AUGIWorld

The Official Publication of Autodesk User Group International

February 2015

Basics for Beginners

Also in this issue:

- **Introduction to Reality Computing**
- **The Transition from AutoCAD to AutoCAD Civil 3D**
- **Best Practices for Plumbing**

AUGIWorld

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Letter from the President

AND THE RESULTS ARE IN!

By the time you read this you may already know the results of the latest election for the AUGI Board of Directors. I would still like to take a few minutes of your time to discuss the changes on the Board of Directors.

I would like to acknowledge Desirée Mackey. Her term was up at the end of 2014 and she decided not to run for reelection. Dezi, as she is affectionately known, worked hard for a long time as AUGI's Treasurer and last year was one of our Vice Presidents. She was a great addition to the board and provided a voice that got things done. We wish Dezi success in her new endeavors. Her presence on the board will be missed.

Tommy Holder stepped down from the board a few months before his term expired due to personal reasons. Tommy did a lot while on the board to help create a shipbuilders community for AUGI. We hope that he can continue to help that community grow.

Kate Morrical was an appointee to the board and was a great addition. You may know that she used to work with Autodesk. Kate's experience with a large corporation and her knowledge of the people within Autodesk have been invaluable. Her appointed term was over at the end of the year and we were all happy when she decided to run for election and then was elected to the board by you.

Chris Lindner was elected to the board this year. He served on the AUGI board in the past and I had the pleasure of working with him previously on the board. We appreciate Chris's experience and are happy that he has returned to the board. We acknowledge his commitment to AUGI by his seeking election once again.

Curt Moreno, who has been involved with AUGI for many years as a volunteer, recently took on the role of Social Media Manager. He decided that he wanted to contribute even more to AUGI and ran for election. We are happy that he was elected to the board and look forward to the enthusiasm he will bring.

The AUGI board will appoint the officers at the January meeting. By the time you read this, the officers will be announced by AUGI.

AUGI's Board of Directors for 2015:

R. Robert Bell	Melanie Perry	Kate Morrical
Scott Wilcox	Shaun Bryant	Chris Lindner
Michael Smith	Walt Sparling	Curt Moreno

Please join me in welcoming the new members to the board and take a moment to express your thanks to Dezi and Tommy for their service.

R. Robert Bell
AUGI President

BIM

by: Jennifer Suerth

Benefits of BIM and VDC: A Contractor's View

Unsurprisingly, statistics show that the percentage of contractors using building information modeling (BIM) and virtual design and construction (VDC) is rising each year; but why is that number increasing and how are contractors using them? Personally, after pushing the envelope with technology as a designer, working for a contractor was my next logical career move because contractors are now the leading users of BIM. That is why I am proud to work for Mortenson Construction, which has been using BIM and VDC for nearly 20 years. Today, Mortenson is one of the many contractors across the world using technology to improve processes, safety, quality, cost, and schedule.

STUDY SHOWS SIGNIFICANT BENEFITS

In July 2014, Mortenson Construction and its research partners published results from an analysis of 18 Mortenson projects completed between the years 2003 and 2013. It details activities beneficial to the projects, highlighting those benefits, and why VDC activities are important. While not all benefits are quantifiable, the analysis identified three consistent key performance measures:

DIRECT VDC RESULTS ON **18 PROJECT CASE STUDIES:**

600 TOTAL DAYS
DIRECT **SCHEDULE** REDUCTIONS

32 DAYS AVERAGE SCHEDULE REDUCTION DUE TO **VDC PROCESS**

25% AND GREATER **PRODUCTIVITY** INCREASES

2.95% AVERAGE DIRECT **COST** REDUCTIONS

Mortenson construction

Figure 1

time, cost, and productivity. The measurable results are significant, and suggest there are increasing opportunities for the building industry to deliver value through the implementation of VDC. With 600 total direct days of schedule reduction and 2.95 percent average direct cost reductions attributable to VDC processes, the numbers speak for themselves. In addition to savings on cost and schedule, quality and productivity have increased significantly as well. Some studies show a 25 percent increase in productivity, while others show an even higher increase. Regardless, the benefits of VDC for contractors are substantial, and the value increases when the model is the basis of fabrication and assembly.

EXTREME INTEGRATION AT THE UNIVERSITY OF CHICAGO

The Mortenson study found that the higher the adoption of BIM and VDC on a project, the higher the value output. A great example is the University of Chicago's new North Residence Hall and Dining Commons, currently under construction by Mortenson. At the University of Chicago, Mortenson is creating an extremely integrated VDC process within the entire project. This design-build project allowed Mortenson and some critical path trade partners to be on board at the start of the project.

Using digital fabrication software called SysQue, our mechanical, engineering & plumbing (MEP) trade partners were able to create fabrication-ready 3D models in Autodesk® Revit® for the first time in Chicago. This allowed our MEP trades to work in the same software platform as our designers. While the standard Navisworks® 3D coordination process didn't change much for this project, the design team and trade partners were able to use one model for both the creation of design documents and shop drawings. This way, the design team focuses on design and not drafting, while the trade partners create detailed fabrication models and provide input into the

design based on their own construction experience and expertise. The model was then passed between the trade partners and design team in order to create a higher level of development drawings for permit documentation. From the very start of the project, this high level of team integration driven by Mortenson provided huge benefits to the team including:

- increased quality of drawings;
- increased productivity of team members from early project engagement and design familiarity;
- reduced RFIs;
- reduced schedule time and model re-work; and
- opportunities to utilize the model even further in both the field and facility services within the University.
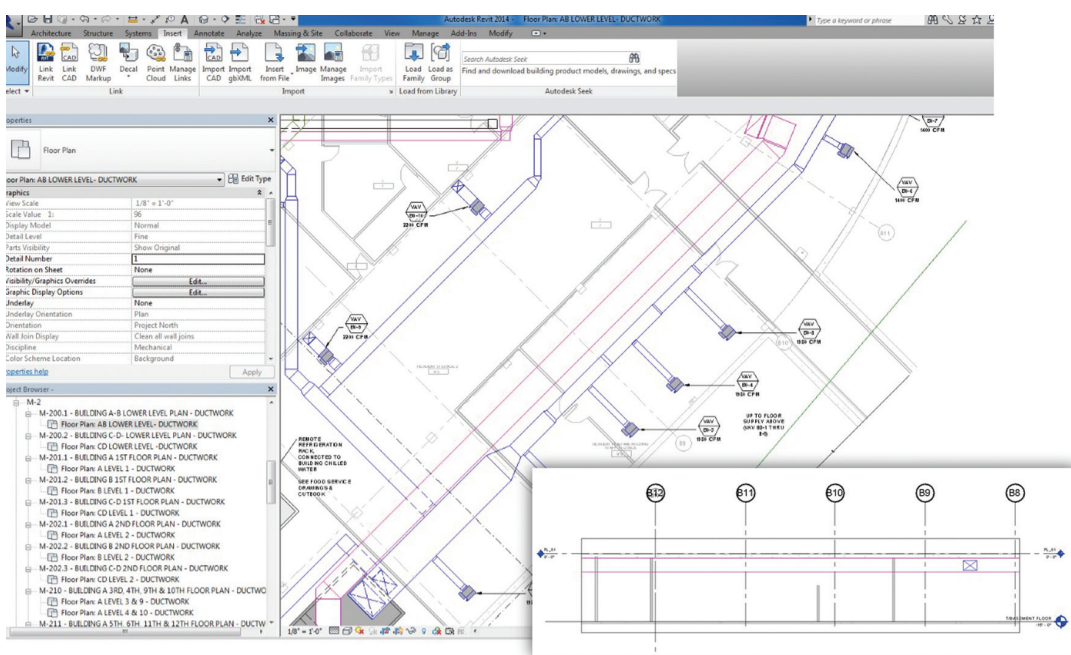
Figure 2: LOD 300--Design-intent Revit model
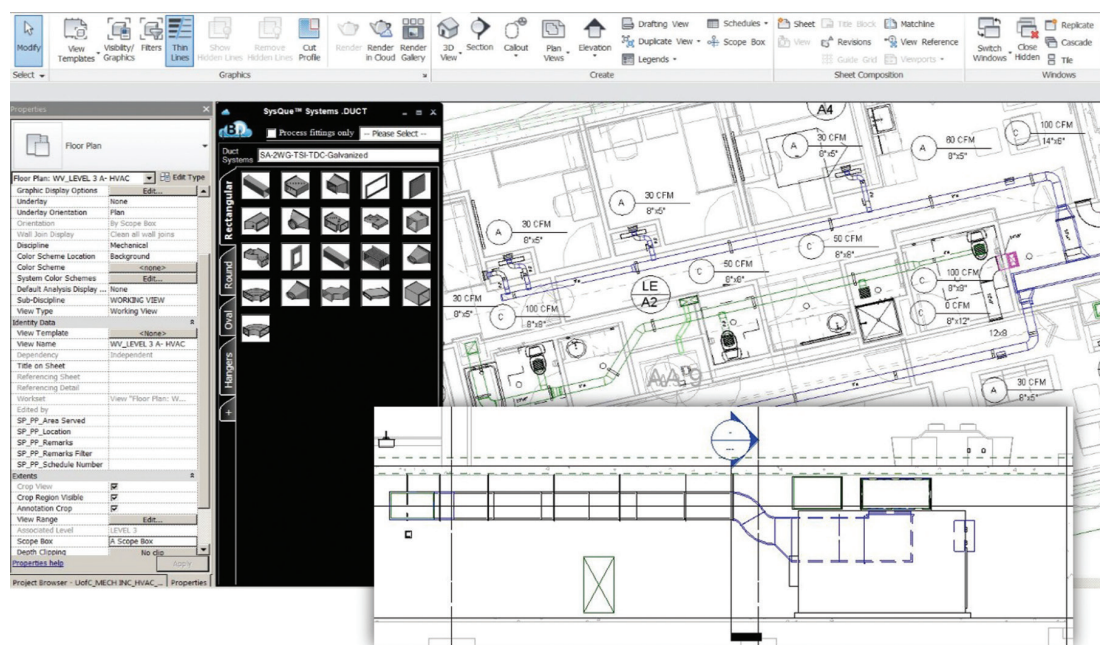
Figure 3: LOD 400--Fabrication Revit model (SysQue)

BIM

The MEP team was not the only team that integrated VDC processes into their workflow on this project. Prior to construction, Mortenson's estimating group was able to use model base estimating with a higher level of accuracy due to early involvement of both the design team, Mortenson, and the trades. Mortenson was able to provide feedback to the design team and create parameters that helped with the estimating process. This allowed for tighter prices from trades based on confidence in design information. The visual planning models (4D) were also created simultaneously with the project schedule. These models were crucial for communicating the construction phases throughout the life of the project and finalizing the schedule.

computers, in the field and in the Mortenson trailer. With such detailed and coordinated 3D fabrication models, Mortenson and the trades will be installing various systems in the building using Trimble and other similar layout tools. Some trade partners will also pre-fab their systems for the first time in their company history, which also improves quality and time on the project. BIM 360™ will be used on this project for checklists, punch lists, and commissioning as well. All of this is possible because of BIM and VDC. While Mortenson integrated multiple VDC processes in the North Residence Hall and Dining Commons project, many other successful projects and contractors have seen huge benefits from even implementing just one of these VDC processes.

In addition, our precast trade partner modeled all panels and connections in Revit. Once completed, our team did an extensive review of the enclosure system in both 2D and 3D. Using Bluebeam Studio, we were able to review submittals in the cloud in real-time, with multiple parties at once. In addition to running 3D clash reviews in one shared Navisworks model shared on Box.com, we used the drawing comparison tools in Bluebeam to compare 2D drawings of both the design and fabrication precast panels.

Figure 4: Visual planning models (4D)

Due to this extensive and highly integrated process, our design team members ultimately removed the precast panels they created in their model and linked in the precast trade partner's model for the creation of the permit documents. This was possible because both parties were modeling in Revit and confident in the trade partner's model due to this extreme review process. For Mortenson, this enabled an improved decision-making process, which dramatically reduced quality risks because the design-intent model literally matches the fabrication model.

Now in construction and scheduled to be complete in May 2016, the North Residence Hall and Dining Commons will have VDC processes continue into the field. Mock-ups were created and reviewed in 3D before being built on-site, and all team members have access to linked drawings and 3D models on both iPads and large-screen

Figure 5: 3D Coordination
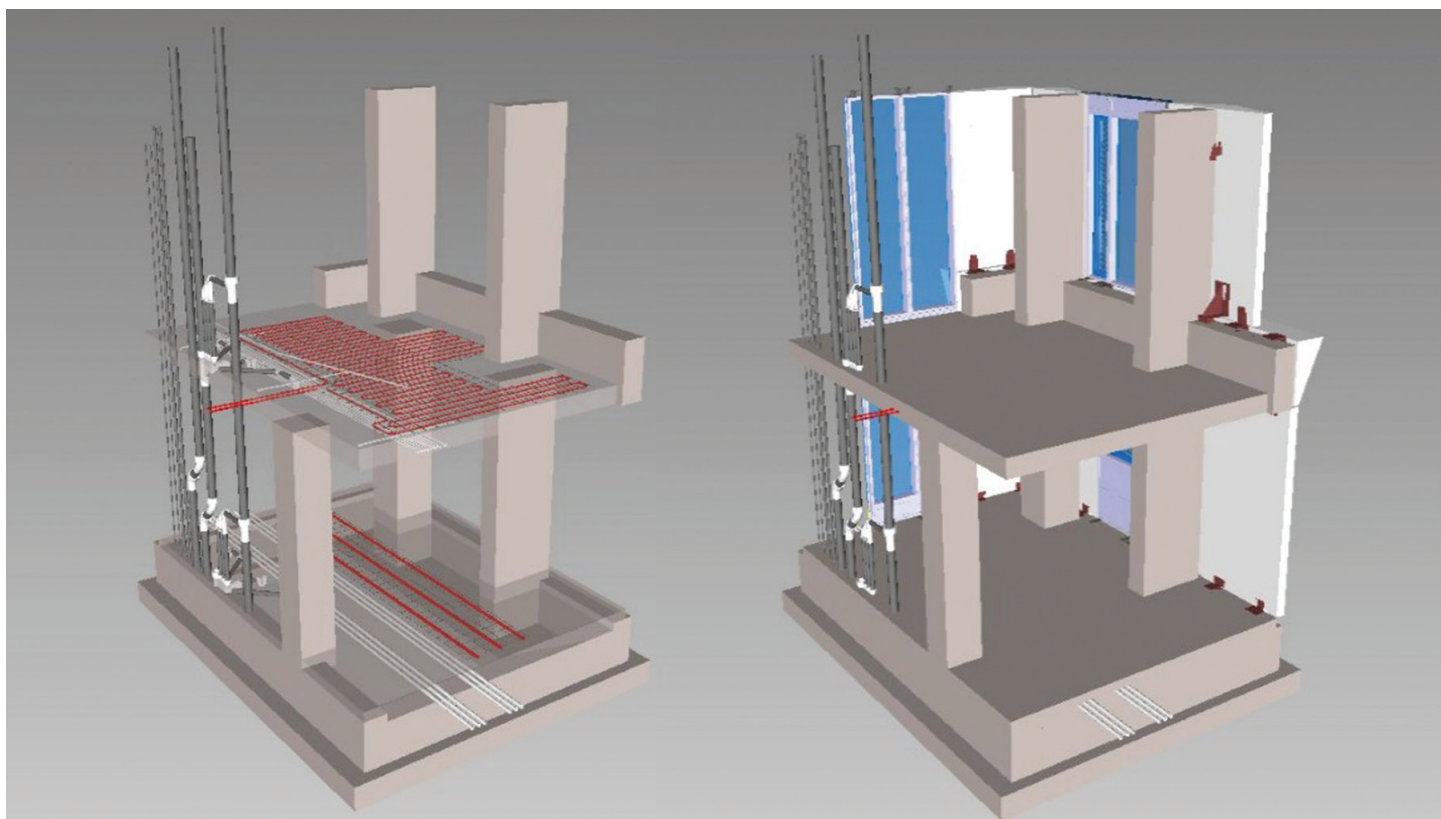
Figure 6: Virtual mock-up

IMPLEMENTING BIM AND VDC FOR YOUR PROJECTS

While the value for a contractor is huge, not all contractors are using BIM and VDC. Many of the new processes and ideas need to be encouraged from the top. With nearly all young engineers coming out of school with a wide range of technology experience, companies should take advantage of this knowledge and ambition. While the generation gaps in the industry are often cited as a reason for the disconnect between the office and the field, education and training programs can help create these integrated and high-performing teams that many owners are seeking for their projects.

Mortenson integrates VDC into key construction operational processes, which is deployed through a company-wide best practice education program. Through a "40 to 400" program, our VDC team provides "just in time" training to our project team members on various tools that support and improve operational processes. This is continued in the field with what we call The Last 100 Feet®, which bridges the technology to our people and process through mobile solutions.

In addition, many third-party companies can assist contractors in starting a VDC or BIM program within their companies. These firms can provide consulting or modeling services for a competitive fee. Some software companies such as SysQue also allow people to "lease" software licenses for a shorter period of time to try them out before buying a full license.

A successful process is one that is scalable and repeatable, and this concept can also be applied to BIM and VDC. Therefore, no matter the size of your company, it is never too late to start implementing VDC processes into your workflow and gain the substantial benefits of improved productivity, safety, quality, cost, and time.

Jennifer Suerth is an integrated construction coordinator at Mortenson Construction and is currently managing the implementation of BIM and Virtual Design and Construction on the University of Chicago North Residence Hall and Dining Commons. With a unique design background in both Architecture and Structural Engineering, Jennifer offers a comprehensive approach to the use of BIM and VDC. Along with industry speaking engagements, she has been actively involved with educating others. Recently a recipient of the Chicago Building Congress Future Leaders Award and ENR Midwest's Top 20 under 40, she is also an active member of the Chicago Architecture Foundation Auxiliary Board and City of Hope Future Leaders Board. Jennifer is a graduate of the University of Illinois Urbana/Champaign with both a BS and an M.Arch. http://www.mortenson. com/vdc-report

Revit Structure 2015   by: Philip Russo
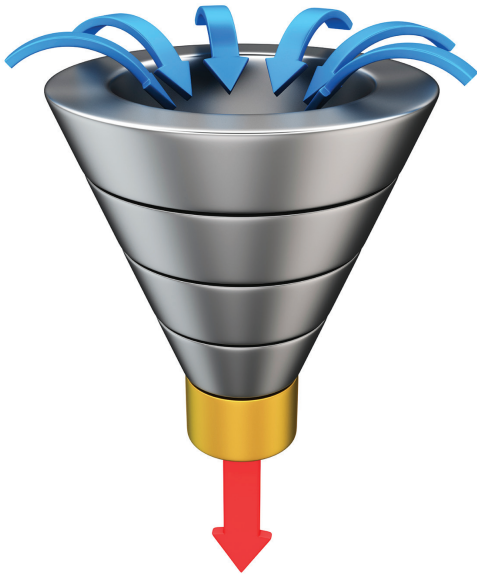
Filters for Quality Control

BIM QC VERSUS PAPER QC

We all are too familiar with scrubbing redlines while developing a set of construction documents. The problem with most people moving into a 3D world and a BIM process is that we all still think that is how we check a job. Do not take this wrong—I still think we need to publish documents to review them on paper to make sure they are branded with the company standard and show design intent and constructability. However, working in a 3D environment requires other QC methods and model checking to take place. Developing a BIM QC process is essential when moving into a 3D environment. Depending on your deliverable there may be several checklist items that need to take place.

For this article I will focus on leveraging filters. For the beginner and most seasoned Revit Structure users this is a simple technique that can be implemented hundreds of ways depending on your needs. Revit MEP users are very familiar with filters because they use them to display systems in the model. For example, they can show hot water piping in the color red while cold water piping is the color blue, and so on.
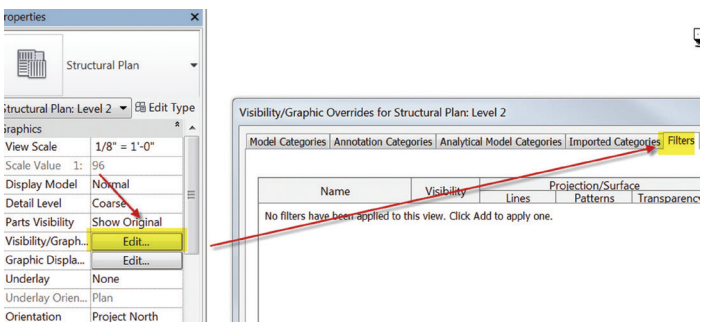
Figure 1: Where to find filters

WHAT IS A FILTER?

A filter allows you to select items in your model based on their properties. These properties could be a comment placed in the comment field, the length of the entity, etc. I am suggesting that you add your own property to all structural elements in your model. To do this we need to talk about project parameters.
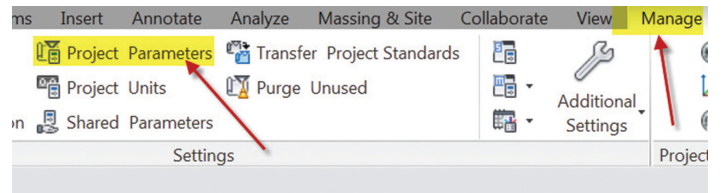
Figure 2: Where to find project parameters

WHAT IS A PROJECT PARAMETER?

Project parameters allow you to add a parameter to all structural objects in your model. Once this parameter is in place we can give structural objects values and use a filter to control the display of the objects that fit the criteria of the filter. Let's go through the steps of adding a project parameter called QC_Status. We can use this parameter to add values to structural elements such as Check Connection, Needs Approval, Clash Issue, and so on. First, open
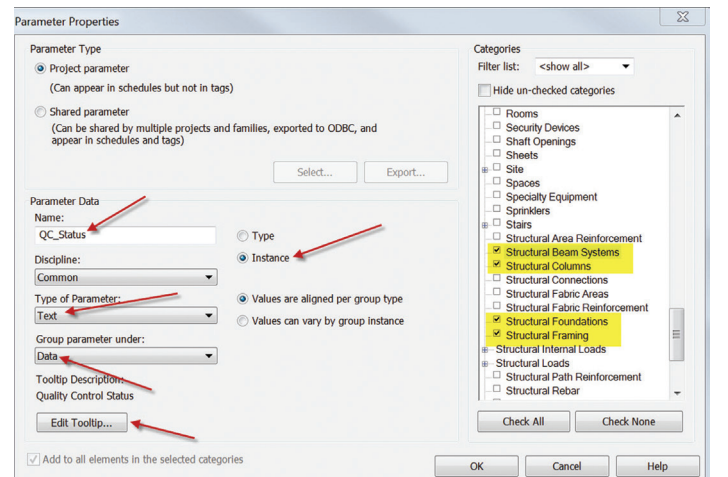
Figure 3: New project parameter settings

up the project parameters dialog box and select Add. Once you do this, the Parameter Properties dialog box opens and we need to add a parameter name and properties shown in Figure 2.

The type of the parameter is set to text so we can enter any alpha or numeric value. The group data is where the value will appear in the properties of the selected item. The tooltip description is something new in Revit 2015 that will display when hovering over an object. On the right-hand side you select all the structural objects in your model to which you want to add the parameter.
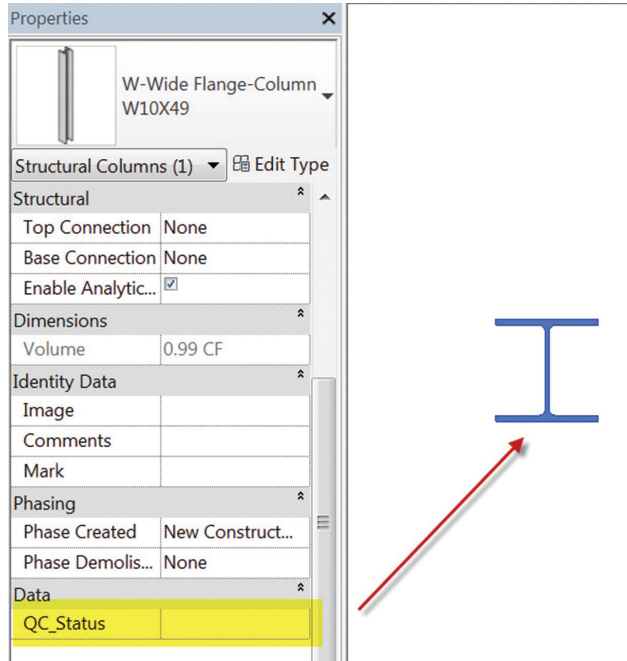
Figure 4: Properties of selected structural column

Figure 4 above shows the QC_Status parameter that was added to the selected column. Now all structural components in your model will have this common parameter. The next step would be to add values to this parameter so a filter can be applied. For this lesson, let's assume we are not engineers, but possibly EITs or skilled designers. As we develop a model we may have areas of concern that we would like to flag so the engineer can check our design on some beams. Figure 5 shows the value "Verify Size" has been added to the two selected beams.
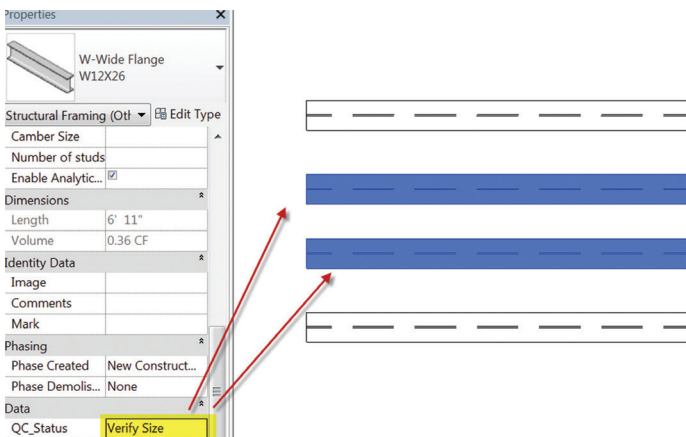
Figure 5: Verify size parameter value added

Now we can create our filter to highlight the areas of concerns in our design. Select visibility graphics for the view to which you want to apply the filter. Then in the filter tab, select Add.
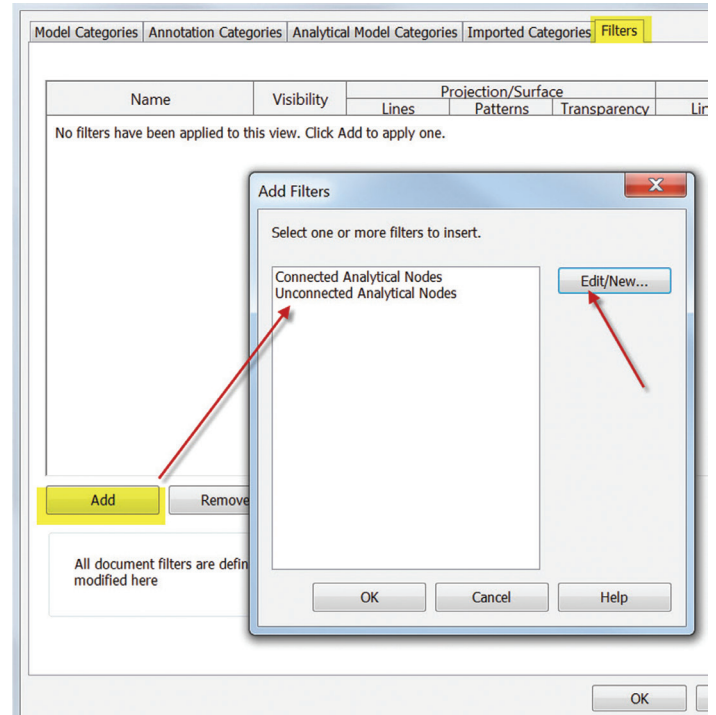
Figure 6: Add new filter

Create a new filter called Struct Sizing Concern as shown in Figure 7. Once that is created we need to define the criteria of the filter.
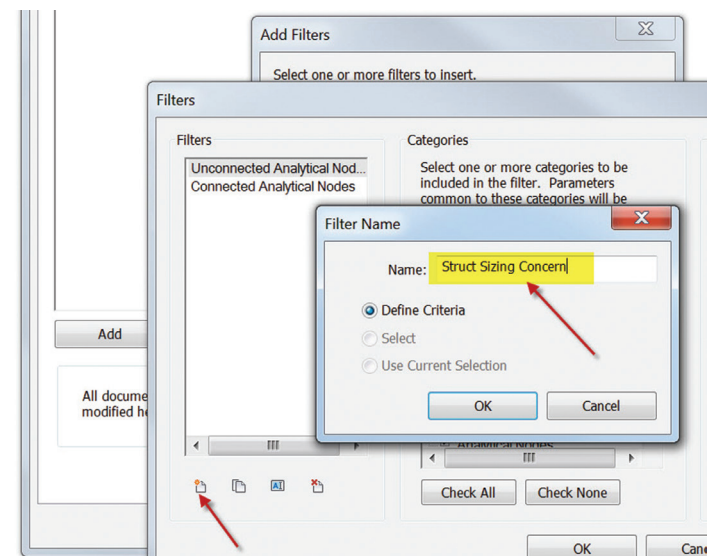
Figure 7: Add new filter

Revit Structure 2015

Figure 8 shows the properties for the new parameter filter we created. This filter will look at all structural beam systems, columns, framing, and foundations for a QC_Status parameter value equal to "Verify Size."
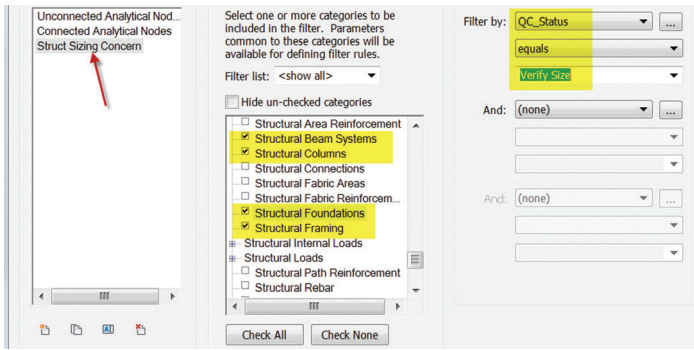
Figure 8: Filter properties

Once you select OK, after the properties are established, make sure you select the new filter in the list before exiting the "Add Filters" dialog box. This will apply the filter to your view. Filters are view specific, so this same filter can be applied to any other view that makes sense.
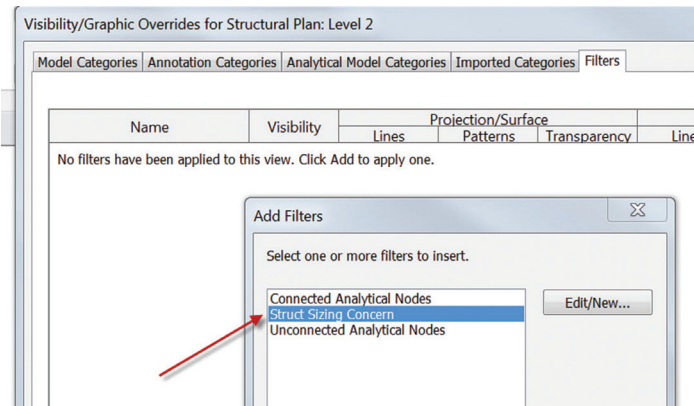
Figure 9: Filter properties

Now that the filter is applied to the view we need to apply the overrides to the graphics. Figure 10 below shows the settings used.
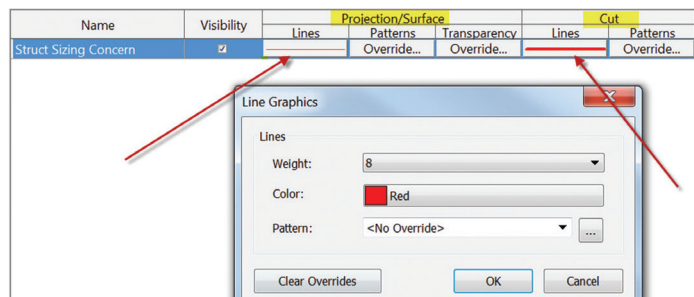
Figure 10: Filter graphic overrides
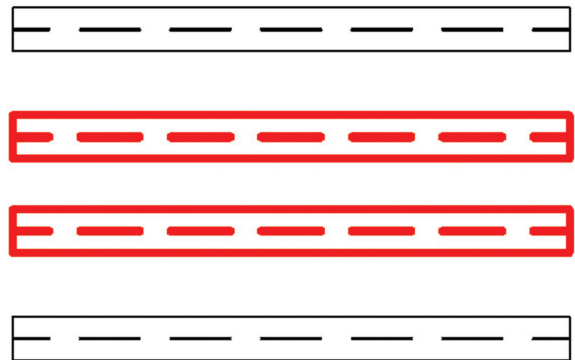
Figure 11: View results

You can see from Figure 11 that the two structural beams that meet the criteria of the filter have the graphic overrides applied to them. This is a very simple technique that can go a long way. These project parameters and filters can be part of your project start-up template so they do not have to be created all the time. Another consideration is to create quality control views in your template with the appropriate filters already applied. The point is to leverage all the tools you can to help perform better quality control checks to your models. This process is a lot different than a piece of paper and a red pen, but essential.

Philip Russo began with AutoCAD version 2.5 in 1986. Through the years he has held positions in the CAD industry as CAD Draftsmen, CAD Manager, Sr, Applications Engineer, and is a Certified Autodesk Instructor. Lately Phil's focus has been on the implementation of standard practices for Revit. He currently holds the position of Corporate BIM Applications Manager at O'Brien & Gere Limited, an engineering firm located in Syracuse, New York. Phil can be reached at phil.russo@obg.com

New Best Practices for Plumbing

Plumbing has a long-established set of best practices for drafting. But now, with the transition to Autodesk® Revit®, it is time to reconsider some of these practices. What made sense for your father's drafting table doesn't necessarily make the most sense for Revit. In particular, Revit tends to favor drawing plumbing the way it will be installed rather than drawing it in order to improve drawing clarity. Historically, plumbing has been represented diagrammatically in order to make the drawings easier to read and to reduce the number of views. Revit, on the other hand, is very good at representing pipes and valves precisely where they are, but struggles somewhat with producing clear diagrammatic representations. This is a significant change for those of us who have been designing plumbing for decades. It is no longer enough to create drawings because "this is the way we have always done it." Instead we have to be asking, "are any of these conventions still relevant?"

Many of the drawing conventions around floor plans are not necessarily relevant in Revit. Let's start with a simple example of line spacing. On a typical 1/8" scale domestic water plan, cold and hot water lines are drawn nine inches apart. The reason is so that there is enough space in the drawing for text to be legibly written in the gap between pipes without overlapping the opposite line work or text. Yet, in reality, the pipes are not nine inches apart. If the pipes are each a half-inch diameter with two inches of insulation, they will be installed six inches apart. By following the past conventions and drawing these pipes nine inches apart, we are deliberately introducing a degree of inaccuracy to our Revit model in order to uphold an anachronistic standard developed to accommodate text on drafted drawings. This inaccuracy could potentially lead to false clashes in the model. And if there are a large number of pipes being drawn—say, cold and hot water, a return line, a fire protection main, and a gas line—the problem is compounded several times over. The following example illustrates

Revit MEP 2015

why it is often not good practice to model like we are drafting. We are not drafting anymore, we are modeling.
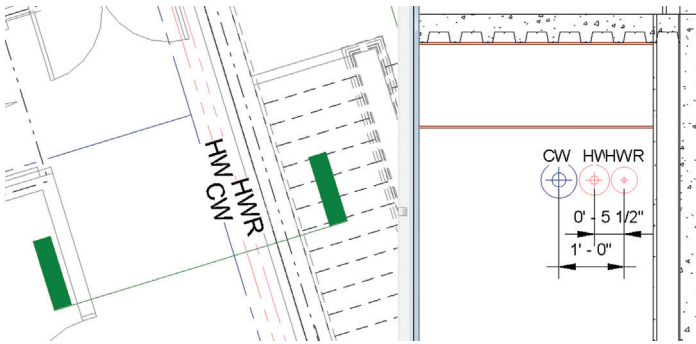
Figure 1: Needed spread
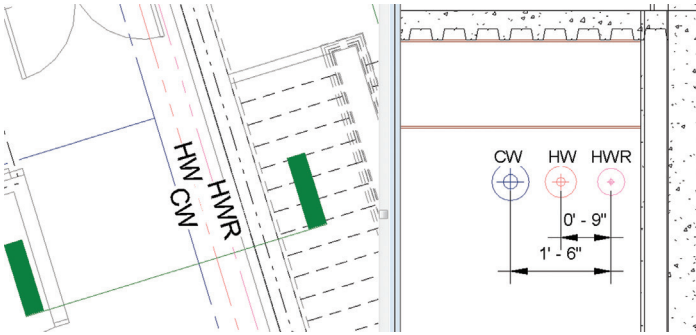
Figure 2: 9-inch spread

The 1/8" scale is another tradition that lacks relevance in the world of Revit. Historically we have limited ourselves to the 1/8" scale because we only wanted to "show it once." That is, when we were hand drafting, we only wanted to represent objects one time. We didn't want to correct multiple views whenever we made a single change. Also, we didn't want to make larger scale views and add more sheets to the drawing set because this would add significant labor and material costs.

These practices survived the CAD transition because the principles behind them were still valid when we were still drafting with CAD. But I don't believe they are valid anymore now that we are modeling in Revit. The "show it once" mentality doesn't apply to BIM. The element is represented once in the BIM database and can be shown in any number of drawings. You model it once, but show it as many times as you need. Should you make a change, the element is automatically updated in all the places it is shown. With "show it once" no longer applying, we are free to use larger drawing scales. This may add additional sheets to the set, but the time needed to manage the additional sheets is insignificant compared to the days of hand drafting. Any extra printing cost will be negligible, especially now that most drawings are exchanged electronically, either as PDFs, DWFs, Navisworks®, or Revit models themselves. I would argue that using a larger scale stays true to the traditional drafting principles of clarity and readability. It does so by providing a drawing that is clear to read with less clutter.

Now let's turn our attention to the representation of vents and waste in Revit. Most people show the waste below the level and the vent in the plenum space above. This can be confusing because the
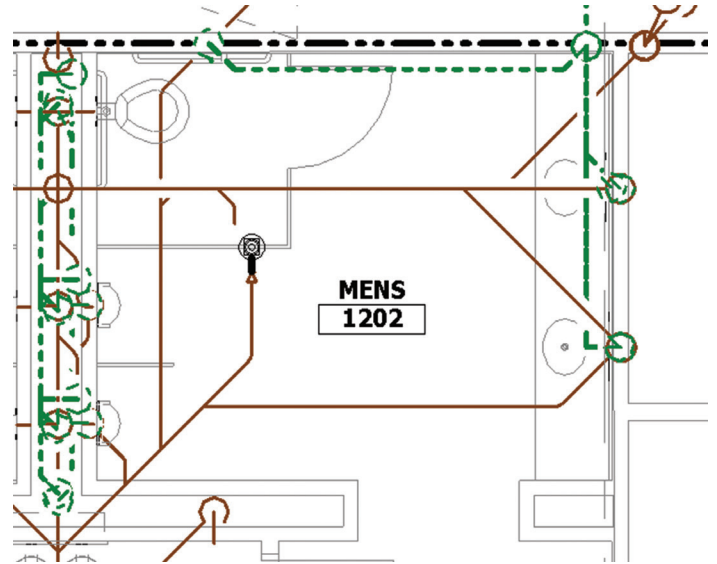
Figure 3: Overlapping view ranges
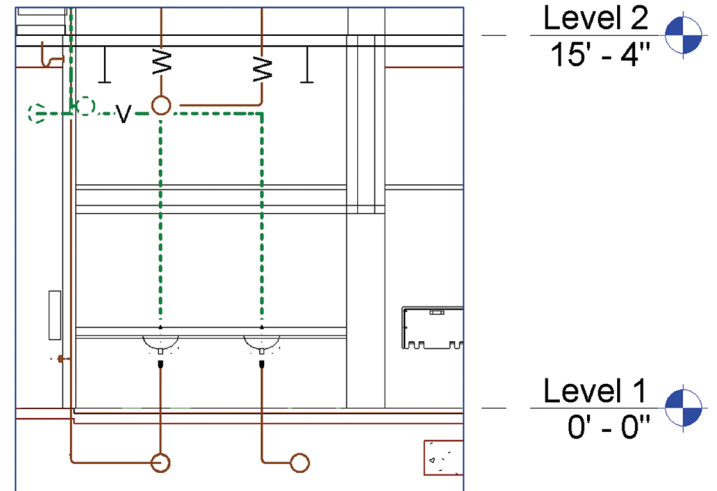
Figure 4: Overlapping section

plenum space above also has a waste line in it for the floor above. The waste line serving the floor above is also in the same view range as the vent line for this floor. We need a way to differentiate between the waste on the current level and the waste serving the floor above that is within the view range. There are several solutions to this. One solution is to create separate worksets for each level and use a filter to isolate only the piping pertinent to the current level. This method requires significant effort to maintain the accuracy of which elements are on which workset. One trick that helps is to have an odd workset and an even workset instead of having one workset per floor. This reduces the number of worksets to three: odd, even, and common. If you are using this method be sure to pay close attention to the pipe rise drop symbols because they can easily get confused if you have one portion split between two worksets.

Another way around this complication is to create one waste view and one vent view. Place the vent view over the waste view on the same sheet. If the two views are using the same scope box, then Revit will assist you with placing the second view by providing an alignment guide vertically and horizontally. There is one drawback to this

approach: the pipe gap settings do not get applied when the vent line crosses over a waste line. It helps to have good differentiation between the line types as does printing to PDF with a good line merge setting. Annotating these views can get tricky as you don't see the elements and annotation from the other view. If you are working directly on the waste view, you won't see the vent lines and corresponding annotation. If you open the sheet and activate a view to annotate, you see the elements and annotation from both views.

Vents and waste are another element where historic drawing conventions need to be reconsidered. Traditionally, vent line risers are drawn in plan rotated out at a 30° angle so that you can view the lines more clearly. This isn't an accurate representation of what will be installed and is, rather, a convention intended to improve clarity. Yet in Revit, it is no longer necessary to rely exclusively on 2D plans. One of Revit's strengths is the way it draws sections and 3D views. You can model accurately and use sections and 3D views to provide clarity instead of rotating objects 30°. For areas where the plan view is not sufficient, I recommend including a section or an isometric view. It takes little to no time to generate, so why not?
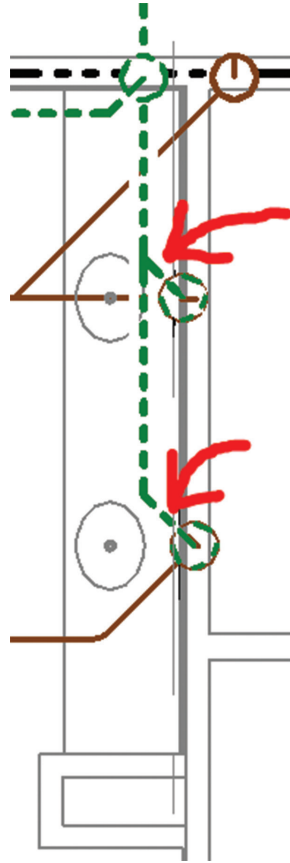
Figure 5: Vent lines kicked out

The last drawing convention I want to discuss pertains to riser diagrams. These diagrams resemble the piping systems designed, yet the pipe lengths, fixtures, and connections do not represent how it will actually be installed. It is just a diagram, after all. In Revit, a view skewed 30° will give you a view that resembles a riser diagram, but there may be areas where critical piping is hidden by a gang toilet or some other obstruction. Traditionally, the piping would be stretched until the obstruction was out of the way, but in Revit stretching the piping around would ruin your floor plans.

Well, with a few simple tricks, riser diagrams can be better in Revit than they have ever been before, all while actually using the piping from the model. The riser diagram shown in Figure 6 is composed of three duplicated 3D views, each with a different scope box that shows different areas. These can be placed onto the same sheet in the relatively correct locations. The gang toilets can be stretched out of the way by moving the 3D view. Add some continuation squiggles to your views where the lines appear to end. Then maybe add some drafting lines with a hidden line type along with pipe
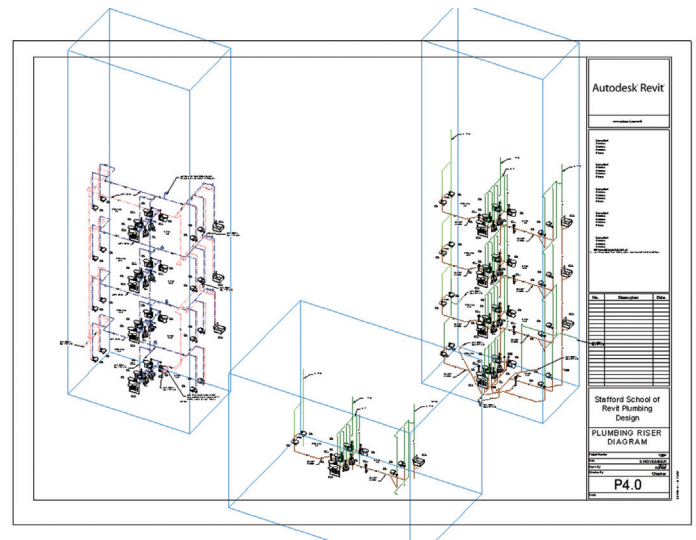
Figure 6: Riser diagram

tags and fixture tags so that it will continuously update as the design changes. You have your same old riser diagrams that are now built from the actual piping used in your model.

Regrettably, there is still an issue with the pipe gap setting being ignored on 3D views. If this is causing you trouble, my only suggestion is to break from the traditional single line riser diagram and show it double line. As double line, you still don't get a pipe gap, but the closer pipe does hide the pipe in the background where they overlap. For domestic water, show the insulation increasing the hidden portion of pipe. This makes for a good-looking set of riser diagrams that are much clearer and more accurate than the traditional conventions.

With the introduction of Revit and the transition to modeling for plumbing, some of our drafting practices have become outdated. Some can be adapted, some may need to be pruned, but I don't think any are immune to change. We should take this as an opportunity to advance our craft. With the improvements to Revit's sloped piping and system calculation abilities, plumbing is going through a significant transition from 2D drawings to 3D models. Although modeling is different from drafting, we do not need to sacrifice our traditions of quality and clarity, but we do need to update our traditional drawing practices in order to adapt them for this new modeling paradigm.

David Raynor is a Senior Building Information Specialist at CASE and is based in Raleigh, North Carolina. With more than 10 years experience in the engineering field, David has supported and trained several teams transitioning to Revit MEP. He has worked on projects ranging from small tenant upfits to large-scale renovations. More of his writing can be found on his blog at digitaldesignrevolution.blogspot.com.

CAD Manager

by: Mark Kiker

The Myths of Mentoring

Last month we learned that mentoring someone was not exactly the same a sponsoring someone. Mentors pass on the wisdom they have gathered. They advise, suggest, and allow the protégé to pick their brains. Sponsors are more directly connected. Sponsors may have been part of the hiring or promotion of the protégé. Sponsors may encounter negative feedback about themselves if the protégé stumbles or makes a major mistake. Both mentor and sponsor are needed, but they are not the same.

We dug into what a sponsor does in last month's article. Now we will turn our attention to mentoring from the perspective of the mentor. Mentoring has changed over the years. When people think of mentors, they may think of the seasoned, mature executive passing pearls of wisdom on to young, eager, ladder-climbing rookies. But gone are the days of slow steady rises in the ranks by early career staff. No longer is the typical career started and finished at the same firm and maybe not even in the same industry. While mentor-protégé relationships still exist and often thrive, they are not what they were in the past.

MENTORS ARE GIVERS

Mentors offer input, perspectives, advice, suggestions, and even warnings to those they are mentoring. In a respectful manner, they look for ways to provide direction to others who have given them permission to provide such feedback. They enjoy passing on what they have learned. They embrace the challenge of assisting others. They focus on providing information that others can use to make better decisions, learn new skills, improve their management efforts, advance their careers, and open new areas of opportunity. Mentoring is not about the mentor. It is all about the protégé, but the mentor has advantages also (as we will discuss later).

If you are working from outdated frameworks and yesterday's definitions, you might have trouble making progress in your efforts to be a mentor, sponsor, or protégé. Let's look at a few myths that some may have about mentoring and being a mentor.

MYTH #1: MENTORS CAN HAVE ONLY ONE PROTÉGÉ

A singular approach may have worked in the past or in very formal processes, but today the matrixed organization provides so many opportunities to connect that it would be foolish to think that just one mentoring relationship is all that is needed or available. With so many areas of business, trade, technology, and finances that touch every person in their career, mentors can and should connect with more than just one person.

I encourage multiple connection points as you look to give input, advice, and provide perspectives to others. At any given time in your career you may be mentoring several persons in your firm at the same time. You may often see opportunities to provide perspectives to others that might help them gain insight into specific situations. Each relationship should take on its own flavor and areas of interest. You may be providing business understanding to one and technical tips to another. Several simultaneous relationships can happen, so don't think it is just one person you will be mentoring at any given time.

MYTH #2: MENTORING IS A FORMAL AND LONG-HAUL PROCESS

Mentoring may be a formal process that your firm has put in place. When I ask people if their firms have formal mentoring programs, about 10-15 percent indicate they do. When I ask how many are actually involved in the programs, I get about 10 percent. I have been in formal programs before and they have value, but I have seen the informal take hold with better results. Formal programs may not involve those who are really energized to be mentors. Many times, people get involved because they have to, not because they want to. Some formal mentors may be really motivated, but I have seen more

who are not. Another reason for lower success rates is that formal programs may go on too long. Some programs last for a year or more and the relationships seem to fade away after three to six months.

Some may disagree, but I think that the informal and short-term approach works best. This is the best way to get the motivated folks involved and also encourage some who may not think they are cut out for mentoring to give it a shot. There are lower commitment requirements and shorter periods of time. There may still be some formal components about it—such as how often you meet and what is discussed—but there is not a restrictive formal agenda, timeframe, and duration.

Mentoring can be successful if two people meet on an agreed-upon schedule and discuss an agreed-upon topic for an undefined length of time. It might be over coffee, in a conference room at work, or lunch or breakfast at a local diner. Whatever it is, the connection lasts as long as the need and agreement to continue exists. If the parties reach an end to the discussion, then they stop meeting or stretch out the meeting times by going twice as long between meetings, or check in once a quarter. It is a good idea to have a milestone date where both parties agree again to continue or to terminate the process.

MYTH #3: MENTORING IS JUST ABOUT GIVING ADVICE OR COACHING

I encourage everyone to provide input and advice when it is needed and welcomed, but do not confuse giving advice with mentoring. Giving advice, or coaching, is focused more on performance improvement as opposed to mentoring, which is focused on personal growth. Coaching is often part of a job function, but mentoring is not. And finally, giving advice is given in the arena of task or project function, while mentoring is geared toward life-long impact.

Everyone needs to pass on skills to others as part of their job. Training the next group of workers in the things that are needed is part of the fabric of working. Firms need people to train others. They need to have people coach others in their advancing job duties and scope. On the other hand, mentoring may span a job title, job function, and firm. The mentor is focused on refining the personal, management, and leadership prowess of the person, which in turn makes the firm stronger.

MYTH #4: MENTOR AND PROTÉGÉ MUST BE A PERFECT MATCH

I have been at firms where they set up an extensive process of matching the two people involved in mentoring. The leaders of the effort have discussions, interviews, Q/A, and much more. All efforts are focused on getting the right people together, having them click and get into lock step for the process to start. After all the effort and energy, the success rate at the end of the process still had a combination of successful matches and some dismal failures.

Since the process can be informal and not for the long haul, I would suggest a teaming of partners that happens naturally. As a mentor, look for someone who is eager to learn and teachable (actually taking advice and acting on it). Find someone you think needs a little help.

It is not that complicated. Strike up a conversation and ask if you could provide some feedback and maybe meet on a regular basis. They may push back a little and think it strange for you to ask, but don't give up. As a mentor, ask permission to feed into someone's life. Let the protégé define some of the areas of interaction beyond what you have in mind, then start talking and see where it goes.

MYTH #5: MENTORING BENEFITS ONLY THE JUNIOR PERSON

Many think that mentoring benefits only the protégé. While I think there are immense benefits to the early career professional as they seek to learn the ropes, the mentor also gains payback. While mentors should not be motivated by what they can get out of the process, there are some advantages to being involved as a mentor.

Mentors gain bragging rights when the protégé advances or masters a new skill. Others in the firm will notice and know that the mentor provided guidance and will look to assign the mentor when new project opportunities or tasks come along.

Mentors gain insight into areas that the protégé may know better than they. The mentor does not know it all. Not to typecast, but early career staff may know more about the latest technology or social media trends. The protégé may steer the mentor in new directions.

The protégé keeps the mentor connected to other staff and informal networking within the firm. When the protégé connects the mentor to staff that do not run in the same circles as the mentor, the mentor gains a viewpoint that may not have existed prior to the mentoring process.

CONCLUSION

By dispelling the myths of mentoring, I hope I have encouraged some of you to give it a whirl. It is open to all levels of employee, but managers and leaders should be involved. Do not shy away from a chance to connect and encourage another staff member as they move into areas of leadership within your firm. Next month we continue to look at mentoring. Until then, start looking for someone to help.

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

case

Printing in the AEC industry

For years people have been predicting the demise of the printed drawing. They have forecasted that drawings would be outmoded by phones, tablets, and virtual reality (VR) glasses. All of these technologies have arrived on the market. And while they have their place—so do drawings. Go to any construction site today, and you'll see a stack of drawings. In many ways the drawing has been unfairly targeted. The sheet of paper remains a universally understandable method of communication. There are no batteries or Internet signals to worry about. There is no interface to learn. The reality is that there is no pressing need to get rid of drawings—and it doesn't look like they will be replaced anytime soon. In fact, with the steady advance in printing technology, drawings remain as useful and as accessible as ever.

The reprographic industry is a mature and highly competitive market. Over the past couple of years, many reprographic companies have faced tough competition in terms of price, quality, and customer service. One particularly noticeable trend in the AEC industry has been the move from black-and-white to color drawings. Today, color is increasingly becoming a prerequisite. In part, this can be attributed to the widespread adoption of CAD, and the fact that architects have become more comfortable communicating in color. Color drawings aid communication and readiness, which makes project comprehension easier for everyone involved.

Color printing certainly isn't new. In 1991, HP introduced the DeskJet 500C, which was HP's first 300 dpi color desktop printer. In years since, the technology of color printing has advanced significantly, but it has never been able to match monochrome printers in terms of speed and price. As a result, most AEC firms utilize two types of printers: LED printers for monochrome printing and inkjet printers for color printing. Considering that the AEC firms often need both large-format and small-format printers, quite often they end up owning several different combinations of machines, which isn't very efficient. It means having different printers to maintain, interfacing with different software, and mistakenly sending drawings to the wrong machine.

HP's PageWide Technology overcomes the traditional division between color and monochrome printers. HP PageWide Technology uses tens of thousands of tiny nozzles on a stationary print bar rather than a scanning printhead. The reliable drop ejection process reduces print quality defects from 'nozzle outs'. Automated printhead servicing and calibration, including nozzle compensation, enable consistent operation and minimal service intervention. Printers incorporating this technology can print at twice the speed of LED printers. This means both monochrome and color can be produced faster and more efficiently. In fact, with HP PageWide Technology, AEC firms can produce color prints at the same cost as black-and-white drawings.

Of course, many AEC firms outsource their reprographic work to specialists. While they may not be aware of the machines printing their drawings, they will certainly be aware of anything that can speed up printing times and reduce cost. Those who do outsource still often maintain a few printers in their office just in case they need to quickly produce one-off print jobs. So almost every AEC firm, whether or not they outsource their reprographic work, will be affected by developments in printing technology.

As AEC firms face tighter project completion times, they are also under increasing pressure to quickly produce high-quality prints. Automation is one of the key factors of a smoother and faster print process. Technology including end-to-end workflow software, combined with peripherals such as online folders, makes print management more efficient. Additionally, automatic detection and correction of corrupted PDFs, automatic selection of small- and large-format pages, and on-screen soft proofing can all help reduce job preparation time by up to 50 percent.

For AEC firms, gone are the days of the LED and inkjet printer sitting side-by-side. Innovative technology that can provide end-to-end solutions and that can deliver much more, in terms of faster turnaround times and with less labor involved, are just around the corner. Both color and monochrome prints will be produced at much lower costs than ever before. And this will make it easier for AEC Firms to meet increasingly high expectations.

For more information, please visit:
www.hp.com/go/largeformatpagewide
www.hp.com/go/pagewidesubscribe
Or contact us at: pagewidelargeformat@hp.com

ABOUT HP

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ABOUT CASE

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

Technology in Practice, with CASE & HP

What to Expect Now That You're Hired

So you just completed a post-secondary course that taught the ins and outs of a particular Autodesk product, and now you are one of the lucky few to be hired in a challenging economy.

Not to sound like an over-protective parent, but do you have any idea what you have gotten yourself into?

Hopefully, this article will address just that. If you are a young beginner in a world of professional CAD users, we will look at what you can expect in a professional office environment, and what you can do to navigate safely through potentially unknown waters. Employers understand that you are young and new to this game, and generally they try to be patient and accommodate your needs to get you acclimatized in the office environment as quickly and stress- free as possible. But always keep in mind their expectations of you may still be high, so here are a number of tips that may help.

KNOW YOUR SOFTWARE!

This should go without saying, but there are a lot of things you will discover on the job that are simply not taught in a classroom environment. In a high-pressure office situation where "time is money," your new employer may expect quick turnarounds, not "on-the-job-training." To ensure that you work quickly and efficiently, you should get to know your software's commands and tricks as much as possible to help make your creating/editing time more efficient.

For example, you are probably aware of the MLEADER command in AutoCAD® that allows you to create a dynamic leader attached to a piece of MText for robust note creating, but you may be unaware of the MLEADERALIGN command. This command helps you to manipulate the arrangement of several MLeader objects at once so you don't waste several minutes "eyeballing" the position of every MLeader object individually. My suggestion is to purchase a command reference book and learn as many commands (along with their settings, sub-options, and tricks) as possible. Once you become more familiar with the capabilities of the software, you will find yourself busier for more than one designer and will possibly guarantee your stay past your probationary period.

LEARN ACTUAL DRAFTING TECHNIQUES

If your post-secondary education was a technician or technologist course, or "just" an Autodesk-related software course, there is a chance you did not get proper drafting instructions. You may know the software and you may have been taught how to design, but unless you know how to properly lay out a drawing, your skills will get critiqued—hard! Even though your company may have pre-defined templates established to eliminate all the up-front work, they won't do the actual drafting for you.

Take the time (and yes, this will be on YOUR time) to find help online, or check out a book from your library on how to do proper drafting. Even if that book may not pertain to your particular

discipline, the fundamentals will still apply (i.e., layout of objects and details and placement of notes, etc.). One trick is to get a set of drawings from within your company to see how they do drafting as well as talk to the "old school" drafters who have been with the company for many years. One thing to keep in mind is that even though your company may follow traditional drafting conventions, it may still have a particular style that makes your company stand out against other companies, so prepare yourself for things that may seem unconventional.

GET TO KNOW THE DESIGNER

One of the biggest challenges every beginner will face in an office environment is to understand the psyche of the person they are working under. In every office, regardless of the profession, there are people whose personalities are polar opposites of one other. You may be working for a designer who is very relaxed with an easy-going personality, or you may work for a designer who always seems under pressure with a high-octane personality. Keep in mind this is true regardless of their age, gender, and/or experience.

At the end of the day, every designer expects the same thing from you—a high-quality product provided with a quick turnaround time. But exactly how you get there is the challenge you will face. It is virtually impossible to explain in this article how to work with the personalities of your designers, but the best piece of advice you may take from this is to not take things personally if your designer seems disappointed in your work. Even with established company drafting and CAD standards, every designer wants something a little different on their drawings. The trick is to listen carefully to understand what they want, and if necessary, read between the lines. Sometimes what designers see in their heads or what they scribble on a drawing may not get translated verbally. Over time, and maybe even after some potential verbal abuse, you will finally give them the product they were expecting. From that, patterns will reveal themselves, and that is when you will learn what your designer wants. In the long run (the "silver lining," if you will), you will start anticipating the designer's needs, and when you start giving the designer the product he or she is expecting in shorter turnaround times, you will finally earn that designer's trust and respect, and you may soon become a "favorite" and maybe even a friend of your designer.

GET TO KNOW THE "GO-TO" CAD GUY/GAL

In nearly every office, either officially or unofficially, there is one person who appears to have all the answers to everyone's CAD questions. This person is commonly referred to as the "go-to guy" (or gal!), or the "AutoCAD guru." These are the people that other CAD operators, designers, managers, tend to trust the most with regard to anything related to CAD, and are generally very approachable when it comes to troubleshooting your problems. Not to generalize, but the go-to guys usually love to "geek out" with CAD software and are always trying to discover new secrets or solve new problems that arise within the software. It is very rare you will meet a go-to guy who feels obligated or burdened to be in that position and who is not approachable. No matter if your questions or issues may seem amateurish or not worthy of his

Employers understand that you are young and new to this game, and generally they try to be patient and accommodate your needs to get you acclimatized in the office environment as quickly and stress-free as possible.

or her time, the go-to person is usually more than happy to help and share knowledge. At the end of the day, the go-to guy wants everyone to be efficient with the software and is generally more than happy to help you get there—even if you find yourself asking the same question[s] over and over again.

STAY IN TOUCH WITH FORMER CLASSMATES

No matter what size city you live in or what size company you work for, the CAD community tends to be small and tight with one another. Having said that, I suggest you keep close ties with the former classmates that you knew back in school, and in this age of communication technology and social media, it is a lot easier to maintain close ties than it was for those of us "back-in-the-day." Since your classmates are also getting into the industry at the same level as you, their stories and perspective can help you gauge how well—or not so well—you are doing by comparison. However, when hearing their stories, keep in mind that the personalities of your former classmates may affect their opinion, so take everything they say with a grain of salt. One clue to listen for in their stories is how good the company is to work for overall rather than just how "bad" things are for your classmate. Assuming their stories are objective, they can help you avoid certain pitfalls.

In closing, I hope these suggestions will help you have a long and prosperous career using CAD software.

Murray Clack is the CAD Systems Coordinator for CBCL Limited, a consulting engineering firm operating in Halifax, Nova Scotia, Canada. He has been using Autodesk-related products for 26 years. Murray has had articles published in Autodesk's 'a' magazine, submitted tips and routines to Cadalyst magazine's "Hot Tip Harry," and recently provided consultation to Autograph Technical Services for the metric version of the CADCard.

Introduction To Reality Computing

The use of digital models, information, and workflows for product and project development is a well-established expected practice in many industries. Technologies for computer-aided design (CAD), computer-aided manufacturing (CAM), digital prototyping, and building information modeling (BIM) have already changed many design and delivery processes.

This use of digital information about the physical world is now laying the groundwork for another transformation: the integration of digital design environments and the physical world. Technologies to capture information about the physical world, manipulate and analyze that information digitally, and actualize the result back into the physical world are combining to enable new ways of working. These new technologies for "Reality Computing" are already improving workflows across industries that design, produce, or manage physical products or projects—from jet engines to highways to running shoes.

WHAT IS REALITY COMPUTING?

For anyone engaged in the design, delivery, or management of physical things, Reality Computing is a vision for how technologies are breaking down the barriers between the physical and digital worlds.

Since the advent of digital recordings and audio CDs, music enthusiasts have been copying music tracks, editing or reformatting them to suit their needs, and publishing the results for other people or other devices. Colloquially known as "rip, mix, and burn," this practice completely upended the music industry.

Reality Computing is the same idea for data capture, creation, and delivery:
- capturing reality in a digital form,
- using that reality data to digitally create simulations, designs, and other information,
- then delivering the results back to the real world.

Virtual model-based designs that feed construction, fabrication, and manufacturing processes are commonplace across today's industries. But many model-based design workflows begin with a digital blank slate. Any design context—be it the wing of a jet or the environs of a new road—is then modeled using geometry

Figure 1: Reality Computing enables the direct capture of spatial information about the real world, use of that data in design processes, and delivery back to the physical world. Reality Computing technologies were used to carry out the I-95 New Haven (Connecticut) Harbor Crossing Corridor Improvement Program, pictured here in a digital rendering of the proposed infrastructure improvements. Image courtesy of Parsons Brinckerhoff

to represent spatial information. For example, the "existing conditions" of a building renovation project are usually created manually by modeling the existing building from archived drawings, supplemented with surveyed or scanned data for important measurements as needed. Anecdotally, this ratio (of modeled geometry to captured reality data) is roughly 90 percent versus 10 percent. As a result, design teams are spending hours, days, even months on modeling current reality before they ever get to the design phase of a project.

New technologies are now enabling the direct capture of spatial information about the physical world for integration into design processes. Design context is moving from geometry (modeled representations of the physical world) to this captured reality data. Reality Computing helps design teams improve design accuracy and accommodate physical-world conditions through customized fabrication of a design that is shaped to fit precisely with real-world conditions and environments. Furthermore, there is a technology explosion occurring for how digital projects or products can be realized in the physical world, from 3D printing and machine-controlled grading to augmented reality devices.

FUNDAMENTALS OF REALITY COMPUTING

Reality Computing is a high-level concept that integrates the digital and physical worlds, bringing together many products and technologies to digitally capture existing conditions, use that information to digitally create designs, simulations, and other

new information, and then deliver a physical representation of the results.

Capture

The ways information can be captured digitally from the physical world are increasing every day. Capture technologies—from laser scanning and point survey to photogrammetry and ground-penetrating radar—coupled with plummeting prices are promoting both ease of use and accessibility. For example, Figure 2 below illustrates the development of 3D scanning, including the introduction of the first commercial 3D laser scanning systems for the AEC industry. However, the systems were complicated and very expensive, limiting their market penetration, whereas today laser scanning is a staple of infrastructure and land development projects. Intel's announcement at the 2014 Consumer Electronics Show (CES) that it will start building RealSense 3D camera technology into its product lines is another example of how 3D scanning technology is becoming commonplace.

Consider when mobile phones first started to include cameras. Initially, the cameras were used as expected—to capture still photographs. Who would have imagined that today you can use that built-in camera technology to deposit checks, measure your heart rate, or translate a street sign in a foreign language? Similarly, as 3D scanning technologies (and the reality data they produce) become more available and more established, the derivative applications and integrations with consumer and commercial tools will follow—further broadening the reach of 3D scanning.

Timeline of 3D scanning
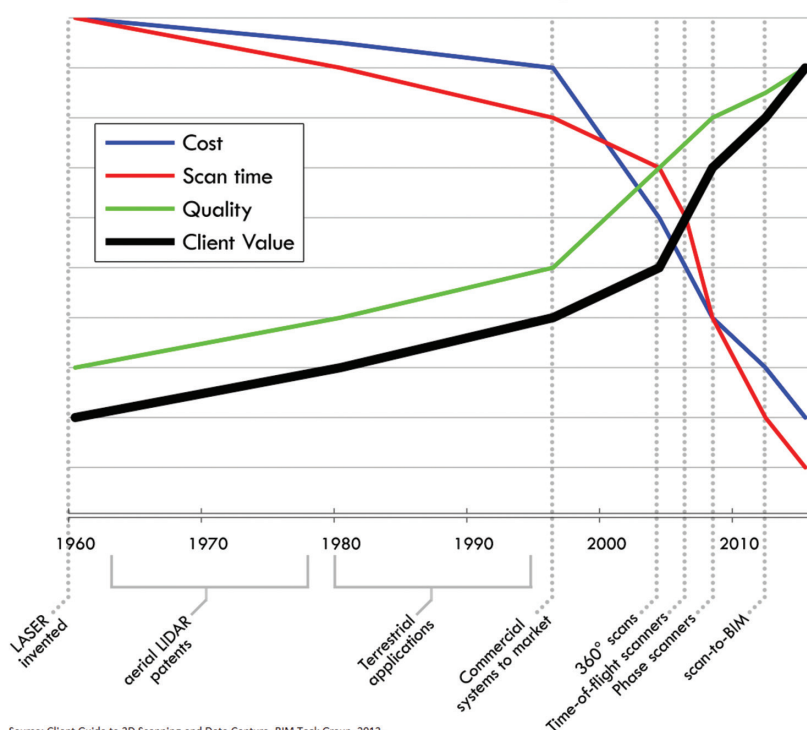
Source: Client Guide to 3D Scanning and Data Capture, BIM Task Group, 2013.

Figure 2: The first commercial 3D laser scanning systems for the AEC industry were complicated and expensive, limiting their market penetration. Today, the value and cost of laser scanning has made its use commonplace.
Source: Client Guide to 3D Scanning and Data Capture, BIM Task Group, 2013

This captured reality data is generally represented as high-density point clouds, which are very different from the descriptive geometry that design software uses today. The use of captured point cloud data in a 3D design application usually requires some sort of pre-processing. Processing typically involves registering different scans within a common coordinate system and then georeferencing that point cloud to a project's existing coordinate system. Moreover, the size of raw point cloud files can reach hundreds of gigabytes for large projects—rendering them almost impossible to work with in a modeling environment. Preprocessing software helps users visualize and work with these massive datasets.

Create

Once "reality" is captured and processed, the next step of Reality Computing is the ability to operate on the digital, real-world information. This may involve editing it to filter erroneous or unwanted data, manipulating it into new designs, adding new model information around it, analyzing it for new information, or using it to simulate real-world behavior or perform clash detection. Depending on the application, some teams may take the optional step of creating surface meshes or 3D solids from some or all of the scanned or surveyed data.

3D design software can be used to manipulate and directly interact with the reality-captured data. For example, a
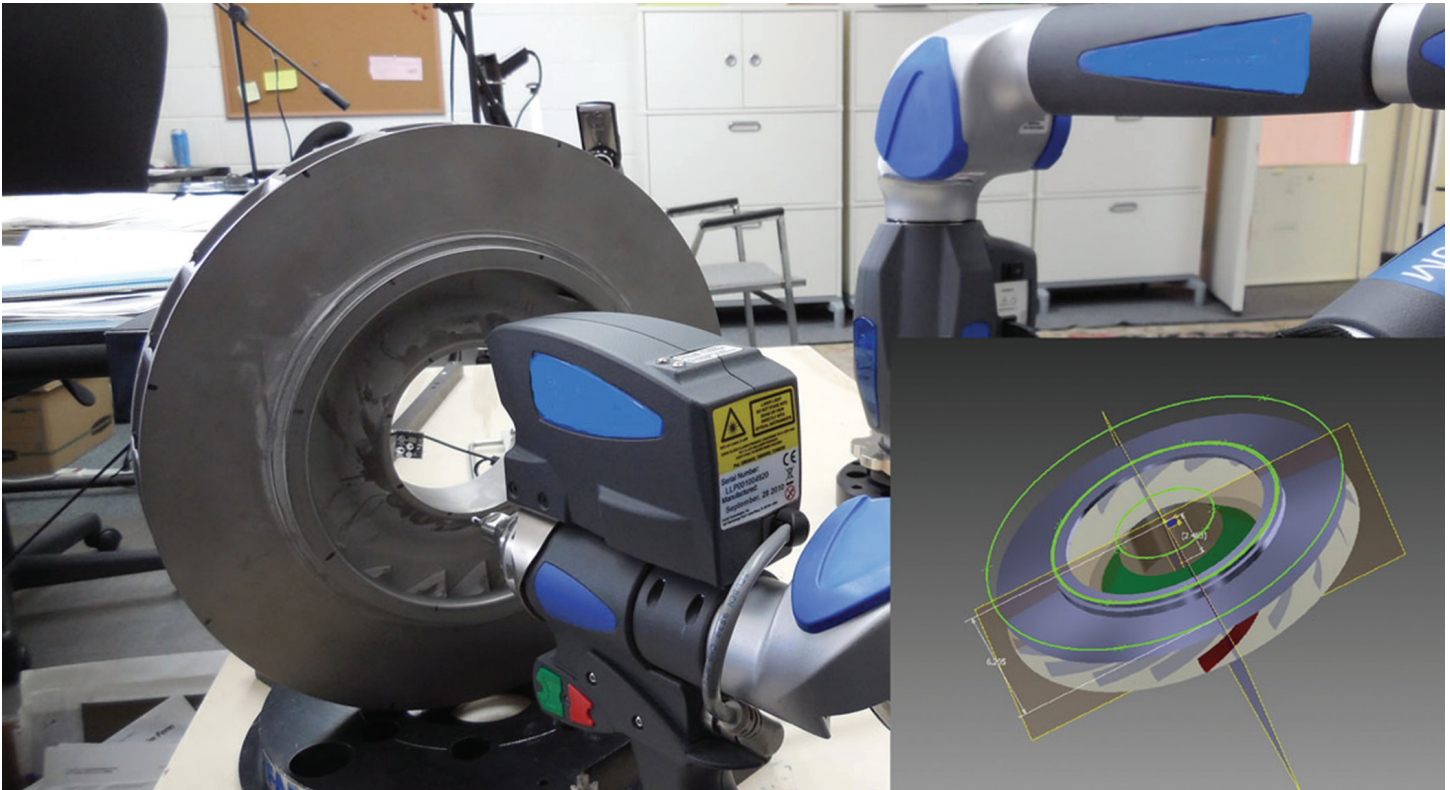
BIM

Figure 3: Reality Computing enables manufacturers to use metrology technology combined with feature recognition software to create 3D solid models for quality inspection, reverse engineering, and so forth.

civil engineer can import 3D laser scans of a congested roadway intersection into road design software as a real-world reference for early planning efforts to redesign the intersection. A damaged bracket on a military aircraft in a combat zone can be scanned and the reality-captured data uploaded to a manufacturing facility across the world where the data is imported into mechanical design software, the damaged portion is digitally repaired, manufactured, and replacement part is shipped back to repair the aircraft.

In addition, enabling technology for segmentation and feature recognition of reality data allow designers to interact with point clouds and high density meshes in more intuitive, object-like ways. Manufacturers can use metrology technology—both laser scanning and contact-based coordinate measuring machines (CMM)—combined with feature recognition software to convert point cloud and contact-probe data of manufactured components into 3D solid models. These models can then be used for a variety of purposes such as quality inspection during the manufacturing process or for reverse engineering. Similarly, feature recognition software helps civil engineers manipulate point clouds of existing terrain or infrastructure as an object rather than a collection of points. For example, specialized feature recognition software can automatically identify relevant features from point clouds, such as bridges, signs, and streetlights in scans of highways corridors.

The ability to import, visualize, and edit reality-captured data can also help streamline "scan to BIM" processes. Scanned data of a building can serve as a reference to create or validate a building model used as a starting point for the building's renovation. Scans of a newly poured concrete slab can be imported into a 3D

design model of a new building (that contains the digital design of the slab) to perform deviation analysis—highlighting high and low areas that need adjustment. Scanned point cloud data of an existing facility can be combined with digital models representing new equipment or renovated spaces for project coordination and clash detection.

Deliver
The last leg of Reality Computing is the delivery of captured and modified reality data back in the physical world. This can be accomplished digitally (using project visualizations or augmented reality) or physically (using 3D printing, machine-controlled earthworks, and other digital fabrication techniques).

Digital Realization
The ability to produce and present high-quality images or animations of a new building or a consumer product can sometimes serve as a replacement for product prototypes or scaled-down physical project models. Project visualizations can be particularly important on large projects where sheer size and complexity make it difficult to fully convey designs using traditional engineering drawings. Model-based project visualizations that include reality data help project teams depict the project in the context of actual surroundings, making it easier for clients, project stakeholders, and the public to understand the project.

Inexpensive mobile devices and the growing field of wearable computing devices that layer digital information directly onto your visual field will soon make augmented reality presentations routine. The popularity of tablets and smartphones have already

Figure 4: Model-based project visualizations help project teams depict their projects in the context of actual surroundings, such as this rendering of the Shanghai Tower.
Image courtesy of Shanghai Tower Construction and Development Co., Ltd. Rendering by Gensler.

improvement of 2D printers (from dot matrix and ink jet printers to color laser printers), the speed, quality, and versatility of 3D printers is increasing while costs are decreasing.

In the commercial world, 3D printing is a well-established technology used by manufacturers for cost-effective prototyping, mold-making, and small-scale production. Car companies are 3D printing full-size prototypes of a car body for aerodynamic testing. Manufacturers of military parts use 3D printing to quickly and remotely produce customized replacement parts for military equipment. Industrial designers developing consumer products use 3D-printed prototypes to examine the aesthetic and functional appeal of their product designs.

Consumer applications for 3D printing are still the domain of hobbyists, but already enthusiasts can buy action figures with their own likeness. Imagine a household that designs, downloads, and prints its own products—from custom toys, jewelry, or iPod cases to foods such as pasta and chocolates.

resulted in countless consumer-level augmented reality apps, like pointing your iPad at the night sky to see overlaid star charts, or using your smartphone camera to superimpose ATM or subway locations.

Sure to follow will be an explosion of commercial augmented reality technology. Shop floor supervisors and facility maintenance managers can already point their tablet at the QR code on a piece of equipment to access manuals, warranties, preventive maintenance schedules, and work histories. Construction workers already use automated laser surveying instruments to map coordinates from digital models directly onto construction in progress to ensure that steel anchor bolts were installed according to the design and within tolerance.

Physical Realization
For decades, the manufacturing industry has used digital design models and computer-aided manufacturing (CAM) techniques to support digital manufacturing—generating digital information to control robotic assembly, CNC (computer numerical control) milling, laser cutting machines, and so forth. More recently, AEC firms are physically realizing digital designs at the civil infrastructure scale by robotically sculpting landforms through machine-controlled grading and using GPS-guided paving machines.

A more recent development for physically materializing digital objects is additive or 3D printing, a technology currently experiencing substantial price reductions. Similar to the

VALUE OF REALITY COMPUTING
Change
The comparison of reality-captured data over time can yield important information about progress, deterioration, or movement. Reality Computing helps teams monitor construction progress to evaluate subcontractor productivity and quality, measure changes of a building's critical structural supports while a tunnel is bored below it, or identify a new object on an airfield that may pose a security risk.

Location
Reality Computing enables processes to be accomplished digitally (and remotely) that otherwise would have to be accomplished in the physical presence of the site or object. For example, a team of construction experts in Chicago, working on a high-rise project being built in Singapore, study scanned data of a building's structural system to assess crane placement—without having to fly to the construction site. Researchers, curators, educators, and the general public use web-based interactive tools to digitally view, study, interact, and manipulate objects from museum collections—without having to physically see them or touch them.

Knowledge
Reality Computing allows analyses and simulations to be performed digitally rather than on the actual object or system. Industrial designers use 3D-printed components to test a product's form, usability, and ergonomics. Engineers use models
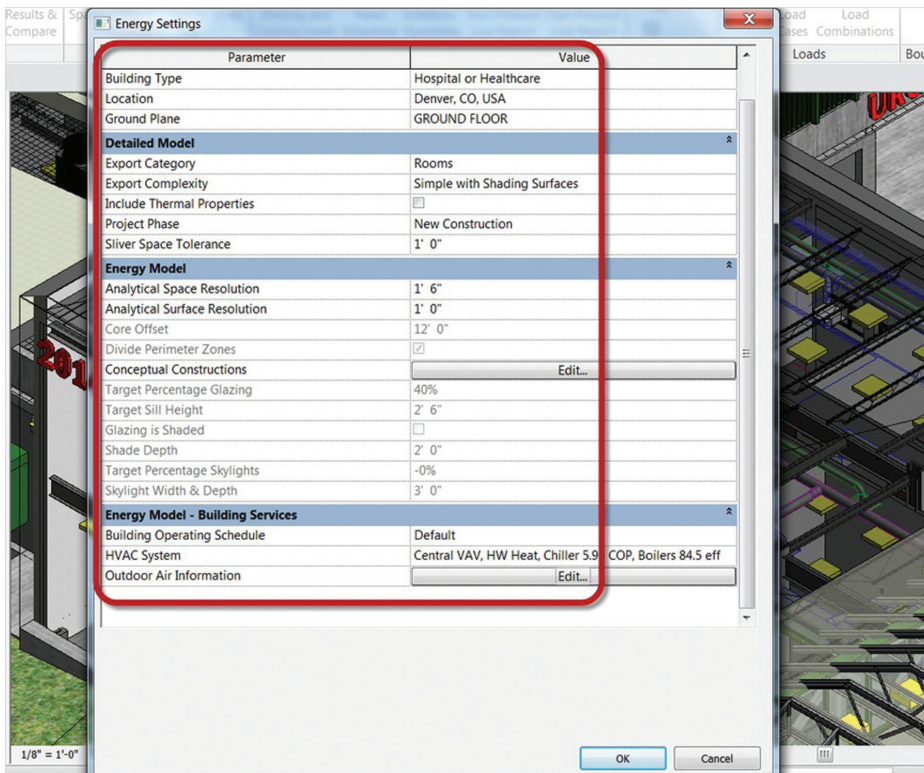
Figure 5: Reality Computing enables engineers to use digital project models derived from scanned buildings to perform energy analyses.

Fidelity

Reality Computing can replace complicated, failure-prone adjustments to fit an object to an exact physical condition. Reality Computing allows designers to accurately reflect the physical world (existing or as-built conditions) in their design model for coordination and manufacturing/construction planning. For example, "driving" a virtual model of a new car body through the digital point cloud of an existing automotive assembly line to verify production; or scanning and importing the existing abutments that will support a replacement bridge.

INDUSTRY RAMIFICATIONS

The Reality Computing examples mentioned above are just a few high-level illustrations. Below are some more specific examples of how forward-thinking organizations across industries are using Reality Computing technologies. In these examples, organizations are capturing physical information digitally using a variety of different technologies. They are working directly with this captured reality data using digital tools that do not require them to turn the scanned data into modeled geometry. Additionally, they are putting that data back to work in the physical world through 3D printing or other numerically controlled production or visualization technologies.

derived from scanned buildings to perform energy analyses and determine a facility's carbon footprint. Civil engineers create cinematic-quality project animations to support project approval and public outreach efforts for large (sometimes contentious) infrastructure projects.

Specificity

By recreating and accommodating physical real-world conditions, Reality Computing is helping designers move directly from a digital model to a finished physical object via custom fabrication and construction processes. Examples include creating brackets to precisely position a curtain wall system on a less precise structural frame, or 3D printing a perfectly fitting dress or jacket.

For more than a century, modern manufacturing has been defined by the maxim that complexity and uniqueness are expensive; in other words, it's cheaper to produce a large volume of the same thing at a lower unit price. But digital realization is beginning to break that industry touchstone. Digital fabrication, 3D printing, and related technologies are enabling designers to move directly from a digital model to a finished physical object. As a result, complexity and uniqueness have become cheap and manufacturing is being democratized.

— Construction Executive, September 2013
Digital Dreaming by Dominic Thasarathar

Building Construction and Maintenance

McCarthy Building Companies is saving hundreds of thousands of dollars on the Kaiser Permanente Oakland Medical Center by not modeling as-built conditions. Instead, they are laser scanning the construction at key milestones for a higher level of detail and accuracy than would ever be possible in an as-built 3D model. If they (or the hospital's facility group) need to go back into a completed section of the hospital for additional work, these scans will help them perform "arthroscopic surgery" on the facility—using a hole saw to access the services in the wall instead of closing down an operating or patient room to open up the wall.

Stiles Corporation used Reality Computing to coordinate the installation of an 8.5-ton chiller during the renovation of a performing arts center in Florida. To limit the center's downtime, the firm used scanned reality data of the facility's existing mechanical room and the access hallway, combined with a digital design model of the chiller, to perform 4D clash detection and carefully plan the movement of the new unit.

Infrastructure Construction

Terrametrix paired mobile LiDAR scanning with powerful feature recognition technology for a survey of more than 7,200 bridges for the California Department of Transportation. This resulted in increased safety for the survey workers and a sizeable reduction in survey information turnaround time: from one month to one day.

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Figure 6: Automotive manufacturers use reality scanned data to capture existing conditions of factories and assembly lines. Image courtesy of Volvo Car Group.

Weaver-Bailey Contractors has started to replace conventional, manual survey and control methods in their highway construction business with grading and paving equipment controlled directly by digital design files, GPS, and laser control systems. By forming the physical highway directly from digital information on a six-mile stretch of Highway 67 in Arkansas, they expect a 40 percent reduction in labor and reduced material overruns from as much as 30 percent to 2 percent or less.

Automotive Factory Design and Manufacturing

Volvo Cars no longer tries to maintain as-built geometrical models of the manual assembly cells for their plants because the models are expensive to develop, immediately out of date, and lose the rich detail captured with the reality data. Instead, they scan existing assembly cells and the resulting point cloud is their digital plant. Rather than interrupting production to move physical mockups through an assembly line, Volvo Cars uses a combination of reality-captured and modeled data (of new assembly components and car bodies) to simulate and verify production processes for new models.

Aerospace Manufacturing

After thousands of hours of operation, the individual blades in a turbine or jet engine are worn but in balance with the rest of the fan. Businesses that specialize in the maintenance, repair, and overhaul (MRO) of this kind of equipment are often required to repair a damaged blade. But the work must match the worn state of the original, and therefore the original design models cannot be used. Instead, they scan the existing blade and use numerically controlled machines and specialized welding techniques to repair areas to the original, worn contours.

Consumer Manufacturing

Nike engineers modified a computer-controlled sweater knitting machine to manufacture the upper portion of one of their newest products—the lightweight Nike Flyknit. As the shoe is digitally stitched, the materials can be modified to alter the shoe's strength or flexibility.

Align Technology's Invisalign system uses digital modeling software and 3D printing for mass customization of clear, removable aligners that are used to straighten teeth. The system uses x-rays, pictures, and impressions—and more recently 3D digital scans—of a patient's teeth and mouth to create a digital model. This model is used to develop a treatment plan and produce 3D-printed custom-fit orthodontic appliances.

Healthcare

Healthcare providers and manufacturers use Reality Computing to produce medical solutions customized to individual patients such as orthodontic braces (mentioned above), orthopedic insoles, hearing aids, and hip implants. Doctors are also starting to use Reality Computing to create 3D-printed replicas of anatomy that help them plan and prepare for difficult operations. For example, a team of pediatric heart surgeons in Kentucky studied a polymer 3D-printed replica of a 14-month-old baby's heart prior to surgery to repair the child's heart defects.

In addition, 3D scanning and printing is being used to create custom surgical implants. For example, doctors in Wales successfully performed reconstructive surgery on a man disfigured in a motorcycle accident. CT scans were used to create a 3D-printed skull used for surgical planning, surgical cutting guides used during

Figure 7: The use of Reality Computing to support augmented reality will enable municipal and utility workers to visualize underground utilities superimposed over real images of a street. Image courtesy of VTN.

the operation, and a medical-grade titanium implant to hold the bones in their new shape.

Future Scenarios

Reality Computing represents a huge potential across multiple industries and as technology evolves, so will uses within and across industries. For example, consumers can already customize their Nike Flyknit shoes by choosing different color combinations for various parts of the shoes (upper, sole, laces, even the Nike swoosh). But in the near future, one can imagine a completely customized shoe that is contoured to an athlete's foot. You visit your local Nike store, have your feet laser scanned, and get a custom-sized custom-made pair of shoes printed for you while you wait. Longer term, maybe consumers will have their own household 3D printer to fabricate items such as custom clothing, toys, even replacement parts for household appliances.

"Most AEC firms laser scan existing conditions for use for design development on a renovation project. But we're doing it during the course of construction—creating as-builts as we go, and using that as a component within our change-management process. This has allowed us to mitigate the impacts of changes, and has helped to keep us on schedule and within budget."

— *Chris Pechacek*
Virtual Design and Construction Director
McCarthy Building Companies

Within the construction industry, the production use of augmented reality is just on the horizon—where utility workers and excavators will have ground-penetrating scanner devices hooked into equipment monitors (or even Google Glasses) displaying georeferenced 3D models of the underground utilities superimposed over live images of the construction area.

The use of Reality Computing to produce medical solutions customized to individual patients is already happening (see examples above). Currently, medical researchers are investigating ways to 3D print actual soft-tissue organs—a finger or a kidney for example—that will not be rejected by a patient's body.

For industrial manufacturing, military personnel in combat zones or technicians in remote areas are already scanning equipment and machinery parts to digitally repair and fabricate a new part. In the near future, these groups could carry small portable 3D printers to produce the part on the spot and repair technicians using Google Glasses could view information related to the equipment (such as animated repair instructions) to quickly get the equipment back in service within days or even hours.

Reality Computing may even be destined for space one day. A professor at the University of Southern California has developed a layered fabrication technology for automating the construction of whole structures as well as sub-components. Single or multiple houses can be 3D printed, complete with conduits for utilities. "Contour Crafting" was initially seen as a way to quickly construct emergency concrete housing or to build concrete structures in locations such as Hawaii where concrete must be imported. But NASA is considering the technology to robotically print an airport on the moon or habitats on Mars.

CONCLUSION

Reality Computing—from capturing reality data and digitally creating new information, to the physical or visual delivery of digital information in the physical world—represents an information platform shift for the design, production, and management of physical things.

While the constituent technologies of Reality Computing have developed independently, they are increasingly being integrated into new workflows by organizations and teams across a range of industries to improve performance and better serve customers and clients.

by: Paras Nanavati

PRODUCT REVIEW

Real-Time Rendering With Fuzor

A s the BIM manager for an architectural firm specializing in residential, commercial, retail, and hospitality, I am always looking for new ways to present our designs to clients as well as to have ways to better interact and visualize our designs.

There are various rendering and visualization tools that have the ability to add accurate materials, light, and entourage to create a realistic sense of the final architectural product. Some of these tools are complex and some not, but all of them have something in common: it takes a certain amount of time for the completion of the rendered view or animation. If more changes are made to update the original scene, there is often additionally waiting involved to get the updated result.

For those of you working in Autodesk® Revit® who want to be able to realize your visualizations in an effortless environment without compromising on speed, quality, and, accuracy, meet Fuzor, a high-quality, real-time rendering application that integrates seamlessly with Revit.

WHAT IS FUZOR?

Fuzor is an application developed by Kalloc Studios (a former game design company with offices in San Diego, California, and Hong Kong) for the AEC industry. The application takes after a sophisticated live link engine originally designed for game designers working in Autodesk Maya to enable them to see their gaming assets directly in the game. The AEC application to live link allows designers to immerse their Revit models into the live link (gaming) engine and interact with it from a third person (desktop) or first person (mobile) perspective. As tested, Fuzor Ultimate consists of the following major toolsets:

- Getting Started
- Navigating the Model
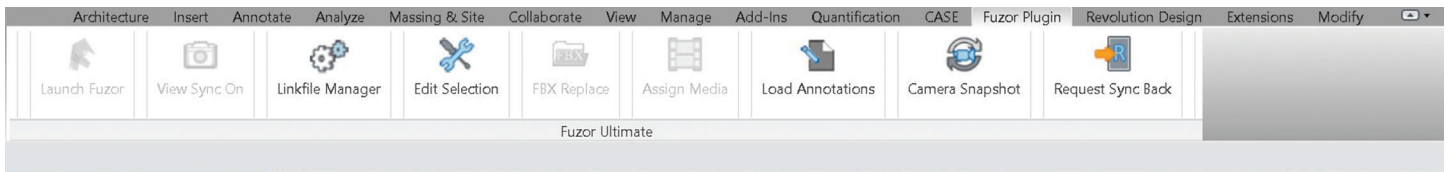- Presenting the Model
- Extensive Device Support

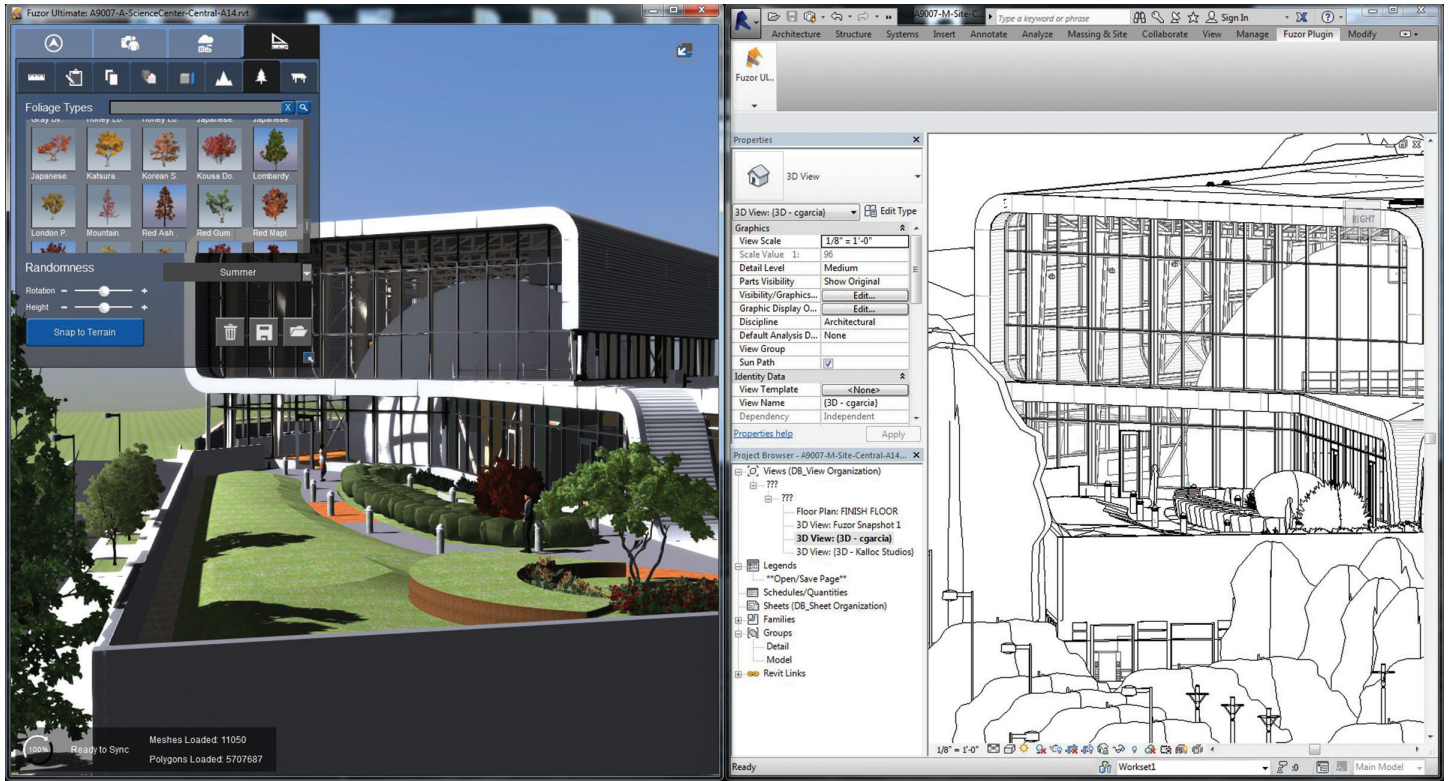Figure 1

Figure 2: Fuzor Plugin tab

Figure 3: Revit + Fuzor.

GETTING STARTED

The value in Fuzor lies in the design synergy between Revit and Fuzor. The bi-directional live link between Revit and Fuzor is quite impressive and has enabled me to have my projects visualized in real time effortlessly. All that was required was to click on the launch Fuzor command from within the Fuzor Plugin tab. On launch, Fuzor loaded all the 3D content and its lightweight engine was able to not only have all RPC content realized accurately, but also offer a range of four render modes (sketch effect, realistic, abstract, and consistent). Next I made sure my View Sync option was checked on, thereby ensuring that navigating to any view in Revit will have the same view in Fuzor. This is useful as it allows for easy sectioning in Revit and being able to view the same view with rendered materials and lights in Fuzor without the excessive wait times that would be endured if rendering solely in Revit.

The next interesting toolset was the bi-directional linking. Here, any change made in Revit such as changing the location of a chair updates the Fuzor file in real time. Additionally, deleting another chair in Fuzor can delete the chair in Revit if the changes are synced back. Moreover, since Fuzor logs all the families in the Revit file, additional instances of the families can be placed in Fuzor and synced back to the Revit file as needed.

NAVIGATING THE MODEL

There are a variety of navigation modes in Fuzor. There is a choice between using basic Revit controls, Naviswork controls, free camera control, Avatar control, and Oculus Rift control. I personally prefer the Revit controls to orbit the model, zoom and pan to a desired camera location to set up a scene and save a view. The highlight of the application is the ability to navigate the project model per an avatar's point of view. There are a variety of avatars available—you can choose between being a man, woman, or child. There is also a range of avatar customization, from construction worker to formal, casual, and even a fitness theme. Additionally, we can have a vehicle if the project in question involves an Infraworks model.

The avatar control uses the direction keys to walk through the model and uses a PhysX engine for physical simulation of movement and material rendering. The movement through the building appears seamless and can be assisted with a mouse for directionality. Some navigation pointers use space for jumping, hold shift for running, and use the right-click to open doors.

Fuzor inherits the location of the project from Revit and is able to further control the time of day using a simple clock dial. This dial controls the exterior ambient lighting and dictates when the interior lighting should go on and off. In addition to lighting and

Revit Architecture 2015

Figure 4: Avatars

time of day, we can also control the weather—from a clear sunny day to a dark stormy night.

To assist with navigating in a controlled manner and to assist in navigating vertically through a project, Fuzor provides all users with a 2D mini map usually shown on the top right-hand corner of the screen. The map can be clicked on to allow the avatar to be teleported to specific locations in the project model. The 2D mini map also has the ability to accept X, Y and Z coordinates to teleport the avatar to a specific location. To teleport vertically, the 2D mini map has a drop-down to select specific Revit levels to teleport to. Unfortunately, I was unable to customize this to not show certain levels in the selection criteria. By default, Fuzor takes all active levels and has them available as a teleport option.

PRESENTING THE MODEL

Once set up, the model can be presented in several ways. A fully functioning standalone cache file can be created by simply saving the project as a Fuzor Cache File (*.che). This option allows us to open Fuzor as a standalone application without the need of having Revit open and providing all the features in Fuzor Ultimate.

There is also an option to create a Fuzor viewer file where, once saved, all the settings of the project as set up before are committed

Figure 5: 2D mini map
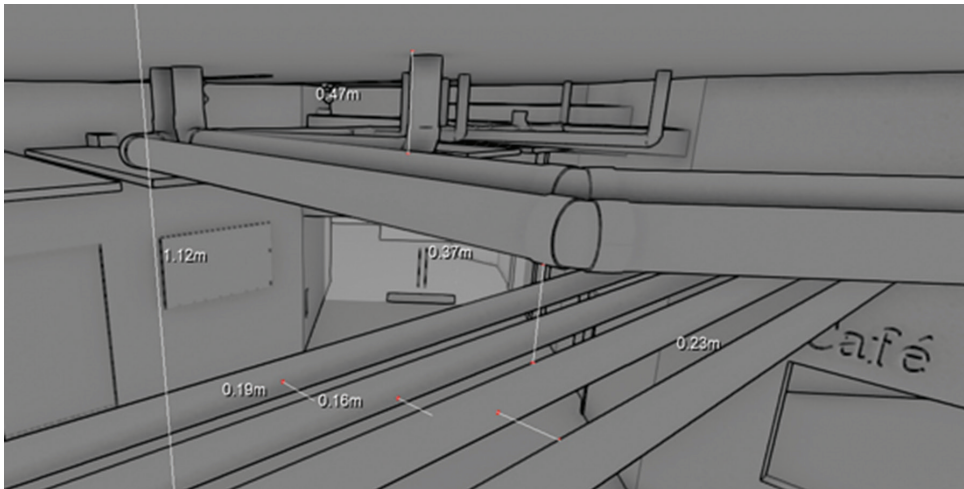
Figure 6: Screenshot 1

Figure 7: Measurements

Animations can be saved in two ways. They can either be saved as a pre-determined walkthrough or flythrough. The walkthrough follows a first person view that has me create a path through the project to experience the space in the model. This can then be exported as a MP4 (*.mp4) file. A cinematic video option has a lot more features allowing for a frame by frame reel that can accept more effects, annotations, visibility options, and view orientations. This can be saved as a Fuzor Movie Project (*.fmp).

EXTENDED DEVICE SUPPORT

Fuzor has extended in-built support for various devices. All Fuzor suites are compatible with:

- Oculus Rift
- 3D Connexion mouse
- Mobile device: Currently in beta (Android & iOS)
- USB Gamepad

ADDITIONAL FEATURES

There are several other features of Fuzor that are interesting:

- Design Option tool
- Linked file support
- Real-time lighting adjustments
- Real-time foliage/tree placement
- Real-time door animations
- Spawn particles, fire, smoke
- CCTV design and simulation
- Clash analysis and report generation
- Light meter measurement and report
- Footstep counter measurement

to a self-executable (*.exe) file, which can be opened on any computer even if it does not have Fuzor. This has been a great way for me to share project models with clients and consultants. Not only can I share the entire project in an application that is intuitive and easy to use, but it is also a read-only version of the file, which ensures that no one viewing the file has the ability to accidently or consciously write to it.

The mobile cloud panel has the ability to save the Fuzor project to a mobile device running on an Android or iOS device. There are three options to create a Fuzor mobile file (*.fzm): we can save the file to Google Drive, Dropbox, or to a local/network location. I personally like the in-built Dropbox, integration and have used this successfully to save the Fuzor mobile file and access the same via my iPad. Please note that the mobile platform is currently in beta and needs further development.

HD screenshots can be saved as an image file (*.png) and there are several resolution options available during the save process. Selected views can be saved as Fuzor snapshot project (*.fss) within the project or exported as screenshots individually.

INSTALLATION AND LICENSING

The installation is pretty straightforward. You will be directed to download the package after you have purchased the software. Just follow the onscreen prompts and you will be ready to go. It is not an MSI install so Revit cannot be open during installation or any updates / upgrades. Fuzor uses the Autodesk Revit API and SDK, thus it has the ability to translate native Revit families to Fuzor content making its bi-directional link possible. After the install, you will have a new tab in Revit titled Fuzor Plugin. The first time you click on the tab it will prompt you for your license key, which you should have received after your purchase confirmation. Enter the key and you now have access to all the Fuzor tools. Fuzor, though complex and powerful, is pretty intuitive and can be learned by exploring over a few days. Still, some users may opt to get formal training.
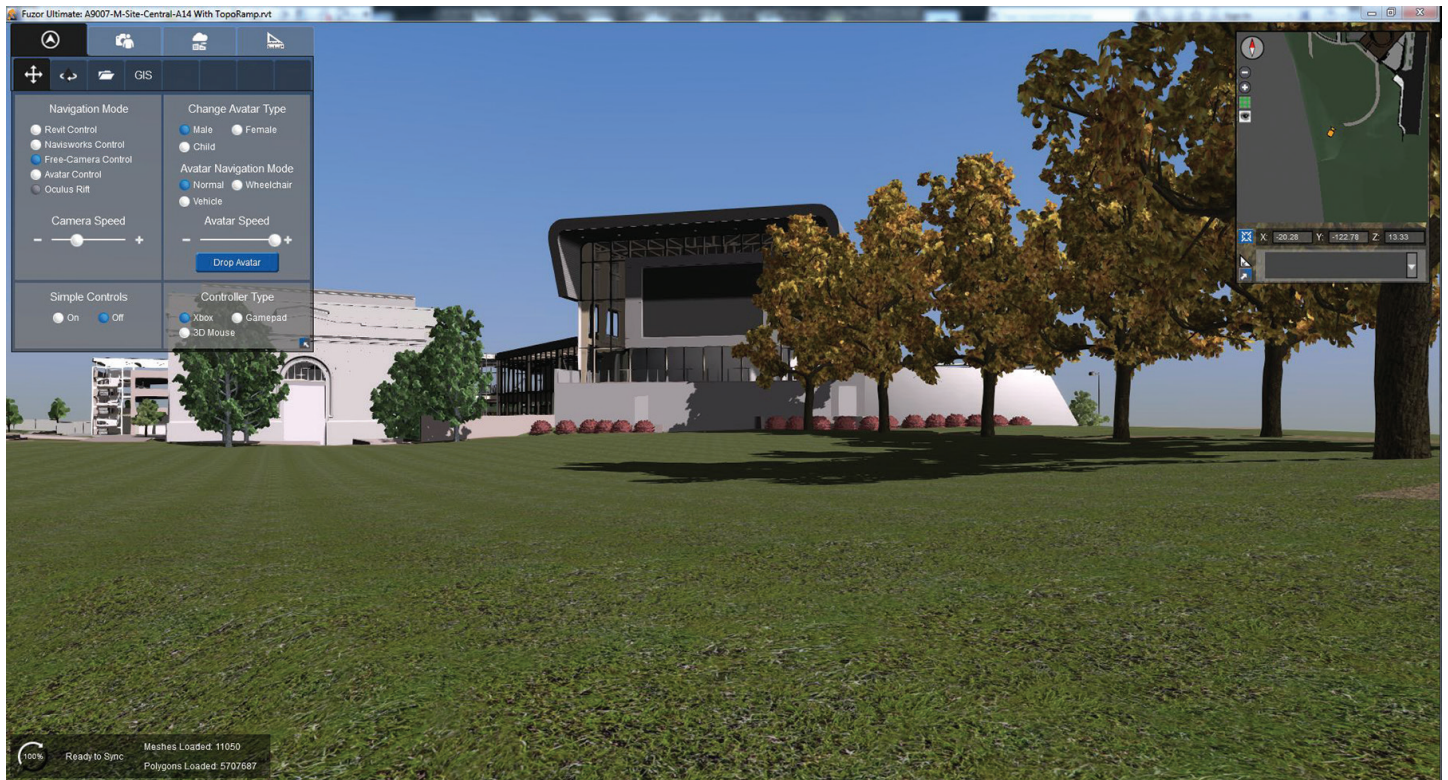
Revit Architecture 2015

Figure 8: Screenshot 2

CUSTOMER SUPPORT AND TRAINING

The company's customer service and the training personnel I talked to are very friendly and knowledgeable. They are experienced training professionals not only with their product but they also understand Autodesk Revit and have a very good idea of how the design process works within an architectural office. They have support staff available in their San Diego office available from 9am to 5pm Pacific Time. Their reseller network consists of Redstack for Singapore, Malaysia, Indonesia, Vietnam, Taiwan, Germany, and Australia. YTC is the reseller for South Korea. CTC (CAD Technology Center) is the reseller in the Midwest (USA). They also have a lot of feature videos and are always happy to jump on a call with you to answer specific questions.

WHAT WILL IT COST AND HOW CAN I GET IT?

Fuzor offers both monthly and annual subscription and perpetual licenses. The monthly subscription for Fuzor Ultimate costs $300 and an annual subscription costs $3,250. Perpetual licenses are offered as standalone or networked. You also have the option of purchasing other modules if you do not need Fuzor Ultimate. To purchase the software or for more information, go to the Kalloc Studios website www.kalloctech.com or email them at info@kalloc.com.

PROS AND CONS

Pros:
+ Ease of installation, use, and speed
+ Rendering quality is good
+ FBX support
+ Software is capable of producing standalone viewer for clients
+ Easily integrated with Revit
+ Price – an easy pay-as-you-go for monthly subscription
+ Mobile device support
+ Oculus Rift support

Cons:
+ Not quite a design tool in itself, but does integrate well with one
+ Some of the BIM workflows are anemic so using it as a standalone tool is hard
+ Mobile support in beta
+ No ability to have dynamic movement of objects in animations
+ No formalized training curriculum and materials

FINAL THOUGHTS

Fuzor is a powerful application with great ambition. Every update to the software has seen some major enhancements and it has gone from strength to strength since the first time I used it more than a year ago. Its ease of use, minimalistic interface, and incredible speed worked exactly as advertised. If the annual commitment is too much, I recommend a pay-as-you-go approach and use it as needed. I give it 8 out of 10 stars and urge you to try it.

Paras Nanavati is the BIM manager at Architects Orange. With a background in physics, architecture, and sustainable building, Paras has more than 10 years of experience in the construction industry. He is experienced in managing and implementing BIM programs on a variety of project types.

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3ds Max 2015

by: Brian Chapman

Intro to 3ds Max
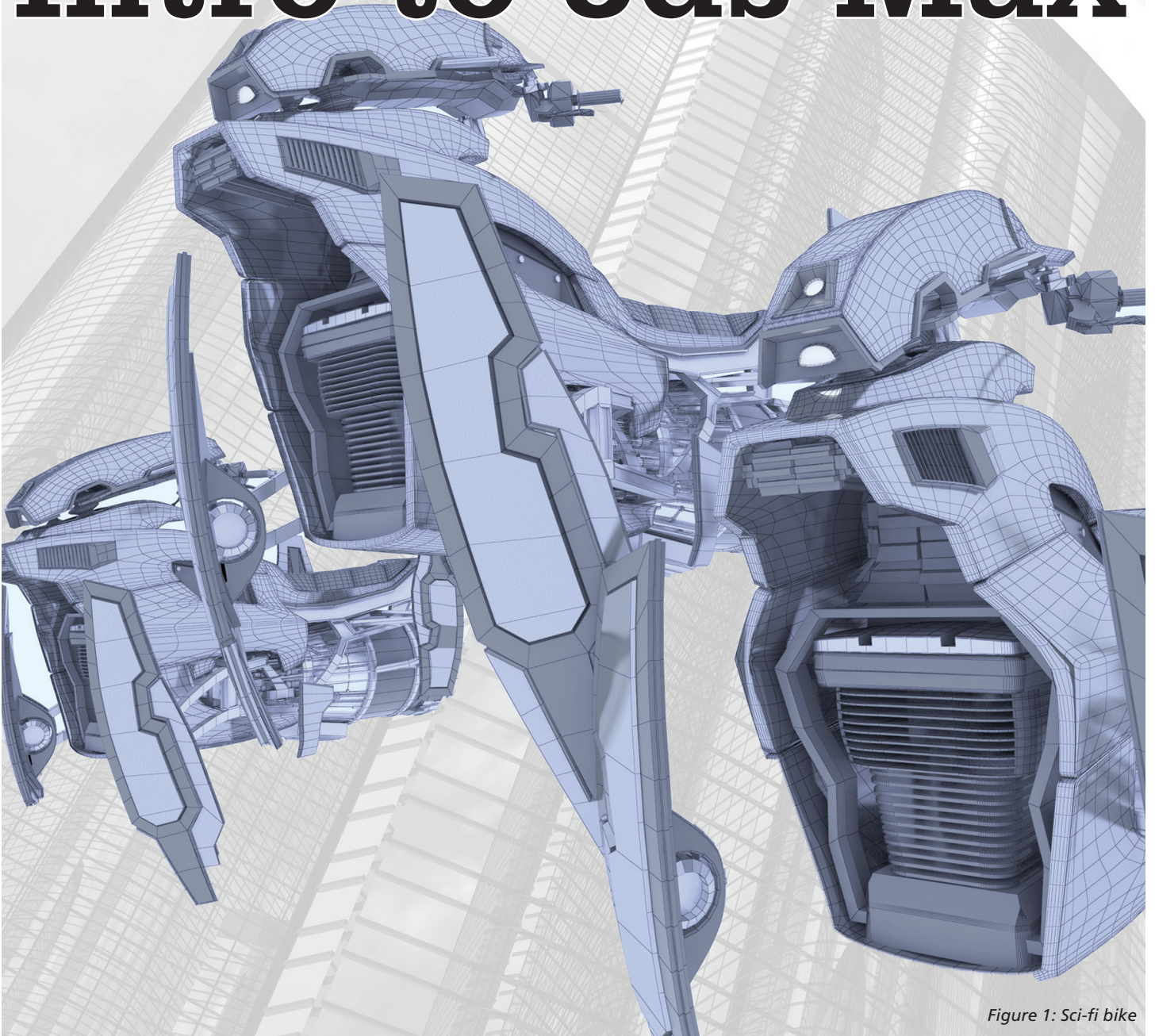
Figure 1: Sci-fi bike

3ds Max is meant to provide comprehensive tools for 3D modeling, design, creative, or analytical tasks. This includes AEC design and applications, movie effects, game development, animation, fashion, scientific research, and more. Some users dive in, stumbling through the software and grinding through for years to become Max's "jack of all trades." Others choose a more specific approach, mastering specifics areas, focusing on individual aspects such as scripting, stellar effects, rendering, animation, and others. In short, 3ds Max is for everyone who has the desire to dive in and learn to create virtually anything they want in a 3D environment of their own.

FIRST IMPRESSIONS

3ds Max can appear daunting, largely because it caters to so many users' needs. For most of us, however, tasks are streamlined using specific sets of tools within the Max interface. As you dive in and learn to use 3ds Max with tutorials, forums, and videos, each of them will refer to areas I've identified in Figure 2 and describe below.

Area 1 is referred to as the main toolbar. Users have the option to show or hide this toolbar, but since it contains several buttons to access various dialog boxes and options in 3ds Max I recommend users leave it on. Common tools within this toolbar include undo
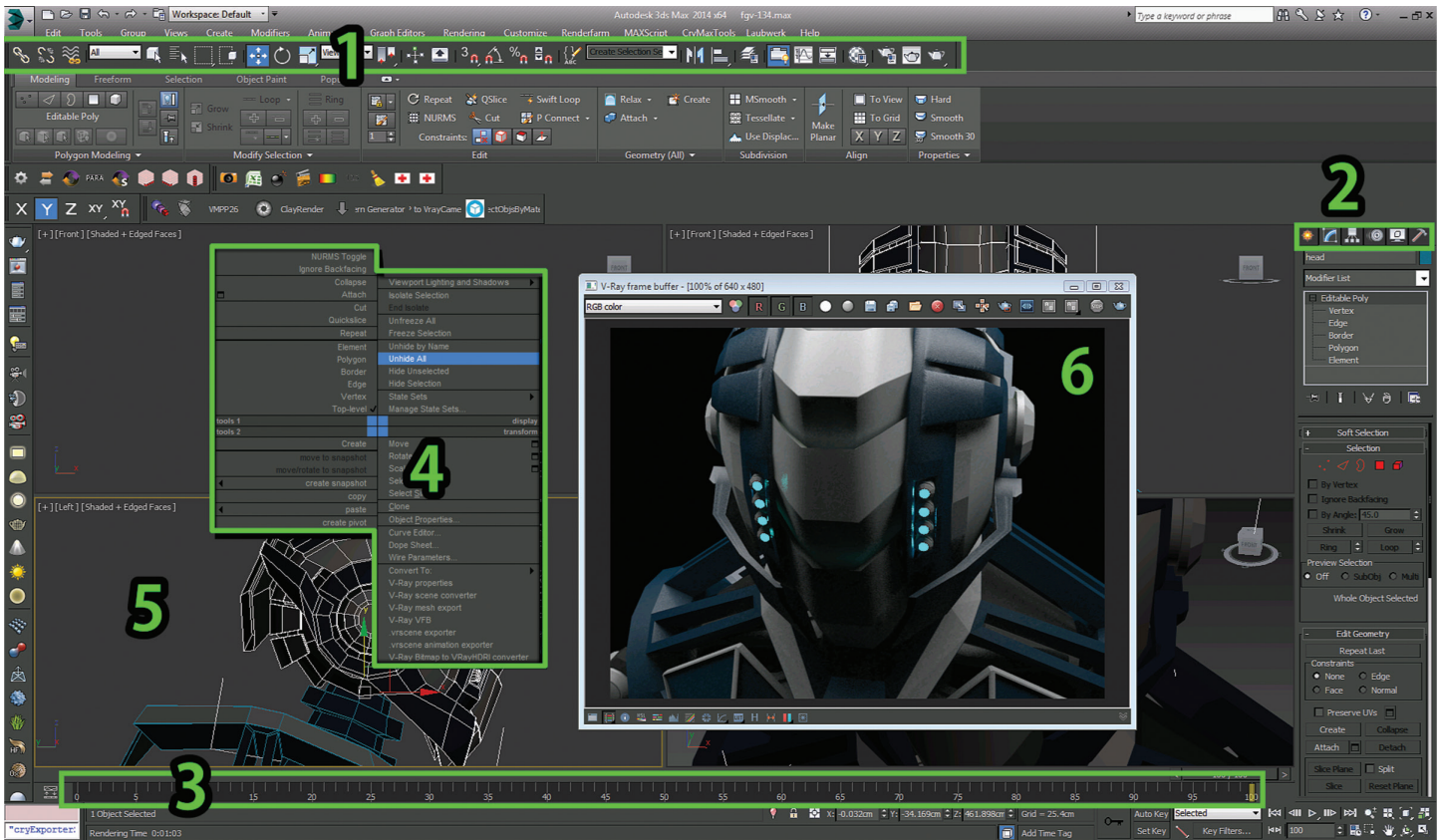
Figure 2: Interface

and redo, object selection and scaling options, and snap tools to aid in the selection by locations or points on an object or the screen. Also within this toolbar are the alignment tools, which allow moving one object to another based on the various options one chooses. Finally, access to render and material tools are also located on this bar.

Area 2 is referred to the command panel, where you'll spend most of your time. This command panel is separated into six different categories: create, modify, hierarchy, motion, display, and utilities. Area 2 can be described as the most geographically important piece of real-estate on your screen. Each panel contains its own tools, organized below each tab and in groups referred to as rollouts. Each rollout is expanded and contracted similar to the way directories can be explored in a Windows desktop environment.

Area 3 is referred to as the time slider. The time slider is specific to animation and will allow users to jump to any timeframe in a scene. Here, users can set and modify keys. Keys are essential to animation, allowing animators to control much more than just the movement of an object's position from one location to another. Keys can allow animators to control all aspects of transformation (position, rotation, and scale of objects), as well as give them options to control movements such as easing and actions such as thrusts or jumps so they look as realistic and believable as needed.

Area 4 is the quad menu, one of the more popular features in 3ds Max. When right-clicking over any object or within a viewport,

the quad menu provides users with quick access to common tools related to the specific object selected.

Area 5 is the viewport. Max provides several options for users to adjust the layout and number of viewports, but by default max starts with four viewports in different angles. On the top left of each viewport, users can control the angle at which they are viewing their object as well as how they wish to view it (shaded, wireframe, and so on).

Area 6 is the render window. This area is not specifically part of the interface and doesn't open by default, but because everything we do in 3ds Max eventually ends up here, I wanted to point it out. The render window is used to review an image or animation in its final state.

Brian Chapman is creator of pro-cad. net and Senior Designer for Slater Hanifan Group. Slater Hanifan Group is a civil engineering and planning firm dedicated to superior client service with locations in Las Vegas, Nevada, Lake Havasu, and Phoenix, Arizona. Brian can be reached at pro-cadman@pro-cad.net.

Welcome to The Family: The Transition To Civil 3D

Transitioning from existing technologies to new ones or implementing new technologies usually poses a challenge during the implementation phase for many reasons. If you are already familiar with the previous technology, in this case regular AutoCAD® as a drafting and design platform, the transition might be not so hard. However, if you are just getting familiar with the AutoCAD environment your learning curve might be steeper. But either way, transitioning to AutoCAD® Civil 3D® is worth the effort, and once you try it you cannot go back. I know there is more than one flavor of AutoCAD and I think regular AutoCAD will always have its place, but if you use it in civil engineering, land development, or a related field, then AutoCAD Civil 3D is for you.

BUILDING ON COMMON GROUND

As a user of both regular AutoCAD and AutoCAD Civil 3D, I know about the transition and the learning curve that comes with it. I know it might be a little difficult at first and, just like developing many other skills, it takes training, time, and effort, but it is all worth it. So whether you are coming out of college or have many years of experience, let me talk to you user to user.

Civil 3D is built upon regular AutoCAD so you still need to maintain good CAD standards such as having solid templates and good data management practices. Templates in Civil 3D have more elements than the templates for regular AutoCAD. Therefore, whenever you start a project, use a Civil 3D template rather than the acad.dwt template because it doesn't work well in Civil 3D.

Another big difference between the two programs is how data is managed within Civil 3D. For example, in regular AutoCAD the palette used most often is the Properties palette. This palette is also in Civil 3D and serves the same purpose, but Civil 3D also has the Toolspace palette. The Toolspace palette, along with the four tabs it has (Prospector, Settings, Survey, and Toolbox), is how data is organized and managed within Civil 3D. Once you start using it you realize that it is very intuitive and resembles how data is organized in some geographic information system (GIS) applications.

Figure 1: Graphical user interface for AutoCAD

TAKING AUTOCAD TO A CIVIL LEVEL

My background is civil engineering and construction management, and with that comes things such as design, drafting, and plan production. This makes me appreciate Civil 3D even more. So now let me tell you a little about some of the tools and workflows in Civil 3D for surveying, conceptual design, surface creation, land development, road design, pipe networks, earthwork, and more.

Civil 3D helps you work from field to completion. As you may know, in AutoCAD there are ways to import survey data and turn it into points that you can later use for drafting, but in Civil 3D you can do much more. For example, you can almost start drafting in the field while you collect survey data and assign codes to points you capture, then those codes tell Civil 3D what each point is—e.g., trees, hydrants, ground shots, fences, etc. All of this gives you a huge advantage when good workflows and standards are in place. The Survey tab in Prospector is where you organize survey data, create databases, and tell Civil 3D how to treat the data you bring in. In addition, when you work with the settings you find how you can start drafting as you import and process the data from the field while keeping the raw data intact.
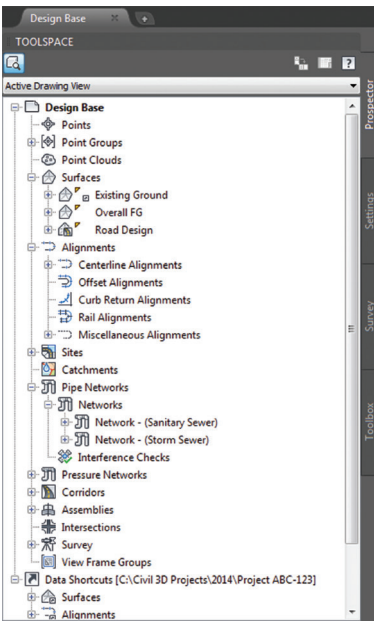

Figure 2: Graphical user interface for Civil 3D

Figure 3: Toolspace palette in Civil 3D
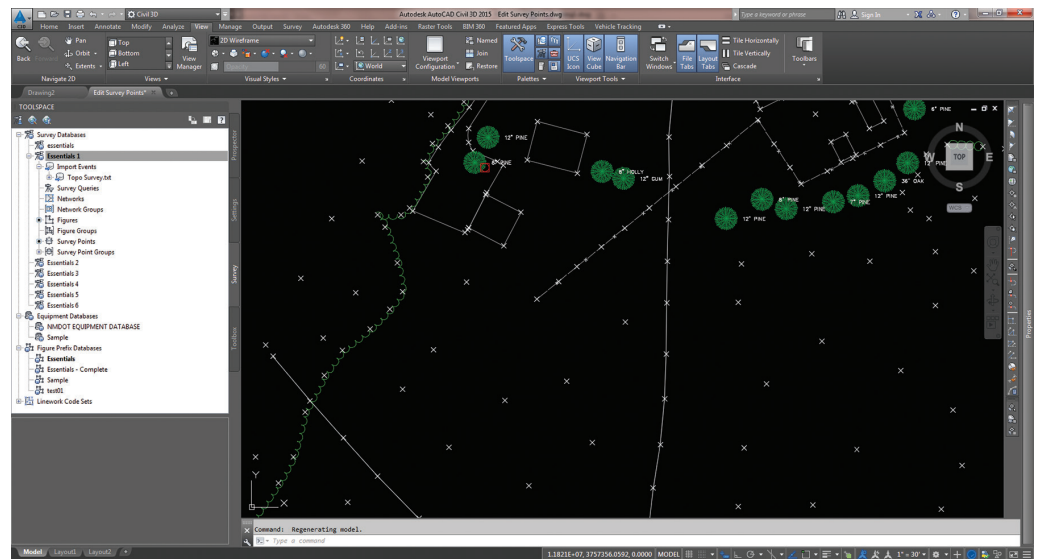

Figure 4: Survey tab and survey database

GEOGRAPHIC INFORMATION AND ELEVATIONS AS THE 3D ELEMENT

As we are talking about data, it is important to point out that the amount and quality of data you have will greatly affect the decision-making process and the planning phases of most projects. Sometimes the data collected by the surveying crew is not enough and you might have to look at some other sources. Civil 3D has GIS capabilities that help you make use of much of the GIS data available out there; this data is georeferenced, which helps put everything in context. Amid the GIS data Civil 3D are aerial photographs that you can use as background images in your drawings, shapefiles representing road centerlines that you can turn into road alignments, shapefiles representing parcel boundaries that you can use for subdivisions, contour lines that you can turn into existing ground surfaces, and so on—all within the same program.

As the name suggests, Civil 3D uses the elevation component in the data to take drafting to a new level. The most common example of this is the creation of ground surfaces from point data—with just a few clicks you have a 3D representation of the existing ground conditions of your project based on survey data. Regular AutoCAD also has some 3D capabilities, but they are limited compared to what you can do with Civil 3D. This is particularly true in the context of land surveying and civil engineering because the 3D capabilities in regular AutoCAD are used mostly in other industries.

URBAN PLANNING AND SUBDIVISIONS

When you work in Civil 3D you use a combination of 2D and 3D objects. Let's say that you are doing a residential development and you already have an existing ground surface, which is a 3D object. Now you want to determine the best layout for a given number of lots, common areas, and a retention pond you want to accommodate. You can do this by drawing lines and polylines, then you find the areas of the closed polylines and add text to label lots and common areas, but if the layout changes you do it all over again. Does that sound like a workflow you have seen before?

Civil 3D provides automated tools that can be used for subdivisions and urban planning. These tools calculate areas, add labels, maintain relationships between objects, split areas according to the user-given parameters, etc. The objects you work with are dynamic so if you make changes to the layout the rest of the objects change accordingly. In Civil 3D you use Sites, which basically are containers that tell Civil 3D what objects interact with each other. You can create and use different sites for different layouts, in each site you can have multiple Parcels, which in Civil 3D are closed polygons that can represent the original traverse and the proposed lots in your subdivision. Working with sites and parcels allow designers to quickly develop and manipulate layouts; they also provide immediate feedback about sizing and the interaction between objects. In addition to immediate feedback during the design process, you can apply different styles to your parcels. These styles can include specific
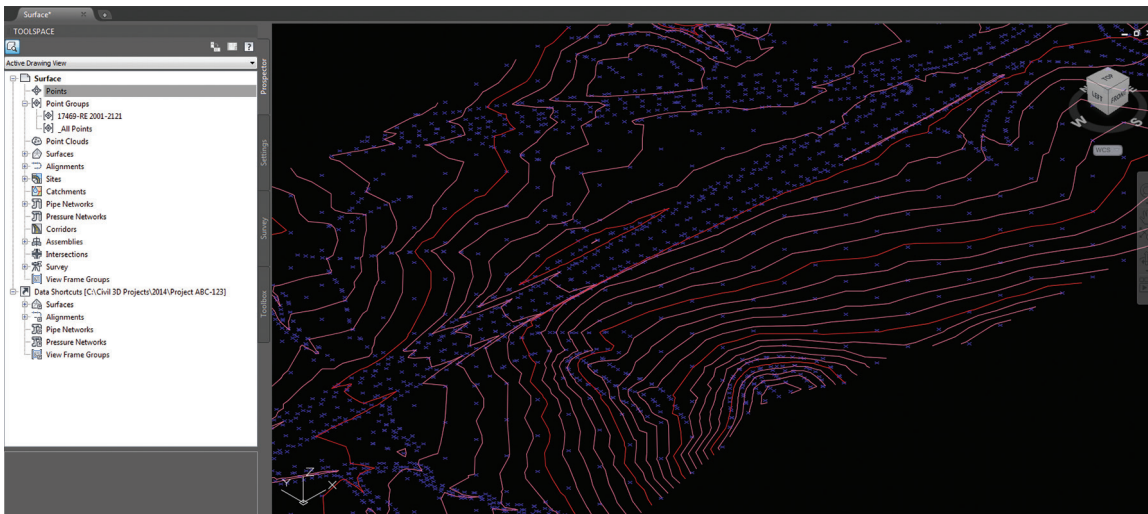

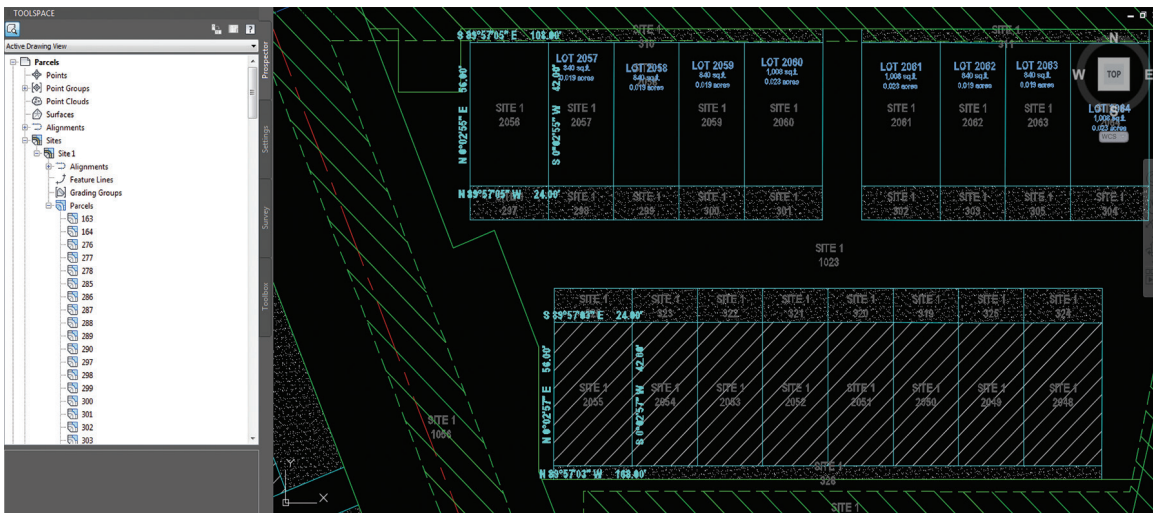
Figure 5: Surface created from point data

Figure 6: Parcels showing areas, distances, and bearings

hatch patterns to indicate what each parcel is, and by using styles you can keep track of areas and land uses in your development.

LET'S HIT THE ROAD

When it comes to road design, in AutoCAD you can start by using lines, arcs, and polylines to draw the initial geometry of the road you are designing, then add markers every 100 feet and labels—but if the geometry changes you might have to make some major adjustments to your work. As expected, Civil 3D has tools that specialize in road design, so whether it is for a residential development or new roads, as the city is expanding or the design of a freeway that connects two cities, you find a much more efficient workflow in Civil 3D. You can also start with traditional drawing objects such as polylines and arcs or import GIS features, turn them into AutoCAD objects, and then turn them into Civil 3D alignments. Alternatively, you can start off by drawing alignments from scratch.

Alignments in Civil 3D are dynamic objects used for horizontal geometry and include labels and markers for points or curvature, points or tangency, stationing, and so on. Because they are dynamic objects, you can confidently make changes to the geometry without having to worry that you will have to fix all your labels and markers.

Vertical geometry is another main component in road design and it is where the elevation data comes into play. Vertical geometry is drawn using profiles and, similar to alignments, they are dynamic objects that have markers and labels for points of vertical curvature, points of vertical tangency, etc. Civil 3D combines horizontal (alignments) and vertical (profiles) geometry in an automated way that facilitates the road design process. Profiles can also be used to sample an existing surface along an existing alignment.

Once you have the horizontal and vertical geometry for your road, you can take the design process a little further by using assemblies and corridors. An assembly is a collection of subassemblies, which are the basic building blocks of a roadway. They can be the typical components of a roadway such as lanes, curbs, shoulders, etc. A corridor is a path or road defined by an alignment, a profile, and an assembly. The combination of these elements creates a 3D object, or in this case, a 3D roadway that can later be used to create a finished ground surface that, in turn, can be used for earthwork volume calculations.

And speaking of earthwork calculations, we also have grading objects in Civil 3D. By definition, grading is the process of adjusting slopes and ground elevations. Civil 3D, being a 3D design program, handles this very well. We can create retention ponds, embankments, dams, and so on, or simply manipulate ground elevations for proper drainage in a parking lot, for example. Remember that the capability of using elevation data in the design process is one of the things that make Civil 3D the type of program it is.
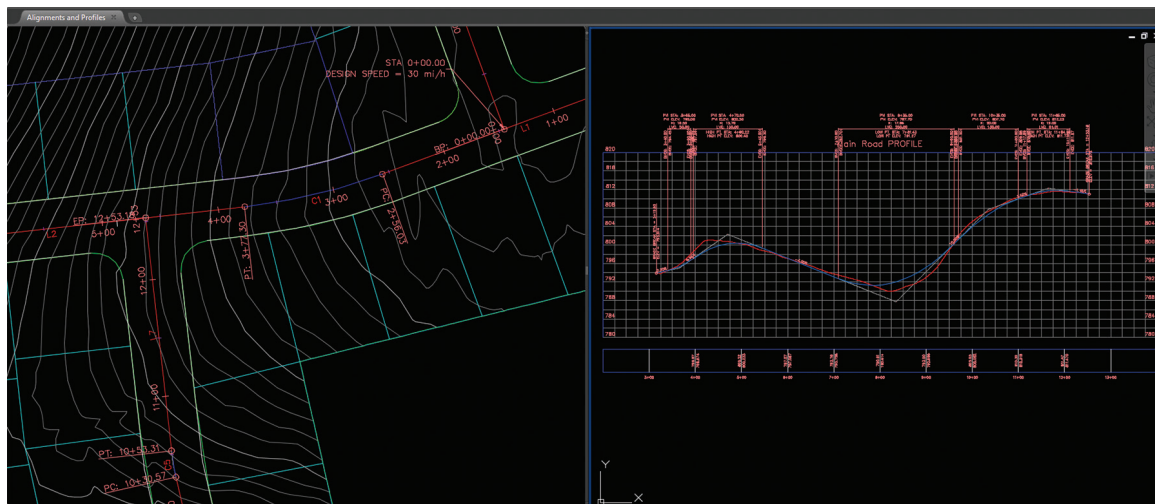

Figure 7: Alignments and profiles for road design

PIPE NETWORKS

Now let's say you are still working on the same residential development that was previously mentioned and now it is time to design the sanitary pipe network. Again as expected, Civil 3D provides tools to accomplish these tasks in an automated way. You can turn existing lines and nodes into pipes and manholes or you can draw the network from scratch
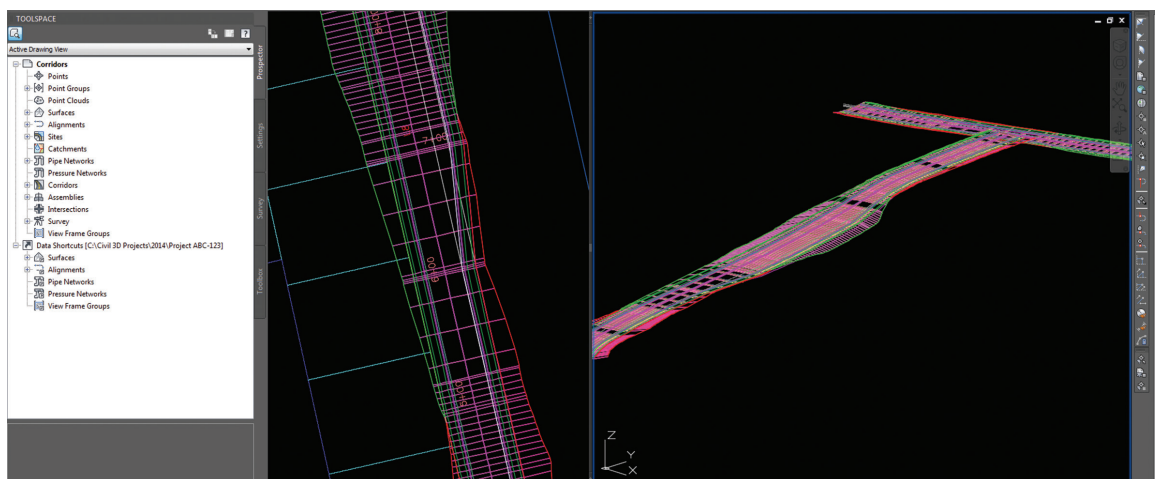

Figure 8: Corridors and roadways in Civil 3D
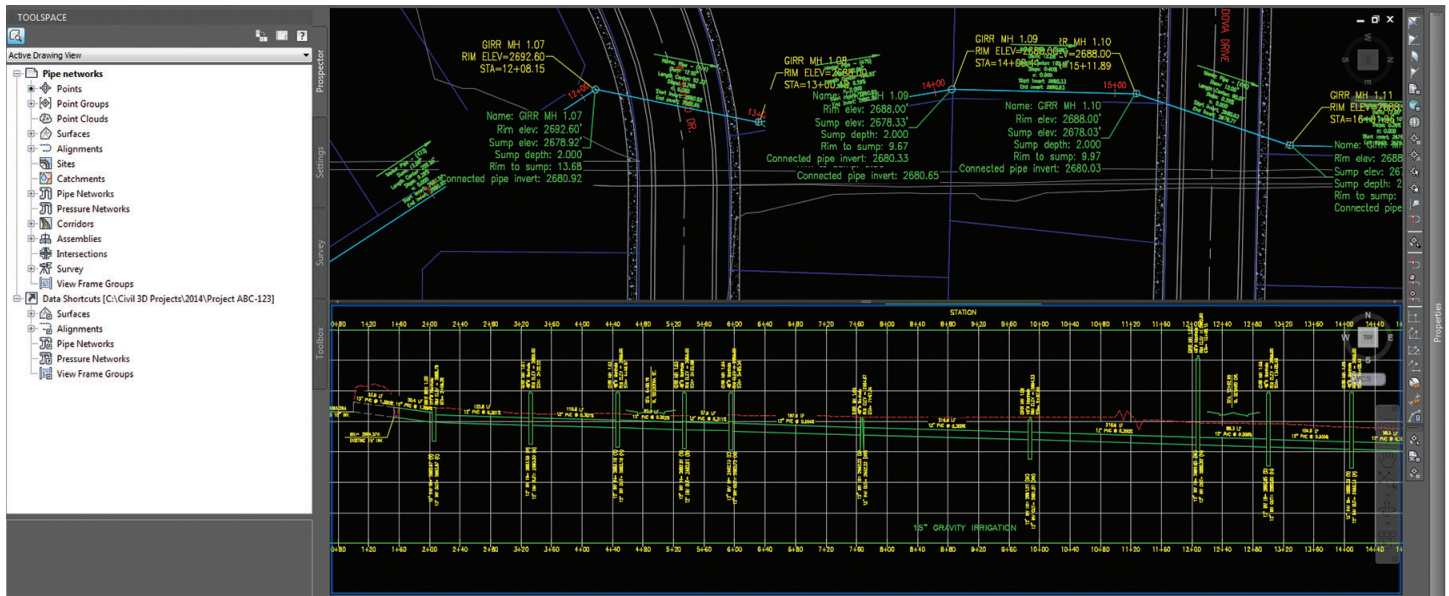
AutoCAD Civil 3D 2015

Figure 9: Pipe networks in Civil 3D

using pipes instead of lines and structures instead of nodes. You adjust the settings and select the types of pipes and structures you want and you are ready to go.

Because elevation data is a crucial design element, you can specify how deep you want to bury the pipes in your network and the slope of the pipes which, in turn, will determine invert elevations. Then you can add labels to pipes and structures to show elevations or other data already in them. When you make changes to the network such as raising or lowering a pipe, the labels update to show the new elevations. Now if you make changes to the pipe network imagine the time you will save when network components and labels are linked and update automatically. Furthermore, you can also show these elements in profile view and again, data and labels are dynamic and update as you make changes.

COHESION

So far I have mentioned some of the common usages of Civil 3D and how objects are interrelated. The ability to use elevation data, the connectivity between vertical and horizontal geometry, the connectivity between corridors and surfaces, and the ability to annotate objects to show information contained within the objects are some of the features that make Civil 3D a powerful design platform where drafting becomes a by-product of design.

As mentioned before, Civil 3D is built upon regular AutoCAD so it has all the regular AutoCAD tools, which means that the good practices you already know in AutoCAD are still valid. External references and plan production work the same way; furthermore, you have data shortcuts that work similar to xrefs in the way they call data from external files.

CONCLUSION

There is much more to the program than what I can tell you, but I hope that you are starting to envision how transitioning to Civil 3D would affect the work you do and how it would boost your productivity. The tools that come with the program are powerful enough to accomplish many design tasks in civil engineering and related fields. When you add your own creativity and out-of-the-box thinking you can accomplish much more. After you start working with the tools you have at your disposal you will find that you cannot go back to the old ways. No matter how familiar you are with AutoCAD Civil 3D, whether you have just heard of it or are starting to use it, there is one last thing I want to say to you: welcome to the family!

Miguel Medina is a Civil Application Engineer for ProSoft, an Autodesk reseller based out of Utah. He has worked in construction management and design since 2008 and has implemented and trained companies on Civil 3D for the past year. Miguel can be reached at mmedina@prosoftnet.com

Analysis Powerhouse: Autodesk Nastran In-CAD

ast year Autodesk purchased NEI Nastran. Why? Because they could. A few things made that purchase important:

- Nastran is the household name in analysis; it's powerful and respected
- Nei developed a CAD embedded UI in Solidworks for the Nei Nastran solver, called Nastran In-CAD.

Autodesk has since adapted In-CAD for Autodesk Inventor® and now gives Inventor users far more analysis power than ever before. Essentially, if you wanted to use Nastran as your solver or simply wanted more than linear static analyses, but didn't want to leave your Inventor interface, then Autodesk has the tool for you.

This enables Inventor users to use Inventor as their modeling software, as well as the pre- and post-processor for their Nastran studies.

I am writing this for companies using Inventor that are considering a Nastran purchase or have In-CAD and are wondering about how it works.

USER INTERFACE

The UI is divided between a Nastran In-CAD tab and the Browser.
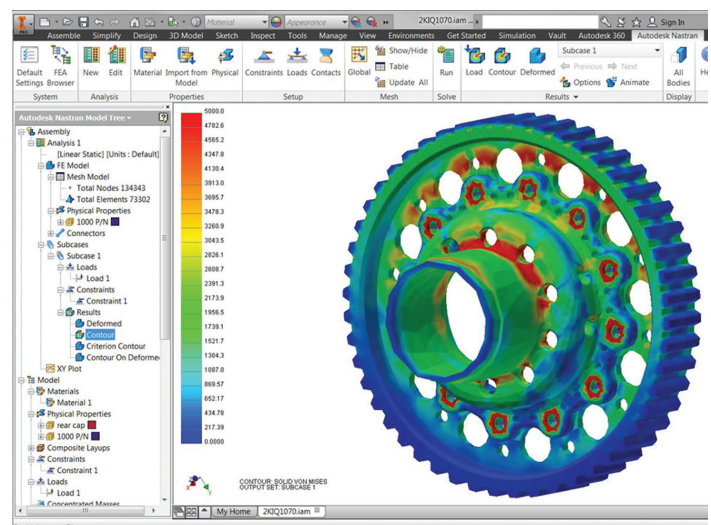
Figure 1

Inventor 2015

Nastran In-CAD Ribbon Tab

This displays a new set of ribbon panels dedicated to the analysis model. These panels include settings, meshing tools, boundary condition applications, results plotting, and others.

Browser

The Browser is populated not only with the Model and Assembly component sets, but also three additional Nastran panels.

Nastran Model Tree

Nastran Model Tree is divided into the assembly and model groups. The model group accounts for all boundary conditions and templates defined in the model. The analysis group assigns these to individual analyses and subsets as the user dictates to accomplish different studies.

Nastran File

This gives users a look into the Nastran file data rather than trying to interpret everything through the CAD interface.

Nastran Output (Log)

The output window shows the progress of the Nastran run, including real-time convergence data. This browser window is displayed by default during the run process. Once solved, this output log can be reviewed as needed and the contents thereof are saved alongside the other Nastran model and results files.

From this window the analysis can be stopped, paused, and resumed.

AUTODESK NASTRAN SOLVER

The Autodesk Nastran (formerly Nei Nastran) solver's accuracy is routinely tested against the NAFEMS standards at every release. Mitch Muncy, product manager for Autodesk's Nastran product, came along with the Nei purchase. He has stated that the company had spent countless hours verifying every detail of the solver to ensure that it met the advanced requirements of its customers in industries such as aviation and automotive.

Linear, Static Stress, Thermal, and Modal Analyses
* Prestress static
* Static fatigue – repeated loading cycles
* Heat transfer – conduction and convection heat in examination of temperature distribution
* Linear buckling – compression induced loss of stiffness
* Linear statics – stress, strain, and deformation from applied static loads and constraints
* Normal modes – component natural frequencies

Advanced Analyses
* Pre-stress normal modes – capture true stiffness when complex loading is present
* Frequency response – structural harmonic response based on frequency-dependent loads
* Random vibration fatigue – long-term structural robustness where operation must be characterized by power spectral density (PSD) inputs

* Transient response – response through a period of time under the influence of constant or time-dependent loads
* Random response – behavior due to random dynamic loads such as road vibration, wave cycles, engine vibration, and wind loads
* Nonlinear static and transient response – time-varying events including dynamic loading that result in resonant vibration or stress amplification
* Superior surface contact, impact analysis, and automated drop tests – includes nonlinearities of large deformations, sliding contact, and nonlinear materials
* Advanced material models – complex nonlinear phenomena, including plasticity, hyperelasticity, and shape-memory effects
* Composites – straightforward complex ply data and progressive ply failure including Puck and LaRC02 algorithms

Element Types and Modeling
* 1D, 2D, and 3D element types open a whole new world of modeling capabilities at a fraction of runtime
* Automatic bolt connector modeling with preload – simplified setup
* Associative intelligent meshing

USING IN-CAD

While I have had some experience with Siemens FEMAP interface for Nastran, I have had very little experience with Autodesk's new In-CAD UI. I thought that this article would be a good opportunity to get in and try it from the perspective of a new user. (I should mention that I crashed an In-CAD seminar at Autodesk University for about an hour, so I did have an hour jump-start.)
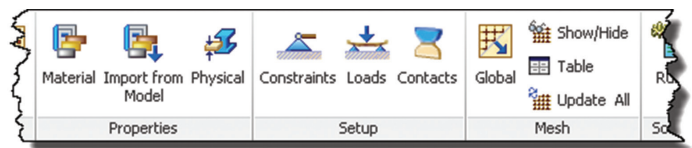

Figure 2

The setup workflow is the same as one would expect:
1. Establish materials, boundary conditions, and loads
2. Double-check everything
3. Run the solution, which fails
4. Adjust the model and rectify and oversights
5. Run the solution – success
6. Review the results
7. … a laundry list of review and comparison to ensure that you are confident in the analysis model and results

Material Properties

Nastran In-CAD sorts components into material categories that are easily defined. It will pull in the material properties from the CAD model with the push of a button. In addition, it can import material properties from any of the Inventor or Autodesk material libraries, or allow users to create their own.

Setup

Constraints, contacts, and loads all use similar dialogs that permit faces and bodies to be selected and deselected as desired. Once selected, the particular conditions can be configured and applied as required.

The constraints dialog also contains buttons that identify limiting concepts (i.e., no rotation, free, symmetry, and others) that directly relate to the 6 degrees-of-freedom check boxes to which most analysts can relate.
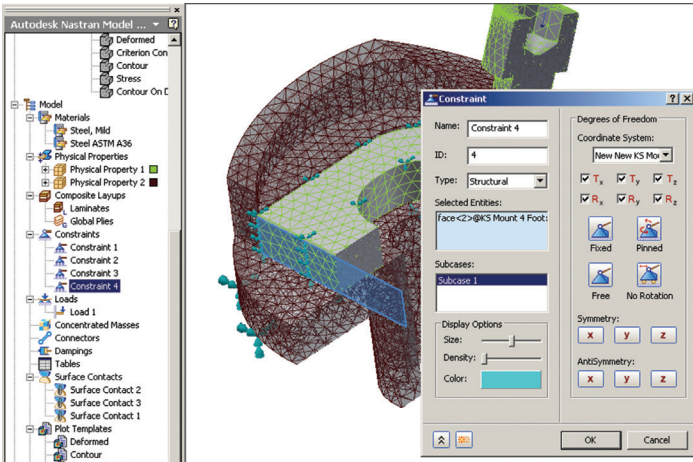

Figure 3

Discerning between various surfaces is handled through the Inventor alternate surface explorer popup.

Five contact types are available: General, Slide, Welded, Rough, and Offset Weld.
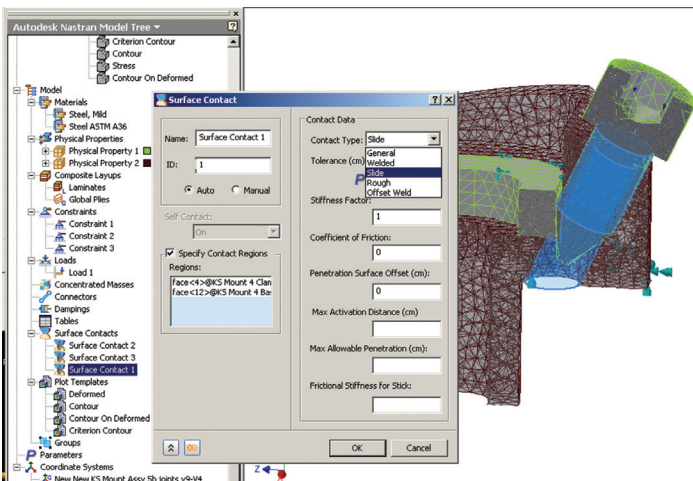
Figure 4

Various limitations to contact proximity, penetration, and others are available to configure.

Loads can be applied statically, using basic magnitude fields and directions applied by:
* Individual component coordinate systems (X,Y,Z axes)
* Normal to face
* Geometric entity (by edge of selected geometry)

Dynamic loading is also available in an "advanced" expansion of the loads window. These can be applied through linear, linear equation, and quadratic methods.

MESHING

I have always loved Nastran's adaptive meshing. It does it well and effortlessly. I often get mesh concentrations how I need them without a lot of manipulation.

Meshing is carried out with both global refinement settings and individual component settings. One feature I like is the mesh properties table, where all the component mesh settings are managed in one setting and are easily editable.

Nastran In-CAD also offers an element check, where In-CAD will inspect the model meshes for inconsistencies such as
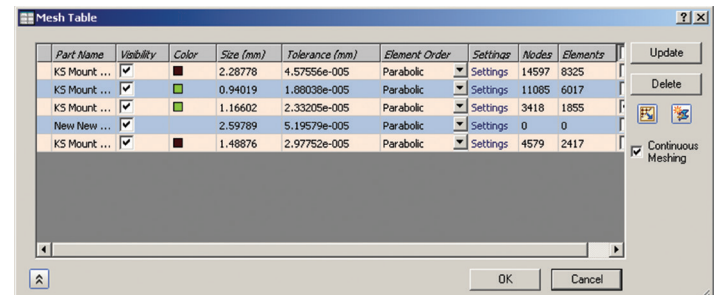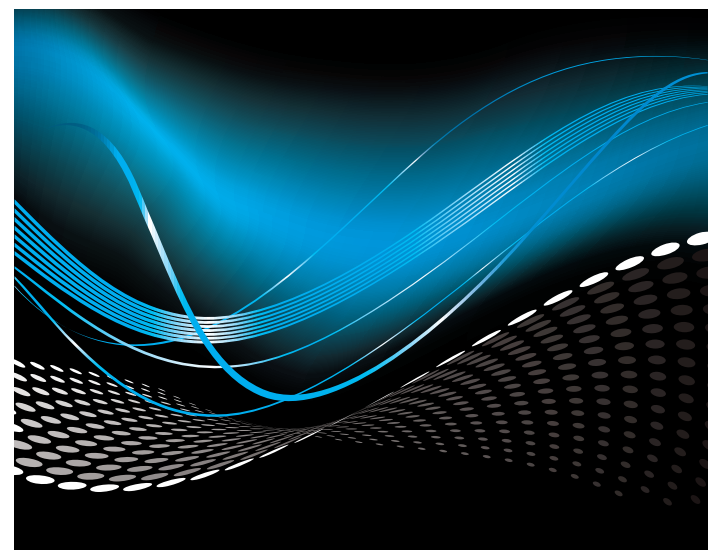

Figure 5

Skew, Aspect, and Jacobian limits. The results of these can be highlighted, making detection and adjustments much easier.

NASTRAN EDITOR

It has been brought to my attention that In-CAD does not give access to the Nastran Editor developed by Nei for their (now Autodesk's) Nastran solver. This is unfortunate, and as the license fee for both In-CAD and Nastran are identical, I cannot see why it would be a financial imposition. I have no idea at this point whether this would be create a programmatic conflict, but I hope they will make that available to subscribers of In-CAD.

RESULTS

I only ran through a simple linear static analysis for this test, but the results were consistent with what you would expect.
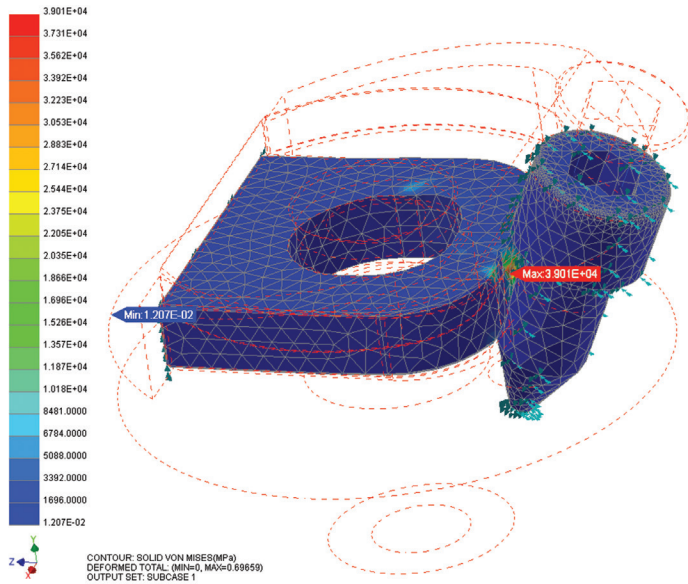

Figure 6

The standard array of plot types are available including displacement, Von Mises stress, principle stress, and more. XY plots can be configured by element or node.

Nodal information per result plot style can be reviewed by turning on the nodal display and passing the cursor over the nodes.

Tip: Remember to create a new Analysis subset! (Like a new Inventor "Scenario.") Subsequent runs of the same analysis will overwrite the previous results. If you (like I just experienced) get a failure and overwrite your previous good results, you will feel quite foolish.
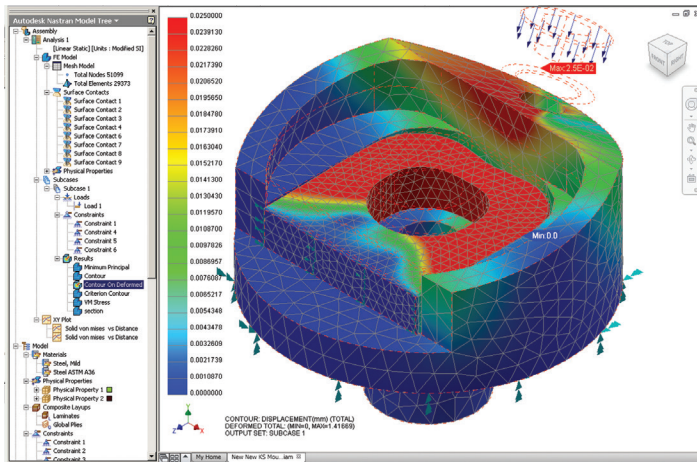
Figure 7

CLOSING THOUGHTS

Nastran is a fabulous analysis solution, no doubt. Having the ability to reach out to Nastran directly from Inventor is also a

welcomed reality now. It is easy to learn and you can be up and running in less than an hour.

You will need some hardware in order to run In-CAD. Meshing can rapidly become quite complex. While you may be accustomed to running Inventor comfortably on the machine, In-CAD will suck up resources quickly, depending on how carefully you limit your model DOF and mesh complexity.

In-CAD model setups will increase your assembly and model file size quite a bit as well. This is something that should be considered and a reasonable strategy should be imposed from the start.

There are some areas that need improvement, and a few glitches that should be addressed soon. While this UI is not tuned for analysts, I think In-CAD is a good tool to allow Inventor users (who don't want to leave Inventor and learn a very complex interface) to have some access to the power that Nastran offers.

Companies purchasing Nastran should consider the type of pre- and post-processor they require. In areas where both CAD users and analysts will be using Nastran, the purchase of both Nastran and Nastran In-CAD licenses might be a wise choice, as the cost is the same, and users can access the Nastran Deck and Results files with either setup.

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Object Linking & Embedding (OLE)
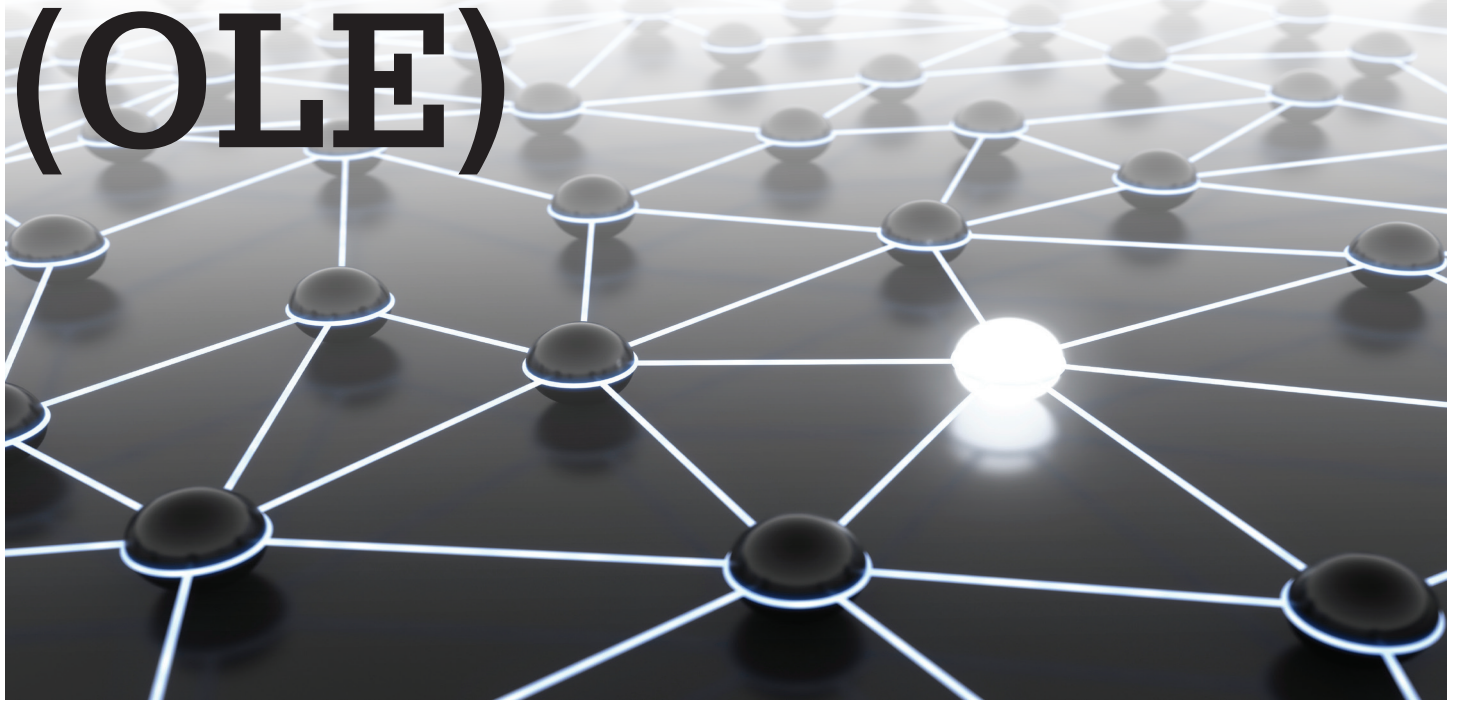
Object Linking and Embedding (OLE) is a Microsoft Windows feature that allows you to copy or move information from one application to another while you retain the ability to edit the information in the original application. Basically, OLE combines data from different applications into one document. For example, you can create an AutoCAD® Architecture drawing that contains all or part of a Microsoft Excel spreadsheet.

OLE is a great way to use information from one application in another application, which can be useful for presentations, etc. To use OLE, you need both source and destination applications that support OLE. Information can be inserted from one document into another by either linking or embedding the information. Both linked and embedded OLE objects can be edited from within the destination application. However, linking and embedding store information differently so it is important to ensure that you are using the correct option for the situation. The relationship between embedding and linking is similar to that between inserting a block and creating an external reference. Let's look further into using OLE objects with AutoCAD Architecture. We will use Microsoft Excel as an example.

IMPORTING OLE OBJECTS

You can use one of the following methods to insert information from Excel as an OLE object.

+ Cut or copy information from an existing Excel file and then paste it into the ACA drawing
+ Import an existing Excel file
+ Open Excel from within the ACA drawing by double-clicking on it and creating the information that you want to use

When the Excel information is inserted into your drawing, you will need to specify an insertion point. By default, the OLE object is displayed with a frame that is not plotted. OLE objects are opaque and they will plot as opaque, which means that they hide objects in back of them. OLE objects are supportive of draw order. The display of OLE objects can be controlled in one of two ways.

+ Set the OLEHIDE system variable to either display or suppress the display of all OLE objects within paper space, model space, or both
+ Freeze or turn off a layer to suppress the display of OLE objects on that layer
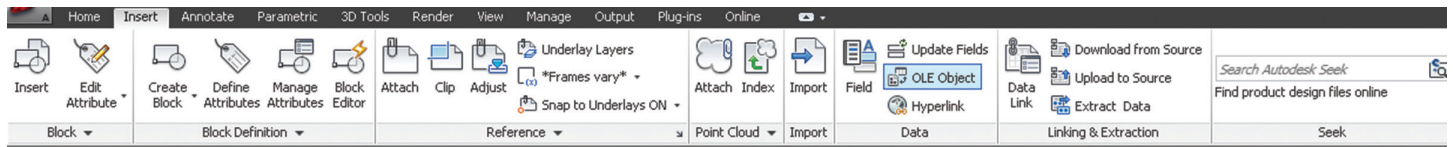
AutoCAD Architecture 2015

Figure 1: OLE Object tool

When OLE objects with text are printed, the text size is approximated by the text size in the source application, Excel. It is important to note that OLE objects in ACA drawings are not displayed or plotted in external references or block references.

EMBEDDING OLE OBJECTS

An embedded OLE object is simply a copy of information from another document—for example, a copy of an Excel spreadsheet in AutoCAD Architecture. When you embed objects, any changes made to the source document are not reflected in destination documents because there is no link to the source document. You should embed objects only if you want to be able to use the application that created them for editing but you don't want the OLE object to be updated when you edit information in the source document.

To embed an OLE object in a drawing, open the document you wish to embed, select, right-click, and copy the information. Next open your ACA drawing, right-click, and paste the information. Another way to do this is to open AutoCAD Architecture, go to the Insert tab on the ribbon, Data panel, OLE Object (see Figure 1). This will bring up the Insert Object dialog box. Next, select Create New. Under Object Type, select an application and click OK (see Figure 2). This will open Excel (or whichever application you choose). Now create the information you wish to insert and save the document. In Excel's File menu, select Exit and Return. Close Excel and the object is now embedded in the AutoCAD Architecture drawing.

If needed, you can adjust the text size. To do this, select the OLE object, right-click, select OLE, and then select Text Size. This opens the OLE Text Size dialog box. Now you can select a font, point size, and text height. When finished, click OK.
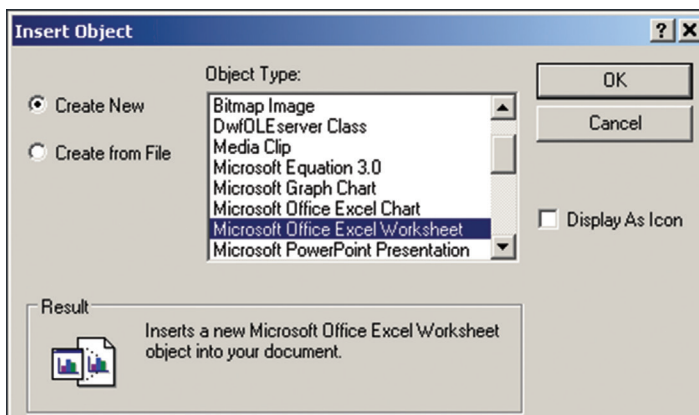

Figure 2: Create New

LINKING OLE OBJECTS

A linked OLE object is simply a reference to information that is located in another document. Link objects when you want to use the same information in more than one document. If you change the original information, you only need to update the links in order to update the document that contains the OLE objects. Links can be set to update automatically. It is important to note that when you link a drawing, you need to maintain access to both the source application and the linked document. If you rename or move either of them, you may need to reestablish the link.

To link a file as an OLE object, go to the Insert tab of the ribbon in AutoCAD Architecture, Data panel, OLE Object. This will bring up the Insert Object dialog box. Select Create From File (see Figure 3). Next, browse and find the file you wish to use. Click Link and then select OK. Now you will need to select where you want the OLE object to appear.

To link part of a file as an OLE object in a drawing, begin by opening ACA and Excel. Select the information in Excel you want to link and copy it to the Clipboard. In ACA, click the Home tab on the ribbon, Clipboard panel, Paste drop-down, and then Paste Special. In the Paste Special dialog box, click Paste Link. Paste Link pastes the contents of the Clipboard into the current drawing and also creates a link to the file in the source application. If you click Paste, the Clipboard contents are embedded instead of linked so it is important to select Paste Special. In the "As" box, select the data format you want to use and click OK.
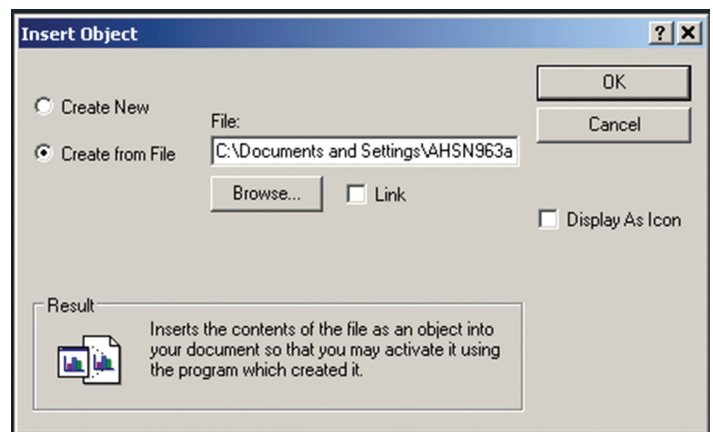

Figure 3: Create From File

EXPORTING OLE OBJECTS

You can link or embed a view of an AutoCAD Architecture drawing within another application that supports OLE such as Excel. The COPYLINK command copies the view in the current ACA viewport to the Clipboard and you can then paste the view

into the destination document. If you paste an unnamed view into a document, it is assigned a view name such as OLE1. Then if you exit the drawing, you will be prompted to save your changes to the newly named view. In order to establish the link and to save the view name, OLE1, you must save the drawing.

You can select objects and embed them in documents created by other applications. Embedding will place a copy of the selected objects within the destination document. If you use AutoCAD Architecture to edit the OLE object from within the destination document, the object is not updated in the original drawing.

To embed objects in another document, begin by opening AutoCAD Architecture and selecting the objects you wish to embed, right-click and select Copy. The selected objects are now copied to the Clipboard. Open Excel and open a new or existing document. Paste the clipboard contents onto the spreadsheet, following the instructions for embedding the Clipboard contents given by Excel.

To link a view to another document, begin by opening AutoCAD Architecture and save the drawing that you want to link so that it has a drawing name. If multiple viewports are displayed, you will need to select a viewport. Next, enter COPYLINK at the command prompt. Then, open a new or existing document in Excel. Paste the clipboard contents into the document, following Excel's procedures for inserting linked data (see Figure 4). The inserted OLE object is displayed in the document and can be edited from AutoCAD Architecture through Excel.
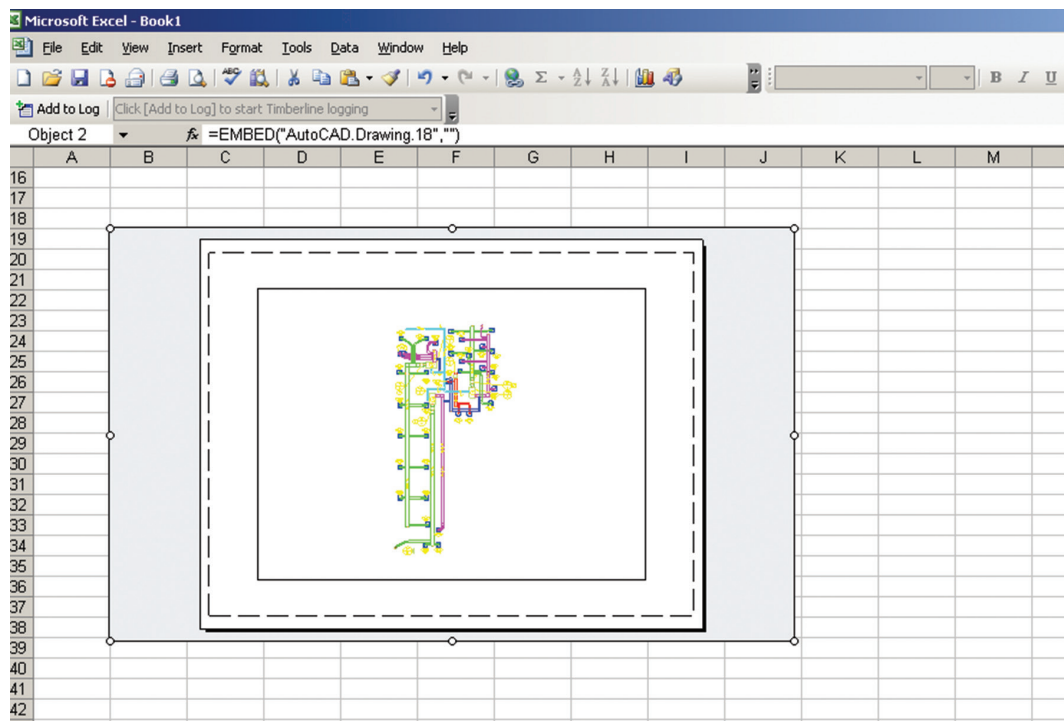
use any selection method to select OLE objects and then you can use most editing commands, the Properties palette, or grips to make changes. When grips are used to change the size of an OLE object, the shape of the object does not change as long as the aspect ratio is locked in the Properties palette. If you have resized an OLE object and wish to restore it to its original size, select the OLE object, right-click, and select OLE Reset. It is important to note that the following editing commands are not available for OLE objects: BREAK, CHAMFER, FILLET, and LENGTHEN.

Before looking at how to edit OLE objects, it is important to understand the difference between editing a linked object versus an embedded object. The document that contains a linked drawing stores the drawing's file location. You can edit a linked drawing either from the destination application or in the source program. The program must be loaded or accessible in the system along with the document you are editing. An ACA drawing that is embedded within a document can be edited only from within the destination application. You will need to double-click the OLE object to start the program. Editing the original drawing in the program has no effect on documents in which that drawing is embedded.

To edit a linked ACA drawing from within the destination application, begin by opening the document that contains the linked drawing (for example, a Microsoft Excel file). Double-click the linked drawing and the drawing will open. You can also select the OLE object, right-click, and select AutoCAD Drawing Object, and then Edit (see Figure 5). Next modify the drawing as necessary and click File menu and select Save when done. To return to Excel, click the File menu and hit Exit. The drawing is now changed in all documents that have links to it.

To edit a linked drawing in the source application, begin by starting the program and opening the linked drawing. Make modifications to the drawing and view as necessary. Save the changes when finished. Update the link in the destination document if necessary. The drawing is changed in all documents that have links to it.

To edit embedded objects begin by opening the Excel document that contains the embedded AutoCAD Architecture objects. Double-click the embedded objects to start the ACA program, display the objects and modify them as necessary. Save changes to the embedded objects by clicking the File menu and selecting Update. Now return to the destination application by clicking the File menu and selecting Exit.

Figure 4: Copylink drawing in Excel

EDITING OLE OBJECTS

Linked or embedded OLE objects can be edited in a drawing by double-clicking the object to open the source application. You can

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To control the display of OLE objects in AutoCAD Architecture enter the command OLEHIDE. Now enter one of the following values:

- 0 - Displays OLE objects in both paper space and model space
- 1 - Displays OLE objects in paper space only
- 2 - Displays OLE objects in model space only
- 3 - Does not display OLE objects

You can also control the display of the OLE frame within a drawing. To do this, enter OLEFRAME at the command prompt. Then enter one of the following values:

- 0 – Frame is not displayed and is not plotted
- 1 – Frame is displayed and is plotted
- 2 – Frame is displayed but is not plotted
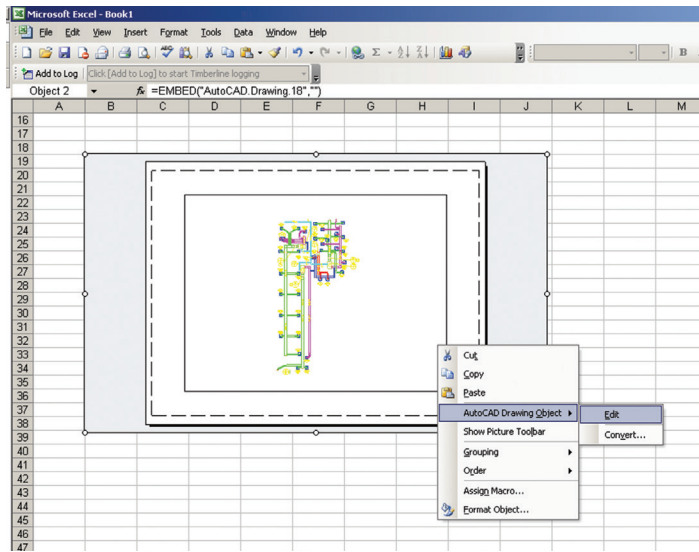
Figure 5: Edit OLE object

CONTROLLING PLOT QUALITY

When a raster plotter is used, OLE objects are treated as raster objects. Since large, high-resolution, color-rich rasters can be expensive to plot, the OLEQUALITY system variable can be set to control how each OLE object is plotted. The default setting is Automatically Select and it assigns a plot-quality level based on the type of object. The higher the plot-quality setting, the more time and memory are used to plot.
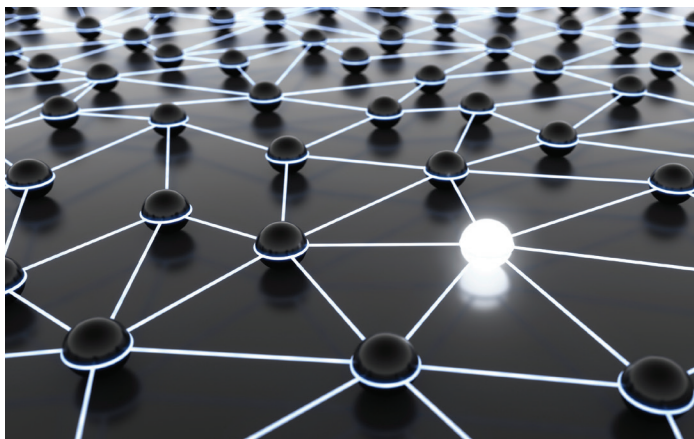
The Plotter Configuration Editor can also be used to adjust OLE plot quality. The Graphics option displays a Raster Graphics dialog box with a slider that controls OLE plot quality. It is important to note that nested OLE objects may cause problems. For example, an OLE object that is not in the current view plane is not plotted, but the frame is plotted based on the setting of the OLEFRAME system variable.

To set the plot quality for OLE objects, begin by clicking the Tools menu and selecting Options. In the Options dialog box, select the Plot and Publish tab, and then in the OLE Plot Quality list select one of the following settings (see Figure 6).

- Monochrome – for text spreadsheets
- Low Graphics – for color text and pie charts
- High Graphics – for photographs
- Automatically Select – plot-quality setting assigned based on the type of file

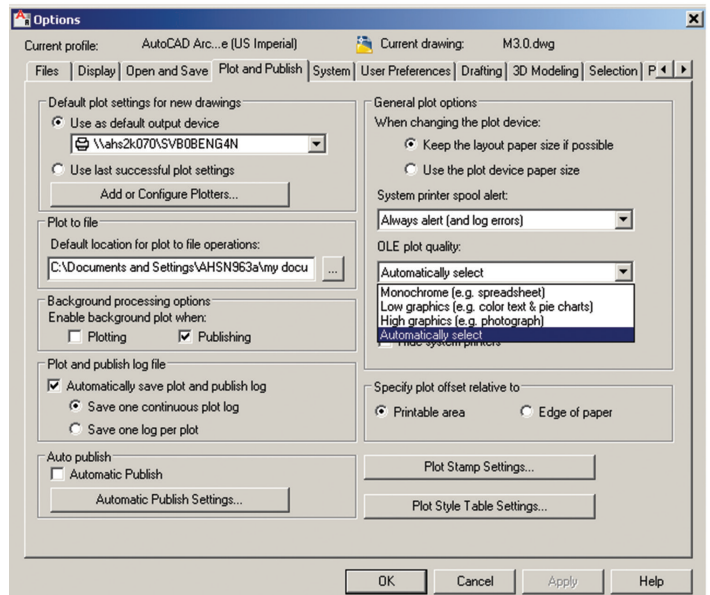Click Apply to continue setting options or click OK to close the dialog box if you are finished.

Figure 6: OLE plot quality

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by: Brian Andresen

Inside Track

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This month Bluebeam is releasing another version with bigger and better options. Their words: Be better and work smarter than ever before with the launch of Revu 2015. Learn more at Bluebeam's website and take advantage of feature sneak peek videos and register to attend a launch party or one of the firm's Revu 2015 webinars.
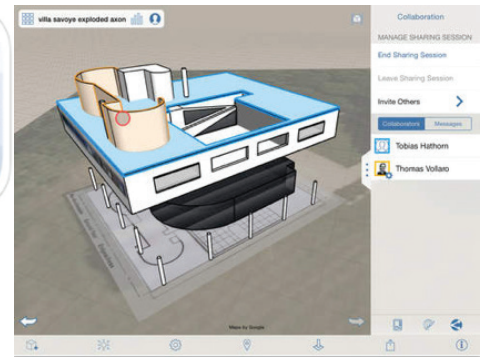
http://bit.ly/1AxLO2J
Autodesk® FormIt mobile app helps you capture building design concepts digitally anytime, anywhere ideas strike. Use real-world site information to help create forms in context and support early design decisions with real building data. Experience a continuous building information modeling (BIM) workflow by synchronizing designs in the cloud.

www.theprovingground.org/2014/11/get-rhynamo-package.html
At this point most people are aware of how Rhino has been used over the years to assist with Revit and other BIM projects to offer more open and creative designs. You are probably also aware of Dynamo as an opportunity to extend building information modeling with the data and logic environment of a graphical algorithm editor. Well, CASE has taken it all further.

Rhynamo is an open source plug-in authored by CASE (www.case.com). Rhynamo exposes new visual nodes for reading and writing Rhino 3dm files. These tools expose new workflow opportunities between common design and production environments used in architectural design.

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