AUGIWorld

The Official Publication of Autodesk User Group International
December 2016

What's Happening? Industry and Tech Insights

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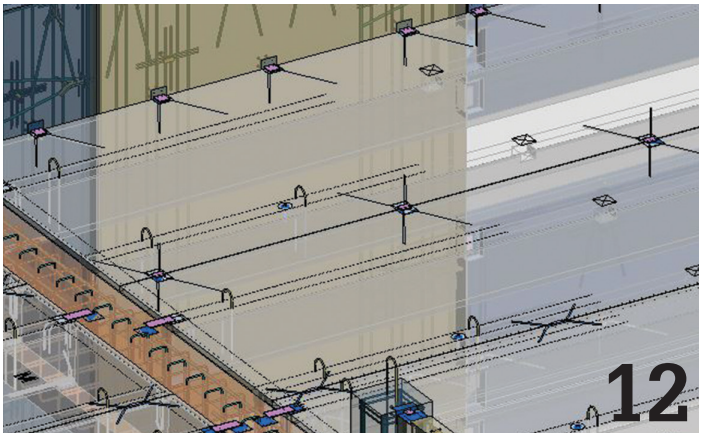
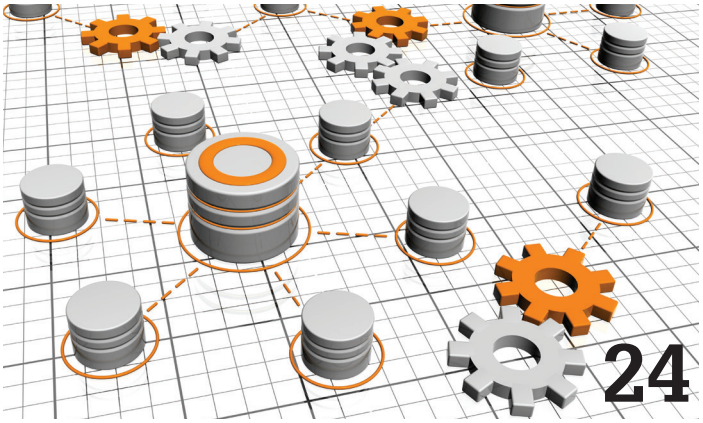
contents





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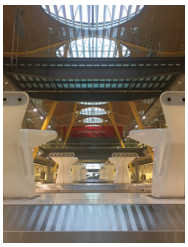

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Madrid Airport, 2016
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Letter from the President

MY FAREWELL

This will be my final letter to you as your AUGI president. It is time for me to concentrate on other endeavors and seek out brave new worlds (I couldn't resist).

I am leaving the role of president in the capable hands of Kate Morrical. I feel that her experience as a former Autodesk employee and skilled presenter are going to be extremely valuable to the organization in the years ahead. Please join me in welcoming her to this new role. But enough about her, this is my swan song! ;-)

I hope that my letters have inspired you and opened your horizons. It has been a pleasure to cover topics about which I am passionate.

I see three primary themes when I look back over my previous letters.

- Training
- Conferences
- Collaboration

Training is the foundation for success. Yes, there are other factors, but success rarely happens when someone is given an unfamiliar task with no training. A well-educated person, or someone with innate talents, might be able to tackle an unfamiliar task and succeed. Yet I'm sure that they would have appreciated training in that task instead of starting with none. If you are in a position where you work with new people, then provide them with the training they need to be successful. If you are starting at a new company or taking on a new role or task, don't tolerate a lack of training.

Conferences are a great way to get some additional education. But I think they are even more important as networking opportunities and inspirational sources. Attend at least one conference each year. It is even better to attend different conferences for fresh perspectives and new faces. Seek out conversations with people you don't know. You might be amazed at what you learn from them. Don't just find people who are like-minded—get to know someone with an opposing viewpoint. Reach out to people in other trades that touch on your own. This will help you understand how the things you do and the decisions you make will affect them.

Collaboration is becoming ever more important in our industries. We should not be afraid to pick up the phone or send a message to someone in another company about issues on a common project. Too many decisions are still made in a vacuum. What seems to make sense in a single office may have negative implications beyond the office. A lack of real collaboration (not just treating the word as a marketing bullet item) will cause problems in today's working environment. Don't let the sins of the industry's past affect its future.

R. Robert Bell
AUGI President

AUGIWorld
www.augiworld. com

Editors
Editor-in-Chief
David Harrington - david.harrington@augi.com

Copy Editor
Marilyn Law - marilyn.law@augi.com

Layout Editor
Tim Varnau - tim.varnau@augi.com

Content Managers
3ds Max - Brian Chapman
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by: Kevin Sartori

Reality Capture Made Easy: The Complete Workflow with 3DR Site Scan

Figure 1: The silo

Data capture has been discouraged in many industries because it is thought to be expensive, time consuming, and it requires skilled personnel to collect and analyze data. This is particularly relevant for the AEC space. In its latest industry report, McKinsey & Company shows that construction is one of the least digitized industries, only second to agriculture and hunting[1]. Drones are going to commoditize data capture—making it easy, cheap, and accessible to everyone. Under the new FAA Part 107 drone regulations, everyone—after passing the Remote Pilot Certificate knowledge test—can fly drones legally for commercial purposes.

However, the last thing you want on a construction site is just more data! You want this data to be actionable and already integrated into the software tools you are using every day.

With Site Scan, 3DR has built a platform that makes reality capture quick and simple, manages the data in the cloud, and pushes it to the Autodesk tools you know. The workflow from camera over cloud to Autodesk software just takes a couple of clicks.

THE JOB TO BE DONE

To showcase the complete Site Scan workflow, I would like to use a real-world example.

This silo is a part of a retired cement plant that isn't being used anymore due to its outdated infrastructure (see Figure 1). The structure will need to be refurbished and the site redesigned for optimal operations. Site Scan was used to create an as-built model of the structure and the rest of the site to initiate the preliminary design and engineering phases.

PLANNING A MISSION

The first step to any data acquisition is mission planning. With Site Scan, this planning is done completely on an iPad running the mobile app "Site Scan Field." While a controller is required for emergency and legal reasons, gone are the days when a drone operator had to learn the intricacies of flying completely manually using the control sticks.

[1] *Imagining Construction's Digital Future*, McKinsey & Company, June 2016, http://www.mckinsey.com/industries/capital-projects-and-infrastructure/our-insights/imagining-constructions-digital-future

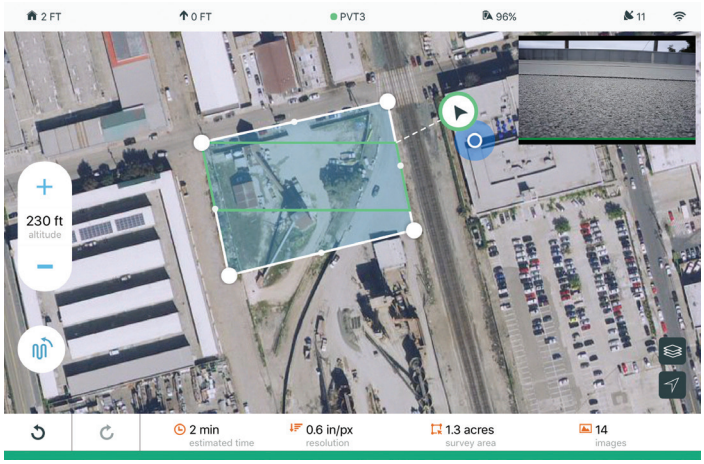


Figure 2: Plan mission with Site Scan Field on iPad

With Site Scan Field, the drone operator can zoom into the area of interest using familiar gestures on the iPad. Pressing "Plan Survey" will insert a standard polygon in the center of the screen (see Figure 2). You can drag this polygon to the desired area, and move or add vertices to ensure the bounding box is correct to capture all the data required. Site Scan Field will automatically build the flight path in addition to adding camera triggers in order to optimally cover the area you want to survey.

Along the bottom of the screen, you can view estimated flight time to complete, ground sampling distance (GSD) or resolution, area covered, and number of photos to be captured. The flight plan can be adjusted by increasing the flight altitude or by changing the bearing of the flight lines. As these options are adjusted, flight information is updated in real time so you can see how raising altitude adversely affects GSD, but lowers the estimated flight time to cover the same area.

FLYING SITE SCAN

After the flight has been planned, all you have to do is press "Fly Survey." The app will run through a set of checklists to ensure the aircraft is ready for takeoff. These checks make sure all components of the system are functioning properly. Once the checklist is complete, a green slider appears. When ready to start, you can swipe the slider to the right. The drone will boot up, spin the props, and take off autonomously.

Figure 3: Site Scan with Sony R10C in flight

After takeoff, the drone flies itself. Your job is to keep an eye on the system to make sure everything is operating normally. The aircraft flies a back and forth pattern that's similar to mowing a lawn. During the mission, the autopilot triggers the Sony R10C camera, a large 20 megapixel APS-C sensor, which is the largest imaging sensor carried by a drone weighing less than 2 kilograms. Site Scan is able to cover up to 30 acres in one flight at a resolution of one inch per pixel. With the three batteries included with the system, the operator can acquire up to 90 acres of data in only 45 minutes.

There are a number of safety failsafes that the autopilot handles automatically. For instance, if the battery drains faster than planned, or if the drone loses connection with the controller, the

ReCap 360 Pro

autopilot will trigger a return-to-home sequence. Before starting the mission, you should set a "return home altitude," which is the minimum safe altitude at which the drone can fly back home once failsafe is triggered.

Once the drone lands itself from where it took off, you can wirelessly download the images to your iPad. This is done by pressing the "Download image" button at the bottom of the screen. Once downloaded you can review the full resolution images on the iPad (see Figure 4) while you are is still on site. This is important for quality assurance as one can quickly check if all the images have been acquired before leaving the site.

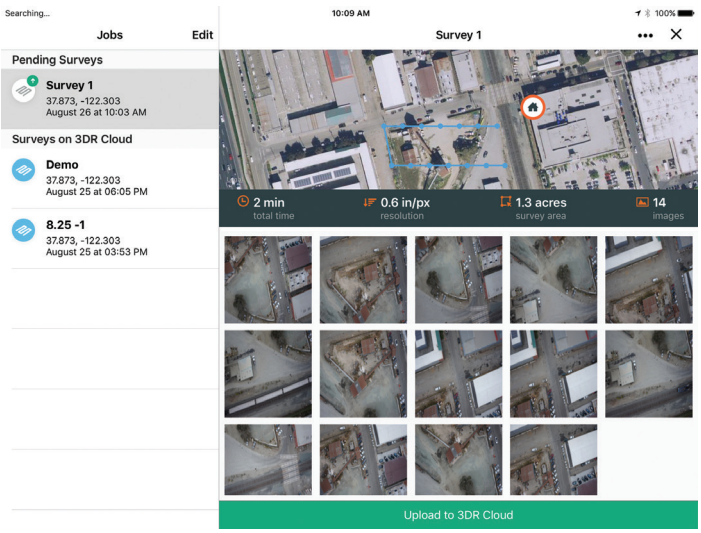


Figure 4: Review images in Site Scan Field

Now that you have all the images you need, you can connect the iPad to the Internet and safely upload all data to the cloud. If you have a 4G-enabled iPad you can do this step while you are still in the field and your colleague in the office can view the images right away by logging into the web application, "Site Scan Manager." Otherwise, you can upload the data when connected to Wi-Fi.

PROCESSING YOUR DATA

The next part of the workflow is done from the office using the Site Scan Manager web application. Just login to sitescan.3dr.com with your account credentials and the first thing you will see are all the missions you've flown with your Site Scan drone. The mission you just flew will be visible on the top left side and by clicking on it, you'll be able to review all the details. You can flip through the images in the browser, viewing the full-quality data so that proper coverage and QC checks can be made without having to download any data locally. These images can also be shared outside the 3DR Cloud by generating a "share link." Sending this link to anyone will allow them to download the images without having to log into Site Scan themselves. This is a perfect method for sharing data outside your organization.

In order to create data products such as orthos, point clouds, and 3D meshes, a photogrammetric process needs to take place. With Site Scan, this processing takes place in the cloud, using the Autodesk ReCap stitching engine.

Included in the Site Scan package is unlimited cloud storage and processing, so the data products can be generated as many times as needed. To start the process, click the "Process" button. This will bring up a pop-up with multiple file formats from which to choose. You can select one or many file types to process at the same time. The following are available file types the engine can export:

- Ortho (orthorectified georeferenced image and raster DEM)
- RCM (ReCap 3D mesh)
- RCS (ReCap point cloud)
- FBX (Autodesk 3D mesh)
- OBJ (Open-source 3D mesh)
- LAS (Open-source point cloud)

Once the processing has been kicked off, the models will be generated in less than an hour for ~30 images to 6 hours for 500 images. As with the raw image files, these models can be shared outside the organization using a share link. The orthophoto can be reviewed in the browser, overlaid on top of a basemap for location and quality checking (see Figure 5).

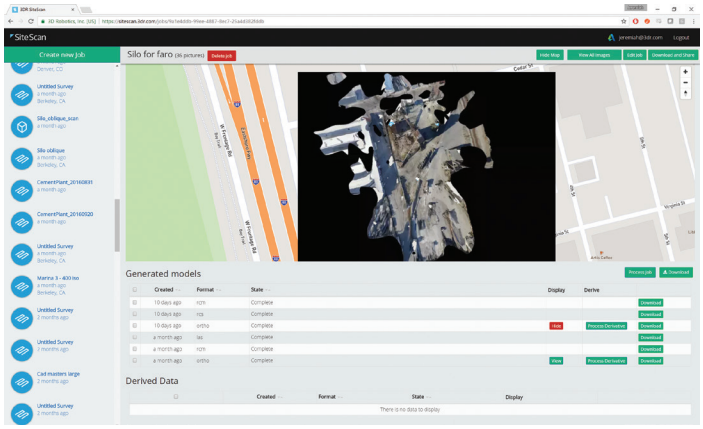


Figure 5: View ortho in Site Scan Manager

USE WITH AUTODESK TOOLS

Even though the 2D and 3D files created by Site Scan can be imported in any Autodesk tool, I would like to showcase an example using Autodesk ®ReCap 360™ Pro and ReMake. ReCap Pro 360 is a desktop software that manipulates point cloud files. You can easily import the RCS (point cloud) file created from Site Scan straight into ReCap 360 Pro (see Figure 6).

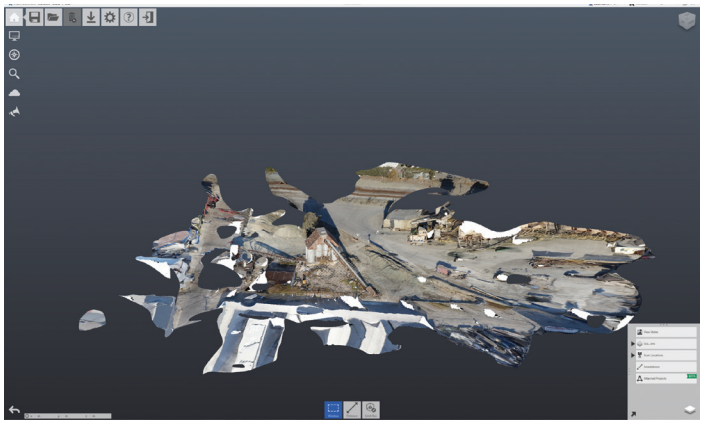


Figure 6: Silo point cloud imported in ReCap 360

There are a lot of points around the edges of the model that aren't very accurate due to the drone also capturing low-quality data outside the selected area. You can quickly select the points you want to keep and delete the rest. In order to simplify the use of the point cloud, you can create regions for buildings, terrain, and other features. Doing this splits the point cloud into separate files for each region. This will speed up the software when analyzing the point cloud of reach region.

The first task is to determine the roof area so that a cost estimate can be created for a new roof. Recap 360 Pro makes this easy by using a distance tool that snaps to the points, ensuring accurate dimension (see Figure 7).

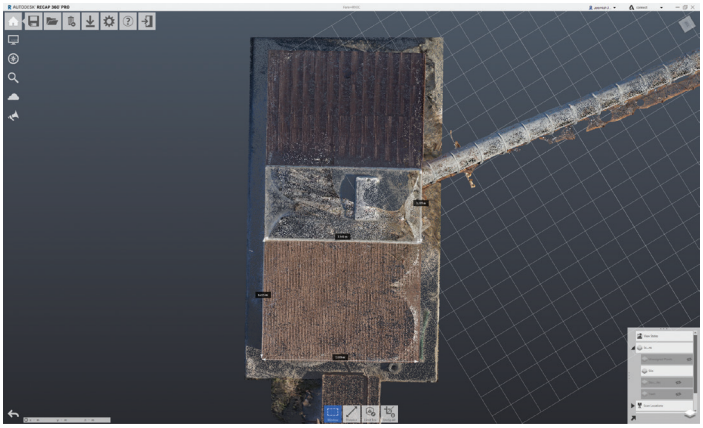


Figure 7: Calculate the silo roof area with ReCap 360

The second task is to determine the size of the trash pile next to the silo. This will help us find out how many trucks to order to haul out the trash. You can use the RCM (3D mesh) file inside of Autodesk ReMake to "Slice & Fill" the pile to determine the volume. ReMake is a simple Autodesk tool to edit and analyze 3D meshes. As ReMake opens RCM files natively, importing is simple.

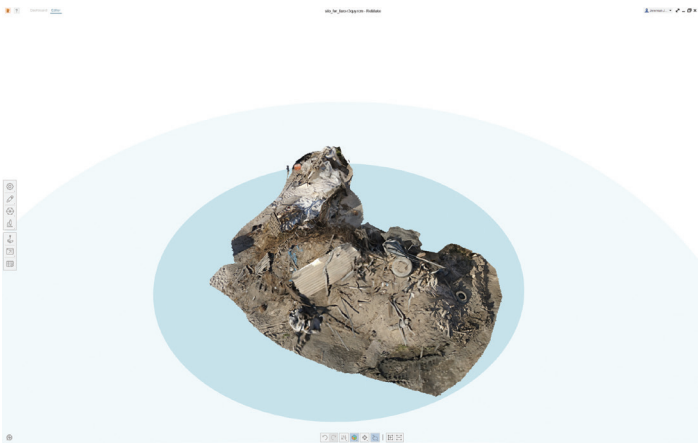


Figure 8: Calculate volume in ReCap 360 Pro

To calculate the volume, select the pile or feature and delete everything except the selected feature. Next, perform a slice and fill to create a plane that the software will use as a bottom plane of the pile. After the feature has been "solidified," the ReMake Mesh Report will show the volume of the trash pile (see Figure 8).

WHAT'S IN THE BOX

The complete Site Scan package comes with everything you need to put the best sensor in the sky, process the aerial data, and push it to your Autodesk tools. The box contains:

- Site Scan drone and controller
- New Sony R10C camera + 32Gb SD card
- Camera gimbal
- Two lenses
- 3 Batteries
- Rugged hard case

The yearly software license includes unlimited cloud storage and processing. Customers also have a direct line to our success engineers and a worry-free drone replacement per year.

CONCLUSION

The workflow couldn't be easier! Reality capture generates value for business in AEC across all stages of a construction project, from preliminary design to earthwork, construction process, and maintenance. We typically see clients start using Site Scan for a specific use case and then quickly realize they can successfully deploy it in other phases as well. As it seamlessly integrates into Autodesk A360, customers can quickly deploy it on projects without having to learn new tools or changing workflows.

Finally, Site Scan is built to evolve. We are constantly working on new features for the Field and Manager app. I would love to hear from you regarding the current Site Scan functionality and features you would like to see added or enhanced, so feel free to email me anytime.

Happy flying!

Kevin Sartori is a Robotics Engineer by training based in Berkeley, California. Early in his career he was part of the founding team of the open source PixHawk UAV autopilot. Later, as a strategy management consultant for BCG in Switzerland he worked with industrial goods and heavy infrastructure clients to optimize their business operations in Europe. Today, he is Product Marketing Manager at 3DR and can combine his passion for helping clients improve their businesses with UAVs. Kevin can be reached for questions at sartori@3dr.com. For more information on Site Scan visit ww.3dr.com.

by Robert Green

HP Z2 Mini
The world's first mini workstation designed for CAD users[1]

Autodesk users use aggressive applications that require computing resources beyond that of the consumer PC's many of us are forced to use. Underpowered, oversized and noisy describes many of the consumer PC's that occupy too much space on millions of CAD user's desktops. HP's new Z2 Mini brings workstation punch in a package size 10x smaller than HP EliteDesk 800 G2 tower, elegantly styled, cool, quiet and easy to deploy.

Designed to deliver workstation performance for mainstream CAD users, the HP Z2 Mini Workstation provides an ideal balance of high speed processors, up to 32 GB RAM (2X many desktops), storage and superior graphics performance (3X other mini machines) options in an ultra-small, quiet package that can be mounted behind a monitor, under a desk or even thrown into your briefcase for trips to remote offices. In short, the HP Z2 Mini Workstation is a game changing machine that provides no compromise CAD performance in a radically small package.

Figure 1 - HP's Z2 Mini provides workstation power in a router sized package.

4.0 GHZ PROCESSING AND PERIPHERAL POWER

Before talking about the advantages of the Z2 Mini's small size lets establish the fact that this is a workstation not a toy. A quick summary of the Z2 Mini's internals read like industry leading mid-size tower workstations.

Processor: Delivering high clock rate quad core processing via a variety of Intel® Core™ and Xeon® processors (including the 4.0 GHz Intel® Core™ i7 6700), the HP Z2 Mini is an ideal platform for applications like Inventor, Revit and AutoCAD that perform the bulk of their work on a single core. The Z2 Mini's emphasis on high clock rate single processors[2] delivers excellent price to performance ratios for these CAD applications at a very reasonable starting price point of $699.

RAM: Offering up to 32 GB of RAM[3,4] the HP Z2 Mini Workstation provides plenty of memory for even aggressive 3D model editing encountered by many Revit users or large point cloud data sets used by AutoCAD or Civil 3D.

Drives: To reduce boot up times, speed disk reads/writes and buffer large CAD assemblies/models the HP Z2 Mini Workstation can support the 512 GB NVMe based HP Z Turbo Drive G2 via a motherboard installed module. The optional Z TurboDrive G2 solid state drive (SSD) delivers up to 4x the speed of conventional SSD drives leading to notably better disk performance for large data set applications like CAD. In addition to the SSD an optional 1 TB hard drive can also be installed to expand storage capability[5].

Graphics options: To deliver glitch free, certified graphics performance for Autodesk users the HP Z2 Mini Workstation utilizes the new NVIDIA® Quadro® M620 GFX graphics subsystem. Equipped with 2 GB of graphics memory, the M620 delivers 3.3x the graphics performance of a business-class mini[6]. Supporting up to a 4K video resolutions via the Z2 Mini's 3 DisplayPort™ connectors there is plenty of graphics power for CAD usage.

Multiple monitors: For CAD users who desire a multiple monitor working environment the HP Z2 Mini Workstation supports up to 4 DisplayPort™ devices via its rear panel or up to 6[7] devices using DisplayPort™ daisy chaining connectors.

EXPANSION AND MOUNTING OPTIONS

All expansion and connectivity ports are accessed at the rear face of the Z2 Mini's chassis. In addition to the power input and DisplayPort™ connectors (previously mentioned) a variety of USB ports, an RJ45 1 Gbit LAN connector and security slot are provided.

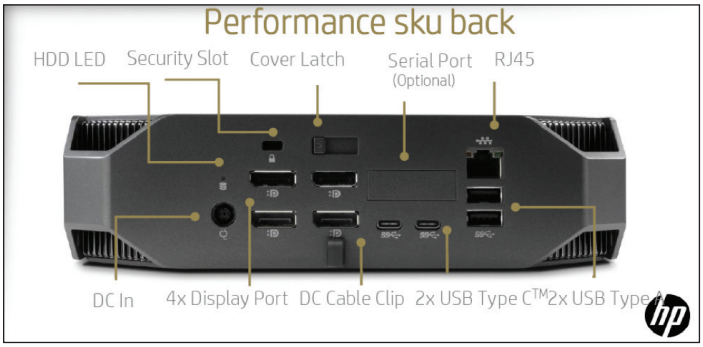


Figure 2 - The Z2 Mini's rear panel can be reconfigured to eliminate access to USB ports in security sensitive environments.

The Z2 Mini's small size lends itself perfectly to mounting at any angle on monitor stands or arm mounts using a VESA standard bolt mounting pattern[8]. With the wireless keyboard and remote power-on proximity to the user is of no concern so workspaces stay clean and wire free even in multiple monitor working environments. And if you're visiting another office where a spare monitor is available the Z2 Mini's size lends itself perfectly to being thrown in a briefcase and taken along.

Figure 3 - Remote power-on capability allows the HP Z2 Mini Workstation to be mounted out of the way for a clean, wireless look.

HP DESIGN AND RELIABILITY

While the design aesthetic of the HP Z2 Mini Workstation yields a sleek look and small form factor on the outside the traditional HP commitment to reliability and performance is alive and well on the inside. The HP Z2 Mini Workstation has been rigorously evaluated to achieve stable performance via robust cooling, quiet operation and certified graphics performance through with over 380,000 hours of application testing backed by HP's 3 Year Limited Warranty.

Like other HP Workstations, the HP Z2 Mini employs a tool-free chassis design for easy maintenance, includes HP Performance Advisor software for system optimization and driver maintenance, and comes standard with HP Remote Graphics Software for remotely accessing and sharing your HP Z Workstation.

And when it comes to software support the HP Z2 Mini Workstation is ISV certified by Autodesk and HP to deliver a complete technology solution to Autodesk users. As a result, HP Z Workstations deliver an enhanced user experience free of the driver and graphics compatibility issues that are often encountered with uncertified consumer computers. (Find out more about certified HP Z Workstations at hp.com/go/isv.)

BIG CAD IN A TINY PACKAGE

For Autodesk software users desiring workstation level performance the HP Z2 Mini Workstation delivers enough power for most CAD users in a disruptively small package that revolutionizes how you'll think about workstations. No longer does workstation power mean big, noisy, heat producing boxes that clutter up your office - you can now have your power and enjoy the small, quiet performance and HP quality in the HP Z2 Mini.

1 Based on publicly available information of workstation competitors as of October 3, 2016 with volume of at least 1 million units annually as of October 3, 2016 having < 3 litres volume, professional graphics, Intel® Xeon® quad core processor, ISV certified applications, ECC memory.

2 Multi-Core is designed to improve performance of certain software products. Not all customers or software applications will necessarily benefit from use of this technology. Performance and clock frequency will vary depending on application workload and your hardware and software configurations. Intel's numbering is not a measurement of higher performance.

3 Intel® Xeon® and Intel Pentium processors can support either ECC or non-ECC memory. Intel® Core™ i5/i7 processors only support non-ECC memory.

4 Each processor supports 2 (Intel® Core™) or 4 (Intel® Xeon®) channels of DDR4 memory. To realize full performance at least 1 DIMM must be inserted into each channel. Actual memory speeds dependent on processor capability.

5 For hard drives, GB = 1 billion bytes. TB = 1 trillion bytes. Actual formatted capacity is less. Up to 36 GB (for Windows 10) of system disk is reserved for system recovery software.

6 Based on business-class towers with >1 million units annually as of October 3, 2016 with performance measured by processor clock speed and ViewPerf12 rating, having 4th or 6th Gen Intel processors or AMD Pro processors, integrated VESA mount, VGA, 6 USB Ports, Windows Pro OS and TPM.

7 6 display functionality delivered via the combination of NVIDIA® Quadro® M620 graphics and Intel® HD 530 or P530 graphics. 6 display support only available on the Z2 Mini Performance base unit.

8 Mounting hardware sold separately or as an optional feature. 3rd party displays must have a 100mm x 100mm VESA hole pattern to be compatible

by: Dan McCloskey

Industry Insights

In the commercial building industry, advances in the capabilities of Autodesk® Revit® have created a trend toward the use of Revit as a tool for shop drawing creation. From its inception, Revit was geared toward building designers (architects, structural engineers, and mechanical engineers) as a BIM tool for design, documentation, and collaboration within design teams. Design teams have typically modeled up to LOD 300 (per BIMForum Specifications), at best.

In recent years, Autodesk software has made a push into fabrication, to help link the design and construction phases of the commercial building industry. One way that Autodesk made an immediate impact is by acquiring Advance Steel as a true steel detailing platform. The other approach Autodesk took was to enhance the tools embedded in Revit to enable users to produce fabrication models and shop drawing natively in Revit. The addition of the Parts and Assemblies tools, robust rebar modeling and documentation tools, and the addition of a steel connection module in Revit 2017 have given Revit users a toolbox to allow them to push models past LOD 300 and into LOD 350 and 400 for structural elements. Additionally, third-party add-ins for Revit have enhanced the ability to use Revit for fabrication modeling and shop drawing creation for structural elements.

There is a trend in the commercial building construction industry toward structural engineering firms, outside consultants, subcontractors, and contractors leveraging the software enhancements to push models from design into fabrication and construction. In the traditional approach, structural models created in the design phase have not typically been used by fabricators or builders, apart from some Navisworks coordination. Instead, fabricators and builders have either used traditional 2D methods to create structural shop drawings, or created new 3D models and shop drawings from scratch. This has created a tremendous opportunity for structural engineering firms and outside consultants to use structural design models as a starting point, add a higher level of detail to structural components, and use the same model to create shop drawings.

Structural engineering firms have started to offer detailing services for structural components on projects for which they are the Engineer of Record. This gives them a competitive advantage by offering a streamlined service that has the potential to compress the construction schedules. Structural firms can start detailing during the later stages of design, rather than after design is complete. From a construction team perspective, this helps prevent the drop-off of knowledge and intent from design into construction, and can reduce schedule and cost.

This article will briefly discuss the trends toward using Revit to help with shop drawing creation and fabrication data for steel, cast-in-place (rebar shops and lift drawings), precast concrete, and metal stud framed buildings.

REBAR SHOP DRAWINGS AND FABRICATION DATA

For the last five years or so, I'm sure you have noticed that when you run through the annual "What's New in Revit Structure" blog posts and videos, there are always structural reinforcement topics. Little by little, over the last few years, Autodesk has made Revit into a true rebar detailing software.

The big leap came a few years ago when Autodesk introduced automatic bar numbering and partitions. With this tool, Revit gained the ability to identify rebar with the same size, shape, and bend segments, and give them the same rebar number. Other annotation tools such as bar presentation controls and multi-rebar annotation have made the creation of rebar shop drawings much more efficient.

Similarly, Autodesk introduced rebar modeling tools over the last several years that allow users to populate their models with rebar much more easily. They have enhanced the rebar constraints dialog, introduced varying length rebar sets, and added rebar couplers.

Additionally, there are several software packages out there to help with modeling and annotating rebar in Revit. SOFiSTiK is particularly useful in the annotation and creation of rebar shops. Their plug-in, as well as Graitec's PowerPack, seek to help engineers take the results of their analysis into actual modeled rebar within Revit.

In the U.S. commercial building construction industry, rebar fabricators have typically been responsible for the rebar detailing scope of work. However, in many European countries, that responsibility has been that of the structural Engineer of Record. With the native tools in Revit, U.S. structural engineers have started to realize that they can offer rebar modeling and detailing as an add-on service for their projects. While there is a learning curve, shift in risk, and it takes the right project participants and relationships, structural engineers have started to offer this on their projects. For many projects, the potential schedule and material savings are significant. Because the structural engineers are most familiar with the project and can leverage the Revit models created in the design phase, they are well suited to push the rebar portion of the model into the fabrication and construction phase.

CIP CONCRETE LIFT DRAWINGS

For cast-in-place (CIP) concrete, subcontractors and self-performing general contractors have for years been creating lift drawings, slab edge drawings, and formwork using everything from hand sketches, to Bluebeam, to AutoCAD. To create an accurate and useful concrete lift drawing, information from the structural drawings, architectural drawings, and shop drawings from various other trades (such as stair and elevator shops, MEP penetration, steel embeds, and glazing system embeds) must all be brought together and incorporated. A current trend in the industry is to use Revit models to perform this task. The end result is highly coordinated, clear, and intuitive lift drawings that enhance coordination and improve field productivity.

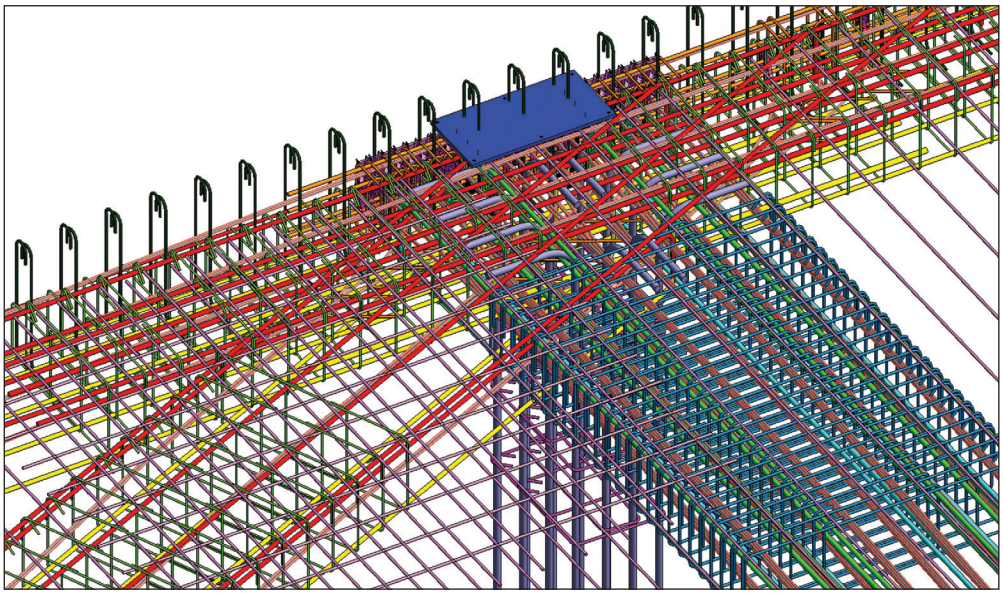


Figure 1: Rebar modeled in Revit

Again, a great starting place for these lift drawings is to use Revit models from the design teams as a background from which to build the accurate concrete geometry. Often, structural and architectural Revit models may only show concrete geometry to a LOD of 300 or 350. For instance, slab-on-grade pour-downs may not be shown at door thresholds, accurate sloping and stepping of slabs may not be modeled, doors and windows may not be modeled to the correct rough openings, and architectural and structural may not be completely coordinated. However,

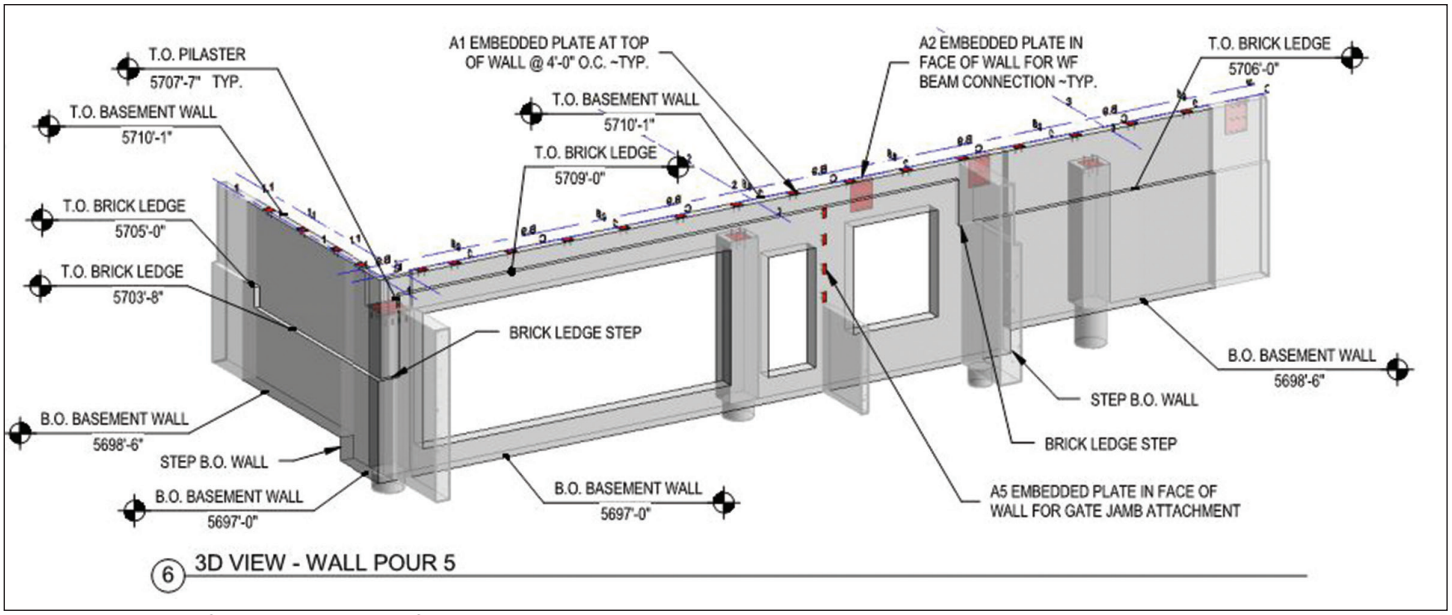


Figure 2: Concrete lift drawing isometric from Revit

Revit 2017 – Structure

concrete professionals and outside consultants are increasingly using design models as a starting place for their LOD 350 or 400 concrete models.

STEEL DETAILING

Structural steel detailing is one segment of structural fabrication that has been using 3D modeling and BIM to create shop drawings for years. Detailing software such as SDS/2 and Tekla have been the most common for the commercial building industry in the U.S. in the past, and Advance Steel was very common in Europe and elsewhere. A couple of years ago, Autodesk acquired Advance Steel, and added a true steel detailing software to their product lineup and customer workflows.

Partially because of Autodesk's acquisition of Advance Steel, partially because of better interoperability between Revit and other steel detailing software, and also because of better IFC file transfers, structural engineering firms have been able to push into steel detailing services. Some larger firms have in-house steel detailing departments, while others partner with structural steel fabricators and detailers to offer steel detailing services on projects for which they are the Engineer of Record. Smaller firms and outside consultants have also started to realize that with their current tools at hand, they can offer steel detailing services as an expansion of their current workflows.

The seamless interoperability between Advance Steel and Revit has enabled a workflow that allows design teams and steel detailing teams to share models quickly and easily. With the new tools available in Revit 2017, structural engineers can now quickly and easily populate their Revit models with steel connections from extremely robust pre-defined templates, which work very much like those in Advance Steel. Then, the model can be sent to Advance Steel to do the "heavy lifting" required in steel detailing, such as the annotation and documentation.

For smaller structural steel framing projects or miscellaneous metals scopes of works, some design firms have provided steel shop drawings directly from native Revit. The Assemblies tool in Revit is geared perfectly toward steel detailing, as members can be assembled together with their corresponding connection elements and annotated and scheduled accordingly. Though tedious and difficult on a large job, it is possible to create steel shop drawing directly in Revit. Some add-ins are available, such as Smart Assemblies from AGACAD, to help automate some of these tasks.

PRECAST CONCRETE

Unlike rebar and steel framing, precast concrete members are not standardized and vary by each individual fabricator. Because of this, precast concrete has been largely left out of advances in the tools within Revit for fabrication level modeling and shop drawing production. However, because of the variance in products, geometry, and preferences between fabricators, design teams have a hard time defining accurate precast geometry and layout during the design phase. Also, general contractors are asking precast fabricators for fabrication-level models more and more, as a means to coordinate with other trades.

Because of this, precast concrete manufacturers and their outside consultants have begun to take the plunge into fabrication-level modeling within Revit. The native Parts and Assemblies tools in Revit were one of the catalysts to allow this to happen, as precast members and their connection elements are grouped together and scheduled as assemblies for piece drawing purposes. Additionally, some Revit add-ins have been developed that are geared toward the precast industry, such as AGACAD's Precast Concrete Suite, IDAT GmbH's tools, and Edge^Revit.

One of the big challenges facing precasters when switching to Revit is building libraries of families for all of their various products, connection elements, raw material, and inserts. Then, this content must contain data that accurately feeds into other processes internally, such as material ordering, production scheduling, quality control, shipping, and erection. Though challenging, the payoff is great, and there is a trend in the precast industry toward adopting Revit.

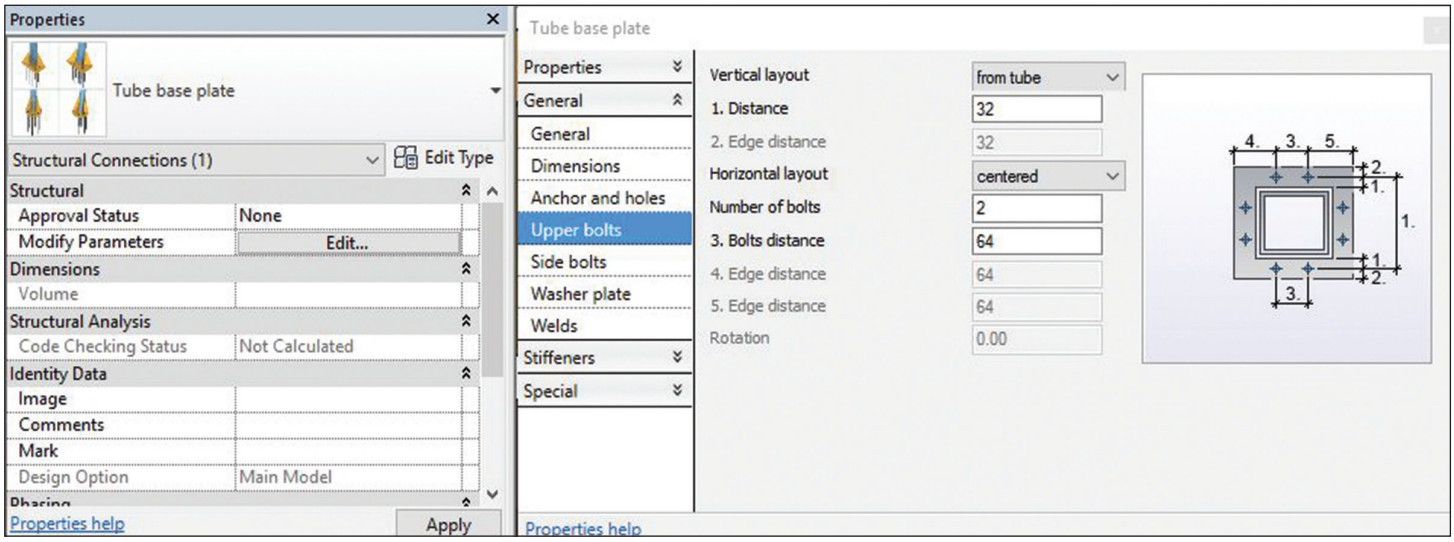


Figure 3: Steel connection module in Revit 2017

METAL STUD FRAMING

Some firms are also using Revit for to create shop drawings for cold-formed steel studs (CFS). Here in Colorado, cold-formed metal framing for walls is typically a delegated design item with the shop drawings as a deferred submittal. The subcontractor is then responsible for securing the engineering and shop drawings for the CFS members. Increasingly, structural engineering firms are taking on that responsibility and offering the engineering and shop drawings for these elements. Because they already have a geometrically accurate Revit model (included the architect's walls linked in), it is easy for engineering firms to take their models a step further and include the CFS framing. This puts them at a competitive advantage over an outside entity that would have to re-create the geometry, and also gain the knowledge of the building and loading.

Though useful in some cases, creating a model with individual CFS members is not necessary. The structural EOR can use existing elevation views created and define layouts to create simple and efficient shops drawings. Several metal stud manufacturers have Revit families and details available for download to help with this. If Bills of Material (BOMs) for the studs and connectors are desired, then there are add-ins for Revit to help with modeling and shop drawing creation. StructSoft and AGACAD both have created tools that work well for this.

SUMMARY

Over the last few years, improvements to Revit and the availability of add-ins have put fabrication modeling and shop drawing creation tools in the hands of those best suited to use them—the structural engineers. Because of this, the trend in the industry has been for structural engineering firms and consultants to leverage these tools, as well as their project and technical knowledge, to start offering detailing services for structural elements. While different challenges and opportunities exist for each type of structural element you now have the software available to dive in and give it a shot!

Dan McCloskey, P.E., is a structural engineer with a background in commercial building design. While a design engineer and then later a project engineer for a structural engineering firm in Denver, Colorado, he was tasked with learning and implementing Revit for the firm in 2006 and became an in-house Revit expert. In 2011 Dan co-founded MB BIM Solutions as a BIM-focused consultancy that provides construction-level modeling of structural systems and components for its clients. Dan is active in the Denver-area BIM community with Rocky Mountain Building Information Society, has taught several classes at Autodesk University, is a Revit Beta contributor, and is also a Revit Gunslinger participant.

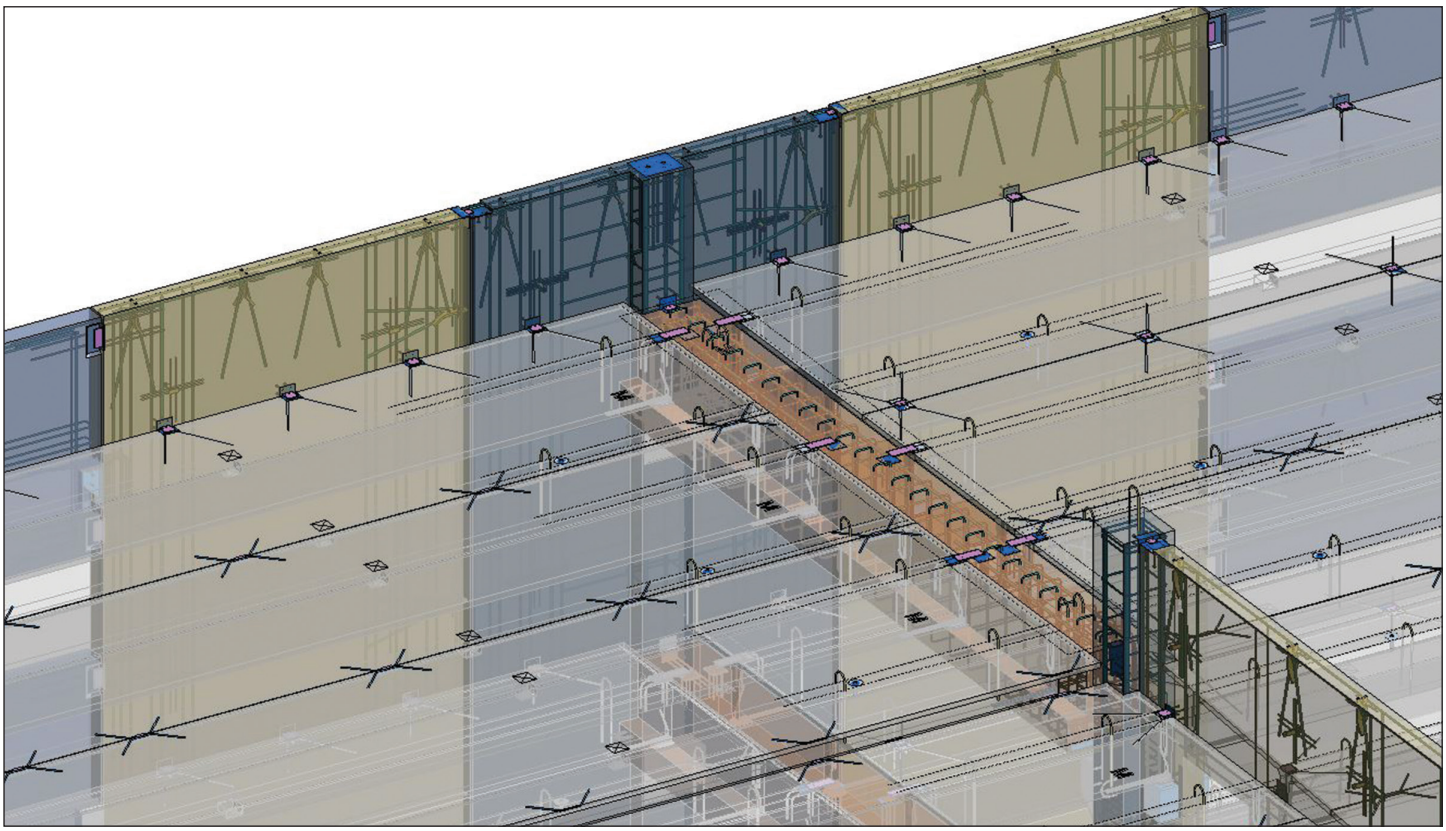


Figure 4: Precast fabrication model in Revit

by: Mark Kiker

Becoming Resilient

We live in an age where technology touches everything. The Internet of Things is growing every day. Workplaces have high-tech workers who know how to self-manage their devices and work environments. Design technology and project processes can go awry and go downhill fast. You are called on when things go bad. When the going gets tough, people turn to you. You need to have a positive resolve.

Getting through the tough spots. Landing on your feet. Knocked down but not out. Surviving a crisis and getting stronger because of it. Tech Managers have to be resilient. In fact those who succeed in the long run are those who are resilient in the face of adversity. They push forward. They find ways of getting things done, often without help, time, or money. They are resilient.

WHAT IS RESILIENCE?

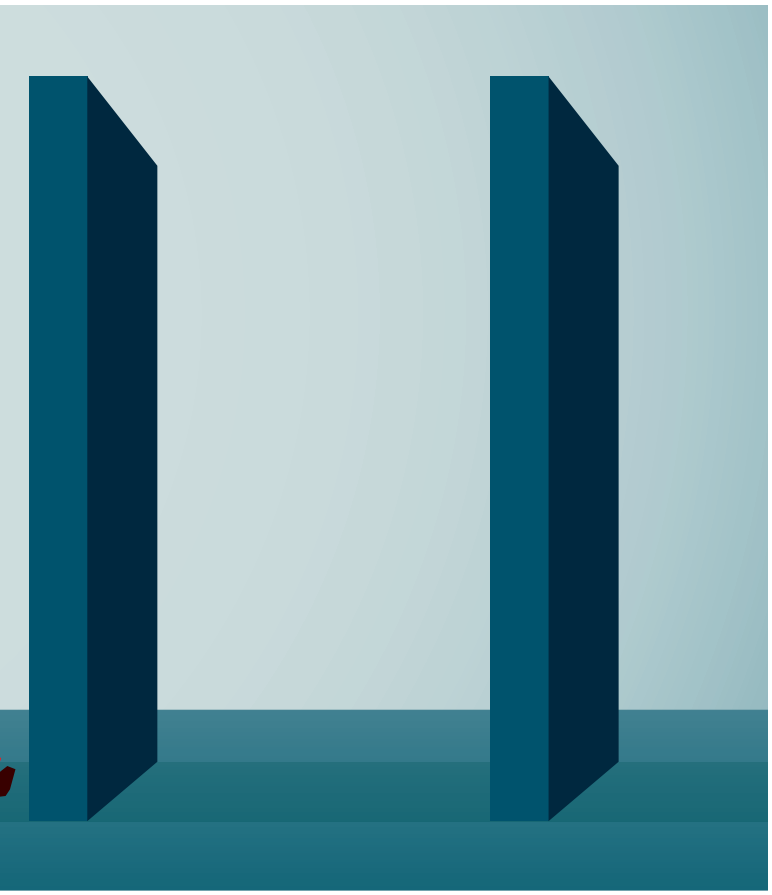
Psychology Today defines it this way: *Resilience is that ineffable quality that allows some people to be knocked down by life and come back stronger than ever. Rather than letting failure overcome them and drain their resolve, they find a way to rise from the ashes. Psychologists have identified some of the factors that make someone resilient, among them a positive attitude, optimism, the ability to regulate emotions, and the ability to see failure as a form of helpful feedback. Even after misfortune, resilient people are blessed with such an outlook that they are able to change course and soldier on.*

According to Christy Matta, MA on the PsychCentral website: *"Resilience is the process of adapting well in the face of adversity, trauma, tragedy, threats, or even significant sources of stress — such as family and relationship problems, serious health problems, or workplace and financial stressors. It means "bouncing back" from difficult experiences."*

Ms. Matta goes on to state that everyone is resilient at some level, but it can be more highly developed with focus and effort. *"People who have experienced good outcomes tend to see themselves as effective. With each good outcome, their confidence in themselves builds. These are often the people who you might consider resilient. If they experience a failure, their confidence in their abilities motivates them to continue to try until they succeed. Very often they do succeed and over a lifetime become proficient in many areas. On the other hand, doubt in oneself often leads to resignation after unsuccessful first efforts. Those who view themselves as competent and capable also often experience initial failure. The difference is that they maintain a commitment to their goal, even in the face of obstacles."*

Back to technology and your workplace. It is full of stress and challenges every day. Things take longer to complete. People miss deadlines. Technology breaks. Things get derailed. It can get you down at times, but bouncing back should be your trademark.

What do you do? Throw your hands up and quit? Tell someone else to fix it? Ignore it? These are not options that are given to Tech Managers. We have to make it work, get it done, make



progress. Here are some tips for becoming resilient when you are challenged by stresses, roadblocks, and failures.

Get Control. You need to be a calming agent when others are losing their heads. Hitting the "pause" button, even for a few minutes or seconds, can help you not freak out. Controlling your initial responses can be tough, but getting a handle on surprise, annoyance, anger, disappointment, and defeatism can go a long way in setting the stage for positive outcomes. Others are looking to you for answers, not panic.

Get a Grip. Understand the real impact of events. Don't catastrophize, which is to think or act as if something is worse than what it really is. Do not keep going down the "What if…" scenarios that may never transpire. Don't make events into catastrophes if they are not (and most events are not). Step back and take stock in what is really happening and what the impact of it might be. Once you have a good handle on the real problem, you can dive in and get it fixed or contained.

Get a New Attitude. Change your perspective. If you have a negative slant—a "not again" attitude—then you need to refocus and approach it anew. Shifting from defeat to resuscitate can be as easy as taking a few breaths or maybe taking a short walk. Borrow a view from someone else by asking what they think. Talk out the negatives with a person who is a sounding board. Just getting these negatives out of the way allows you to see some positives.

Get a Move On. Lean toward action. After you have defined the problem, then start taking action. Attempts at remediation will allow you to make positive progress or at least let you know what does not work. If it is a people problem, keep the conversation flowing. Ask more questions. Make an effort to mend fences or tear down walls.

Get a Plan. Think beyond the challenge. Look past the immediate. Reach beyond your day-to-day. Develop goals that stretch you. This will allow you to not get trapped in the things that are pulling you down, making you frustrated, or derailing your plans. Define longer term goals. I am talking really long-term, career-focused goals that your firm can capitalize on and that can help you reach beyond your current position. Dream a few big dreams.

Get Help from the Past. Remember what you have gotten through in the past. So many people get downtrodden with the current state of affairs. Move beyond that by remembering the past. You have come so far, made such progress, fixed so many things, helped move tech forward. You will do it again and again. Think about what you may have developed or created or refined in the past months or years.

Get Unstuck. Think creatively about the options you may have. If your challenge is a career setback, you still have options ahead. If your roadblock is a strained relationship, get creative on how you might reach out and strengthen the bond. If it is a hardware failure, think about where you might get other devices to fill in the gap. Rarely are there no options.

Get Healthy. It might be as simple as getting healthier. Putting on few pounds or sitting too long can get you out of sorts. Nagging pains can be a drag on your stamina. Attend to your health. Make a new start before the holidays. Enjoy life in a measured way. Get moving more. Take a walk every day. Play with the kids or the dog. Eat more dark chocolate. Get outside more.

Resiliency is a trait that differentiates great Tech Managers. They press on. They continue to seek solutions. They don't give up.

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.

by: Brian Chapman

Reflections on Lighting

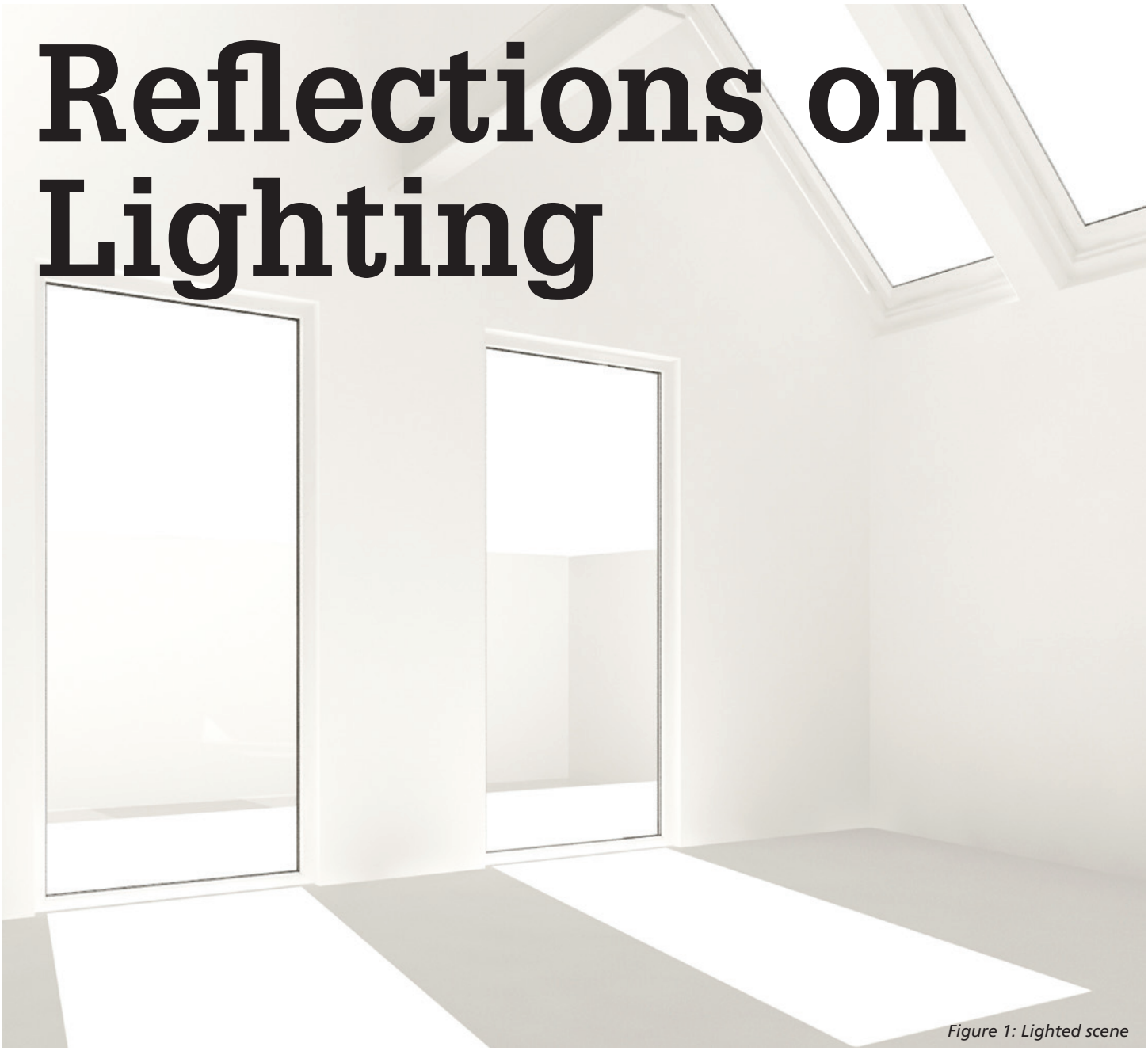


Figure 1: Lighted scene

Beyond the AEC and gaming industries, 3ds Max® has been employed as a low-cost solution to conduct a multitude of technical and advanced studies to present detailed simulations and analysis related to a number of topics. In this article, I'll be discussing simulations related to 3ds Max and its lighting system.

Understanding light is more complicated than some might imagine. For example, in cloudy weather sunlight has a tent of blue, but in clear weather it's primarily pale yellow. Good light is generated by the sky, but not necessarily the sun, and the measurements we use to gauge lighting are dependent on multiple factors. By understanding how the lighting components inside 3ds Max work we have the ability to apply our understanding of lighting in the real world to a multitude of projects. A few areas 3ds Max and its lighting system have been used are listed below:

- Maximizing the use of natural light in buildings, solar power, and agriculture
- Studying security concerns related to low-light conditions
- Reducing cost by maximizing light spacing
- Studying the effects of light on habitats and working environments
- Review shadows and light-pollution related to natural and manmade features
- Emergency service and military applications such as supplemental lighting for target detection
- Presenting the effects of lights on biomass and various environments
- Presenting planetary exploration options utilizing solar-powered robots and much more

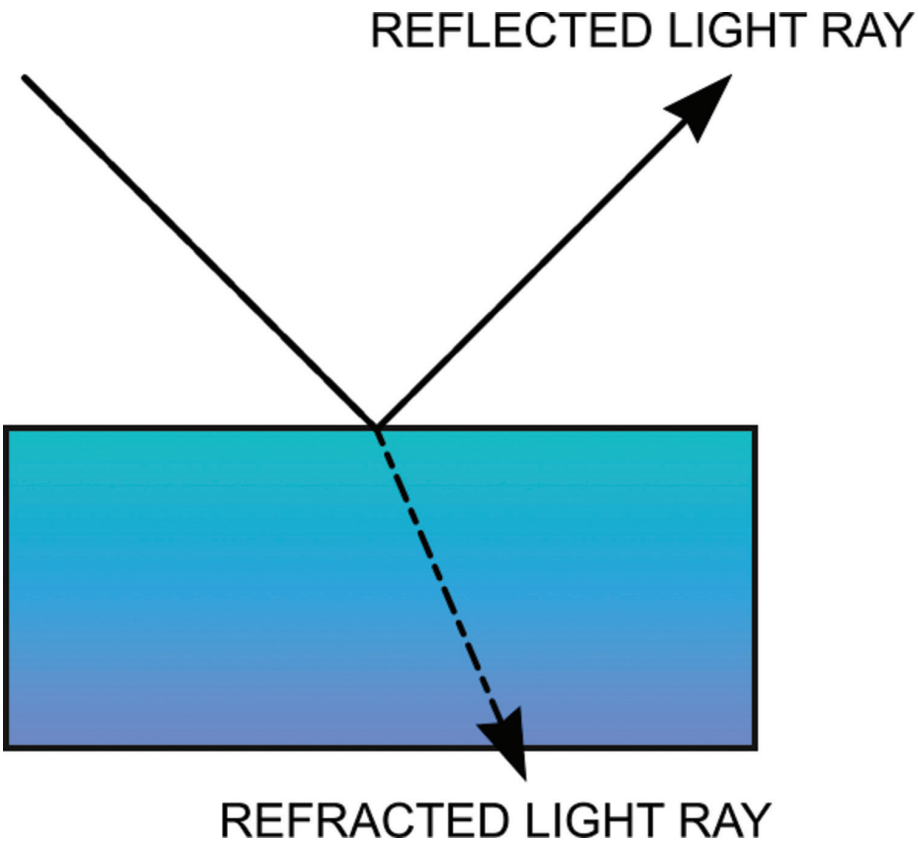


Figure 2: Light ray figure

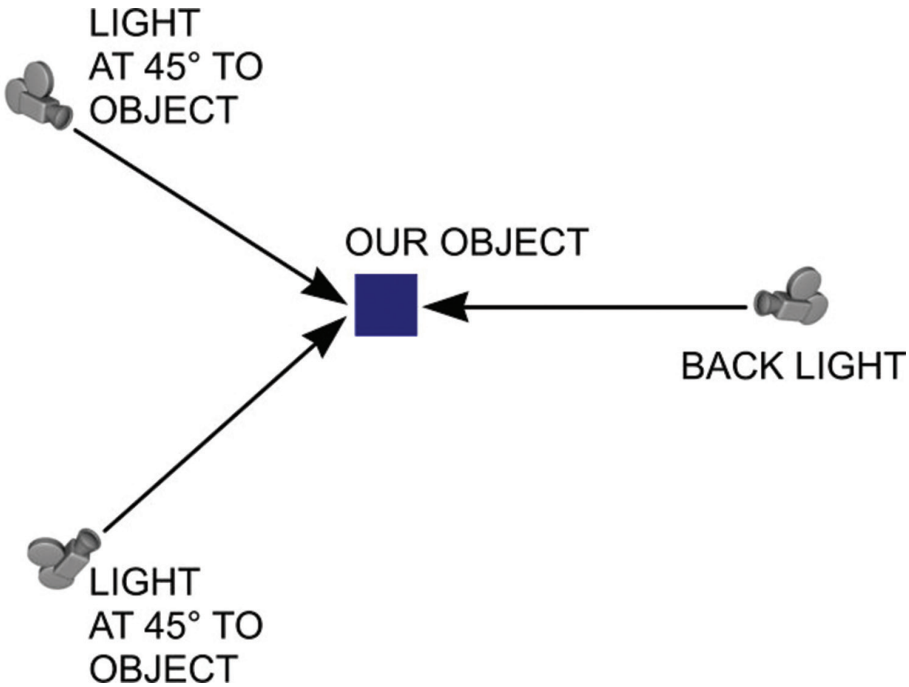


Figure 3: Optional lighting layout

LIGHTING

3ds Max is a powerful tool for both artificial and natural lighting analysis. This is due primarily to the software's ability to visually present accurate luminance and illuminance values. Illuminance is basically the light travelling toward a surface from a light source. Luminance is the amount of light reflected from the surface of an object. With 3ds Max we can generate a point-by-point analysis of lighting to review and present its effects on a particular environment. This is primarily where materials play an important part when rendering a scene in 3ds Max. Every material reflects light differently. Some absorb light (in a manner of speaking), which is typically referred to as refraction. See Figure 2 for a visual explanation.

PLACEMENT

By imagining our scene in 3ds Max is a virtual stage we can begin to place lights accordingly. The decision to mimic natural or artificial light should be determined early in the process. Primarily, outdoor scenes will use 3ds Max's Daylight system to appropriately simulate the sun and realistically generate the necessary shadows to ensure realism with our three-dimensional objects, while interior scenes will use a series of lights to accent our objects or provide a wide area of lighted coverage or "wash" a scene. Balance, ambience, and additional illumination can be provided with additional light sources added to our scenes.

While randomly placing lights is perhaps acceptable, there have been studies completed to ensure elements are presented well and that the viewer's eye is not distracted by imbalance such as areas that appear either too dark or too bright. Some of these theories include angling lights at 45 degrees above an object on each side of the center, with a single back light to enhance the three-dimensional appearance. This particular layout enhances the objects shadows and pulls the object from the background. Adversely, if a light is placed directly on top of an object the shadows are eliminated and the object appears to be very flat. See Figure 3 for the light layout discussed.

3ds Max also gives us the ability to set light strength based on different units of measurement (such as watts) as well as by color. Open to cool and warm colors, we have the ability to adjust our lights for a various number of environmental effects to study or improve our scenes.

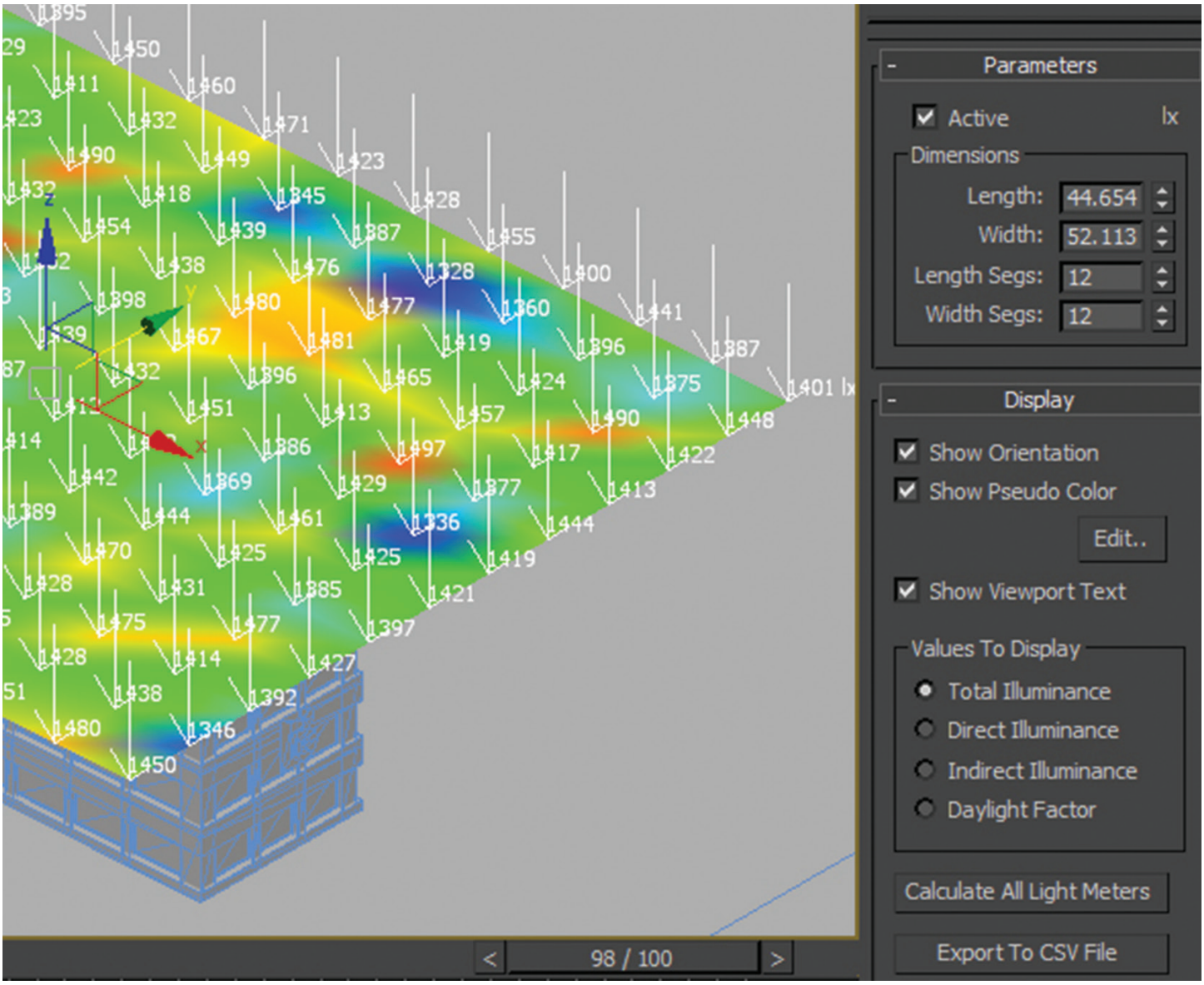


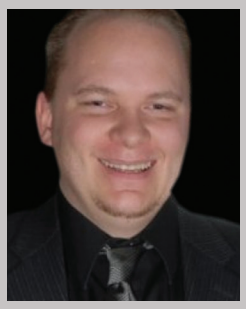
Figure 4: Lighting analysis

ANALYSIS

To calculate the light levels in a scene we use the LightMeter object located under the Helpers in the Create panel. The helper exports the values to a .csv file that can be reviewed where we can identify areas that need improvement or decide how those particular areas affect our objects and materials. By controlling the minimum and maximum values found by selecting the Edit button in the LightMeter object panel, we can create a color-coded visual representation of the values calculated to increase the quality of our visualization, display the results in studies and presentations, or analyze the effects lights have on our scene. A quick example of a LightAnalysis object is displayed in Figure 4.

CONCLUSION

The 3ds Max lighting system is perhaps the most advanced system available to users for simulation and visualization with components such as Skylights, Area Lights, Radiosity, Light Tracer, Photometric Lights, and more. In addition, solutions for more advanced lighting simulations are provided through a number of plug-ins available to 3ds Max, including E-light and VRay, and simulations can be used in conjunction with applications such as Ecotect, Radiance, and Dayism to produce highly detailed and accurate models pertaining to environments and the effects lights have on them.



Brian Chapman is an Autodesk Authorized Developer, creator of Pro-Cad.Net and a Senior Designer for Slater Hanifan Group, a civil engineering and planning firm dedicated to superior client service. Brian can be reached at procadman@pro-cad.net.

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Inside Track

by: Brian Andresen

Welcome to *AUGIWorld* Inside Track! Check out the latest opportunities to advance your skills, processes, and workflows in your firm with the most current AEC-related software and hardware updates available.

CHEETAH SOLVER PLUG-IN

http://bit.ly/2g144An

Modern applications in mechanical design, architecture, and many other areas of engineering require a powerful and reliable geometric constraints solver capable of handling large quantities of data.

Autodesk® uses a D-cubed solver for implementing 2D constraints in AutoCAD® and Inventor®. However, even this production-proven solver, which provides the geometry foundation for most of the leading CAD applications, has its significant limitations.

Cheetah Solver opens the way for parametric modeling beyond these limitations. It can work with geometric models that contain a hundred times more geometric and dimensional constraints, and resolve them much faster than you can do with the constraints solvers of the present CAD applications.

Visit the link above to learn more about how this plug-in can provide you the opportunity to take AutoCAD to the next level!

SCAN TO BIM

http://bit.ly/2fF3iXv

The Scan to BIM™ add-on for Autodesk® Revit® enables you to create and validate a model from a point cloud with automated recognition and placement of architectural elements such as walls and columns, as well as MEP elements such as pipes, ducts, conduits, and more.

Scan to BIM provides the ability to create native Revit geometry from a point cloud and to analyze differences between model geometry and the point cloud.

Key features include:

- Tools to assist with creation of Revit elements including walls, Construction geometry, mesh modeling, and clean topography extraction
- Automated recognition of pipe and wall batches across a whole Revit point cloud
- Supports interference/clearance detection for geometry versus point cloud
- Workflow-based tools to help set up and work on your model with the point cloud
- The ability to measure points within your scan to quickly find true dimensions
- The ability to export/import data in a format understandable by electronic surveying equipment so you can read in survey data for as-built conditions, as well as exporting design data for field verification
- Support for floating network licenses
- Direct feedback to our development team from within the product

IDEATEAPPS TRIAL - 2017

http://bit.ly/2c1ioGZ

IdeateApps is a set of Autodesk® Revit® -based tools designed to increase the productivity of the entire project team. Developed with specific tasks in mind, these tools address the challenges identified most often by Ideate Software customers who use Revit every day. The 14-day free Trial version is full-functioning.

These tools will decrease the time spent on common tasks and increase the accuracy of BIM data in a Revit model, helping to keep projects of all sizes and complexities on time and within budget.

If you have some news to share with us for future issues, please let us know. Likewise, if you are a user of a featured product or news item and would like to write a review, we want to know. Contact brian.andresen@augi.com

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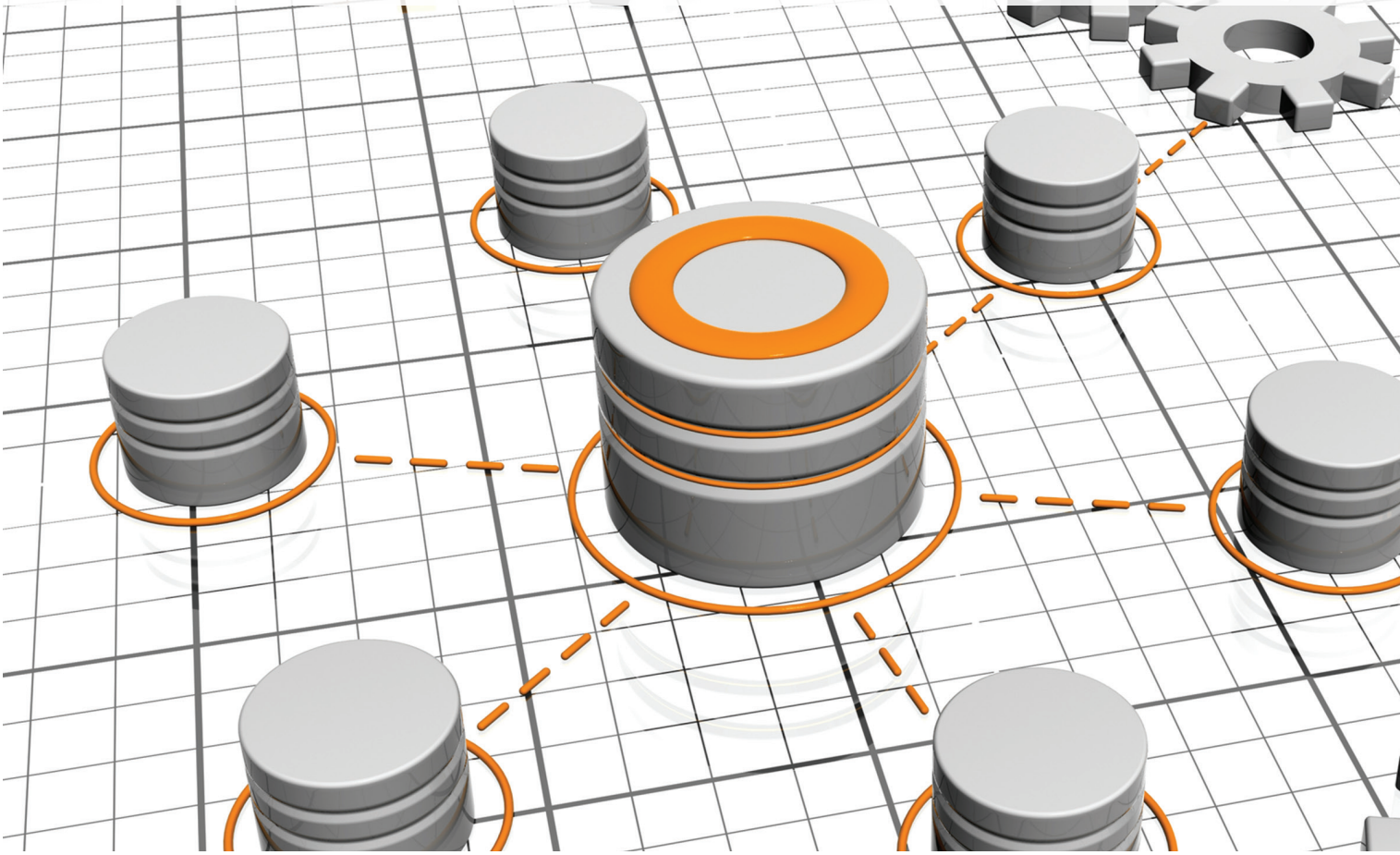
AUGI

by: Melinda Heavrin

Arrange Your Workspaces

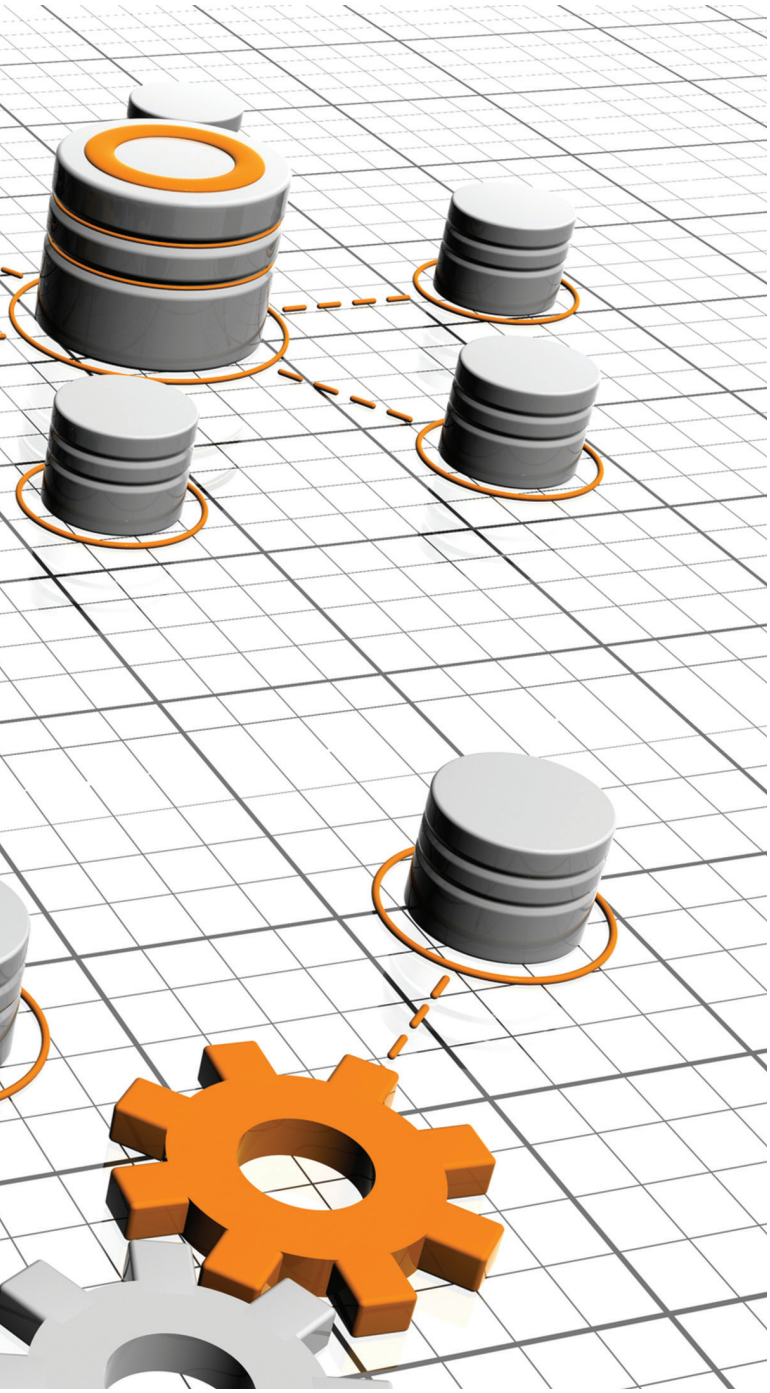


A workspace in AutoCAD® Architecture is the basic user interface that includes those palettes, commands, and controls you need for your architectural process. When you first start AutoCAD Architecture during implementation, the default Architecture workspace is displayed. The workspace can be reconfigured according to your preferences as you work. You can move or hide various components as needed, display additional ribbon controls, or add new tools and tool palettes. You can even save your customization as a new workspace that you can access for later drawing sessions. You can also switch from one workspace to another at any time.

THE WORKSPACE USER INTERFACE

The workspace is designed to make it easier and faster for you to find and use the tools and commands you need. The workspace user interface consists of several components.

- The Ribbon – Similarly to Microsoft Office, AutoCAD Architecture 2015 introduced the ribbon as the central access point for commands. The ribbon contains a number of tabs on which commands are grouped according to conceptual task types or selected objects. The ribbon replaces the menu bar and the toolbars as the primary command access point.
- The Application Menu – The Application menu contains basic commands pertaining to the drawing as a whole, such as Open, Save, and Print. Like the menu browser it replaces,



the Application menu is accessed by clicking in the upper-left corner of the workspace.

- Workspaces – AutoCAD Architecture is equipped with one single default workspace (Architecture). The menus and commands associated with the previously provided workspaces (Design, Document, Detailing, and Visualization) can be accessed from the tabs of the ribbon.
- Help Access – With the removal of the menu bars in favor of the ribbon, the commands to access Help features have been moved into the InfoCenter at the top right of the application window. Here, you can find the online resources of InfoCenter and the Help menu, which allows you access Help, Tutorials, and other interactive resources.
- Status Bar Menus – Commands on the status bar have dialog boxes and options that can be launched by clicking on them or on the drop-down arrow next to them. Click the Customization icon on the status bar to select what you view on the status bar.
- Autodesk Seek – You can use Autodesk Seek to find product design information. Many content providers, including corporate partners and individual contributors, publish to Autodesk Seek. Content includes 3D models, 2D drawings, specifications, brochures, and other descriptions of products or components.

  You can also share your own content with others using Autodesk Seek. Upload drawings or blocks to Autodesk Seek to give your partners and customers ready access to your content.

CUSTOMIZING A WORKSPACE

Workspaces control the display of sets of user interface elements and are typically organized by function or workflow. You can create and manage workspaces from the user interface with the WSSAVE command or Customize User Interface (CUI) Editor. You can also define the properties of a workspace with the CUI Editor. These properties allow you to identify the workspace from other workspaces in the CUIx file and control the behavior of some of the user interface elements related to the application window.

A workspace must be set current to update the user interface based on the properties and settings of the workspace. Only workspaces in the main and enterprise CUIx file can be set current. If a workspace is in a partial CUIx file and you want to use it, you must transfer the workspace with the Transfer tab of the CUI Editor to the main CUIx file before it can be set current. The most recent workspace is set current after closing and restarting the program.

If you are setting up a Network Deployment, you can define which workspace to set as the current workspace the first time the program is started by setting a workspace as Default. The CUIx file containing the workspace set as Default must be defined as the main or enterprise file with the deployment. A workspace set as Default is also set as the current workspace when the CUIx file containing the workspace is loaded with the CUILOAD command.

If you wish to set a workspace current, you can use the Quick Access toolbar, click the Workspace drop-down list and select the workspace you want to set current. You can also set a workspace current from the CUI Editor by clicking on the Manage tab of the ribbon, customization panel, and select User Interface. In the Customize tab, Customizations In <file name> pane, click the plus sign (+) next to the Workspaces node to expand it. Right-click the workspace you want to set current and select Set Current. Last, select Apply.

Workspaces in a CUIx file can be marked as default. Setting a workspace as default determines that it should be restored when the CUIx file is loaded into the program the first time or after the CUIx file has been loaded with the CUILOAD command. To do this, click on the Manage tab of the ribbon, Customization

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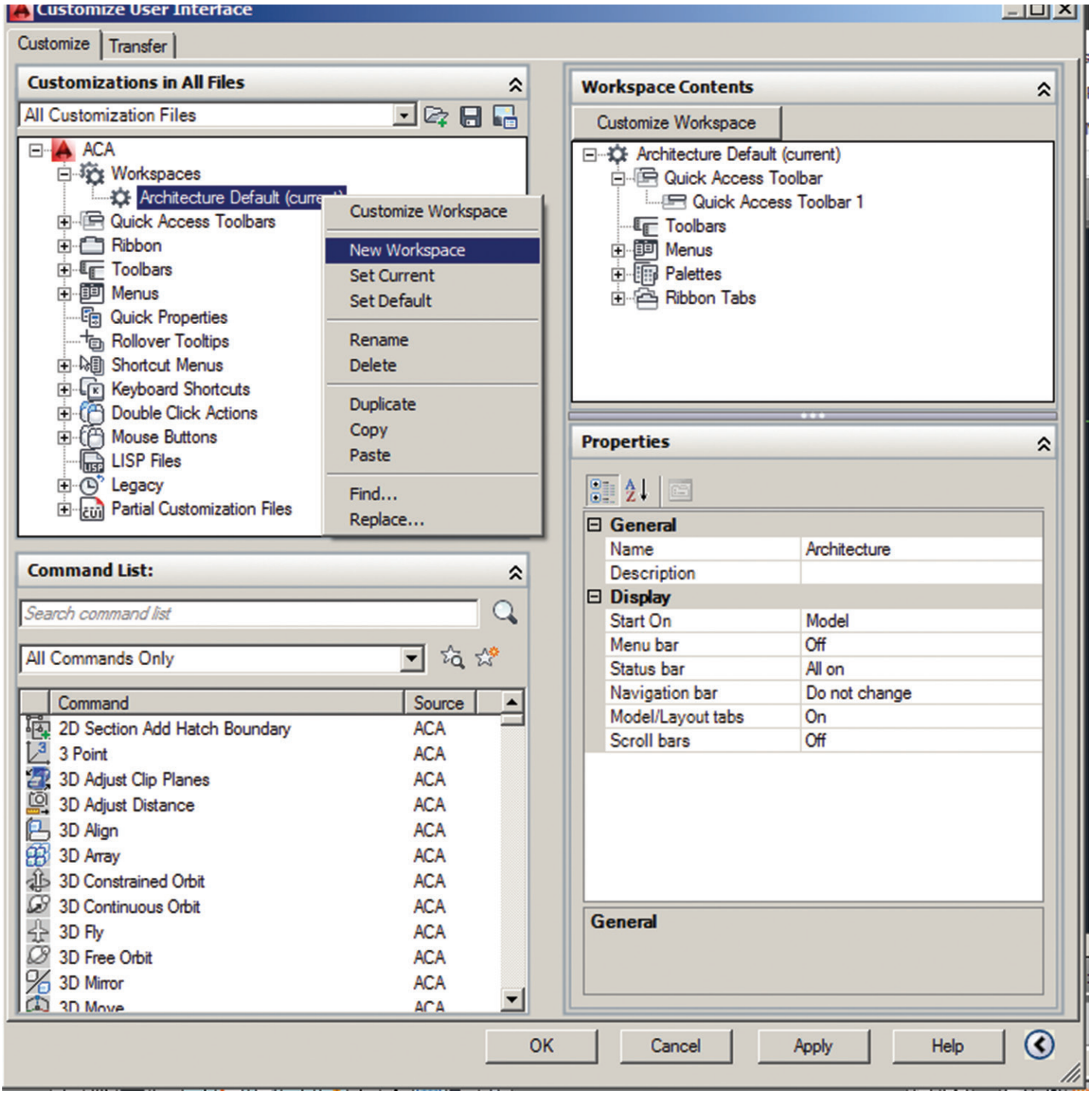


Figure 1: New workspace

panel, and then select User Interface. In the Customize tab, Customizations In <file name> pane, click the plus sign (+) next to the Workspaces node to expand it. Right-click the workspace you want to set as default and then select Set Default. Last, select Apply.

You can save changes to an existing workspace from the Application window. On the Quick Access toolbar, click the Workspace drop-down list and select Save Current As. In the Save Workspace dialog box, Name box, enter a name to create a new workspace or select an existing workspace from the drop-down list to overwrite it. Click Save to create or modify the workspace.

If you wish to create and customize a new Workspace, begin with the Manage tab on the ribbon, Customization panel, User Interface. Now, in the Customize tab, in the Customizations In <file name> pane, right-click on the Workspaces node and select New Workspace (see Figure 1). A new, empty workspace (named Workspace1) is placed at the bottom of the Workspaces. Right-click on Workspace, select Rename and enter a new workspace name. Now, in the Workspace Contents pane, click Customize

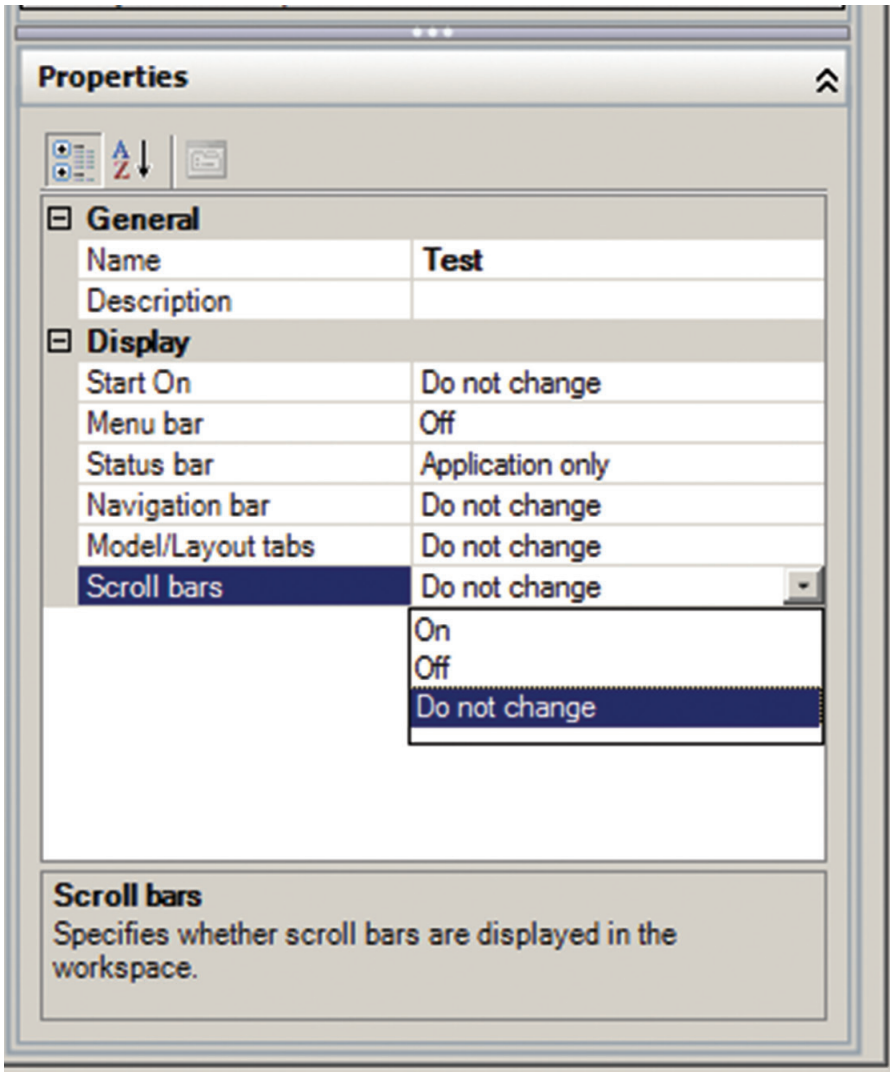


Figure 2: Workspace properties

Workspace. In the Customizations In <file name> pane, click the plus sign (+) next to the user interface elements to expand them. Click the check box next to each user interface element that you want to add to the workspace. The selected user interface elements are added to the workspace. In the Workspace Contents pane, select Done and then select Apply.

Once you have created your new workspace, you may find that you need to change the properties of that Workspace. To do this, select the Manage tab on the ribbon, Customization panel, User Interface. In the Customize tab, Customizations In <file name> pane, click the workspace whose properties you want to change. In the Properties pane, do any of the following (see Figure 2):

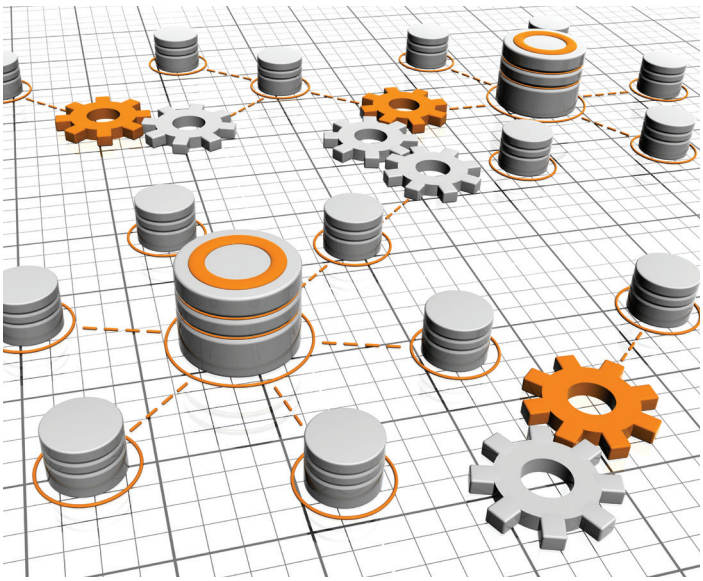
- In the Name box, enter a name for the workspace.
- In the Description box, enter a description.
- In the Start On box, select an option (Model, Layout, Do Not Change).
- In the Menu Bar box, select an option (Off, On).
- In the Status Bar box, select an option (Application only, All Off, All On, Drawing Status Bar Only).
- In the Navigation Bar box, select an option (Off, On).
- In the Model/Layout Tabs box, select an option (On, Off, Do Not Change).
- In the Scroll Bars box, select an option (On, Off, Do Not Change).
- Once your changes are complete, select Apply.

WORKING WITH OBJECTS IN A WORKSPACE

The AutoCAD Architecture workspace is where you add and manipulate the architectural objects that make up your drawings. You can add objects to the drawing using tools. Tools generally have preset creation parameters called properties. When you click an object tool to add an object in the drawing, the Properties palette opens and you can change properties for the new object if desired. If not, you can go ahead and place the object in the drawing. Tools are arranged on tool palettes for easy access. To open the default Design tool palette, click Home tab on the ribbon, Build panel, Tools drop-down, and then select Design Tools (see Figure 3).

You can modify an object in a workspace using any of the following methods:

- Object-specific ribbon tab – When you select an object, an object-specific tab is displayed on the ribbon. The object-specific tab contains commands that apply to the selected object.
- Properties palette – The Properties palette is one of the central locations for entering and changing information about an object. This palette contains categories that group the properties by type.
- Matching properties between objects – You can use the Match Properties command to copy the style and display properties of one AEC object and apply them to one or more other objects of the same type.
- Context menu – Right-click the object to display its available commands.



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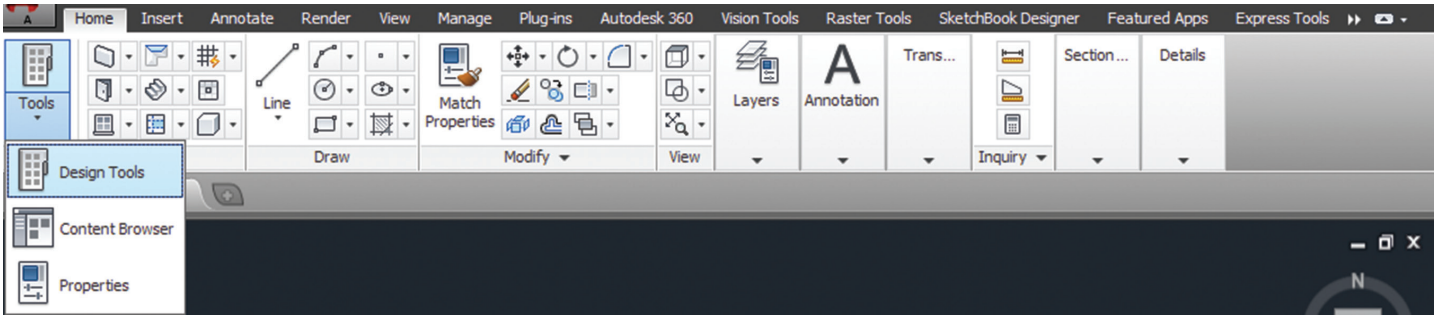

Figure 3: Design tools

- Direct editing with grips – Commands for modifying an object are accessible from the object's grips. Click an object in a two-dimensional (2D) or three-dimensional (3D) view to display its grips.

COPYING TOOL PALETTES AND TOOL PACKAGES TO A WORKSPACE

You can create a linked or unlinked copy of the tool palette. A linked copy remains connected to the original in the tool catalog so that you can easily update the copy with any changes made to the original. An unlinked copy is treated as a new tool palette, with no relationship to the original.

To do this, begin by clicking the Home tab on the ribbon, Build panel, Tools drop-down, and then select Content Browser. Open the tool catalog containing the tool palette to copy to the tool palette set. If the palette is located in a specific category of the catalog, open that category. Move the pointer over the i-drop icon next to the tool palette, so that the pointer image changes to an eyedropper (see Figure 4).

To copy multiple tool palettes, press and hold Ctrl while clicking each palette and then position the eyedropper over any of the selected palettes. Drag the eyedropper according to the desired action. If you want to store a linked copy of the tool palette in the tool palette set, then click the eyedropper and drag it to a tool palette in the tool palette set. If you want to create an unlinked copy of the tool palette in the tool palette set, then press and hold Alt. Then click the eyedropper and drag it to a tool palette in the tool palette set.

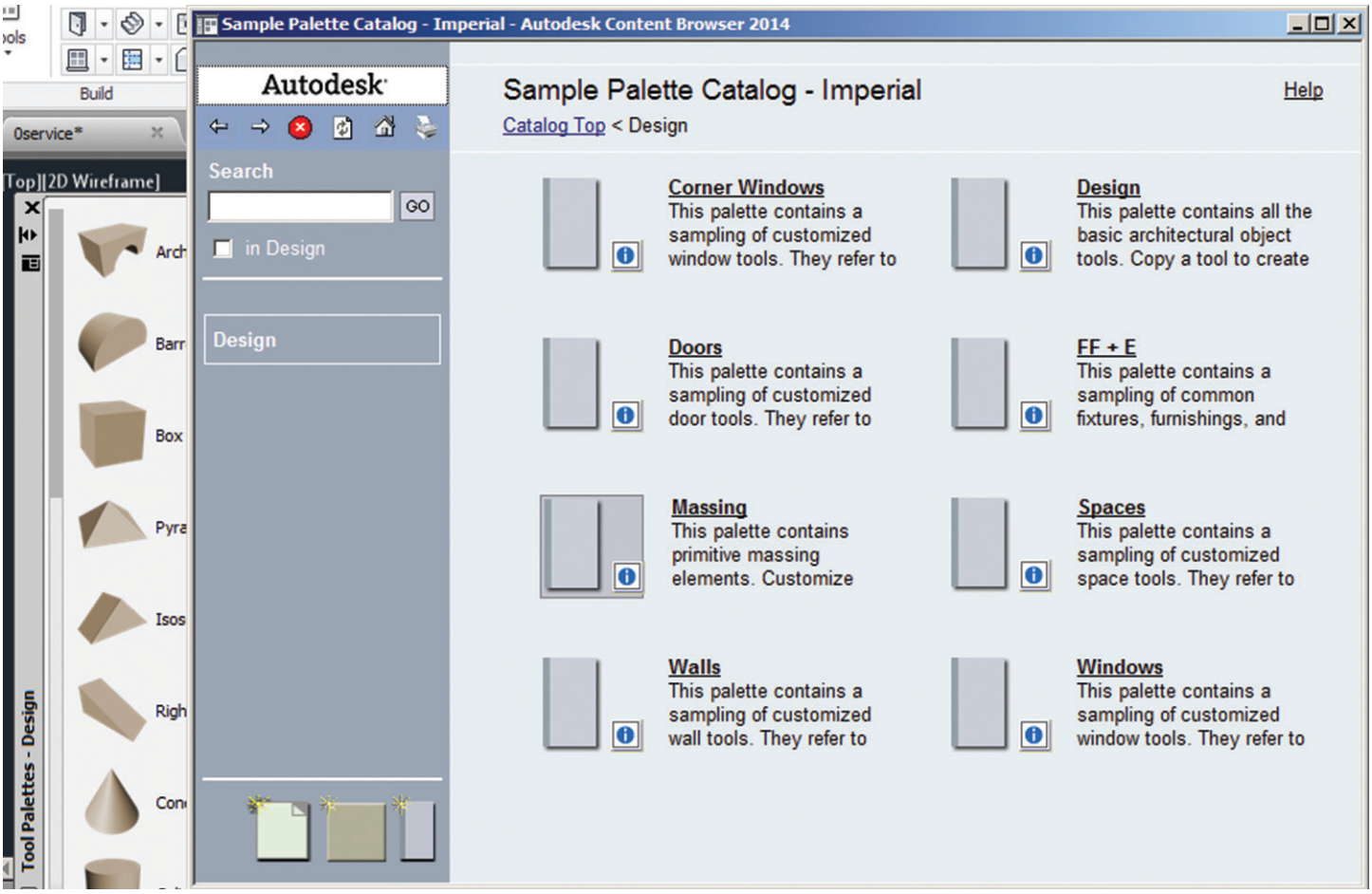

Figure 4: Tool palette

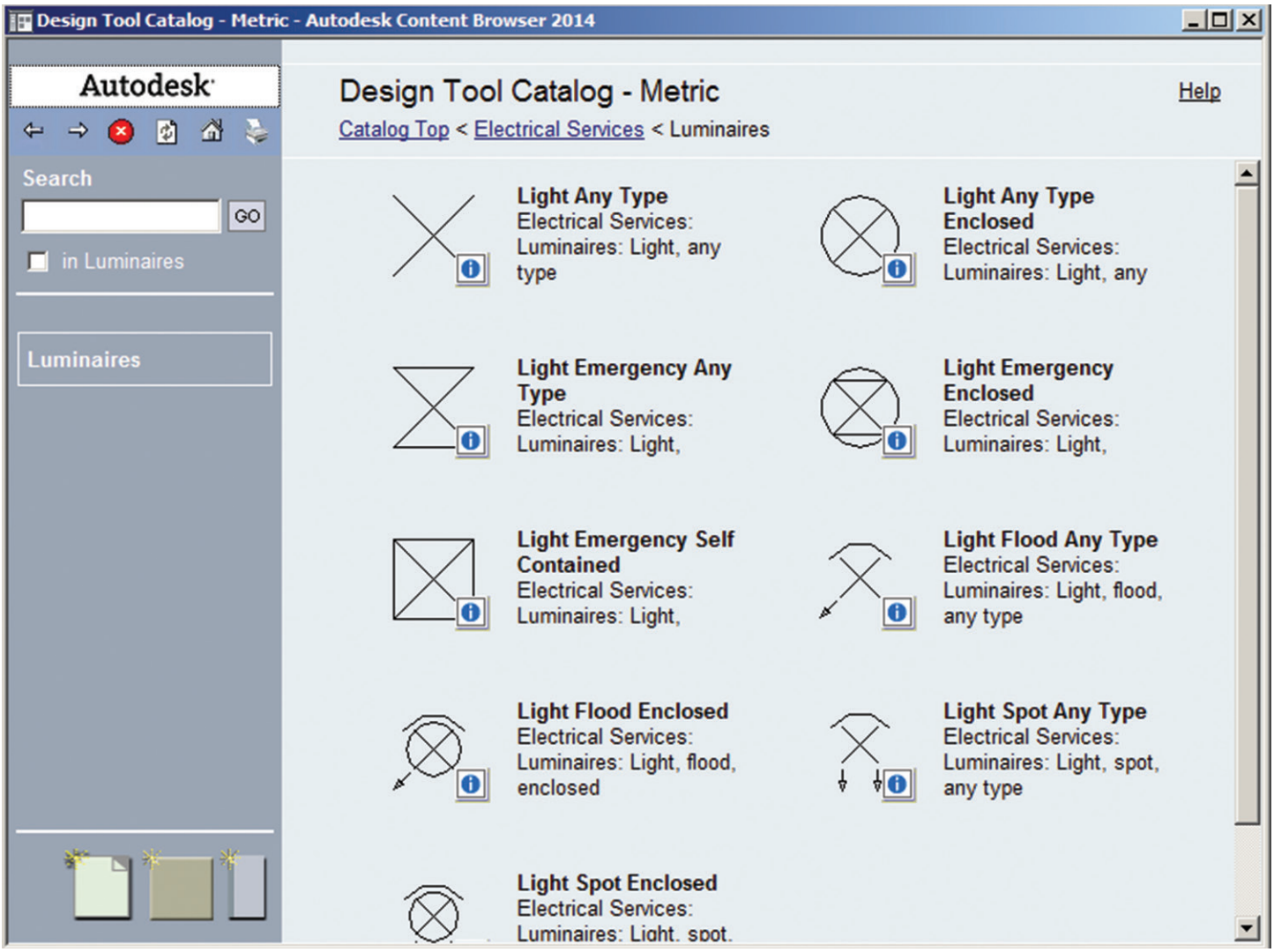

Figure 5: Tool package

You can also create linked or unlinked copies of the tools in the package. A linked copy remains connected to the original in the tool catalog, so you can easily update the copy with any changes made to the original. An unlinked copy is treated as a new tool, with no relationship to the original. Just as you did with the tool palette above, begin by clicking the Home tab on the ribbon, Build panel, Tools drop-down, and then select Content Browser. Open the tool catalog containing the tool package to copy into the tool palette set. If the package is located in a specific category of the catalog, open that category. Move the pointer over the i-drop icon next to the tool package, so that the pointer image changes to an eyedropper (see Figure 5).

To copy multiple tool packages, press and hold Ctrl while clicking each package and then position the eyedropper over any of the selected packages. Drag the eyedropper according to the desired action. If you want to store linked copies of the package's tools in the tool palette set, then click the eyedropper and drag it to a tool palette in the tool palette set. If you want to create unlinked copies of the package's tools in the tool palette set, then press and hold Alt. Then click the eyedropper and drag it to a tool palette in the tool palette set.

CONCLUSION

Workspaces are sets of menus, toolbars, palettes, and ribbon control panels that are grouped and organized so that you can work in a custom, task-oriented drawing environment. Workspaces keep things organized and simple to find within AutoCAD Architecture. It is important to customize your workspace so you are as productive as you can be.

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

by: Behzad Meskini

Modern Design from Historical Perspective

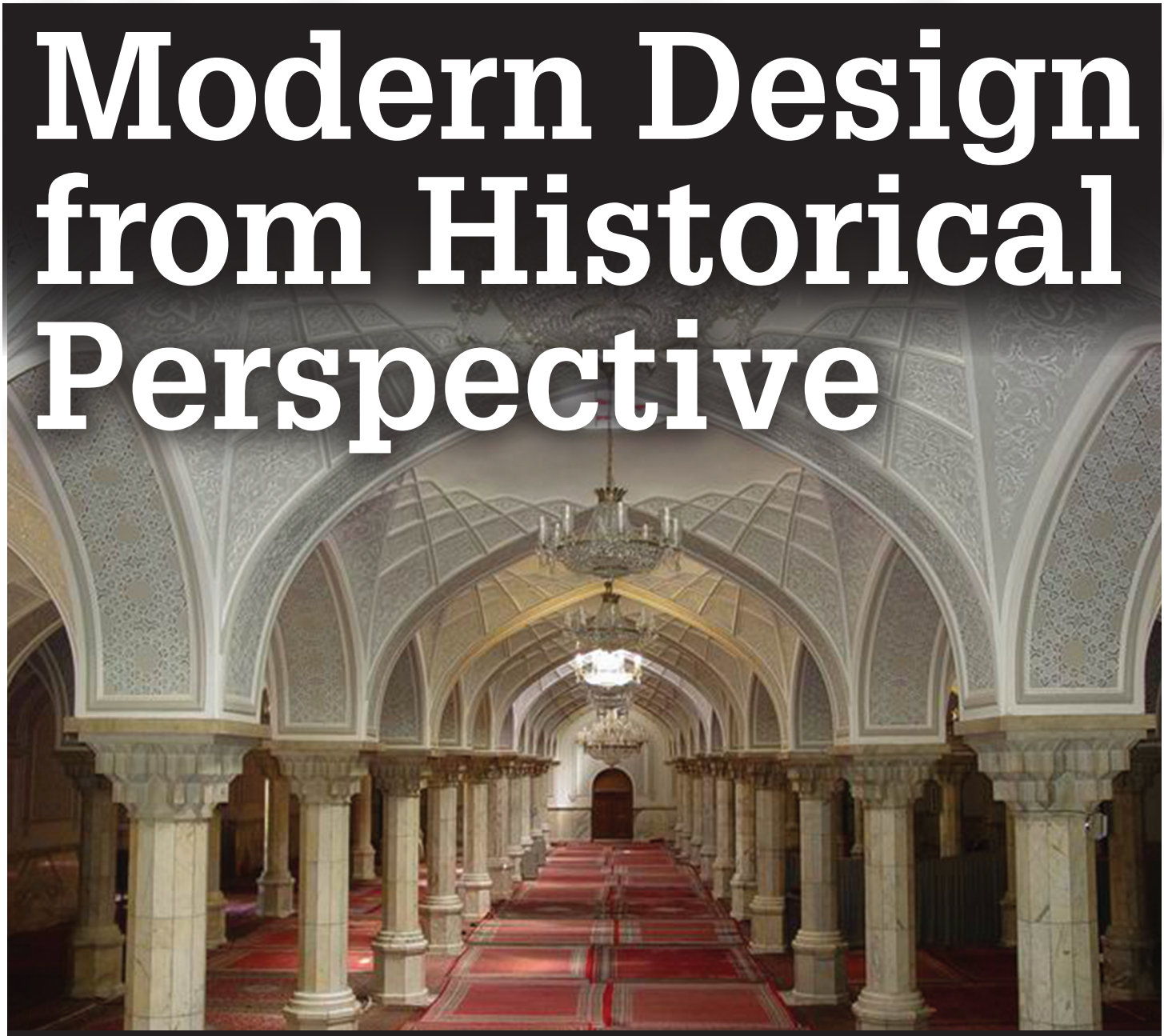

Figure 1: Sepah Sallar

Around the globe many experts, scientists, and engineers have researched ways to preserve historic art, including architecture, for the future.

While we are grateful for the experts who recognized the historical significance of their works and published books, we recognize that there are those who didn't transfer their wealth of knowledge and experience to others before they died.

We can surely design modern buildings, but without the knowledge of culture and history, we're missing something.

With new technology we are able to create documents for every type of building. Using software such as Autodesk Inventor® Professional, we can renovate and build new structures while preserving culture and history.

In this article I describe how we can save this art and create documents of it with Inventor Professional.

Inspiration for doors, windows, niches, and more come from a variety of sources. For example, view Figures 2 and 3.

While Inventor Professional is essentially designed for the mechanical engineer, its abilities make it one of the best tools in the world for this type of design.

We use 2D and 3D sketching, part Modeling, multibody modeling, adaptive modeling, assembly design, frame generator, IPN presentation,

Figure 2: Karbandi and Kaseh Bandi

Figure 4: Arch and niche

Figure 3: Entering and arch 5 O 7

documentation, iLogic, and many other features for this project.

OUTLINE OF THE NEW FEATURES

- Quick look at Karbandi
- Preparation of skeleton part
- Generative shape design
- Design connection part
- Documentation and benefit

QUICK LOOK AT KARBANDI

Archs

We have many type of arc combinations for creating arches for opening areas in the walls for any type of entrance.

In Figure 5 you can see an important type of arch, 5 O 7.

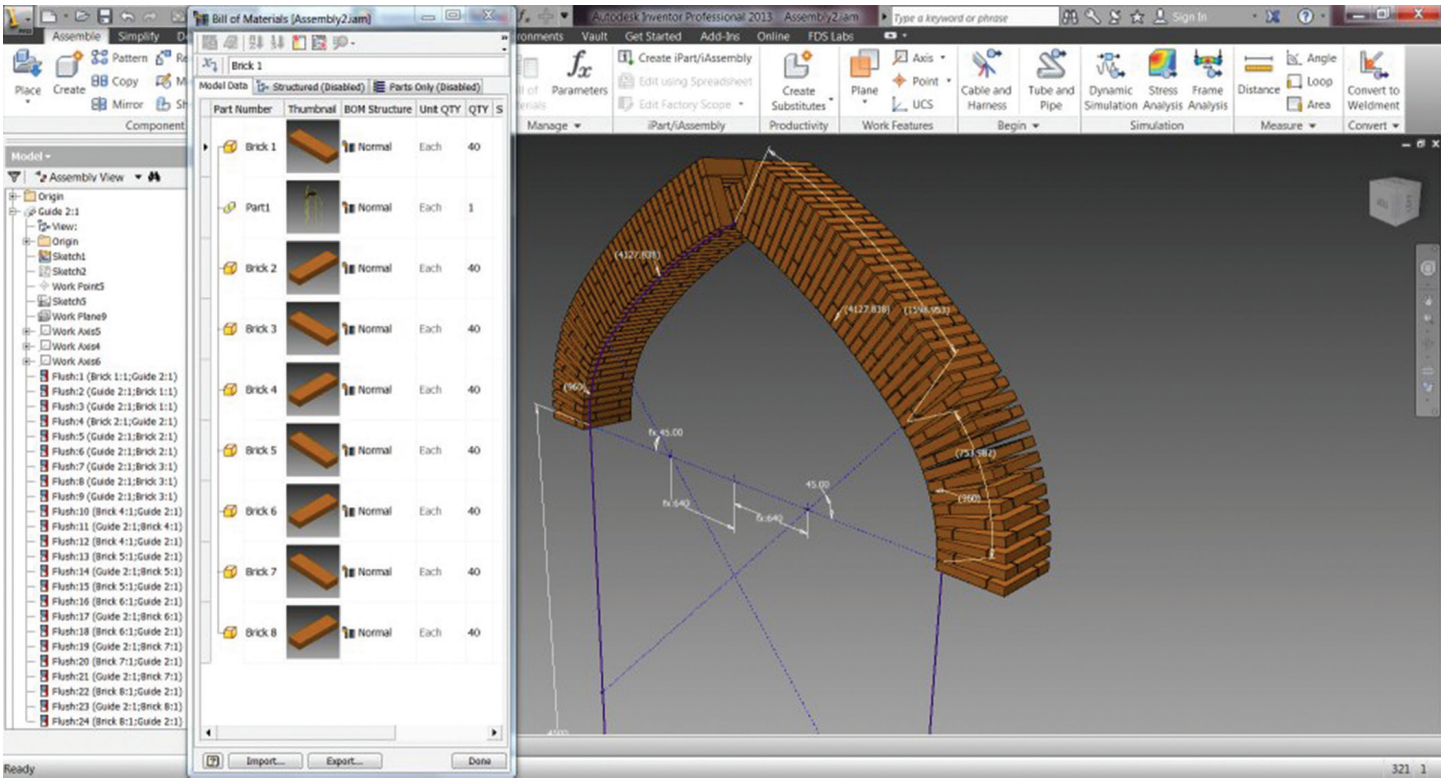

Figure 5: Prototype modeling for 5 O 7 arch

Domes

The base plan for domes comes from polygons, with a modular circular pattern around the Z axis of the polygon and a combination between arches. We create the dome shape; the name for this type of dome is Karbandi.

Figure 6: Karbandi in Mosque Ghazvin

Construction of this type of dome was dependent on workers' skills. Often they did not have precise documentation and, in fact, they were doing this job based on experience. The whole structure was built in the site area and most of the time they couldn't create good connections between the parts of the structure. Also, they are using a welding connection between the beam parts, and if you check some of structures in the site area you can find many faults in the connection point.

In many cases, the dome is shearing by itself and in other cases the dome has two separate parts: structure of the dome and the shell over the structure.

We can use Autodesk Inventor in both cases.

Figure 7: Current connection in the project

After structure preparation the area between beams should fill with masonry material and with this method we have a shell over the structure.

The final step could be tile or masonry material. In most situations, workers try to fill the area between the structure with a modular pattern of brick. This could be finishing layer for Karbandi.

PREPARATION OF SKELETON PART

Introduction of Sketch for Arch

In Figure 8, you can see we have an arch for the opening in the wall. This shape name is 5 O 7.

Each arch has a width for the opening area and in the half of width we have a vertical mirror line.

Each side is a combination of two arcs. The first arc is 45 degrees and the center point distance for this arc is (Length*1/6). The

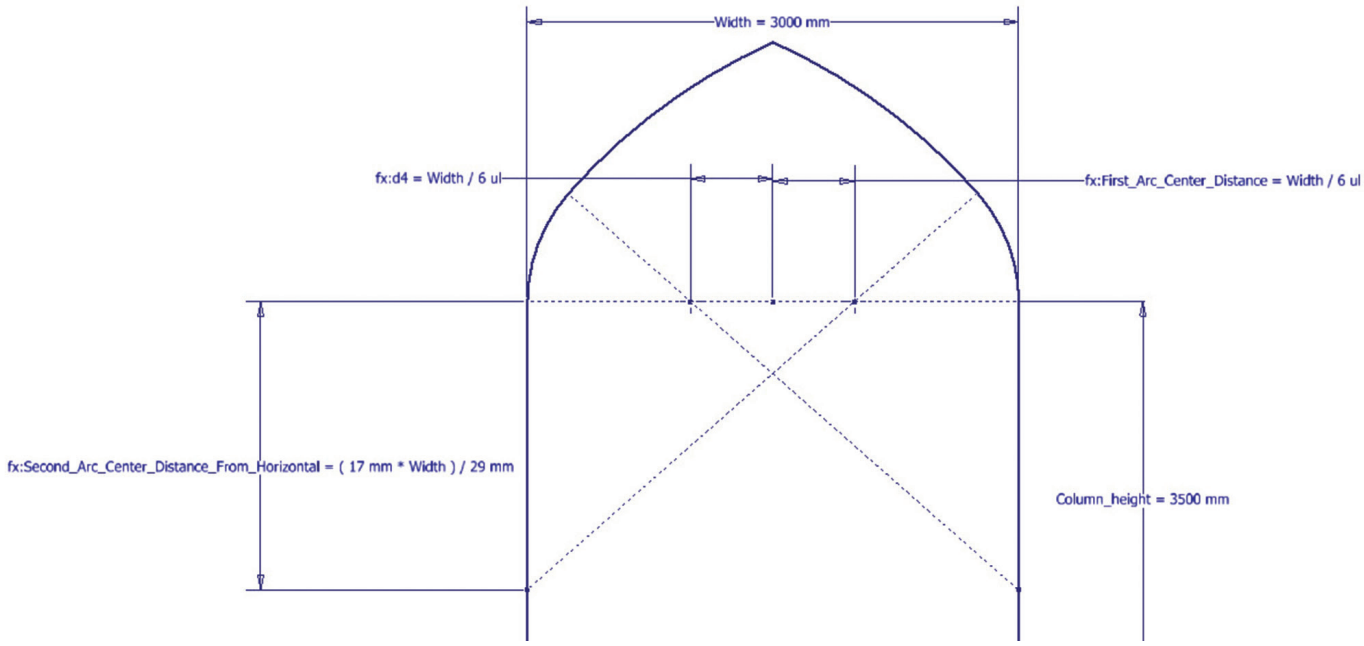

Figure 8: 5 O 7 is sort of a shear arch

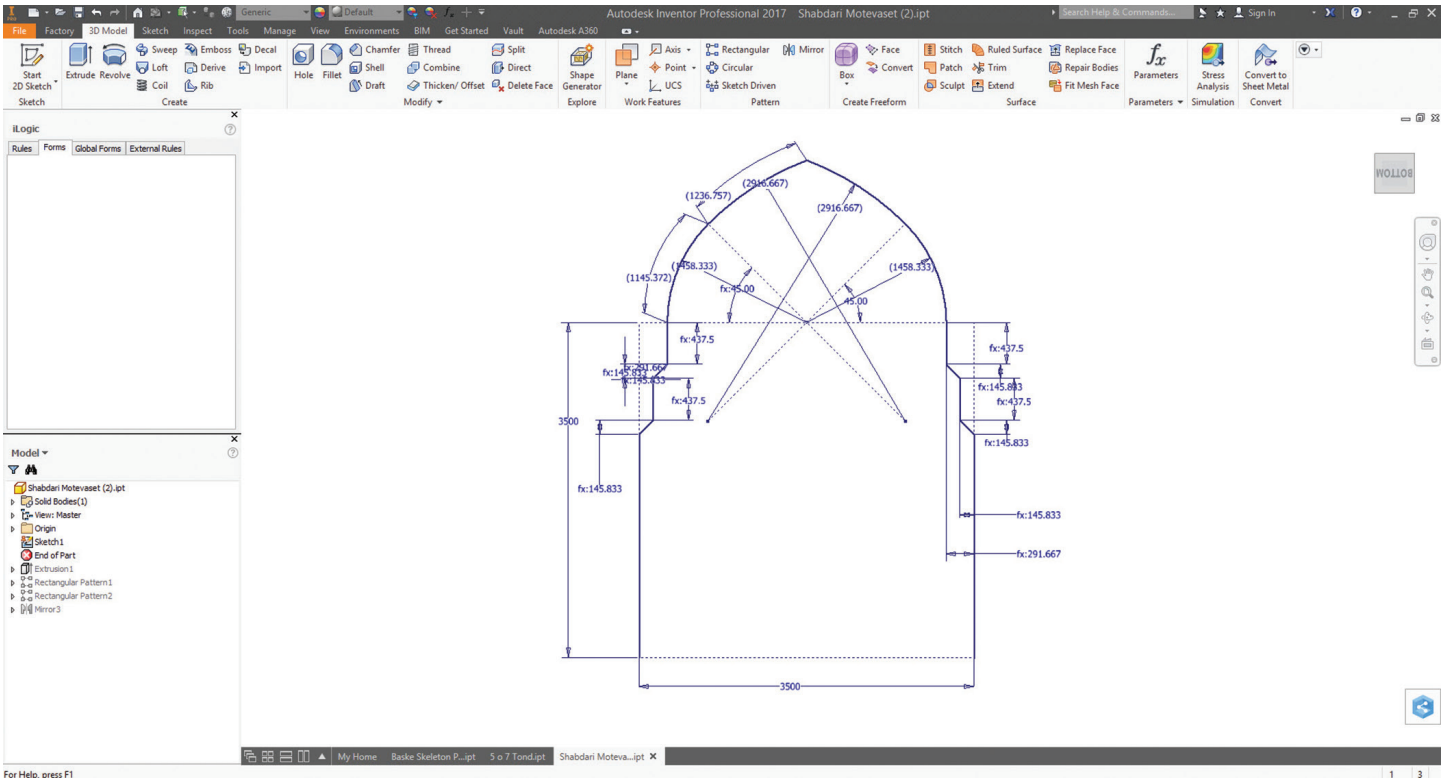

Figure 9: Shabdari Arch

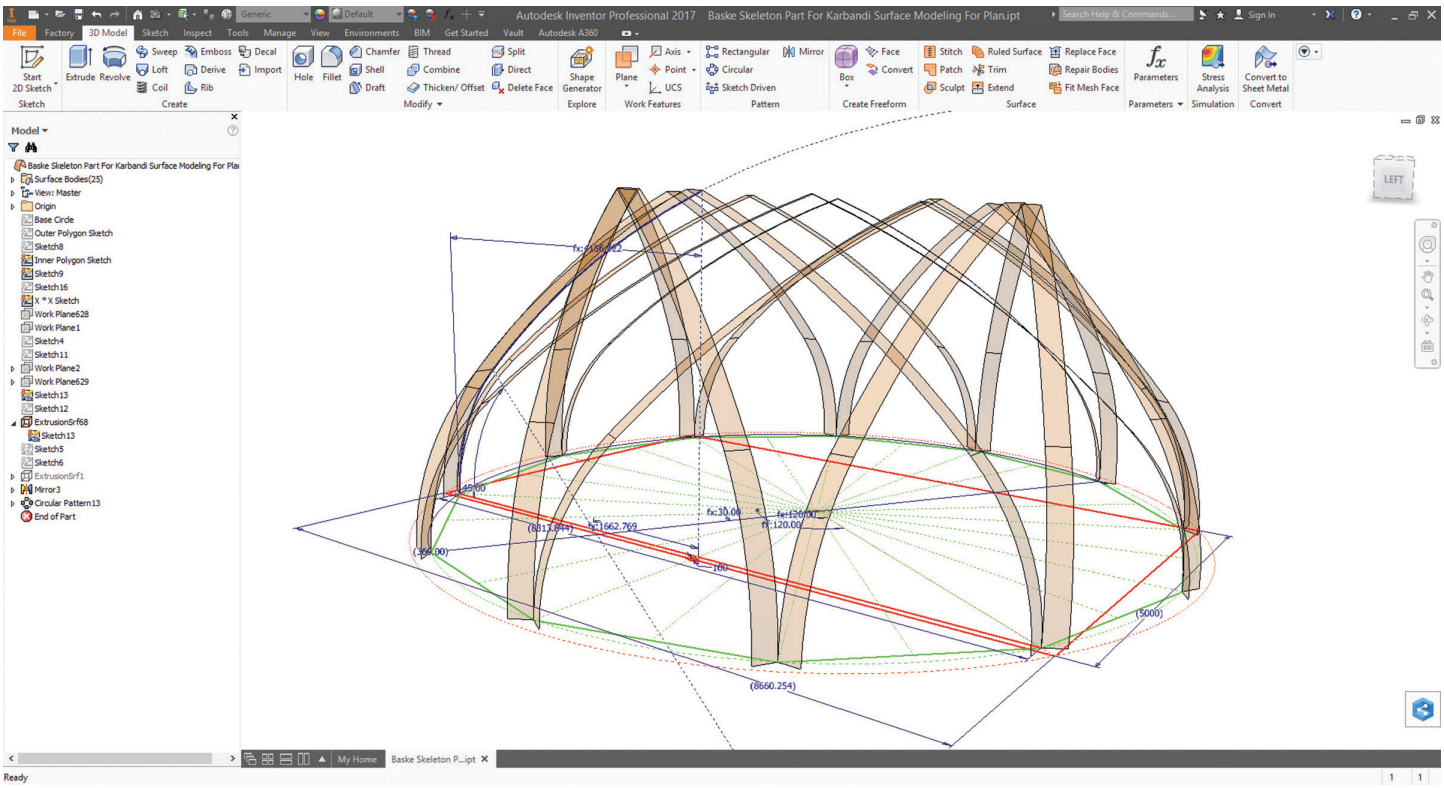

Figure 10: Skeleton part

second arc is tangent; the first and center point of this arc should align vertically with the width of the arch.

You can use this arch for a door, window, and entry opening. Also you can use this shape for Mudolar pattern.

Introduction of Dome for Karbandi

Review Figure 10 below and pay attention to the parts you can see.

For the first step, we have a base polygon (green color) in the ground X,Y plane. Next is about a parameter with two X variables

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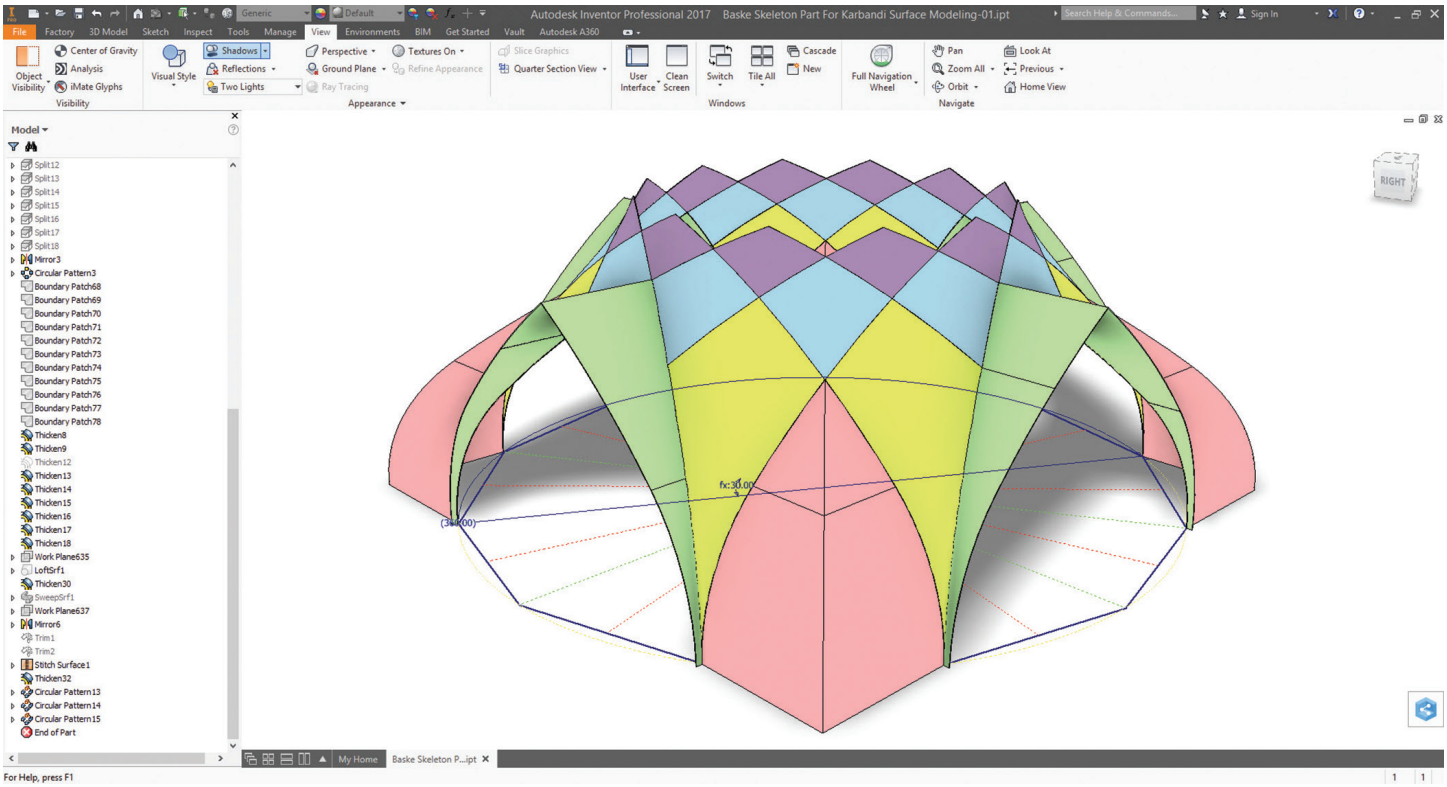

Figure 11: Shell of Karbandi structure

	Phil Gosh	Elephant Ear
	Sosan	Lily
	Pa Barik	Thin Leg
	Toranj	Bergamot
	Shaparak	Moth
	Shamseh	Sun

Figure 12: Legend

(X*X), with the first X an integer number and second X an angle of one segment for the polygon.

For the line that comes from X*X, we can create a rectangle (red color). The segments of this rectangle give us the orientation for arches that should be patterned around the Z axis of the polygon.

A 2D sketch that contains arches should start from the start point at which segment is the length of X*X rectangle and the end of the arch should be in the end of length segment (black color).

Then if we have a polygon with 12 segments, we should have 12 arches around the sides of polygon.

Note: Inventor does not have the ability to create patterns from 2D sketches, so I prefer to create simple extrude, like a surface, and then create patterns from the extrudes.

DOME STRUCTURE

After introduction with Arch and Dome, you need to know more about dome structure parts. You can see the name for each part of the interior body in the dome.

As described earlier, the area between arches should be filled with tile or bricks or some sort of masonry material. In Figures 11 and 12 below, you can see the name of each part for the dome and how we separated dome parts in Karbandi.

GENERATIVE SHAPE DESIGN

Now we need the skeleton part and then we can bring the skeleton part in the assembly environment and save our file. We are able to use the generative shape design environment.

Beam Generation

After placing the skeleton part and saving, you need to create many structural beams, shown in Figure 13. In real-world construction, this structure is built with square or angle profile shapes.

I use a circular shape for many reasons. First, the shape of the circle in a section of beam can be very helpful for designing connection parts. Other issues can be solved with a circular shape; for example, where two beams intersect at the same point.

The tools available in Frame Generator make it simple to create and manage what we need for the Karbandi structure.

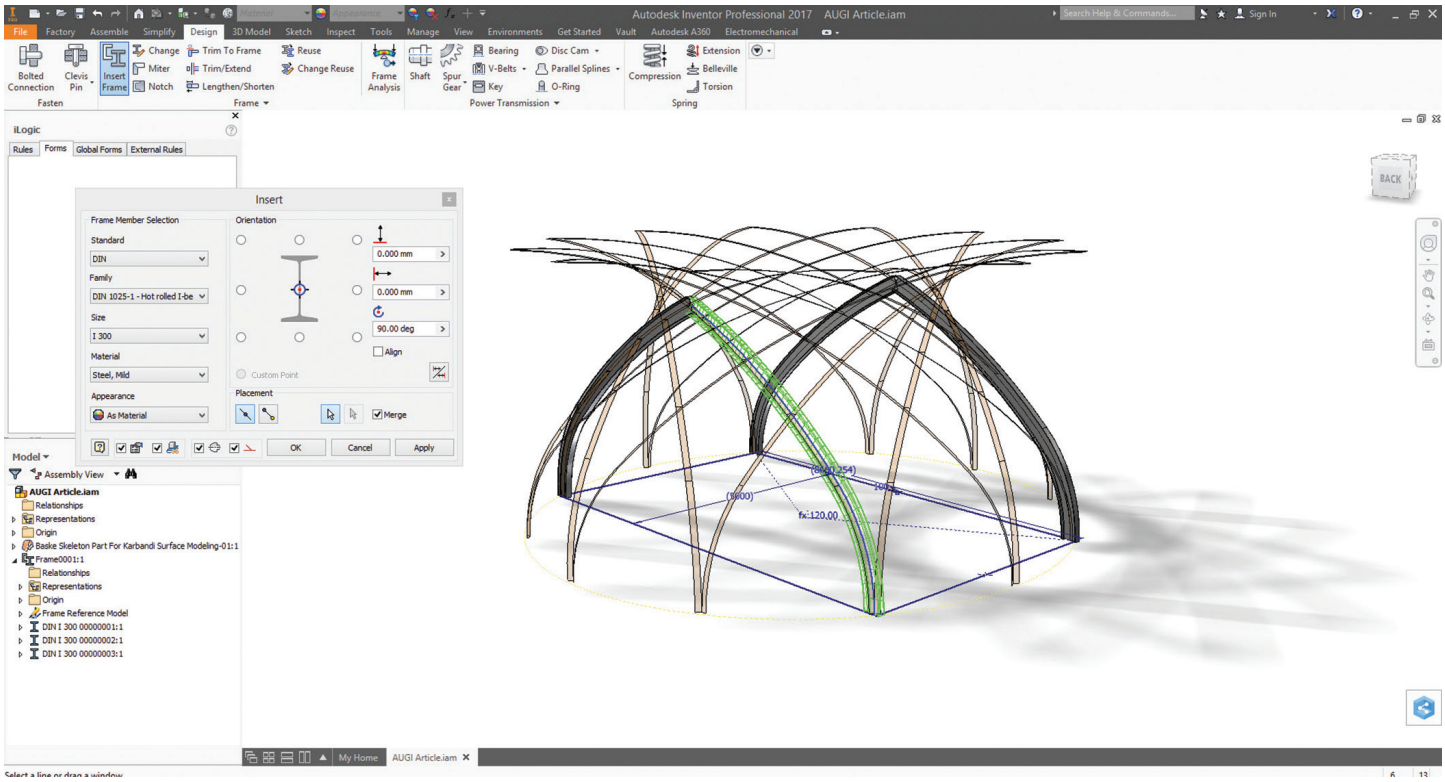

Figure 13: Skeleton with beams

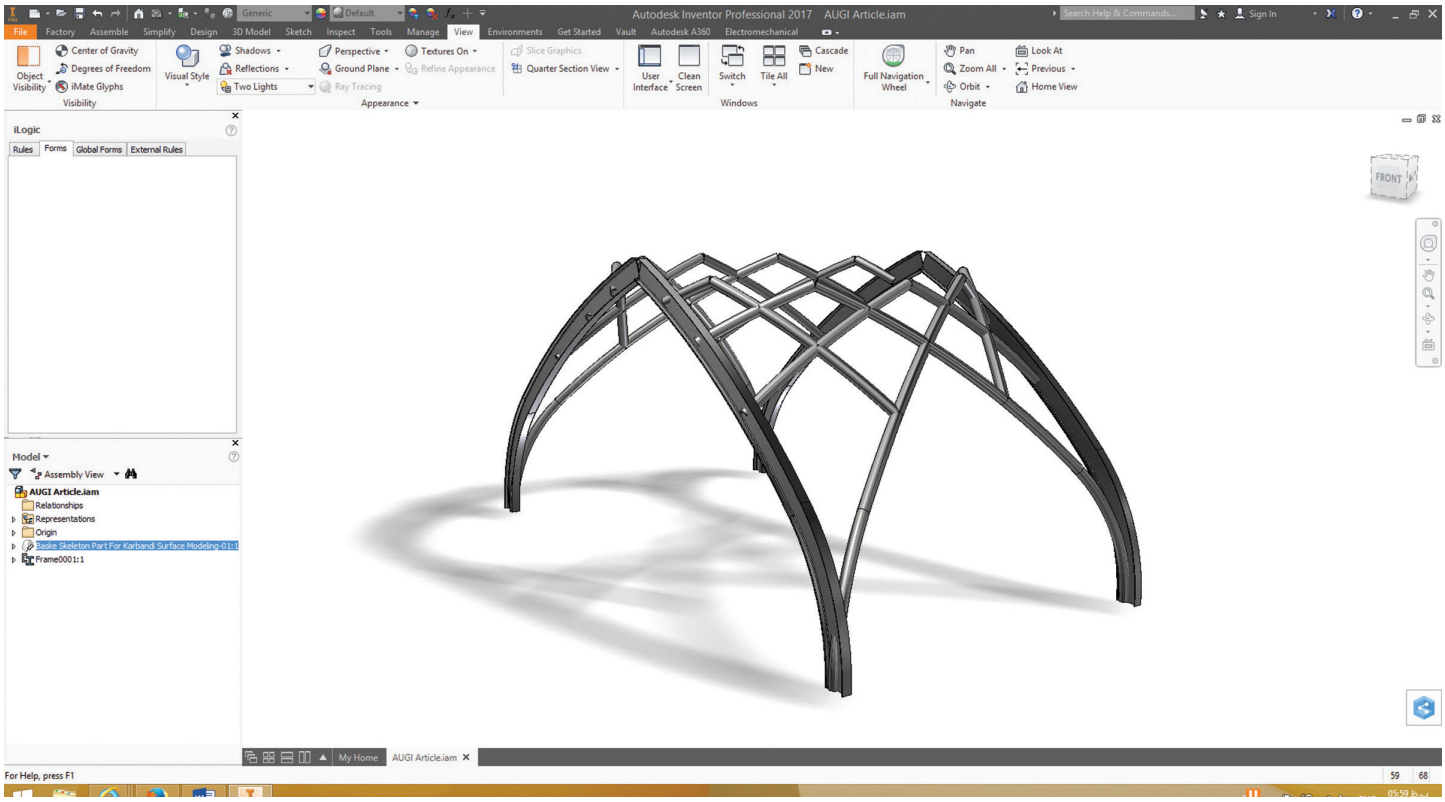

Figure 14: Final Frame Generator

DESIGN CONNECTION PART

Now for the most important part of the job. We did not have any type of connection part for Karbandi until now.

The theory for this part is a combination of some rules:

1. Simple procedure for fabrication
2. Minimum machining work
3. A simple method for fabricating one connection part

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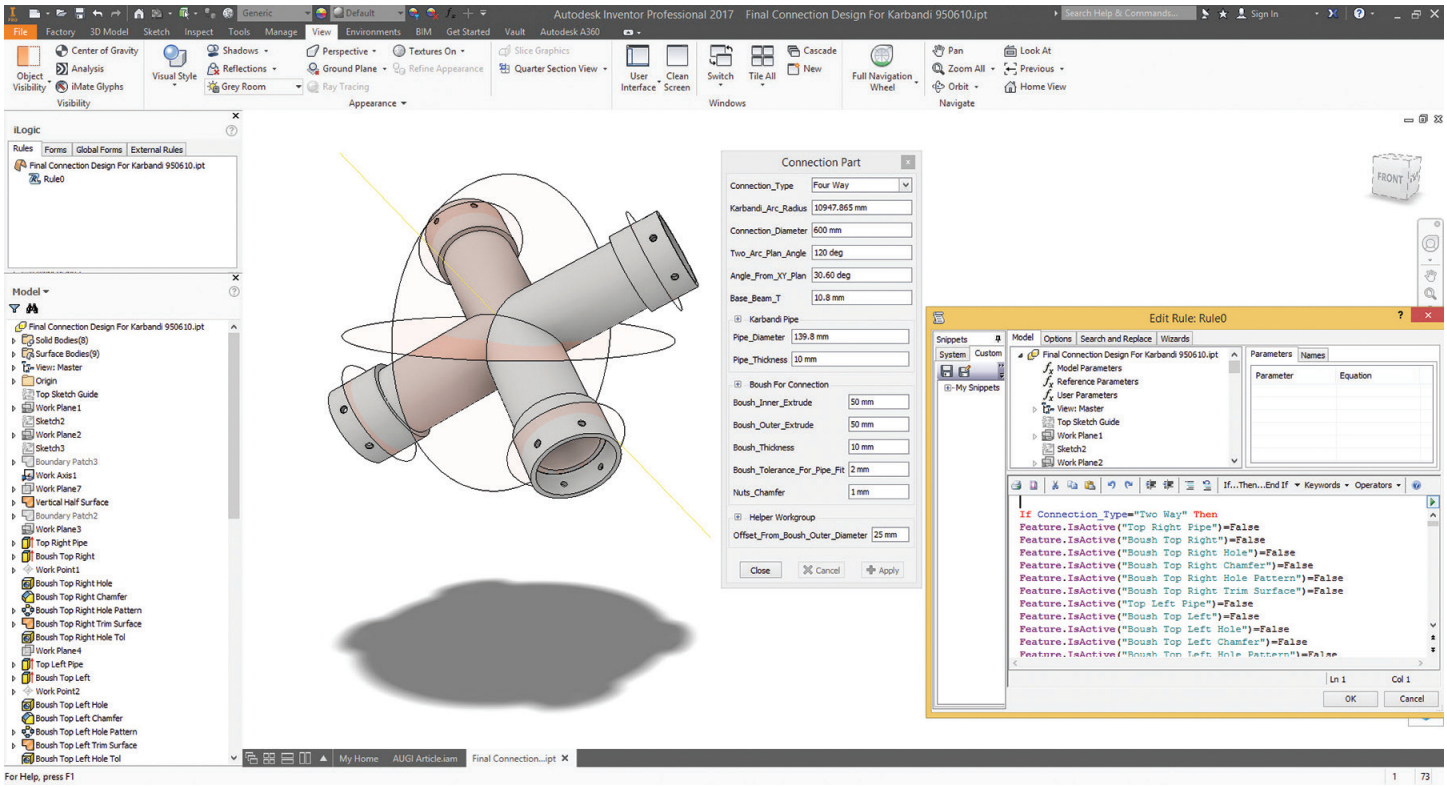

Figure 15: Connection part

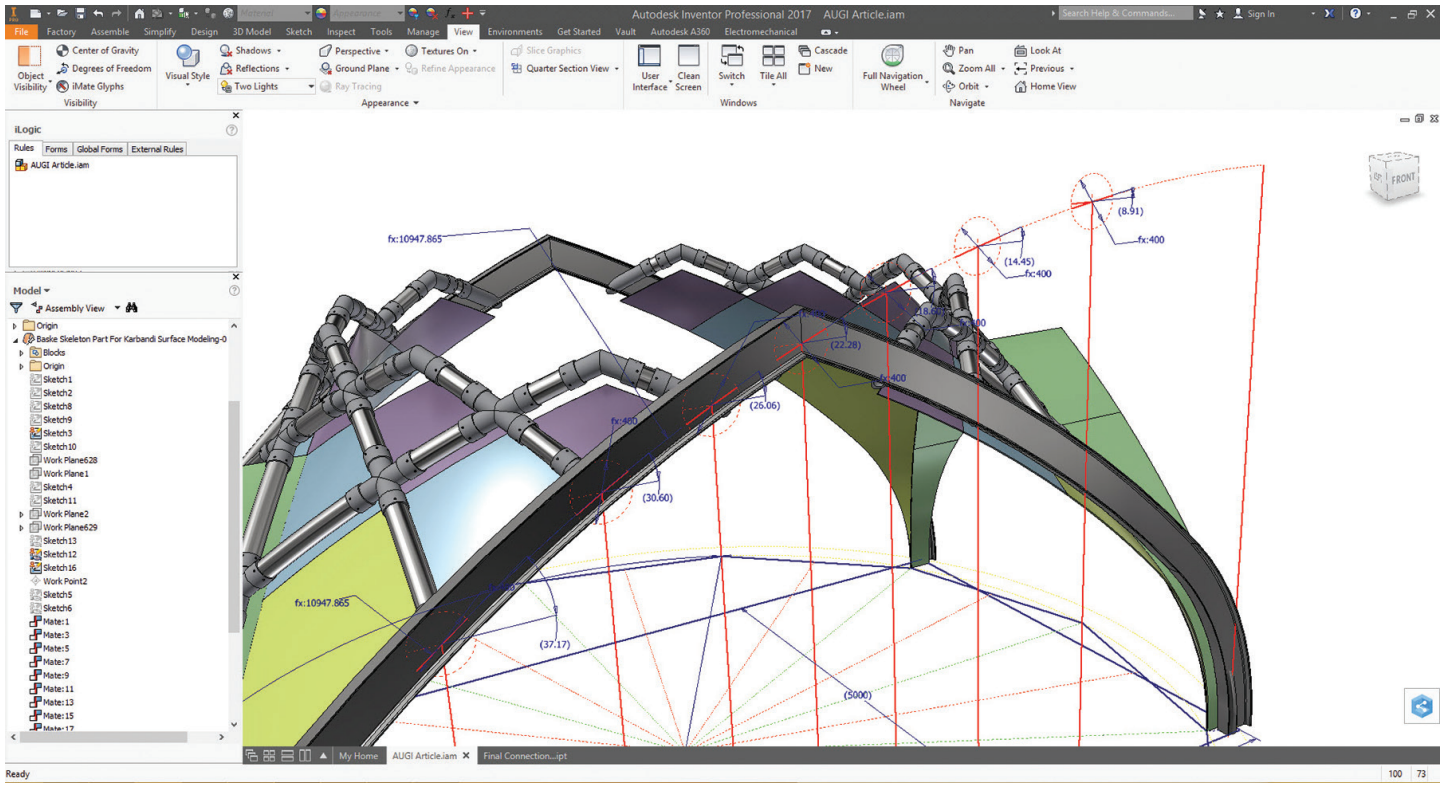

Figure 16: Relation with connection part (red color)

4. Similar and simple modular cut
5. Ability for a simple assembly in the structure
6. Using pitch and nuts for the structure assembly

The whole dimension and shape of the connection parts are coming from the location: what is the connection part length and what is the plan of Karbandi?

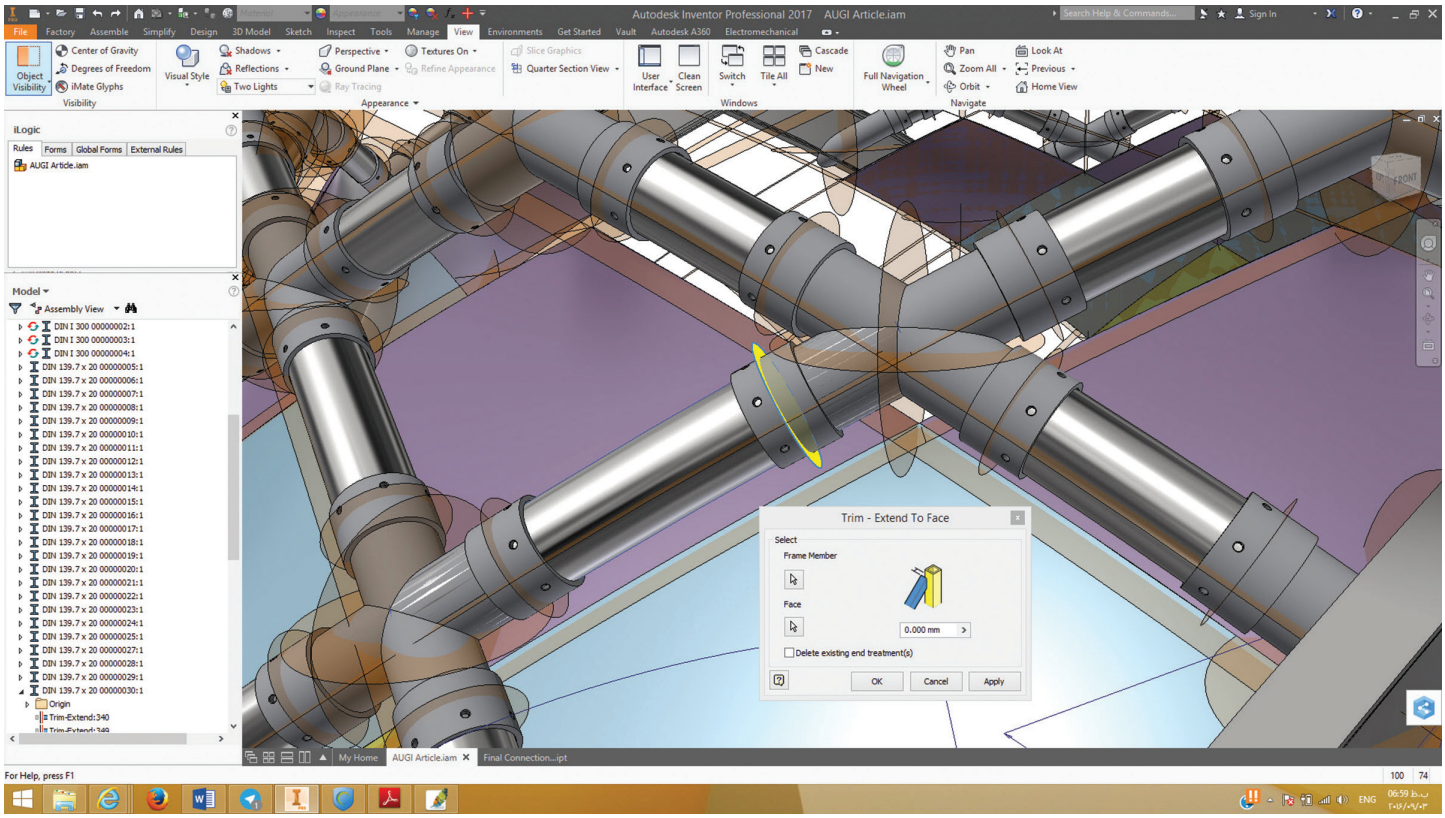

Figure 17: Beam trimming according to the guide surface

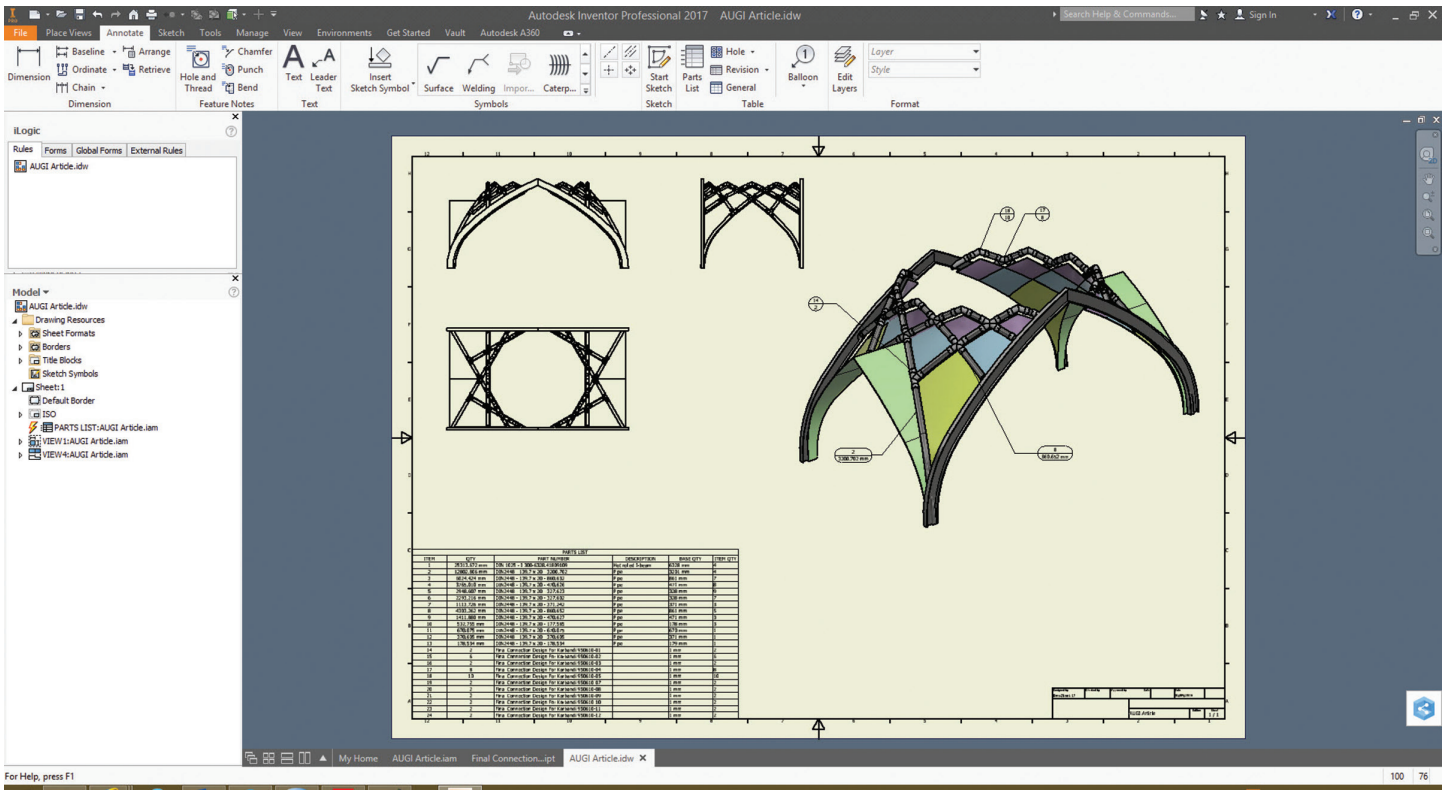

Figure 18: Document and BOM table

iLogic option is very useful for this part. I wrote some rules between parameters for managing the whole connection part.

For entering correct values in the iLogic dialog, we need to take some information from the skeleton part. Inventor is very handy for this kind of thing.

Inventor 2017

We also need to prepare a guide surface for future beam trimming and modeling in the assembly environment. For example, we need a guide surface for trimming beam parts in assembly.

DOCUMENTATION AND BENEFIT

The final result is documentation and bills of material (BOM). According to the procedure of modeling that we used, it can be very simple to create precise BOM, cut lists, etc.

One of the most important things about this procedure is the preservation of art and knowledge. We can use this type of model for teaching in universities and other schools.

Because of the modular design for connection and the new procedure for fabrication, we can build this structure in the facility and assemble them on the site.

It is a very fast workflow to build this type of structure.

- BOM list for material
- Nesting list for pipe
- Decrease the fault in fabrication workflow
- Decrease overwork
- Decrease cost
- Create precise documents and guide parts for bending pipe according to what is needed in the structure
- Create base exemplar for connection parts
- Ability to renovate buildings corrupted as a result of earthquakes or war

Behzad Meskini is a BIM manager, BIM trainer, 3D modeler, and 3D modeling software trainer. He has more than 19 years of experience with 3D modeling software and is a Certified Professional in 3ds Max, AutoCAD, Inventor Pro, and Revit Architecture, Structure, and MEP. Behzad volunteers as a beta tester and was a speaker at Autodesk University ASEAN 2016.

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