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# AUGIWorld

The Official Publication of Autodesk User Group International

March 2011

- **Display Themes in ACA**
- **Five AutoCAD Commands You Can't Live Without**
- **Lighting Fixture Schedules in Revit MEP**

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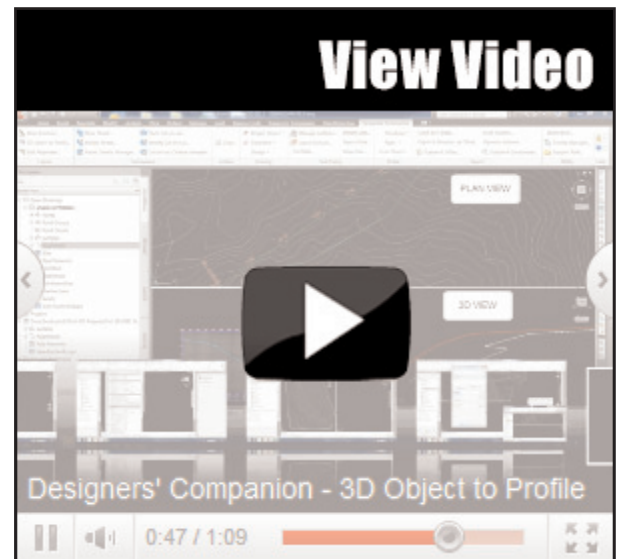
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## Reduce steps and simplify your workflow in AutoCAD® Civil 3D®.

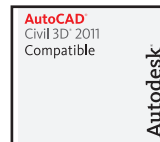
Guided by a straightforward interface, Designers' Companion offers you efficient tools to rapidly lay out streets, lots, highways, parking lots, detention ponds and subsurface terrain. By leveraging the dynamic, iterative power of the Civil 3D model earlier in the design process, project alternatives can be quickly modified and finalized sooner.

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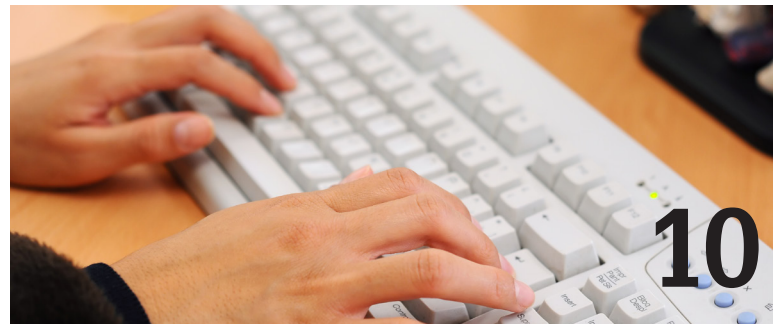
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# AUGI



**H**ello there! In the previous issue we unveiled the new and improved *AUGIWorld*. Frankly it was built on the bones of *AUGI | AEC EDGE*. With this issue we are more good ol' *AUGIWorld*, and less *AUGI | AEC EDGE*. This too will change with the next issue. Development of a magazine is about a two-month process and, as such, requires the turning radius of a super tanker. In this issue we have some AutoCAD (which some members complained was lacking in Feb 2011 *AUGIWorld*) with a little A/E/C as well. I can give you a preview of the April issue – What's New from Autodesk! I've been told they have some new software on the horizon and we'll get a sneak peek next month! I wonder what it could be... ;)

Also new is my head here on the Editor's page. Inasmuch as Steve Stafford, our previous Editor-in-Chief (EiC), has a huge heart and the desire to see this transition through he simply couldn't find the extra time with his work and Revit Technology Conference duties. Because I was basically here anyway, with the previous *AUGIWorld* magazine incarnation, I'm filling this role for the time being. It is my intention to be replaced, however. I do have other things to do as well! We have the feelers out and are looking around for a qualified replacement.

With the EiC role, we are also making a few more adjustments to the production process. Normally a technical magazine would have a single technical editor (TE) who runs through the content before it goes to print. With the expansion of *AUGIWorld* to cover a wider range of products, it has been challenging finding someone who can do the TE work alone. As was mentioned in the Feb 2011 issue, we are migrating towards having editors who focus on specific products or industries. This will not only help us over the occasional vacation, or worse, resignation, but will also put more staff out there looking for content. We have rebranded these fine individuals Content Managers. Although editing will be a task they perform, the management, i.e., collection of articles, is really what is important. In other magazines, they would be columnists, perhaps.

Here is the current team (alphabetical order by product or activity):

#### Production Staff

David Harrington – Editor-in-Chief (temp)  
 Marilyn Law – Copy Editor  
 Debby Gwaltney – Production Editor  
 Tim Varnau – Production Editor

#### Content Managers

AutoCAD API - Unassigned  
 AutoCAD Architecture - Melinda Heavrin  
 AutoCAD Civil 3D - Chris Fugit  
 AutoCAD MEP - Beth Powell  
 AutoCAD Platform - Brian Benton  
 Collaboration - Unassigned  
 Inside track - Erik Lewis  
 Inventor - John Evans  
 Heads Up – William Troeak  
 Revit Architecture - Brian Myers  
 Revit MEP - R. Robert Bell  
 Revit Platform - Lonnie Cumpton  
 Revit Structure - Unassigned  
 3ds Max - Unassigned

As you can see, we still need some help! Now you may and probably won't see every content topic in every issue, but you will see it most of the time. As we continue to massage our process, we may further expand, adding new products (all it takes is you!) and might combine some as well. These are goals and have proven to make a great magazine for Autodesk users.

It was mentioned last month that articles from *AUGIWorld* (and other publications) will at some point be housed in the Library as well. The Library will provide the means to search for topics as opposed to flipping through old issues looking for something randomly. Additionally, it provides a breeding ground for new authors. You yourself can submit content for the Library, you can write in *HotNews* (AUGI email newsletter) or for *AUGIWorld*. Everything ends up in the Library.

With that I would like to extend my sincere thanks to Steve Stafford for his hard work and dedication to AUGI publications. He started *AUGI | AEC EDGE* back in 2009 because he wanted to ensure that AUGI would have a publication to call its own and that the A/E/C community was well served.

I do hope that our merging of the magazines will not only continue to allow our A/E/C members to exchange insight and expertise, but also that the non-A/E/C members will take their rightful place in *AUGIWorld* magazine and show the world what they can do as well. Every issue of *AUGIWorld* will strengthen what you do personally and enlighten you as to what else is going on in AUGI's world...

Thanks for reading!

David Harrington  
*AUGIWorld* Editor-in-Chief (temporary)



**AUTODESK RESEARCH: PROJECT HELIX**

Project Helix at Autodesk Research URL: [http://labs.autodesk.com/utilities/3dsmax\\_pointcloud/](http://labs.autodesk.com/utilities/3dsmax_pointcloud/)

From Autodesk // Labs: *"Bring your visualizations into context with Project Helix, a powerful technology prototype enabling display and rendering of 3D laser scanning/LiDAR data sets with Autodesk® 3ds Max® and Autodesk® 3ds Max® Design software. With the 3ds Max Point Cloud Tools you can more quickly import as-built site references to help evaluate and visualize your designs in context of their surrounding elements."*

Overview video available at <http://www.youtube.com/watch?v=bv5vrnNGBko>

**AUTODESK RESEARCH: BIM FAMILY TOOLKIT**

BIM Family Toolkit at Autodesk Research URL:

[http://labs.autodesk.com/utilities/bim\\_family\\_toolkit/](http://labs.autodesk.com/utilities/bim_family_toolkit/)

The Overview reads: *"The BIM Family Toolkit Technology Preview allows building product manufacturers the ability to easily export Inventor configuration ... directly to Revit families... reducing the amount of time it takes to create BIM Ready Models."*

Overview videos available at [http://labs.autodesk.com/utilities/bim\\_family\\_toolkit/](http://labs.autodesk.com/utilities/bim_family_toolkit/)



Inside  
Track



Inventor to Revit

**NEWFORMA: NEWFORMA PROJECT CENTER 8 ADD-IN FOR AUTODESK REVIT**

Newforma Add-In for Autodesk Revit URL: <http://www.newforma.com/Project-Center/Newforma-Revit-add-in.aspx>



Newforma Project Center 8

Overview: *"The Newforma® Add-in for Autodesk® Revit® allows you to get more out of an investment in BIM by bringing project information management (PIM) capabilities into the Autodesk Revit suite of building information modeling (BIM) applications."*

Animated Demonstrations at: <http://www.newforma.com/Project-Center/Newforma-Revit-add-in.aspx>

Until next issue!

If you'd 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.

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



# Creating New Materials in AutoCAD 2011



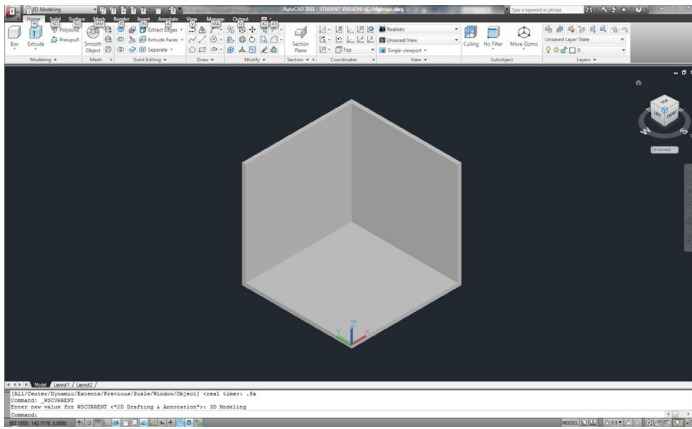
**A**utoCAD® 2011 has introduced a new Materials Browser and new Materials Editor. The Materials Browser lets you find and choose materials quickly. The Materials Editor lets you create new materials to use in your drawings.

In this article, you will learn how to create new material in AutoCAD 2011. Autodesk offers a large library of predefined materials for your use, which you can find through the Materials Browser. Don't overlook textures, which add realism and complexity to a material. For example, to reproduce the indentations on a paved road, you can apply a texture like NOISE to an object that represents a road in a drawing. To simulate a standard brick and mortar, you could use a brick texture.

First, we will prepare our workspace to create materials and textures.

1. Open a new drawing.
2. Type WORKSPACE and press ENTER.
3. Type C letter and press ENTER.
4. Type 3D Modeling and press ENTER.
5. Create two new layers called Walls and Floor.
6. Make Floor layer the current active layer.
7. Type BOX and press ENTER.
8. Define the first coordinate of the BOX equal to 0,0,0 and press ENTER.
9. Define a second coordinate of the BOX equal to @300,300,-10 and press ENTER.
10. Type -VIEW (with a preceding hyphen) and press ENTER.
11. Type SWISO and press ENTER.
12. Make Walls layer the current active layer.
13. Type BOX and press ENTER.
14. Define the first coordinate of the BOX equal to 0,300,0 and press ENTER.
15. Define a second coordinate of the BOX equal to @300,-10,280 and press ENTER.
16. Type ZOOM and press ENTER.
17. Type EXTENTS, and press ENTER.
18. Type BOX and press ENTER.
19. Define the first coordinate of the BOX equal to 300,300,0 and press ENTER.
20. Define the first coordinate of the BOX equal to @-10,-300,280 and press ENTER.
21. Type UNION and press ENTER.
22. Select both walls to apply the UNION command.
23. Type VSCURRENT (to choose a Visual Style) and press ENTER.
24. Type REALISTIC and press ENTER.



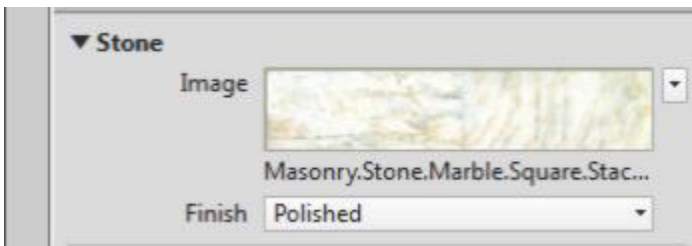


Now we will create a polished ceramic tile texture to apply to the floor and a wallpaper texture to apply to the walls.

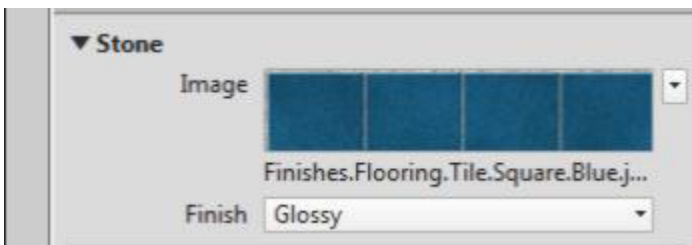
1. Click in Render tab.
2. Click Materials Browser in Materials panel. The tool palette Materials Browser will appear.
3. In the tool palette Materials Browser, click in Create Material list and select Stone. The tool palette Materials Editor will open specifically to the stone material.



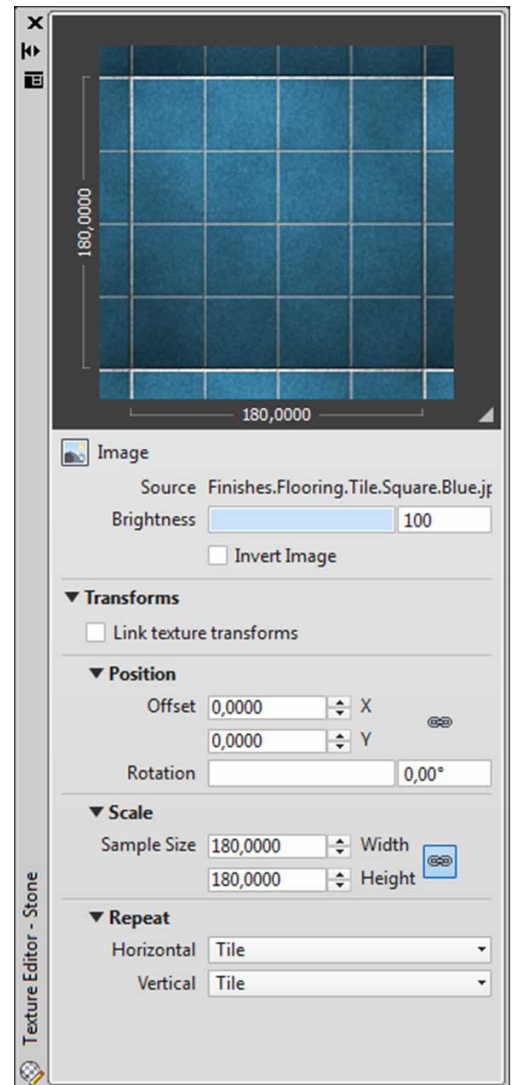
4. In the tool palette Materials Editor, in the text box Name, type the name of the new material. You can type Polished Ceramic Tile.
5. In the section Stone, click in the texture name below the sample image.



6. In the dialog box Materials Editor Open File, follow this path: C:\Program Files (x86)\Common Files\Autodesk Shared\Materials2011\assetlibrary\_base.fbm\1\Mats (C:\Program Files\... for 32-bit Windows operating systems) to find many textures provided by Autodesk.
7. Find and select the file Finishes.Flooring.Tile.Square.Blue.jpg and click Open.

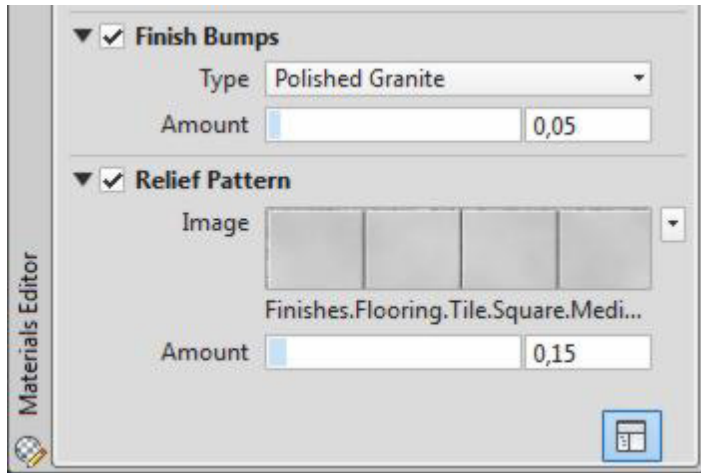


8. In the Finish list, find and select the Glossy finish.
9. Click in the blue tile texture to open the tool palette Texture Editor. In this tool palette, you can define the size and the rotation of a texture.
10. In the upper section of Texture Editor, you will see a sample of the texture and two numbers that present the final vertical and horizontal sizes of the texture.
11. In the Source section, find the name of the texture's file.
12. In the Brightness section you can change the material brightness. Type 100.
13. By expanding the Transforms section, you will find other options such as Link texture transforms, where you can choose to synchronize all transformation properties of a material.
14. In the Position section, you can offset the texture horizontally or vertically through Offset X and Offset Y and rotate the texture by defining an angle. Type 0 in Offset X, Offset Y, and Angle.
15. In the Scale section, define the horizontal and vertical sizes of a texture. Type 180.
16. In the Repeat section, choose Tile.
17. Close the tool palette Texture Editor.



In the Materials Editor, you can apply some specific features to the stone material like Finish Bumps, which you can define as Polished Granite with the Amount equal to a 0.05, and Relief Pattern, which could be a P&B image of the ceramic tile (you can use the file Finishes.Flooring.Tile.Square.Blue.bump.jpg and you can find it in that same path), with the Amount equal to 0.15.





## APPLYING MATERIALS TO THE OBJECTS IN THE DRAWING

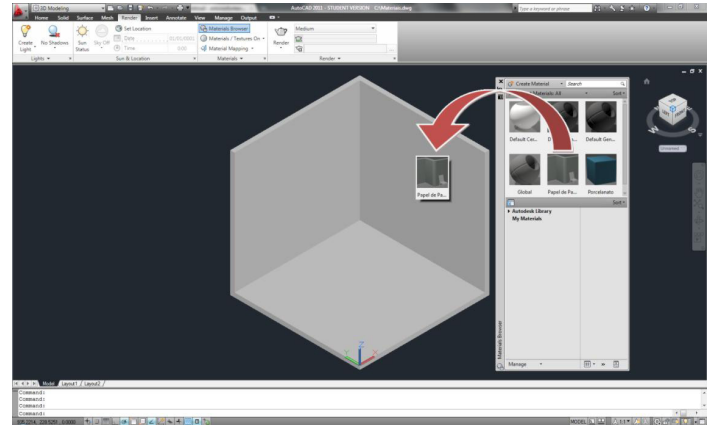
We can apply a material to an object through the Materials Browser in two ways.

1. By dragging the material directly to the object.
2. By previously selecting the objects and, in the Materials Browser, right-click the material and select Assign to Selection.

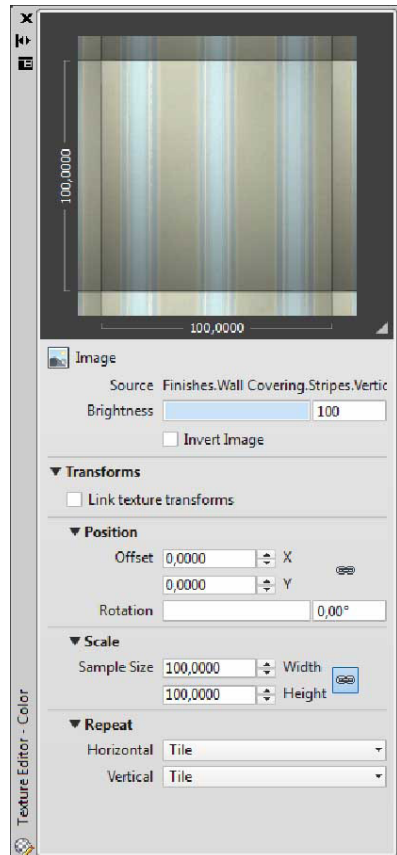
The figures below show the final result of our demonstration.

Freely experiment with all materials features and you will discover that you have a powerful tool to create, edit, and apply materials in your drawings.

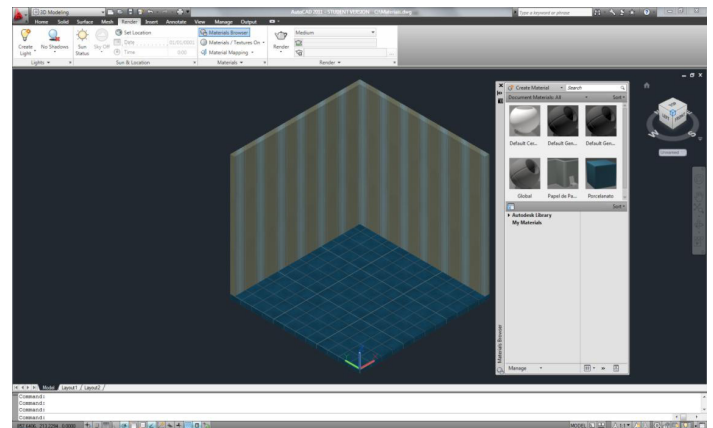
18. Now, you will create a wallpaper material to apply to the walls. In the tool palette Materials Browser, click in Create Material list, and select Generic. The tool palette Materials Editor will be open specifically to the generic material.
19. In the tool palette Materials Editor, in the text Box Name, type the name of the new material. You can type Wallpaper.
20. In the Generic section, select Color by Object in the color list.
21. In the section Generic, click in the texture name below the sample image.
22. In the dialog box Materials Editor Open File, follow this path C:\Program Files (x86)\Common Files\ Autodesk Shared\ Materials2011\assetlibrary\_base.fbm\1\Mats.



23. Find and select the file Finishes.Wall Covering.Stripes.Vertical.Blue-Grey.jpg, and click Open.
24. In the Brightness section, change the material brightness. Type 100.
25. Expand the Transforms section. In the Position section, type 0 in Offset X, Offset Y, and Angle.



26. In the Scale section, you define the horizontal and vertical sizes of a texture. Type 100.
27. In the Repeat section, choose Tile.
28. Close the tool palette Texture Editor.
29. You will find some specific features to the generic material.



Antonio Fontenele is a Brazilian architect, Autodesk University Virtual Speaker, ATC Faculty, AUGI Training Program Faculty, member of AUGI since 2001, and he is an AutoCAD 2009/2010/2011 Certified Associate and AutoCAD 2009/2010/2011 Certified Professional. You can contact him through [projeto@antoniofontenele.arq.br](mailto:projeto@antoniofontenele.arq.br)



# Five Commands You Can't Live Without



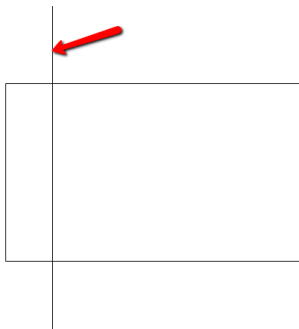
We all are creatures of habit and most likely use some of the same commands over and over. Maybe you use some of my top five favorites described in this article. Hopefully, you'll learn at least one new command here.

## 1. CONSTRUCTION LINE (SPECIFICALLY THE OFFSET OPTION)

Whether you use the ribbon or a toolbar, you'll find the construction line command with the draw tools. You can also type XLINE. This command has been around for many years now.

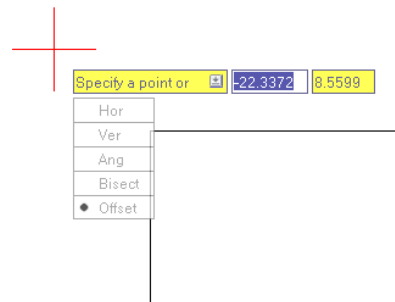
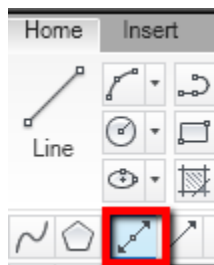
*Note: If you use AutoCAD® Architecture or AutoCAD® MEP this command will react slightly differently. There is no difference with AutoCAD® Civil 3D®.*

The construction line command differs from a line or polyline in that a construction line is infinite in both directions. So no matter how large or small the drawing is, you can have a reference line that you won't see the end of in the drawing.

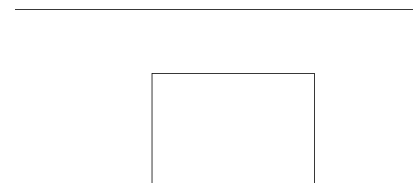


When you need a line to use for construction and later erase, it's often difficult to see the line under your other geometry. That is exactly why the construction line works so well.

My personal favorite option in the construction line command is the Offset option.



From the command line you can type "O" for Offset or choose it from the drop-down menu of your dynamic input. It works just like the Offset command in your modify tools. Let's say you have a rectangle. If you use the Modify version of the Offset command it will offset the entire rectangle. But if you use a construction line offset you can offset only one side.



## 2. CONVERT TEXT TO MULTILINE TEXT (EXPRESS TOOLS)

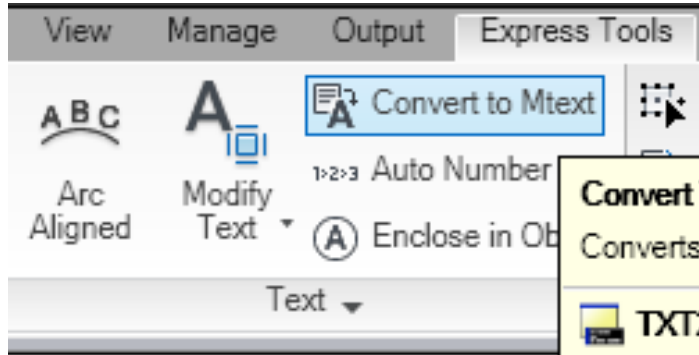
this is a single line text

Before we had the Mtext or multiline text tool, we had Dtext or single line text. The difference in the two is that single line text has to be edited one line at a time. Mtext wraps and works very similar to Microsoft Word.

If you open a drawing where there is more than one line of single line text, you don't have to suffer with editing or moving one line at a time.



The tool has been part of Express Tools for several years. Because it's one of the Express Tools, you must have Express Tools installed with your version of AutoCAD®. If you don't have Express Tools, you can certainly load them and take advantage of this and other Express Tools. Be sure and look up references about Express Tools on AUGI.com.



Choose Express Tools from the ribbon or pull-down menu. The tool is Convert to Mtext. TXT2MTXT is the actual command.

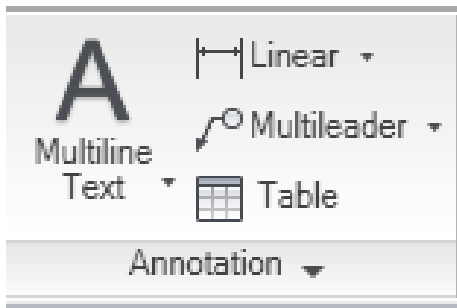
You select any lines of single line text. Beware that in some cases the results could be slightly different depending on the way the text was created.



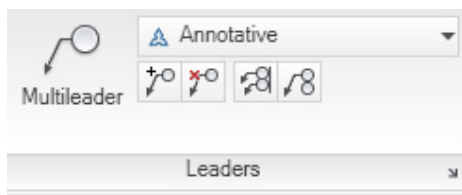
In this example, the pieces of text except for the "a" were selected and converted. The grips show that it is now a single piece of Mtext. Now it can be edited easily.

### 3. MULTILEADER

This tool is one of my favorites, yet few people seem to have tried it on their own from what I've found. A multileader has several benefits. First, several leaders can be associated with one piece of text. Second, the multileader can be text or a block. Let's take a look.

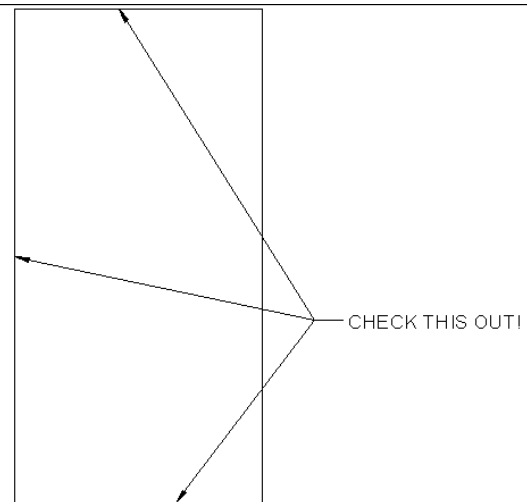
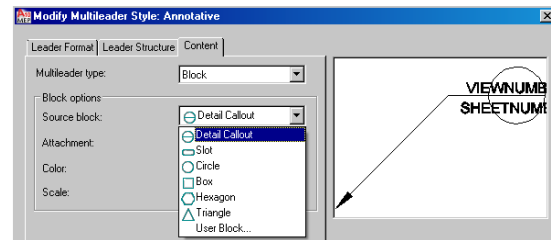
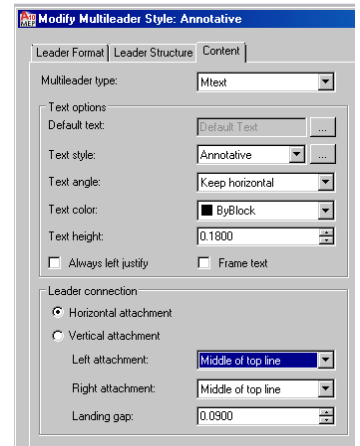


An annotation panel on the Home tab of the ribbon contains Multileader tools as does the Annotation tab.



You format your Multileader Style. We will not go into depth on that in this article. You can choose straight or spline and mtext or block. Several blocks are available for you to try.

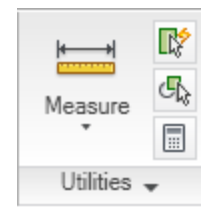
Creating a multileader is similar to creating the old quick leader that we used for so many years. You select where the arrow should point, drag and then one click and you are prompted for your mtext or block attribute.



By right-clicking on the leader or selecting the leader tool with the + on the icon, you can add more leader lines. This is very useful because if you move the text or a leader, the entire leader and all associated text and leaders move together. No more loose pieces!

### 4. MEASURE

The measure command is often overlooked, while the dimension command is used and erased. Why erase when you have the handy Measure command? Measure allows you to gain the same information as the linear dimension. The difference is that when you're done with the measure command you can move on with your next command. Measure puts itself neatly away until you need to use it again. From the Home tab of the ribbon you'll find Measure under Utilities. From the pull-down menu or using toolbars it's found under Tools>Inquiry. Simply select your two points and you'll see the measurement either on the command line or through your dynamic input.



## MEASUREGEOM

Enter an option [Distance/Radius/Angle/ARea/Volume] <Distance>: D

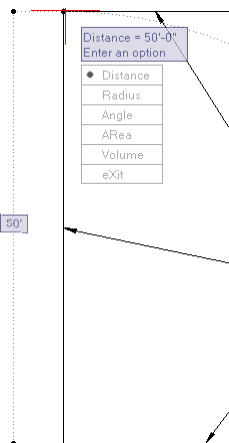
Specify first point:

Specify second point or [Multiple points]:

Distance = 50'-0", Angle in XY Plane = 90, Angle from XY Plane = 0

Delta X = 0'-0", Delta Y = 50'-0", Delta Z = 0'-0"

A handy little tool, indeed.

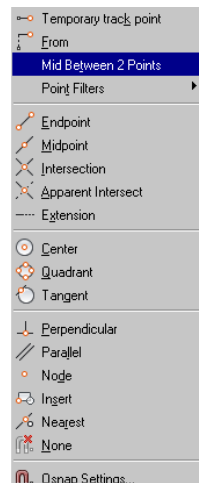
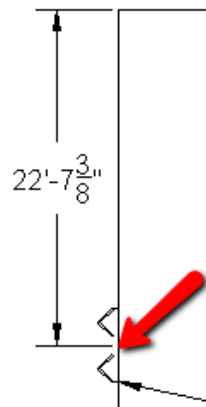


## 5. MIDWAY BETWEEN TWO POINTS (OSNAP)

This tool is actually an OSNAP. I will confess that I learned this one from Autodesk's Lynn Allen when it first came out in AutoCAD. I use this OSNAP daily, even though it has never had its rightful place on the running OSNAP list. You can access it by either typing M2P on the command line or by using your Shift+right mouse click to choose it from the OSNAP pop-up list.

Midway Between Two Points is a great tool that allows you to pick a point that you might otherwise need to draw a construction line to accomplish. It requires you to choose two OSNAPS.

Let's say you need to make a dimension from the midpoint of a door opening. Well, we choose the linear dimension tool. Then when we're prompted for our first point we select M2P. We want to select both endpoints of the door as where we want that dimension to begin. We want the dimension midway between those two points. Then we continue on and select the second point of our dimension as normal and choose the endpoint of the wall.



Try one or all five of these tips and see if they save you time and effort.

Beth Powell owns CAD Fuel Design. She produces drawings for the fueling industry and provides training and support for AutoCAD and AutoCAD MEP. Her blog is <http://bethscadblog.blogspot.com/>. She can be reached at [beth@cadfuel.com](mailto:beth@cadfuel.com).



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# Civil 3D Guide to Sustainable Designing



One of the fastest growing markets for the civil engineering industry is sustainable design. There has been an increase in this market even during the recent economic downturn. Sustainable design is a practice that I feel very strongly about; in my mind, green is always better. It is better for the environment. It is better for the inhabitants of such developments and better for the developers and owners. It can also have a higher value than traditional designs.

There are many levels of sustainable design, from minor changes in how we develop or redevelop, to certified sustainability designs such as a Leadership in Environmental and Energy Design (LEED®) project that is certified by the U.S. Green Building Council and other programs as well. Some of these programs are regional, and a quick Internet search could reveal other options available to you or you can have your designs certified. Bear in mind, however, that your designs do not have to be certified to make them sustainable designs. It's all in how we decide to design our projects, but the certifications certainly do help and make it easier to judge just how sustainable our designs are. We have also been designing some forms of sustainability our entire careers. A perfect example of this is a detention or retention pond and many other design practices that we might not even recognize as sustainable practices. Of course, some of these design practices are forced on us due to regulations that we must follow in order to get our designs approved. But they are sustainable practices nonetheless.

The software we use can play an important role in our designs, not only in the design itself, but in the evaluation of sites and the surrounding area. When working on a sustainable design we have to consider more than just our lot and surrounding lots. We have to look at a much bigger picture. We have to consider many factors other than cost and a client's desire. In many traditional design situations, owners would buy a piece of property and then come to an engineer with their intent for this property.

This method does not work as well in a sustainable design process. The engineer has to get involved sooner in the development process if a sustainable design is the intent of the owner, especially if he or she would like the development to be certified. As I have stated, there is much more to developing sustainably than just the property we are developing. With that being said, any development can be a sustainable development, or at least more sustainable than traditional developments. Even small changes can have a large impact overall. One day in the near future we will no longer refer to sustainable designs as sustainable. They will simply be "designs" once more, as this type of development becomes the norm. For the rest of this article I will refer to sustainable designs simply as "designs."

## AERIAL IMAGERY

One very useful tool in designing is the use of aerial imagery. Images can come from many sources and in many formats, so I cannot get too in-depth in this short article. Of all of the data we work with, imagery is by far the one item that will use up our computers resources and make for a very bad day. Therefore, we have to be careful about the data we use in our drawings. AutoCAD® Civil 3D® gives a somewhat better result when working with images obtained by way of the Feature Data Objects (FDO) data access technology. FDO can use coordinate systems to place our imagery in the correct location based off of the Earth's surface, or translate from one coordinate system to another. If you have never tried this option, I recommend that you test it out. You can also use Google Earth, which contains free data that we can pull into our drawings, and is not limited to only imagery. In many locations you can also pull in surface data. Keep in mind this is not survey-quality surface data, but it can be very useful in a preliminary stage of design and site evaluation.

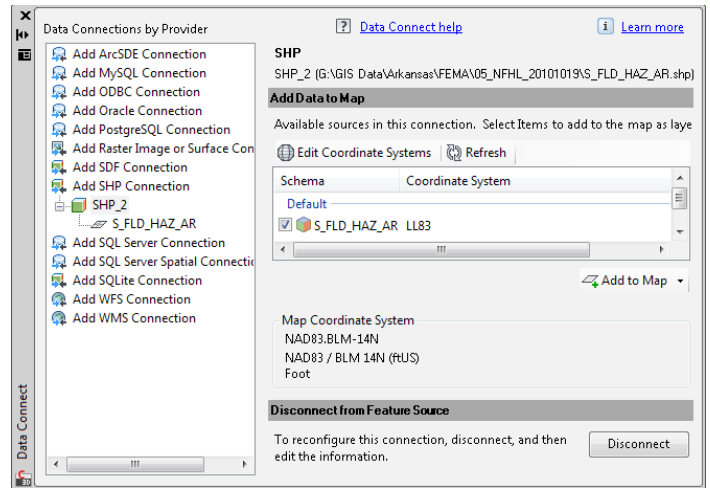




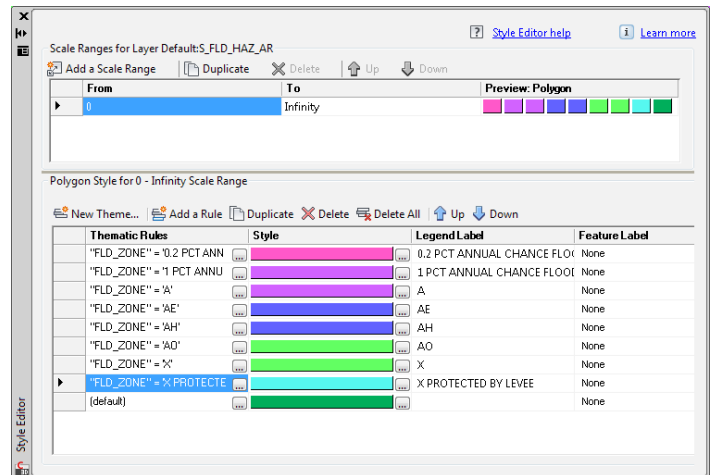
With imagery in our drawings we can get a better idea of not only our site, but also the surrounding area. What kind of development is around our site? Are there bodies of water or streams nearby? What type and amount of development is in the area; what type of vegetation is on our site; is there public transportation in proximity to our development? An aerial image can easily show you the types of roads that surround our site. Last, but not least, images give our designs a much clearer picture. People without engineering degrees can understand the design intent and the impact on the environment a little easier.

## GIS DATA

Geospatial data can serve so many purposes in our design process, and the amount of data in some locations is growing at a rapid rate. You may have to look pretty hard to find the data you're after, or you may find that a simple Internet search will result in an almost overwhelming amount of data available to you for free or for purchase. The ways in which we can use this data and the different types of data that may be available in your area are beyond what can be covered in this article, but I will point out a couple of the ways to use this GIS data. Again, I would recommend the FDO connection to get this data into your design drawings.



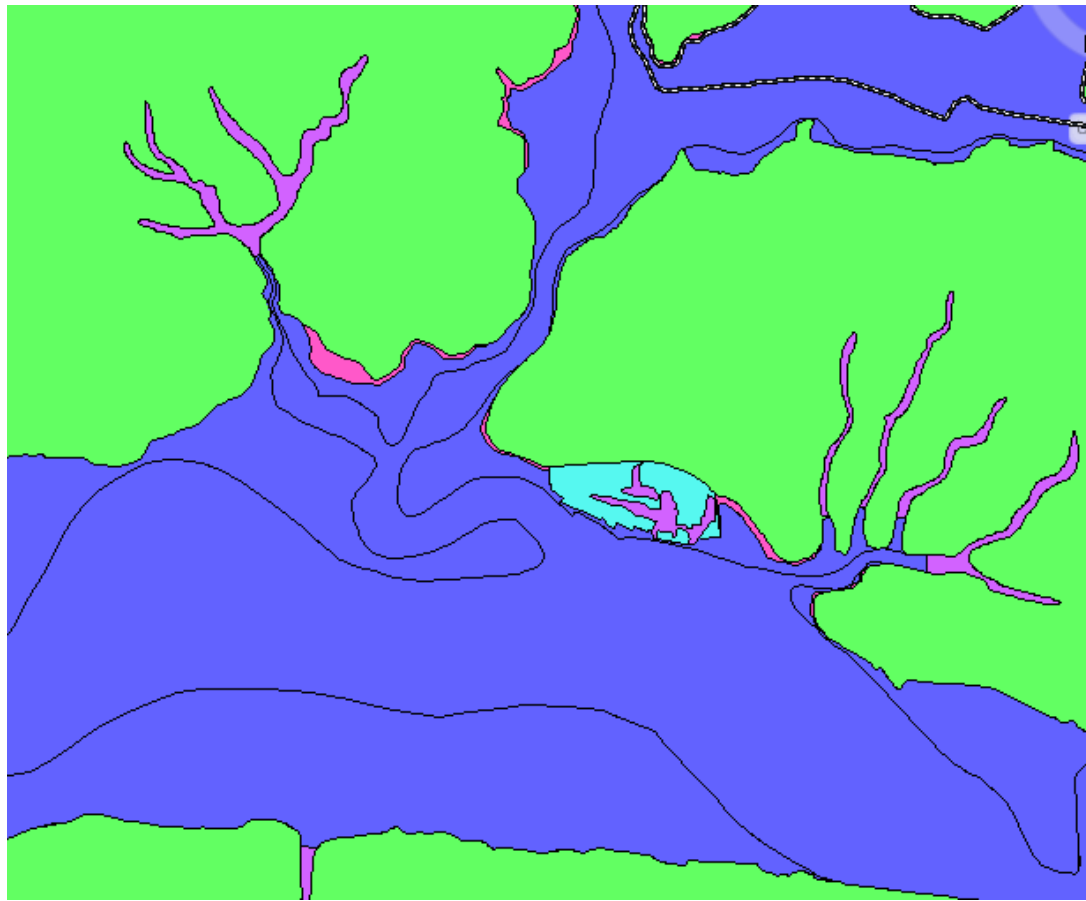
Proximity analysis is one method that you may use in your design. It could be proximity of infrastructure, intersections, and even public buildings and green spaces. You may have access to the types of soils in the area or flood plain information. Let's look at flood zone data, and let's say that this data is in the form of a shape file or .shp format. Using the FDO connection, we bring the data into our drawing and let the FDO do any coordinate translations for us. After we have this in our drawing, we will likely want to adjust our style for these objects, adjust how this data is visually shown on the screen and when we create our documentation. Whenever possible, the documentation will be in a digital format, not plotted on paper. Remember we are creating a sustainable design, which should include digital printing.



The Map task pane is where you will have your data listed and where you will make the adjustments to the data's style. Select your data in the task pane, right-click, and select edit style; or select style in the upper section of this pane. A pop-up window called the Style Editor will appear and this is where you will make your adjustments. Next you will likely need to create a new theme to show the different flood zones. This is located in the middle of the editor on the left side in another pop-up box. You will need to know where the data for the flood zones is stored. It will be listed as a property, which is the first option to change in this box. After you select the correct property it will generate a range based on how



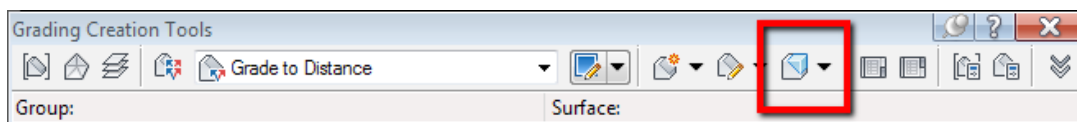
many ranges are available. Next you can assign a style or color range to apply the look you want. The same steps can be used for soil types and many other types of data as well.



### SITE GRADING

Another important factor to consider is the site grading. We want to reduce the overall site grading to an absolute minimum, and if possible, to not have a single truck bring in or remove soil from the site. This will also save our clients money as well. After all, what tends to be one of the most expensive site improvements? Site grading of course!

Let's pretend we already have a grading group created for our design. The next thing we are going to do is to check our cut and fill. We are going to do a simple elevation adjustment to balance our grading to get it as close as possible to a net zero value. On the ribbon's Home tab > Create Design panel > Grading, and select Grading Creation Tools. The Grading Creation toolbar will appear. Next select Grading Volume Tools. Take a moment to evaluate your current values and select the automatically raise and lower button on the far right. Presto! Like magic, Civil 3D has balanced this grading group for you. Evaluate the model to see if the result is acceptable.



### TRAINING

AutoCAD Civil 3D contains some powerful tools that we often overlook or don't utilize. These Map tools are built into Civil 3D. It is very common to get so overwhelmed with just learning Civil 3D that we take very little time to learn the Map functions and tools. Even the plain or "vanilla" AutoCAD functions tend to get overlooked by many civil designers. One of the biggest reasons for this, other than simply being overwhelmed with the number of features, is lack of training. Even expert CAD designers and the trainers themselves still need on-going training. I readily admit that I need lots of training and welcome any that comes my way.

As for those who claim not to need training, well, they don't know what they don't know. Hence, they can't recognize that they also need on-going training, just as every other CAD user does. I understand that often the reason we do not get the training we need or desire lies in management decisions over which we have little or no control. Believe me, I feel your frustrations! So explain to management that you need AutoCAD, Map, and Civil 3D training. After all, they bought the software already so why not use it to its fullest?

Christian Barrett is an AEC Applications Engineer at Applied Technology Group, North Little Rock, AR. He has over 10 years of Civil and Surveying industry experience as a CAD designer using Land Desktop & Civil 3D, and has been a CAD Coordinator at Multi-disciplinary Engineering/Architectural Firms. He was the creator and author of Autodesk Users Group International's (AUGI) Hotnews column "The Civil Side," and is a Civil Engineering forum moderator for the AUGI organization. As a civil applications technician and trainer, Christian has guided many engineering firms in the implementation of Civil 3D for



design and CAD management, National CAD Standards, and Building Information Modeling (BIM) workflows.

Civil 3D  
All Versions

# What I Don't Know



If you aren't taking the time to figure out what you don't know, you may not be doing yourself any favors. I'm often amazed at what people don't know about the programs they use nearly every day. In my case, it is AutoCAD® Civil 3D®. I realize there is a large chunk of Civil 3D

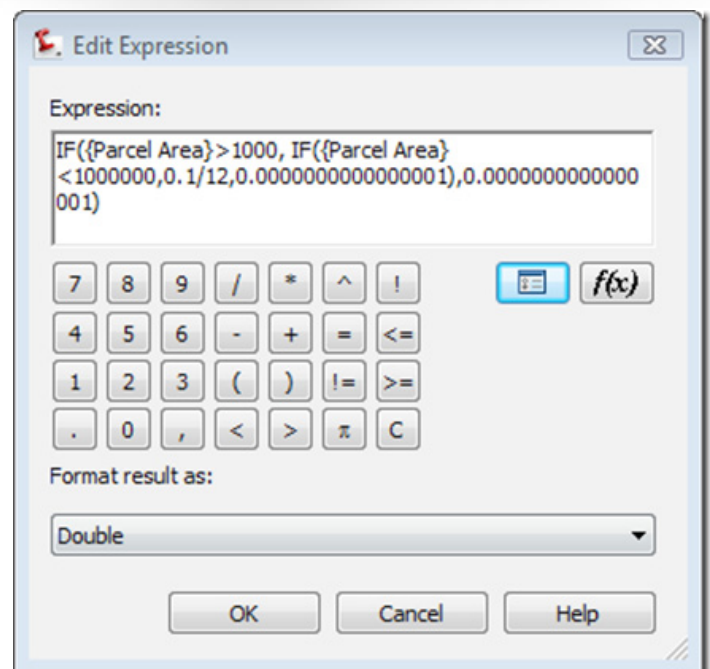
that I don't know.

Granted, much of what I don't know is functionality that I have not needed to use. For instance, I don't regularly interact with a survey crew that effectively utilizes field codes. If you asked me how a surveyor is supposed to create codes I'd have to look in Help. But the important thing to know is that the survey database exists. If you know it exists then you can look for resources to learn the feature.

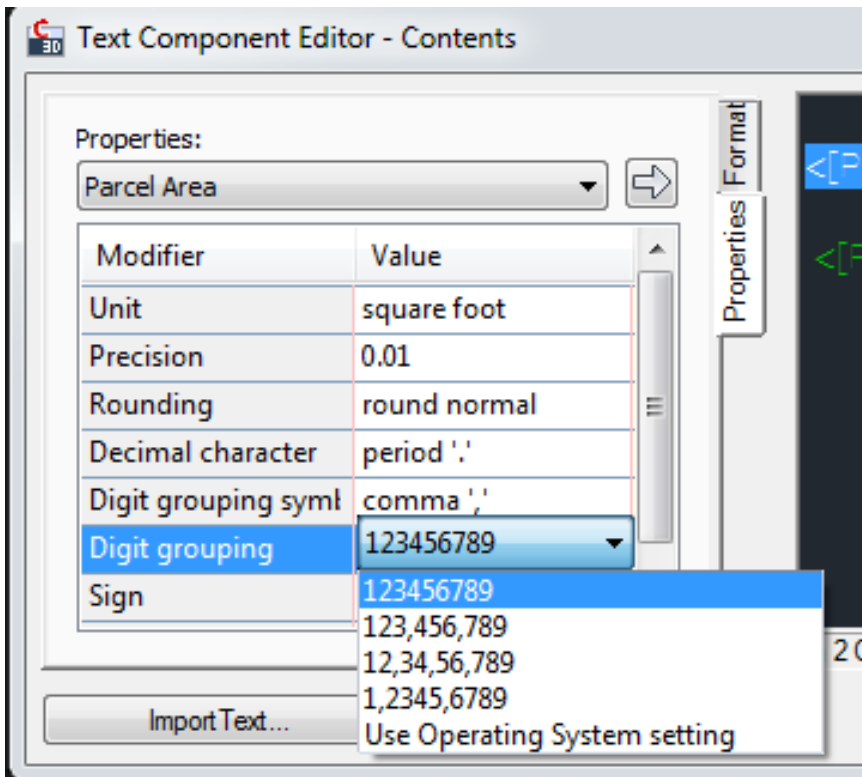
## RESOURCES

Maybe you're just starting out and need some resources to find the "know" so you no longer don't know. The first place I look is in Help. It's that frustrating button next to the Esc key. If you've disabled the F1 key, type HELP at the command line and do a search of Help. Unfortunately, I usually don't get exactly what I'm looking for when I do a search. When that happens I go to the Internet and search there, which usually brings me to the name of the command I'm seeking. Then I go back and look in the program's Help for the command.

In my first three-day Civil 3D course I learned a bunch, but probably the best bit of information I got was to hit the F1 key every day and read about a different command. Okay, so I didn't do it every day, but I did it often enough to learn numerous things I didn't know.



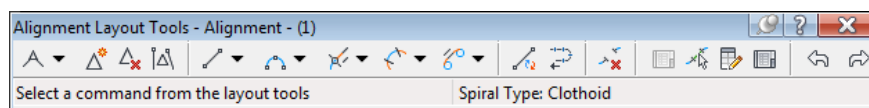




A Civil 3D-related search will likely provide links to one of the many blogs about the program. A word of caution about blog posts: you might run into old, stale information that has been superseded by new features in the program. For instance, in March of 2009 I did a post on how to get commas for parcel areas. It provided a way to get commas for areas up to 999 million. While it was a good method at the time, the introduction of Civil 3D 2011 provided a better way to accomplish the task with digit grouping. Digit grouping is a fancy term for adding commas to the area of the property being added to a label.

Other resources include Autodesk's Civil 3D pages where you can search through the knowledge base, check to see if any updates need to be installed, or look through documentation. Discussion forums are another great resource. I've found (and provided) many solutions on AUGI's forums and the Autodesk Civil 3D forums. Your reseller is another resource for information. Also, look for free webcasts focusing on Civil 3D; Autodesk and many resellers offer them.

## AUTOCAD LAND DESKTOP



When I began the transition from Land Desktop to Civil 3D, I wish I knew how to use the Alignment Layout Tools. I knew they existed, but they were a bit intimidating. They used "nonsensical" terms such as Fixed, Float, and Free. There were many options—which one do I use? I definitely wasn't in the know. While part of me wanted to use the Land Desktop method of creating an alignment from a polyline, the Alignment Layout Tools appeared to provide a way to

skip the step of creating a polyline and go directly to creating the alignment. By using the aforementioned resources, I learned how to use the Alignment Layout Tools to increase my productivity. For example, in Land Desktop occasionally the curves and lines would get out of whack and not connect correctly. With the Alignment Layout Tools I don't have to worry about it as much since the float and free types of alignment tools ensure they are always connected the way I want.

Now that I've brought up the Fixed, Float, and Free terms, I probably should explain what they are. When you use a Fixed tool, the curve, spiral, or line location is determined by the parameters used and doesn't look to other objects for its location. For example, a Fixed Line (two points) will be defined by the two points determined when you place the entity. Now I say "almost," due to the ability of the float and free to affect it.

A Floating layout tool is constrained by another object and determines where it's shaped by the various parameters you are able to select. The Floating Line (from curve, through point) allows you to create tangency to a curve and have the line go through a point. The floating line will adjust the length of the curve to ensure tangency.

The last term I found confusing. It's called Free, yet it is controlled by other objects. In no way is the object "free." For instance, a Free Line (between two curves) connects two curves with a line that is tangent between them. The location of the line is determined by the two curves to which it is being connected.

What if you don't want tangency? Then connect using a fixed curve and a fixed line. Now I don't know about you, but this explanation (and most other ones I've read) wouldn't let me get it. It would provide the basics, but I'd have to actually use the product and play around with how the various tools work. That's where a Home Use License comes in handy. If you don't know about Home Use Licenses, ask the person who handles the licensing of your Civil 3D product and see if you can get one. It's a great way to use the product at home, learning and experimenting in your free time.

Part of the problem of being in the know is the desire to change how your coworkers want to work. But hopefully, you work with people who want to be in the know also. Now go out and learn what you don't know!

Christopher Fugitt is a Civil Engineer and has spent the last eight years designing government projects as well as residential subdivisions. Before working as a Civil Engineer, Christopher worked for a General Engineering Contractor on subdivision and mining projects. Christopher earned his B.S. degree in Civil Engineering from California Polytechnic State University, San Luis Obispo. Christopher maintains and authors the Civil 3D Reminders blog at <http://blog.civil3dreminders.com/>





## Earthwork Volumes in Living Color



One thing that AutoCAD® Civil 3D® is known for is the speed with which it calculates earthwork. In fact, if you've already defined an existing and a proposed surface for your site, you can generate accurate cut/fill volumes in a matter of seconds. In addition to knowing "what" your earthwork calculations are, Civil 3D can also "show" you the areas of cut and fill in your design.

It's said that a picture is worth a thousand words. Likewise, a colorized cut/fill analysis is more descriptive than a single Net Volume calculation. *(It's also a great tool for spotting surface errors that might otherwise go unnoticed.)*

In this article I'm going to show you how to use Civil 3D to display your earthwork volumes graphically. I should also mention, in the interest of full disclosure, that the following instructions are 100 percent compatible with Civil 3D 2011 and 2010. Most of it will work with 2009 as well.

### LAYING THE GROUNDWORK

Throughout the course of this article we'll be creating some styles from scratch. If you'd like to work along with me, you can save and re-use these styles (or adaptations of them) on your own production work. You may find the styles helpful the next time you're reviewing earthwork calculations.

We'll start by looking at what I've created so far. As you can see in Figure 1, I have two surfaces.

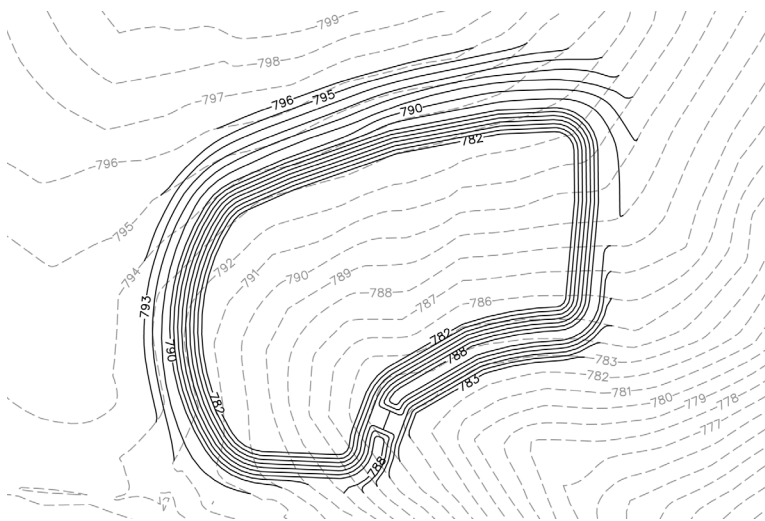


Figure 1: We're starting with two surfaces representing the existing and proposed conditions.

One surface represents the existing topography of my site. I've called it EXTP (existing topography) and it's displayed using light gray, dashed contour lines. The other surface represents a proposed detention basin. I called this surface PRTP (proposed topography) and it is displayed using black, continuous contour lines.

If you're working along with me, you can use any drawing that contains Civil 3D surfaces representing both existing and proposed conditions.



## CREATING A TIN VOLUME SURFACE

Fortunately, Civil 3D has several tools for calculating the volume between two surfaces. In this example, since we'd like our cut and fill information displayed graphically, we'll use a TIN volume surface to do the calculations. A TIN volume surface is a surface whose elevations are determined by the "differences" in elevation between a pair of surfaces.

Let's get started...

**Step 1:** Right-click on the Surfaces heading inside Prospector and select Create Surface. **Step 2:** In the Create Surface dialog box, open the Type: menu and choose TIN volume surface. **Step 3:** Click in the Name field and call the surface "Volume Calcs."

(Next we'll select the two surfaces we'd like to compare.)

**Step 4:** Click in the Base Surface field and select the surface representing existing conditions. (In my case, I selected EXTP.) **Step 5:** For the Comparison Surface, choose the surface representing proposed conditions. (I selected PRTP.)

Note the optional Cut and Fill factors to compensate for expansion or compaction of material. When finished, compare your settings to the ones shown in Figure 2.

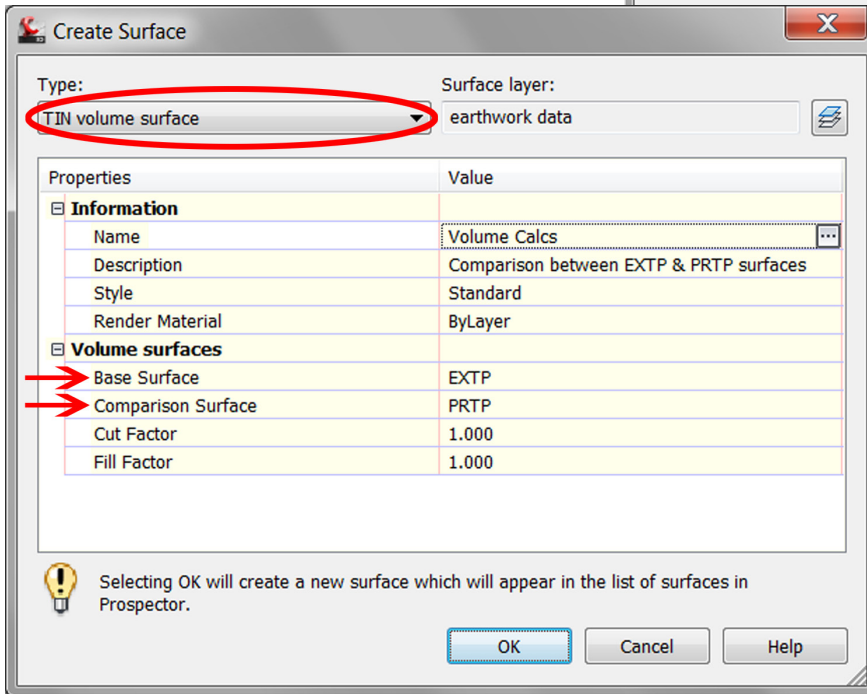


Figure 2: A TIN volume surface represents the elevational differences between a pair of surfaces.

Before clicking OK, pay attention to the Surface Layer in the upper right corner of the dialog box. This is the layer on which your new surface will be sitting. (I chose a layer called "earthwork data".) Turning off or freezing this layer may cause your surface or its labels to disappear. Click OK to dismiss the dialog box. At this point you'll find that the new Volume Calcs surface has been added to the Surfaces group inside Prospector.

## VIEWING THE EARTHWORK CALCULATIONS

To review the earthwork volumes, right-click on the Volume Calcs surface inside Prospector and select Surface Properties. When the dialog box opens, select the Statistics tab and (if necessary) click the "+" to open the Volume group (see Figure 3).

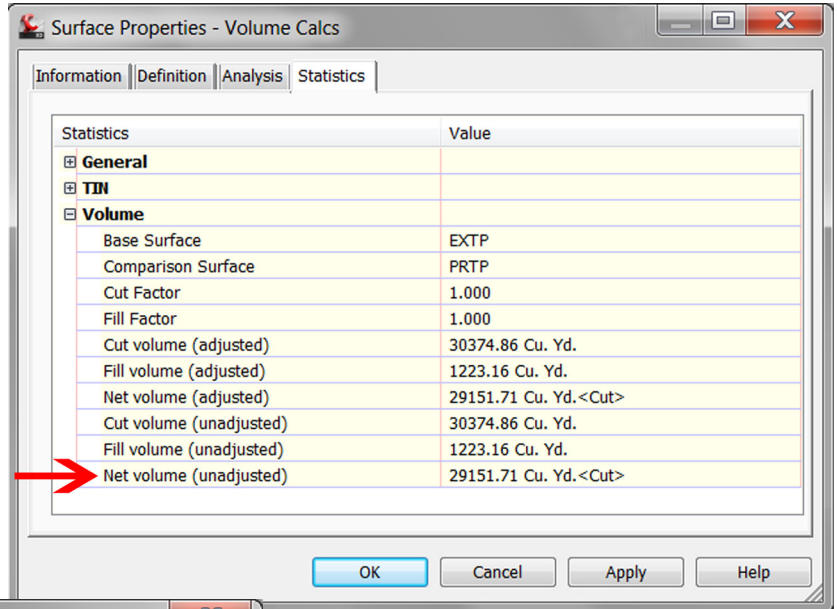


Figure 3: Earthwork calculations can be found on the Statistics tab of the Surface Properties dialog box.

Notice the volumes are given as adjusted and unadjusted values. The adjusted values come into play if a cut or fill factor has been applied. For this example we'll look at the unadjusted volumes.

As you can see in Figure 3, we have a net volume of 29,152 Cu. Yds. of "Cut," which makes sense because this design represents a detention basin. Also notice there is a small amount of fill required to construct the design.

While these numeric values are nice, they don't tell us the whole story. Knowing WHERE the cut and fill areas are located would also be helpful. By creating some new styles, we can easily have Civil 3D highlight these areas in our drawing.

## CREATING A SURFACE STYLE TO ANALYZE ELEVATION DATA

To colorize the areas of cut and fill, we'll create a new surface style and apply it to the Volume Calcs surface.

**Step 1:** On the Settings tab of the Toolspace, open the Surface group, right-click on the Surface Styles heading, and select New. **Step 2:** In the Surface Style dialog box, select the Information tab and name the style Cut-Fill Shading. **Step 3:** Select the Analysis tab and open the Elevations group to display the settings (see Figure 4).

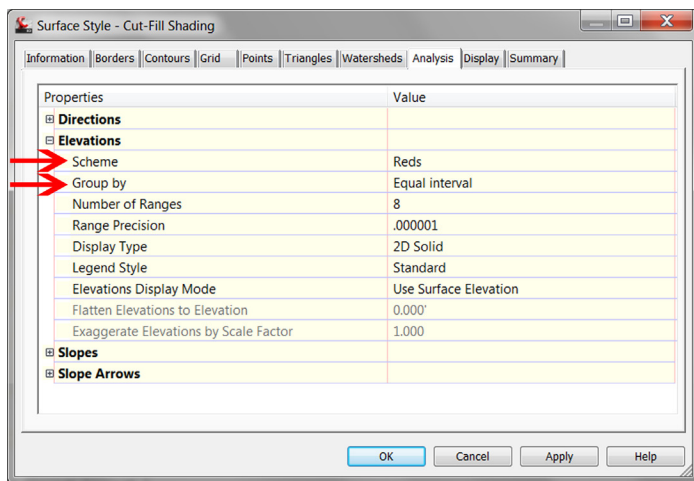


Figure 4: The Surface Style dialog box is used to customize the display of a Civil 3D surface.

**Step 4:** Change the color Scheme to Reds. (The color scheme is what Civil 3D uses as a starting point when shading the surface.) **Step 5:** Change the “Group By” setting to Equal interval. (This setting will allow you to divide the total “height” of the surface into nice equal increments.) **Step 6:** Finally, select the Display tab and make sure the Elevations component is the only one allowed to be visible. Click OK to complete the style.

## COLORIZING CUT AND FILL AREAS

Now that our new style is finished, let’s assign it to the Volume Calcs surface. Start by jumping back to the Prospector tab, right-click on the Volume Calcs surface name, and choose Select from the menu. Once the surface is selected, press CTRL+1 to open the Properties Palette and use the Style field to select the Cut-Fill Volumes style. Your drawing should now look similar to Figure 5.

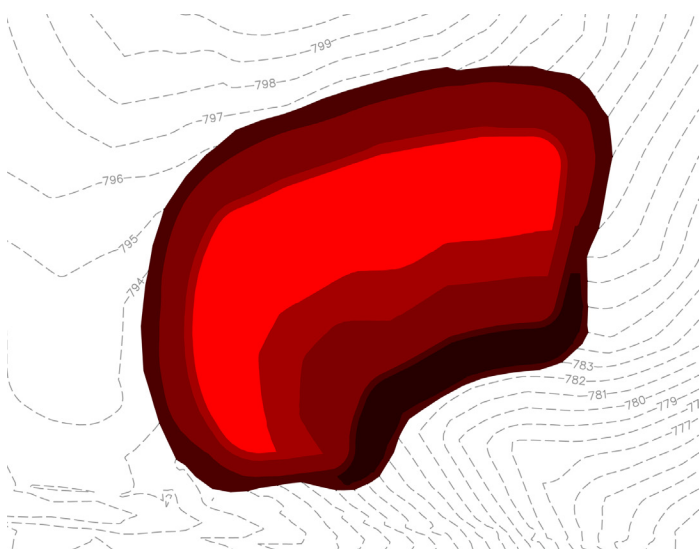


Figure 5: Specific analysis properties need to be assigned to a surface object or it will display using the default properties within the style.

As you can see, the surface is displayed using the default properties defined by the style. (Equal elevational increments colorized using shades of red.)

To make this “colorization” more meaningful, we need to adjust the analysis properties of the surface itself. Try this...

**Step 1:** In Prospector, right-click on the Volume Calcs surface and select Surface Properties. **Step 2:** Select the Analysis tab (see Figure 6).

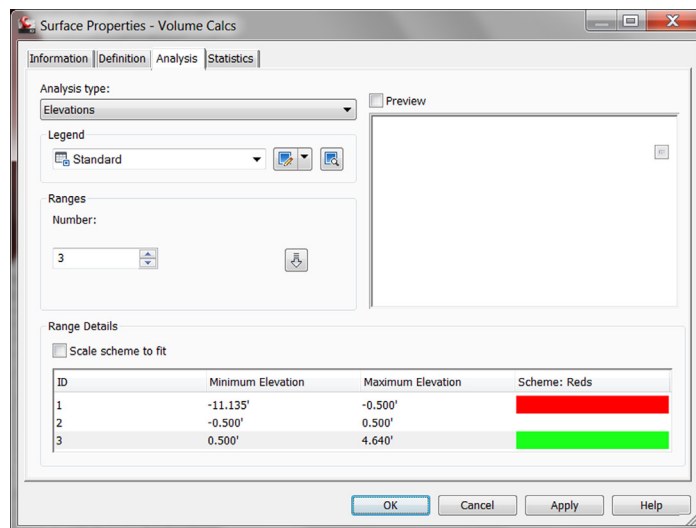


Figure 6: The Analysis tab of the Surface Properties dialog box is where we can finalize our ranges and color choices.

**Step 3:** Make sure the Analysis type is set to Elevations, change the number of Ranges to 3, to divide the surface into three equal parts, and click the downward arrow to display the calculated ranges below.

As far as a Volume TIN surface goes, negative elevations represent cut, and positive elevations represent fill. Since the surface is divided into three parts, we can use one range for cut, one for fill, and one to represent “no change.” To edit an elevation value, simply double-click on it.

**Step 4:** Set the elevations of the middle range to -.5 min. and .5 max. This range will represent virtually unchanged conditions. **Step 5:** Set the max value of the top range to -.5 to represent all cut elevations. **Step 6:** Set the min. value of the lower range to .5 to represent all fill elevations. **Step 7:** Finally, double click on the color samples at the end of the rows to define the colors of the shading. (Use Figure 6 as a guide.) Typically, I like to select colors from the True Color tab because these colors don’t conform to the plot style table. They will always appear the same on screen and on the finished plots. Click OK when finished.

Your drawing should look similar to Figure 7.

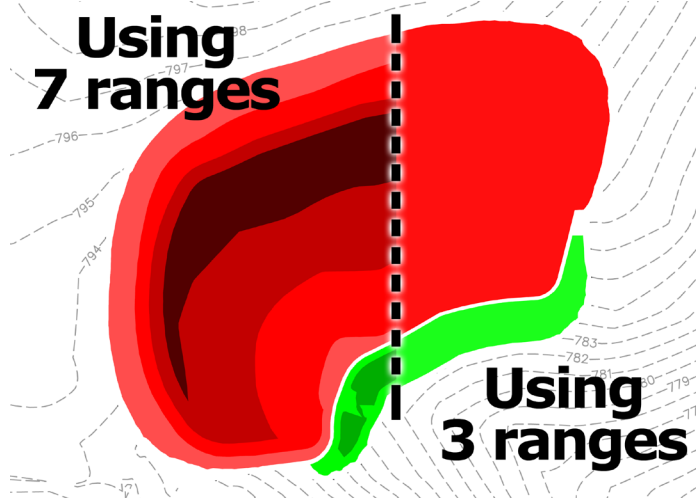


Figure 7: Increasing the number of ranges can add detail to a cut-fill analysis.



It's now very easy to see that the fill volume represents the berm on the south side of the basin. To finish the exhibit, use the Draworder command to push the Volume Calcs surface to the back of the drawing and you're ready to send it to the printer.

The best part about this analysis is that it's completely dynamic. If the existing or proposed conditions change, the volume calculations, and the colorized shading will update automatically. (Note: The Volume Calcs surface may need to be updated using the "Rebuild" option to see the changes.)

### CREATING A STYLE TO LABEL CUT/FILL MEASUREMENTS

Another way we can bring our earthwork calculations to life is by adding a series of spot elevations that represent cut-fill measurements. While this seems like it might be a time-consuming task, Civil 3D does most of the work for us. Before we get started, we need to create a label style.

**Step 1:** On the Settings tab of the Toolspace, expand the Surface group followed by the Label Styles group. **Step 2:** Right-click on the Spot Elevation heading and select New to open the Label Style Composer. **Step 3:** Select the Information tab and name the style "Cut-Fill Labels." **Step 4:** Select the General tab and use the Label Layer setting to select an appropriate layer name for the labels. (Example – volume lbls). **Step 5:** Select the Layout tab, choose an appropriate Text Height, and set the Anchor Point and the Attachment settings to "Middle Center" (see Figure 8).

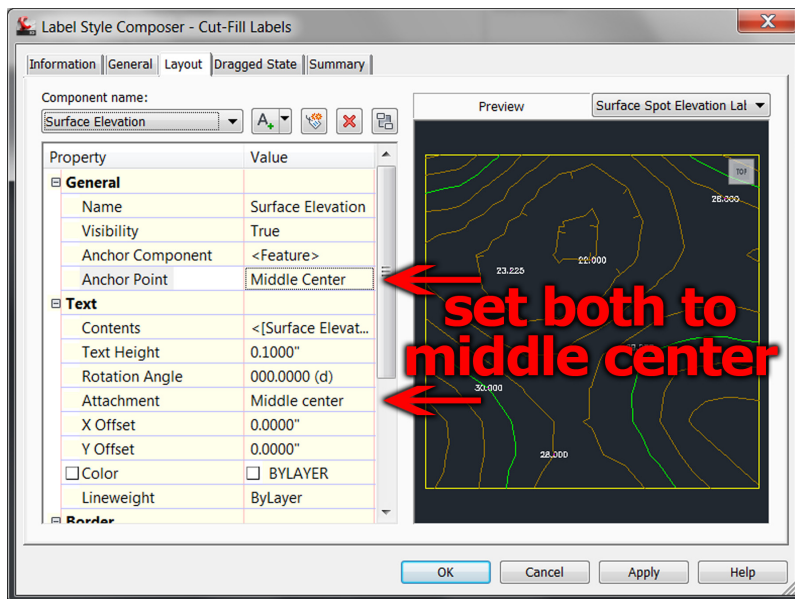


Figure 8: Setting both Anchor Point and Attachment to "Middle Center" allows the label to define the measurement and the sample location.

This step will ensure the label is centered over each spot where a measurement is taken. **Step 6:** Click in the Text Contents field and click the ellipsis button to open the Text Component Editor (see Figure 9).

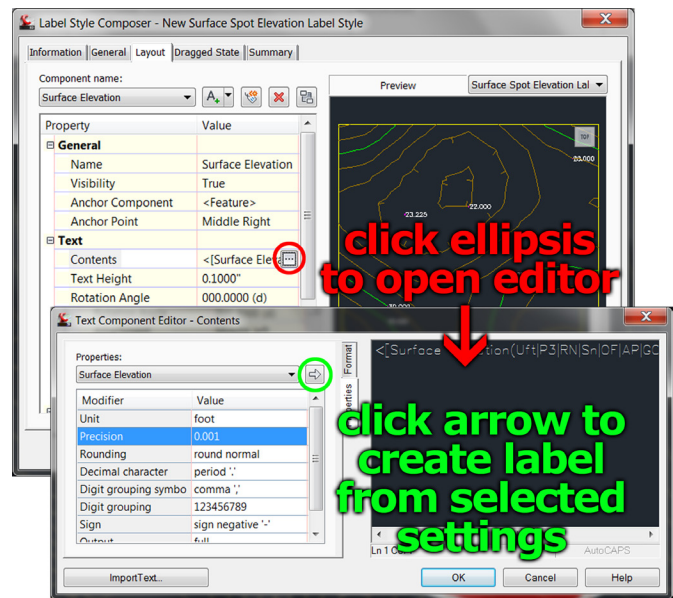


Figure 9 – The Text Component Editor is where we define the properties of a Civil 3D label.

On the right side of the Text Component Editor is some "programming code" that represents the properties of the label. We'll be creating a new label, so click in this area, select the code, and delete it.

**Step 7:** In the properties area on the left, click in the Precision field and select 1. This will eliminate the decimals and round all labels to the nearest foot. **Step 8:** Click the arrow (circled in green in Figure 9) to create a new "label code" from the revised settings. When finished, click OK to close both dialog boxes.

### CREATING A GRID OF CUT/FILL LABELS

Now that our label style has been created, we can use it to label our cut-fill measurements.

**Step 1:** Select the Annotate tab on the Ribbon and click the Add Labels icon on the far left side to open the Add Labels dialog box (see Figure 10).

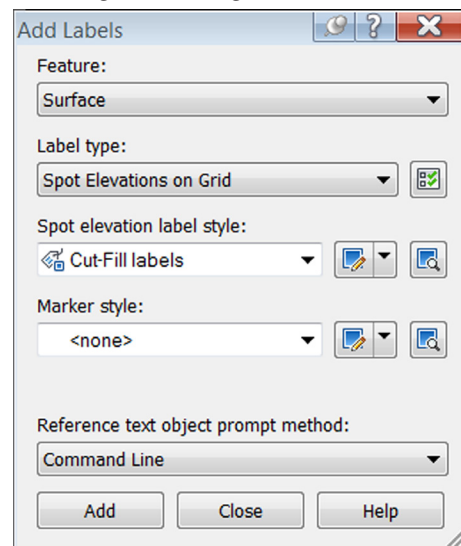


Figure 10: The Add Labels dialog box is a "one-stop-shop" to label most anything in Civil 3D.

# Civil 3D 2010 and 2011

**Step 2:** Set the Feature to “Surface” and the Label Type to “Spot Elevations on Grid.” **Step 3:** Change the Label Style to Cut-Fill Labels and set the Marker Style to <none>. The marker is an optional “tick” that specifies where each measurement is taken. Since our labels will be centered over these points, the marker isn’t really necessary. **Step 4:** Compare your settings to the ones in Figure 10 and then click the Add button. **Step 5:** At the “Select a surface” prompt, click on the Volume Calcs surface. **Step 6:** When defining the grid, use the following settings.

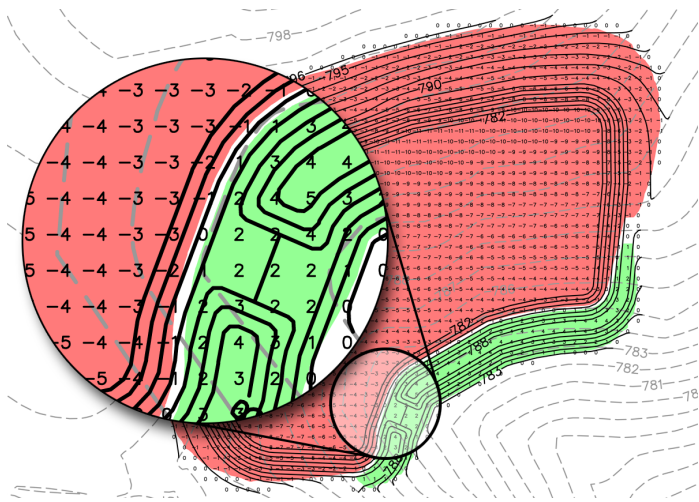


Figure 11: The size of the overall grid (and its squares) determines the placement of the cut/fill labels.

- ♦ **Base Point** - Select a point to define the lower left corner of the grid. Refer to Figure 11. **Grid Rotation = 0** (Non-rotated grid)
- ♦ **Grid X & Y Spacing = 20** (Determines the distance between the labels)
- ♦ **Upper Right Location** – Select a point to define the upper right corner of the grid.

**Step 7:** When given the opportunity to modify the values, press Enter to accept the grid as defined. When finished, your drawing should look similar to Figure 12.

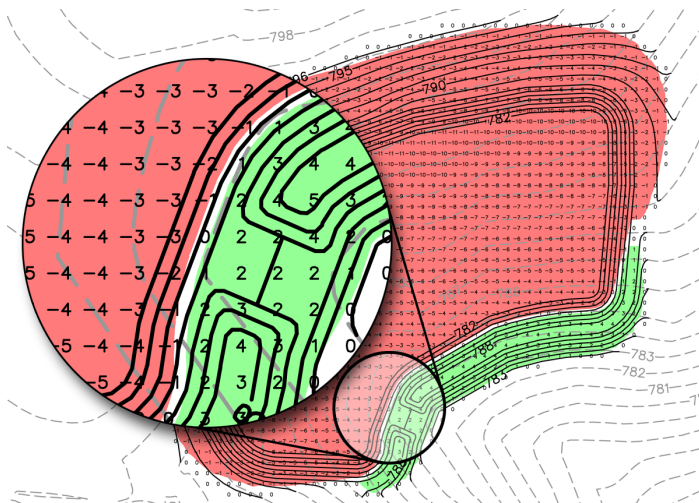


Figure 12: Grid labels make it easy to identify cut-fill locations and amounts.

Using grid labels in conjunction with cut-fill shading gives us a “forensic” display of the earthwork calculations. We now have an easy way to see the results of our design and verify if the numeric calculations make sense for the site. Did I mention that the grid labels are also dynamic? Go ahead, make a change to the proposed surface and you’ll find that you can update your volume calculations and cut-fill exhibit in less time than it takes to plot the drawing!

## CONCLUSION

As you can see, Civil 3D makes analyzing your earthwork calculations simple (and colorful) while also saving you a great deal of time along the way. To be honest, there is much more to see! Do a little exploration on surface analysis and you’ll find that you can also create colorized cut-fill contours. You can even omit the surface shading altogether and create colorized grid labels to identify areas of cut and fill.

If you’ve worked through the exercises with me, you have a new surface style and label style that you can incorporate into your production work. Try using these styles as a starting point the next time you calculate earthwork volumes. I’m sure you’ll agree, your earthwork calculations are much more descriptive when viewed in living color!

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# Display Themes in ACA 2011



The Display Themes tool has been around since release 2006, but is not widely used and is, therefore, under-appreciated by many. Display themes will work with any AutoCAD® Architecture (ACA) object you have created. Manual properties of an object—such as

a wall's fire rating or a door's manufacturer—are not typically visible in a drawing. Display themes lets you incorporate such non-graphic data in your drawing (both 2D and 3D) by using certain colors, fills, or hatches to highlight objects that meet the criteria or theme rules that you have established in a display theme style.

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

Note that if you use a display theme style that is provided with AutoCAD Architecture 2011, the property set definitions and property data formats for the style are already created for you.

## CREATING DISPLAY THEMES

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

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

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

# AutoCAD Architecture 2011

## PROPERTY DATA FORMATS

Property data formats are created and edited in the Style Manager under the Manage tab of the ribbon, Style & Display panel. You can also enter the command AECSTYLEMANAGER. To create a new one, expand Documentation Objects, right-click Property Data Formats, and click new. Enter a name for the new format and click enter. If you wish, you can also select an existing Property Data Format, right-click and copy, then paste and rename.

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

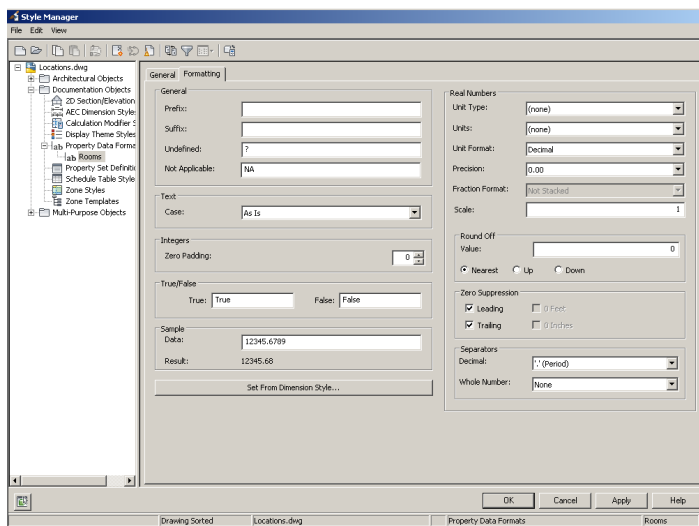


Figure 1: Property data format

## PROPERTY SET DEFINITIONS

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

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

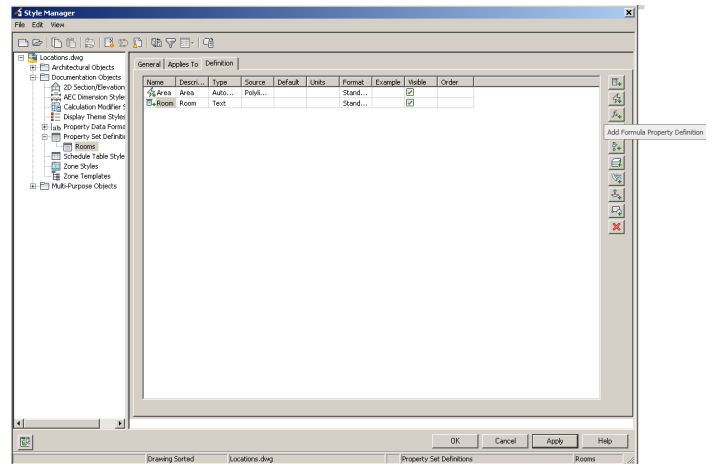


Figure 2: Property set definition

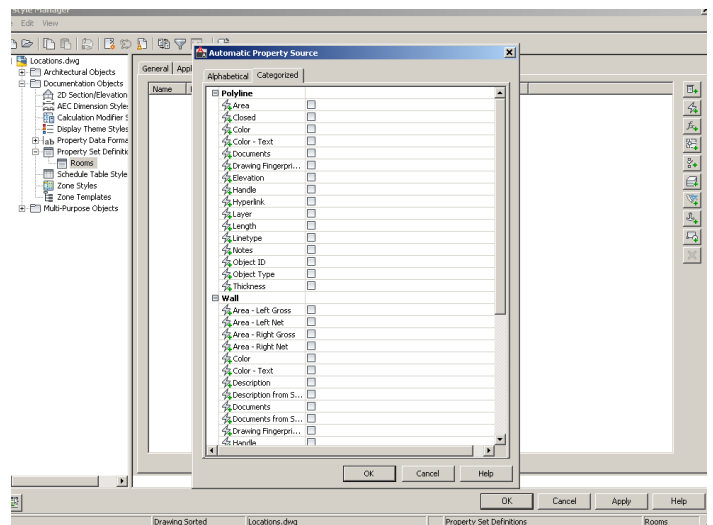


Figure 3: Automatic property definition

## DISPLAY THEME STYLES

Display theme styles are also created and edited in the Style Manager. To create a new style, expand Documentation Objects, right-click Display Theme Styles, and click new. Enter a name for the new definition and click enter. Enter a description for the display theme style. If you wish, you can also select an existing display theme style, right-click and copy, then paste and rename.

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

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



property set definition and property you selected. Then you will enter a value appropriate to the condition you selected and select an operator appropriate to the formula you are creating for the theme rules.

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

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

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

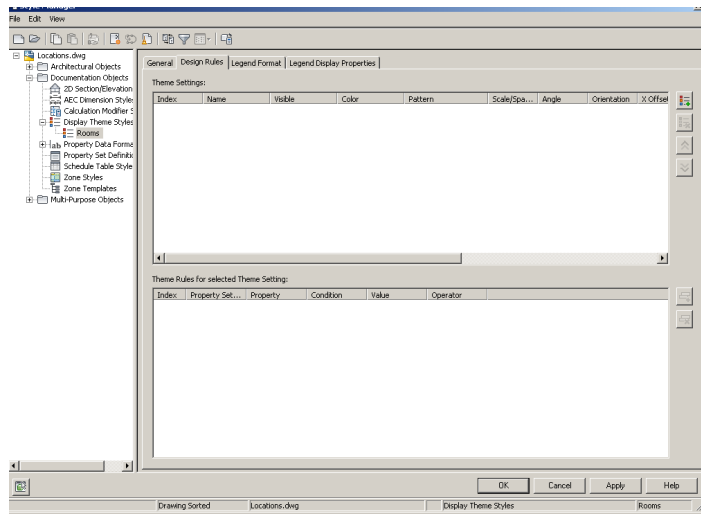


Figure 4: Display Theme Style Design Rules tab

### ATTACH PROPERTY SET DATA

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

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

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

### ACTIVATE DISPLAY THEME

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

At this point, you are ready to add the theme you created into your drawing. The display theme is added to

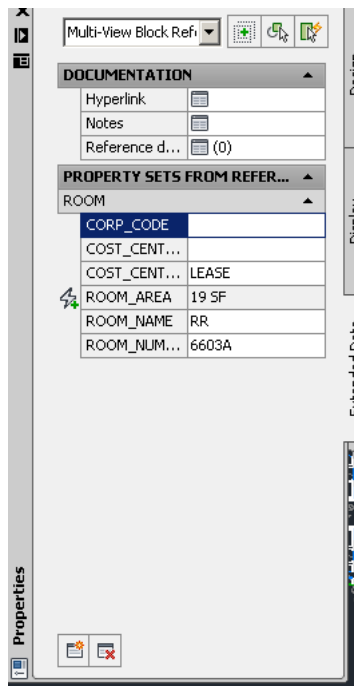


Figure 5: Properties extended data

the drawing through either the scheduling tool palette or the command DisplayThemeAdd.

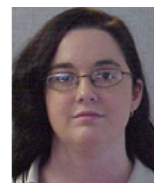
Open the tool palette that contains the display theme tool you want to use and select the tool. In the drawing area, specify the insertion point for the upper-left corner of the display theme legend. Then specify the lower-right corner of the legend or press enter to scale the display theme legend to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

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

### CONCLUSION

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

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# Good Old AutoLISP, for a New Year



It's a new year and a time that New Year's resolutions are made. If you are looking for a way to work in AutoCAD® more efficiently, this should be the year you resolve to learn AutoLISP. AutoLISP is an excellent tool that is easy to learn and will speed up those tedious tasks and automate AutoCAD.

AutoLISP has been around since AutoCAD 2.18. Since its inception, AutoLISP has been a great tool for increasing productivity. At times it can be very frustrating, especially when your code isn't working as planned. But when it does, it is very rewarding.

When choosing a language to write in, there are several factors to consider. For one, there has been a discussion floating around for years that AutoLISP will no longer be available. There is still a lot of customization happening via AutoLISP, so don't let the fear of longevity stop you. .NET is a great platform to program in, but AutoLISP doesn't need the extra overhead to run. You can use an ASCII editor to write in and you can paste your code directly in the command line. While I do not know Autodesk's intentions, regarding the future of AutoLISP, it does appear that AutoLISP has outlasted VBA.

When you automate AutoCAD you can increase your productivity, which affords you more time for other tasks. Imagine a project where your deadline is tight and all your time must be spent designing. Your manager comes to you and needs your help fixing the date on the title block of your last project. That might not take much imagination; it's pretty common in the places I've worked.

Now imagine typing a few key strokes to run a program you wrote that changes a title block attribute on an entire project. You are now free to continue your current project and your manager is happy your salary is going towards more profitable tasks. AutoLISP is also a great way to speed up the smaller tasks, like switching the color of two entities. These are the types of programs that help you the most often.

## A FEW BASICS

I remember my first AutoLISP class. For the final exam, we needed to write a program with a certain amount of substance. It was about 15 minutes before we needed to turn in our floppy disc and my code had suddenly stopped working. My mind began to race, what happened to the code, it was just running fine, everything looks fine! The final was pass or fail. If the code finished, you passed. And now I'm about to fail the final.

This scenario still happens from time to time. My code worked fine, but I thought it could be improved just a bit more. In my haste to beat the deadline I forgot one of the most important rules of AutoLISP: for every opening parenthesis you must have a closing parenthesis. Fortunately today we have the Visual LISP Editor, which has tools to find the matching parentheses. I was using notepad at the time and had to go line by line before I realized my mis-

take. It was a huge relief to find that one extra character that prevented the code from running and me passing the final.

Another helpful tip when writing new code is to write out your steps in pseudo code. As you write in your actual code you can use your pseudo code as comments. Comments are nice when reviewing your code down the road and you can't quite remember why you chose a certain technique. To place a comment insert a semicolon (;) in front of what you want to comment. When AutoLISP sees a ; it will stop processing that line and go to the next.

It is a good idea to remember that AutoLISP is a list processing language. At its core, most everything is a list wrapped in parentheses. Your entire command is wrapped in parentheses and so are the rest of the expressions. The expressions are a list of items where the first item is a function and the rest are arguments. AutoLISP will process line by line and function by function. Similar to algebra, AutoLISP will start with the innermost function and work its way out. In each expression, AutoLISP will always process the function, then the arguments. For example `(+ 1 (* 3 (/ 8 2)))` AutoLISP will divide eight by two then multiply it by three and add one. Or `(alert (strcat "Hello" (getvar "loginname")))` First AutoLISP will grab the user's login name and concatenate that with Hello, then it will place an alert box on the screen in AutoCAD. To test these examples you can simply copy and paste them directly in the command line.

When AutoLISP executes, it will return the last expression evaluated. Many programmers will place `(prin1)` or `(princ)` as the last expression. This habit will leave the command line a bit cleaner when your program is finished.

## EVOLUTION OF AUTOLISP

While AutoCAD has evolved, so has AutoLISP. Visual LISP was integrated in release 2000. With the release of Visual LISP we were given access to object-oriented programming and the ability to talk with COM. With COM we have the ability to communicate with external software such as Microsoft Outlook, Excel, and Access, as well as being able to grab windows forms and other COM-related functionality.

Object-oriented programming can be overwhelming, but very helpful once you understand the object model. There is a parent and child or children for your objects. Everything is an object when programming in an object-oriented language, including the session of AutoCAD. For example, the layer of an entity is the child of that entity. Children objects can also be parents. Let's go back to that layer. When you look at a layer as a parent it has children like name, color, linetype.

Think of Visual LISP as an extension for AutoLISP. Even though the syntax of the expressions are different, you can mix AutoLISP and Visual LISP in the same program. In order to use Visual LISP, you will need to load `(vl-load-com)` for each session of AutoCAD. I generally place it at the top of most programs.



In the code below I will compare some differences between AutoLISP and Visual LISP while we change the layer of an entity. You may notice that I indented the lines of code so the opening and closing parentheses line up. This technique is entirely for ease of reading. AutoLISP code can be broken up into different lines or placed all on one line. An example of this can be seen in the downloaded file. I have also added comments to the companion code found at <http://forums.augi.com/showthread.php?p=1114099#post1114099> to better explain each function in the program.

## ON TO THE CODE!

For the following examples you will need to make a layer named Road with a color of red. To change the layer of an entity you would use the following code:

```
(defun c:EntChangeLayer (/ entSelected entInfo)
  (setq entSelected (entsel "\nPick Object:"))
  (setq entInfo (entget (car entSelected)))
  (entmod (subst (cons 8 "Road") (assoc 8 entInfo) entInfo))
  (prin1)
)
```

To execute the above code you will need to first load it into AutoCAD and then type EntChangeLayer at the command line. When you are looking at AutoLISP functions you can search for the c: to determine what functions can be ran at the command line. To change the layer of an entity in object form you would use the following code:

```
(defun c:ObjChangeLayer (/ entSelected objSelected)
  (vl-load-com)
  (setq entSelected (entsel "\nPick Object:"))
  (setq objSelected (vla-ename->vla-object (car entSelected)))
  (vla-put-layer objSelected "Road")
  (prin1)
)
```

I prefer the second option since I can take an easy guess what vla-put-layer means. It's a little more difficult to know that 8 is the layer of the entity. One benefit to using object-orientated programming is you have a huge help utility in the object itself. You can use (vla-dump-object objSelected T) to grab the properties and methods that are available to you.

In the previous examples we needed to manually create a layer. Let's create that layer using Visual LISP.

```
(defun addLayer (strName strColor strLinetype / objLayer objLayers)
  (setq objLayers (vla-get-layers (vla-get-activedocument (vla-get-acad-object))))
  (if (not (tbloname "layer" strName))
    (vl-catch-all-error-p (vl-catch-all-apply 'vla-add (list objLayers strName)))
  )
  (setq objLayer (vla-item objLayers strName))
  (vla-put-layeron objLayer :vlax-true)
  (if (/= (strcase (vla-get-name objLayer))
        (strcase (getvar "layer")))
    (vla-put-freeze objLayer :vlax-false)
  )
  (vla-put-lock objLayer :vlax-false)
  (vla-put-color objLayer strColor)
  (vla-put-linetype objLayer strLinetype)
)
```

)

Notice there isn't a c: in front of addLayer. This function will need to be wrapped in parentheses for AutoCAD to understand what to do with it. Here is an example of implementing the addLayer code:

```
(defun c:ObjChangeLayer (/ entSelected objSelected)
  (vl-load-com)
  (setq entSelected (entsel "\nPick Object:"))
  (setq objSelected (vla-ename->vla-object (car entSelected)))
  (addLayer "Road" 1 "continuous");the function addLayer and its
  three arguments are wrapped in parentheses
  (vla-put-layer objSelected "Road")
  (prin1)
)
```

Another function that has saved me hours of design time is a tool that will switch the values of two attributes.

```
(defun c:ATTS (/ objFirstText strFirstText strSecondText)
  (vl-load-com)
  (setq objFirstText (vla-ename->vla-object (cdar (entget (car (nentsel "\nSelect First Text :"))))))
  (cond
    ((= "AcDbAttribute" (vla-get-objectname objFirstText))
     (setq strFirstText (vla-get-textstring objFirstText))
    )
  )
  (setq objSecondText (vla-ename->vla-object (cdar (entget (car (nentsel "\nSelect Second Text :"))))))
  (cond
    ((= "AcDbAttribute" (vla-get-objectname objSecondText))
     (setq strSecondText (vla-get-textstring objSecondText))
     (vla-put-textstring objFirstText strSecondText)
     (vla-put-textstring objSecondText strFirstText)
    )
  )
  (prin1)
)
```

A good understanding of the basics will make it much easier to grasp the complex functions. Take this one program at a time and ask a lot of questions and search for examples. You are learning to write in a new language; fortunately, there are many great resources.

Open up the Help that Autodesk provides. The AutoLISP Developers Guide is a nice source to determine which arguments are needed for most functions. Be sure to check out the helpful members on the AUGI forums. Search the forums or Google for similar topics. You will not always find an exact match, but it should be close enough to give you an understanding of how your program can be written.

AutoLISP isn't the latest programming platform, but it is still the first choice for many programmers. Good luck in learning AutoLISP, and I hope to see you in the forums.

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Matt Worland has been designing and programming in AutoCAD since R13. He is currently working in Denver, Colorado, as a designer and CAD IT. He enjoys learning and teaching others the power of Visual LISP and automation. Matt can be reached at [cadhelp@mattworland.com](mailto:cadhelp@mattworland.com)





# Using Formulas for Engineering Calculations

## BACKGROUND INFORMATION

Working for an engineering firm in central Florida has unique requirements that may not exist in other states. One of these requirements is to supply building departments with design pressures for openings. These are positive and negative pressures whose values are based on several pieces of design criteria. These include, but are not limited to, wind speed, exposure, and opening size. The location of the opening plays a part in the design pressures as well. An opening located closer to the corner of a structure usually has higher design pressures associated to the opening.

ASCE (American Society of Civil Engineers) has code-related documentation for minimum design loads for buildings and other structures. In this documentation you can find charts of standard design pressures to use. These charts give you values covering different opening sizes, but not all needed.

ZONE	EFFECTIVE WIND AREA (SF)	100 MPH POSITIVE	100MPH NEGATIVE
4	10	18.0	-19.5
4	20	17.2	-18.7
4	50	16.1	-17.6
4	100	15.3	-16.8
4	500	13.4	-14.9

Figure 1: Sample values from ASCE 7-05 minimum design loads for buildings and other structures.

## THE THOUGHT PROCESS

Based on this information, the problem we faced was how to automate these values into our Autodesk® Revit® projects. The manual method was obvious; we could have our engineers figure out the design pressures and manually enter them as text values. Another solution would be to add the values in the door and window families themselves so it can be extracted into a schedule. Once you think about that solution you come to a conclusion rather quickly. All the iterations of wind speed, window sizes, etc. would make this extremely difficult to manage. Finally, we decided the best path was to create a formula that would calculate these pressures for us.

## THE FORMULA

The goal of an engineer or any design professional is to show the client value. Design pressures for windows and doors are values that a manufacturer must meet so it can receive product approvals. These product approvals are required during the permit review process.

With this in mind, the charts provided by ASCE are through a prescriptive method using a formula to generate the design pressures. Figure 1 shows a positive design pressure of 17.2 for an opening size of 20 square feet and a positive design pressure of 16.1 for an opening of 50 square feet. Typically if an engineer is providing design pressures for an opening that falls in between 20



and 50 square feet, he or she will provide the worse case value of 16.1. By doing this, the window or door manufacturer may have to provide a more expensive product to meet that design value. If an engineer wants to have the opportunity to pass value along to the client, he/she needs to be more accurate with the design pressures they provide.

The formula shown in Figure 2 takes the values in the chart and interpolates the design pressures based on the actual size of the opening.

$$\text{if}(\text{Opening} = 10, 18, \text{if}(\text{Opening} = 20, 17.2, \text{if}(\text{Opening} = 50, 16.1, \text{if}(\text{Opening} = 100, 15.3, \text{if}(\text{Opening} = 500, 13.4, \text{if}(\text{and}(\text{Opening} > 10, \text{Opening} < 20), (18 - (\text{Opening} - 10) * 0.08), \text{if}(\text{and}(\text{Opening} > 20, \text{Opening} < 50), (17.2 - (\text{Opening} - 20) * 0.0367), \text{if}(\text{and}(\text{Opening} > 50, \text{Opening} < 100), (16.1 - (\text{Opening} - 50) * 0.016), \text{if}(\text{and}(\text{Opening} > 100, \text{Opening} < 500), (15.3 - (\text{Opening} - 100) * 0.00475), 0))))))))))$$

The Formula

**BREAKING DOWN THE FORMULA**

This is a typical “If, Then” statement. The formula starts with  $\text{If}(\text{Opening}=10,18$ . This just tells Revit that if the opening is exactly 10 square feet then use the value of 18 for the positive pressure. The first five “If” statements in the formula take care of the values that are provided in the chart shown in Figure 1. The next part of the formula becomes a little more complicated, because we now have to interpolate the values between the ones provided in the chart. To do this we first have to isolate the range we are going to calculate.

The portion of the formula shown below in Figure 3 isolates openings that are greater than 10 square feet but less than 20 square feet. If the opening size meets those criteria, the formula passes that opening value through a secondary formula.

Let’s assume the opening is 5 feet by 3 feet, which would result in a 15 square foot value. The secondary Formula would do the following calculation:  $(18-(15-10)*0.08)$  with a result of 17.6 for the positive pressure.

$$\text{if}(\text{and}(\text{Opening} > 10, \text{Opening} < 20), (18 - (\text{Opening} - 10) * 0.08),$$

Partial Formula

From the chart shown in Figure 1 a positive design pressure for a 10 square foot opening is 18.0 and for a 20 square foot opening the value is 17.2. The difference is  $18.0 - 17.2 = 0.8$ . The difference between a 10 square foot opening and a 20 square foot opening is 10 square feet. The 0.08 multiplier in the secondary formula comes from dividing the difference in design pressures by the difference in square footage ( $0.8 / 10$ ). The result is that for every square foot in between 10 and 20 square feet, the design pressure changes by 0.08. The part of the formula that determines the change in square footage is  $(\text{Opening}-10)$ . The number 18 in the formula shown in Figure 3 is the design pressure for a 10 square foot opening.

We just broke down the partial formula shown above. Keep in mind that the formula is only for 100mph wind speed and exposure B. If you have seen a United States wind speed chart, you know there are several wind speeds and exposures that need to be addressed.

**IMPLEMENTING THE FORMULA**

Now that the basic formula has been established we need to implement it into our Revit projects. One thing that is missing from Revit is the ability to pass a project parameter through a formula. In this case it would be great if we could make the wind speed a project parameter that could be plugged into the formula to drive the values. Because this feature is not available, the next best thing is to establish a Key Schedule.

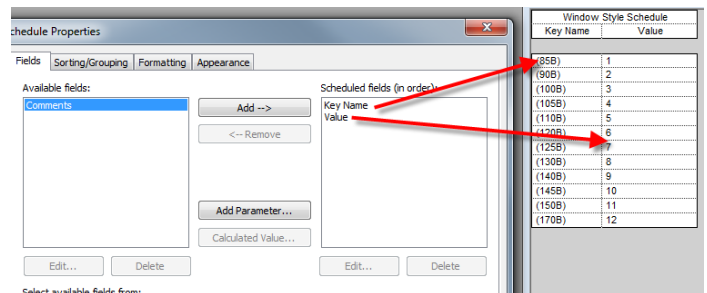


Figure 2: Window Key Schedule.

A Schedule Key by default needs at least a name and a value. In this case, the name is the wind speed and exposure, and the value is numeric. Once the Schedule Keys are established, all the calculated values need to be placed in the window or door schedule.

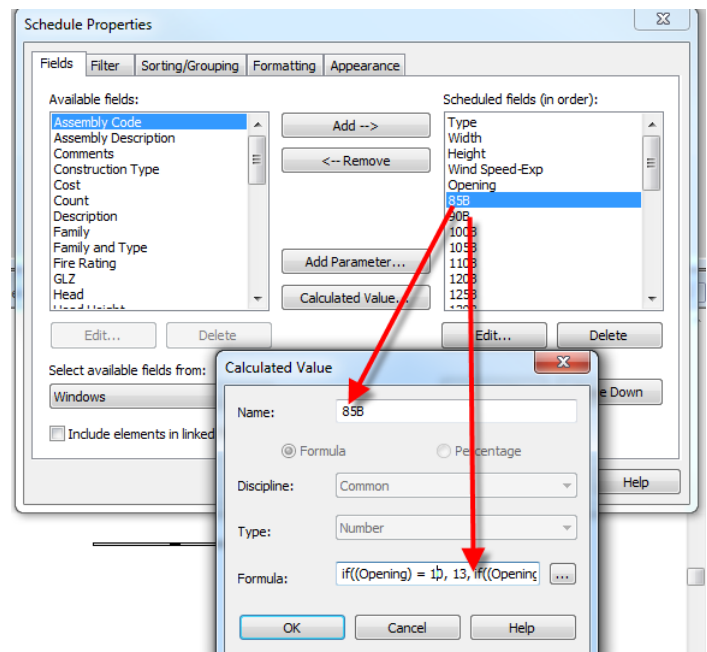


Figure 3: Calculated Values in Window Schedule.

After all the wind conditions are added to your window or door schedule, another formula has to be placed to tell Revit which formula to use.

# Revit Structure

if(Value = 1, 85B, if(Value = 2, 90B, if(Value = 3, 100B, if(Value = 4, 105B, if(Value = 5, 110B, if(Value = 6, 120B, if(Value = 7, 125B, if(Value = 8, 130B, if(Value = 9, 140B, if(Value = 10, 145B, if(Value = 11, 150B, if(Value = 12, 170B, 10)))))))))))))

Schedule Key Formula

This formula is another “If” statement that tells the Schedule in Revit which formula to use.

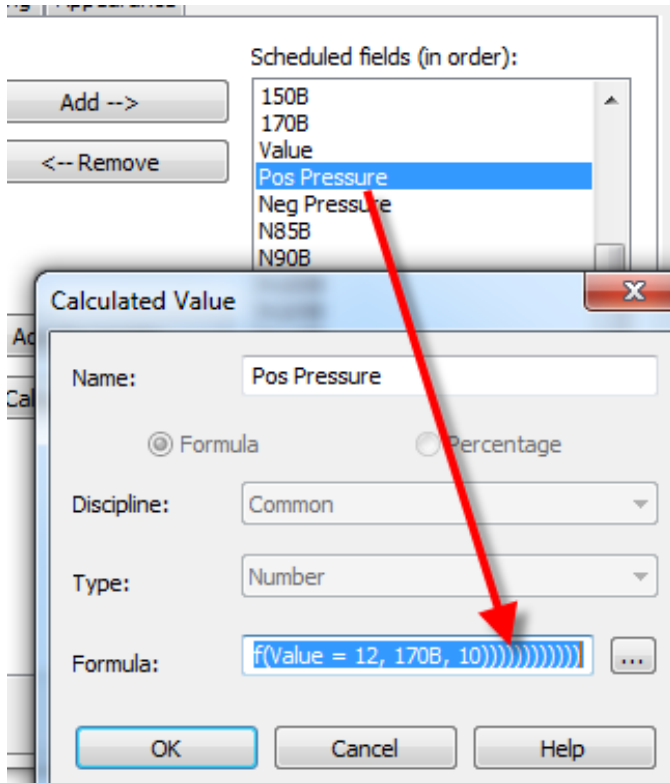


Figure 4: Schedule Key formula placement.

When creating the window or door schedule, a calculated value is added to the schedule in which to place this formula. Figure 4 shows the location of this formula.

The last calculated value that you need in your window or door schedule calculates the square footage of the opening.

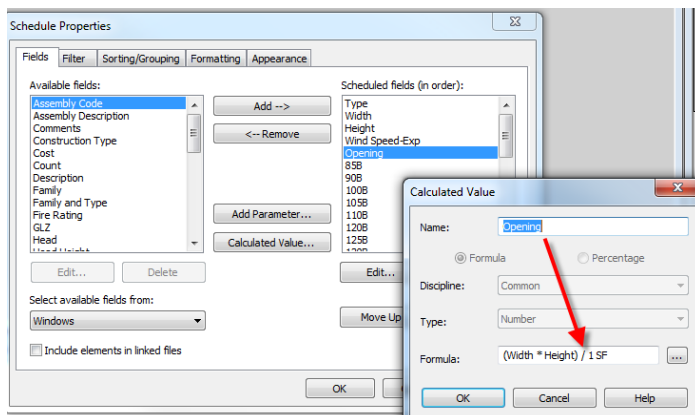


Figure 5: Opening calculated value.

Window Schedule					
Type	Width	Height	Wind Speed-Exp	Pos Pressure	Neg Pressure
SH3050	3' - 0"	5' - 0"	(85B)	12.7	-16.8

Schedule Key      formula Results

Figure 6: The complete window schedule, the location of the Schedule Key, and the resulting formulas producing the positive and negative design pressures.

Window Schedule					
Type	Width	Height	Wind Speed-Exp	Pos Pressure	Neg Pressure
SH3050	3' - 0"	5' - 0"	(85B)	12.7	-16.8

Schedule Keys

Figure 7: Schedule Keys are a drop down used to select the different wind speed conditions.

Window Schedule					
Type	Width	Height	Wind Speed-Exp	Pos Pressure	Neg Pressure
SH3050	3' - 0"	5' - 0"	(85B)	12.7	-16.8

Figure 8: Results shown after switching the Schedule Key to a different wind speed design.

## SUMMARY

When trying to implement formulas to automate engineering calculations make sure you always have your end goal in mind. This example took some time to work out, but the end result passes the value to the client and automates some of our internal engineering processes.

Phil Russo began with AutoCAD version 2.5 in 1986. Through the years, he has held positions in the CAD industry as CAD draftsman, CAD manager, applications engineer, and Autodesk Certified Instructor. Lately Phil's focus has been on the development and implementation of standard practices for the Autodesk Revit product line including Revit Architecture, Revit Structure, and Revit MEP. He currently works at Lindemann Bentzon Bojack, an architectural and engineering firm located in Clermont, Florida. He can be reached at [philr@lbbe.com](mailto:philr@lbbe.com).





# Revit MEP Lighting Fixture Schedule



Autodesk® Revit® MEP offers many advantages over 2D CAD programs. A big advantage is the ability to quantify Revit objects in schedules. Knowing exactly what you have in a model at all times and knowing that number is correct brings a level of confidence

that enhances the design. Out of the box, a user need only understand the scheduling function in Revit to start leveraging the data inherent in the model. As firms get savvy with the software, the out of the box families might not provide all the required information for a complete schedule. This article will demonstrate all the components required to create a functioning lighting fixture schedule with custom data. The instruction shown here can be equally applied to any schedulable family in Revit.

Revit schedules report data that is contained in families. The first step to creating a good schedule is knowing what information is required. In this case lighting fixtures are scheduled and the data required is fixture number, manufacturer, catalog number, lamp quantity, lamp type, volts, mounting, description, and remarks.

Once the required information is quantified, you will have to decide whether to make each parameter a “Type” parameter or an “Instance” parameter. Type parameters will be common to every fixture of that type. Instance parameters can be different for every instance placed in the model. Consider process when making these decisions. It may be common practice to use one

family to represent two similar yet different fixtures. If this is the case, the fixture number must be an instance parameter because it has to represent two different fixtures. What works best for different firms will take careful consideration. For this example, the parameters have been broken down as indicated below.

#### Instance parameters

Fixture Number  
Manufacturer  
Catalog Number  
Lamp Quantity  
Comments

#### Type parameters

Mounting  
Lamp Type  
Volts

If the out-of-the-box family, “Troffer Light – 2x4 Parabolic,” is placed in an empty project without using a template, the only parameters available when creating a new schedule are the manufacturer and lamp type. That leaves quite a few blanks from the list above. This is because Revit schedules are looking for project parameters and shared parameters only.

### SHARED PARAMETERS

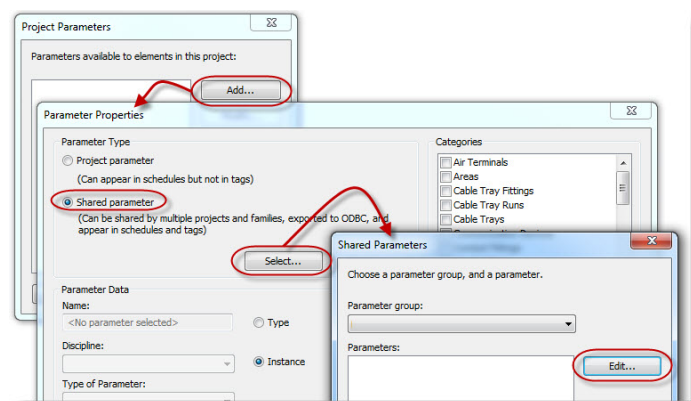
For a shared parameter to function it must first be associated with a shared parameters file associated with the project. It must also be added to each family of the category—Lighting Fixture in this case. Create a new shared parameter by clicking the Shared Parameters tool on the Manage tab of the ribbon and add it to the list.

## PROJECT PARAMETERS

Shared parameters can be made into project parameters by going to the Manage tab of the ribbon and selecting the Project Parameters tool. The advantage of project parameters is that they are automatically attached to categories of Revit families. If a project parameter of mounting is created and assigned to the category of lighting fixtures, every light fixture inserted into the project will contain the parameter of mounting. This is helpful when a combination of company families is being used with out-of-the-box content and families found from other sources. They can all be scheduled the same. If project parameters are placed in the company standard template, the user need only place fixtures to start making the lighting fixture schedule. The downside may be that normal MEP firm may have 100-200 different standard schedules. The parameters required for the schedules may number in the thousands, making the shared parameters file quite large and difficult to navigate. A good naming convention can help alleviate this problem.

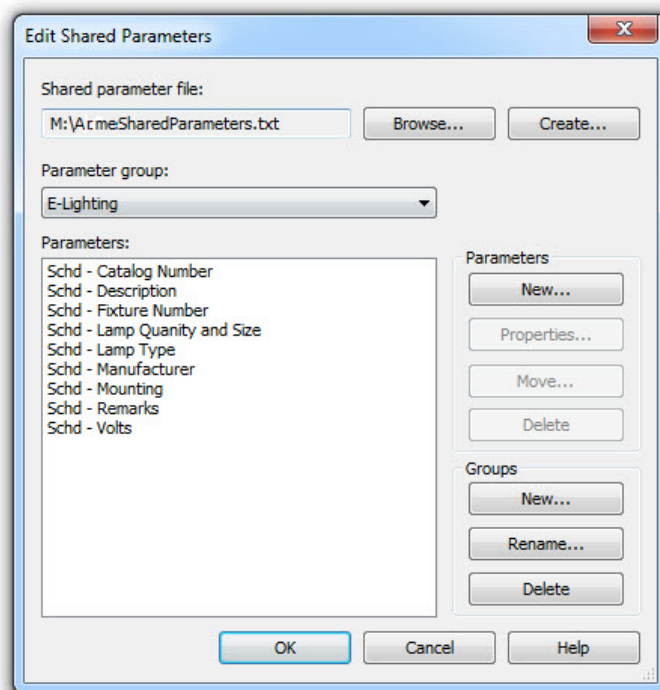
For this example, project parameters will be used. Here comes a long succession of dialogs, but hang in there, it will all work out in the end. Start by selecting Project Parameters from the Manage tab of the ribbon. This will bring up the Project Parameters dialog; click the Add... button to open the Parameter Properties dialog. In this dialog check the Shared parameter radio button and then click the Select... button. This takes us to the Shared Parameters dialog. Click the Edit... button to finally arrive at the Edit Shared Parameters dialog.

To clarify (or further confuse), what just happened here is we started with the Project Parameters dialog and went around the block to add a shared parameter. It may make more sense to simply go to the Manage tab and select the Shared Parameters tool, and add all of the shared parameters first, then simply make them into project parameters. The more experienced user, however, may find that going through these “wormholes” is more direct.

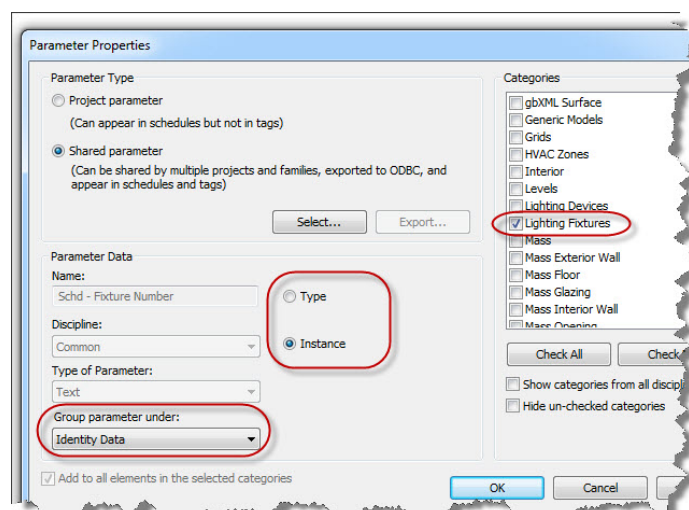


Use the New... button under the Groups heading to create a group for the shared lighting parameters. Grouping the parameter helps users navigate to the required parameter. The example below uses E-Lighting as a group name. Starting each group with a discipline letter such as M for mechanical or G for general also helps speed the search time when looking for parameters.

Use the New... button under the Parameters heading to add a new shared parameter. Naming convention again plays an important role. Prefixing all schedulable parameters with the letters Schd not only makes sense behind the scenes, but also helps users attach data to the correct parameter while within projects. The screen shot below shows a group of created parameters for the Lighting Fixture schedule. In addition to a name, each of these parameters has a discipline and type. The Schd-Remarks parameter, for instance, uses the type Text found under the Common discipline.

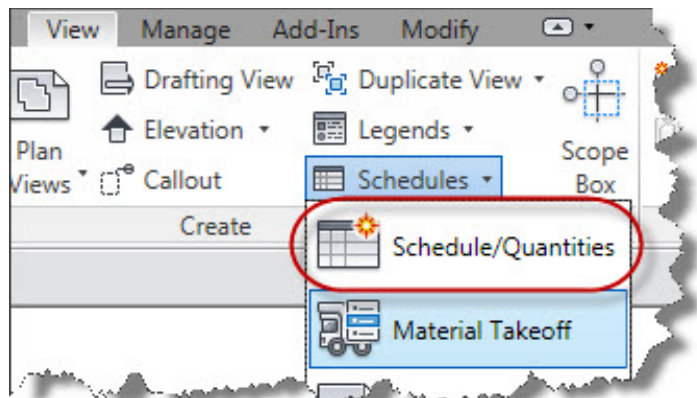


With the shared parameter added, now select it in the Shared Parameters dialog to make it a project parameter and click OK. In the Shared Parameters dialog, check the Lighting Fixtures check box under Categories. Next, pick either Type or Instance, and then group the parameter under the desired group. For scheduled parameters, I prefer grouping under Identity Data.

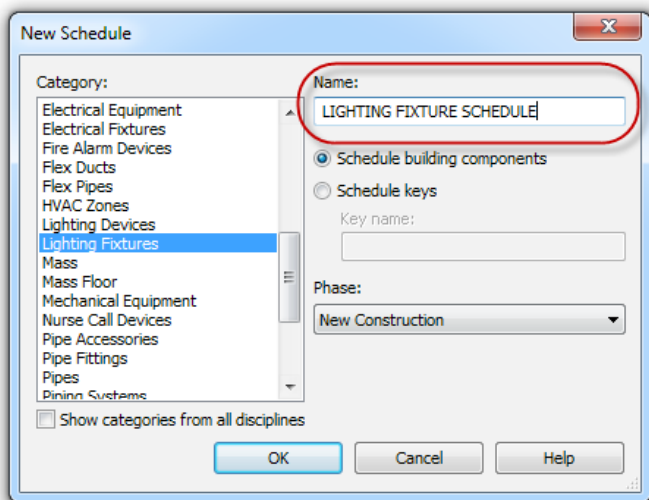




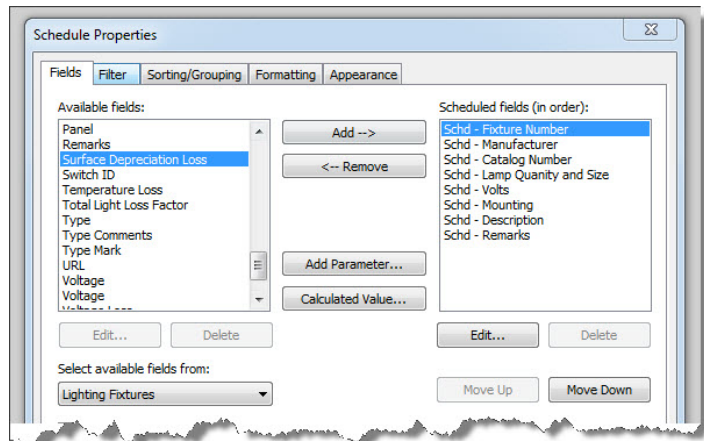
With all of the parameters in place, a schedule can be created. Go to the View tab of the ribbon and select Schedules, then Schedule/Quantities tool.



In the New Schedule dialog, select Lighting Fixtures as the category. It is also a good time to type over the given name with all caps or change the name as needed. Then click OK.

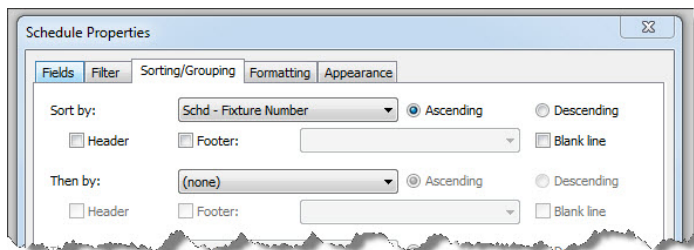


In the fields tab of the Schedule Properties dialog, add all of the required parameters then use the Move Up and Move Down buttons to arrange the fields as required.

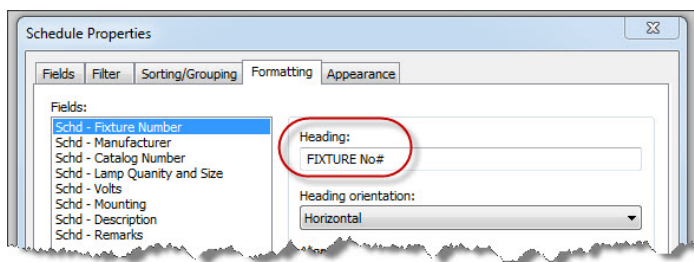


The Filters tab can be used to filter out certain fixtures. For this example, set Filter by: to (none).

The Sorting/Grouping tab is used to sort the data. Since The fixture number is the first column, sort ascending by Fixture Number. Also uncheck the Itemize every instance check box at the bottom of the Sorting/Grouping tab.



The Formatting tab can be used to give the schedule headings different names than the parameters they report. In the example below, the parameters of Schd-Fixture Number will fall under a column named FIXTURE No#.



The Appearance tab controls the fonts and grids of the schedule. Adjust as needed for the best appearance.

Add this schedule to the company template along with the project parameters just created, and the user need only add fixture to start the lighting fixture schedule.

LIGHTING FIXTURE SCHEDULE								
Fixture Number	Manufacturer	Catalog Number	Lamp Quantity and	Lamp Type	Volts	Mounting	Description	Remarks
1	Lightasic	1234ABCD	2 Lamp	T-5	120	PENDA	2x4	SAME
2	Man-O-fac	1234ABCD	2 Lamp	T-5	120	Recess	BALLAS	remar
R	Lightasic	1234ABCD	2 Lamp	T-5	120	PENDA	2x4	SAME
S12	Man-O-fac	1234ABCD				Recess	BALLAS	remar

Todd Shackelford is the BIM Manager for Alvine and Associates, the president of the BIM Board of Omaha, and an instructor for the University of Nebraska. He authors three Blogs; CAD Shack, The Lazy Drafter and Revit Basics. Todd has been a featured speaker at Autodesk University, AUGI CAD Camps, CSI, IEEE and AIA events. Contact Todd at [tshackelford@alvine.com](mailto:tshackelford@alvine.com)



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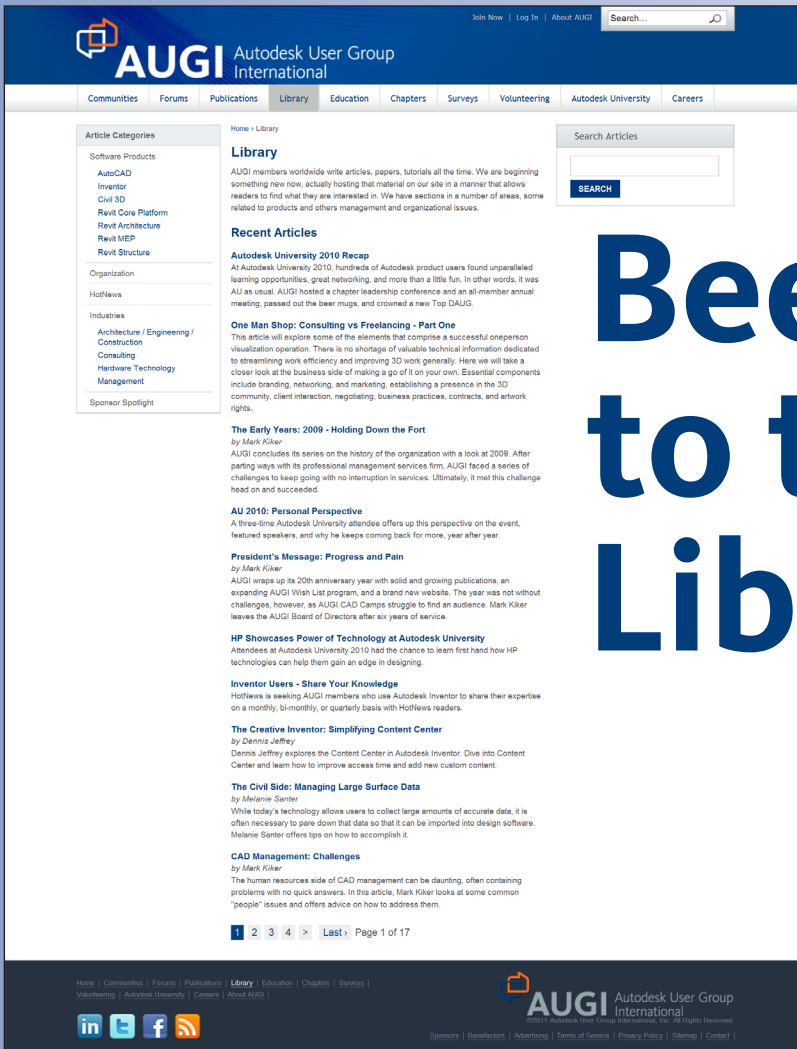
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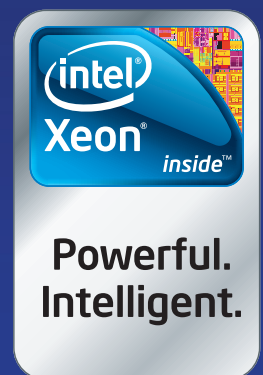


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