](http://AUGI.com) and click on the Resources tab or use this link: <https://www.augi.com/resources>.

The list of AUGI Resources is growing and to use the immortal words of Uncle Sam, AUGI wants you! This is a great benefit for

an AUGI Professional member who runs his own business and attends your LUG meetings. This member will get his name on the website of one of the biggest Autodesk user groups on the planet. How's that for a bit of global marketing?

There are too many AUGI LUG benefits to mention here (it would fill a small book), but if you are not an AUGI member yet, where have you been? Even the free Basic membership gives you access to the AUGI forums, the place of legend, where you can discuss all and everything about Autodesk products, share problems, find solutions, and just meet up and chat (check out the Coffee Without CAD forum, known as CWC).

I cannot stress enough how important AUGI membership is to the Autodesk user. By being a member, you are joining more than 300,000 other members around the world, a global community whose members will all welcome you with open arms. Why not look up your Local User Group on the AUGI website and become a member?

Consider stopping by the AUGI booth at Autodesk University this year, meet me and the other Directors on the AUGI Board, and then we can chat about your existing LUG or how you want to set up a LUG in your local area. Then you will discover the enthusiasm and passion behind AUGI and that will encourage you to set up a LUG or join one!



*Shaun Bryant is the LUG Director serving as a director on the board of Autodesk User Group International (AUGI). He can be reached at [shaun.bryant@augi.com](mailto:shaun.bryant@augi.com).*

# Perspectives on AutoCAD

*Will AutoCAD stay around much longer? Will it change dramatically?*

*Two CAD veterans and AUGIWorld contributors, Walt Sparling and Brian Benton, ponder these questions.*

## WILL AUTOCAD STAY AROUND?

Walt Sparling

I currently work as an electrical designer for a small engineering firm that uses both AutoCAD® and AutoCAD® LT, with the bulk of the work done in LT. Over the last 30 years of my career in the AEC industry, I have worked in the mechanical and architectural worlds as well—both using some version of AutoCAD. I have worked as a CAD drafter, CAD designer, project manager, CAD manager, and IT manager supporting dozens of in-house AutoCAD users. I have also been customizing AutoCAD for many years as well as providing training and customization options for outside companies. AutoCAD has been good to me.

My first exposure to AutoCAD was back in the mid 1980s (Release 1.3 or Release 3) when I first entered the AEC industry. I actually started using AutoCAD in production a few years later with version 9. Since that time I have used nearly every version of vanilla AutoCAD and a few of the vertical products as well. I have seen many improvements and advances in technology that have made the current version of AutoCAD (15 as of this writing) a very powerful and flexible product. As with any technical software though, these products have to improve in order to stay relevant and useful. But does AutoCAD have a future, and if so, how long?

Over the last few years 3D has taken a strong hold in the architectural side of the business for visualization, and although AutoCAD can do 3D, the push that has starting getting people to wonder about AutoCAD's future is Building Information Modeling (BIM). For BIM you need a much more advanced software package that is designed from the ground up to do 3D natively. Products such as Autodesk® Revit® are advancing and showing up in more and more offices every year. In recent years, the classes and technical conferences offered by vendors and Autodesk (Autodesk University) have taken on a much more Revit and BIM focus.

BIM and products such as Revit can do amazing things for coordination and visualization, but it all ends up on paper as 2D drawings at some point (the paperless world is still a ways off). Although many companies are making the move to Revit, many more are sticking to AutoCAD and its core functionality—very fast and efficient 2D drafting software. The companies that have already invested a lot of money in AutoCAD software and training will have to retool to make a complete move to products such as Revit, and from what I'm seeing, it just isn't happening.

Unless there are substantial savings for the companies that utilize the Revit type products, which are needed to justify additional training and hardware costs, or there are governmental or industry

edicts given that require its usage, AutoCAD will keep pumping out drawings for a variety of industries for many years to come with a very minimal learning curve.

Generation expectations and user relational abilities will factor in the molding of future software based on their experience and expectations. Current gaming and media platforms are heavily into 3D and full sensory immersion. As the technologies explode and the new generations grow to expect relating to everything in a 3D environment, the push will get stronger.

## CONCLUSION

I predict you will continue to see AutoCAD used for many years to come. There is a huge existing customer base for the standard drafting duties required for most projects/products produced from its output. Revit and products like it will continue to add value to existing projects for coordination and visualization and eventually will swing the pendulum in the other direction where 2D becomes secondary. Even with advancing technologies, often pushed by the industry suppliers more than the industry users, there will continue to be a huge user base—both existing and new—for the traditional AutoCAD product.

## WILL AUTOCAD CHANGE?

Brian Benton

AutoCAD is a 30-year-old program that I have been using for more than 20 years. It has gone through dramatic changes over those years, yet is still the same. I currently run AutoCAD® Civil 3D® 2015 on a daily basis and had to work in Civil 3D 2008 on some ancient add-on software. It was horrible! No ribbon. No command line auto-complete. I hadn't realized how much I depend on those two features to work quickly. Everything else was nearly the same.

I expect AutoCAD to go one of two ways.

### WAY 1

AutoCAD will continue to see small iterations through tweaks to the interface, small enhancements to existing commands, and simple new commands. These changes will keep happening on a regular schedule. I believe this is the most likely way AutoCAD will change: small bits at a time that keep adding up over the years.

### WAY 2

Complete rewrite to the code. It's probably needed, to be honest. Scrap the entire thing and redo it from the ground up. That's tough to do, though, and this is not likely to happen anytime soon, in my opinion. I would love to see the code modernized so that it can finally take advantage of multiple cores on my workstation—especially in AutoCAD verticals such as Civil 3D that use data connections.

I started using AutoCAD professionally in the mid 1990s. We were running it on a 486 Intel Processor (dual floppy drives) in DOS and I was using a tablet (not the iPad kind today) and puck for the majority of the input; along with the keyboard of course.

No ribbon, no toolbars, no palettes—just the menubar and menu screen. Eventually we moved to Windows, got rid of the tablet and puck, and added a second screen. But I still use the keyboard for most of my inputs. It has changed dramatically, but also remains the same. It looks different, but the line command is still the same. Each command has gotten better and as much as I loved the stability of working in DOS, I would never want to go back.

Change is hard for CAD users so I don't see major changes being made to the software. Look at the outcry there was when Release 11 added paper space and 2009 added the ribbon. Granted, those were major shifts in how you used AutoCAD so some of that is to be expected.

I don't see major change happening in the software itself, but there may be changes to the way we get access to it. Autodesk has already announced the end of the license upgrade path for perpetual licensing. Last year they introduced “pay as you go” pricing plans. The only major change I see possibly happening to AutoCAD is the way it's licensed and paid for. Autodesk has been a huge proponent of the cloud and cloud-based systems for several years. I really think that eventually we will have a yearly “subscription” with consistent updates via the cloud similar to Adobe CS and Microsoft Office 365. In fact, I suspect most software, not only AutoCAD, will move to that type of model in the future.



*Walt Sparling has worked in the building design industry for 25+ years, starting as a hand drafter. He moved on to CADD in the mid 1980s and then into CADD and networking training and consulting. Walt has served as project manager and designer in the mechanical and architectural realms and currently works with an electrical engineering firm in Tampa, Florida. In his spare time, Walt maintains a couple of blogs and a personal website: [FunctionSense.com](http://FunctionSense.com) and [waltsparling.com](http://waltsparling.com)*



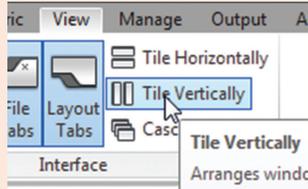
*Brian Benton is a Senior Engineering Technician, CAD Service Provider, technical writer, and blogger. He has more than 19 years of experience in various design fields (Mechanical, Structural, Civil, Survey, Marine, Environmental) and is well versed in many design software packages (CAD, GIS, Graphics). He is Cadalyst magazine's Tip Patroller, and Infinite Skills AutoCAD training video author. Contact him at [cad-a-blog.com](http://cad-a-blog.com).*

# And Here's How to... Paste to Original Coordinates

If you've ever had to lay out phased space plans or have multiple drawings that are just marginally different, the 'Paste to Original Coordinates' feature is quite the helper. I covered this years ago in Michael's Corner, but a few weeks ago one of my students in Manila asked a question where I knew this could be applied, and she was quite pleased!

## SETUP

The optimum application is for floor plans that are duplicates, or that have a common footprint between drawings. After opening the drawings you want to copy objects between, it would be optimal if you tiled the drawings. On the View tab > Interface panel is the Tile Vertically button that I'll use in the following exercise.



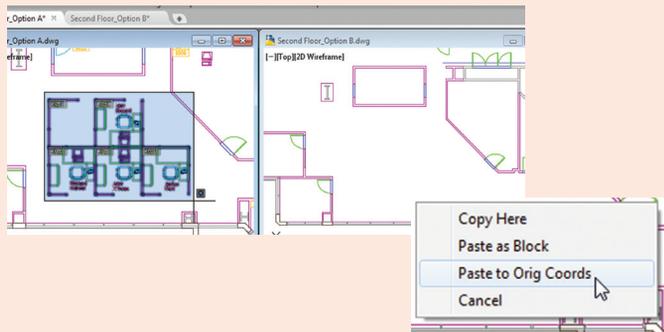
Memo: When you look at your View tab, the Interface tab is at the end ... and probably not near the View tab as you see in the figure. I repositioned the tab by clicking on the panel title and dragging it to a position closer to the View tab to economize my screen capture size.

## KEY FEATURE

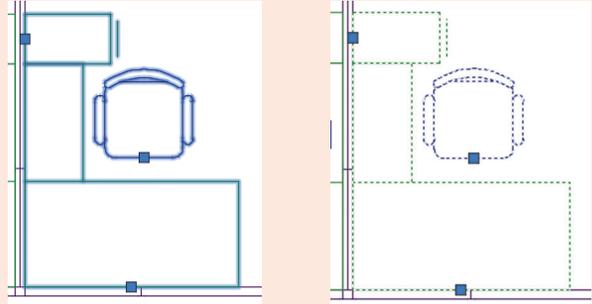
Most of the time you highlight, left-click, then drag. The Paste to Orig Coords option is only available on the shortcut menu when you use a right-click/drag/release action.

## HOW TO DRAG 'N PASTE TO ORIGINAL COORDINATES

1. Open the drawings you want to copy and paste between, then tile them.



2. With no command active, select the objects to be copied and they will highlight. [See Tip below for the highlight options.]
3. Now right-click on the selected objects and drag them anywhere into the other drawing and release your mouse to display the shortcut menu.
4. Click Paste to Orig Coords and you're finished!



**Gold Star Tip:** SELECTIONEFFECT. The variable that allows you to switch between the new A2015 'Neon' highlight <1> versus the old dotted object highlight <0>. You're welcome.

## THANK YOU!

As I sign off on my last *AUGIWorld* article, I want to thank Curt Moreno for inviting me to contribute to this timely and broadly informative publication a couple years ago. I also want to thank those of you who have reached out to me with encouraging words and kudos. It has been a privilege to have this forum to pass along a few things that I hope you have found to be helpful.



*Michael E. Beall (B. Arch.) won the AU 2013 Speaker Award for Hands-on Labs and will be presenting the updated version of that Lab at AU2014. An Autodesk Authorized Author, he is the owner of CAD Trainer Guy, LLC in Shelbyville, Kentucky, and has been presenting onsite CAD training around the planet – most recently in Manila – since 1982. Contact him anytime at michael.beall@cadtrainerguy.com, on LinkedIn at www.linkedin.com/in/cadtrainerguy/, or give him a call at 502.500.2267.*

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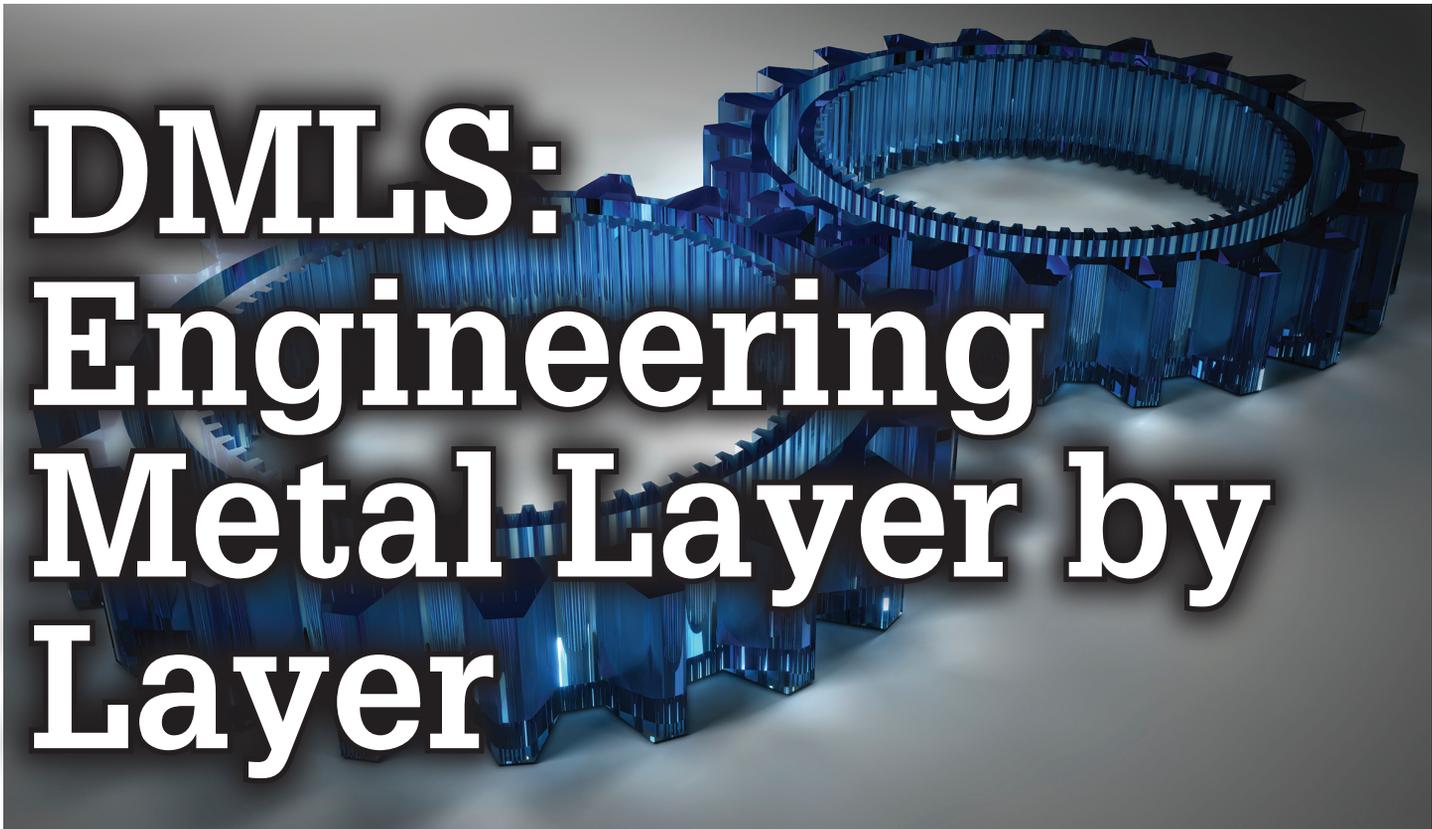
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# DMLS: Engineering Metal Layer by Layer

I have been a fan of 3D printing since I first became involved with the Mendel RepRap project in 2009. That project spurred a host of “affordable” desktop 3D printers, bringing the price down by democratizing the technology involved in Stereo-Lithography Apparatus (SLA) printed plastics.

That said, most of my company’s design studies involve metals and reducing component mass and size. 3D printing, or more correctly referred to as additive manufacturing, is a brilliant idea, but has been terribly unrealistic for serious aerospace metallic components ... until recently.

Enter Direct Metal Laser Sintering (DMLS), Selective Laser Sintering (SLS), Selective Laser Melting (SLM – not discussed herein), and Electron Beam Melting (EBM).



Figure 1: Turbine wheel manufactured by DMLS (courtesy of Solid Concepts)

## THE PROCESSES

### EARLY SLS

SLS involves a powder applied in a layer-by-layer fashion, which is then heated by a laser at precise locations. The powder that is not sintered by the laser is then removed and recycled, leaving the final solid structure where the laser bonded the particles together.

SLS does not melt the powder, but rather heats it to the point where the molecules bond at their contact points (makes the powder really angry). Early SLS products lacked durability. In many cases, parts possessed a non-contiguous density of material, their structure contained far too much residual stress, and a limit of basic materials in general often resulted in poor performance. I have witnessed parts break under loads that traditionally would only result in bending of a continuous solid steel. That kind of brittleness is unsuitable for any type of dynamic load. Add to that the cost of this type of manufacturing and you had a process few companies could embrace.

### EBM, THE FLUID ALTERNATIVE

Electron Beam Melting has been in production since Arcam placed its first machine into operation in 2001. Arcam’s process is quite refined and will be referred to here as the definition. EBM is a process by which powdered metal is turned into complex solids within a vacuum, using electron beams to heat and guide a pool of molten metal. Multiple beams can be generated in order to control multiple pools simultaneously. The temperature of the entire powder bed build layer is maintained at an optimum temperature for the specific material. The process is stated to produce stress relieved structures that have better physical properties than their cast counterparts.

Production speeds are said to be faster than DMLS, but the material data sheets I have found seem to indicate that certain materials actually respond better to the DMLS process, with slightly better overall structural properties of strength and elasticity. This all depends on the application for which you are designing.

## TODAY'S DMLS

What I have witnessed and read leads me to believe that innovations in SLS and DMLS, including increased laser power and decreased layer thickness, have increased the strength of those production parts. In addition, refinements such as modified normalization processes and heat treatment make these parts exhibit robust physical characteristics. But the process is still slow.

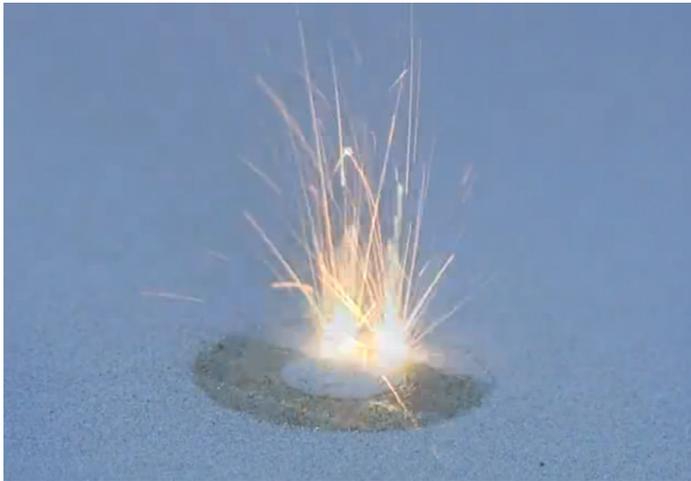


Figure 2: Lasing of stainless steel powder layer by layer (courtesy of Solid Concepts)

Note: SLS and DMLS are essentially the same processes. SLS is used with varying materials and generally anything that can be applied as a powder and bonded by the heat of a laser. DMLS, on the other hand, is restricted to metals.

## HISTORY

Thanks to the research of Carl Deckard, metallic powder SLS has made a tremendous impact on complex metal structure production and has expanded the scope of the industry as a whole. Carl Deckard's patent #US5597589 A (issued 28 January, 1997) defines the SLS process noted above.

Deckard's company, DTM (originally NOVA Automation), was sold after investment cycles and issues. Ultimately it ended up in the hands of 3D Systems, the world's largest provider of additive manufacturing technologies.

The other contender in the ring is EOS GmbH - Electro Optical Systems, a German company founded by Dr. Hans Langer and Dr. Hans Steinbichler in 1989. 3D Systems held the U.S. patent on SLS at that time. In 1997, 3D Systems purchased the Stereos product line from EOS, and agreed to allow EOS to take over the global patent rights to the SLS technology. EOS would then focus its research solely on SLS processes.



Figure 3: Metal powder residue being removed from "printed" stainless steel part (courtesy of Solid Concepts)

After the recent expiration of the SLS patent in January 2014, various DMLS start-ups and initiatives have begun. People are bringing new ideas together to reduce the size and expense of the DMLS process, bringing the technology to the forefront and making it accessible to everyone. The limiting factor there will be the need for inert environments, in some cases, and that power-hungry laser.

## EARLY ADOPTERS KNOW A GOOD THING WHEN THEY SEE IT

We are not alone in the struggle to adopt this exciting and rapidly evolving process. General Electric and NASA are spending a lot of money and time innovating the additive metal processes and how these manufactured components can be used.



Figure 4: General Electric's DMLS printed fuel nozzle (courtesy of GE)

# Manufacturing

GE made a brilliant move by acquiring not only the DMLS and EBM technologies in 2012, but did so by purchasing Morris Technologies, one of the most experienced teams relating to these technologies and making the adoption successful.

“Our ability to develop state of the art manufacturing processes for emerging materials and complex design geometry is critical to our future,” said Colleen Athans, vice president and general manager of the Supply Chain Division at GE Aviation in a press release.

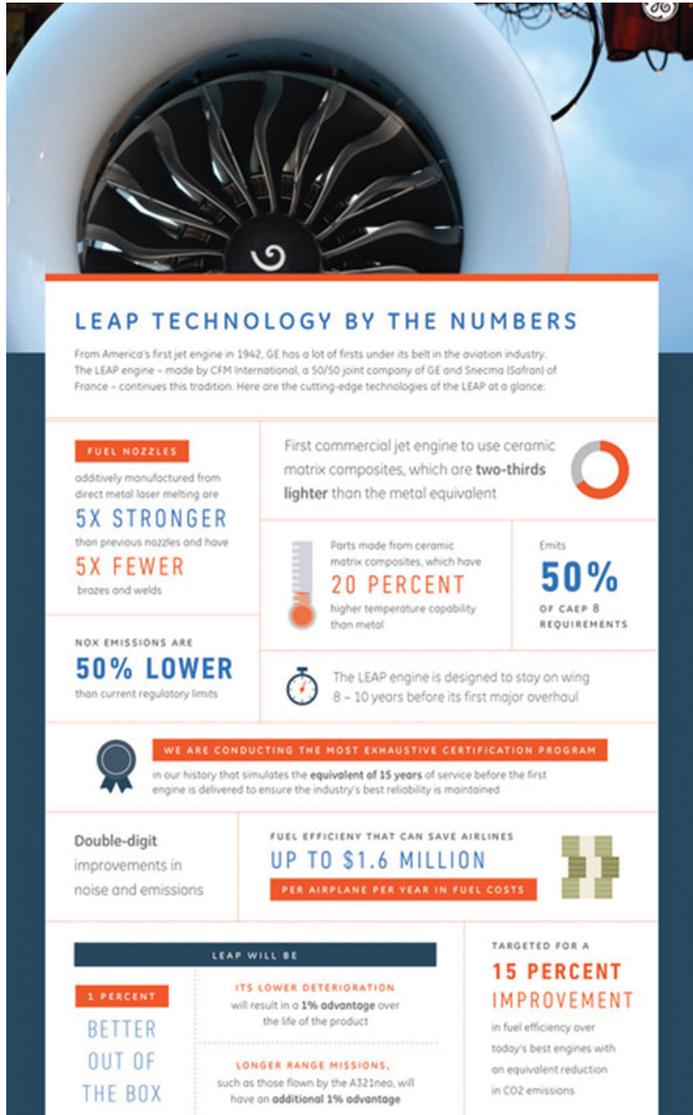


Figure 5: General Electric's LEAP additive manufacturing infographic (courtesy of GE)

GE's involvement and the expanding adoption of this technology is enabling material manufacturers to develop improved powdered metals for these purposes.

## THE MATERIALS

In the last five years I have witnessed the expansion of materials being offered by SLS machine vendors. Here's the list that EOS currently offers:

- + Aluminum AlSi10Mg
- + CobaltChrome MP1 & SP2

- + MaragingSteel MS1
- + NickelAlloy HX
- + NickelAlloy IN625 & In718 (Inconel)
- + StainlessSteel GP1 & PH1
- + Titanium Ti64 & Ti64ELI

These materials are robust and in some cases can take temperatures as high as 1200 °C. EOS thinner powder application has increased sintered densities to ~100 percent, which can be seen in the following properties.

The material specifications here are sourced from EOS and Solid Concepts, and were optimized for use in EOSINT M machines. These are only a partial selection, and are heavily summarized for this magazine format. In all cases, additional heat treatments and conditions apply to the DMLS material properties. (For additional information, see the sources at the end of this article.)

### EOS COBALTCROME MP1

This cobalt, chrome, and molybdenum material is notably used in medical industry as well as a solution for high temperature requirements. This material offers the highest combined stress and temperature resistance in this lineup. Minimum wall thickness of 0.3mm, with a part accuracy of  $\pm 20\text{-}50 \mu\text{m}$  on small parts, and  $\pm 50\text{-}200 \mu\text{m}$  for large parts.

Density: 8.3 g/cm<sup>3</sup>

Ultimate Tensile Strength: 1350 ± 100 MPa (Built)

Yield Strength: 1060 ± 100 MPa (built)

Modulus of elasticity: >190 ± 20 GPa (built and axis dependent)

Maximum operating temperature: approximately 1150 °C

### EOS NICKELALLOY HX

A nickel, iron, chrome, and molybdenum material, notably used in aerospace with emphasis on high-temperature environments that need extended corrosion resistance.



Figure 6: Hot test fire of rocket motor "printed" with CobaltChrome at University of California, San Diego

Minimum wall thickness of 0.3 – 0.4 mm, with a part accuracy of  $\pm 40\text{-}60\ \mu\text{m}$  on small parts, and  $\pm 0.2\%$  for large parts.

Density: 8.2 g/cm<sup>3</sup>

Ultimate Tensile Strength:  $>720 \pm 40\ \text{MPa}$  (built and axis dependent)

Yield Strength:  $>570 \pm 50\ \text{MPa}$  (built and axis dependent)

Modulus of elasticity:  $>175 \pm 20\ \text{GPa}$  (built and axis dependent)

Hardness: 175 HBW

Maximum operating temperature:  $\sim 1200\ ^\circ\text{C}$

## EOS INCONEL NICKELALLOY IN7181

UNS N07718

A nickel and chrome material exhibiting good durability and moderate to high temperature resistance. It takes well to precipitation hardening and heat treatment. The company notes its use in high temperature applications such as aerospace and land-based turbine engine components.

Minimum wall thickness of 0.3 – 0.4 mm, with a part accuracy of  $\pm 40\text{-}60\ \mu\text{m}$  on small parts, and  $\pm 0.2\%$  for large parts.

Density: 8.2 g/cm<sup>3</sup>

Ultimate Tensile Strength:  $980 \pm 50\ \text{MPa}$  (built) /  $1400 \pm 100\ \text{MPa}$  (normalized and HT AMS 5662)

Yield Strength:  $634 \pm 50\ \text{MPa}$  (built) /  $1150 \pm 100\ \text{MPa}$  (normalized and HT AMS 5662)

Modulus of elasticity:  $170 \pm 20\ \text{GPa}$  (normalized and HT)

Hardness:  $\sim 30\ \text{HRC}$  (built) /  $\sim 47\ \text{HRC}$  (normalized and HT AMS 5662)

Maximum operating temperature under load:  $650\ ^\circ\text{C}$

Maximum oxidation resistance temperature:  $980\ ^\circ\text{C}$

## EOS STAINLESSSTEEL PH1

UNS S15500

A robust stainless steel with wide usage in aerospace and medical, where good corrosion resistance and strength are required. This steel lends itself well to precipitation hardening and is ideal for small production runs and spare parts.

Minimum wall thickness of 0.3 – 0.4 mm, with a part accuracy of  $\pm 20\text{-}50\ \mu\text{m}$  on small parts, and  $\pm 0.2\%$  for large parts.

Density: 7.8 g/cm<sup>3</sup>

Ultimate Tensile Strength:

- $>1050 \pm 50\ \text{MPa}$  (built and axis dependent)
- $\sim 1450 \pm 100\ \text{MPa}$  (HT)

Yield Strength:

- $>1050 \pm 50\ \text{MPa}$  (built and axis dependent)
- $1300 \pm 100\ \text{MPa}$  (typ. HT)

Modulus of elasticity: Not listed

Hardness: 30-35 HBW (Built) /  $>40\ \text{HRC}$  (typ. HT)

Maximum operating temperature: None listed

## EOS TITANIUM TI64ELI

AMS F136

This lightweight titanium and aluminum alloy is strong and resistant to corrosion.

Minimum wall thickness of 0.3 – 0.4 mm, with a part accuracy of  $\pm 50\ \mu\text{m}$ .

Density: 4.41 g/cm<sup>3</sup>

Ultimate Tensile Strength:  $>1250 \pm 50\ \text{MPa}$  (built and axis dependent)

Yield Strength:  $>1125 \pm 65\ \text{MPa}$  (built and axis dependent)

Modulus of elasticity:  $> 108 \pm 20\ \text{GPa}$  (Built & axis dependent)

Hardness: Not listed

Maximum operating temperature:  $350\ ^\circ\text{C}$

## ADDITIVE MANUFACTURING PROVIDERS

Along with a lot of web-based research, I spoke with numerous service vendors about the machines being used in the industry.

### MACHINERY

DMLS – Hands down, EOS GmbH. [www.eos.info/en](http://www.eos.info/en)

EBM – Arcam is the provider (and to my knowledge, the originator) of the EBM technology. The firm holds multiple global patents on the process. [www.arcam.com/](http://www.arcam.com/)

SLM – This process was excluded from this content.

### NOTABLE PROVIDERS

Solid Concepts, a Stratasys company in Texas – DMLS, machining, molds, and more. [www.solidconcepts.com](http://www.solidconcepts.com)

Solid Concepts' experience and assistance with information relating to the DMLS materials and high temperature applications was invaluable and are referenced in this article. Kent Firestone, a former project manager at DTM, is the company's vice president of Additive Manufacturing.



Figure 7: Solid Concepts manufactures world's first functional "printed" steel 1911 .45 caliber handgun.

# Manufacturing

TurboCAM Aero in New Hampshire – DMLS and just about everything. [www.turbocam.com/aerospace](http://www.turbocam.com/aerospace)

Morris Technologies in Ohio – DMLS and EBM  
[www.morristech.com](http://www.morristech.com)

[www.linkedin.com/company/morris-technologies](http://www.linkedin.com/company/morris-technologies)

Directed MFG in Texas – SLS and DMLS  
[www.directedmfg.com/](http://www.directedmfg.com/)

## DMLS AND INNOVATION

Design & Motion is committed to the realization of our client’s designs and ideas. Studying new ways to reduce the size of parts and complexity of assemblies has been one of my passions and part of our success. Improvements in DMLS technology including part density and material types have opened up numerous doors and possibilities for us, and are expanding the prospects for our client’s products.

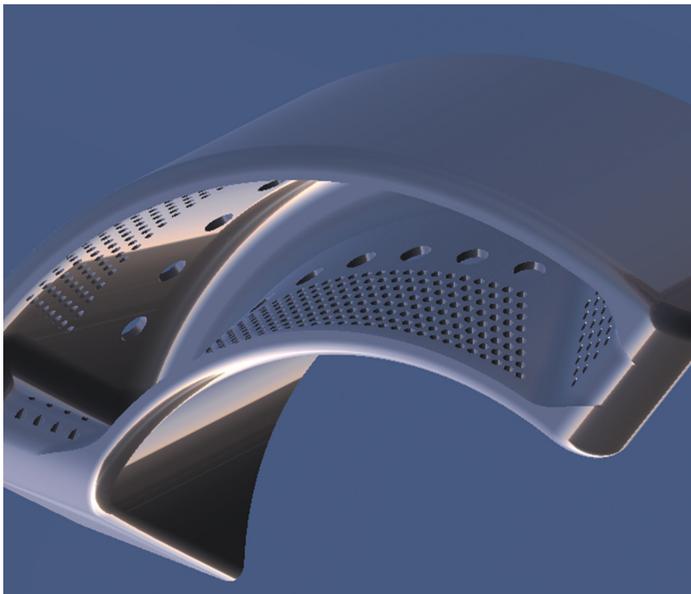


Figure 8: Early prototype of an annular combustor (integrated fuel rail and nozzles not shown); courtesy of Design & Motion

Our R&D turbine and combustor’s upper target temperature limit is ~1150 °C. DMLS and high temperature inconel and cobalt have been essential in making the design possible by providing a realistic safety margin as we work through the fluid dynamics involved in reducing the wall temperatures.

Insight from the DMLS providers that deal with aerospace development is helping our efforts. We can build components that withstand substantial thermal loads, and at the same time manufacture them far closer to ideal design parameters than was ever possible before as well as at reduced scales that are impossible to mill and turn. The other really cool and truly inspiring part of the equation is that so many components that needed to be manufactured separately and assembled can now be “printed” as a single unit. Cooling channels and fuel systems can be integrated in truly creative ways.

## CLOSING THOUGHTS

My discussions with Solid Concepts indicated that cost was tied to production speed, rather than mass. The cost of a 400 – 1000 Watt laser running adds up.

Also, Morris Technologies provided a comparison of DMLS and EBM machine models and the run-time cost relationships. The costs associated with older and newer generations of DMLS and EBM are different. Beware of which machines a company is using. If they are using older machines, your bill might look similar to having a taxi driver taking the long way to your destination.

Develop a good relationship with a DMLS provider experienced in developing applications for your industry. Consider their advice before completing your designs—it can help you avoid many pitfalls and save you a lot of heartache.

DMLS is only the beginning. Now that the patents have expired, the gloves are off and we should see some incredible advancements in cost reduction and new ways to build safer, lighter, and cheaper components without the waste we associated with manufacturing in the past.

More information and complete material specifications can be found at Design & Motion’s Engineering page at <http://designandmotion.net/category/design-2/eng-notes/>



John Evans is the Managing Director and Technical Specialist at Design & Motion, an international R&D firm, helping customers with product design, manufacturability, and validation. He is a US Air Force veteran and has over 20 years of design, manufacturing, and fabrication experience in aerospace and industrial machinery, and holds various industry certifications including Autodesk Inventor Professional. John is a devout fan of simulation technologies, material sciences, and continues to pursue his education in aeronautical and mechanical engineering. John’s role at Design & Motion includes technical research and journalism related to engineering software from around the world, with published articles in various design related journals and magazines, as well as the company website. John speaks Japanese and English, loves aircraft, loves his wife and 2 boys, and would rather be on a 1000 yard rifle range right now. You can reach him at [john@designandmotion.net](mailto:john@designandmotion.net)

# Content: Build or Buy?



According to Autodesk, BIM (Building Information Modeling) “is an intelligent model-based process that provides insight to help you plan, design, construct, and manage buildings and infrastructure.”

Let’s focus on the intelligent model portion of BIM, it’s really the “I” (or Information) part of BIM.

It requires content to provide an LOD 400 level model and that goes for any BIM platform, not just Autodesk® Revit® MEP.

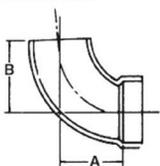
Now let’s talk the difference between Building and Buying content.

## BUILD CONTENT

When I first started on my BIM path I worked for a MEP contractor that spent more than \$200,000 on Fabrication CADmep, ESTmep, and CAMduct software. We had three weeks of training and were provided a database of just over 40,000 MEP items of content.

We knew the content didn’t match the manufacturers’ for our workflow, but we decided to move forward and build the content we needed regardless. We wanted to build items with more information than just the correct geometry. We wanted as much information as we could provide in the drawing including weights, cost, manufacturer, order number, and so on.

PART NO. 302



**OLD**

**1/4 BEND, STREET  
(Sanitary 90° Street Ell)  
SPIGOT X HUB**

SIZE	A	B	C	D
1¼	1⅞	2⅞		
1½	1¾	2½		
2	2⅝	3⅜		
3	3⅞	4⅞		
4	3⅞	5⅞		
6	5	8		
8	6	10		

Figure 1

We quickly realized that building the content we required for our company was going to take months.

We had a two-man team; one team member would build the content geometry and the other member would apply the data information and then verify that the dimensions were correct per the manufacturer’s cut sheet.

After seven months of creating content and applying the data information, we could then create our database of mechanical systems. It took an additional four months of going back and forth with the team to finalize on a database and complete training.

After roughly a year we were running like a well-oiled machine.

As I look back on the undertaking I still cringe. I remember the headache I would get when someone would ask for a new piece of job-specific content.

Those who have built content understand it takes a lot of effort and time to build the content. Maintaining the content is another issue we don’t quite realize.

After I took the opportunity to move into software side of the world, the contractor I worked for didn’t maintain the content. The

content we spent a year creating became corrupt and unmanageable.

This confirmed that content unmanaged can quickly turn into a poor investment.

Unmanaged content is a ticking time bomb and sooner or later it will go off. For example, the

**NEW**

**1/4 Bend, Street  
(Sanitary 90° Street Ell)  
SPIGOT X HUB**

SIZE	A	B
1¼	1⅞	2⅞
1½	1¾	2½
2	2⅝	3⅜
3	3⅞	4⅞
4	3⅞	5⅞
6	5⅞	8⅞
8	6⅞	10
10 <sup>(F)</sup>	14⅞	19¾
12 <sup>(F)</sup>	16⅞	19
14 <sup>(F)</sup>	16¼	23⅞
16 <sup>(F)</sup>	19⅞	23⅞

Figure 2

# MEP Construction

pipng manufacturer Charlotte recently had a new update to its PDF cut sheets. The old cut sheet has Part No. 302 listed at having sizes 1-1/4" through 8". The new PDF has 1-1/4" through 16"; it now has an additional four sizes available (highlighted in green). That's the easy one to notice, but if you take a closer look at the two cut sheets, Charlotte also modified four dimensions (highlighted in yellow). The modification changed some of the fittings to be an additional 3/16" longer than before. Now this was just one of the 877 fittings on the PDF cut sheet update. Do you currently have someone checking your manufacturers' content line by line? If that person is you and you didn't know about the Charlotte change, you're welcome.

## BUY CONTENT

Key factors for a successful BIM project are speed and accuracy. Content falls under both speed and accuracy.

Managed content has been made more accessible and affordable, thanks to the cloud. To have someone spend months building content just doesn't make economic sense. Why, as BIM managers, do we rebuild Rome, when we can download Rome in a day? Change is the biggest factor of people adopting new methods of a content solution. The other is trying to prove self-worth as a BIM manager. I know the BIM managers reading this probably don't agree, but why would I pay someone a yearly salary to build content when you can buy it at a fraction of the cost?

The main focus of a BIM project for construction is to coordinate LOD 400 content for prefabrication. It's not to spend months building content. The focus should be on creating a clash-free model.

Equipment manufacturers have really taken on the responsibility of building Revit families (B&G, Carrier, Trane, and others). MEP manufacturers have content, but not many. Charlotte, Greenheck, and Victaulic are a few.

Now there are lots of Revit families online to download, but not all of them reach the LOD 400 level that we need for construction.

Content and connectivity is the biggest issue with Revit.

## REVIT CONTENT LOD 200 VERSUS MANAGED CONTENT LOD 400

To put this bluntly, the content provided out of the Revit box for construction is what I call cartoon fittings. Basically contractors can't use the model for construction. In Figure 3, Example A was created from Revit out-of-the-box content. Example B and example C were created with LOD 400 content. The main difference between the B

and C examples is the method of the mechanical system. Example B is modeled with a grooved by press fit mechanical system, which uses Victaulic and Viega specific manufacturer content. Example C is modeled with a welded by soldered mechanical system, which uses Weldbend and Nibco specific manufacturer content. As you can see, the dimensions would be completely different between an LOD 200 model compared to an LOD 400 model. Let's say an average Revit MEP family takes four hours to create. Example B has 11 families that would need to be built by a BIM manager. That's 44 hours just for example B and, in turn, would be an additional 44 hours to build the content for example C. Now take 88 hours by the hourly rate of your content builder. Building content internally adds up quickly.

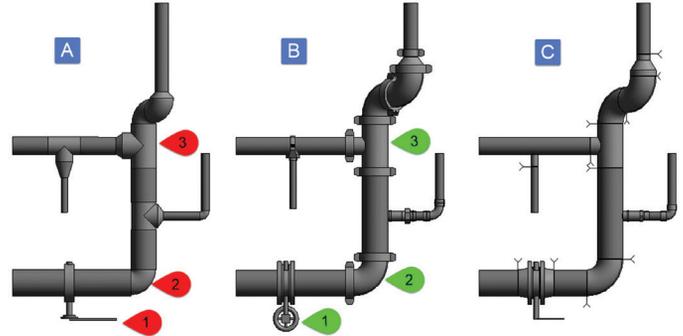


Figure 3

## THE "I" IN BIM

Content today isn't just about the geometry. As you can see in Figure 4, the first table below provides little to no information about the items modeled (Red Numbers in Example A). The second table is the information provided by managed content (Green Numbers in Example B). It's up to you to decide whether to build a cage in shark-infested waters or have a prebuilt cage waiting for you.



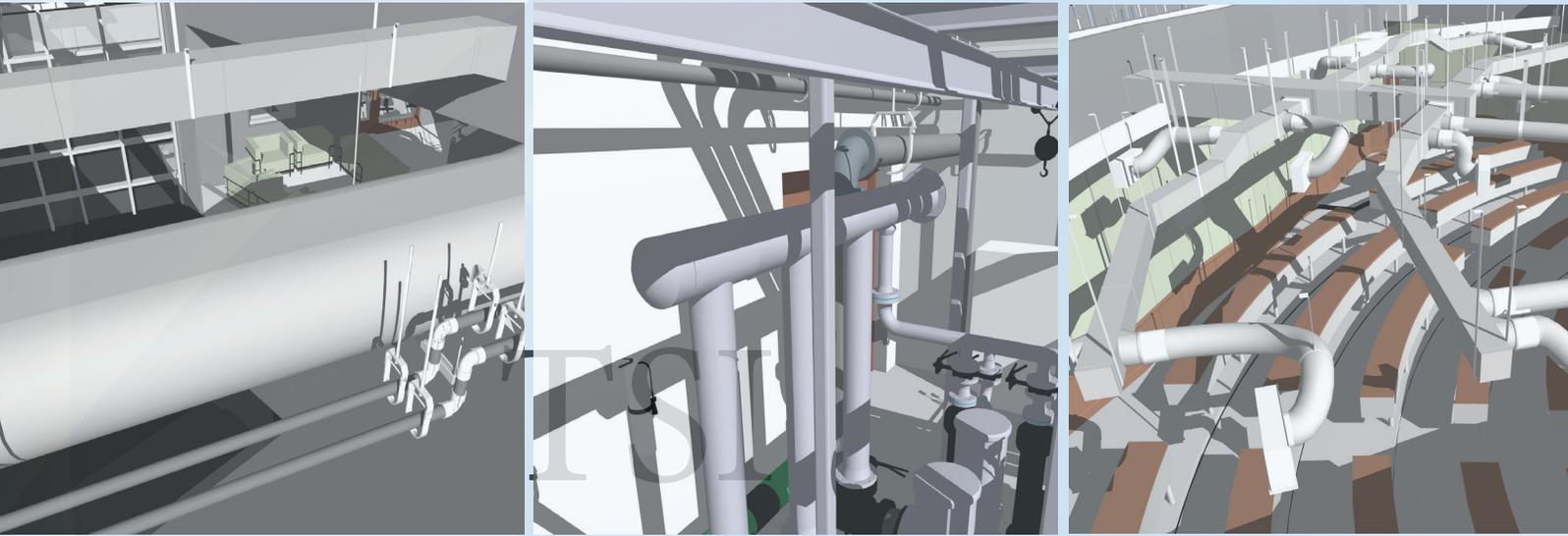
*Kenneth Eastman has over 15 years of construction/engineering experience. He was a CAD Manager for a large MEP contractor in San Francisco where prefabrication was the key objective on all MEP construction projects. Kenneth has trained users on Revit and SysQue worldwide namely Australia, Brazil, Dubai, Malaysia, UK, and the USA. Kenneth truly believes that when it comes to prefabrication, an hour spent in the office saves four hours in the field. He currently is the SysQue Product Manager. Kenneth can be reached at keastman@sysque.com.*

REVIT OUT OF THE BOX CONTENT						
Category	Manufacturer Name	Order	Product Description	OmniClass Number	ID	URL
Pipe Accessories				23.65.55.14.17		
Pipe Fittings				23.60.30.11.14		
Pipe Fittings				23.60.30.11.14		
MANAGED CONTENT FROM BUILDING DATA						
Category	Manufacturer Name	Order	Product Description	OmniClass Number	ID	URL
Pipe Accessories	Milwaukee	CL323E	Milwaukee CI Class 200 CL323E Butterfly Valve	23.65.55.14.17	2476355034411	<a href="http://www.building-data.net/PDFStore/Imperial/V1/Milwaukee/CIWaferMilwaukeeBFV200CLSeries.pdf">http://www.building-data.net/PDFStore/Imperial/V1/Milwaukee/CIWaferMilwaukeeBFV200CLSeries.pdf</a>
Pipe Fittings	Victaulic	NO 10	Victaulic DI IPS Painted NO 10 90 Elbow	23.60.30.11.14	243620425993711	<a href="http://www.building-data.net/PDFStore/Imperial/V2/Victaulic/IPS Grvd Ftgs-C.pdf">http://www.building-data.net/PDFStore/Imperial/V2/Victaulic/IPS Grvd Ftgs-C.pdf</a>
Pipe Fittings	Victaulic	NO 25	Victaulic DI IPS Painted NO 25 Reducing Tee	23.60.30.11.14	24362092599711	<a href="http://www.building-data.net/PDFStore/Imperial/V2/Victaulic/IPS Grvd Ftgs-C.pdf">http://www.building-data.net/PDFStore/Imperial/V2/Victaulic/IPS Grvd Ftgs-C.pdf</a>

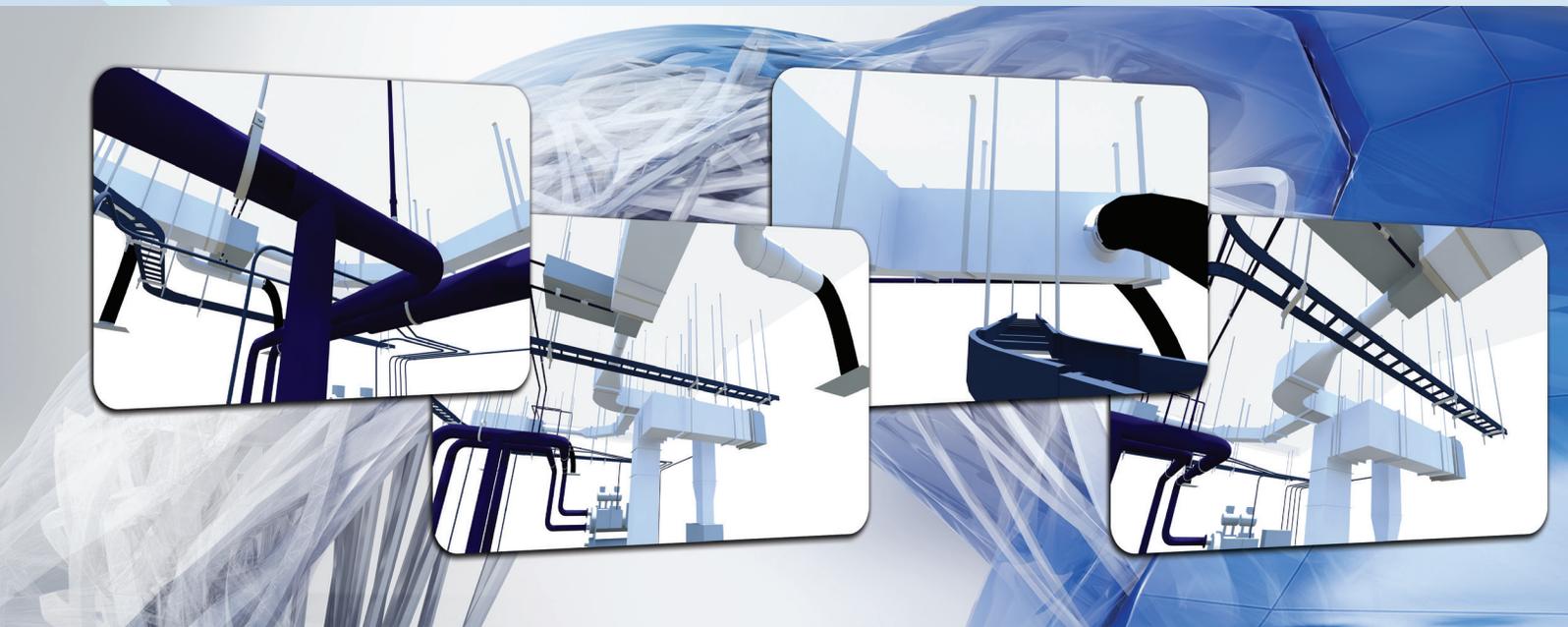
Figure 4



Native  
Revit® MEP  
LOD400  
Content



**Autodesk University Booth # 240**



[www.SysQue.com](http://www.SysQue.com)

1-866-493-6337



# The Power of Design and Change: Best Practices for Conceptual Design

 Spend a lot of time around good AutoCAD® Civil 3D® users, folks that ask me tough questions about how to expand the usage of existing tools to solve new problems. Through this process I've learned to think of corridors as more than "long, linear design objects," points as more than "X,Y,Z," and surfaces as more than "existing or proposed." Out of this rises a challenge I continually pose to engineers and landscape architects: digitize your conceptual design phase. For the record, Figure 1 is an example of what is not digitizing your conceptual design phase (i.e., an aerial image with hatching).

## WHY?

Digitizing your conceptual design phase is less about creating stunning 3D visuals (which, of course, are very nice) and more about using a tool you already own to create a better process throughout the course of your project. That is to say, it's all about starting right. Why is this the "right way" to start? Digitizing conceptual design leads to less data loss between design phases. Currently in our world, most professionals conducting conceptual



Figure 1: Non-ideal concept plan

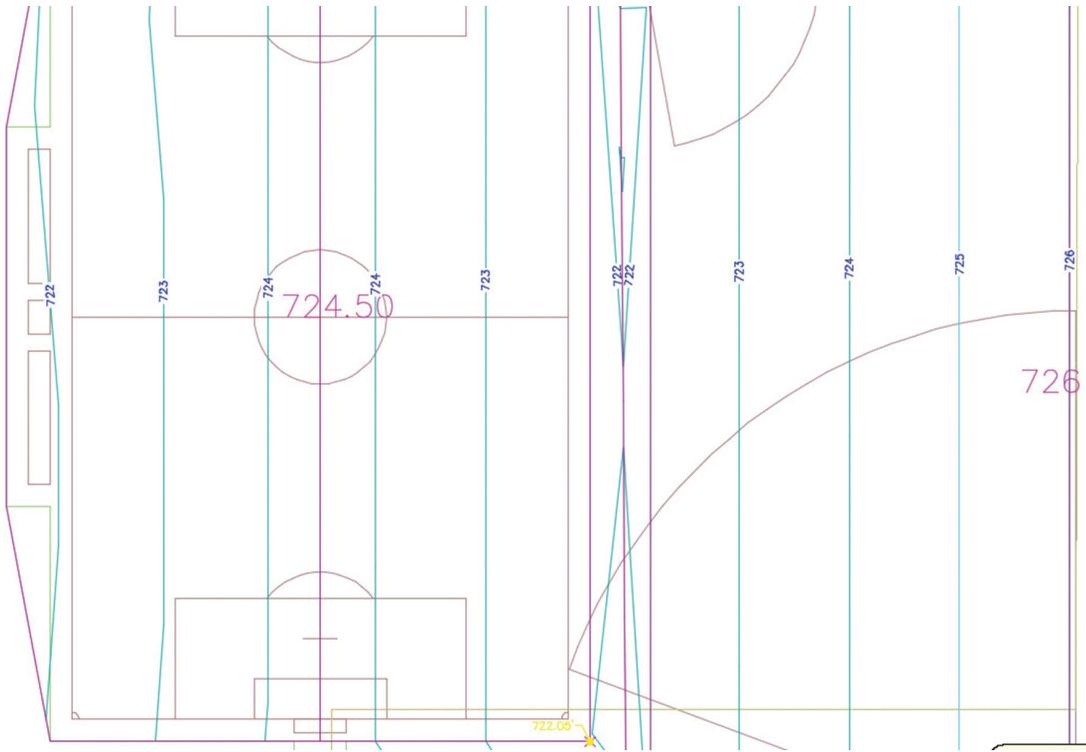


Figure 2: Concept plan using Civil 3D effectively

design have extensive industry experience, but very little CAD experience. This means that most firms are creating with a pen and digitizing. This process immediately removes years of design experience from the design being created, and begins the digital process of a project on the wrong foot.

Am I advocating training everyone that does conceptual design on all the facets of Civil 3D? No, most of that stuff is for construction document creation. What I'm advocating for is digital involvement throughout the course of a project. Just as projects are more successful when all team members are involved in initial planning, so are projects more successful when technology is part of initial planning meetings. Understand how to push Civil 3D to create your conceptual designs—take your firm from using pen and paper (with all design validation in one person's brain) to a design process that instantaneously validates design ideas as buildable and desirable. Save yourself from data loss. Figure 2 is what I want to see from your conceptual design phase.

## THAT'S GREAT, BUT HOW?

First, having good CAD standards (solid templates, good data management practices, etc.) eases this process a great deal. If you're not working with a good template, spend the time to make it right or hire someone to make it right. You're wasting time every day if you're not working with a solid template. Is one template the way to go? Maybe. Should I have a conceptual design template? Sure. Should I start from an empty file? Yes. Should I start from acad.dwt? NO (there's a known issue). There's much knowledge in this area, and every organization is different. Decide what works best for you, or ask someone knowledgeable what you should do. There are a number of different tactics that I believe work best for creating conceptual designs in Civil 3D

and they vary by company and project.

Second, conceptual design is not creating construction documents. The minutia must be removed. The desire/concern for perfect, beautiful, and fully functional drawings needs to be lessened. The name of the game here is speed and validation. You want to use Civil 3D to make the conceptual design process faster, not make the conceptual design process inclusive of your entire design. You want to use Civil 3D to infuse conceptual design with validation, not spend three days during the conceptual design phase revising cross sections.

Third, create everything with deletion/modification in mind. The old adage applies: the only thing final about a conceptual design is that it's not final. Everything will change, so use Civil 3D tools to create the objects to change as easily as possible, and know what it means to change these items and learn more about the tools to edit and create. Let's look at some tools you may already know well, and show how to utilize them for conceptual design.

## HOUSEKEEPING

General housekeeping strategies allow for consistencies between designs and, therefore, a more efficient design path. One of the most commonly overlooked general strategies is as follows: if you'll use it more than once, name it. For example: you want to present 50 ft, 65 ft, and 75 ft wide lots to your client. You needn't use three files for this—use one with Sites named accordingly. This will allow you to have different styles set up, and therefore have plotting pains eased as well.

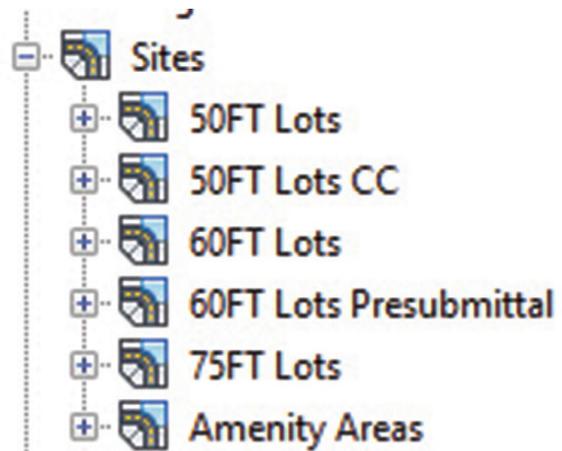


Figure 3: Sites named according to lot size

# AutoCAD Civil 3D 2015

## LAYOUT

There are numerous tools to ease this process, but the most overlooked is Sites. Sites are essentially containers that tell Civil 3D what objects should interact with each other. Want to show parcels of different sizes in the same drawing? Use a Site for each, as in my example in Figure 3. Sites also allow you to have Grading Groups that do not interact with each other, but grading and layout components that do.

**Pro Tip:** Use the ability to move and copy design objects between sites to ease non-geometric revisions, or utilize a previous design's information for future designs.

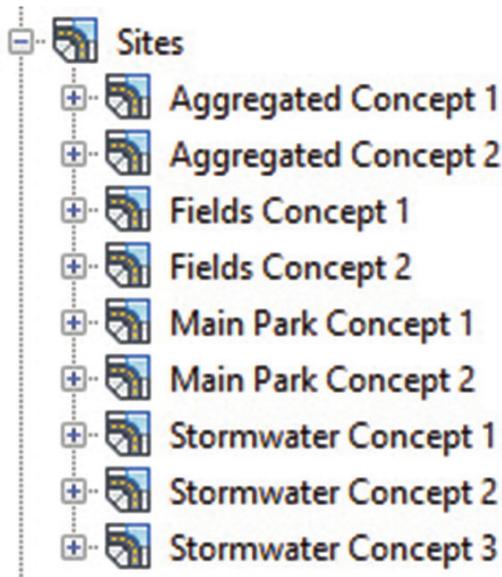


Figure 4: Sites example

Civil 3D Parcels allow designers to very quickly develop and manipulate layouts. In addition, Parcels offer immediate feedback about sizing information for different layouts. This makes a particular impact when utilizing the Parcel Layout Tools. Designers involved in single-family residential design will find these particularly useful to their workflows during concept. For commercial and mixed-use design parcels, offer a quick alternative to manual “bubble diagrams”—set up a few different styles so you can quickly apply them across and keep close track of acreage per use.

Parking is often an issue for commercial and mixed-use projects. That is to say, much of the concept stage is spent determining the following question: with this architectural footprint, these existing conditions, and regulatory requirements, how many parking spaces can I fit or do I need? However, the reality of laying out parking is that it's time consuming. Using the MEASURE command and arrays can help this process. I'd be remiss if I didn't say here that Autodesk Vehicle Tracking software is a more desirable path and will ease this process greatly. Set up your standards and layers, and go.

**Pro Tip:** Learn the grips; they help immensely.

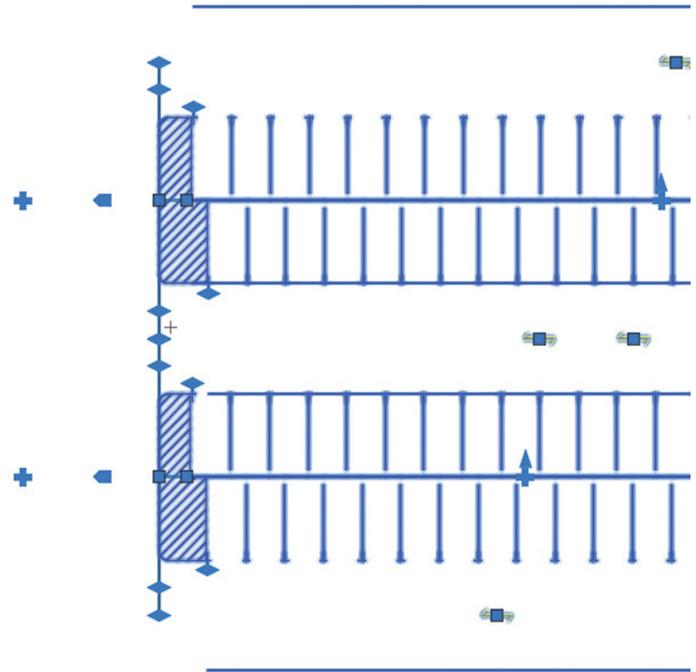


Figure 5: Parking generated from Autodesk Vehicle Tracking (grips shown)

Dynamic and Multiview Blocks offer some very quick and easy methods for conveying design intent and allowing for rapid changes and 3D views of plan view items, respectively. The concept here is to use pre-created blocks with rapidly modifiable properties in order to maintain as much dynamic and changeable content in your conceptual design as possible. See Walt Sparling's coverage of this in *AUGIWorld*, June 2014 for additional information. As an extension, effective use of Tools Palettes helps here a great deal.

## GRADING

While we're on the topic of tool palettes, there's a great deal here that can be created in order to produce Quick Corridors (like common assemblies). By “Quick Corridors” I mean “Grading Studies.” Grading during the conceptual phase is, without question, the most time-consuming of all activities. To add to this, the decision to continue a project is often made during grading studies happening during the conceptual phase. Using Corridors can help this process a great deal. Have to complete a mass grading exercise? Use a single Alignment to represent the outer extents of your developable area and use a daylight subassembly to look at different possibilities.

**Pro Tip:** spend some time and learn the subassembly composer; you'd be surprised how similar different grading exercises can be and creating your own subassembly can save much time on future projects.

Using an Alignment and Profile allows for much better representation of the proposed conditions. This is particularly true with the new profile editing tools in Civil 3D 2015—specifically the ability to lock a profile to an alignment, and the ability to parameter lock/unlock geometry in the vertical profile. I'll admit

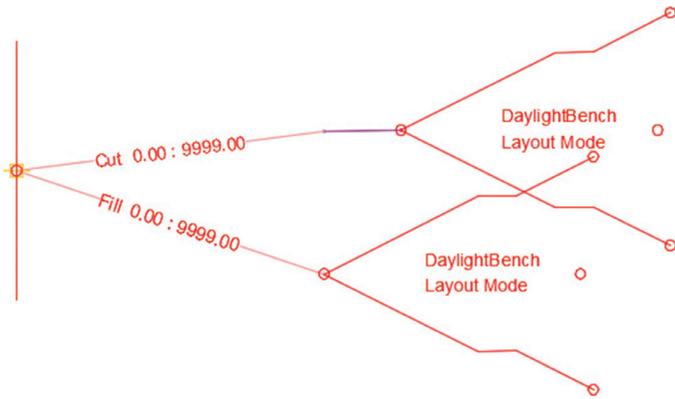


Figure 6: Mass grading using a Corridor (conditional assembly example)

this takes some practice; however, if you stop and think about how you design with your pen and trace paper and use that same philosophy to design using Civil 3D you'll master it in no time.

**Pro Tip:** Don't forget about the Help entries for subassemblies—they are great!

**Pro Tip #2:** Learn your Transparent commands. They allow you to create profiles with ease.

For more complex grading, Grading Groups and Feature Lines are your best strategy. I could write an entire article about this topic. The strategy here is fairly simple, but again takes practice to master. First, use a single feature line to define a major grading requirement (a finish floor, for example). Second, use a grading group to define a relationship and create a surface. Third, create a feature line that is draped over this surface to begin creating more precise geometry. This strategy allows you to let the computer do what it's good at (math), and you to do what you're good at (design).

**Pro Tip:** Set your Feature Line double-click action to be the Quick Elevation Editor.

Land development is tricky; every project is different. Not only that, but every municipality is different, and every manufacturer has different specs. This makes using a feature such as Families in Autodesk® Revit® impossible for civil engineers and landscape architects. Luckily, we can lean on Grading Criteria to allow us to ensure regulatory compliance where practicable.

The most common use here is with water quantity or water quality controls. Ponds represent an area where there is often reproducibility and consistency, not to mention an oft-changing boundary condition. Here I like to have in my template some Grading Criteria that are locked where regulatory requirements must be met, and editable where they are able to be. Setting these up in advance, specifically in municipalities of common work, allows for much less time utilized during project concept planning, and higher accuracy once grading begins.

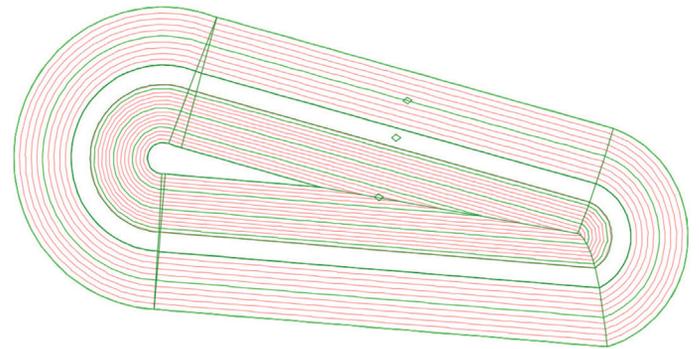
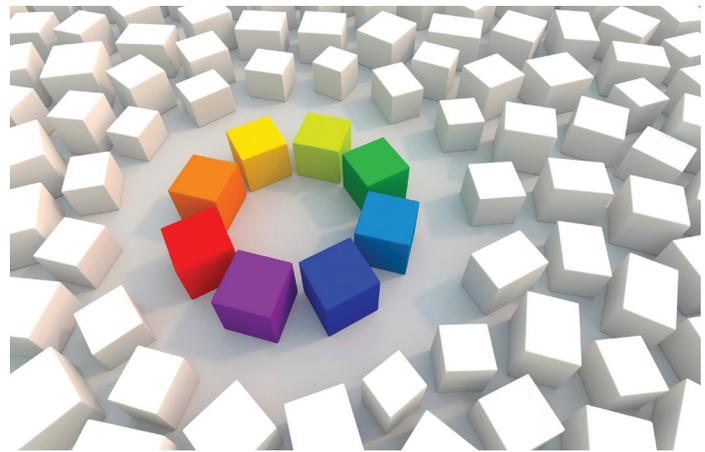


Figure 7: Pond graded with Grading Criteria set

**Pro Tip:** Using dynamic Feature Lines from a Corridor allows for this process to be even more dynamic.

## NOW, GO TRY IT!

It's your turn. Experiment with these tools and workflows, figure out how they work, determine their best uses, understand how to have the highest impact on your conceptual design process. Often you aren't being paid during this time anyhow. Become more efficient, spend less time in concept, change your mind often, incorporate client input, present your ideas, and (most importantly) validate your design concepts before you travel down a path that will not work! Good luck.



Chris Roberts, PE, LEED AP BD+C, is a civil engineer in Charlotte, North Carolina. Chris has 10 years of site design and civil engineering experience, as well as extensive experience with implementation of Civil 3D. Chris speaks throughout the Southeast US on utilizing software to digitize the conceptual design phase, and gather competitive advantage through its efficient use. Chris can be reached for comments or questions at [croberts@tpm.com](mailto:croberts@tpm.com), on Twitter: [crobertsnc](#), and on LinkedIn: [crobertsnc](#).

# How to Develop and Maintain Your Professional Network

**P**eople often stress about the development and maintenance of their professional network. Networking does not need to be thought of as intimidating; it can be learned. Your professional network is one of the most effective career development tools you have and you can carry it with you your entire professional life with the proper engagement.

The ease of developing a professional network is based on your accessibility. You can be accessible in traditional ways—attend a conference, speak, get published, volunteer, join clubs or organizations.

If you are at a conference such as Autodesk University sitting in the corner, at a craps table, or worse yet, in your hotel room, you are not accessible and you will not get the true benefit of your time and money. A better way to approach a conference is to attend the sessions along with breakfast, lunch, and the evening events. You will meet new people while interacting with people you met in years past. This will develop and reinforce your network.

There are large and small conferences and each has its benefits. Large conferences such as AU can help you build a more diverse network because of its sheer mass and attendees of varied backgrounds. By contrast, a small conference, such as the Revit Technology Conference, is more focused, which may help you build a more reliable network and even true friendships.

At any size conference, after a well-presented session many people want to discuss the topic further with the presenter. There is no better way to get to know people, or for people to get to know you, than during these impromptu conversations.

Writing articles or blogs will have similar effects to presenting at conferences. Here, too, people will reach out to discuss the topic further. If there is passion about the topic being discussed or presented then there will be excitement to receive these calls and emails because continued conversation fuels the passion. This will help someone go further, work harder, and strive to achieve more.



Technology also gives the ability to be accessible. Twitter, LinkedIn, Facebook, Instagram, and other websites and apps give people of similar interest the ability to get to know each other and connect. This may be a more superficial connection, but it's a connection nonetheless.

I believe that technology is better suited to helping maintain networks than to building them from the start. Reaching out to people online that you do not know or have never met usually doesn't build a strong network. And if a network isn't strong there is no reliability behind it. You cannot depend on the knowledge of those within your network because you do not truly know them.

Technology can be helpful after you have met someone—then you can connect with them online. Keep in mind that personalizing the message is more likely to achieve positive results. Avoid sending the standard message: "I'd like to add you to my professional network..." Instead, add a personal note such as "It was a pleasure to meet you at AU. Our conversation (or your class) regarding fireproofing structural members in Revit was inspiring. I look forward to seeing you next year." Your new contacts are much more likely to accept the connection and remember you.

Once connected, you have their contact info so you can do the maintenance required to keep that connection. For example, if you see an article that pertains to a project that they are working on or an interest of theirs send it to them, comment, and keep in touch.



Do not let these connections lapse; working on your network once you need it is too late. It is something that needs constant nurturing and cultivation.

Something that is overlooked in this day and age is the importance of connecting on a more meaningful level. Make a phone call, send a letter... yes, I mean a handwritten letter. Tell someone how much what they are doing means to you, how a class they taught motivated you, how their activities were noticed. Think about the joy you feel when someone reaches out in a non-superficial way; it takes effort and it is more significant. Make someone else's day—show them that their friendship, knowledge, and labors mean something to others, specifically you.

How you network depends on your personality. As you may have noticed from the nature of this article, I am a social person and conferences are the equivalent of my spinach. I have a natural internal desire to network and conferences give me this forum. I enjoy talking to people who I know have similar interests and passions. For example, BIM is a passion of mine, so further enhancing the use of technology in the AECO industry is something that I can discuss with anyone who has the slightest interest in it as well. I find value and enjoyment from the relationship-building process. Others may not get the same enjoyment from the process, but they will see the value of the results.

The time and energy put forth to build this professional network can be valuable in a number of ways. A network can be utilized to advance your career. It can be used to gain the knowledge to develop a new way to do something quicker, better, more efficiently. This, in turn, will benefit your company and increase your chances for promotion. You can utilize your network to change jobs within your profession by learning about another company and what they are doing in Revit or with BIM that can feed your desire to change the industry. You can even utilize it to help you change professions entirely, if that is your aspiration. It is the six degrees of separation theory: someone you know knows

someone who can assist you in gaining the knowledge, connection, or introduction required for the change you are craving.

In addition to career development, this network can give you personal growth. It feels pretty darn good to have helped someone. As an example, recently someone reached out to me via LinkedIn. She mentioned that we attended the University of Toledo at the same time in a similar course of study. She wondered if I would talk with her regarding some struggles she was having in her career, and she hoped I would have some pointers or advice for her. We talked on the phone one evening for maybe an hour, and I heard her story and I did have ideas on a different, yet similar direction she could go. I even gave her some names of people to whom she could reach out for a potential career change. It was not a long conversation, but it felt good. I gave her optimism, which, in turn, gave me joy.

The best approach to networking is to think of it as paying it forward. While building your network you should think about mutual needs—not just what someone can do for you, but also what you can bring to them. You only get out as much as you put in.

My challenge to you in preparing to attend Autodesk University is to reach out to those that you met last year—at RTC, AU, online, or even those who published an article that helped you. Let them know that you will be in attendance. Make plans to meet up with them, sit together during lunch, or just let them know a class that you are signed up for that would be of interest to them. Research what classes, if any, they are teaching and tweet about them. A little preparation will go a long way in your network maintenance.



*Jennifer L. Storey, AIA, EDAC, is a Senior Associate at Stantec Architecture in Cleveland, Ohio. She is an architect working with a team from around the country on a prestigious cancer center project. She is managing the collaboration between design assist subcontractors, the construction manager and the design team to improve the execution of the construction. Jennifer utilizes her passion for BIM to change the AEC industry to adopt a more proactive approach for the delivery of building construction. She previously worked as a Senior Healthcare Architect at Leo A Daly in Los Angeles and a Project Architect and BIM Manager at Bostwick Design Partnership in Cleveland. Jennifer is a Revit Certified Professional and she holds the Center for Health Design's Evidence-Based Design Accreditation Certification.*



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# 3ds Max Versatility



**G**ame developers and animators have been using 3ds Max® for presentation, collaboration, concepts and design since its development. In the last few years though, Autodesk made strides to include more tools to assist outside those areas of specialty, which has allowed 3ds Max to be used in unconventional ways. I'd like to speak about a few of these below.

## 3D PRINTING

Estimated earnings in 2013 for 3D printing were approximately \$2.2 billion USD, up 11 percent from the year before, as reported by Wohlers Associates, a 3D printing consultant company. Whether its buildings, concept cars, prosthetic pieces, toy robots, part replacement, or more, 3D printing is making huge strides and has been said to revolutionize the way we make most anything.

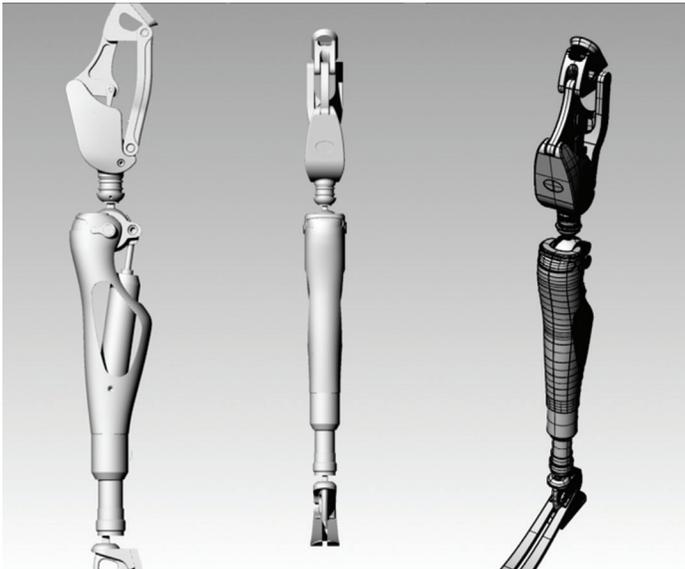


Figure 1: Concept for prosthetic leg

While 3D printing continues to find ways into our minds and hearts (perhaps literally), the steps to producing one's first 3D printed part with 3ds Max is relatively simple.

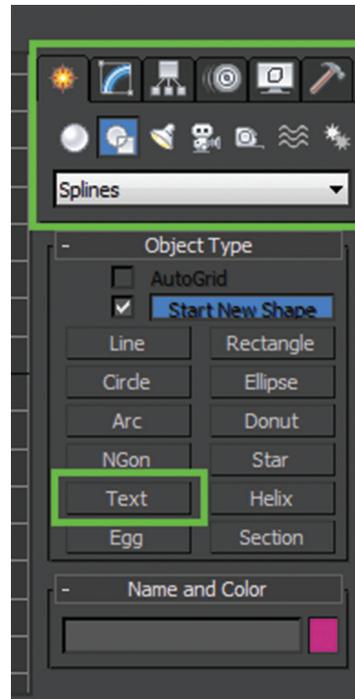


Figure 2: Step 1

### Step 1

To begin, select the Create Icon in the tool panel, select the Shapes icon, choose Spline, then Text.

### Step 2

Under parameters select your various font and font size then type your text in the text area.

### Step 3

Text in 3ds Max inserted this way simply consists of line segments programmed to create each letter's shape. We can manipulate the line segments as we could any other object in 3ds Max. For this step, we'll extrude the

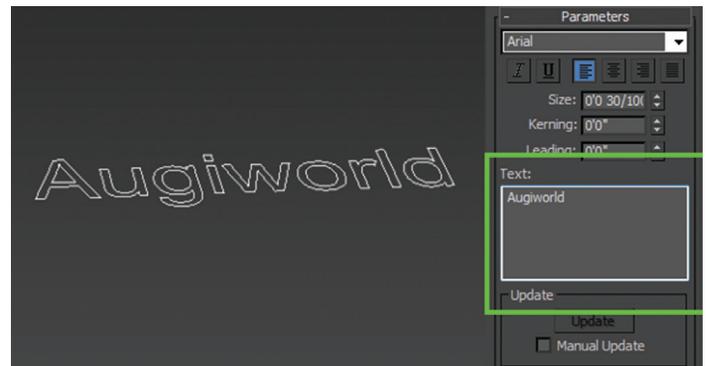


Figure 3: Step 2

# 3ds Max 2015

text. Make sure you have your text selected then pick the Modifiers tab and choose Extrude. Enter an amount to extrude and number of segments.

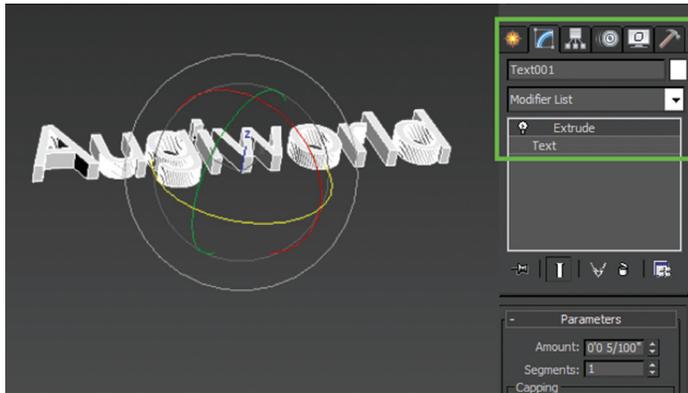


Figure 4: Step 3

## Step 4

For our purpose we don't want to print multiple letters separately. As our model sits, the printer would print nine separate letters. We'll combine those letters using a ProBoolean and Box. First, create a box that overlaps your text by a fair amount; extrude it down so that the top of the box is at the same level of the bottom of your text. Second, join the two by selecting your box, then the Geometry tab, Compound Objects, and finally ProBoolean. Choose Union under Parameters then Start Picking. Select your text object.

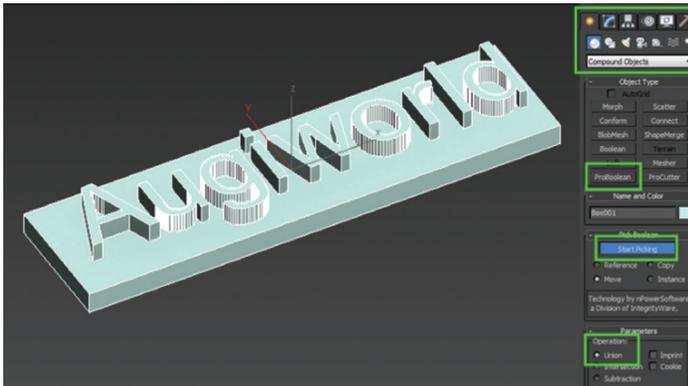


Figure 5: Step 4

## FINAL STEP

You are now ready to export your model for printing. One of the most common formats to export your file to is .STL (stereolitho). Simply select File, then Export, and choose .STL as your file format. Other file formats often supported by 3D printers and 3D printing services are X3D, Collada, VRML97, and VRML2.

If you can't purchase a printer of your own, 3D print shops have opened worldwide, and many offer their services online. Examples are Shapeways (<http://www.shapeways.com/>) and RedEye (<http://www.redeyondemand.com/>). Local shops may be available in your area (there is in mine), or you might consider opening a shop of your own (#winks).

## AEC, GIS, AND VIEWERS

GIS has predominantly been its separate, distinct function in the past. Recent advances in computers and software have allowed GIS and AEC industries to merge more effectively and develop an entirely new level of sophistication in design, construction, asset management, tracking, and collaboration. Specifically, Autodesk has introduced ways teams can collaborate in a streamlined fashion to quickly identify design flaws and constraints. Recent advances are 3ds Max Civil View inclusion and 3ds Max software's ability to export to Autodesk's FBX Viewer.

## CIVIL VIEW FOR 3DS MAX AND CIVIL 3D

Civil View is an application that allows the civil engineering community to export models in the same way architects and mechanical engineers have been doing for years. Together they are now able to collaborate as a team more effectively while providing site models that encompass an entire project and all its aspects. In the future, this will allow more sophisticated studies to be conducted with the models that could include emergency service routes/building accesses, detailed flood studies showing the effects of structures on pathways, visibility studies identifying security risks and premium views, optimal direction for solar panels on residential homes, and much more.

## 3DS MAX EXPORT TO FBX VIEWER

The last item I'd like to discuss is FBX viewer. 3ds Max exports directly to .FBX file type and I'd recommend everyone at least try it out if you haven't. The viewer is easy to navigate, can be downloaded by clients and design teams for free, and can be used to review massive 3D models and animations with predefined camera locations and textures.

## CONCLUSION

3ds Max and tools made available have given artists, designers, scientists, medical industries, architects, and engineers the ability to collaborate worldwide and study the effects and influences of their designs in detail. With hope, persistence, and determination it will lead to a brighter future for us all.



Brian Chapman is creator of Pro-Cad. Net and a Senior Designer for Slater Hanifan Group. Slater Hanifan Group is a civil engineering and planning firm dedicated to superior client service with locations in Las Vegas, Nevada and in Phoenix and Lake Havasu, Arizona. Brian can be reached at [procadman@pro-cad.net](mailto:procadman@pro-cad.net).

# External References in ACA

 The Drawing Management feature in AutoCAD® Architecture 2015 uses external references (xrefs) as a means to create a project and maintain it. This means that elements are referenced into constructs, constructs are referenced into views, and views are referenced into sheets. The mechanism of referencing is identical to the regular AutoCAD External References Management feature. However, the background methods employed have additional features.

Xrefs that have been created in Drawing Management can automatically make use of project data, while those that are created manually through the xref palette or command line cannot. For example, a construct that is placed on a specific level will use that level's elevation data to control the Z-axis insertion point when being xrefed into a view. If you are working in a project environment, the best practice for referencing project drawings into other project drawings is to use the Project Navigator rather than the standard AutoCAD Architecture Xref Manager. The Xref Manager cannot differentiate between project drawings and non-project drawings. If you reference a non-project file into a project file by mistake, you cannot use the full Drawing Management functionality on that file.

Keep these considerations in mind when working with a project:

- Do not delete any XML files generated by the Drawing Management feature. They are vital for the project.
- Use the Project Navigator to create, modify, and reference project files within the project. If you want to use existing non-project files in a project, convert them to project files first.
- Drawing Management supports the use of relative paths for external references. In the project setup, you can decide whether to use full paths or relative paths. Working with relative xref paths makes moving the project and transmitting it easier and reduces the need to repath the project.

## EXTERNAL REFERENCES PALETTE

The External References palette in AutoCAD Architecture organizes, displays, and manages referenced files, such as DWG files (xrefs), DWF, DWFx, PDF, and raster images. DWG, DWF, DWFx, PDF, and raster image files can be opened directly from the External References palette. The External References palette contains several buttons and is split into two panes (see Figure 1). The upper pane, called the File References Pane, can display file references in a list or in a tree structure. Shortcut menus and function keys provide options for working with the files. The lower

# AutoCAD Architecture 2014

pane, called the Details/Preview Pane, can display properties for the selected file references or it can display a thumbnail preview of the selected file reference.

It is important to note that when using the External References palette, it is recommended that you turn on the auto-hide feature or anchor the palette. The palette will then hide automatically when you move the cursor away from the palette.

You can use the buttons at the top of the External References palette to choose the types of files to attach to the drawing and to refresh the status of file references that you already have attached. The following options are displayed:

- Attach (file type) button – displays a list of file types that you can attach (see Figure 2).
- Refresh/Reload All References button – synchronizes the status data of referenced drawing files with the data in memory. Reload All References updates all file references to ensure that the most current version is used. Updating also occurs when you first open a drawing that contains file references.

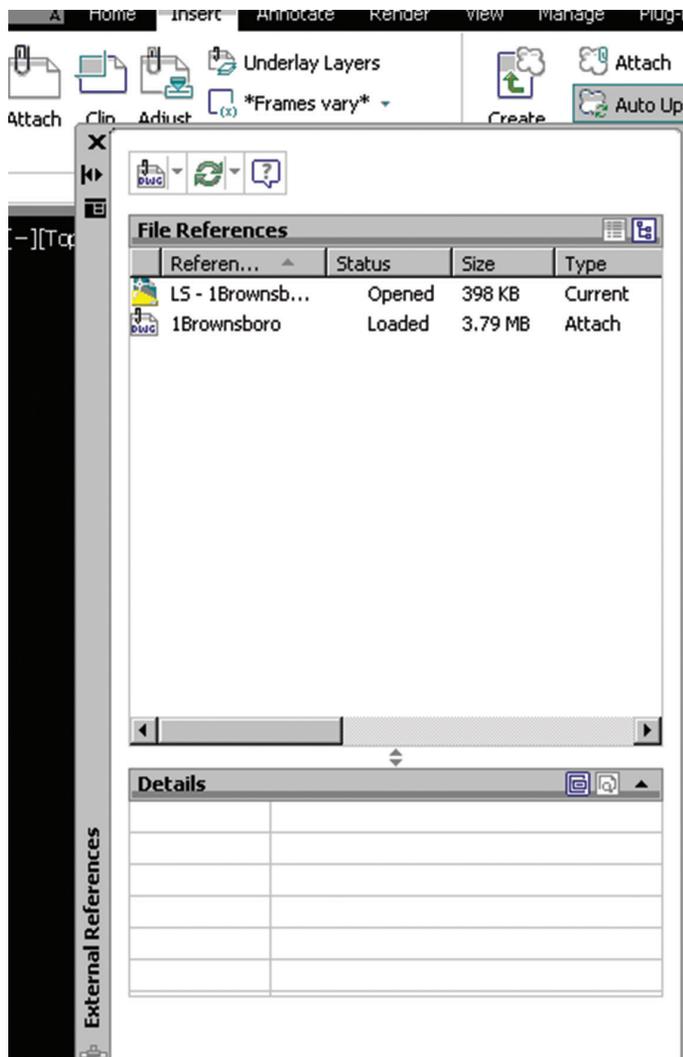


Figure 1: External References palette

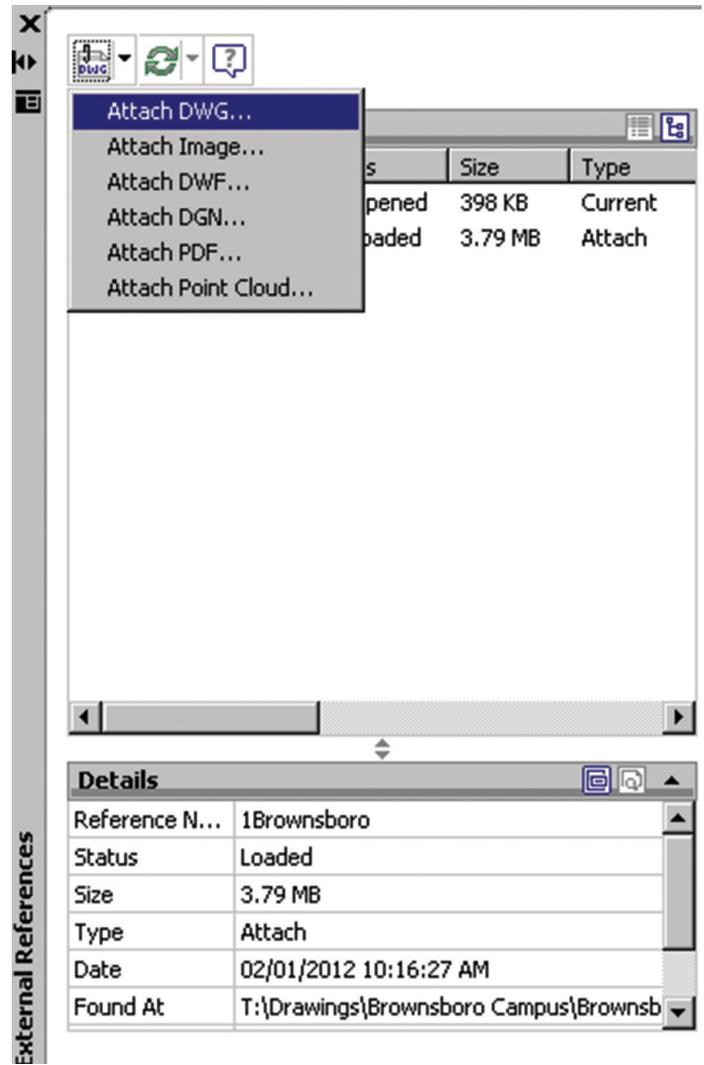


Figure 2: Attach file types

## ATTACHING AND DETACHING XREFS

You can attach an entire drawing file to the current drawing as a referenced drawing (xref). With xrefs, changes made in the referenced drawing are reflected in the current drawing. Attached xrefs are linked to, but not actually inserted in, another drawing. Any changes to a referenced drawing are displayed in the current drawing when it is opened or reloaded. With xrefs you can build drawings without significantly increasing the drawing file size.

By using referenced drawings in AutoCAD Architecture, you can:

- Coordinate your work with the work of others by referencing other drawings in your drawing to keep up with the changes being made by other designers.
- Ensure that the most recent version of the referenced drawing is displayed. When you open your drawing, each referenced drawing is automatically reloaded, so it reflects the latest state of the referenced drawing file.
- Keep the names of layers, dimensioning styles, and text styles in your drawing separate from those in referenced drawings.
- Bind attached referenced drawings permanently with your current drawing when the project is complete and ready to be archived.

A drawing file can be attached as an xref to multiple drawings at the same time. Also, multiple drawings can be attached as referenced drawings to a single drawing. To attach an xref, click the Insert tab, Reference panel, Attach. Select the file you wish to reference and select Open.

This will bring up the Attach External Reference dialog box where you can choose to attach or overlay, scale, insertion point, path type, and rotation (see Figure 3). Click OK when finished. It is important to note that if an xref contains any variable block attributes, they are ignored. Once the xref is attached to the drawing, an xref icon will be displayed in the lower-right corner of the application window. When one or more xrefs are not found, an exclamation point is added to the xref icon. If you click the xref icon, the External References palette will be displayed.

To completely remove xrefs from your drawing, you need to detach them rather than erase them. Erasing xrefs does not remove layer definitions associated with those xrefs. The Detach option removes the xrefs and all associated information.

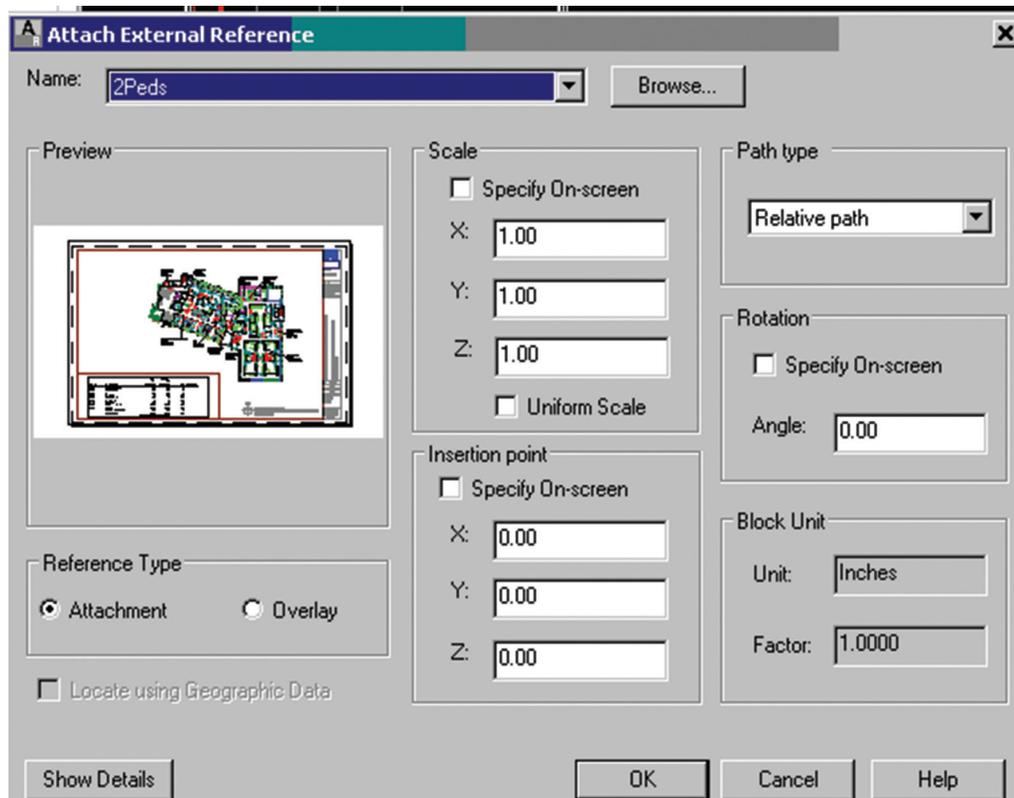


Figure 3: External Reference dialog box

Sometimes it becomes necessary to find an xref in a complex drawing. To do this, select an item in the External References palette to highlight all visible instances in the drawing. Also, you can select an external reference in the drawing to highlight its name in the External References palette.

You can control the visibility, color, and linetype of an xref's layers and make these changes temporary or permanent. If the VISRETAIN system variable is set to 0, these changes apply only to the current drawing session. They are discarded when

you end the drawing session, or when you reload or detach the xref. You can also control the fade display of the DWG xref. The XDWGFADECTL system variable defines the fade percentage for all DWG xrefs.

## UPDATING REFERENCED DRAWING ATTACHMENTS

When you open a drawing, all xrefs update automatically. You can also use the Reload option from the External References palette to update xrefs whenever you want to ensure that the most current versions are displayed in your drawing (see Figure 4). Whenever you modify and save an externally referenced drawing in a network environment, other people can access your changes immediately by reloading the xrefs in their open drawings.

When you attach xrefs to a drawing, the program periodically checks whether the referenced files have changed since the last time the xrefs were loaded or reloaded. The XREFNOTIFY system variable controls xref notification. By default, if a referenced file has changed, a balloon message is displayed near the xref icon in the lower-right corner of the application window. Click the link in the balloon to reload all changed xrefs. If you close the balloon message without reloading, an exclamation point is added to the xref icon. If you click the xref icon, the External References palette is displayed.

By default, the program checks for changed xrefs every five minutes. You can change the number of minutes between checks by setting the XNOTIFYTIME system registry variable using (setenv "XNOTIFYTIME" "n") where n is a number of minutes between 1 and 10080 (seven days). It is important to note that when changing the value of XNOTIFYTIME, you must enter the system variable with the capitalization as shown in Figure 4.

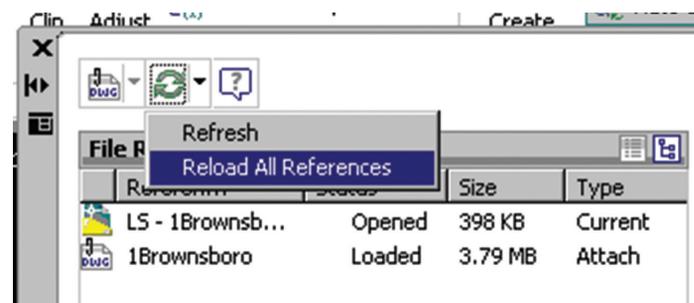


Figure 4: Reload referenced drawings

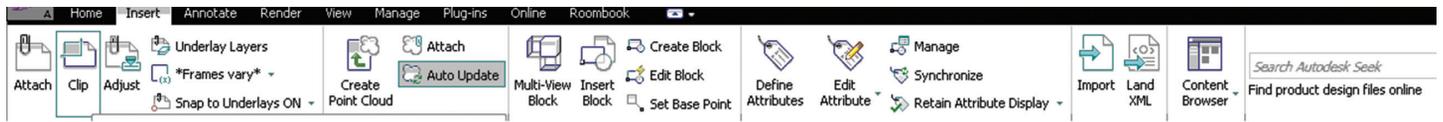


Figure 5: Clip external reference

## NESTING AND OVERLAYING REFERENCE DRAWINGS

Xrefs can be nested within other xrefs. This basically means that you can attach an xref that contains another xref. You can attach as many copies of an xref as you want and each copy can have a different position, scale, and rotation. It is important to note that when using the parametric drawing feature, you can only constrain objects in the drawing to the insertion point of an xref and not its nested objects. The saved path for an xref can be a full path, a relative (partially specified) path, or no path. For a nested xref, a relative path always references the location of its immediate host and not necessarily the currently open drawing.

You can also overlay an xref on your drawing. Unlike an attached xref, an overlaid xref is not included when the drawing is itself attached or overlaid as an xref to another drawing. Overlaid xrefs are designed for data sharing in a network environment. By overlaying an xref, you can see how your drawing relates to the drawings of other groups without changing your drawing by attaching an xref.

## ISOLATING OBJECTS IN EXTERNAL REFERENCES

When working in drawings with external references, you should note the following points.

- You can isolate an external reference within a host drawing as a whole by selecting it and isolating it.
- You can isolate individual objects within an external reference by opening the external reference, isolating and hiding objects as needed, saving the external reference drawing, and then reloading the external reference.
- You cannot isolate or hide objects in an external reference while editing it with REFEDIT in the host drawing. You need to use XOPEN and save the desired Hide/Isolate settings within the external reference.
- You cannot redisplay hidden objects in an external reference while editing it with REFEDIT in the host drawing. You need to use XOPEN and save the desired Hide/Isolate settings within the external reference.

You can save a drawing in which object isolation is currently active. The next time you open the drawing, it will display with the isolation settings you defined. It is important to note that if you want to distribute a drawing with isolated objects, make sure that you and the recipient of the drawing are working with the same version of AutoCAD Architecture. A recipient who is working with an earlier version of the software, plain AutoCAD, or Object Enabler is not able to display the hidden objects. In this case, end the object isolation before saving and distributing the drawing.

## CLIPPING EXTERNAL REFERENCES

You can clip external references such as DGN, DWF, IMAGE, PDF underlays, or block references. With a clipping boundary, you can determine the portions of an external reference or block reference that you want to display by hiding the redundant parts of the reference inside or outside the boundary. You can control the display of the clipping boundary with a clipping frame. The clipping system variable for XREF, PDF, DGN, DWG, and IMAGE underlays are XCLIPFRAME, PDFFRAME, DGNFRAME, DWGFRAME, and IMAGEFRAME, respectively.

The clipping boundary can be a polyline, rectangle, or a polygon with vertices within the boundaries of the image. You can change the boundary of a clipped image. When you clip a boundary, the objects in the external reference or block are not altered. It is only their display that has changed.

After an external reference or block reference has been clipped, it can be moved, copied, or rotated just like an unclipped external reference or block reference. The clipping boundary moves with the reference. If an xref contains nested clipped xrefs, they appear clipped in the drawing. If the parent xref is clipped, the nested xrefs are also clipped.

If you want to change the shape or size of a clipping boundary for external references and block references, you can use grips to edit the vertices just as you edit any object with grips. In case of rectangular grip editing, you can maintain the closed four-sided rectangle or square shape of the rectangular clipping boundary because two vertices of the same side of the rectangular clipping boundary are edited together. It is important to note that with clipping boundaries, you cannot display self-intersecting polygonal boundaries. An error message is displayed and the boundary reverts to the last boundary.

To clip a boundary for an external reference, begin by clicking the Insert tab, Reference panel, and then select Clip (see Figure 5). Next, select an xref. At the prompt, specify New Boundary by pressing Enter. Select a polyline or specify a rectangular or polygonal clipping boundary. Specify the corners or vertices of the boundary. The xref is clipped based on the area that you specified.



Melinda Heavrin is a CAD Coordinator & Facility Planner for Norton Healthcare in Louisville, Kentucky. She has been using AutoCAD Architecture since release 2000. Melinda can be reached for comments and questions at [melinda.heavrin@norton-healthcare.org](mailto:melinda.heavrin@norton-healthcare.org).



# Navisworks for Detailers

**N**avisworks® is a powerful tool that should not be limited to BIM managers. The misconception of all the responsibility for clash detection falling on BIM managers hurts coordination efforts. Detailers can and should incorporate Navisworks into their workflows to avoid clashes and speed up the coordination process.

## THE WEAKEST LINK

A chain is only as strong as its weakest link and a coordination is only as strong as its weakest team member. Anyone who has participated in a BIM coordination has seen the delays and complications that come from having even one weak team member. Delays to a coordination can come from members taking too long to populate a complete model, or not making adjustments to their model between meetings, or creating new hits every time they do make adjustments. I have worked as a detailer and a BIM manager and I have experienced the frustrations that both deal with. Whether you're a manager or a detailer you know who's the

weak link during a coordination. If you have felt like the weak link before, don't worry—Navisworks is here to help you become the one waiting on everyone else to finish.

Recently I have seen some confusion with regard to the responsibilities of BIM managers versus detailers. One of the main duties of a BIM manager is clash detection; clash detection however, is not the sole responsibility of the BIM manager. Even minor clash detection should be a common practice for detailers while modeling. Many, if not all, construction schedules are aggressive and do not allow time for a "complete" review of all clashes during meeting times. Effective meetings are spent covering large issues that require team collaboration. If that time is used looking at minor hits you will see meetings start to run four or more hours and become mind numbing. Detailers have the responsibility to correct those minor issues between meetings so that no time is wasted in meetings covering issues that can be fixed without help from other team members.

# Navisworks Manage 2015

Here are some tools that detailers can incorporate into their workflows that will help them get the job done faster and right the first time.

## CLASH DETECTION

You should never be caught off guard during a meeting with a major issue related to your system. Who wants to feel like a fool when asked what to do with their system? No one wants that—you want to know, or at least have an understanding of your systems issues so you can contribute during the meeting. Basic clash detection should keep you aware of any issues related to your system. I won't go into how to run a clash detection because there are many in-depth guides already out there to help you, but I do want to stress the benefits of running clash detection as a detailer.

## SECTIONING

Once you have found an issue through clash detection, one tool that will help you understand the issue, and maybe more importantly recognize the solution, is the sectioning tool. Using the align to surface or align to view options with the section tool will help you quickly cut an elevation view along your route. The goal for most detailers is to find that perfect space to run so they don't have to add bends and offsets, and one of the best ways to recognize that perfect space is to cut sections along and through your route.

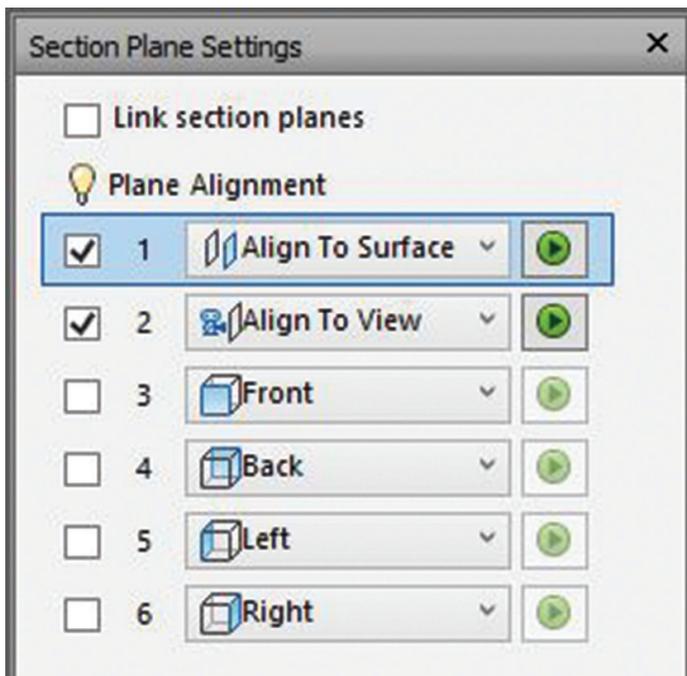


Figure 1: Sectioning tools

## MEASURING

Once you have section cuts you can start to pull measurements using the XYZ axis locking features and shortest distance in the measure tools. You can quickly and accurately find how much space you have to work with and how far you need to adjust. But as good as the measuring tools in Navisworks are, there is a more effective way to find that perfect path. That method is through the move tool.

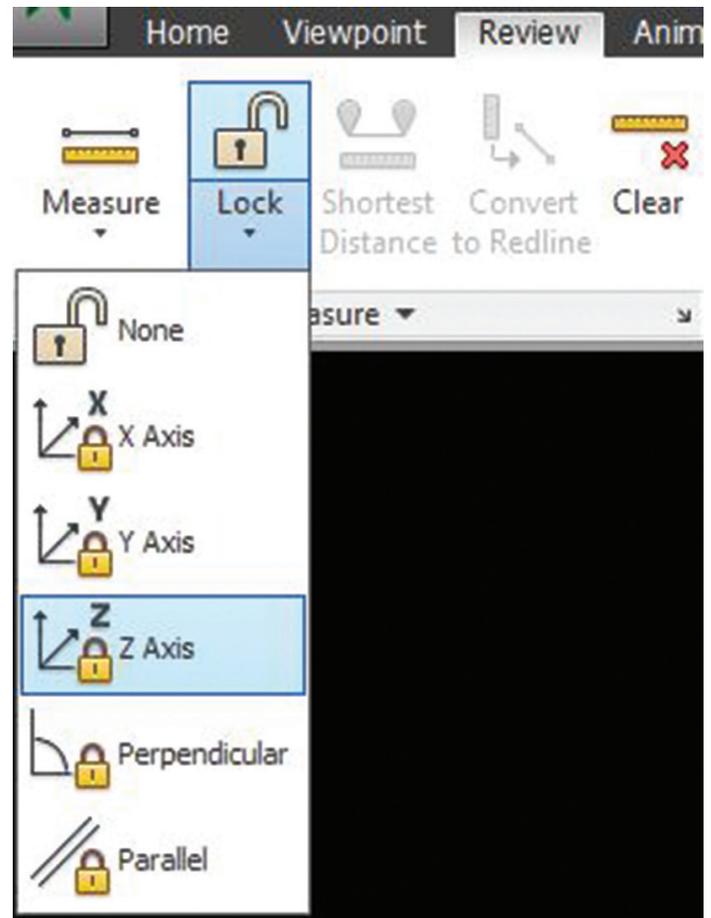


Figure 2: Locking measurements

## PLAY PRETEND

The move tool allows detailers to quickly play pretend with their systems and find that perfect path (or the closest thing to it). Detailers can easily visualize solutions and see if their systems will fit without having to pull a single measurement. Once a solution is found, the transform bar will show you exactly how far you

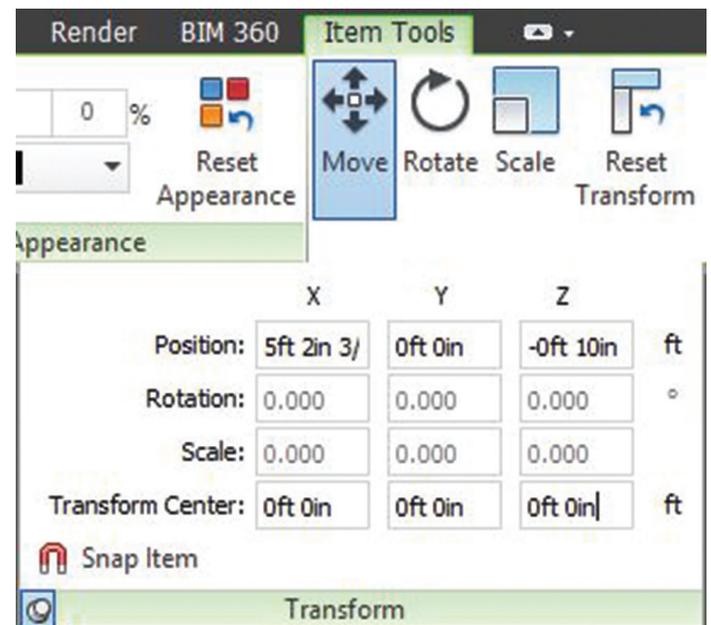


Figure 3: Getting the transform

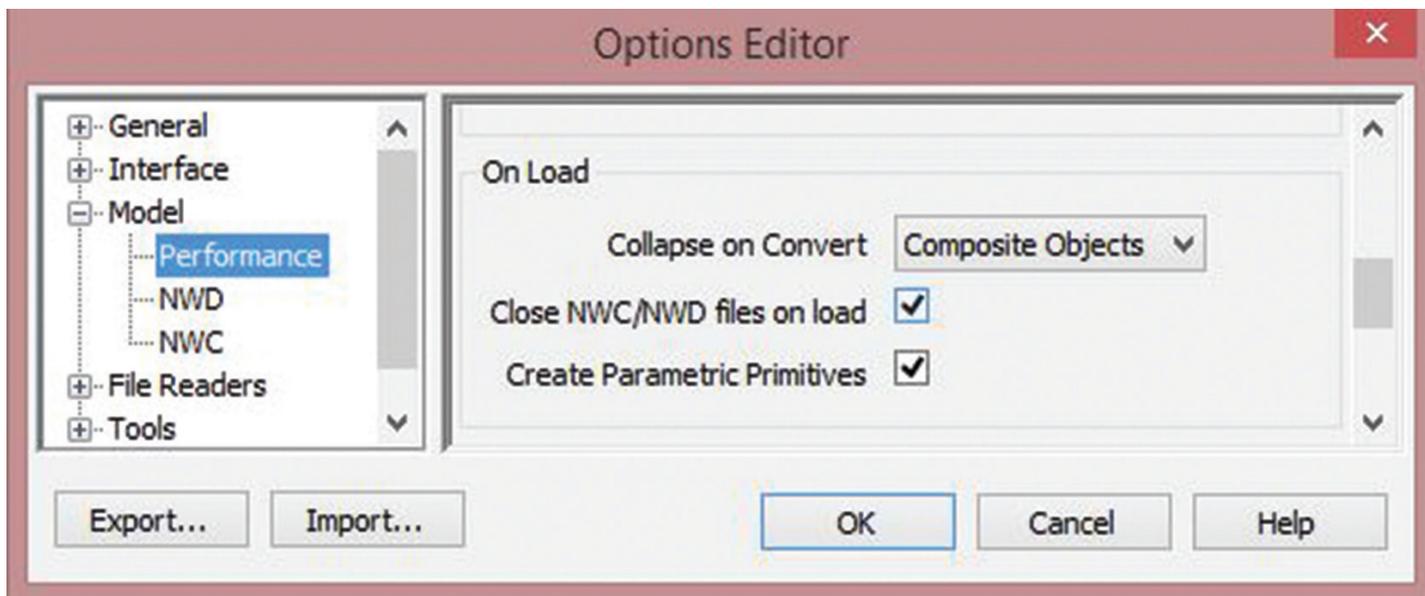


Figure 4: Options editor

need to move in the X, Y, and Z axis. Then when you have that information you can adjust your model and reset the transforms in Navisworks.

## UPDATE AND REFRESH

Now that you've found the perfect path to route your system it's time to update the model. For anyone using Autodesk® Revit® as the modeling platform it's as simple as selecting the object you need to adjust and using the switchback command. For many detailers it's not that easy—they have to find that piece manually. No matter what modeling software is used, there is one simple setting in Navisworks that should always be checked when working with NWC files. Under the options editor Model>Performance>On Load the check box that asks to close the NWC and NWD files on load should always be checked.

Typically a detailer should have the modeling software open along with Navisworks. If the option to close NWC and NWD files is not checked, then Navisworks will prevent modeling software from copying over those model files. This means in order to update the NWC files you would have to close Navisworks then export an updated model and then reopen the NWF. This simple option allows detailers to simply copy over old NWC files and hit the refresh button in Navisworks.

If detailers incorporate Navisworks into their workflows they can flip back and forth between their modeling software and Navisworks and update instantly to make sure they get their systems placed right the first time. That is not to say that other



systems won't change and possibly cause more problems, but that can be minimized through frequent model posting from all team members, not just once a week.

And even if the rest of your team doesn't update frequently or they cause hits when moving, it will still become clear that you are not the weakest link.



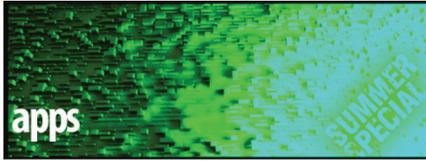
*The Navis Ninja, aka Mark Hunter, is an innovative and talented Navisworks professional. After being recruited by C.W. Driver as a BIM Manager, the Navis Ninja developed a new workflow for coordinating buildings that slashed the prep time in half. Key to the Navis Ninja's success was his ability to help his team members "take their blinders off" and shift the paradigm for coordination that made the process twice as efficient and twice as fun. Outside of coordinating some of the most complex and congested buildings for C.W. Driver, the Navis Ninja is known for vetting new technologies (i.e., integrating augmented reality through a high-end professional quadcopter) and constantly finds himself evading sleep while working on his next innovative project. To follow and track some of the Navis Ninja's latest developments, frequent [www.navis-ninja.blogspot.com](http://www.navis-ninja.blogspot.com). Mark can also be reached at [mbhunter@cwdriver.com](mailto:mbhunter@cwdriver.com), or at 909.945.1919.*

# THANK YOU!

The AUGI Board of Directors and the Editors of *AUGIWorld* wish to thank the following authors and volunteers for their contributions to AUGI in 2014. The growth and success of our organization would not be possible without the dedication of these talented individuals who share their knowledge with their fellow AUGI members. The editors of *AUGIWorld* wish everyone a wonderful holiday season and a happy new year! See you in 2015!

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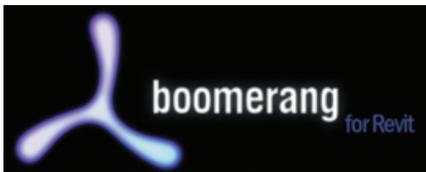
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[www.emanuefavreau.com/](http://www.emanuefavreau.com/)

This month we take a look at a series of apps created by a single source, architect Emanuel Favreau. These apps are all part of a series dedicated to enhancing the Autodesk® Revit® experience and are available individually or together as a package.

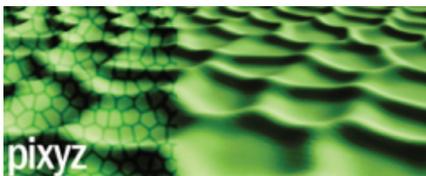
We will take a quick look at each one, but you can download a demo from the website to learn more.



[www.emanuefavreau.com/boomeranginfos.php](http://www.emanuefavreau.com/boomeranginfos.php)

Boomerang allows for communication between Revit and other programs. Options include:

- ✦ Place elements easily in a Revit project from an Excel file by linking rows and columns with family properties
- ✦ Convert data extraction from AutoCAD® or clash reports from Navisworks® into Revit objects by simply assigning XYZ and text parameter values to families
- ✦ Edit schedules exported from Revit with Excel, change values, and re-import it in a Revit project



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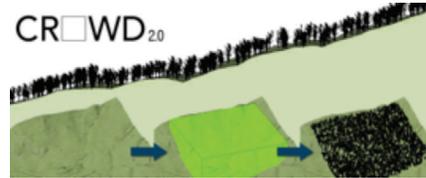
Pixyz lets you create surfaces and topographies with Revit using pictures and drawings.



[www.emanuefavreau.com/rebuild2infos.php](http://www.emanuefavreau.com/rebuild2infos.php)

RebuildWalls allows users to convert AutoCAD 2D lines into Revit walls and lines. Version 2.1 includes:

- ✦ Add line styles from AutoCAD Layers
- ✦ Convert AutoCAD lines and arcs to Revit Detail Lines
- ✦ Convert AutoCAD lines and arcs to Revit Room Separations
- ✦ Convert AutoCAD lines and arcs to Revit Area Boundaries



[www.emanuefavreau.com/crowdinfos.php](http://www.emanuefavreau.com/crowdinfos.php)

Crowd is a tool for Revit that allows users to place multiple elements randomly in an area defined by an adjustable box. Create a forest in a few seconds, add hundreds of components such as people, vehicles, and more on a straight or irregular topography.



[www.emanuefavreau.com/flipbookinfos.php](http://www.emanuefavreau.com/flipbookinfos.php)

Flipbook for Revit can be used to create series of images as a base for an animation. Options include:

- ✦ “Views” can generate a series of 3D or floor views
- ✦ The tool “Objects” is used to generate a series of objects and isolate objects in a view



[www.emanuefavreau.com/rewriteinfos.php](http://www.emanuefavreau.com/rewriteinfos.php)

Rewrite allows you to rename multiple views, sheets, family types, families, family parameter values, rooms, and areas in Revit:

- ✦ Add prefix or suffix to names and numbers
- ✦ Replace names and numbers
- ✦ Modify or renumber multiple parameter values
- ✦ Modify multiple yes/no type parameter values
- ✦ Modify multiple phases and workset type values
- ✦ Duplicate multiple views
- ✦ Duplicate multiple component, wall, floor, roof, or ceiling types



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

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