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Cover image: The future Malibu High School (California) designed by HMC Architects, rendered using 3DS Max Design

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Editor’s Note

It is gratifying to find that our members and others alike find the magazine worth their while.

During the first three days after our first issue of AUGI AEC Edge became available on June 23, 2009 we had over 2000 visitors to our web site per day. The number of visitors since has since tapered off but for the remainder of the week and the following week the number of visitors approached a high of 800 per day. Three months after it went live we still see as many as 100 visitors every day.

Numbers do not tell the whole story though they do show a positive response from our members and others. Here are just two member comments we received, “I must tell you that seeing AUGI active in such a way gives me motivation to enjoy AUGI’s platform especially during this downturn economy.” and “In short, this is the best publication of its type I’ve seen. Great job!”

That’s enough statistics. Suffice it to say that it has been well received based on the overwhelmingly positive feedback we have received so far. It is gratifying to find that our members and others alike find the magazine worth their while.

NEW PRODUCTS

As promised in the last message, we reached out to our members who use products other than Revit. This issue features articles about Civil 3D, AutoCAD, Ecotect, Navisworks and Inventor. Yes there are still many articles about Revit, it is popular! We get more pitches for Revit related articles. Nevertheless we remain committed to getting relevant articles for as many products as we can. We must admit that we were a bit surprised to get little response from users of ACA. We may not have used the best methods to recruit them and we hope that will change in the future. If you want to share your knowledge and fondness for your favorite product but don’t find it included in our pages you can help us change that.

THANKS AND RECRUITMENT

We want to thank the authors who contributed their time and expertise to this issue, many of whom are new and some you’ll recognize for various reasons:

Paul Aubin, Bob Bell, Sean Burke, Erik Egbertson, Tannar Frampton, Chris Fugitt, Ted Goulet, Bruce Gow, David Harrington, Debasis Karmakar, Karen Kensek, Jonathan Landeros, Anthony Mason, Phillip Miller, John Morgan, Michael Partenheimer, Behzad Sanikhatam, Todd Shackleford, Chad Smith, Scott Womack and alphabetically last, but not least, Jay B. Zallan.

We are not choosing new authors without regard for the previous authors. We don’t want being part of the magazine to be a burden on authors. Many hands make light work, so the saying goes. We are happy to accept new work from previous authors, we just aren’t imposing that expectation on them.

As always if you want to be a part of this magazine as an author or an advertiser please let us know.

- Steve Stafford - Editor: steve.stafford@augi.com
- Karen Popp - Sales: kpopp@extensionmedia.com

Thanks for reading!

Steve Stafford
AUGI AEC Edge Editor
Member AUGI Board of Directors 2006-08
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An Alternative for Tool Palettes

I remember my first adventure into the world of Tool Palettes, and the accompanying pain. The platform was Architectural Desktop 2005. I only used the 2004 version briefly and didn’t even take the time to look at Tool Palettes. I was in a small network environment of three users. I decided to take it upon myself to create and manage our palettes. At first everything seemed like it would be pretty straightforward. I created the palettes on my workstation and was happy with the results. I followed the instructions and exported my work to a catalog. I then referenced the catalog from the other workstations. Everything was great, at first.

It wasn’t long before things began to go wrong. Sometimes one of the users’ palettes would just disappear completely. Any updates I made seemed to decide on their own whether they would be applied, and to which workstations. Seemingly random files appeared in various locations. I tried to figure out what I had done wrong with the Content Browser but it was like trying to nail Jell-O to the wall. In the end, we each had a different version of our company standard tools and just resigned ourselves to live with it. At least there were only three of us then.

Fortunately for my present employer I’ve figured out it’s possible to manage Tool Palettes without ever using the Content Browser. While this method is contrary to the Help file and the opinion of most experts, I have found it to be simpler, less error-prone, and easier to keep updated. I now manage more than 50 seats of AutoCAD across three office locations as well as secondary installations on laptop and home computers. I am happy to say the only reason I’ve needed to think about the process lately is for the purpose of writing this article.

If you have a method in place for managing Tool Palettes and it’s working well for you, there is probably no need to change your current setup. If you struggle with or don’t understand how the Tool Palette system works, hopefully I can spare you a fair amount of frustration.

GET ORGANIZED

To get started, you will need to decide where you want your newly created palettes to reside. If you go to Options > Files tab > Tool Palettes File Locations, you can specify one or more paths for the Tool Catalogs you wish to make available. Since these paths are held in the user profile, which can be exported to an .arg file, it’s easy to include the office standard in new deployments or to update current users.

CREATE A CATALOG

To create a Catalog, make sure that the top path in the Tool Palettes File Locations does not already have a Catalog file in it. When you create a new palette, AutoCAD will generate the Catalog file. A subfolder titled ‘Palettes’ will be generated, and the Palette file will be placed in this subfolder. Palette files also have the .atc extension, and are composed of the name of the palette, followed by a GUID (e.g., New Palette_A0CCA60A-AB56-4EFD-83A5-8764BC08CDA8.atc). You can rename a palette from within AutoCAD by right-clicking on the Palette title and choosing Rename Palette. Keep in mind, however, that this will modify the Catalog file to affect the name change, but the Palette filename will remain unchanged. This can become a source of confusion if you are trying to locate a particular Palette file, since the filename and palette name will not match.
Each tool on a palette points to an image file for its icon. These image files are generated and stored in the Images folder, which is a subfolder of the Palettes folder. The image files generated by AutoCAD are 64 x 64 pixels, and have the .png extension. It is possible to create your own images to specify for your tools and I suggest placing them in the Images folder so they are easy to find and copy.

I highly recommend keeping a folder that only you have access to so you can create and edit Tool Palettes as needed, as well as a backup folder. This will allow you to work on the Tool Palettes without users being able to access tools that are works in progress, and may not yet be approved content. When you are ready to make an update, just copy the files from your folder to the user and backup folders. I also set the user files to read-only, to further prevent unauthorized content.

WORKSPACE FILES
Finally, the Tool Palette system relies on Workspace files. These files have the .aws extension. There are two important locations where Workspace files reside. First, I will mention C:\Documents and Settings\<current user>\Application Data\Autodesk\ACD-A 2008\enu\Support\Profiles\ProjectProfiles. Any time you set a Project Navigator project current in AutoCAD Architecture, a new file is created here, with a GUID name. In fact, a large number of AutoCAD crashes and various other problems can be blamed on a corrupt .aws file in this folder. For this reason, I suggest for all AutoCAD users to keep a shortcut to this folder, and clear out these files regularly, as shown in Figure 1. Any time you are creating or editing palettes, make sure you do not have a project set current and that any files in this folder have been deleted.

Side note: Keep in mind that all files related to Tool Palettes are generated when AutoCAD closes successfully. This means you will want to close any current projects, then close AutoCAD, then delete these files. When finished working on the Tool Palettes, close AutoCAD immediately, since if the program crashes, any edits made will be lost.

The other important Workspace file is found at ...\Application Data\Autodesk\ACD-A 2008\enu\Support\Profiles<current AutoCAD profile>, and is named Profile.aws. What makes this file important is that it holds the information for any Palette Groups that have been defined.

CREATE A PALETTE GROUP
To create a Palette Group, right-click on the Tool Palette spine and choose Customize Palettes. The dialog box will show two panes, as shown in Figure 2. The left pane displays all palettes made available by the Catalogs found in the Tool Palettes File Locations. The right pane shows any defined Palette Groups.

To create a group, right-click in the pane and choose New Group. To populate groups, drag palettes (unfortunately you are limited to one at a time) from the left pane into a group in the right pane. It is perfectly fine to have a palette exist in multiple groups. Groups may also be nested. The other unfortunate thing is that AutoCAD Architecture users no longer have the option to export palette groups to an .xpg file. This is why the Profile.aws file is important. If all users use identical Palette groups, this file can just be copied to each user’s hard drive whenever palettes are added to groups. If users are allowed to create their own groups, as is the case in my office, they should be advised to create a backup copy of this file, since it can become corrupt also, forcing a complete re-population of Palette Groups. When finished, just click Close. To set a group current, right-click on the Tool Palette spine. The available groups will appear at the bottom of the menu. Notice that any groups not containing palettes are omitted from the list.

DEFINE THE ORDER OF TOOLS
For the sake of space, I won’t go into each way that the tools can be created, but it is important to know how to set the order of tools on a palette, since it is helpful to users to have similar tools grouped together. You can drag-and-drop tools on a palette to re-order them, as shown in Figure 3.
When you do this, AutoCAD modifies your Profile.aws file. If you are distributing this file as part of rolling out updates, the drag-and-drop method is fine. However, if you don't update users' Profile.aws file, their tools will be in a different order than yours. The order of tools on a palette is determined by the order in which they were created (unless the user drags a tool to change its order, in which case that tool’s location is saved in Profile.aws). So when you re-order a tool or add one to the middle of a list, you will need to copy each tool that occurs later, in the order you want them to appear, and then delete the original version of each copied tool.

If you right-click a tool it is possible to just copy, then right-click to paste (useful when copying a tool from one palette to another), but I find it easier to right-click and hold on the tool, drag it to the end of the list, release, and choose Copy Here as shown in Figure 4.

**KEEPING EVERYONE IN SYNC**

To update local office users with new content, copy the files as I mentioned previously to the users’ Tool Palettes File Location on the network. For remote offices, you can either copy the files yourself if you have a VPN connection or email them to someone in that office you trust to place them in the correct location. For home and laptop users, I recommend placing the files (and any other AutoCAD support files your company uses) on an external drive. This can be a USB thumb drive, a conventional external hard drive, or even an mp3 player. It is critical that all offices and external users have the same drive letter defined to hold the support files. It’s simple to map a network drive, but changing the drive letter for an external drive is a bit more involved. To do this, go to Control Panel > Administrative Tools > Computer Management > Disk Management. Select the external drive, right-click and choose Change Drive Letter and Paths.

**WRAPPING UP**

I recommend keeping the support files and templates for different versions of AutoCAD separate so that changes you make after upgrading do not affect previous versions, especially when a .dwg file format change is involved. When setting up Tool Palette files for an upgrade you will need to change the content path for each tool. You can open the palette .atc files with Notepad and perform a Find-Replace to change the old path to the new one. Since it is possible to have a large number of palette files it is nice to be able to batch them all together, but this cannot be done with Notepad.

**HELPFUL APPLICATIONS**

The best program I have found for dealing with an upgrade is TextPad. It is not freeware, but they do allow you to download a fully functional evaluation copy.

http://www.textpad.com/download/index.html

Another tool I have found to be incredibly helpful in rolling out content is the freeware program SyncBack by 2BrightSparks. The user interface makes it easy to set parameters, and once setup you can perform updates with the click of a button.

http://www.2brightsparks.com/downloads.html#freeware

Hopefully the information in this article will help your next Tool Palettes implementation be a success instead of a horror story.

Anthony is the CAD Manager for Nichols Melburg & Rossetto Architects + Engineers in their Redding, California office. In addition to performing in-house training and support, he develops and maintains CAD and BIM standards for Healthcare, Education, Civic, Commercial and Residential project types. He has worked in the A/E/C field since 1998.
"Leveraging the Information in BIM"

Erin Rae Hoffer AIA LEED AP
Autodesk Inc.

Gaining Insight from Experience
Recently, I prepared a seafood paella dish for a group using a large steel pan over a wood fire in a place where I'd never been before. There were many uncertainties—a heat source which was hard to control, local ingredients combined in heretofore untested conditions, unanticipated workarounds due to a change in the number and tastes of diners, schedule shifts in the time when everyone was ready to dine, the list goes on. Nevertheless, I was confident that the final result would delight everyone at the table, because I was able to leverage insight that I’d gained after many years of preparing similar dishes, insight which I had recorded experience by experience in the margins of a well-worn recipe book which served as a knowledge management source for this particular activity.

How do AEC practitioners leverage the knowledge that we have gained by developing project after project in conditions of great uncertainty? For architects, engineers and contractors, our knowledge and insight is a competitive differentiator and very precious in today’s challenging economy. Traditionally, design practice is built upon mentorship as a means to inculcate knowledge. Architects suffice their firms with competency and pass on the knowledge and judgment of senior practitioners while coaching junior design teams to solve project-based problems. Unique design ideas and insights developed for any specific project are likely to have inherent value for future projects. In today’s economy, these insights must be leveraged to meet clients’ demand for creativity, expertise and superior project delivery.

The Impact of BIM
Today, there is a remarkable transformation occurring in the design and construction of the built environment. As established design technologies give way to building information modeling (BIM), designers are empowered to create 3D models of their projects from building elements packaged with relevant information about how these elements behave in the real world. When a designer introduces a column or a window into a design using a BIM process, the project team builds up a database of information that can be used to analyze the impacts on predicted energy consumption, along with many other factors including water usage, waste, construction sequencing and cost. A basic building model enables a project team to analyze, compare, or audit potential renovation projects based on financial or environmental criteria. BIM technology and analysis tools allow for comparison of renovation options within a building. For example, BIM can provide information useful in answering questions such as, “what generates a better economic and energy-efficient return: installing higher R-value wall insulation, or modifying a heating system?” or “which buildings in my portfolio would benefit the most from an HVAC upgrade?” The growing adoption of BIM provides opportunities for innovation in the way that architectural knowledge is developed, captured and leveraged. Yet to capitalize on the opportunities to leverage information through BIM, firms must begin to think differently about their business models and their means for capturing critical practice content.

Typically, architectural knowledge is developed and maintained throughout a project in the form of contract documents and specifications (see Figure 1). Along with these legal documents, project information includes allied artifacts such as meeting notes, sketches, email archives, reports and many other information about how these elements behave in the real world. When a designer introduces a column or a window into a design using a BIM process, the project team builds up a database of information that can be used to analyze the impacts on predicted energy consumption, along with many other factors including water usage, waste, construction sequencing and cost. A basic building model enables a project team to analyze, compare, or audit potential renovation projects based on financial or environmental criteria. BIM technology and analysis tools allow for comparison of renovation options within a building. For example, BIM can provide information useful in answering questions such as, “what generates a better economic and energy-efficient return: installing higher R-value wall insulation, or modifying a heating system?” or “which buildings in my portfolio would benefit the most from an HVAC upgrade?” The growing adoption of BIM provides opportunities for innovation in the way that architectural knowledge is developed, captured and leveraged. Yet to capitalize on the opportunities to leverage information through BIM, firms must begin to think differently about their business models and their means for capturing critical practice content.

Figure 1 – Timeline of Information throughout traditional project delivery (courtesy Autodesk).
tion sources some of which are difficult or inefficient to archive or retain. Firms will habitually retain libraries of details, listings of vendors, or material collections which have been applied successfully in the past while side-stepping the opportunity to capture critical information about team collaboration and project workflow.

ANSWERS IN BUILDING INFORMATION MODELS

What are the trends driving innovation beyond the traditional approach to nurturing architectural knowledge? Around the world today, there is a growing imperative to convert our built environment to lower energy consumption modes. The AEC industry is under pressure to reuse or recreate relevant data about existing buildings, and owners will find value in building information for operations as a means to reduced energy consumption. This suggests that we will see more widespread application of BIM for renovations and retrofit projects aimed at increasing building sustainability.

A basic model for this purpose requires generalized information on quantities, sizes, shapes, location, and orientation of the building. This includes windows, exterior doors, and openings; roof area and geometry; interior core arrangement and zoning; floor-to-floor slabs; and other major functional spaces, such as parking garages, auditoriums, and atriums. An existing building may be documented in either paper or CAD construction plans or design files, and some older buildings have no documentation at all. A model can be developed in any case - by using paper documents as dimensional take-offs, by using CAD data as a reference for model development, or by physical dimensioning and field verification in a conventional survey process. It is also possible to input an existing building through the process of 3D laser scanning or the use of digital photography. Laser scanning uses a laser device to precisely size and position roofs, exterior walls, windows, doors, and other openings into an accurate 3D point cloud model. This point cloud can then be imported into your design software.

Additional interior volumetric verification completes the process of creating a basic model.

For this knowledge to be useful beyond the life of a particular design cycle, the information must be developed with a consideration of its future use. Who are the individuals who will access the information? What will their objectives be in applying it? In the case of the retrofit described above, the owner of the building may find the building information model particularly useful to monitor and control energy usage. The process of converting the relevant aspects of the model would need to be informed by the specific questions and tasks which define ongoing operations.

IMAGINING THE FUTURE

The Autodesk AEC Headquarters building on Trapelo Road outside of Boston provides an example of the effective development of building information models and the ongoing application of this data in innovative ways. The project was designed and built by an integrated team which included KlingStubbins and Tocci Building Companies. It was executed under an integrated project delivery agreement which linked the owner, architect, contractor and a number of key consultants and sub-contractors. BIM was an integral component of the communication and decision-making process for this successful project.

One example of data development and leverage was found in the design of the partitions within the office spaces. The partitions for the Trapelo Road project were initially modeled as simplified double-walled elements in the programming phase by the architect (see Figure 2). As the design evolved, the contractor was responsible for model development which added data about construction elements. Further development was completed by the architect, as details about reveal locations and wallboard joints were added. Ultimately, the model was coordinated with an onsite system for precision layout. This project also made use of Vela Systems.

Figure 2 – Building information model sequence – partition design from programming through construction (courtesy KlingStubbins and Tocci Building Companies).
Field BIM application - using RFID tags attached to fixtures (cubicle elements) to track progress against delivery, off-gassing, and installation milestones which could be incorporated into a modeling system for visualization of project completion status. For more information on this project, see "How to BIM-Enable IPD" in AUGI AEC EDGE Spring 2009.

The Trapelo Road project suggests the positive outcomes for cost-effective, high-quality sustainable buildings which can be realized by owners who can apply innovative practices. This glimpse of the future links BIM to downstream uses, and highlights the opportunities for highly sustainable renovations or retrofits. As cities increase the stringency of requirements for the built environment, and as funding becomes available to support energy-oriented retrofits of public and commercial buildings, advances in project delivery and design technology enable our professions to respond to society and achieve these ambitious goals. The effective application of building information beyond traditional production of construction documents will help the industry succeed in meeting goals for effectiveness and performance, and may additionally provide AEC companies with opportunities to serve their clients in new and valuable ways.

As Industry Programs Manager with Autodesk, a leading provider of software for architecture and engineering, Erin Hoffer fosters the adoption of innovative approaches to design and practice. An architect with twenty-five years of experience in technology and computer-aided design, Erin contributed programming for D.O.E solar energy analysis software in the early 80s, developed computer-aided design tools and techniques for architecture and engineering with Skidmore, Owings & Merrill, and created award-winning effects for the entertainment industry on “The Last Starfighter” and other features. Prior to joining Autodesk, Erin served as Executive Vice-President with the Boston Architectural College and served on the board of directors of the Boston Society of Architects as Commissioner of Technology. She led technology and services organizations for Harvard, MIT, and Tufts University. Erin published articles in Construction Specifier, Military Engineer, MICROCAD News, Progressive Architecture, ArchitectureBoston, Landscape Architecture, Practice, taught graduate level courses at Harvard and the BAC, and is a frequent presenter with conferences including the AIA, Greenbuild, CEO.net, CTBUH, A/E/C SYSTEMS, BuildBoston, ASTM, ALN, Architekten Computer and Systeme, eCAADe, and the ARPA conference at Biosphere II. She is a LEED Accredited Professional and member of the AIA and CSI. Erin received a Master in Architecture from UCLA, and a Master in Business Administration from MIT’s Sloan School of Management. She is registered to practice architecture in California and is a Ph.D. candidate in Northeastern University’s program of Law, Policy and Society.
Navisworks – Clash Detective
Reduce Risk and “Save Lives” on a Project

PAST
I think we all remember the time when we lived in the 2-D world. Sheets spread across the conference table, architects and engineers geared up together to scan through every area and tried their level best to avoid any clashes between disciplines. They re-evaluated the whole design to make sure that the coordination between disciplines was perfect and flawless. This however used to be a very tedious job and most importantly the accuracy achieved was never 100%. That was then.

PRESENT
Today is the era of Building Information Modeling, what we all fondly call BIM – a phrase and acronym that is spreading like wildfire in the AEC industry. BIM is an integrated process that allows architects, engineers and builders to explore a project digitally before it’s built in 3-D.

Coordinated and reliable information is used throughout the process to:
- Design innovative projects,
- Accurately visualize appearance for better communication
- Simulate real-world performance for better understanding of important characteristics such as cost, scheduling and environmental impact.

ENTER NAVISWORKS
To put it very simply Autodesk Navisworks is a 3D geometry design review tool. This means we cannot create or model any geometry within the software. At OBELISK, we have been using Autodesk Navisworks for almost two years now. I lead the BIM revolution at OBELISK and our experience during these last two years with Navisworks enables me to say confidently that it is the most effective design review tool available today.

We believe it helps a firm “Reduce Risk and Save Lives on a Project.”

The reason we say this is because the software has the ability to detect clashes between various model elements, as well as create 4-D simulation and producing photo-realistic images. Most importantly Navisworks can import 3-D data from a wide range of formats, including .dwg, .rvt, .dgn, .3ds, .ifc (to name just a few) and most of the other prevalent 3-D formats (Refer to Figure 1). Even formats that are not supported often have an “exporter” that will create a file formatted for Navisworks. It provides an independent or neutral platform where related project information is combined even if created in disparate and competing CAD systems.

Though we can write pages explaining the advantages of Navisworks and its usage, in this article I shall restrict myself to writing about the most powerful tool of the software, which is its Clash Detective, or using Revit terminology Interference Check.

My endeavor through this article is to help the readers understand the Clash Detection process in a Step by Step format. So let’s get started.

Step1: Exporting files from Autodesk Revit
When Navisworks is installed, an additional tab in the name of Add-Ins is added in Revit 2010. For exporting, simply click Add-Ins > External Tools > Navisworks 2010. You need to export files from each discipline individually. Say for example, separate

Figure 1- Wide variety of file formats are supported
exports for Architecture, Structure and MEP. These files get exported in .nwc format, which are cache files, and they contain the information that Navisworks will need to display the model.

**Step 2: Importing files**
Open any one of the exported files (.nwc) in Navisworks Manage 2010. Then append the other exported files one by one. The append icon is located in the standard toolbar. Once you have finished appending all the required files you need to save the file. The file should be saved using the .nwf format, which are pointer files. These files reference your files and contain no geometry so they are the smallest Navisworks files.

Note: There is one other file type .nwd. This file is the format you use when you want to share a complete Navisworks model that captures all geometry as well as viewpoints and review comments.

**Step 3: Creating search sets/selection sets**
You are now ready to work within Navisworks. The first thing you need to do in Navisworks is to create search sets. Search sets are a combination of geometrical entities. You can group objects by using Find Items located in the control bar (Refer to Figure 2). Say, for example you create separate sets for ducts, structural beams, fire fighting pipes and so on. Alternatively you can also manually select items and create selection sets. Both are an effective way of grouping entities but search sets have an upper edge as compared to selection sets. The reason why I am insisting on grouping items by search is because search sets can be exported from one project to another in .xml format. This allows you to re-use those sets over and over again for your projects. This does assume that the export platform (in this case Revit) remains the same.

With your search defined and the resulting items selected, open the Selection Sets control bar.

Right click in the Selection Sets control bar and select, Save Current Search. With the search set created, rename this as desired. Create additional sets as required.

**A NICE TRICK**
There is an alternate way to group entities without using selection/search sets. The above mentioned procedure involves a potentially major effort of creating different search sets. Instead of creating search sets (which might be tedious) we can opt for a different approach. We can manage what is exported to Navisworks in Revit instead. This is easy to do by choosing which categories are visible each time we use the Exporter. Let’s walk through that process, remembering the purpose of creating search sets was primarily to group objects in a logical manner. Now let’s go back to Step 1 where we exported files from Revit to .nwc format. The last time we exported files per the discipline (Architecture, Structure & MEP). This time the process will be a bit different. Let’s see how.

Open the Architecture.rvt in Revit. Now perform the following:
- Go to 3D view in the project browser and select the default 3D view. Right click and select duplicate view. Once the view is created go to the Visibility/Graphics dialog. In the model categories tab uncheck all the model elements except walls. Now what you have in the view is only the walls. Click Add-Ins >External Tools > Navisworks 2010. Give it a name like walls.nwc.
- Repeat the procedure again and duplicate the view once more. This time in the Visibility/Graphics dialog, uncheck all the model elements except floors. Now what you have in the view is only the floors. Export the file and give it a name like floors.nwc.
- Similarly, create duplicate views and export different model elements like glazing, roofs, ceilings etc. individually into *.nwc files. Repeat the same procedure for exporting your MEP and structural elements. What we have now is a lot more *.nwc files rather than the previous process where we had only three *.nwc files.
- Open any one of the exported files (.nwc) in Navisworks Manage 2010. Then append all the other exported files one by one.
- The best part is that you no longer have to create search sets. Because you created carefully defined search sets in Revit first and this will ease the selection process in Navisworks.
- Now it will make more sense to directly choose the elements from the left and right panes of the clash detection tool under the standard tab. Just select the desired appended .nwc files from the two panes and run interference check between entities. The relevant clashes will be reported.

Now that we know how to group model entities by making selection sets as well as by judiciously exporting .nwc files let’s move on to the next step for detecting clashes.

**Step 4: Clash Detection**
Once the desired search sets are ready, you can use Clash Detective to test between two groups of objects. Naturally to run a test, you need to open the Clash Detective tool.

As shown, the Clash Detective tool contains two identical panes, the left and the right pane. Both the procedures for selecting and grouping objects has been shown in Figure 03 and Figure 04. Let’s focus on the search sets option to run clash test. Here you can see
all of the search sets we created in Step 3. The Select tab is where we define our clash test. You will see the tabs Standard, Compact and so on under each tree. Scroll these to the right and select the Sets tab (for both Left and Right). Perform the following steps:

- In the left pane, select a search: Choose Ducts.
- In the right pane, select a search: Choose Pipes.
- Ensure Self-Intersect is un-ticked on both sides (we do not wish to detect clashes against itself).
- The Run type should be set to Hard, looking for physical intersections between items on the left and items on the right.
- The Tolerance should be set to 1mm to ignore any clashes found with interferences less than 1mm.
- Click the Start button to perform the clash test. Related clashes will be found.
- Now let’s review the results.
- Click on the Results tab (see Figure 5).
- Click on any of the clashes detected. You should be automatically zoomed into the clash area.
- The clashing items are highlighted in red to signify that it is a newly found clash (there are other colors for clash management that we will not go into here).
- The clash draws our attention to a pipe passing through a duct. Details of the clashing items are shown at the bottom of the Results tab making it easier to identify them.

As part of the review process a decision has to be made whether to approve a clash or whether action needs to be taken. Navisworks provides tools to add comments and mark-up clash results which can be recorded and kept as part of an audit trail. They can also be passed back to the engineering teams to advise how best to re-route the ducting, for example. Once any changes to the original project files (and exports to .NWC) have been made, the clash test can be run again to determine whether the changes have resolved the clash, and to also check that the change hasn’t resulted in a clash with another item.

CONCLUSION

Obviously Navisworks is a great partner tool for Revit. Its ability to bring in data from many other sources to produce a single unified 3D model is a massive improvement over the disconnected way in which construction projects have been managed historically.

It can be said that Autodesk Navisworks provides a group of tools that allow us to reap big benefits on multiple levels and create a single environment to aid 3D model design reviews. This collaboration will quickly help anticipate potentially expensive on-site problems and provide the project team with clear indications of the viability of the chosen construction methods and schedule.

For a comprehensive tutorial on the Navisworks clash detective tool you may check the Youtube links mentioned below:

Clash Detection Part I: http://www.youtube.com/watch?v=JZ0PcEt-o08

Clash Detection Part II: http://www.youtube.com/watch?v=CdeCcOzuWcI

Clash Detection Part III: http://www.youtube.com/watch?v=BqyBeaUQNkg

We also want to acknowledge Abhishek Tyagi for his help with preparing this article.

**Debasish Karmakar is a young and enthusiastic architect based in New Delhi, India with 7 years of experience of working on global projects. Debasish is a firm proponent of BIM and heads the BIM revolution at OBELISK (www.obelisk.in), with which he has been associated ever since its incorporation in 2008. Debasish has been working on the Revit Platform since 2003 and has been instrumental in preparing implementation and training modules.**
For those of you not yet familiar with this application, it is one of the latest offerings from Autodesk focused on sustainable design analysis. Part of an acquisition slightly more than a year ago, Ecotect brings a very powerful suite of tools to the already rich landscape of design analysis typically reserved for engineers. Where this product differs from those is in its decidedly architectural focus. It has a very graphical interface and the analysis feedback looks good enough to eat. More than eye candy, though, its results and output can be a fantastic way to get your ideas across to clients and to the extended design team, see Figure 1.

In addition to Ecotect, Autodesk offers Green Building Studio (GBS) (http://greenbuildingstudio.com), a web service for whole-building analysis also acquired in 2008. It may feel like Autodesk is competing with itself again, but these tools can work together to satisfy different simulation needs. In fact, an annual subscription to Ecotect Analysis 2010 is bundled with access to GBS.

Where Ecotect improves on many other building performance analysis (BPA) tools is its inherently familiar 3D graphical design environment. Coupled with the fact that all input and output data can be displayed within the context of the model, in some cases simultaneously, this enables rich feedback that helps make quick decisions concurrent with the design. Since Ecotect both supports models created in other tools and has its own purpose-built modeling environment, designers can work in ways that feel most natural to their processes.

As a supplement to instructor-led training there are downloadable training packages available from Autodesk, by visiting http://www.autodesk.com/ecotect and selecting the link for Training in the sidebar. While not comprehensive to all the capabilities in the Ecotect toolset, more are being developed. The training packages will install as help files, and will add themselves to the application’s Help menu. A 30-day trial of the application is also available from the same site, to aid in getting used to the concepts of the tool and how it may be used to perform BPA.

**TIMING IS EVERYTHING**

The first step to using Ecotect effectively is to discover where the tools may be used in the design process and integrated into a BIM workflow. The most benefit will come from incorporating BPA, using Ecotect, at the right time in your design process. So, when is the right time? When should Ecotect be employed? Start at the start. That’s what I tell new users. My reasoning is straightforward: early decisions are cheap and you can discover opportunities you didn’t realize were there. Using Ecotect solely as an evaluation tool—after the design process is well into development—can have only a minimal effect on design decisions.

**PICKING THE LOW-HANGING FRUIT**

It is a misconception that all aspects of building performance analysis require intense modeling and enormous amounts of data input. Early in the design process information is usually scant, and designers simply want to test different schemes within Ecotect. Some early simulations may not even require a complete building, simply a single room, and you can derive much feedback without having a building at all. Some methods involve surrounding buildings and general site conditions such as: grade, elevation, and sun exposure. Below are some examples of simple studies that can be done to help inform multiple iterations of building form, orientation, and thermal zoning strategies:

- Solar Access and Right-to-Light
- Overshadowing
- Prevailing Winds
- Access to Views
- Daylight Factor
- Testing Passive Design Strategies

**UNDERSTANDING PLACE**

The importance of place cannot be over-emphasized when designing sustainable buildings. It may seem like common sense that where you are in the world can be as important as building type when forming a design strategy, but in the last century we seem to have forgotten. Rather than go into the reasons why, let’s look at how we can get back to our roots and begin again with place. As Brown and DeKay, authors of Sun Wind & Light - Architectural...
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**ORIENTATION**

Once a local weather file is selected, it can be very easy to see the balance between potential overheating due to sun exposure and maximizing daylighting. As a matter of fact, the Weather Tool will do it for you! This benefit is available before even having a design. In the Weather Tool, select the Solar Position panel and choose Best Orientation. Sometimes, the best orientation is to avoid direct sun exposure altogether (as in this example for Las Vegas in Figure 2).

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IDENTIFYING TRENDS

Not all buildings we design are in our own backyard. When we don’t have an intimate knowledge of the climate, Ecotect helps us do a little investigating. Trends such as percentage cloud cover, wind speed averages, solar radiation, and temperature can identify candidates for on-site renewables such as wind and solar. These metrics may be studied individually or displayed at the same time to see correlations between data points. Refer to Figure 3 for an example of weather data.

The Weather Tool also helps identify what passive design strategies work best for a given climate. From the View menu, selecting the Passive Design analysis allows the choice of one or more of six different passive strategies. By specifying the hours of operation, or when a building is occupied, you can see the results displayed alongside the standard conditions (with no passive strategies employed). Refer to Figure 4 for another weather data example.

In the example of an office building located in Seattle, we can see that the best strategy is a night purge system (see Figure 5). During the summer months we can expect a comfort percentage of between 75 and 95%, which potentially reduces the need for mechanical cooling. With this information in hand early, planning and systems design conversations with an HVAC engineer can take place in a meaningful way. Of course, once the building design begins to take shape, and loads are applied, validation of this strategy can also take place within Ecotect.

UNDERSTANDING TRADEOFFS

One of the unique benefits of Ecotect is that you can automate much of the environment through scripting. There are many pre-built scripts available with the application, as part of the training packages, and online at the Ecotect Wiki at: http://squ1.org/wiki. (Building your own scripts requires a certain type of dedication as documentation in this area is a little sketchy.)

Here’s an example of a tradeoff in design and performance where you can see immediate results. By enabling the script called

Figure 2- The best orientation for the Las Vegas weather file is represented by the yellow line in the NW direction, at 335 degrees

Figure 3- Example of weekly weather data - Direct Solar Radiation

Figure 4- Another example of some weekly weather data - Maximum Temperature

Figure 5- The effect of passive design strategies on comfort percentage for each month can be seen by the red bars, in comparison to the yellow baseline
DynamicDaylight.scr (found in the Introductory Product Demonstration training package), you can see that it automatically loads a model, then displays a slider bar. The slider is tied to the glazing ratio for the hosted walls (see Figure 6). Moving the slider shows the daylight factor data on an automatically updating analysis grid. Running the next script, Dynamic Loads.scr, makes the effect on heating and cooling loads immediately obvious as the glazing ratio is changed.

STAGES OF DESIGN WHERE ECOTECT IS USEFUL

Of Course, starting at the start is where Ecotect has the most potential to influence good decision-making. But don’t discount the effect the tools can have throughout the design process. Ecotect is useful across all stages of design, but its impact and ability to transform the design diminishes as ideas become more concrete. Below is a rough guide (see Figure 7) for where Ecotect can be effectively integrated into stages of the design process.

Notice that I’ve left off the “Construction Documents” phase, or “Implementation Documents” in the case of IPD (Integrated Project Delivery). Since this is a detailed phase, most design decisions affecting building performance should have occurred in prior phases. Although represented in the diagram as a linear progression, the process of design is not really linear. This is especially true in a BIM workflow, or when using the principals of integrated project delivery. While continuing to run simulations during the final design phase will produce more accurate results, and require fewer assumptions, making significant changes to the building form at this time is not usually possible. It is, however, possible to resize systems, or change the performance of glazing in response to new findings. Therefore don’t discount the feedback that can come from the engineering and specialist disciplines on your project team.

BIM WORKFLOW

Models may be imported into Ecotect from a wide variety of 3D applications and other BIM tools, but let’s take a look at working with Revit.

ITERATIVE PROCESS

Often times the process of “design, construct, analyze” seems like an endless carousel ride—until, eventually, something clicks. The iterative process of design is filled with discoveries, failures, and near misses. Using a combination of Revit and Ecotect, the way in which a building form, glazing pattern, or shading scheme works can be quantified, so the near misses can be refined. Similarly, inappropriate forms can more easily be eliminated before progressing too far. Using comparative analysis, by storing results in Ecotect and running subsequent simulations, or simply exporting results to view side by side, makes arriving at an answer more elegant than random trial and error.

Some simulations provide a direct answer to the proper question asked. For instance, you may desire the criteria of an adequately sized and shaped shading device to prevent overheating or glare in a particular space. This can be auto-generated by selecting the window and filling out the appropriate parameters in one of several wizard screens (see Figure 8).

USING MODELS IN ECOTECT

Ecotect supports many, many file formats for import, and the primary method of getting geometry from Revit is either through gbXML - Green Building (gb) extensible markup language (XML), or by exporting to DXF. Both have their advantages, and both should be used at the proper time:

- gbXML converts Rooms from Revit Architecture, or Spaces and Zones from Revit MEP and supports analysis such as: Thermal Performance, Acoustic Performance, Energy Demands, Sustainable Indexing, and Transmitted Solar Radiation.

![Figure 6- Dynamic updating of window components and associated results of daylight factor and solar-related heating and cooling loads](image1)

![Figure 7- Start from the start, and iterate the analysis model along with the design process](image2)

![Figure 8- A generated optimal shading device for the summer, allowing winter heat gain strategies](image3)
Cross-Discipline

- DXF brings in detailed building geometry and is useful for studying: Shadows and Overshadowing, External Solar Availability, Air Flow and Ventilation, as well as Lighting and Daylight Analysis

PERFORMANCE MODELING
When modeling for building performance analysis, it’s not necessary to have all rooms and interior partitions defined. Rooms, for the purpose of converting to Zones in Ecotect, should be considered as contiguous homogeneous volumes of air. In other words, in a design for an office building, it may be advantageous to model all south facing enclosed offices as a single bar. This strategy is repeated for the other directions of the building perimeter and the core is modeled separately. By simplifying the design representation, it can be modeled faster in Revit and analyzed sooner, providing the timeliest feedback on design assumptions.

When designs call for more complex geometry, or compound curved elements such as a sweeping curtain wall, Revit Architecture 2010 is very useful (see Figure 9).

Geometry created with the conceptual massing tools may be subdivided and pre-rationalized in Revit to prepare the geometry for analyzing solar radiation in Ecotect. These panel shapes do not need to represent the actual design at first, merely a simple way of breaking down the form so each panel can receive insolation data and display back to the designer for interpretation (see Figure 10).

PRESENTING IDEAS AND RESULTS
The resulting analysis data is informative, easy to read and can be extracted for use in presentations and reports. If a picture is worth a thousand words, then Ecotect will speak for you, helping to sell your ideas. It can make the case for investing in higher quality design, since it can show how to improve the comfort of occupants, save money on energy, and reduce a building’s carbon footprint. Data can be displayed as results in the following ways:
- Color coding on the surfaces of the model
- Over an Analysis Grid of points or individual points
- As particles or rays within the model
- As data mapped on to a graph or in tabular form

The display takes advantage of OpenGL graphics, and can represent the model in many different ways to enable presentation to suit a given style. Models can be sketchy, or transparent to see the interior details, and may also be sectioned to hide portions of the model. Saving as tabs allows for dynamic movement between views and convenient discussion of particular aspects of the model. These attributes make Ecotect excellent for live, interactive presentations.

WORKING WITH RATING SYSTEMS
While they are not comprehensive, nor designed to be used for documenting points, you can certainly use the analysis features of Ecotect to work toward the rating system applicable in your jurisdiction. For instance, in North America, LEED credits aimed at Access to Views, Daylighting, Heat Island Effect Non-Roof, and Light Pollution Reduction are all good candidates to investigate early using Ecotect.

Even though Ecotect is not yet certified to perform the final calculations for the various rating systems out there, it does have a comprehensive system for Part L regulations compliance in the UK. The developers have teased us, though, by including grayed-out menu items for Australia’s BCA Energy Codes, LEED, ASHRAE 90.1, and others, so it’s difficult to say whether these are in the works or bookmarks for a possible future functionality. For now, it’s better to work with specialists to validate and document the requirements of various building regulations and rating systems.

LOOKING FORWARD
As the tools for BIM and BPA become more sophisticated and intertwined, the transformative potential of these workflows becomes more evident. The difficult job of balancing competing and often counter-balanced ideas becomes more easily accomplished through commitment from the industry and the tool makers. The climate is right for this transition.

DEVELOPMENT
Overall, Ecotect is very well-suited for production. Much like any tool, it takes getting used to holding it in your hands. Ecotect is certainly one of the most graphically rich environments to per-
form analysis and test out design scenarios. It is easy to learn and use and has plenty of freely available learning tools. However, the development of Ecotect could use some attention in critical areas. Interaction with the tools and the UI are decidedly not like the corporate portfolio of design tools.

Interacting with the model and using the mouse does take a little adjustment, especially when you are used to using Revit or 3DS Max. Some of the orbit, pan and zoom operations are opposite those in other applications. Also, when a tool like Ecotect is used on multiple projects in your office, you may notice that the larger master-planning and highly detailed models can begin to tax the system (though careful modeling can mitigate much of this).

Given the origins of Ecotect in Australia and the UK, there are not as many weather files bundled for all regions as would be expected. While within the application there are links to obtaining additional weather files online, from both Square One and the U.S. Department of Energy, having that content out of the box would be more useful. The process of creating accurate weather files for Ecotect from the USDOE Energy Plus site is not spelled out completely in the help file, and without proper care of the data, it could provide inaccurate results. Additionally, for some analysis, it would be nice to have hourly rain data, which is randomly seeded into a few files, but not all.

There have been two Autodesk branded releases since the acquisition of Ecotect, and that’s impressive work. However, as of the writing of this, Ecotect Analysis 2010 is only available in the US, other regions having access only to Ecotect 2009. Localization (or “localisation” depending on your preference) has been similarly slow in coming. It’s also a little baffling that the latest release allows only a network installation. This could be an obstacle to sole proprietors, who may lack a server setup (and the dedicated IT staff to create that environment).

Many users who are accustomed to working with Ecotect make their wishes known on the wiki (mentioned earlier in the section called Understanding Tradeoffs) and the newly created Autodesk discussion forum dedicated to Ecotect.

http://discussion.autodesk.com/forums/category.jspa?categoryID=189

A consensus opinion is that, in the near future, it would be nice to see stability improvements, and code that takes advantage of multi-processor and 64-bit workstations.

**FUTURE INTEGRATION? PERHAPS.**

A best practices white paper produced by Autodesk, “Using Autodesk Ecotect Analysis and Building Information Modeling,” can be found on the Ecotect Analysis product page http://www.autodesk.com/ecotect). It covers the process of preparing and exporting a Revit model for use in Ecotect. However, while the export/import mechanisms that exist are very flexible and graphic data can be gleaned from other design tools such as Autodesk Revit and Google SketchUp, the level of non-graphic data that is passed into Ecotect is limited to name, volume, area and the names of the bounding elements.

Furthermore, knowing that Ecotect plays a part in a larger ecosystem of tools, there could be better integration with the design and documentation process. A clear strategy of data and graphic information flowing back and forth between Revit, Ecotect and Green Building Studio is lacking.

A sneak peak at what’s to come can be found on Autodesk Labs. For a limited time, Revit users can download the Solar Radiation Technology Preview plug-in which enables incident solar radiation analysis to be performed on mass models directly in the Revit project environment.

http://labs.autodesk.com/utilities/ecotect

This is only a single type of analysis, and, while the data produced has visual representation, the reporting and interrogation of that data is rather limited, when compared to Ecotect. Where this tool is powerful is in its ability to iterate quickly through complex geometry within a single environment.

Does this indicate that there may be more integration in the future? Of course, we can’t know until (unless) it materializes, but this peek into the goings on at the factory does look promising.

What are you waiting for? Start at the Start!

Sean Burke is a Digital Design Technology Specialist with extensive experience in the architecture profession. Sean has his own strategic BIM implementation practice, SDB Consulting, and is a LEED® Accredited Professional. He is considered a leading expert in Building Information Modeling (BIM) processes and tools for the design and construction industry. Sean has presented at Autodesk University and many local user groups. As a technical consultant with Autodesk, he provided training and implementation for firms throughout North America. He has a B. Arch. degree from Roger Williams University, and currently resides in the scenic Pacific Northwest.

Sean’s blog, “Paradigm shift” (http://www.seandburke.com/blog), explores the trends and integration of Revit and sustainable design.

For more information visit: http://www.seandburke.com. He can be reached at: web@seandburke.com.
Cross-Discipline

by Scott R. Womack AIA

Revit Documentation & Detailing

Whenever new technologies have been largely adopted in our profession, there are the inevitable issues that arise surrounding this change. We have all experienced this. Being old enough to have spent the first 3 years of my architectural career drawing by hand, I have seen several major shifts in the workflow occur in our profession. For example, fax machines beginning to show up in construction trailers, then email, and the resultant changes in the speed of communications between the field, and the firm that occurred. Though similarities exist BIM/Revit is a much larger shift when compared with the transition from hand drawing on the boards to CAD.

Virtually every firm that has adopted new technology has battled similar issues. You can substitute changing from Hand Drafting to CAD twenty years ago, many of the same issues were raised then. A few of the more common complaints I have heard and read surrounding the adoption of BIM by the A/E community are as follows:

• The drawings do not look as good as what the firm has developed using CAD.
• Revit cannot do so many of the things that our Lisp/Excel modified AutoCAD can.
• Things seem to get missed or not corrected when a large number of staff are “thrown” at a project late in the CD phase.
• It takes more hours to produce working drawings than it did in CAD.
• Can’t I just use the AutoCAD detail library I already have in Revit?

Trying to address all of these issues is beyond the scope of this article. However, just as the early days of CAD and the development of layer standards for example, there is an investment in time/effort that needs to be made to try to mitigate at least a few of these issues.

WHERE DO YOU START?

A library of families, schedules and other procedures needs to be developed to aid the Revit documentation process. Once some of this investment is made, and the gains in productivity and quality are seen, it gets a little easier to see where your efforts can best be spent.

Of course not all items provide the same amount of benefit to every firm. The type of practice you are in, the level of “Revit” knowledge your staff has, as well as the level of commitment a firm’s ownership has in the Revit process can affect these issues as well. Let’s start discussing some of the ways to improve both the appearance, and the quality of your Revit documents.

There are several items, that in this author’s personal opinion, should be learned and used to improve the construction documentation process from Revit. These items listed below are the cornerstones to saving time in the documentation stage of a project.

• Create “Working Views” for users to work in as they model elements, instead of modeling in the Sheet views.
• Create different types of Building and Interior elevations, Roof, Ceiling, Wall, and Floor Detail Marks
• Create Filters for the various view types, various worksets, and other combinations of things you’ll want to control the appearance of.
• Create and Religiously use View Templates on EVERY view that goes on title blocks. The settings above can be quickly be applied to multiple views at one time using View Templates
• Use the Drawing List and View List features of Revit
• Develop all sorts of schedules, even if they will never be shown to contractors or clients.
• Model as ACCURATELY as humanly possible!

**VIEWS**
The first item on this list seems easy. However, long term users of AutoCAD had it strongly ingrained in them to make those views they needed to work on. This was especially true if they are old enough to have drawn production work by hand. A majority of the partners in mid to larger sized firms fall into this category. Our working views, especially of plans, have a user’s initials in the view name, as shown in Figure 1. We find it has tremendous value since the user can alter the display settings anyway they want and know they are not inadvertently altering the display of the views on the sheets. (See Figure 1)

Creating more elevation/section view types means that you have more control over them in the Project Browser because each type has its own branch. Visibility/Graphics through the use of Filters in 2010 permit us to selectively display certain annotation types. View templates provide the icing on the cake because these allow us to apply consistent settings across many views. Many people waste a lot of time just because they haven’t taken time to understand View Templates.

**SCHEDULES**
Any task that requires me to spend time to calculate, report, and coordinate information repeatedly during multiple phases of a large project are my primary targets. Also, the greatest number of man-hours spent in a project tends to be in early design phases and then in the detailing and wall sections of a project. We have developed several schedules (see Figure 2) and key schedules to help eliminate some of the repetitive tasks we experience. One kind is used to calculate the egress capacity of a building based on area plans, gross square footage by floor, and in total. We also use them to determine the code required number of toilet fixtures required for a given group of buildings.

**COMPONENTS/FAMILIES**
One area that I have personally spent a fair amount of time on is developing families, both model and detail components.

**MODEL COMPONENTS/FAMILIES**
For example we have concentrated on Toilet stalls, essentially taking the out-of-the-box families and taking them to a higher level of information. Our toilet stalls have a toilet, grab bars, and other toilet accessories nested into each stall as shared families. In this way, in a gang toilet room, when a stall is placed, all of the other items get placed at the same time. We set the visibility of the majority of the toilet accessories to be visible only at Detail Level: Fine. The Grab bars are visible at Detail Level: Medium. The enlarged toilet room plans are set to Detail Level: Fine and, by judicious use of the Tab key, each can be tagged. They can be scheduled as individuals because each nested component is Shared.

We are developing a portion of a two-wall chase, and the stalls/fixtures on both men’s and women’s sides along with an invisible line at the minimum distance from stalls to sinks/counters as a group (see Figure 3). This can be loaded into an early design as a group, moved, and manipulated, and then when the design settles down, ungrouped for final manipulation, tagging and dimensioning.

**Figure 3- Group showing chase walls and toilet room concept**

Another set of families are our doors. All of them have the ADA/ANSI clearances on both sides of the door. Both side, and frontal

**Figure 4- Door family showing accessibility clearances**
Cross-Discipline

approaches can be toggled for each side of the door independently, as shown in Figure 4. This saves time, dramatically lessens code/ADA clearance issues, and aides our Interior Designers in their casework and furniture work as well.

DETAIL COMPONENTS/FAMILIES
We have developed a significant numbers of families Detail components (see Figure 5). They allow us to fill in the details, for the type of projects we produce, much faster. Creating a series of line-based detail components, to more quickly "fill" in the detail on top of Revit’s cut sections and enlarged details, allows us to save a significant amount of time. Not to mention making the drawings look better graphically.

Figure 5- Project Browser view of Detail Components

Several of our metal stud detail families have the GWB on both sides of the studs, have an adjustable width, and have top and bottom tracks that can be individually turned on or off (see Figure 6). The back side of GWB, can be turned off on an instance basis by the user to make a furred wall or one side of a shaft wall. The user can also, by using a simple check box, turn on a deflection track at the “end” or top of the studs as well. (see Figure 6)

A wide variety of detail families like, metal stud openings, masonry veneer anchors, CMU units, brick, etc. are then used to create repeating details to also aid this detailing/documentation process. This also provides a potential upgrade in the appearance of our documents, while saving time. See Figure 7 for a typical wall section view using these detail families.

FINISHING TOUCH
Setting standards for Left and Right justification of text on sections and details will also assist the users. WTW Architects uses a True-Type font that looks more like hand lettering to maintain some "style" in their drawings. Put all of this together and you should find, as we have, that documentation and detailing with Revit will provide what you need as efficiently, if not more so, than the software you have been using (see Figure 8). This coupled with the other virtues of Revit and BIM just reinforce the motivation to undertake this change in process.

FOR YOUR USE
My firm and I have provided the following for you to download and examine (Version 2010):
- Metal Stud Plan - Line Based.rfa (family)
- Metal Studs-Section w Gyp n Tracks.rfa (family)
- Door Illustration.rvt (project file)
- Toilet Stalls.rvt (project file)
- Sheet A-3-3 Wall Sections.pdf (sample of complete sheet)
We encourage you to take the next step and focus on improving your documentation and detail processes.

Scott R. Womack AIA, NCARB - Scott first began using Autodesk products for production in 1985. In the ensuing years he has used AutoCAD in Dos, Sun Unix, and Windows operating systems, 3D Studio Dos, 3D Studio Max, Architectural Desktop and then Revit. During those years he has produced K-12 school projects, both corporate and themed retail work including complete mall renovations, as well as collegiate buildings across a total of more than 12 states. More recently, he has used Revit to create documents for elementary education, retail, and collegiate work. The vast majority of his experience has been in the multiple prime, public bid arena. He has also been an independent trainer for 3D Studio Viz, and 3D Studio Max, as well as having taught visualization classes at Autodesk University for five years. He is one of the founders of the Steel City Revit User's Group. He is a graduate of Kent State University with bachelor’s degrees in Architecture, and Fine and Professional Arts. Currently he is an active project manager with WTW Architects in Pittsburgh, PA. doing primarily collegiate work. He is beginning the implementation of e-Specs.
Custom Content in a BIM World

When CAD first entered the world of building design, it came with no special layers or blocks. Any firm that used CAD had to create standards, procedures, shortcuts and content of their own. These standard details, blocks, styles, templates and lisp routines have become woven into the fabric of most every firm’s culture, style, and mission. Treated as company secrets, some firms use PDF and DWF formats to protect their drawing files. They encrypt drawing files and lisp routines. There are contracts, copyrights and disclaimers to discourage duplication. The number of firms that create and market CAD specific content show the value of custom content. Thousands of pieces of pre-created content are available on the web for sale. There is no shortage of consultants and resellers ready to create custom content, program, and implement CAD software for a price.

BUILDING INFORMATION MODELING (BIM)
However content is attained, the investment of time, money, and effort, does not lend itself to sharing it. This has been the case since design professionals first started using CAD. Twenty-five years later, the building design industry is embracing Building Information Modeling (BIM) and Integrated Project Delivery (IPD). These processes require universal access to the same types of content we have spent decades lovingly protecting. The industry now finds itself in a place where we must evaluate our long-standing tradition of secrecy. We must quantify what the value of our content really is, and if it is better to hold our content for individual gain or share for a combined gain.

OWNERSHIP
Legally, is a lisp routine, a wall style, or a Revit family, intellectual property? If it has been sold, the exclusive rights do not transfer. It would be difficult to find a firm that sold CAD content of any kind, which did not sell it over and over again like music downloads. Songs, like most CAD content sold, are governed by a license agreement. Typically, the purchaser gets full use of the product, absolves the seller of any burden from its use, and agrees not to resell the content. Music files can have protection that prevents excessive copying and reselling. This should sound very familiar to anyone who uses Autodesk software. For now, the real intellectual property has always been the design itself. Firms have copyrighted designs but not AutoCAD blocks.

WHAT ABOUT NOW?
Could BIM data be different? Would it make sense to license BIM data for use by the design team? Charging for something that has been free for so long would not inspire many to pay for it now. Beyond that, the BIM process requires that data be available and used throughout the life cycle of a building up to and including its demolition and the reuse of its land. The practicality of licensing CAD or BIM content can be analogous to licensing a Word macro. No matter how long it took to create, or the mind power invested, the macro is a function of Word. Only the actual text can be protected by copyright. At present, the software we use is licensed to us and the designs we create are protected. The content we create within that design is simply an efficiency.

Unable to profit from selling content to design partners, most firms believe the efficiencies gained by their custom content will outweigh any profit generated by selling that content to the competition.

CONTENT SERVICES AND RESOURCES
There are companies which specialize in selling CAD/BIM content, and their numbers are growing. Turbosquid certifies and sells user generated content ala cart for $3 to $20 a piece. Formfonts 3D sells content through subscription for fees around $199. Andekan sells manufacture specific content, like their US Plumbing Starter pack, for around $3999. They compete with free services like RevitCity.com and Autodesk Seek. RevitCity.com is a site that enables users to post their content or find other user generated content. Autodesk hopes that Autodesk Seek will become the de facto gathering point where manufacturers can post up their own information-rich content. Manufacturers have a vested interest in supplying free content to anyone who might spec their products.
Autodesk Seek recently partnered with Turbosquid to offer Revit Market, which claims to currently be the world’s largest online marketplace for generic Revit content. With all this content floating around in the market; Michele Bousquet, Director of Marketing for Emerging Markets at Turbosquid says, “We are not concerned about the content market reaching a saturation point. There will always be advancements in design software, and new content must be developed to incorporate changes in an evolving market. Turbosquid continues to grow after nine years of selling content for a variety of software products.” Vases, trees, bottles and candles are their hot sellers right now. They also see growth in families, which have great textures and interesting features for rendered images.

SHARING PITFALLS?
The open exchange of CAD/BIM content often raises a concern of liability, with the expectation that content must be shared in a BIM process. What if the content used, no matter where it came from, gets misinterpreted down the line? What if a W20x35 structural column is called out in the construction documents, but the modeled content itself is a 3” pipe? A wall style made in AutoCAD Architecture could be used to represent a sidewalk in a design. A general contractor querying that job for wall materials would receive inaccurate data. Dimension strings have often been changed at the last minute without changing the object they refer to, and drafters are told to “just make it look right”. Today’s content has the potential to expose our shortcuts and confuse matters even after the building is complete. Autodesk itself has not addressed the protection of AutoCAD Architecture, AutoCAD MEP styles or Revit families. So far, no 3rd party protection solutions have come to market.

LEGALITIES
The contracts and expectations of BIM projects continue to evolve. The AIA 202 document can dictate levels of development at each phase of the construction process. It leaves room for the use of a design model and a construction model. The design model would contain generic content used for pricing. The construction model would contain specific content like an as-built. In that situation, design professionals could deflect legal complications due to misinterpretation of custom content. The legalities of any job depend upon the contract; however, time lost, and confusion on the job, will always lead to increased expense.

EXCLUSIVE OR INCLUSIVE?
Even with the use of separate design and construction models, design professionals are left with a conflict. Our custom CAD content has been an investment; we cannot protect it once it has left our office. More and more, we are asked to share our content, with the expectation that we will be held accountable for its accuracy. When the BIM Board of Omaha (BIMBO) was asked about sharing custom content, BIM managers from firms including Alvine and Associates, HDR, Leo A Daly, Merrick, RDG and Schemmer all agreed that custom CAD content on its own holds very little value. It does not transfer well. It may be reverse engineered but not used directly. It can often be unusable because it is detached from its environment of origin. No matter how great content might be, it is not likely to be stolen or even used “as is”.

FOCUS ON THE PROJECT
In the end, it doesn’t matter how useful our custom content is, it won’t make us any more creative, it won’t listen to our clients, it won’t establish relationships and build trust, it is only a building block in our designs. Custom CAD content is essential to our business, but it hardly defines it. Letting it go may be difficult, but we may find that putting the focus on our designs, our projects, instead of on our content, frees us to do what we do best.

Resources: (mentioned earlier)
- Andekan: http://www.andekan.com
- Autodesk Seek: http://seek.autodesk.com
- FormFonts 3D: http://www.formfonts.com
- RevitCity: http://www.revitcity.com
- Turbosquid: http://www.turbosquid.com

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VIDEO LEARNING KEEPS GETTING EASIER
I’m not sure about you, but I love watching movies, often for entertainment. My wife usually manages our Netflix queue, which consistently has 300+ titles on it, and I’m piling up more as I think about what I want to see. Occasionally, I like learning new things by watching videos. There are so many providers out there, and as I mentioned earlier, Autodesk now has there own YouTube channel, but then again who doesn’t? You can even watch previous years’ Autodesk University classes online at au.autodesk.com.

Also, for those that are interested in learning Ecotect, I’ve been pointing them to the training packages available for download (see image to the left). These really give the student a head start, and when I come in to provide training, we can cover in-depth the topics that matter most to them.

Which brings me to my own efforts to reduce communication barriers through the use of free video clips, as in the past three posts. I’ve been posting on YouTube and Screencast.com. My reason being: they both have their strengths. Screencast.com is much higher quality...

Subscribe to paradigm shift at http://www.seandburke.com/blog/
After BIM Implementation
Improving your skills well into the future

I don’t think anyone would argue that software training for your team members is an integral part of a successful BIM implementation. Jumping right in on a real project without any form of guidance, is not only a bad business decision, but also project suicide.

In the last issue of AEC Edge, Cyril outlined his “Train the Project” system, which enables you to get your team members up to speed quickly, while focusing on real projects. The benefits being that you’re able to keep your project’s billable time to a maximum and moving forward.

But where do you go from here? While completing your first few projects is a reassuring comfort, you can be guaranteed that your processes and office standards can be improved upon, and new modelling and documentation techniques will be required as you move onto more complex projects.

The ongoing development of user’s skills is just as critical as the implementation itself. If users don’t understand how to gain the most out of the product they use daily, then they are unable to perform at their maximum potential.

Over my many years of using Revit, and my past roles as office CAD/BIM Manager, I have developed and discovered from other BIM users, different techniques for training and delivering new BIM information to my team members. Some of these techniques can be directly beneficial for yourself, while others are aimed towards you being the ‘teacher’ and training your team members.

Whether you’re a company that is still new to BIM, or are looking for more advanced methods of up-skilling users, I hope that you might be able to find some, or even all of the following suggestions useful. I have broken the tips down into three categories; BIM Consultants, In-House and Self-Paced.

BIM CONSULTANTS
Following on from the BIM implementation and pilot projects, you probably already find yourself in a good relationship with your BIM consultant. If this is the case then there is nothing wrong with continuing to use their services. Considering that they have already spent numerous days or even weeks involved with your team members on real projects, they already have an understanding of your individual user levels, your projects, and any company office CAD standards you have in place. So it makes sense that they already know how to tailor their own experience toward your specific project needs.

By this stage, the users should already have a greater understand of the software, to be able to identify troublesome areas of the project, and also question where they think improvements could be made. It’s a good practice for each user to get into the habit of keeping a log book at their desk to document these issues.

Organise one or two sessions each week with your BIM consultant for the next few months, so they can guide you through the issues from your log books. It’s also advisable to email them your issues a few days in advance so that they have adequate preparation time. Using this method you will find that you are having more focused training sessions, which will result in training that is far more cost beneficial. Over time, your skill level should go up and the reliance on the consultant will go down.

Naturally, there will be users who will absorb the concepts of BIM and the software tools much quicker than their team members, and their reliance on a consultant will diminish rapidly. It is these users, possibly even yourself, that the rest of this article is aimed towards.

IN-HOUSE OFFICE MEETINGS - THE MINI “USER GROUP”
Once at least 50% of the users are up to an intermediate skill level, office meetings are without a doubt the most effective training method that I have used. At this skill level, users are starting to think about advanced techniques but typically don’t know how to
tackle them. So why not pull the team members together for an official office networking session.

I would recommend getting together at least every one to two weeks, in groups of no larger than a dozen. If you have more than a dozen users, then you might want to run multiple sessions back-to-back, then collate the information and distribute back to the users. But more on that in a later section.

Here are some tips for your office meeting:

- Try to keep the meetings structured, and 1 to 1.5 hours long. Attention spans start to wander if you go any longer.
- Get each user to submit to you one issue a few days in advance, so that you can plan the meeting and provide a solution on the day. Once again, these should be recorded in their log book.
- Get the users involved. If you are fortunate enough to have a boardroom with a large size monitor or flat screen TV, make the most out of it by hooking a PC into it. A wireless keyboard and mouse is also great for passing around the table.
- Have the users each bring one new tip they have learnt since the last meeting to present to everyone else, no matter how insignificant they may think it is. Chances are there will be at least one user who won’t have heard it before. I’m always amazed at how often a single user tip will spark further discussion, and before you know it you will have a newly discussed technique that no-one in that room had thought of before.
- As the meeting organiser, you should try to bring an advanced tip along. Your role should be to make sure that each user walks away with learning at least one new thing.
- Make it compulsory attendance. This way no team members miss out and everyone is working the same way.

The office meeting is also the perfect place to announce new features for a new software release. Focus on the features that you see as being advantageous to the company and spend some time discussing them in detail, while leaving the less important features as just footnotes. You also don’t want to overload the users with too much information at once.

During the meeting, it is recommended that you take notes so that you can write minutes of the meeting to distribute back to the attendees. Maybe even gloss it up a bit in the form of a newsletter, and also throw in an article about a BIM project you may have come across on the internet.

Group BIM training in this kind of environment can be quite a rewarding experience in being able to pay-forward your experience to new users. Add to that, while you may think you know everything there is to know, you don’t! You will be amazed at the additional small nuggets of information your ‘students’ will teach you.

THE KNOWLEDGE BASE

When you go to all that time and effort to organise your office meetings, the last thing you want to see is that information forgotten. You need your users to have a centralised location to freely access past discussions. Here are a couple of suggestions;

1. Server Folder Structure
   Possibly the simplest method. You will most likely already have a folder on your server that has the company’s CAD/BIM standards documented, so why not keep the training documentation nearby.

2. Content Management System (CMS)
   This method is definitely for the more technically skilled. Most CMS’s will be accessed through a web browser. Users can have a login profile so that they can provide their own content for everyone in the company to view. A lot of good CMS’s will also have wiki and forum features to promote further internal discussions.

1.0 SELF-PACED

Software Documentation

As an example, the tutorial documentation that comes with Revit would have to be some of the best that I have ever come across. New users should be offered the time to go through as many chapters as they can.

From a training perspective of new users, I find sitting them down with the tutorial book for one to two days straight will get them up to speed pretty quickly with the basics, and
usually with minimal interruptions to you. After the two days, you and any of the other experienced Revit users in the office, can mentor them for the next few months while they are working on real projects until they become comfortable.

This training technique works best if you already have your BIM system implemented with standards documented, and have the more experienced users as mentors. This way the new user can concentrate on their project, rather than questioning if they are going about it correctly.

Tip: One thing a lot of users don’t know is that Autodesk provides free printed documentation for each software license; http://www.autodeskdocandmedia.com/. Try ordering one or two books for your entire office to use. It’s much easier to go through tutorials from a printed media than reading from a monitor.

[Editor Note: Recent changes within Autodesk and their ongoing effort to reduce paper consumption may have affected the validity of this tip by press time.]

Demo Mode
If users are willing to do extra learning outside of business hours, and if your BIM software (such as Revit) supports a ‘demo mode’, give the user a copy to install at home. Being able to practice and not save, is far better than nothing at all. All software is different, so please read the licensing agreement for your particular product.

Diversification
If users are still in search of more learning information, then there are more public avenues that can be explored. Large national events such as Autodesk University (U.S.A.) or the Revit Technology Conference (Australia) will provide you with a wealth of focused BIM topics. With plenty of likeminded software users, these are events that should not be missed.

Why not use these events to send one or two different users each year from your company. When they return to the office, ask them to give a presentation about what they learned at your next office meeting.

Since you’re reading this publication, then you already know about AUGI, but there are other great resources such as Autodesk’s own Discussions Groups (http://discussion.autodesk.com/forums/), and the multitude of BIM focused Blogs that are around on the internet.

And finally, look for a local User Group in your area. Taking one evening out of your day every month or two to attend isn’t that big of a task, especially if you are unable to make it to the larger national events.

In my experience, I have used all the training techniques above, and have found them all to be useful in some way. You might find that only some of the techniques work for your company, but you won’t know unless you explorer them.

The key question that you now need to ask continually is; “What is it that your company is able to do to expand your collective BIM knowledge?” Be sure to search out or even create your own processes in order to help keep that thought progressing.

BIM Strong!

Chad started in this industry working for Spaceframe Buildings where he primarily designed industrial and commercial projects. It was during that time that he found an interest for CAD Management, which ultimately led to BIM Management and the early adoption and implementation of Revit. More recently he worked for Mirvac Design documenting low-rise residential and helped with leading their national Revit implementation strategy and standards. He gets great satisfaction out of helping others learn Revit and the realizing benefits gained from using BIM software.
Sustainable Parametric Objects
A Professor’s Challenge

BACKGROUND
The transformation of computer aided drafting (CAD) to building information modeling (BIM) was enabled by the development of parametric objects, 3D components that have parameters that can be edited on the basis of their type and associated with non-graphic data. These objects were initially simple items like boxes and spheres. Then architectural components such as doors, windows, staircases, and trees could be assigned properties, and currently 3D geometry with sophisticated user defined attributes define building information modeling. It is no longer just the lines on paper or vectors on the screen that describe the building, but a database of spatially connected parts, with varying degrees of intelligence.

Concurrently, there has been increased sophistication, accuracy, and user friendliness of software available for analytical modeling including, for example, sun paths and shadow calculation, structural engineering, day lighting and energy predictions, ventilation and wind studies, collision detection, and cost estimation. There has been more demand and ability to provide a better integration between geometric and analytical models, to develop a “complete” virtual building that contains the necessary information to describe the digital building in graphic and non-graphic methods that allow for predicting the building’s behavior in the real world.

Combining these two technologies, parametric modeling and performance-based calculations, BIM has the opportunity to enhance processes and enable architects and engineers to explore many concepts early in the design process.

DESCRIPTION OF COURSES
The University of Southern California has many courses in architecture and engineering that explore BIM, analytical modeling (such as energy and structural calculations), and sustainable design from a variety of viewpoints. Two courses specifically about BIM that used Revit were taught in the spring semester of 2009. The introductory course was designed for second and third year students. It emphasized 2D/3D coordination, introduction to families, and a smattering of environmental design tools that demonstrated interoperability between software programs: sun path diagrams, day lighting prediction, and simple energy calculations.

The second course is the focus of this article. It was taken by upper division undergraduate and graduate students. Assignments were given for many aspects of using Revit including massing, modeling, sheet layout, rendering, animation, schedules, phasing, detailing, and families. Several components of the workshops in the Autodesk Sustainability Curriculum could also be completed by the students for additional credit. Guest lecturers by architects, construction managers, and BIM experts complimented the course.

The most interesting assignment focused on creating relationships between families and sustainable design issues. The students were required to develop their own Revit families. Many suggestions were given as to the kind of parametric family to create including very simple, geometry-only objects to those that did simple calculations. This assignment was not about file exporting through gbXML or IFC, but focused instead on what could be done inside of Revit. Examples of potential families were given and an overall description provided. We encouraged them to explore with the statement that complex families would be worth more points than simple graphic families.

For example, making a recycled paper bin with the recycle logo on it will get you minimal points. Formulas, useful Revit reports, and appropriate parameters help to produce a more interesting and useful Revit family. For example, creating a solar panel that can resized (and has a library of standard types) as well as calcu-
Cross-Discipline

lating how much energy it produces is a more complex and useful family. Useful reports might be items like water usage (you create a low water toilet and occupancy chart based on building type) or potential day light factor in a room (based on window orientation, square footage, and chart of daylight during the year) or water harvesting potential of roof surfaces. Other ideas that were discussed in class, but not implemented, included developing families that did partial calculations that could be sent to other analytical modeling programs or exported for further development in a spreadsheet template.

CLASS PROFILE
There were twenty-four students in the class, predominately from the School of Architecture: two 4th year B.Arch., eleven M.Arch., 8 Master of Building Science (MBS), two construction management students from the School of Engineering (one undergraduate and one Master of Construction Management), and one USC staff member. We chose six of our students’ projects to summarize for this article. The featured students are: Joe Garcia and Ulises Gonzalez (4th year B.Arch.); Lei Fu, Kenneth Griffin, and Ryan Hansanuwat (MBS); and Victor Asperez (staff).

STUDENT EXAMPLES
As is typical with student homework assignments, the results ranged from simplistic to interesting, from “the family doesn’t work” to “this is an excellent idea.” Their submissions included the following concepts (there were duplicates): solar panels, rainwater collection tanks, operable louvers and sun screens for window shading, bike racks for LEED points, low-E and dual glazing window specification, recycling bins, solar hot water heaters, wind turbines, light shelves and skylights, roof ponds, mechanical air handling units, green roofs, Trombe walls and straw bale construction, solar powered radiant floor, low flow toilets, and “compost bins + easy LEED Revit families points.”

Caveat: not all features of all the families work properly! The descriptions for the families are partly derived from the students’ own written descriptions, which may be overly optimistic or even wrong. This problem is discussed further in the summary.

In addition to other objects he made, Joe Garcia created a non-hosted residential recycling bin family (figure 1). It is a good example of using simple parameters: Length, Width, and Symbol Width that relate to each other and then is used to calculate Recycling Capacity.

Lei Fu’s solar water heater (figure 2) is a bit more flexible. It includes a tank and tank-less option, helps users decide the correct angle to install this device based on latitude and roof slope (when the roof slope is less than the latitude), and gives an approximate value of how much money might be saved compared to using an electrical hot water heater.

Several students developed wind turbine families. In Ulises Gonzalez’s version, some of the applicable parameters were fin length, height, air density, and wind speed, and the power generated in watts was the final result along with the 3D turbine (figure 3). Kenneth Griffin created a hybrid system combining a turbine and photovoltaic array that could calculate the total wattage of power generated by both solar and wind power (figure 4). This is his description of the final project:

“This family is used as a component and can be placed on any ground. I used a lot of formulas all based off of the wind mill height. As the height increases the hub increases in size, the front radius of the hub uses the formula height/60 and the back radius of the hub is the front radius of the hub/5.”
As the height increases the blade width and length increases using the formula 0.3 * Height. Solar panels are supported by a steel beam at the midpoint of the wind mill cylinder. The size of the solar panel width is based on height/10 and its length uses the equation height/5.

Keeping both the wind mill and the solar panels constrained was difficult. The Solar panels consisted of a different pieces thus it need to be locked, constrained, and dimensioned many times.

The equations I used for the wattage generated for the wind turbine and solar cells were found online. The Power wattage for the wind turbine is determined using this formula:

\[ \text{Wattage} = \left( \frac{\text{Collection Area}}{1 \text{ SF}} \right) \times (\text{Wind Speed in MPH}^2) \times 0.0054. \]

The wind speed can be entered by the user depending on their desired conditions.

The photovoltaic cell’s equation for wattage of peak power is:

\[ \text{Watts per Square Foot} = \left( \frac{\text{Solar Panel Area}}{1 \text{ SF}} \right) \times \text{Solar Cell Efficiency} \times \text{Solar Radiation Watts per Square Foot}. \]

The solar efficiency is based on what type of solar panels the user wants and the solar radiation is also up to the user based on where the sun is located and how much sun is hitting the solar panels. Another equation for the solar panels is Watts per square foot. The user enters whatever watts the solar panels use and divide it by the area of both solar panels.

One last feature I really tried to make work was the user entering a latitude, which is also the solar angle, to change the angle of the solar panels. I was not able to constrain the parts properly to keep the solar panels together in time to submit my work.

Victor Asperez designed a mechanical air handler (AHU) that would meet the intent and requirements of energy optimization for LEED – New Construction V2.2. Simple dimensions about the building are entered and using average allowable envelope loads based on respective exposure and general allowable fenestration percentages by Title 24 (for example, 60.5 for the south exposure). Next the number of people, lighting densities, number of floors, and the total building loads will provide the total building load divided by the total building CFM required in cubic feet per minute and compared it with the general Title 24 allowances. Other parameters for the AHU are calculated, for example the AHU Height is driven by total CFM to be delivered. It is generally a good practice not to exceed a velocity of 500 FPM across a cooling coil. The formula to evaluate this is:

\[ \text{AHU Height (in feet)} = \sqrt{\left( \frac{\text{Grand Total Building CFM Rqd.}}{500} / 4 \right)}. \]

Dimensions are also calculated for the return air ducts, outside air ducts, supply air ductwork, and mixing length, and constants are supplied for fan, coil, filter, and discharge, lengths. This family is not designed for complex calculations, but instead acts as a planning tool for understanding the gross requirements for air quantities and dimensions of equipment (within Title 24 boundaries), when making early decisions on a building in terms of size and exposures.

Ryan Hansanuwat’s project submittal was entitled “Compost Bins + easy LEED Revit Families Points.” He created six families that could help in LEED accreditation.

1. These are a set of recycle bins with labels for paper, cardboard, glass, plastic, and metal (figures 5 and 6). It helps satisfy the requirement in the LEED NC Rating System, MRp1 – Storage and Collection of Recyclables.
2. This a design for a bicycle storage rack (figure 7). It is based upon the LEED NC Rating System, SSc3.3 – Alternative Transportation – Bicycle Storage & Changing Rooms. The user adds the FTE occupants; it calculates the number of bikes, length, bottom length, and number of bars.

3. This is a set of marked parking stalls for alternative transportation to satisfy the LEED NC Rating System, SSc4.3 – Alternative Transportation – Low-Emitting and Fuel Efficient Vehicles (figure 8). This simple family creates stalls in an array based on 5% of the total parking capacity input by the user; it provides graphics for priority parking for low-emitting vehicles or carpools.

4. This is a low-flow water fixture that fits within the LEED NC Rating System, WEc3.1,3.2 – Water Use Reduction (figure 9). The requirement for this credit is to document a 20% or 30% reduction in water usage as compared to a baseline calculation. The number of Full-Time Equivalent (FTE) Occupants is calculated by the number of standard uses a day multiplied by the efficiency of the fixture. The USGBC standards set a water closet for females at 3 uses per day, and for males 1 use per day. The family is designed so that the designer enters the known number of FTE Occupants and the Fixture Efficiency into the instance parameters for each water closet. The final result is Total Water Usage which can be compared with the baseline calculation for this credit.

5. This a 2D representation of a smoking area to meet the requirements of LEED NC Rating System, EQp1 – Environmental Tobacco Smoke (ETS) Control (figure 10). The purpose of this credit is to reduce the amount of exposure for tenants to tobacco smoke. The credit requires that any designated smoking area be placed 25 feet away from any building entrance, outdoor air intake or operable windows. The family creates a dashed rectangular area with the text “Designated Smoking Area”. The size of the designated area can be modified using the “Length” and “Width” instance parameters. The smoking area family has two graphical op-
6. This an individual task light that can meet the requirements of the LEED NC Rating System, EQc6.1 – Controllability of Systems, Lighting (figure 11).

**SUMMARY**

Generally, the student projects turned out well for what they attempted to do, especially since this was the first time the assignment was given, and I wasn’t quite sure how it would turn out. Next time, I will allow for more time to develop and especially test the families. I will also encourage the students to be even more creative about their choices of what to do and how to do it. Ideally there needs to be more background information given about the calculations. I over-estimated the technical ability of some of the students. Next time we will find a suitable consultant(s) to help them derive the formulas they need for the assignment. Unfortunately this resulted in several students giving up on some of their more ambitious ideas. Producing the graphics was not an issue; what to parameterize and determining the appropriate calculations proved to be the difficult part of the assignment. Overall the students learned that building information modeling is not CAD and through the use of parameterized objects it is possible to add significant intelligence to a digital model. It also demonstrates that BIM can be used to pursue sustainable design goals more efficiently.

**ACKNOWLEDGMENTS**

Special thanks to all my students in Architecture 507, spring 2009, for their work!

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Hello, my name is Erik Egbertson. I took a meandering path from architect to my current role as an Interaction Designer in the AEC User Experience group at Autodesk. While I have been working on Revit longer than anything else in my life I find my day to day design tasks still map closely to those I first encountered while studying and later practicing architecture. Before joining the Revit quality assurance department in 2000 I was an architect in Cambridge, MA, USA. There I took a keen interest in the use of technology as a new tool in the practice of architecture. I soon gravitated to IT and CAD management, which then led me to Revit which was being developed just a few miles away. CAD had obvious drawbacks and the idea of BIM, while still nameless at the time, seemed a promising new tool worth pursuing. With the addition of Revit to its portfolio, there was a push to expand Autodesk’s capabilities in Human-Computer Interaction (HCI). The focus on HCI required new methods and tools that could fit within in a traditional design process. This seemed like the ideal time to go back to school and learn more about design that was specific to computers and software.

WHAT IS HCI?
HCl is an evolving discipline that applies design, evaluation techniques, and the scientific principles to improving the interaction between people and technology. “Human Factors” is a broader term that may also be commonly used to refer to this discipline. There are many aspects to HCI that overlap with architecture. Christopher Alexander’s A Pattern Language inspired a whole segment of interface design relating to the identification and proper use of layout and interaction patterns. It was the scientific aspects covered in HCI that most interested me. Many aspects of a good design should be supported and justified with some science and user research.

What can more science bring to design? In the Parthenon, the Greeks had a rich understanding of visual perception and manipulated their structures in subtle ways to correct for visual illusions. HCI teaches how the human sense organs produce signals and models how the brain interprets those signals. It shows how the mind can easily detect a variation within a visual pattern or decide that there is an organization of elements present based on how the elements are grouped. The latest scientific models of how human visual and audible memory work are also taught. Understanding these models of sensation and perception can ensure, for example, that elements important to a specific step in a task are given the prominence and clarity they require.

This knowledge can also ensure related elements are properly interpreted as related and the loads placed on the user’s memory are not excessive. Two other aspects of HCI education are the...
tools and processes that can be employed in the various stages of designing and evaluating a product. In the rest of this article I want to share some of these tools. Whole books have been written on each of these tools but I will give you a short description and example of how they are used in a product design context.

TOOLS AND THE DESIGN PROCESS
After receiving a new project description and requirements from product management there is often a period when more information gathering is required. If the project is well defined, such as an enhancement on an existing feature, this information gathering may be limited but more often there are gaps that need some serious use of HCI tools. As an example, imagine a project to increase the performance of the application at startup. There are many approaches to solving this problem.

One way would be to invest a lot of development time making the startup sequence more efficient (of course, this would reduce the amount of time development could spend on other features that are also important). Another approach would be to look at all the events that occur during startup and note how they affect the time. Can some be deferred? To answer this question a better understanding of what the customer typically does on startup is required.

WHAT ARE SOME METHODS TO GET THIS INFORMATION?

Interviews/Focus groups
Interviews are fairly self-explanatory but do require some skill and careful preparation to avoid leading questions and biased answers. In focus groups the interviewers are called moderators and it’s their job to control the discussion. Focus groups can lead to a very engaging discussion by utilizing the group effect where one contribution can spur another. The moderator will intervene to ensure more reserved personalities participate, prevent stronger personalities from dominating, or redirect a discussion that is digressing from the central topic.

Surveys
These can be used to get more information on a targeted subject fairly quickly without a tremendous amount of effort. On-line tools such as SurveyMonkey.com have made the preparation of a survey very simple. The HCI field has established guidelines on how to avoid biased questions and answer options. I have seen surveys used to indicate a preference between a set of potential icons for a command or to choose the desired wall join configuration. The results can help identify a clear customer preference or indicate when there is no preference. In the later case it’s a cue that the design must be more accommodating or offer a level of configuration. Surveys have also been used to screen candidates for participation in usability studies. A usability study may require participants with specific qualifications, such as their discipline, job title, architectural experience, and product experience. A study of training material may require novice users while a test of an advanced feature may seek an expert. Surveys can help ensure a design is evaluated by the broad, but targeted audience.

Observation
Trips to a customer site to perform interviews can be enhanced by using video equipment to record customers performing specific tasks and video tape them during this process— with permission of course. This video can be later analyzed to extract workflows and identify issues and problems. This practice can often uncover items that are missed in interviews or other methods. When an individual is asked what they do during a task they will tell you what they can remember, but memory is imperfect and often lacks details. The interviewees may not even remember details present in an interface because they were completely unaware of it. One example was when drawing walls in an “L” arrangement, we saw that customers always made the join the last click rather than the third click. The reason for this practice was that temporary dimensions prevented users from snapping at the join location until they started the second wall. They never complained about this and had obviously adapted a workaround, but in the video it was clearly observable.

Diary Study
A diary study involves a participant keeping track of activities by creating entries on a form using their own words. There are many types of diary studies, one of which is event-based. In this type of diary, customers are asked to record their activities as a new entry whenever a specific event occurs. For example, they could be directed to record their tasks after they startup the application. Analysis may show they typically open an existing file instead of creating a new one. Further detail may show that they typically model grids after creating a new file, but after opening an existing file they hunt for an existing view to open in the project browser.

Scenarios and Tasks
These HCI tools are used to test different designs using quantitative and qualitative testing methods with prototypes and customers. A scenario is essentially a story that provides additional context to a group of tasks that must be performed to achieve a goal. Tasks are more specific and describe actions a participant will need to perform using a specific system. Scenarios and tasks used for product testing must be written in the language of the intended user and be written in a way that does not reveal the specific steps to satisfy a goal. For example, scenarios and tasks used in usability testing should not tell the participant the specific command name or indicate which icon to click on. Here is a sample scenario, “Setting up a Cartoon Set”, that I recently posted on our “Inside the Factory” blog:

“Sharon, the project manager, has just guided a project through schematic design. It is now time to get a handle on the documentation requirements and staffing assignments. To begin this effort she identifies a standard set of plans and details as well as specific elements in the design requiring detailed documentation. (Enlarged plans, curtain wall sections, details etc.) This will be the digital cartoon set that will become the starting point for the team.”

Some tasks related to this scenario:
- Create and name several series of sheets A0, A2, A3, etc.,
- Create a cover sheet with information on the project, team consultants, and a list of drawings
autodesk insiders

- Establish a title block
- Create and name new views
- Compose the drawing sheets

This scenario and its tasks can be used to evaluate existing behavior to establish a benchmark. It can also be used to evaluate potential enhancements to the existing functionality, or completely new designs.

FLOW CHARTS
These can be sketched by hand or produced easily in programs like Microsoft® PowerPoint® or Microsoft® Visio®. The charts help visualize all the paths that need to be considered in a highly interactive design and can ensure that the desired workflow or sequence is well represented. Flowcharts can be used to indicate where there are pain points, bottlenecks, or other issues that need to be considered during product design.

CARD SORTS
These are helpful in organizing a large amount of content. Cards representing an array of items, such as menu items, commands, or content names are prepared in advance. A group of customers are then asked to place these cards under set categories (this is called a “closed sort”) or organize related items into groups and suggest their own category names. A sort may be conducted with more than one participant at a time but individual sorting sessions are more common. While the result produces valuable information about how to organize content, the process itself is also observed and comments collected to record any reasoning used in the formation and naming of groups of content. The goal is to uncover the customer’s mental model. The information gleaned from the sorting sessions is then used to ensure that content is well organized and nomenclature is appropriate and understandable.

PROTOTYPES
Prototypes are representations of a set of features at different levels of fidelity. High-fidelity prototypes can consist of configurable real functioning code that is limited in completeness yet sufficient to evaluate a design approach. Lower or medium fidelity prototypes can be made with hand sketching, HTML, Microsoft PowerPoint or special purpose prototyping tools. Paper prototypes are common very early in design because they can be created and updated quickly and used to evaluate a single design or compare multiple designs. These low-fidelity prototypes seek to visually simulate a design approach and evaluate it before significant coding is completed or even before any coding is attempted. The practice is similar to constructing a virtual or physical building model to evaluate aspects of a design before attempting to construct the real building.

USABILITY TEST
This is one of my favorite tools and a one that can be employed at almost any stage in the design process. The mantra of those who champion usability tests is “Early and often”. For those who have not yet participated in a test a session will often last from 30 minutes to a few hours during which the participant is asked to perform a set of tasks and provide feedback as they work on these tasks. Participants in usability tests may use a fully functional feature or a prototype that can range from low fidelity paper to high fidelity working code.

We have conducted some tests using paper prototypes where the user uses a pencil as a mouse and an assistant swaps out paper screens to simulate the user interface. Paper prototyping testing can be challenging if you have many user interface elements, but it often helps validate critical aspects of a design well before any significant effort is expended on real coding. When a test is performed on a fully functional feature the goal is often to establish a benchmark or validate the original design goals and functional requirements.

Our tests are recorded and later analyzed to uncover common usability problems. Every test has a moderator whose job it is to encourage the participants to speak aloud and share their reasoning as they perform the task. Care is exercised by the moderator to prompt in a way so as not to lead the user and influence their responses. A participant may say something as simple as “Hmmm” while cocking their head or furrowing their brow. This is a clue for the moderator to then ask “Can you tell me more?” What comes next is usually a gold mine of feedback about design flaws, missing features, and usability issues that we can catalog, prioritize, and improve.

SUMMARY
While some of these tools and processes have been used for years many others are new and this list could easily extend too many pages. The incorporation of these tools into the software design process should lead to more effective and usable designs. The AEC user experience group is also continually seeking more contact with customers to ensure that the features in each new release are more effective, easier to use, and more efficient. I encourage you all to participate whenever you can. A survey is available from the “Inside the Factory” blog where you can sign up for inclusion. Design in the factory is still a collaborative and iterative process that would be familiar to most building designers yet in the same way the building industry is embracing BIM good software designers avail themselves of any and all tools that can assist them in producing a more solid and usable design. The next best thing to being a designer on a building project is supporting an AEC community where you, our customers, take these products and do great things.

Publisher note: URL for Survey link above: https://www.surveymonkey.com/s.aspx?sm=aMQxsYXlntl_2fwWN58bS3zQ_3d_3d

Erik Egbertson has been involved in architecture and building technology for over 16 years. As an architect, CAD Manager, Quality Analyst and now Interaction designer, he continues to advance his career of solving AEC design and production challenges through the application and development of technology. To learn more and follow internal factory events visit: http://insidethefactory.typepad.com
You’ve seen it all: the road shows, the webcasts, and the magazine articles. You’re convinced the future of the industry is a new design paradigm. You want the ability to automate your quantity take-offs. You want linked dynamic plans and profiles. You want to attach Revit Architecture data exports for an enhanced interface between disciplines. You want to use the new design and analysis tools because you know you can do more with less! You anticipate you’ll save on your drafting costs because you know some of the drafting is now a by-product of the engineering design.

You’ve made your decision and you load up Civil 3D to leverage all this great stuff. Wow! The design tools are impressive! But wait...there’s nothing like a dose of reality to stop you... and you’ve just hit reality head-on. Your project deliverable is still a 2D drawing and it’s supposed to look like someone drafted it... Oh no! You just can’t seem to make that happen. Why? ...Styles! You need to address Civil 3D Styles...and in Civil 3D, we’re talking miles and miles of Styles. Fortunately for you, Civil 3D 2010 ships with some aid on the disk. But many people don’t know about it.

**FROM PROMISE TO PRODUCTION**

Whether you call it BIM, Intelligent Design, or Dynamic Modeling, you’ve got some expectations. The product demonstrations you saw at the road show led to an anticipation of finished quality design output, easily achieved and integrated into the workflow... and it can, once you’ve established your styles.

Let’s discuss styles for a moment. Styles are a foundational element in Civil 3D. In regular AutoCAD, object visibility is limited and primarily layer based with basic controls such as On/Off, Color, and Linetype. In Civil 3D, however, your object visibility is much more robust. You use Styles not only to control your object visibility but also to vary the object’s actual appearance. As an example, depending upon the style applied, you can display your surface object as contours, triangles, slopes, elevations, solids, invisible, or any combination of those elements and more. Styles control whether the viewed surface is red or black or grayscale or thick or thin or dashed or continuous...and that’s just the object styles.

Like Civil 3D design objects, your dynamic Civil 3D annotation objects are also style based. Civil 3D annotation objects are linked to their specific design objects and so their powerful capabilities are regulated by the requirements of those design objects as defined in their assigned style. Regular AutoCAD text objects do not possess a link with design objects and are handled differently; they can be placed anywhere, anyhow. This may seem like an advantage, but in the grand scheme of things, it’s not. AutoCAD text is static and requires manual data re-entry any time you modify your design. Civil 3D annotation objects are dynamic and update when the design does.

Civil 3D Annotation Styles determine whether your annotation objects have leaders, have no leaders, are vertical, are horizontal, are right-handed at a 45° rotation, are left-handed at 135° rotation, are stacked, are in a single line, use a particular font, include formulas or expressions, or contain any number of other necessary and critical settings.

Based on the sheer number of variations possible, it’s clear you need an effective and efficient style management plan. Inevitably, you’ll need to generate deliverables for different agencies with different standards. To accomplish this, your Civil 3D style count will rise exponentially and when it does, you’ll need a robust style naming convention to keep both your sanity and your project(s) on track.

**INCLUDED ON THE DISK**

Civil 3D 2010 ships with content to help you better understand styles and provide you a solid starting point from which to build your standard styles. When you install Civil 3D 2010, look for the Content Pack page and be sure to include the US California Content pack in your installation.

The US California Content pack, also known as the USCA Country Kit, includes a set of preconfigured Civil 3D styles and is an excellent starting point for a firm to develop their own Styles library. Even if you don’t use the included styles as-is, you can still benefit from the analysis and critical thinking used to create the USCA style naming convention. After all, why start from
The Country Kit includes PDF documentation that fully describes the USCA style name nomenclature and an explanation as to the reason for its development. There's even an explanation as to why other derivative choices were ruled out. In short, there's a lot of research you no longer have to do yourself.

I spoke with Autodesk's Civil Engineering Technical Specialist, Angel Espinosa, about the USCA kit. He told me he was surprised by the sheer quantity of the content. He described it as an exhaustive set of components which users can dissect and learn from. Angel believes the kit will be beneficial for those individuals who wish to see how a completed project comes together and should get their imaginations going as to how to set up their own projects.

The USCA Country Kit contains over 2000 Styles and a robust Template collection, see Figure 1.

But wait! There's more! The folks at CADPilot.com are the original developers and offer plenty of free resources (free registration required) to support the USCA kit, known as Jump Station 2010 on their website. You can access this content at http://www.cadpilot.com/Resources/Downloads.aspx

Civil 3D 2009 users aren't left out. You'll want to download the free Jump Station 2009 for your version. 2010 users will want to access all the free information on the website over and above what ships on the Civil 3D 2010 disk. Of significant note: The Jump Station version of the USCA kit includes a lot more content than the shipping version, about 75MB more! It's not simply a set of templates and styles. The kit contains an entire finished Civil 3D project ready for you to analyze. The goal is for you understand how styles work in an actual production environment with less experimentation so you can achieve a faster, more fully leveraged implementation.

While at the website, be sure to view some of the video archives. See Figure 2. Two outstanding videos are the “Jump Start Installation” video archive listed under “Jump Station Goodies” and the “Civil 3D 2010 at Jump Speed” video archive listed under “Free Video on Demand Training”. The former helps you understand the inner workings of the USCA style set so that you'll be able to deploy your own, if desired. The latter is an overview of new Civil 3D 2010 release which uses and features the USCA style set. CADPilot.com also offers for-fee styles in larger packages and maintenance.

Folks who wish to focus on the shipping version of the USCA Content Kit should also visit the site to view the “USCA Known Issues” page at http://www.cadpilot.com/Products/US_Country_Kit/USCA_2010_Issues.aspx. See Figure C. The page contains an explanation and solution of a known disk installation issue. That way you'll be able to leverage the entire package.

Are you going to attend AU2009 this year? Be sure to catch session CV-104-1 “I Manage 2500+ AutoCAD® Civil 3D® Styles and I'm Not Crazy”. You'll get Civil 3D Styles and Template advice straight from the USCA kit developer himself.

OTHER RESOURCES
Of course, USCA/Jump Station is not the only style set available. Visit Autodesk's Civil 3D Country Kit page at http://usa.autodesk.com/adsk/servlet/index?siteID=123112&id=7271531
Another good styles resource is your own Autodesk reseller. Be sure to contact them and see what services they have to offer. Some, such as USCAD (www.uscad.com), offer pre-packaged style sets for a fee and can develop styles sets to order for your local agency requirements. Many resellers offer Civil 3D Styles training and include style sets as part of the class courseware.

On a different note: CAD Masters offers a for-fee Standards Manager that not only manages AutoCAD Standards but also manages Civil 3D Styles as well. View the CAD Masters AutoCAD Civil 3D Style Management video at http://www.cadmasters.com/standardsmanager.asp

DON’T OVERLOOK THIS GEM

While the software itself is relatively easy to use, a full implementation of Civil 3D involves agency/user specific configuration via styles. The easy output and workflow you see in Autodesk presentations requires a styles foundation to realize. Autodesk recognizes proprietary development is needed and has provided you some assistance to build it. Be sure to make use of the included content to get Civil 3D rolling for your firm.
Civil Engineering

Making an Impression with Expressions

Civil 3D has numerous options when creating labels, sometimes the default options come up short in getting the appearance or the required information included in the label. Other than wishing the item was in the program we can use expressions to create the look and content needed. Expressions provide flexibility, controllability and extend the benefits of using Civil 3D.

CREATING EXPRESSIONS

Creating expressions is rather simple. You go into Civil 3D’s Tool-space, Setting Tab and go to the Civil 3D label type you want to create an expression for, right clicking the Expressions icon.

Once a new expression is created the New Expression dialog pops up as shown in Figure 01. The first, and probably hardest, decision in expression process is providing a name. This is because once you name the expression you can’t revise the name once the dialog box is closed. When naming the expression try to use something succinct and easy to understand what the expression does. Utilize the description to provide a more verbose explanation on the purpose of the expression. Thankfully the description and expression formula may be changed after the expression has been created.

In building the expression various tools are available and they are identified in Figure 2. The most basic is the numbers on the left side of the New Expression Dialog Box. An expression may be as simple as using a numerical value. Moving to the right of the number pad are the logical operators. When used logical operators return numerical values of 1 for true and 0 for false. Further to the right are the Insert Property and Insert Function buttons.

The Insert Property inserts information from the Civil 3D object. The properties available depend on which Civil 3D object the expression is created from. The Insert Function provides mathematical functions, including, but not limited to, geometric functions, returning the absolute of a number or the ability to use an If/Then evaluation. At the bottom of the screen is the Format result as: drop down. The format chosen determines what options are provided when adding the expression to a text component. In the New Expression Dialog Box provided in this article the result
is formatted as a Double. A Double is a special numerical value format capable of displaying accuracy to 16 decimal points. If the expression is planned to be used in a text component it is important that the correct result is chosen to make utilizing the result easier. Additional, or incorrect, options may be provided that will give incorrect results in the label.

USES
Modifying the location of label components is a good example for using an expression. For instance in a station Offset label it may be desirable for a label line to be directed away from an alignment, as shown in Figure 3.

If expressions were not used two different labels would be required, one for the left side and one for the right side. The expression used is the Offset Rotation expression in the New Expression Dialog Box above.

Expressions may also be used to hide label components. Some Civil 3D users prefer not to see the ending major station because it typically ends at an uneven number. An expression may be used to hide the last label. To do this the expression will utilize an If/Then statement to check to see if the station value matches the alignment ending station. If it does the expression will return a small value, 0.00001, if it is not it will return the value of the text height. For meter drawings the text height is the actual value, for feet drawings the text height is the height desired divided by 12, in order to convert the text height from feet to inches. The expression used and the graphical difference is apparent in Figure 04.

The expression for Q for feet drawings is below:

\[
1.486\pi * (\frac{(({\text{Start Crown Elevation}}-({\text{Start Invert Elevation}})/2)^2)* (1/\text{Manning Coefficient})^*(({\text{Start Crown Elevation}}-({\text{Start Invert Elevation}}))/4)^{(2/3)})* \text{SQRT}({\text{Pipe Slope}}))
\]

Once we have the Q expression created, the expression may be used in other expressions, such as calculating the flow velocity, V.

\[
\frac{Q}{\pi * (\text{Inner Pipe Diameter}/2)^2}
\]

Another example of deriving information from properties of Civil 3D objects is calculating the Sight Distance of a profile vertical curve. There are two cases that need to be examined when calculating the Sight Distance, S. The first case when S is greater than the Curve Length, L, and the other is when S is less than L. The expressions to calculate the two cases are below.

\[
S > L \text{ Expression: } \frac{({\text{Profile Curve Length}}+(2158/(({\text{Grade In}}-\text{Grade Out})*100)))/2}{S < L \text{ Expression: } \text{SQRT}((\text{Profile Curve Length}^2*2158)/(({\text{Grade In}}-\text{Grade Out})*100))}
\]

This example, as shown in Figure 05, is based on the State of California Highway Design Standards; some states utilize a different formula. Once added to a vertical curve label it is easy to see the Sight Distance provided by the vertical curve. Utilizing expressions within Civil 3D allows the user to extend the capabilities of the program. From controlling how label components are located to getting additional information from the labels. Expressions will help you make a good impression with your plans.

Christopher is a Civil Engineer and has spent the last eight years designing government projects as well as residential subdivisions. Before working as a Civil Engineer, Christopher worked for a General Engineering Contractor on subdivision and mining projects. Christopher earned his B.S. degree in Civil Engineering from California Polytechnic State University, San Luis Obispo. Christopher maintains and authors the Civil 3D Reminders blog at http://blog.civil3dreminders.com/.
Richmond AutoCAD Manifest (RAM) was first started in 1988 by a few people in civil engineering firms who were trying to integrate AutoCAD into their workflow. We had an initial membership of six. We have met nearly every month since then. We began meeting at the offices of Greeley and Hansen and the early discussions were about hardware requirements, training, documentation, features, workflow, and about any other topic related to AutoCAD.

WHAT’S IN A NAME?
One of the first things we needed to do was to give our group a name that would give us a catchy acronym, because every group must have a catchy acronym. RAUG does not roll off the tongue, and RAG (Richmond AutoCAD Group) did not seem appropriate. We then thought of computer words beginning with “RA” and decided on borrowing an existing acronym. The tough part was coming up with the “M” word. We decided on “Manifest”
which, according to Dictionary.com, means “to make evident or certain by showing or displaying”. It seemed appropriate.

**OVERCOMING HARDSHIPS**

Through word of mouth we grew steadily to a solid core of power users and loyal user group attendees. After awhile many of the power users left the group. We had a newsletter and a BBS. If you don’t know what that is, ask someone old. We had some great regular speakers and attendance climbed to about 20 people per meeting.

We then started to have problems. The group was rotating locations, the president was doing all of the work, the group was overrun with resellers. Everyone that attended just wanted to complain about Autodesk. Nobody was having any fun.

We did several things to help correct this. We established a free central location for meetings, a regular meeting night every month, and a more upbeat program. We started charging membership dues and had door prizes, including taking advantage of the old NFR program. At the end of the year, there was a dinner at a local restaurant for paid members.

**COMMITMENT AND PARTICIPATION**

This helped for awhile, but we started to fade again. The primary reason for this was that the president was still doing all of the work. About six years ago at the annual dinner, we had ten people show up. It was a low and the discussion went to whether or not we should disband the group. Everyone at the meeting felt the group was worth saving. The question was whether or not all of those who did not attend the dinner felt the group was worth saving.

We came to the realization that to be a successful user group, you needed active participation by a significant number of members. That night we reestablished the group and nearly every person at the meeting became an officer. In fact, we have no limit on the number of vice presidents in our group. People were given responsibility and tasks and they embraced them.

Some of the important decisions that came out of that group meeting:

- Move the start time to 5:30 PM (get people to the meeting before going home)
- Feed everyone a meal
- Establish a standard format for presentations
- Develop a web site
- Engage other members as leaders in the CAD community

This has allowed us to have a steady slate of officers and enjoy increasing membership. For the each of the last three years we have had over 40 members at our annual dinner.

**A SUCCESSFUL SMALL MARKET GROUP**

RAM is located in Richmond, Virginia. Richmond ranks about 100 in the US largest cities. This puts us in the same league with cities such as Boise, Idaho, Salt Lake City, Utah, Des Moines, Iowa, and Rochester, New York. This is a respectable size, but not even close to being a metropolis. RAM thinks that this may contribute to the long-term success of this local user group. In Richmond, nearly everything is a one-half hour drive or less to everything else. All of the engineering and architectural firms know each other. Many members of the user group have been co-workers or worked together on projects at one time or another.

The closeness of this community allows the meetings to be familiar and informal. People are comfortable sharing stories, tips, and tricks with the group. We help each other work through problems. This includes helping those that get laid off find new work. Lynn Allen commented once after speaking at our user group that our members share more information about our companies’ struggles and successes with AutoCAD than most of the user groups she has encountered. We take a lot of pride in this.

Because of our close community, we are able to grow by word of mouth. With the help of several resellers, occasional membership drives, and some excellent guest speakers, over the last 21 years we have grown to a high of over 200 members. Many groups can claim far greater numbers of members, however, we charge a membership fee and can claim 30 active members that attend meetings monthly, speak at CAD Camps and Autodesk University, maintain their own CAD Blogs, and write for professional publications. Please check us out at http://www.ramlug.org.

John Morgan is the CAD Manager for Greeley and Hansen, a water/wastewater firm based out of Chicago. He has been working with AutoCAD since 1986 as a draftsman, technician, designer, programmer, consultant, and manager. John has been a member of RAM (Richmond AutoCAD Manifest) since 1999 and was a member of NAAUG in the late 1980’s before becoming a member of AUGI. He is currently on the AUGI Board of Directors.
WHAT IF I COULD?
When I was first asked to look into AEC Exchange, I felt like I had been asked to pass through the proverbial looking glass into an entirely new world. A world defined by Architects, and Building Information Modeling (BIM).

I've spent the vast majority of my career in the world of manufacturing, where tolerances measured in thousands of an inch, discussions regarding the merits of a socket head cap screw versus a hex head cap screw, and which grades of aluminum to use are commonplace.

Now, I find myself in the architectural world, and learning to understand the details that are important to them.

Why? Architects need manufactured goods such as HVAC systems, water tanks, and appliances (among other things) for their designs. But until this time, there hasn't been an easy way for a manufacturer to pass their design to the architect.

CHANGING 'WHY CAN'T I?' INTO 'HOW CAN I?'
One of the challenges in passing information from a manufacturing product such as Autodesk Inventor to an architectural product such as Autodesk Revit is a fundamental difference in the design paradigm of the manufacturing and architectural worlds.

Manufacturers require levels of details such as the location of holes, thickness of material, and number of fasteners that are critical to their design. Without these details, manufactured designs would be extremely difficult (if not impossible) to manufacture, increasing lead times and cost if they could be made at all.

Architectural designing for BIM, however, don't require this type of detail. What thickness of sheet metal used to build an internal bracket, or how many fasteners to attach a cover, isn't required by the architect to create an accurate design or BIM model. As a matter of fact, if an Inventor model were brought into Revit, that level of detail would unnecessarily weigh down the Revit model.

Still, what would be possible if we could bring an Inventor model into Revit, bringing just the data necessary for the Architect to use? What if Inventor had a way to 'strip away the unnecessary data and export it into a file that Revit could easily use? What if BIM information could be kept in the exported model and brought into Revit?

What if the answer to those questions was... Yes?

FINDING THE ANSWER IN AEC EXCHANGE
AEC Exchange tools inside Inventor quickly remove information not required by the Revit BIM model. This simplified model reduces the 'heft' of the model significantly. In addition, information about the Inventor model required for BIM (such as manufacturer's part number) can be included to ensure that vital information is transferred from the manufacturer using Autodesk Inventor to the architect using Autodesk Revit.

HOW IT WORKS
Let's consider a designer using AEC Exchange to transfer information to an Autodesk Revit user.

We have a model, in this case a dish washer as shown in Figure 1, fully detailed for manufacturing. All components, including fittings, and fasteners are present. These details are critical to manufacture the dishwasher, and it functions correctly.

Architects using Autodesk Revit don't require the same details as the manufacturer using Autodesk Inventor. Particulars, such as how many ¼-28 screws required, for example, don't add value for them. They only serve to weigh down their models unnecessarily.

Inventor uses the following steps to create a file for Revit to use efficiently.

1. Designate the proper connection points and their type, if required, using the connector tools shown in Figure 2.

2. Shrink wrap the component to remove the details that are not required for the Revit model. The Shrink Wrap tool is found on the Manage panel of AEC Exchange ribbon tab, as shown in Figure 3.
3. Export the data using the Export Building Components tool, also found on the Manage panel of the AEC Exchange ribbon tab, as shown in Figure 4.

As part of the export, AEC Exchange will prompt for details, in the dialog shown in Figure 5, about the Inventor model. These include important finer points such as Component Type (Equipment and Furnishings, Waste Management, and Climate Control, among others), model number, and manufacturer.

4. With these parameters filled in the file is saved with the new *.adsk format.

Now this file can be made available to Revit users to integrate and spec this product in their designs. The resulting file is shown inside a Revit building project in Figure 6.
Not only that, important data that can be used to provide critical information for the architects can be brought over from the Inventor Model, and placed in the Revit schedule, as shown in Figure 7.

CONCLUSION
In this discussion we saw how a model created in Autodesk Inventor can be quickly and easily transferred into Autodesk Revit. Not only is the data transferred rapidly, AEC Exchange ensures that the information transferred is what's critical to the Revit designer.

So for this Inventor driver, I've learned to start embracing that world beyond the looking glass. I'm quickly finding it's an amazing world indeed.

ACKNOWLEDGEMENT
Special thanks to Jorge Fernandez of KETIV Technologies for lending his Revit experience. Also, I’d like to extend a special thanks to the South Coast Revit User Group (SCRUG), for inviting me to their user group and opening this new world to me.

Jonathan has a BS in Mechanical Engineering from Cal State Fullerton. He worked as a design engineer before joining the Autodesk reseller channel as an application engineer. He has over ten years experience in sheet metal design, data management, and CAM. Jonathan has certifications from Autodesk as a Manufacturing Implementation Certified Expert and is also recognized as a Data Management Implementation Certified Expert.

UPDATE BLOCK ATTRIBUTES
ATTSYNC will update the location and position of block attributes. If you make a change in the Block Editor of the location or position of block attributes, the change won't be reflected in the blocks already in the drawing. Running the ATTSYNC will make the block attributes reset to the new location of the block attributes as defined in the block definition.

MTEXT – REMOVE COLOR OVERRIDES
Sometimes people do strange things like adding color overrides to mtext. This usually isn’t a problem when using an STB to plot out, but it can be troublesome when using CTB to plot. It becomes especially hard if the color in the mtext is the wrong color and going in to each mtext to remove the color overrides can take a long time. Now this hasn’t happened to me, but the problem peaked my interest on how to create a VBA Macro to remove the color overrides.

The first thing we have to understand is how AutoCAD stores the mtext overrides. Looking in the properties window we can see that color overrides are handled by using \C4; to indicate the color and { } to determine the text the override applies to...

NATIONAL COMIC SANS DAY

Up until today I was blissfully ignorant of the font, but apparently there is a big debate between people on the web on whether or not the font should be used.

What’s your opinion? Are you for the day or for the comic sans ban.

CHANGE MANNING’S
Occasionally you may have a need to change the manning’s value for multiple pipes. Going to in each pipe’s properties can be a pain. Using the API we can change all of the manning’s value for all of the pipes in a Pipe Network.

There appears to be a bug in the API where it isn’t possible to change the Manning’s value directly. It is possible to change the value by temporarily giving the manning’s value a unit value. Once the units are set the manning’s value may be changed. Just have to remember to change the value back. The relevant code is online...

Subscribe to civil 3D reminders: http://blog.civil3dreminders.com/
Three Axioms
Toward the Zen of Revit

There are many viewpoints on how to run a successful Revit project, as well as many ideas about exactly what a “successful Revit project” is. At times it is producing a set of CD’s that when printed mimic our old CAD graphic & informational (or lack thereof) standards; at others it’s creating a 3D model that looks enough like the building that we can get fees paid; It can be a data rich BIM that incorporates many purpose built 3D building models into a complete lifecycle BIM. With these in mind, the short answer is that there are many kinds of successful Revit projects and their needs fluctuate with project size, fee, schedule, teams and project necessities, etc. Bottom line: do what is appropriate, when appropriate and do it the best way possible.

I offer these three items as a basis for creating your own list of appropriate strategies to use when appropriate:
- Plan the Work, work the plan
- Got Warnings? Got no Zen
- Organize to Realize

PLAN THE WORK, WORK THE PLAN
Just like everything we do, whether in Revit or not, the successes are usually planned well. As a basis to get Revit projects running right I start with these four steps that can help ensure you are on the right path. Whether creating content, implementing Revit or doing most anything in life!!! These concepts are useful for projects macro to micro and can relate to everything one wants to do. Autodesk also agrees with these, if you care. They describe them Assess - Plan - Create - Validate. Oh, and document each step fully!!!

ASSESS
What you have, what you want to have, who you want to be...
- what do you have now
- what do you need
- prioritize the needs
- what do others need (yes it’s good to ask them right about now)
- when is each needed

Whether creating content, implementing Revit or doing most anything in life!!!

PLAN
What will be done; when, by whom...
- what are the objectives
- what is the goal
- what do you already have
- what will you create
- when will it be done
- who will do it

CREATE
Fairly straight forward, no? Do the things you’ve planned.
- methods used
- templates used
- standards used
- what went well, what didn’t
- what part of the plan needs changing (yes adjust the plan if this is the case)

VALIDATE
QA & QC of the entire process.
- what went well
- what were the pain points
Adjust the plan for future implementations and compile into a format all can use to learn from (and replicate).

GOT WARNINGS, NO ZEN
Warnings and errors do not go away just because they disappear from the screen! I have seen the number of these exceed 2,000 and have heard of people having thousands more. My main way to keep Revit projects from going corrupt and running as fast as it possibly can, is to work with zero warnings... Yes zero.

I managed the BIM for a mixed use project consisting of 5 models, encapsulating 66,682 square meters, 22 users in 3 offices and 5 distinct 100 to 250 MB models. Now warnings did pile up a bit with that number of users, even though I checked in on them every couple of hours. The warnings would get to 150 to 250 and were beaten back to zero every few weeks. That was until the week...
of our design development submittal. The team asked me on the Monday before a Friday submittal if it was bad that there were now 850 warnings in the main project file; well my answer then, as always was YES. Unfortunately we chose not to fix the warnings that day and continue work, basically crossing our proverbial fingers, hoping for the best.

Well the best didn't happen!!! The files crashed 2 days prior to printing. No more save-to-central... very useful. It would have taken 2 people on the team about 1 day to repair the warnings previously but that was "too much time away from production" (the team thought). We ultimately paid and paid a lot more than 16 man-hours. It took about 40 man-hours of down time and loss of work, all things considered.

The solution to restore our Central file was to find one of the User Models that hadn't saved the corruption into their file. We backed everything up for paranoia sake and then deleted all other user models and their backup folders. Next we deleted the bad central model, it's backup folders and saved the only good user model as the new central. Not a bad solution, but it was time consuming since we wanted to find the most current possible good file. Twenty one people got to "do other things" for about 1 1/2 to 2 hours while the process was fixed. It was a big file remember, thus...

Use the axiom that I do - No warnings ever.

In case you're not convinced yet, another team sent a file to a remote team to work on it overnight and their first comment was that Worksets could not be implemented. Hmmm? I immediately looked at the warnings and you guessed it, there were already 172 instances of 2 warnings and not one single model element was built yet! By the way, expand those check boxes lest you underestimate the actual number of issues! Most of the warnings were from free standing, yet unbounded, rooms in the middle of a plan that were predefined per the client's program, see Figure 1. I simply bordered those rooms in a grid of room separation lines and in the 30 seconds it took me to create those room separations all the warnings related to the rooms magically disappeared. Implementing Worksets then worked again (magically) just as designed. It did take about 15 minutes in all due to the remaining 20 warnings and the amount of existing elements sitting in their template.

Still think warnings don't matter? If so please see a Revit-Psychiatrist!

ORGANIZE TO REALIZE

These items, among others, are very important and I'll discuss them here:

- Project Browser
- Content

PROJECT BROWSER

A good browser organization is key to any organized project. I like to organize the views into classifications such as Generated Views, User Views, Construction Views and then by Family & Type. It is also paramount to create, then use a good naming convention for views and sheets:

One method I use looks something like this:

For Dependent Parent Views:
C P LEVEL P1 (Construction Parent LEVEL P1)

For Dependent (Children) Views:
C ZONE A LEVEL P1 (Construction Zone A LEVEL P1)

Partial naming list:
- C Construction
- C OA Construction Overall
- C P Construction Parent
- RCP Construction Reflected Ceiling Plan
- RCP OA Construction Reflected Ceiling Plan Overall

Some others that would use a similar approach:
- FFP Finish Floor Plan
- FN Furniture Plan

I suggest, as do many, to use ALL CAPS for views that are to go onto sheets and a variation of Sentence or Title Case for all other views. If users adhere to the concept, it is quite simple to see what views are for, what their purpose is. By the way, sheets should have an organization mirroring the desired construction documentation set ordering.
CONTENT (“GOOD TIMES, BAD TIMES, I STILL DON’T SEEM TO CARE”)

That may be fine for a song lyric but not for Revit projects. I always care about and take care of content, it’s creation and management. This subject could fill an entire book, but suffice it to say, you should develop systems to standardize the creation of content like family planning templates. These are great for sketching the component and listing any necessary parameters, etc. Planning out the content will prove substantially more beneficial than simply creating content in a vacuum.

In addition to creating a predefined library of components you may want to strategize how to get components (good ones) out of existing projects and into a QA/QC review on their way to the library, as well. Devise ways to grow a useful library from a diverse array of content, both internally and externally created. There are good sources out there, just be sure to QC everything before letting users just drop them into their projects or libraries!

The right content at the right time is key! I suggest using a more limited “design” set of content that all look similar in style to one another to start projects off. Then users can swap them out when the time is right, like when the actual pieces are developed and/or deemed necessary. Consider developing standard content on a project so it can be billed for! I suggest creating your own custom modified design sets since many generic families look too dissimilar from one another for rendering purposes.

Again as with all else use the four concepts - Assess - Plan - Create - Validate - when planning content libraries as the need is huge and can get out of control without safeguards or a good roadmap.

I will leave you with these for now. I’ve got more but I don’t want to muddy their importance. I’ll share more with you in the future. Remember, using these three items can get projects and teams a long way toward finding themselves in a state of Zen within Revit.

• Plan the Work, work the plan
• Got Warnings? Got no Zen
• Organize to Realize

Art - Architecture - Technology - Ideas - These are Jay B. Zallan’s professional passions. He is a Designer, an Artist and a BIM futurist.

Jay has more than 20 years of Architectural experience and enjoys a varied & diverse portfolio ranging from High-end Custom Residential Design to large Mixed Use Development projects as well as many practice areas between. He is the Co-President of the Los Angeles Revit Users Group and one of the few people with Autodesk ICE (Implementation Certified Expert) qualifications. He currently implements & teaches Revit at Gensler. He combines his uniquely qualified insights into the creative & business process of Architecture with proven production strategies.

He frequently speaks and consults about BIM and Virtual Design & Construction. Jay presented sessions at Autodesk University in past years and he is speaking there this year too. He is a certified Instructor for Revit, AutoCAD Architecture and AutoCAD and has taught thousands of Architects and Engineers how to use and integrate Autodesk products. He has been a professional user since ACAD version 2.14.

As an Artist Jay works in a variety of styles & media, constantly experimenting with subject, concept and material. Most works are iconic, large, multi-panel mixed media works. Jay also teaches Art, Architecture & Creativity classes both privately and as a frequently invited guest instructor at the Los Angeles County Museum of Art (LACMA). Enabling, empowering and inspiring others to realize their own dreams and creative potentials beyond limitations whether real or perceived.
The Revit API
A Practical Example

The Revit application programming interface (API) is a relatively new addition to Autodesk Revit but it is growing with every release of Revit. With the most recent release, Revit 2010, it has added some significant opportunities that can be tapped into. The Revit API allows programmers and end users the ability to query data in the BIM model and do calculations on that data, allows us to create simple macros that automate repetitive tasks and allows us to create families programmatically, just to name a few examples.

As an end user that has changed from using AutoCAD Architecture to Autodesk Revit, one of the first things I became frustrated with was Revit’s automatic door and window numbering. Revit automatically assigns numbers to those elements in the order that they are inserted. They are very rarely the number that you want for these elements. My next frustration was when you change the “Mark” value of those elements you usually get a Revit warning message informing you that you have duplicate Mark values as shown in figure 1.

This is where the Revit API can come into good use. In this article I’m going to show you how we can use the API to quickly renumber door elements in sequential order using a defined starting number.

There are two ways of programming with code in Revit. One is within Revit itself using Visual Studio Tools for Applications (VSTA) and the other is using any .NET programming language external to Revit. For a more in-depth look at this refer to Matt Mason’s article in the Spring edition of AUGI AEC Edge Magazine. For this example I’m using Visual Studio 2008 and coding in Visual Basic (VB.net). Microsoft provides free “Express” versions of some of the common .NET languages at this site. http://www.microsoft.com/express/default.aspx

THE SCOPE OF WORK
The basic steps of this “Door Mark Renumber” program are:
1. Get user input for the start number and increment number for the door number
2. User selects the first door object that they want renumbered.
3. API checks the Revit Document for a door already using that Mark value. If there is swap the “Mark” values.
4. If it doesn’t find duplicate mark values set the mark value to the required value
5. Ask the end user if they want to continue. If yes, loop again, if no, end routine.

DEFINING OUR CODE PROJECT
To start programming an API add-in for Revit you need to create a project in Visual Studio by going to the File pulldown menu and selecting “New Project”. You will be presented with some standard project templates and it is very important to select “Class Library” as the template, and then give your project a name. Once that has been done you will need to add a reference to the RevitAPI.dll file for your project. This can be done by selecting the properties of the project from the Project Menu pulldown, clicking on the references tab, and then searching to your Revit Installation directory and in the folder Program you need to select and load the RevitAPI.dll file. Once this has been completed you are now ready to start coding.
WRITING THE CODE

For this project we are going to set up our API as an “External Command” that, once it is loaded, will be accessed through the Add-Ins tab, under the “External Tools” button, as shown in figure 2.

The first 7 lines of code, as shown in figure 3, set up the framework that is required for an External Command. The only part of this code that is variable is the Class name, which in this case is doorRenumber.

The next part of the code from line 9 through to line 20 is declaring the type of variables that we are going to use, and in some cases setting values for them. Lines 9 and 10 create and show a form object that is going to get the end user input of the start and increment numbers, as shown in figure 4. Once the user clicks on the OK button the code continues onto lines 12 and 13 where it sets the counter and increment values from this dialogue box.

Lines 14 and 15 are declaring two objects as Revit Elements as shown in Figure 5. These are needed as the door object selected by the user needs to be compared with the other doors in the model to check if there are duplicate “Mark” values. We also need to declare a Selection Element Set that will contain all of the selected objects (in our case just one) when we have selected the door.

Now that we have a door selected we enter into another loop which will loop around for as many times as the size of the selection “iter” which in this case is once, as we have selected only one door. Between lines 39 and 42 we do a check on the selected element to make sure that it is actually a door as shown in Figure 7. This is achieved on line 39 by querying the element.category.ID value. If it is not equal to -2000023 (which is Revit’s internal ID for a door), then it will inform the user and cancels the routine. If the selected object is a door it will set the “Mark” value from the parameter of the door object and assign it to the variable “initialMarkValue”. We need to store this value to later check against all other doors in the model.

Since we have just set “dialogeAsk.runAgain” to True, Line 24 allows us to enter a loop that is going to check whether the user has already selected a door, and if they haven’t will enter into single selection Mode within the Revit GUI. This is achieved in line 29 and then in line 31 which checks if the selection is less than one as shown in Figure 6.

Once we have the initial door “Mark” value we now need to search all other doors in the model to check if there are duplicates. We could loop through the entire model querying each object to see if it is a door and then find their mark value, but this could take a long time, so on line 48, we have created a filter object just for doors and in lines 50 and 51 we have set the variable “iter” to the door filter as shown in Figure 7. Now “iter” contains only doors. As shown in Figure 8, lines 53 to 80 loop through the contents of “iter” (which just includes doors), to check if there are any duplicate “Mark” values. Because “iter” is a Category Filter of doors, it contains not only the doors that have been inserted into the model but any door families that are loaded into the project. We need to filter through the doors just selecting the ones that have been inserted, so we can get their “Mark” value. This is achieved in line 55 by checking if the current door selected has a value in the Phase Created Parameter. If a values exists, it has been inserted into the model. If we did not do this check the next line of code would create an error as the door would not have a “Mark” value at all.
Lines 59 and 60 are doing the check to see if a Duplicate actually exists, by comparing the selected element with the counter value. Because “iter” contains all doors, we need to make sure we are not comparing the selected element with itself. Line 60 achieves this. If there is a duplicate found in the model, lines 62 to 76 swap the “Mark” values. This is achieved by first setting the door that already has the required “Mark” value to a value of “tmp”, then setting the “Mark” value of the user selected door to the counter value, then finally resetting the duplicate door value back to the initial value of the selected door.

By default when you start an External Command, Revit will process the entire command and then commit the changes to the Model once the command has been successfully completed. If we did not surround lines 65, 69 and 73 with the Begin and End Transactions we would get the error message regarding Duplicate Mark values again, as shown in figure 1. By doing this we are forcing Revit to commit the changes to avoid having duplicate Mark values.

If there are no duplicates found in the model lines 82 to 87 we simply set the “Mark” parameter to the counter value.

The last section of code, as shown in Figure 9, increases the counter by the users increment number set in the first dialogue. It then clears the selected elements and shows the dialogue as shown in Figure 10. If the user clicks on Continue the loop will run again. If the user clicks on Finish, “dialogeAsk.runAgain” will be set to false which will stop the Do While loop in line 24.

Line 100 completes the routine reporting back to Revit that the command has been completed successfully.

PUTTING THE COMMAND TO WORK

Finally to get our program to work in Revit we need to compile our code into a .dll file. This can be done by selecting “build” from the pulldown menu in Visual Studio. Depending on your project settings this will create a .dll file on your hard drive.

Next we have to add a reference into the Revit.ini file to load our Add-In. The Revit.ini is located in the program directory where Revit has been installed.

WOULD YOU LIKE YOUR OWN COPY OF THIS COMMAND?

I have posted the entire VB.net solution for this routine, on my website, for you to download and follow along. There are also video tutorials there that explain the setting up of the project, compiling and editing the Revit.ini file. www.kiwicode.co.nz/augiedge.aspx

This is just one, relatively simple, example of the many possibilities that exist when we use the Revit API. It is my hope that this article will encourage you to try using the API to your advantage in the future.

Phillip Miller has been involved in the architecture for 15 years, with the last 7 years as owner of his own Architecture Design business situated in the lower South Island of New Zealand. Phillip’s architectural design practice uses Autodesk Revit to design and document commercial and residential projects varying in both size and complexity.

Seeing a need for a more customised Autodesk Revit for New Zealand building codes, Phillip set up Kiwi Codes Solutions Ltd, which specialises in creating add on applications that integrate with Revit to help designers comply with the ever increasing demands being imposed by government agencies.

He has a deep understanding of what is required by the end user and they deliver time saving applications that benefit the end user. More information can be found at www.kiwicodes.co.nz

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**Figure 8-** Hunting for duplicate values

**Figure 9-** : Increases counter value using the Increment value supplied earlier by the user

**Figure 10-** Make a choice, continue or finish
In this article we will discuss the creation of custom content in AutoCAD Architecture (often referred to as ACA). ACA is built on top of the base AutoCAD package, this means that while it is certainly possible to migrate and continue to use existing (and often extensive) AutoCAD block libraries in ACA, in many cases, you will want to consider alternatives that leverage AutoCAD Architecture’s unique features. This article will give a brief overview of the features and benefits you may want to consider.

**TYPES OF CONTENT**

The first thing you need to know is that the term “Content” is a broad umbrella. In general, Content refers to any reusable item that you can store externally in “library” files and reuse in multiple projects. Such content offers obvious advantages for maintaining common look and feel among various projects and enforcing company standards. Under this broad definition, content items in ACA include the following:

- **Blocks**—the most familiar type of content. Standard AutoCAD blocks behave in ACA as they do in AutoCAD and can even be used to customize ACA objects. Blocks have no “awareness” of what they are. In other words, a block made to look like a chair behaves no differently than a block made to look like door. To AutoCAD, a block is a block.

- **Object Styles**—A style is a saved collection of settings applied an particular type of object such as a Wall or a Door. When changes are made to the settings in the style, all instances of the style in the drawing update automatically. In addition to the many parameters common to all styles, each type of style has its own unique characteristics appropriate for its object type. Styles, unlike blocks, do have awareness of what kind of object they are.

- **Multi-view Blocks**—A Multi-view Block (MVB) is in many ways a “bridge” between blocks and styles. An MVB simply displays one or more AutoCAD blocks under varying viewing circumstances. This gives the MVB more power than the blocks by themselves. Coupled with Classifications (see Figure 01) MVBs can be given limited “awareness” of kind of object they are as well.

**FEATURES AND BENEFITS**

Several potential features and benefits are possible for content. Having an overall understanding of the possibilities will make it easier to plan your creation.

- **Graphics for drawings**—The most obvious need served by content is to give you the required symbols and graphics in your drawings. Nearly all content must at a minimum serve this need.

- **2D or 3D**—Knowing how your drawings will be used and what they need to convey will inform the way that you build your content. Most ACA content can intelligently switch from 2D to 3D as viewing needs dictate, so it is tempting to always add the 3D geometry. Always remember, “Just because you can, doesn’t mean you should.” Sometimes you can spend a lot of time building intricate three-dimensional models of your content items only to find that your drawing really only requires a simply two-dimensional symbol.

- **Display System**—The ACA Display System powerfully swaps out various graphical representations of ACA objects as viewing circumstances dictate. The most obvious expression of this was noted in the previous bullet when ACA can intelligently switch from 2D to 3D simply by changing the
drawing viewpoint. The Display System can do much more as well; such as display only in plan views, but disappear in reflected ceiling plan. To take fullest advantage of these and other Display System features, content has to be built to take advantage of them.

- **Intelligent or Parametric Properties**—Each object type in ACA has unique built-in characteristics and features. Wall styles can contain one or more internal components representing construction materials. Doors have unique components like frame, panel and swing. Stairs have detailed code driven parameters for tread, riser and other critical dimensions and so on. Styles offer the means to create endless variations of these unique object parameters to create a library of reusable items. Take the time to learn the nuances of each style type so you can make the most of each kind of style.

- **Scheduling**—Sometimes what makes a piece of content unique and special has little to do with graphics. In ACA, everything can be scheduled. A special kind of style called a Property Set Definition stores one or more data parameters for the objects you wish to schedule (Refer to Figure 2). When you build your content, think about how you want them to appear on schedules and what sort of data you would like to query from your drawings. With this in mind you can build and even pre-attach an appropriate Property Set to your content items. This will help facilitate easy scheduling and make for a more robust solution.

- **Classifications**—Another kind of non-graphical style, Classifications are like categories. Classifications allow you to gain more power in your scheduling and even in onscreen display by allowing classified objects to be filtered in or out of the schedule or view.

**STRATEGIES FOR BUILDING**

Careful planning is critical to creating useful content. Don’t skimp on the planning and design phase. Take some time to make a sketch or two of what you wish to create and to list out what features it will require. If you are creating a custom Wall style for example, will it contain a single variable width component? Or will it be a multi-component style, with each component representing a particular material like brick or block? Can your custom Door style be built entirely in the style editor? Or does it require custom block graphics?

Think about the features listed above and decide what features your content needs. Will you take advantage of the Display System and create your content to be aware of multiple Display Representations? Or will it be a simple 2D symbol.

Don’t forget to carefully consider your choice of Content Type. This may at first seem obvious, but is not always the case. Suppose you are planning to build a custom entry style. You may immediately assume that you require a custom Door style. However, this may not be so. If the entrance has multiple panels, doors, sidelights, transoms, you may actually require a Door/Window Assembly style. From a purely graphical point of view, there is no real downside to mixing Doors and Assemblies in the same file. However, in scheduling, querying and other reporting, there may be. Be certain that the Properties you wish to capture for such purposes are readily available in all object types that you plan to group together.

In other words, it is possible to include both Doors and Assemblies on the same schedule if desired, but you may have to get clever to get the correct fields reporting the desired results. Furthermore, when you consider that many Door/Window Assembly styles have nested Door Styles within them, you will have to take this into account when building your styles and schedules to avoid inaccurate counting and reporting. This is a place where Classification Definitions can be very handy.
Paul F. Aubin is the author of many CAD and BIM titles including the widely acclaimed: Mastering AutoCAD Architecture and Paul F. Aubin’s Mastering Revit Architecture. Paul is an independent architectural consultant who travels the country lecturing and providing Revit® Architecture and AutoCAD® Architecture implementation, training, and support services. Paul’s involvement in the architectural profession spans nearly 20 years, with experience that includes design, production, CAD management, mentoring, coaching, and training. He currently serves as Moderator for Cadalyst magazine’s online CAD Questions forum, is an active member of the Autodesk user community, and has been a top-rated speaker at Autodesk University (Autodesk’s annual user convention) for many years. His diverse experience in architectural firms, as a CAD manager, and as an educator gives his writing and his classroom instruction a fresh and credible focus. Paul is an associate member of the American Institute of Architects. He lives in Chicago with his wife and three children.

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Like Door, Wall or Railing styles, they will have no parametric characteristics. Therefore, you can sometimes “cheat” by using another type of object to “represent” the one you are building. For example, the out-of-the-box library includes Wall styles that represent countertops. There are other examples of using Door styles for cabinetry, Railings for fences and even Structural Members for moldings. Don’t be afraid to “think outside the box.”

SHARE YOUR CREATION

The best way to store and share your content creations is by saving them to unique drawing files saved on a server where all of your team has access. Content items can then be accessed via Style Manager from this file or better yet, create tool palette tools! Tool palette tools offer two key advantages: they automatically import the style or block from the remote content file on the server, and they can apply a number of preset instance parameters as the tool is executed. All this with a single click! Simple drag a style or content item to a palette to create a tool. Right-click it and edit its properties as shown in Figure 03.

CONCLUSION

This short primer was meant to expose you to some of the important considerations for designing and building content. The accompanying video includes some examples. Please email me or the editor your requests for future articles.

Paul F. Aubin is the author of many CAD and BIM titles including the widely acclaimed: Mastering AutoCAD Architecture and Paul F. Aubin’s Mastering Revit Architecture. Paul is an independent architectural consultant who travels the country lecturing and providing Revit® Architecture and AutoCAD® Architecture implementation, training, and support services. Paul’s involvement in the architectural profession spans nearly 20 years, with experience that includes design, production, CAD management, mentoring, coaching, and training. He currently serves as Moderator for Cadalyst magazine's online CAD Questions forum, is an active member of the Autodesk user community, and has been a top-rated speaker at Autodesk University (Autodesk’s annual user convention) for many years. His diverse experience in architectural firms, as a CAD manager, and as an educator gives his writing and his classroom instruction a fresh and credible focus. Paul is an associate member of the American Institute of Architects. He lives in Chicago with his wife and three children.

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If you have a question that you would like to see address in the session (or any of my sessions for that matter) please email me or post them here. Hope to see you all at AU...

AB304-2 Breaking Free of the Plan: AutoCAD® Architecture
AB214-4 Detailing in Autodesk® Revit® Architecture
AB318-3 Autodesk® Revit® Architecture Tips and Tricks
AB308-2 "Revit Inside": Autodesk® Revit® Architecture for the Interior Designer
MP222-4 Mastering AutoCAD® MEP: Ask the Experts

FINAL STAGES OF BOOK PRODUCTION

When I first started this Blog, I began with a discussion of the print publishing process as it pertains to CAD books. (I suspect that my experiences with CAD books are similar to those had by publishers of other kinds of books, but lacking first-hand experience, I cannot be sure).

I have written three books this year. Two updates to existing titles and one new title. In addition, I authored three CourseNotes Reference Cards which have a similar (but abbreviated) process. This is quite a bit of work; especially given the annual release cycle of Autodesk products. It looks like we will make Autodesk University however (refer to this post where this crucial deadline is discussed), so I consider that worth it.

At this stage of the process, I still have a few proofs to review, but the projects are mostly out of my hands. I now must shift my attention to the next phase of the process... selling books! In the end, we all want a best seller right? So, I am now polishing up my "online image". Got to log in to sites I haven’t updated in a while and update profiles, edit information, spruce things up. First stop, Amazon.com. Most of my book sales come from places like Amazon.com. So it is important to make sure that the listings are correct and easy to find.

We had a few issues there recently with the new MEP book. Seems like we will make Autodesk University however (refer to this post where this crucial deadline is discussed), so I consider that worth it.

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The latest Autodesk AEC related information!

FEATURED ITEM - AUTODESK LABS
Labs URL: http://labs.autodesk.com/
There are three recent additions: Application Trials, Solar Radiation Technology Preview & Autodesk SketchBook Mobile for the iPhone and iPod touch.

This is Item One-
Posted on September 18, 2009
Blog Post title: Try AutoCAD, Inventor, and Revit without installing them
Labs URL: http://labs.autodesk.com/technologies/trials/

What does it do?
Run trial versions of each without installing by connecting to their remote server. You do need to install a small application and you must be WITHIN 1,000 miles of San Francisco to participate at this time.

SOLAR RADIATION TECHNOLOGY PREVIEW
Posted on August 4, 2009
Blog Post Title: Update Solar Radiation Technology Preview Now Available
Labs URL: http://labs.autodesk.com/utilities/ecotect/

What does it do?
Quoted from the Lab’s overview: “Use the Solar Radiation Technology Preview to analyze the effects of solar radiation on various surfaces of your conceptual building model. Using the Solar Radiation Technology Preview during the conceptual design stage of your project can help you make fundamental design decisions about building shape, orientation, and surfaces early on, when changes are least expensive. The technology preview uses the geometry of conceptual massing elements from Revit and calculates the amount of solar radiation hitting the surfaces of the massing shapes, based on location and weather data.”
AUTODESK SKETCHBOOK MOBILE FOR THE
IPHONE AND IPOD TOUCH
Posted on August 4, 2009
Blog Post Title: Announcing Autodesk SketchBook Mobile
for the iPhone and iPod touch
Blog URL:
announcing-autodesk-sketchbook-mobile-for-the-iphone-and-
ipod-touch.html
What does it do?
Quoted from the Lab’s blog overview: “We’re excited to announce
that Autodesk is the first major design
software company to offer an iPhone
app for industrial designers and
the creative community. Autodesk
SketchBook Mobile is a professional-
grade paint and drawing application
designed for Apple’s iPhone and
iPod touch. The App is available for
download for US$2.99 on the iPhone
App Store worldwide.”
Watch a video at YouTube, URL:
http://www.youtube.com/
watch?v=YwYm5YhA0pQ

AUTODESK SEEK
Autodesk created this site to be
“The online source for product specifications and design files”. They’ve recently created a video to demonstrate using Seek.
URL: http://seek.autodesk.com/demoVideo.htm
Recent content additions:
• A.O. Smith (Water Heaters)
• Livers Bronze (Railing Systems)
• Shaffner Heaney (Wall Systems)
• Pella Corporation (Windows & Doors)
• PPG Metal Coatings Industrial Coatings

AUTODESK NEWS
2009-08-26 - WUTODESK ACQUIRES ASSETS FROM
BOSS INTERNATIONAL, INC.
php?s=118&item=627
“StormNET, RiverCAD and WaterNET Software Tools to
Provide Autodesk Civil Engineering and Utility Customers with
Comprehensive Water Analysis Capabilities”
It will be interesting to see how these compliment and/or join
Civil 3D in the future.

AUTODESK ASSISTANCE PROGRAM
Quoted from their site: “In these uncertain economic times,
many companies have had to let good people go. If you were one
of them, you might be wondering how to advance your career in
this challenging global job market.

In order to get ahead in the workplace, you need to invest in
yourself by increasing your knowledge and expanding your
skills. And the good news is that Autodesk can help you get back
in the game. With the Autodesk Assistance Program you can
take action today to gain a competitive advantage in your field.
The program offers:
• Free Software License*: Student licenses of 17 Autodesk®
products, including AutoCAD®, Revit® Architecture, Au-
todesk® Inventor® Professional, and/or AutoCAD® Civil 3D®
software.
• Free Online Training: On-demand training available
24 hours a day, 7 days a week with Subscription eLearning, Autodesk
University online, and vBooks.
• Reduced-Cost Classroom Training: Over 70 Autodesk Authorized Value
Added Resellers and Autodesk Training
Center (ATC®) partners are offering
classroom training at their training
facilities for free or for a significantly
reduced fee. (Offerings will vary, please
check with your local reseller or ATC to
get details)
• Certification: Certification preparation
and exams available at discounted rates.
Seize the opportunity now. Don’t just
survive, thrive!

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cense terms and conditions.
To learn more about the program and included benefits, down-
load our Autodesk Assistance Program FAQ.”
• Site URL: http://students2.autodesk.com/?nd=assistance_
home&lbon=1
• Assistance Program FAQ URL: http://students2.autodesk.
com/ama/orig/AAP_FAQ_rev5.pdf

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paper
Inside the System - http://blogs.autodesk.com/inside-the-sys-
tem
It's Alive in the Lab - http://blogs.autodesk.com/labs

Information Compiled from the Autodesk web site: www.autodesk.
com by Steve Stafford
Revit Fundamentals: Standards Control

If you use any Autodesk Revit flavor to create AEC drawings, congratulations! Now to determine if you should keep on reading this article we need to find out where you fall in this ‘usage’. There are generally three types.

A) you loaded the software a while back and got to work using the out-of-the-box settings, and you never looked back.
B) you loaded the software recently and have not made too much progress.
C) you loaded the software, built in your standards and don’t need to go through that again.

If you fit A or B you ought to keep on reading. If you fit C you might still pick up something interesting. Whether you recently installed Revit or never really look at the look and feel as a whole this article hopes to explain where you can start to make the biggest impact in the shortest amount of time. Revit controls standards differently than AutoCAD or its verticals ACA/AMEP.

FOLLOW THE LINES

Within AutoCAD you control line weights (how thick a plotted line appears) via a CTB file (color dependant plot style table), and STB file (named plot style table), and depending on that, controlled at the layer properties or even at the object property level.

Notice something? Lots of places where things can be defined and ultimately get messed up. Revit is a bit simpler. Line weights are defined in one place, the Line Weights dialog found under Settings. As shown in Figure 1, this little gem of a dialog doesn’t look like much. You have simple tabs across the top which correlate to the type of Revit view being displayed. The primary tab is Model Line Weights and it is here that you define how wide the line pen slot 1 prints (or plot for you AutoCAD users). Now for each pen slot you can increase the complication by adjusting for each scale. What this does is allow a concrete wall, for example, to have an X wide line for 1/8” scale plans and a Y wide line for 1/16” scale plans. That does have value in my eyes.

But check out pen slot 16 at 1”=1'-0". Yep, you read it correctly. A half-inch line is what you get for scales down to 1/8”=1'-0". Then it thins down to 0.20” at 1/32”. I’ve been around since the days of pen plotters and I don’t recall ever seeing a pen wider than 2mm. At 1/2” I would suspect the pens would have been empty after each plot!

Figure 1- Revit 2010 Line Weights dialog

So where did this pen weight theme come from? I have no idea but it is the first thing I recommend to toss and replace. Notice I said toss not fix. My assumption is you know what you need from your pens and therefore starting with a clean slate is best. The line weights is the first step in a lengthy process of customization, but once you have this done and you plot it out, it will most probably never change again.

So what theme to use? What did you use before? In AutoCAD I’m sure you have a CTB backed up somewhere or perhaps a standards manual. Crack it open and look. But you could go further back, you know, to when drawings were made by hand...whoa... Yea, back when I had hair I created drawings using pens with ink in them. And those same pens are available still today and you can look them up! I did a quick search and turned up ttp://www.scififantmodmadrealm.com/Images/KohinoorRapidograph-PenDiagram2b.jpg to an image of Koh-I-Noor pens tip sizes, as shown in Figure 2.

Figure 2- Koh-I-Noor standard technical pen tip sizes for their Rapidograph pens
It has a range from 0.13mm to 2mm, thirteen pens in total. Now back in the day I recall using 0.45mm as well, so I include it to bring our list up to fourteen pens. Now you may say “I only need five pens” and that may be true, but this dialog has sixteen slots and you can’t reduce that. You will just have to work around that you have more than you need and if needed apply some logic to your theme.

**DROP THAT PEN!**

Okay, so we have a list of pen sizes - time to implement. For starters I personally feel having a bunch of scales isn’t needed for most work. So to begin I delete all the scales except for 1/8”=1’-0”. To delete a Line Weight Scale just click the column header and then click the Delete button. Once that is done ponder how you want to list your pens. Most users go thinnest to thickest and I agree with that. But if you take a look around in any Revit template you will notice that pen slot 1 is used a LOT. And as you poke even deeper into families and other dialogs you will find more cases where pen slot 1 is used.

This is so rampant that I bet even after you “finish” your customization, you will come across a condition you missed. Okay, now wouldn’t it be nice to tell when you didn’t customize something? Sure it would! So here is a concept - use pen slot 1 as something you have yet to set. Then use pen slot 16 as something not your discipline. The other 14 slots are your standard pens increasing in size.

So what you would do as you begin is open the standard template, open Object Styles, show all disciplines and expand categories. Select all slots and change to pen 1. Then as you go about your customization, anytime you see pen 1 used - you have to decide what it should be (2 to 15) or that you don’t need it to be anything of your concern and make it pen 16.

After that I do add one more scale, 1/16”=1’-0” that I use for overall plans. For each pen I halve the size, except pen 1 and 16 which I make the thinnest size Revit will allow. Once done my dialog looks like Figure 3. Now notice I am using metric sizes for the pens, generally only to be absolutely accurate. Soon as I exit this dialog the sizes will be shown in Imperial equivalent as that is my typical units setting.

Now don’t worry about other scale not included. Revit will use the closest (but not larger) Pen Weight Scale to the view being printed. So your 3/4” scale views will use the same pens as 1/8” scale. At 1/16” it shifts to the other scale. Keep in mind that my choices do have a slight bias for structural engineering documentation.

**Notice something? Lots of places where things can be defined and ultimately get messed up...**

**DOT DOT DOT DASH DASH DASH DOT DOT DOT**

Did you know Morse Code is really a line pattern? In Revit you combine a line pattern with a line weight and create line styles. But you also combine line patterns with line weights for object styles. So to begin you open up the Line Patterns dialog, also found under Settings. As shown in Figure 4, at first this should seem familiar as it follows basic CAD principles. My only issue with the out-of-the-box line patterns is who made this up? Was it the AIA? An engineer? Someone else? Again, in an effort to own your standard I suggest creating your own patterns according to whatever guide you choose. You can then decide to make true half patterns to use when required. And my personal favorite, create a Level line pattern to use with level types. The default template uses Grid Line...duh!

![Figure 3- My completed Line “pen” weights](image)

**Figure 3- My completed Line “pen” weights**

**Figure 4- The Line Patterns dialog**

The key to customization here is to name them uniquely so that if and when you have to Transfer Project Standards from an outside Revit project you don’t lose your line patterns. Put your company initials, an odd character, something to just make the odds of overwriting them very low.
DO YOUR OBJECTS HAVE STYLE?

I’m getting to the good stuff now, and the end of this article. The next step and largest is to open up the Object Style dialog, also found under Settings. Once you open this you will be presented with a complete list of all object types available in your flavor of Revit. As needed you can expand the dialog listing to include all discipline categories. Now as shown in Figure 5, I have adjusted all categories to be pen 1 because in my world pen 1 is for what I have yet to set. I then started with Structural Columns and changed the Projection and Cut slots to 6 & 8 respectively. That means when I see a column edge, be it in plan or elevation, it will use pen slot 6 (0.35mm) and use pen slot 8 (0.50mm) for columns cut in the active view.

From here if you have play Sherlock Holmes a bit to determine what category controls what view condition of the object. For example a concrete Structural Column below a slab is defined graphically by the Hidden Lines category slot. Each category has potential to be something you need to customize or something you never will need. This is when I use pen slot 16 again. If am sleuthing and just can’t create a condition when a category is used graphically then I change the pen weight to 16. This then tells me at least I looked at it and decided I didn’t need it.

Now another trick to this is to use a really bright color (perhaps hot pink) during the hunt. And if I never find the condition in which the category is applied, leave it pink! That way if at some time in the future I do see a hot pink line, not only do I know that was a problem it will be obvious back in the Object Styles dialog what category slot needs correction.

So there you go. A little bit of insight of what steps to take to start your customization. Is there more? Absolutely! Not only do you apply your line weight and patterns to the Object Styles, you will need to do so for your Line Styles and then put those to use in your annotation families and detail lines. Then for cases when you have to deviate from the Object Styles, you can apply these same sort of changes at the view properties level via Visibility/ graphic Overrides dialog. If you want more of this story, let me know over at my blog.

David J. Harrington is the technical editor for AUGIWorld magazine and has served AUGI as Local User Group Representative, AEC Industry Chair, Board of Director and President. David has written several CAD related books, most recently Mastering Revit Structure 2010. He currently works for Walter P Moore, a consulting engineering firm based in Houston, Texas and in addition to his role as CAD Designer provides in-house Revit training and customization. David is teaching a class on standards at Autodesk University 2009 and his blog can be found at http://caddhelp.blogspot.com.

Figure 5- Object Styles for Structural Columns
A Case for External References (XREFS)

Do you work for a company that still doesn’t see the benefit of using AutoCAD’s external reference (XREF) feature? If you do, well read on and get inspired!

I went back to school in 1996 to learn cadd and earned an Associates degree. It didn’t take long for me to realize how powerful being able to create and edit drawings on the computer could be! That’s all it took, I was hooked! I started out working for a company that provided cadd support to other companies, kind of like a “cadd temp” service. I did this for a couple of years working with Architecture and Engineering (A&E) firms learning the ropes. I gained a lot of experience working on projects where many disciplines and designers need to share the same information in a project. Using XREFS was and is instrumental in keeping the different disciplines coordinated throughout the life of a project.

WHAT IS AN XREF?
An external reference (xref) is a drawing file that is brought in to another drawing file as a “linked” drawing. AutoCAD treats it like a block, but the definition lives outside of the drawing it’s referenced in. You can edit the xref file and it gets updated in the drawing(s) it’s referenced in. The update doesn’t show up automatically, you need to “reload” the xref or reopen the drawing and it will be updated. This is a great feature because it allows many people to work on one project, each in their own portion, while sharing the same updated information.

HOW CAN YOU USE XREFS AT YOUR COMPANY?
Like with most things in AutoCAD there are many ways to utilize a tool or feature. The following is how we use XREFS in the company I work for. This scenario is based on an A&E project in 2-D AutoCAD. We use vanilla AutoCAD with ADT 2006, but the concept applies to any project where there is a need to share the same geometry and work together on a project.

First of all, it’s important to have a clean, logical file structure on a shared file server. The cadd files need to be accessed by multiple users and the drawing files need to access the xref drawing files.

I use the terms “Model Files” and “Sheet Files”. The model files are the shared files (XREFS) that are used by the design team, and are placed in a folder named “XREFS”. The sheet files are the drawings that get plotted for final output and are placed in a folder named “Sheets”. Our project folder structure is shown in the figure 1.

It’s also important to have a logical file naming convention; we use a modified version of the National Cad Standard for our sheet (shown in figure 2) and model (shown in figure 3) files. For the names of our model files we use the NCS model name with two numbers at the end showing their sequence in the set. For example: the model for an architectural first floor plan would be named “A-FP01.dwg”, and the model for the structural second floor framing plan would be named “S-FP02.dwg”. If the model is the only drawing of its type in the set, we omit the numbers at the end, for example: “A-EL.dwg” is the model for building elevations. Some examples of sheet file names would be: “A-101.dwg” for the architectural first floor plan and “S-102.dwg” for the structural second floor framing plan.
We create our 2-D models like this: each building level (plan) is its own model drawing file, and all models for that building are at the same coordinate in the World Coordinate System (WCS).

We usually place the lower left hand corner of the foundation at coordinate 0,0,0. Three examples are shown in Figures 4, 5 and 6.

Our building elevations and sections (vertical building views) are their own model files as well, and are created around the building plan(s) using orthographic projection, as shown in Figure 07. The plans are xrefed in the model for reference at the predetermined coordinate. The elevation features are placed by projecting the geometry from the plans.
The "Title block" for the project is drawn 1:1 in model space (as shown in Figure 08) and is placed in the xref directory with all the other model files. We usually name this file according to its size, for example "22x34_TB.dwg" is a 22” x 34” ANSID size title block.

It contains all the project level information for the project which gets carried through to all the sheets. It can be a block with defined attributes or lines and text, it doesn’t matter. It can’t, however, be a “raw” block with attribute definitions because they will not carry forward in an xref.

Each sheet file is a separate drawing file with a layout setup for plotting. We usually name the layout tab “SHEET” to avoid the dreaded “wrong named layout” when creating plot files; because someone forgot to rename theirs when doing a “save as” from another drawing. Our final printed drawings (sheet files) consist of two or more AutoCAD drawing files: the sheet file drawing and the title block model drawing which is xreffed into the sheet file drawing layout (in paper space). Sheets for plans, elevations or sections have the model(s) xreffed in model space at the determined coordinate. See figure 09 for the assembly process.

All annotation is done in the sheet file drawings. This is another concept that is great for when many designers are working on a project, if you have all your plot sheets (multi tab layouts) in one drawing, only one person can work on it at a time.

When working on a typical building project, the architects and architectural designers create the initial floor plans. Once they have been worked out, the structural engineers and structural designers (that’s me) create the foundation plans, column plans and framing plans. Meanwhile; the mechanical, electrical and plumbing disciplines use the same architectural plans as backgrounds for their work. The architectural department references...
(XREFS) the structural column plan into their plan models and sheets. During the course of a project, things need to change a few times and these changes are worked out through conversations and meetings with the design team. This is where XREFS work really well for keeping the project on track. If the architectural department needs to move, add or remove something on a plan, the whole team sees it immediately. If the structural department needs to add or move a column, it will show up in the middle of the architectural floor plan and they will need to react to this change. See the basic examples of an architectural floor plan: A-101, building elevations: A-201 as well as the structural foundation plan: S-101, as shown in Figures 10, 11 and 12.

**DO YOU HAVE ANY MORE HELPFUL HINTS YOU ASK?**

As I mentioned before, this is how our company sets up our drawing files and uses XREFS. There are others out there who believe that all annotation should be done in paper space, and who am I to disagree. Yes, that can work too and these concepts still apply. For the most part, model files should be free of scale sensitive annotation so they can be shown at any scale, for detailing etc. In some cases however, the base model files can have some annotation. For instance, we determine what the smallest common scale our building will be shown at, and place the column bubbles at the proper scale in the column base model. We place room tags and stair directions on architectural base models for reference as well. We can freeze their layers when they are not needed in enlarged plans or other plans.

There are some situations where using XREFS really shine and save your company time and money! Let’s say you have a large set of drawings and the project title or address changes, or a company’s logo needs to change on the title blocks, you simply update the title block model and all the sheet files get updated. Another situation may arise where the building footprint changes and all disciplines need to adjust their plans, or find conflicts and interferences. The architectural base models get updated and everyone on the design team can adjust theirs accordingly at the same time.

**WHAT’S THE DIFFERENCE BETWEEN USING “OVERLAY” AND “ATTACH” YOU ASK?**

When you use “attach”, the xref can get carried forward through multiple drawings, not bad if you know what you’re doing but it can cause “circular referencing” issues or just be a nuisance. For example, say you have Dwg-A xreffed into Dwg-B using the attach method. By doing this, when you xref Dwg-B into Dwg-C, you get Dwg-A along with it. Then when someone opens Dwg-A and they xref Dwg-C, it now becomes a circular reference problem, or at the very least they are getting content they may not want and are annoyed.

When you use the “overlay” method, the reference stops at the drawing it’s referenced into. We use the “overlay” option of attaching XREFS, this keeps the references from being carried forward beyond one level of xreffing. Sometimes it is useful or necessary to use “attach” option, but for the most part we use the overlay option, as shown in Figure 13.

Figure 13- Xref Manager showing “Overlay” type of attachment and “Relative” path used

Ted Goulet is a senior structural designer for Oest Associates, an AMEC company. He works as part of their A&E division in Southern Maine. His main function is lead drafter and designer for the structural engineering department, and is also experienced in architectural and civil design. He acts as technical support for the company’s cadd staff, helping with cadd related issues. Ted does a bit of programming, mostly writing autolisp routines to help with production, but writes some script and batch files as well. He is also involved with creating and instituting company cadd standards and procedures. Ted has an Associates Degree in Technical Graphics and Design Technology. He works in AutoCAD 2D and 3D and has experience in 3D Studio Max, Viz Render, and Accurender as well as some experience in 2D Microstation.
HEAD’S UP!
Recent Known Issues and Problems documented by Autodesk and AUGI members

AUTOCAD 2010 - MOST RECENT: “UPDATE 1”
http://usa.autodesk.com/adsk/servlet/ps/dl/index?siteID=123112&id=2334435&linkID=9240618

NAVISWORKS PRODUCTS - MOST RECENT: “SERVICE PACK 1”
Navisworks Manage, Review, Simulate & Freedom
http://usa.autodesk.com/adsk/servlet/ps/dl/index?siteID=123112&id=2334435&linkID=10382102

Support Blog - The Revit Clinic
Get the latest on technical support topics directly from Autodesk Product Support

Revit Support FAQ
Legacy support FAQ content (available during transition to Knowledge Base)

Hot Issues:
- Switching to pre-2010, Classic user interface
- Support for Revit 2010 products and Windows 7
- Revit network license troubleshooting
- The 5090 switch and Revit®
- Product keys for Autodesk® Revit® products
- Unable to find command on ribbon in Autodesk® Revit® 2010 based products
- Resolving the Revit® Architecture 2010 user interface
- An error has occurred while drawing the contents of this window
- The Rendering library is not available
- Rendering with a background image

Figure 1- The latest Revit Hot Issues at Autodesk
head’s up

Updates

Autodesk® Revit® Architecture 2010
Revit® Architecture 2009
Revit® Architecture 2008
Autodesk® Revit® Building 9.1
Autodesk® Revit® Building 9
Autodesk® Revit® Building 8.1
Autodesk® Revit® Building 8
Autodesk® Revit® 7
Autodesk® Revit® 6

Autodesk® Revit® Architecture 2010
Hotfix - Crash when deleting or modifying walls
FLEXnet Licensing Hotfix for 64-bit Windows
Register Today Proxy Licensing Hotfix

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Figure 2- The latest Revit Architecture Hot Fix

REVIT PRODUCTS - MOST RECENT: “CRASH WHEN DELETING OR MODIFYING WALLS”

- Revit Architecture:
  http://usa.autodesk.com/adsk/servlet/ps/dl/index?siteID=123112&id=2334435&linkID=9273944

Updates & Service Packs

Autodesk® Navisworks® Manage 2010
Autodesk® Navisworks® Manage 2009
Autodesk® Navisworks® Review 2010
Autodesk® Navisworks® Review 2009
Autodesk® Navisworks® Simulate 2010
Autodesk® Navisworks® Simulate 2009

Autodesk® Navisworks® Manage 2010
Autodesk Navisworks 2010 Service Pack 1
FLEXnet Licensing Hotfix for 64-bit Windows
Register Today Proxy Licensing Hotfix
Hotfix - Revit Windows and Doors
Navisworks 2010 Language Packs
AutoPLANT Presets Hotfix Download

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Figure 3- The latest Navisworks Updates & Service Packs

- Revit Structure:
  http://usa.autodesk.com/adsk/servlet/ps/dl/index?siteID=123112&id=2334435&linkID=9280927
- Revit MEP
  http://usa.autodesk.com/adsk/servlet/ps/dl/index?siteID=123112&id=2334435&linkID=12828318

Updates & Service Packs

AutoCAD® 2010
AutoCAD® 2009
AutoCAD® 2008
AutoCAD® 2007
AutoCAD® 2006
AutoCAD® 2005
AutoCAD® 2004
AutoCAD® 2002
AutoCAD® 2000i
AutoCAD® 2000
AutoCAD® Release 14

AutoCAD® 2010
AutoCAD 2010 Update 1
Certified Hardware XML Database Update
Regapp ID Cleanup Utility for AutoCAD 2010
Scale List Cleanup Utility for AutoCAD 2010
FLEXnet Licensing Hotfix for 64-bit Windows
Register Today Proxy Licensing Hotfix
Startup Error and Text Editing Hotfix
Raster Design 2010 Hotfix for Licensing and Civil 3D Feature Up
MeasureGeom Hotfix
Hotfix: Korean AutoCAD 2010 Users Guide CHM – animationsunj
Updated BIM file for Autodesk Product Manager Utility
Share with Autodesk Seek Hotfix

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Figure 4- The latest AutoCAD Updates & Service Packs
Updates & Service Packs

AutoCAD® Architecture 2010
AutoCAD® Architecture 2009
AutoCAD® Architecture 2008
Autodesk® Architectural Desktop 2007
Autodesk® Architectural Desktop 2006
Autodesk® Architectural Desktop 2005
Autodesk® Architectural Desktop 2004
Autodesk® Architectural Desktop Release 3.3
Autodesk® Architectural Desktop Release 3
AutoCAD® Architectural Desktop™ Release 2i
AutoCAD® Architectural Desktop™ Release 1

AutoCAD® Architecture 2010
AutoCAD Architecture 2010 Product Update 1
Certified Hardware XML Database Update
Regapp ID Cleanup Utility for AutoCAD 2010
Scale List Cleanup Utility for AutoCAD 2010
FLEXnet Licensing Hotfix for 64-bit Windows
Register Today Proxy Licensing Hotfix
Localization Hotfix - localized AutoCAD commands  
  first attempt
Startup Error and Text Editing Hotfix
Raster Design 2010 Hotfix for Licensing and Civil 3D
MeasureGeom Hotfix
Hot Fix for German Open Light 64 bit installer
Share with Autodesk Seek Hotfix
Workflow Toolkit Hotfix

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Figure 5- The latest AutoCAD Architecture Updates & Service Packs

JUST IN AT PRESS TIME:
Revit Architecture, Structure and MEP all have a new updates, 
Web Update 2. Visit each product page at www.autodesk.com 
for more details.
Layer Management in AMEP

One of the frustrating parts of the AEC world is accommodating a client’s CAD standards. Face it, we like to think that our system is the best in the world and dealing with a client’s layer standard is a step backwards. However, layer key styles actually make it rather painless to produce drawings that the firm can work on using their normal tools and yet make the client happy by placing the objects on their layers.

There are 4 features of AutoCAD MEP that work together in this discussion:
1. Layer Standards
2. Layer Key Styles
3. AecLMrgLisp.arx
4. CAD Standards

An additional tool that is valuable is Microsoft Excel. There are user-created functions to import and export layer key styles. There are several sources for the code needed and the AUGI forums are one of the best sources. (Note that although this article refers specifically to AutoCAD MEP that the tools and principles are just as valid to AutoCAD ACA.)

LAYER STANDARDS
This feature, see Figure 01 for the tool location, defines a naming convention for layer names and their descriptions within AutoCAD. A layer standard will not define a layer’s properties. It is used to determine if a layer name complies with the standard and where it does can automatically define the description based on information within the standard.

The National CAD Standard (NCS) is a good example of a structured layer naming convention. Each part of an NCS layer name is separated by a delimiter, the dash (-). There is a discipline field, a major group, a minor group (two minor groups are permitted), and an optional status field. Oddly, Autodesk does not yet provide a layer standard that matches the NCS. Upon installation there is an AIA-based layer standard which can be copied and modified to match the NCS via the Layer Standard Properties dialog, as shown in Figure 02.

LAYER KEY STYLES
A layer key style contains a set of layer keys, as shown in Figure 03. The layer key style is usually associated with a layer standard. The layer keys map objects to specific layers. When an object is placed in the drawing that object’s key is determined and the object is placed on the defined layer. If the layer is missing it is automatically created using the properties defined by the layer key.
This is the key point (pardon the pun): it doesn’t really matter what layer is ultimately going to be used, it is the layer key for the object that needs to be configured. Different layer key styles can define layers with radically different properties for the same key name. Select the layer key style with the needed client’s layer properties and yet use the same tools (because the name of the key doesn’t change, just the properties of the defined layer).

Both layer standards and layer key styles are stored in drawing files. It is possible to store multiple standards/key styles in a single drawing or to organize them individually in separate drawing files. There is an advantage to keeping different layer key styles in individual drawing files which will be explained later.

Layer key overrides are used to override a key’s target layer by replacing one or more of the fields that make up the target layer name. Note that overrides will not work unless the current layer key style is assigned to a layer standard. An override will create a layer that has the same properties as the original target layer, aside from the name and description.

Layer key styles and overrides are further affected in AutoCAD MEP by system definitions. System definitions are a relatively recent addition to AutoCAD MEP. Systems are used to apply display properties to all objects that make up a particular system regardless of the object type. System definitions may use a very specific layer key or may assign a general key and an override at the same time.

Layer key styles are the best way to develop a system for working on drawings using the firm’s normal tools while accommodating the client’s layer standards. The more clients that base their standard on the NCS the easier this becomes. (Other countries will have their own systems for layers but the principle is the same, the more widespread the support for the system the easier it is for each firm.) Clients that use a radically different layer standard may limit the effectiveness of layer key overrides since they may not provide the fields needed for the override.

There are many functions exposed by this utility. They are fully documented in a PDF file named ‘AecMgtrLisp’ and this file may be found in AUGI’s forums. Four functions in particular are important to this discussion:

1. AecImportLayerKeyingStyle, provides a way to import a layer key style from an external file.
2. AecSetCurrentLayerKeying, changes the current drawing’s current layer key style.
3. AecLayerKeyList, a list of all the layer keys defined by the current layer key style.
4. AecGenerateLayerKey, creates the layer defined by provided layer key.

CAD STANDARDS
The final piece to the puzzle is how to make sure a client’s drawing is not “infected” with layers that they do not accept. To counteract this problem AutoCAD provides a feature called CAD Standards (Refer to Figure 4). A drawing standards file (DWS) is created that stores the properties of named objects such as layers. The standards file is simply a normal drawing file with an extension of DWS rather than DWG.

The standards file is associated to a drawing file and the drawing may then be checked for any named objects that don’t exist in the standards file or have properties that do not match the properties of that named object. The user is then prompted to correct the detected issues.

USING THE TOOLS TO SUPPORT CLIENT STANDARDS
It is counterproductive to maintain a layer key style with all the layer properties defined and also a drawing standards file with the actual layers. It is also easy to forget to add a new layer key to all the different layer key styles.

Use Excel to counteract the latter issue. Export each layer key style to an Excel file. Use Excel to display the master layer key style and a client layer key style side-by-side with synchronized scrolling. When both files are sorted with the same criteria the synchronized scrolling makes it easy to spot missing layer keys.
When a client layer key style needs to be modified use the Excel file to make the needed changes and import the new settings to the drawing file that stores the client's layer key style.

Creating a new client layer key style can be done by exporting the master layer key style and modifying the data in the Excel file, including the layer key style name. Import the revised data from the Excel file into a new drawing to store the client layer key style.

So why create different drawings to store a client's layer key style rather than keeping all layer key styles in a single drawing file? The answer is that it deals with the first issue mentioned earlier: maintaining a DWS file based on the layer key style. Use the functions AecLayerKeyList and AecGenerateLayerKey to populate the drawing that hold the layer key style with the actual layers defined by the layer key style. Save that drawing file as a DWS file rather than leaving it as a DWG file. That DWS file can also be used to import the actual layer key style into any of the drawings for that project using the functions AecImportLayerKeyingStyle and AecSetCurrentLayerKeying.

Make modifications to an existing layer key style in the DWS file (either by importing a modified Excel file or directly editing the layer key style). Purge the existing layers in the DWS file and use the functions to repopulate the DWS file.

**THE KEY POINTS**
Create layer key styles based on the same layer standard for both the firm's normal standards and all clients that use that layer standard. When a project is first started change the drawing's current layer key style. This can be done automatically using functions defined by AecLManLisp.

Store each client's layer key style in a separate drawing that is saved as a drawing standard file (DWS). Use functions from AecLManLisp to add all the layers defined by the layer key style to the DWS file. Associate the DWS file to each of the project's drawing files to enforce the layer standard.

Some initial effort and minor ongoing maintenance by the CAD/BIM Manager can provide a robust system for accommodating client's layer standards while still using the same tools to which the firm is accustomed.

Robert is the Design Technology Manager for Sparling, the largest specialty electrical engineering and technology consulting firm in the United States, headquartered in Seattle Washington. He provides strategic direction, technical oversight, and high-level support for Sparling’s enterprise design and production technology systems. He is instrumental in positioning Sparling as an industry and client leader in leveraging technology in virtual building and design.

Robert has been writing code for customizing AutoCAD since the release of AutoCAD v2.5. For most of those years he worked at an MEP firm. He developed a series of applications for use with AutoCAD similar to AutoCAD MEP years before Autodesk released that product. These in-house applications gave that firm a distinct competitive advantage over other firms in that market.

Robert is one of the more popular speakers at Autodesk University. He has been speaking at that event every year since 2002. He has spoken on topics such as AutoLISP/Visual LISP, VBA, the CUI, and customizing AutoCAD from the perspective of CAD Management.

He has also taught ATP classes for Autodesk User Group International (AUGI). Robert has been a speaker at AUGI's CAD Camps. Robert served on AUGI's Board of Directors for three years.
AutoCAD MEP
It’s Our Choice!

In recent years, the concept of Building Information Modeling (BIM) has been steadily increasing in demand in the engineering and construction industry. The software package getting the most attention is the Revit MEP Suite. At Venture Mechanical, we are primarily a mechanical contractor, with the additional capability of in-house engineering. Of the three programs included in the suite (AutoCAD, AutoCAD MEP & Revit MEP), the one we utilize most often is AutoCAD MEP due to its speed, its full 3-D BIM capability, and the familiarity of running on top of AutoCAD natively. While REVIT is widely used on the architectural and engineering consulting side of the industry, we find that AutoCAD MEP provides the best set of features for us on the construction side.

EXPECTATIONS
We have the capability to use both AutoCAD MEP as well as Revit MEP. The majority of our projects are engineered by others, and we often receive a 2D AutoCAD file with no requirement to provide a 3D file. Our requirements are only to produce an electronic CAD file for distribution among the other construction trades, as well as a set of construction documents for the ductwork fabricator, and for accurate installation purposes in the field. In this scenario, we still find it advantageous to use AutoCAD MEP in-house since it greatly reduces the time it takes to provide a field-ready set of plans over regular AutoCAD. Also, we feel REVIT is not well suited for providing field-ready drawings as we'll explain later.

FAMILIARITY
One of the many things we really like is the fact that AutoCAD MEP still works like AutoCAD. It allows our designers to produce fully 3D mechanical models by using traditional “drawing” techniques for which AutoCAD is well known. In fact, our designers were able to climb the learning curve swiftly due to their familiarity with the base AutoCAD program. The learning curve consisted only of the added features and functionality of the new tools which are part of the “vertical product” category of the AutoCAD based software line. This is a strong argument for us. Utilizing AutoCAD MEP, as our premiere BIM platform, for most of our work essentially knocks out two birds with one stone: fully coordinated 3D models with intelligent objects, for a corresponding BIM related job, generated from the exact same model we produce the 2D views of our mechanical design. This same information can be built ground up, in the field, with zero modifications to the file.

3D & BIM
On projects that require a set of full 3-D CAD drawings for interference checking, AutoCAD MEP is still our preferred program. Not only does it provide the tools needed for 3D modeling and collaboration with other trades, but it allows us to produce accurate construction documents so that our field employees can build directly off the model with no modification of the CAD file. When we provide a set of mechanical documents, there are a number of trades that require the use of our digital CAD files. AutoCAD MEP allows flawless integration with Navisworks for clash reporting among other trades (see Figure 1) so the general contractor can keep track of the BIM project as required. In the same breath, we all waste no effort dealing with file format or compatibility issues. Same for the other trades that need our mechanical design files.

3D and 2D - The Best of Both Worlds

Figure 1- AutoCAD MEP seamlessly integrates into Navisworks for clash reports

AutoCAD MEP gives us the ability to customize 3D objects in 2D plans. Construction documents sometimes need to represent data in a certain way, and not necessarily the literal view of an object. AutoCAD MEP has an optional “plan view” symbol instead of reflecting the actual size and shape of the object. This above all else is what separates AutoCAD MEP with other BIM design platforms.

For example, we recently had a project which had several Opposed Blade Dampers in some ductwork. These 3D objects that are placed within the duct in the literal view would show up as a rectangular object hidden within the sheet metal (see Figure
The construction mechanic would realize that something is there, but not exactly what needed to go there. In AutoCAD MEP, this is easily solved by going into the catalog of the part that is modeled, and editing the Top View of the 3D object to exactly how we needed this object symbolized for the mechanics in the field, without interrupting the actual 3D object in any way, streamlining the entire process of creating a BIM 3D model for Navisworks and other collaboration needs, and representing the symbol needed to match the legend for installation purposes for the mechanics in the field.

WRAPPING UP
For our firm, AutoCAD MEP has provided the best set of features that are important for a construction company. It allows the user to draw projects quickly in 3D but still provide usable 2D plans for field construction. The software itself is robust, but does not slow down the computer you’re working on. Finally, the transition from AutoCAD to AutoCAD MEP was easy for us because of our familiarity with native AutoCAD.

Tannar Frampton is spearheading the design team at Venture Mechanical. Since joining Venture in 2006, he has led the way to define and implement all of Venture’s standards and procedures utilizing AutoCAD MEP & Revit MEP platforms. Thrusting the design team out of an older 2D basic AutoCAD design methods up to par with the latest industry trends is a challenge he enjoys. He is always motivated to find the best approach satisfy the needs of his company. He stays very active in the AUGI network to keep a fresh perspective on his trade.

Figure 2- Visual control using AutoCAD MEP with 3D objects
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