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Charging Ahead with Revit 2020 MEP Engineering

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Learning Objectives

- Gain an overview of key electrical features that improve the design process
- Examine new elevation and control features for scheduling and tags
- Learn how to improve engineering analysis tool results with key settings and tips
- Learn how to push more design into your model by incorporating HVAC and electrical schematics

Description

The evolution of Revit software for engineering, modeling, and design is having a major impact on the MEP design process. Autodesk continues to add new features, but bells and whistles are not the only things a user needs to understand. Taking advantage of key workflows can help you get more from your Revit tools than ever before. This hands-on lab will begin with an overview of the electrical improvements to help represent a more accurate design, and then we'll move into new elevation features that affect all disciplines. Next, we'll take a look at ways to improve your engineering analysis results, and we'll close with new ways to move your schematic designs from AutoCAD software to Revit. Shore up some weak areas in your everyday work by learning how to use these tools and get more from BIM!

Speaker(s)

David Butts is an Autodesk Expert Elite Team member and Engineering Technology Manager for Gannett Fleming with over 34 years of experience in the architecture, engineering, and construction field. He is responsible for implementation, training, BIM project support, and management for engineering design applications, including Revit, AutoCAD P&ID/Plant 3D, AutoCAD MEP, Navisworks software, and more. He was an Autodesk Authorized Training Center (ATC) training manager and application engineer for an Autodesk Reseller for 13 years, providing implementation and training services across the United States, and serving as a Subject Matter Expert for Autodesk, engineering software, training and certification programs. He has design experience for a variety of project types, and he was an Autodesk University top-rated speaker for labs and lectures in 2011 and 2016.

Introduction

The evolution of Revit software for engineering, modeling, and design is having a major impact on the MEP design process. Autodesk continues to add new features, but bells and whistles are not the only things a user needs to understand. Taking advantage of key workflows can help you get more from your Revit tools than ever before. This hands-on lab will begin with an overview of the electrical improvements to help represent a more accurate design, and then we'll move into new elevation features that affect all disciplines. Next, we'll take a look at ways to improve your engineering analysis results, and we'll close with new ways to move your schematic designs from AutoCAD software to Revit. Shore up some weak areas in your everyday work by learning how to use these tools and get more from BIM!

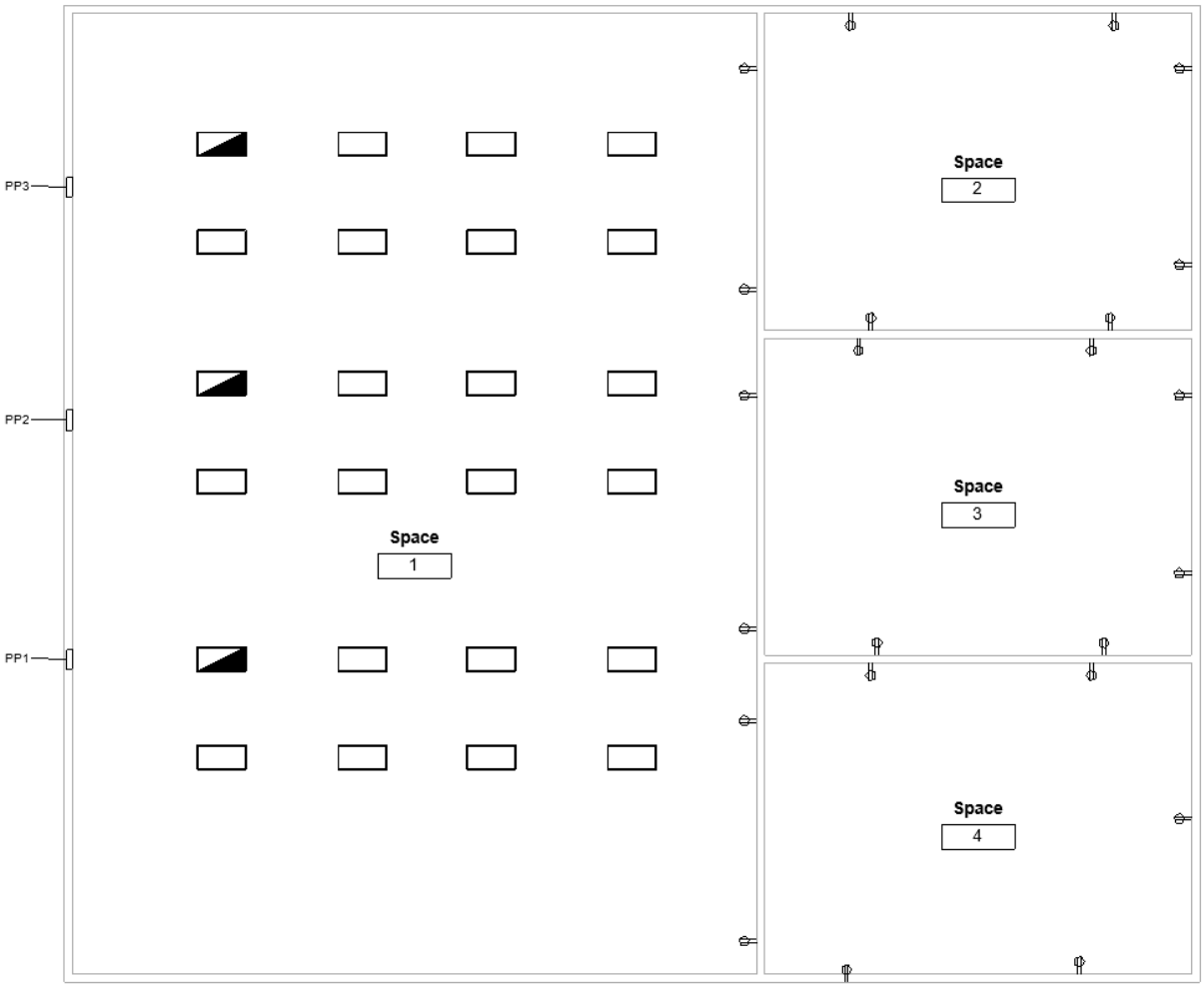
Key Revit Electrical Features and Improvements for 2020

We've been training our users for years about how systems and circuits are defined, but the key is to understand the relationship between target and source devices. A **target** is any item that receives *air, fluid or power*, while a **source** controls the flow of *air, fluid or power*. Systems and circuits are always defined by targets and can have as many devices as needed within the system or circuit. But the system *can only have one source* – so from an electrical standpoint, the panel (and the relative breaker) are the source, while lights, disconnects, and other powered devices are the targets. In Revit, you're always building your systems and circuits from the bottom – the targets – up to the ultimate source (power connection, water connection, air handling unit, etc.).

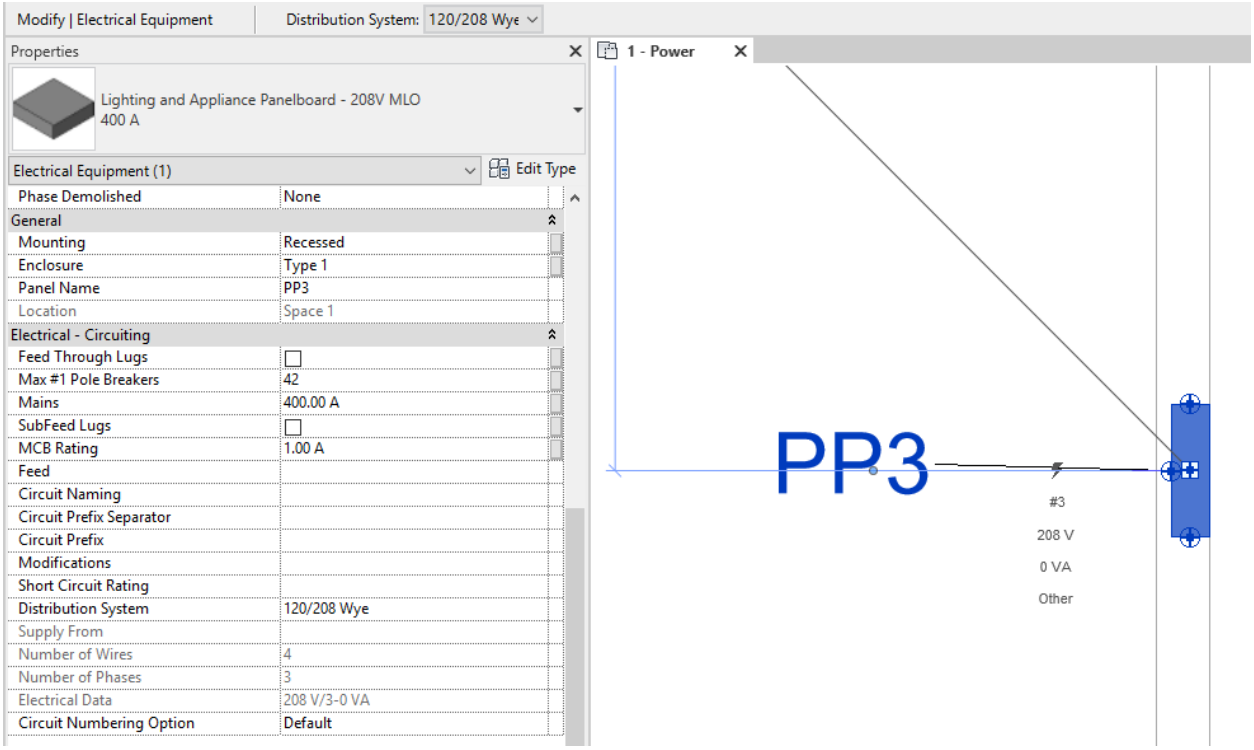
Feeding the Lug

The first key new feature to review is the ability to define feed-thru lug (that's FTL) power connections between panels. Prior to adding this feature, the user had to "fake" connections between FTL panels. Circuit numbering was also an issue, so let's begin by setting up an FTL connection.

1. From the Revit model, ***FTL Panels – 2020.rvt***, make sure you have the ***1-Power*** view open.
2. The plan contains lighting and receptacles, along with three panels:

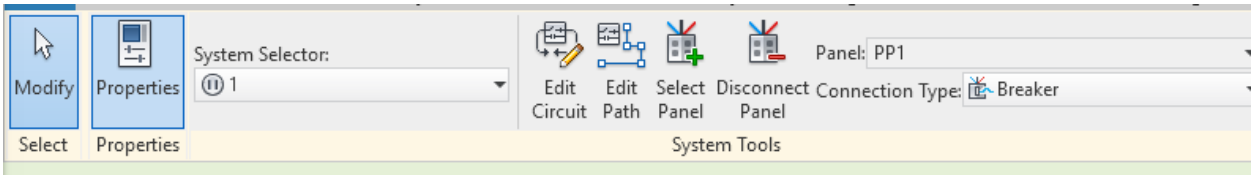


3. Start by selecting panel **PP3** in the upper left corner of *Space 1*. Review the properties palette, **Electrical – Circuiting** section:



The new features for the panel are the **Feed Through Lugs, SubFeed Lugs** and **Circuit Numbering Option**. For this exercise, start by making sure the **Feed Through Lug**s option is *deselected*, and **Subfeed Lugs** is also *deselected.* Click **Modify** on the ribbon or press **ESC** twice to clear the selection after you've applied the changes.

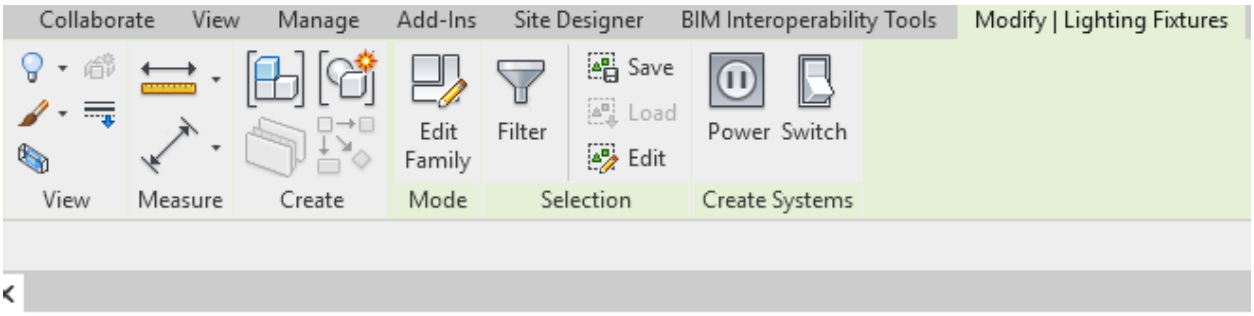
4. Select one of the **receptacles** in *Space 2* and then select the **Electrical Circuits** tab from the ribbon to show the circuit information:

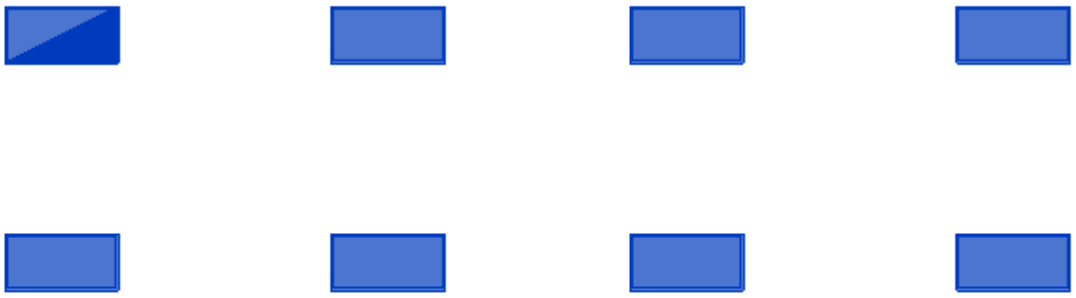


5. There have been several improvements over the past year, including the newer **Edit Path** tool that allows you to physically create the path for the circuit and create a more accurate voltage drop.

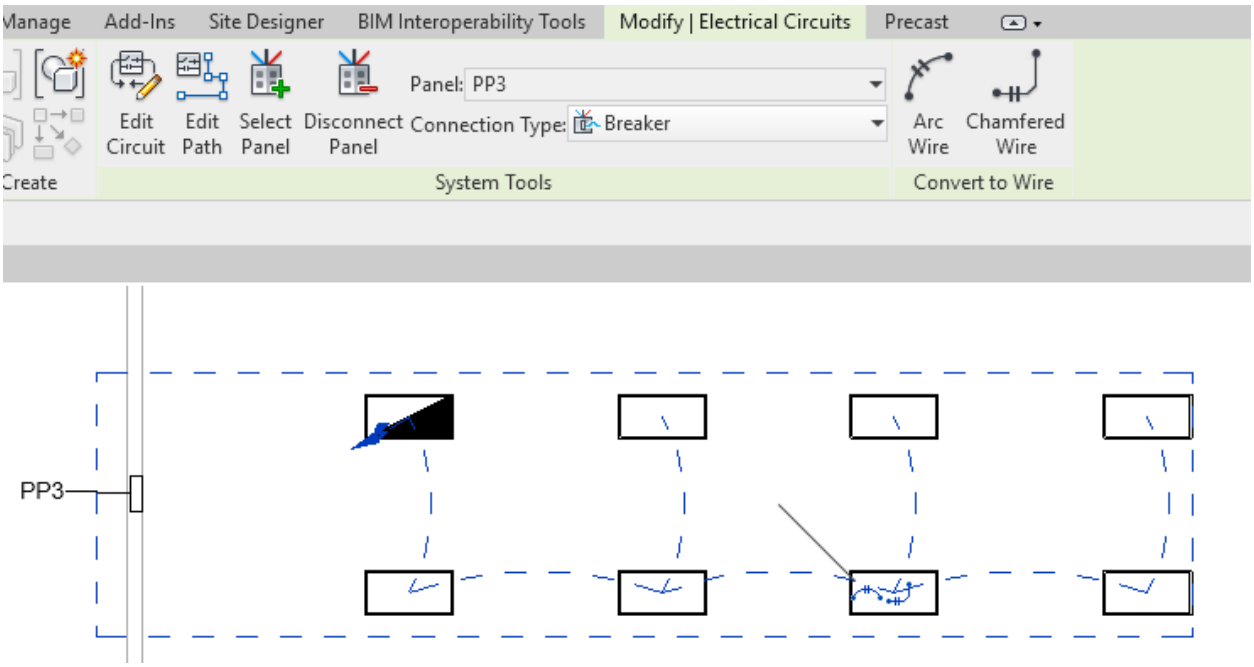
Underneath the **selected panel (PP1)** note the new **Connection Type** which is set to **Breaker**. This is the traditional method that Revit has used to create the circuit – it's been a simple breaker connection that is based on the *voltage* and *number of poles* defined by the targets, and totals the load based on the *apparent load, load classification, demand factor* and *power factor*.

6. Select the **breaker drop down** to see the new **Feed Through Lugs** option. This option is used when creating an FTL connection between panels – so don't use it when creating typical circuits! Press **ESC** twice to clear the selection.
7. To create a new circuit, select the group of lights to the left of **Space 2**:

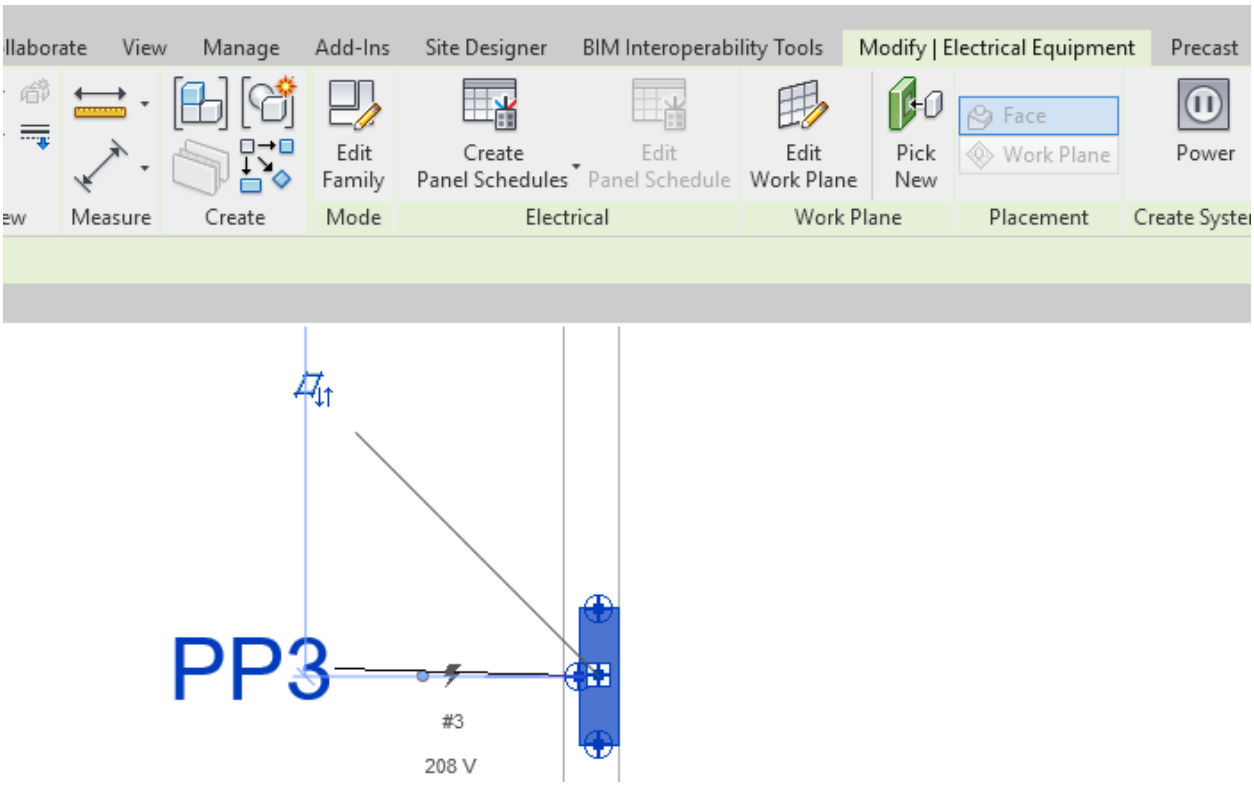




8. Note the **Modify Light Fixtures** tab – to create a circuit for all of these devices, select **Power** on the *Create Systems* tab:



9. By default, if any panel has had items added to it, Revit will automatically place the **next group of circuited devices** to the **last panel used**. If no panel was used, you can **select** the panel. For this circuit, make sure the panel **PP3** is selected. Note that the **breaker** option below, which was also the last option used, appears by default. This is the correctly defined circuit that is associated with the breaker.
10. Next, let's review the loads on **Panel PP3**. Select the panel, and then select the **Create Panel Schedule** tool from the *Electrical* tab on the ribbon:



11. For this exercise, use the **Default** template. Once the schedule appears, note the loads on the panel:

Branch Panel: PP3

Location: Space 1
Supply From:
Mounting: Recessed
Enclosure: Type 1

Volts: 120/208 Wye
Phases: 3
Wires: 4

A.I.C. Rating:
Mains Type:
Mains Rating: 400 A
MCB Rating: 1 A

Notes:

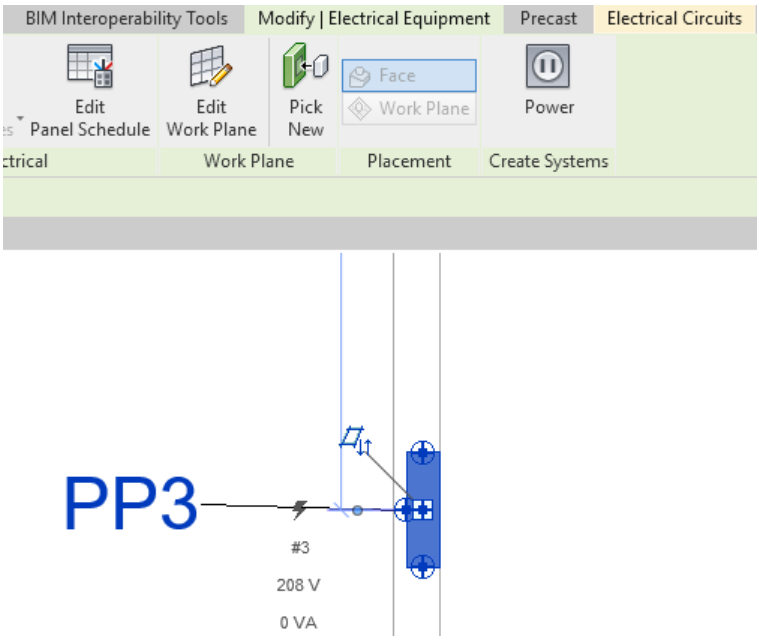
CKT	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	CKT
1	Power	20 A	1	1260 VA	512 VA					1	20 A	Lighting Space 1	2
3													4
5													6
7													8
9													10
11													12
13													14
15													16
17													18
19													20
21													22
23													24
25													26
27													28
29													30
31													32
33													34
35													36
37													38
39													40
41													42
			Total Load:	1772 VA		0 VA		0 VA					
			Total Amps:	15 A		0 A		0 A					

Legend:

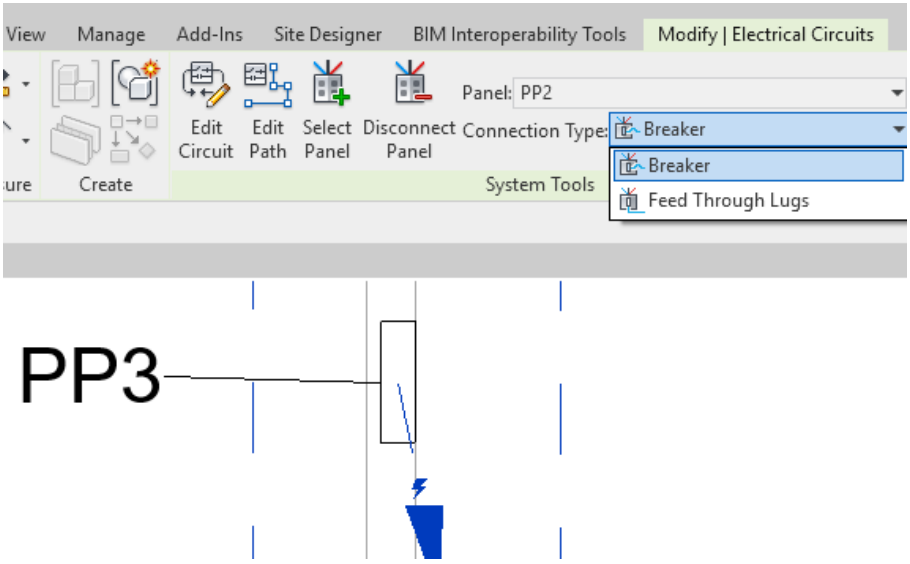
Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Power	1260 VA	100.00%	1260 VA		
Lighting	512 VA	100.00%	512 VA	Total Conn. Load:	1772 VA
				Total Est. Demand:	1772 VA
				Total Conn.:	5 A
				Total Est. Demand:	5 A

Notes:

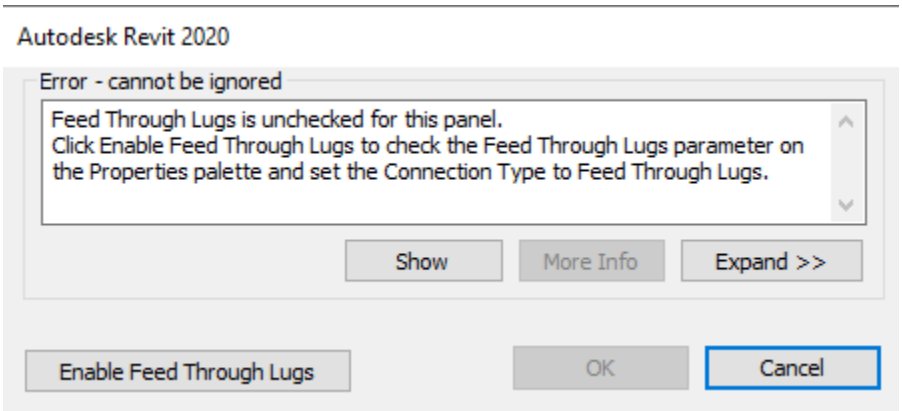
12. The panel is carrying **1772 VA** total load. In a feed through lug situation, this load needs to carry forward to the top panel.
13. Next, let's create the **feed through lug** relationship – the process is the same as when you're defining circuits. In this case panel **PP3** is the target, which defines the circuit, and panel **PP2** is the source. From the **1 – Power view**, select panel **PP3** and then select the Power tool on the Modify tab, Create Systems panel:



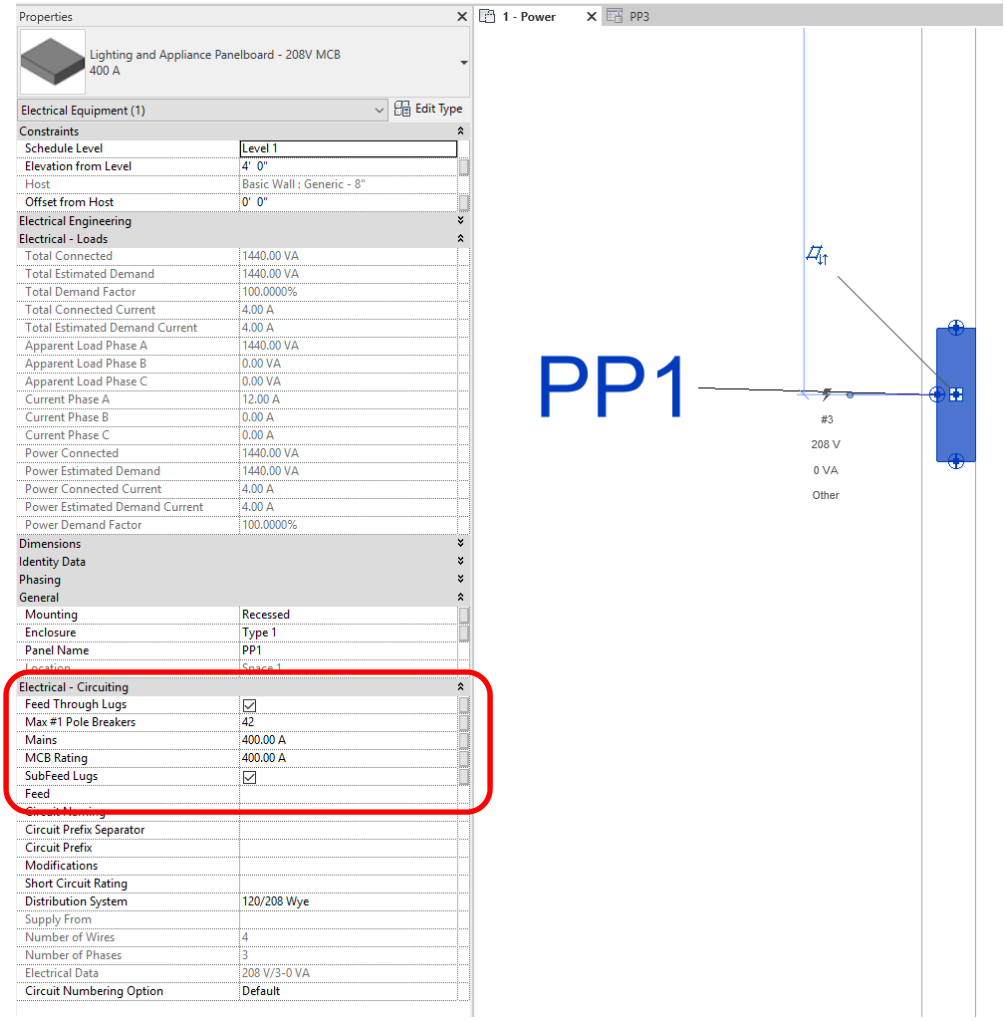
14. By default, the circuit will default to *breaker* – but let's switch this to **Feed Through Lug** by selecting this option under the **Connection Type**:



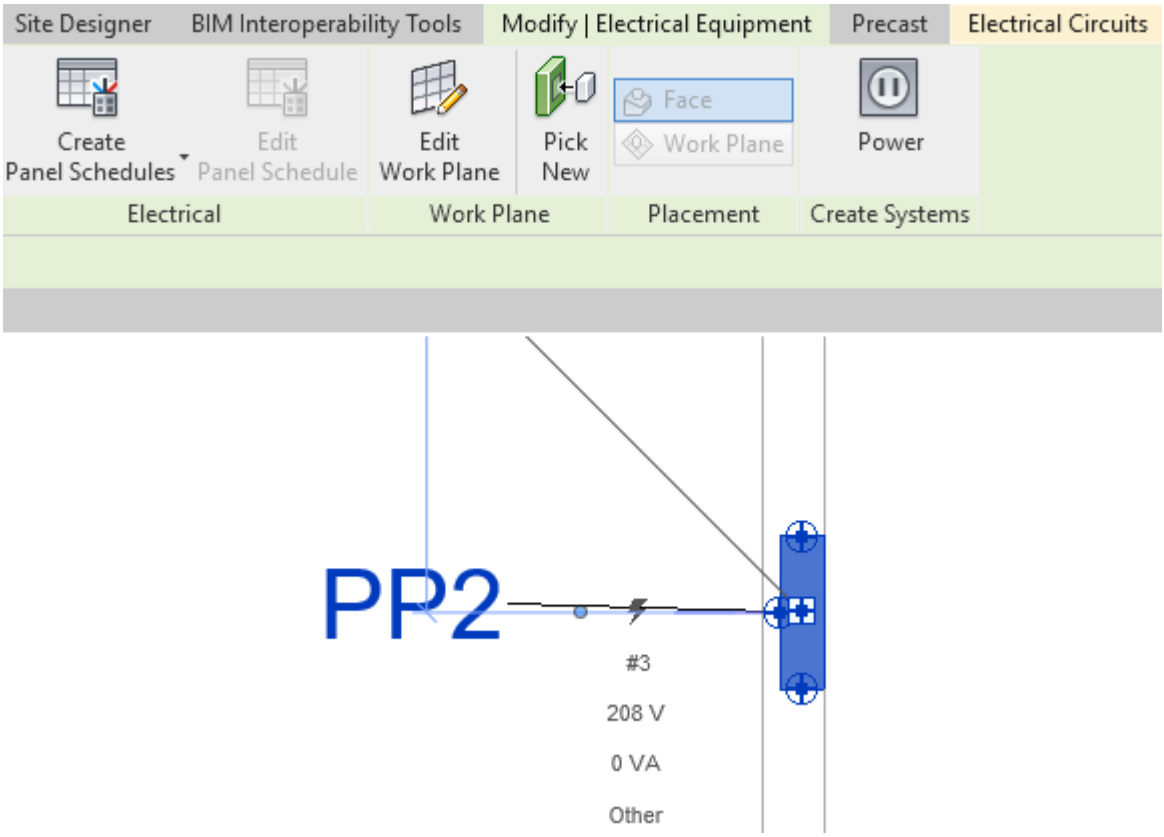
15. If you have not set the **PP2** panel up to support **Feed Through Lugs** prior to making the connection, you'll get a *warning* about it. But now – get this – the tool actually helps you *fix* the solution by including the option to **Enable Feed Through Lugs**:



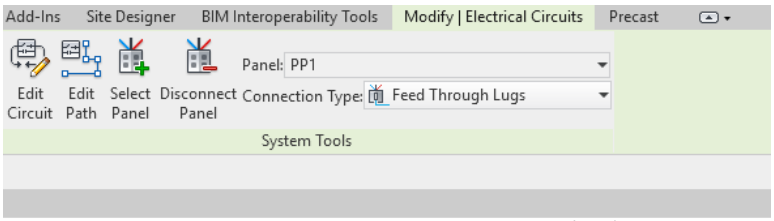
16. To set up a panel to use FTL connections as a default, select Panel **PP1** and review the **Properties** palette:

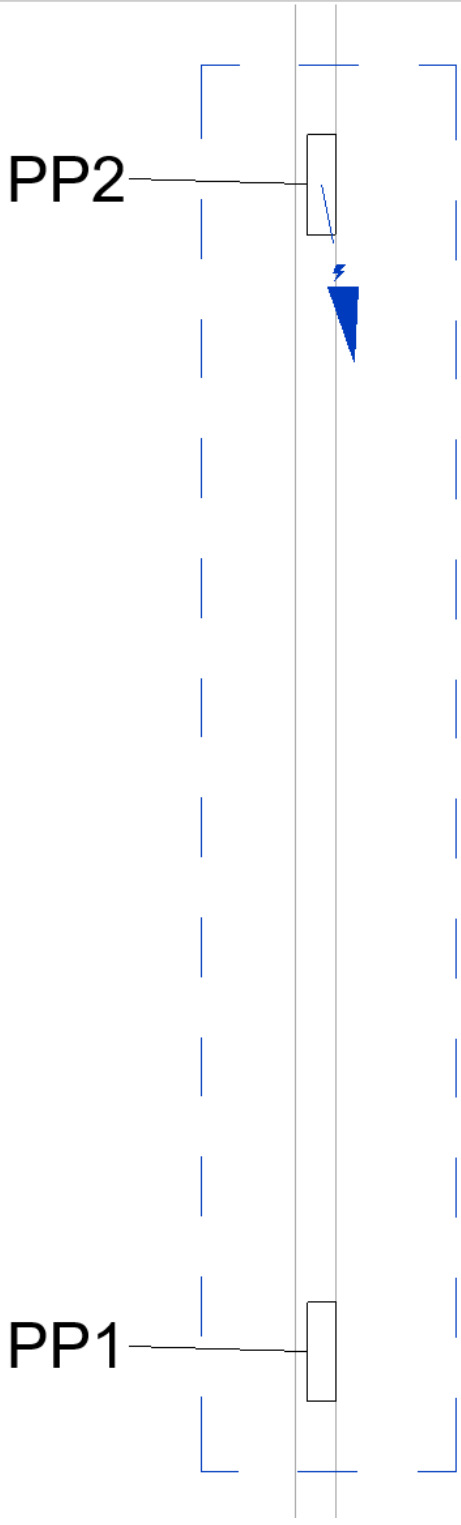


17. At the bottom of the **Properties** palette for electrical equipment, review the **Electrical – Circuiting** section. The first option, **Feed Through Lugs**, is the check box than enables the panel to accept FTL connections. If you want to connect Panel **PP2** to **PP1** as a feed through lug connection, you won't be prompted with the error message – Revit will simply create the connection. Select Panel **PP2** and then select the **Power** tool from the **Create systems** tab:

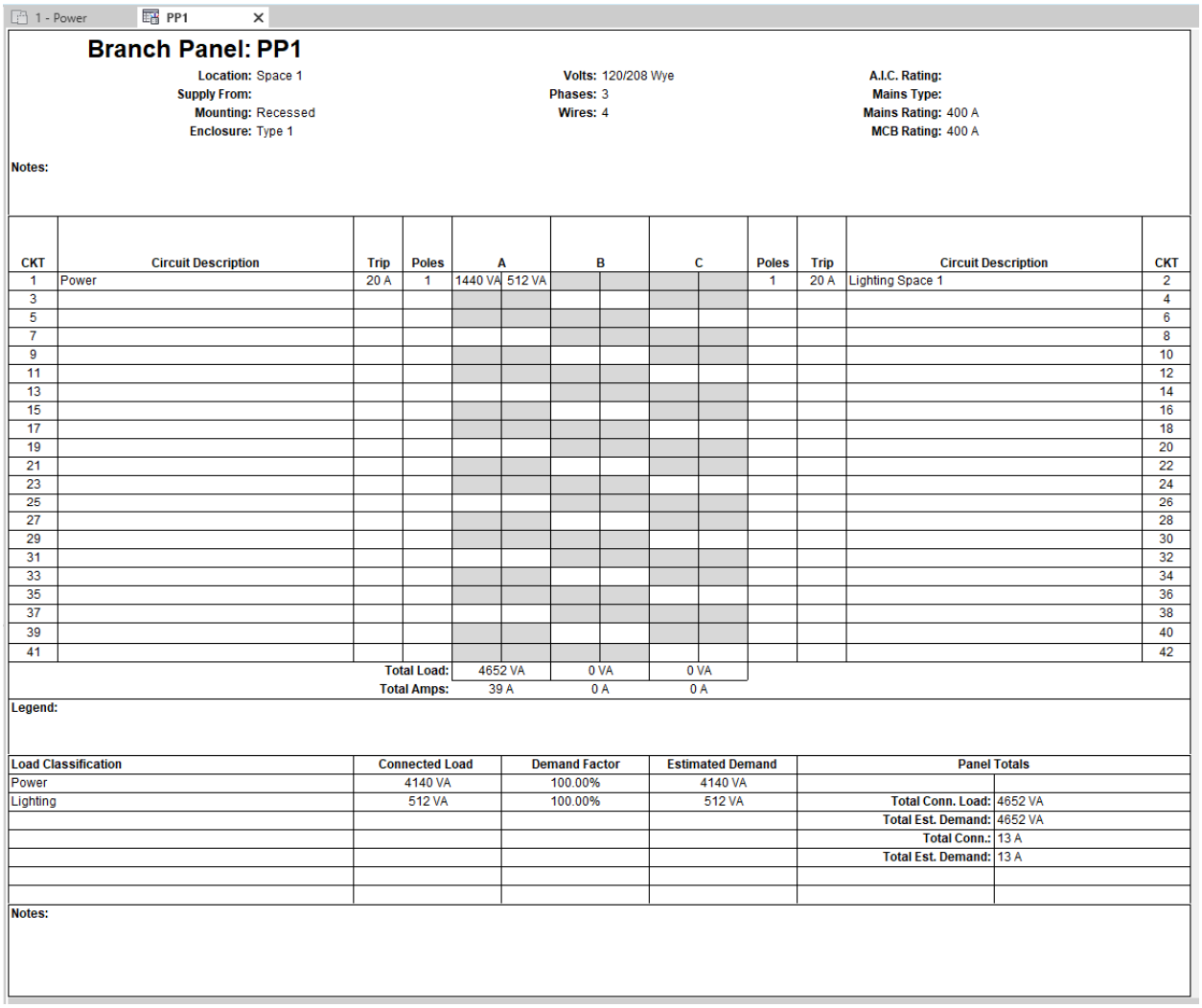


18. Next, from the **System Tools** tab, select the Panel **PP1** from the **Panel** drop down, and **Feed Through Lugs** for the **Connection** type:


Add-Ins
Site Designer
BIM Interoperability Tools
Modify | Electrical Circuits
Precast
Edit Circuit
Edit Path
Select Panel
Disconnect Panel
Panel: PP1
Connection Type: Feed Through Lugs
System Tools


PP2
PP1

19. The circuit is now attached as a feed through lug connection. To see this, select panel **PP1** and then create a panel schedule using the default template.



1 - Power | PP1

Branch Panel: PP1

Location: Space 1
Supply From:
Mounting: Recessed
Enclosure: Type 1
Volts: 120/208 Wye
Phases: 3
Wires: 4
A.I.C. Rating:
Mains Type:
Mains Rating: 400 A
MCB Rating: 400 A

Notes:

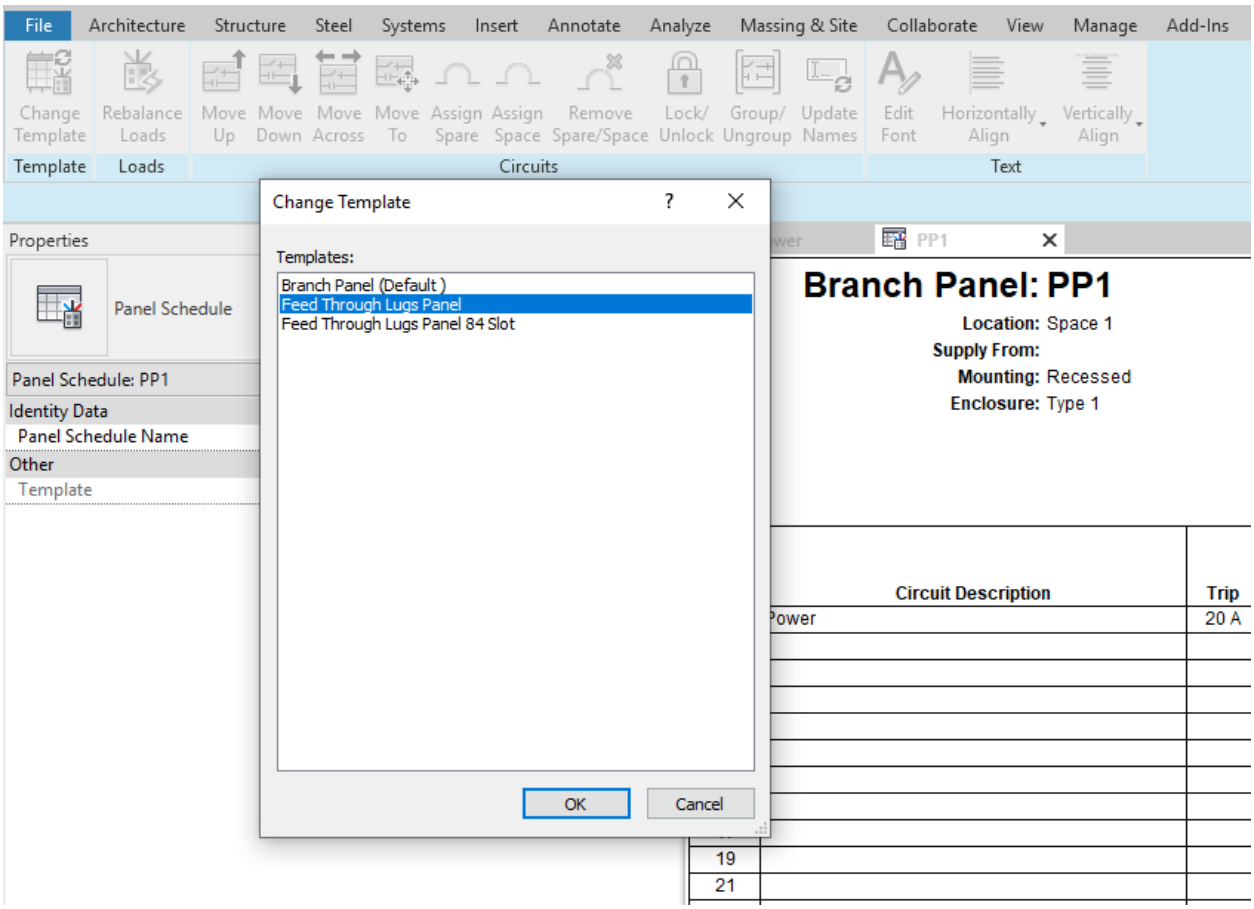
CKT	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	CKT
1	Power	20 A	1	1440 VA	512 VA					1	20 A	Lighting Space 1	2
3													4
5													6
7													8
9													10
11													12
13													14
15													16
17													18
19													20
21													22
23													24
25													26
27													28
29													30
31													32
33													34
35													36
37													38
39													40
41													42
		Total Load:		4652 VA		0 VA		0 VA					
		Total Amps:		39 A		0 A		0 A					

Legend:

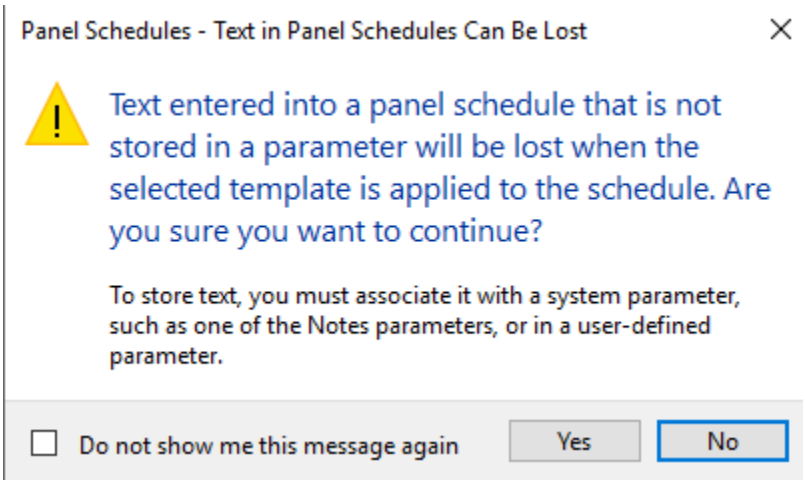
Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Power	4140 VA	100.00%	4140 VA		
Lighting	512 VA	100.00%	512 VA	**Total Conn. Load:**	4652 VA
				Total Est. Demand:	4652 VA
				Total Conn.:	13 A
				Total Est. Demand:	13 A

Notes:

20. But wait – something is missing…the load at the bottom of **phase A** doesn't match the total of the panel PP1. It's actually a lot more…*4652 VA* is the total of *ALL* of the connected panels. PP3, PP2 and their loads are included in the total, but this schedule template isn't formatted to show the separate loads. So how do you fix this? While you're in the panel schedule, select **Change Template**. Select the **Feed Through Lugs Panel** template:



21. If you get the **warning** about changes to the panel template may be lost for the current template, you can ignore this if you didn't change the title area of the panel schedule by adding text. Be aware that anytime you **manually** add text to a panel schedule instead of using a shared parameter in a field area, you could lose that text since it's not associated with the panel.



22. Click **Yes**, and now you using the template showing the FTL connected loads at the bottom of the panel schedule:

1 - Power | PP1

Branch Panel: PP1

Location: Space 1
Supply From:
Mounting: Recessed
Enclosure: Type 1

Volts: 120/208 Wye
Phases: 3
Wires: 4

A.I.C. Rating:
Mains Type:
Mains Rating: 400 A
MCB Rating: 400 A

Notes:

CKT	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	CKT
1	Power	20 A	1	1440 VA	512 VA					1	20 A	Lighting Space 1	2
3													4
5													6
7													8
9													10
11													12
13													14
15													16
17													18
19													20
21													22
23													24
25													26
27													28
29													30
31													32
33													34
35													36
37													38
39													40
41													42

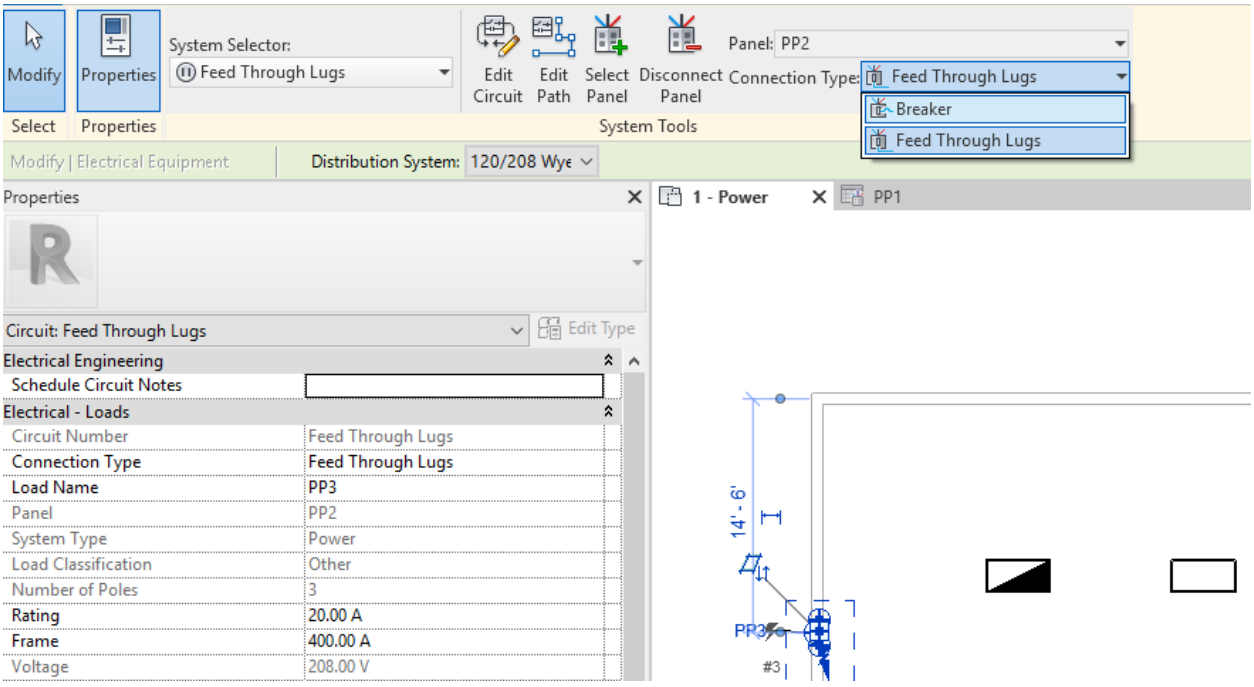
THIS SECTION TOTAL:	Total Load:	1952 VA	0 VA	0 VA
	Total Amps:	16 A	0 A	0 A
TOTAL LOAD CONNECTED TO FEED THROUGH LUGS:	Total Load:	2700 VA	0 VA	0 VA
	Total Amps:	23 A	0 A	0 A
PANEL GRAND TOTALS:	Total Load:	4652 VA	0 VA	0 VA
	Total Amps:	39 A	0 A	0 A

Legend:

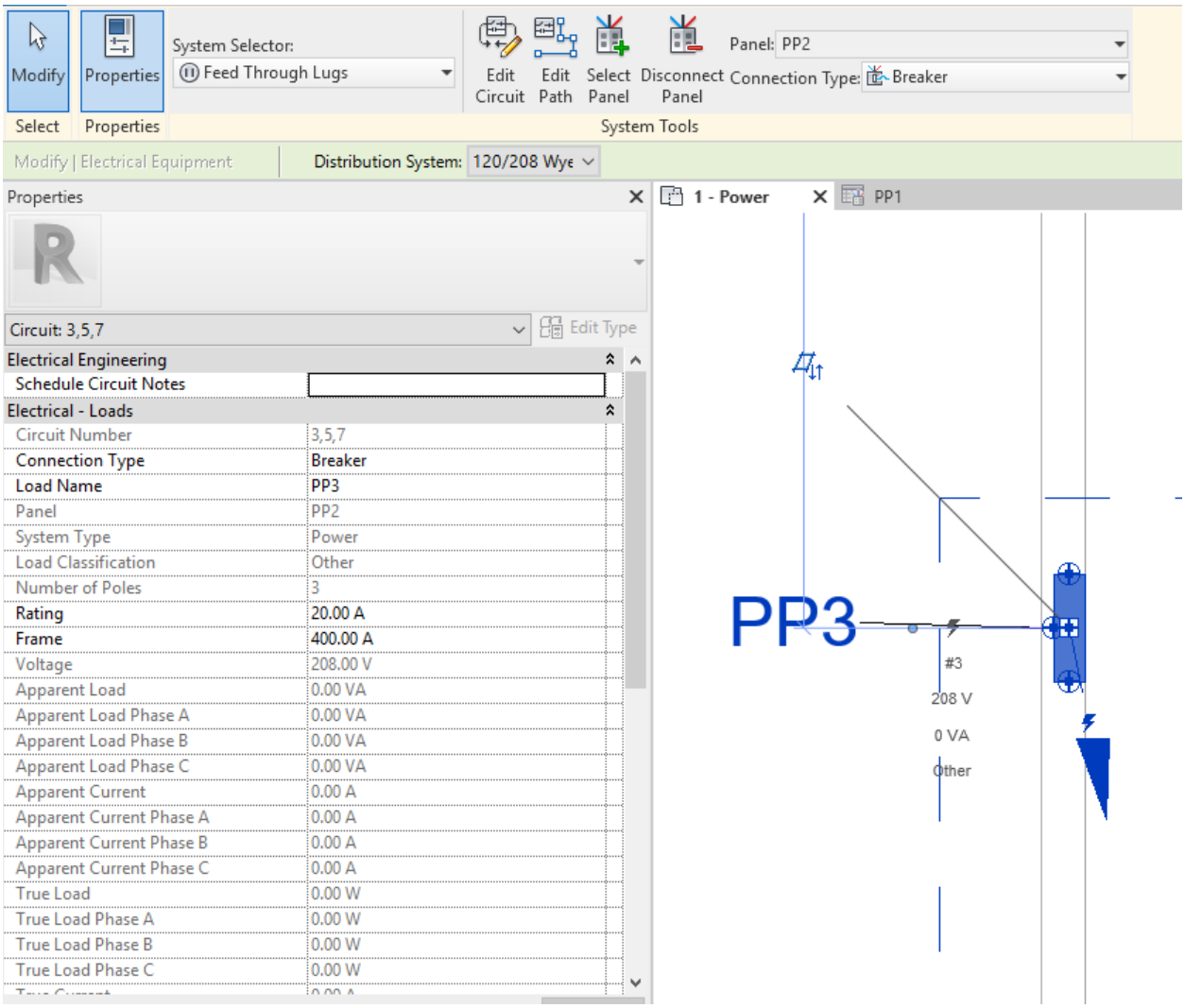
Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Power	4140 VA	100.00%	4140 VA		
Lighting	512 VA	100.00%	512 VA	Total Conn. Load:	4652 VA
				Total Est. Demand:	4652 VA
				Total Conn.:	13 A
				Total Est. Demand:	13 A

Notes:

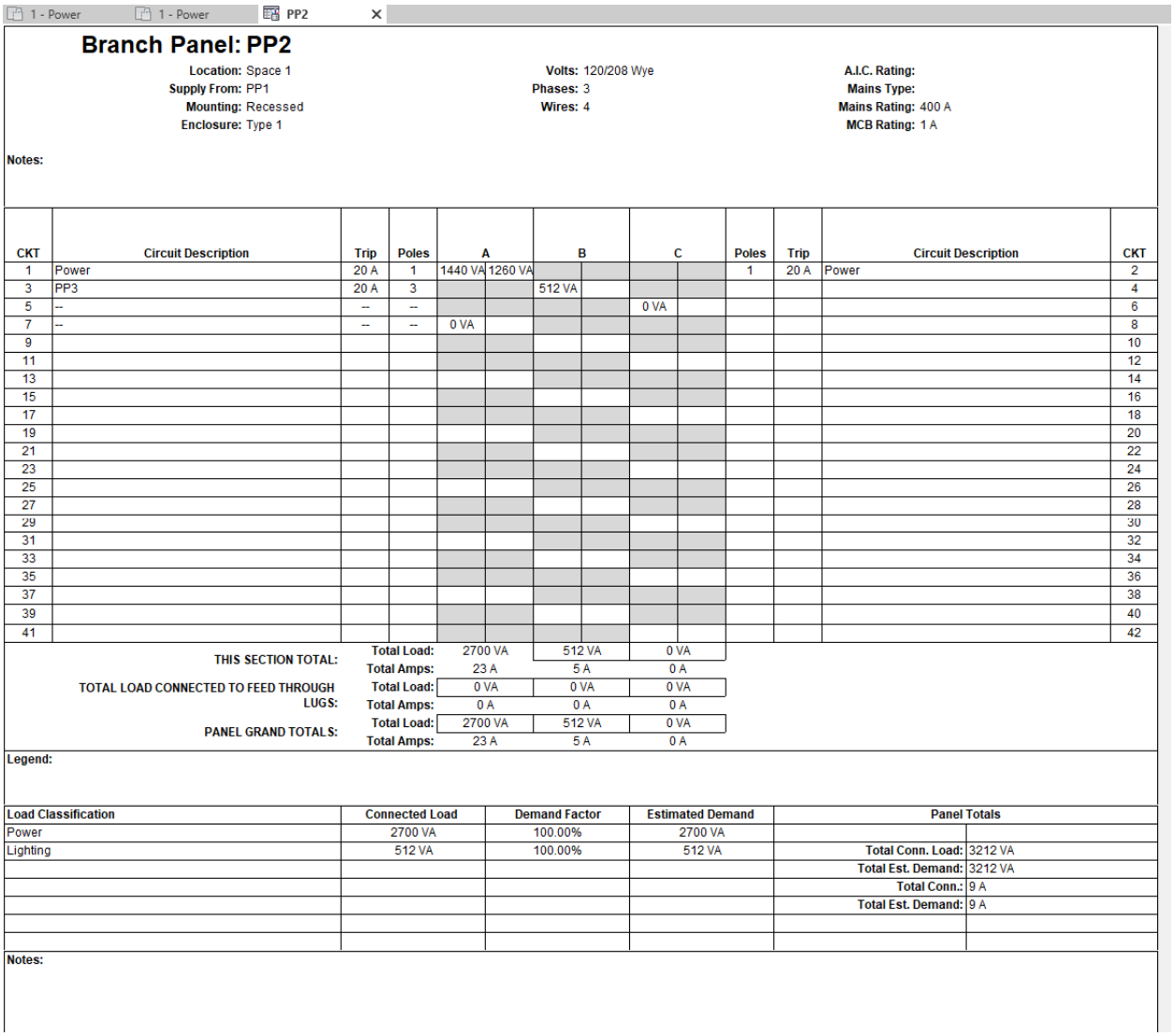
23. The next issue that you could come across would be the panel itself – what if you only want the **PP2** panel to be a **feed through lug**, and have **PP3** set to a specific **breaker**? You can change the **connection type** properties at any time, by selecting the **panel** whose behavior you want to change.
24. From the **1 – Power** view, select **PP3**, and then select the **Electrical Circuits** tab. The system Tools tab will appear. From the **Connection** type drop-down, select it and choose the **Breaker** option:



25. Once this is selected, note that the properties palette changes from **Feed Through Lugs** to **Breaker**, and the **circuit number** is assigned to the next three pole breaker that is available on **PP2:**



26. The **Panel Schedule** you created earlier for panel **PP2** will now show the connection of **PP3** to the schedule.



1 - Power | 1 - Power | PP2

Branch Panel: PP2

Location: Space 1
Supply From: PP1
Mounting: Recessed
Enclosure: Type 1

Volts: 120/208 Wye
Phases: 3
Wires: 4

A.I.C. Rating:
Mains Type:
Mains Rating: 400 A
MCB Rating: 1 A

Notes:

CKT	Circuit Description	Trip	Poles	A	B	C	Poles	Trip	Circuit Description	CKT
1	Power	20 A	1	1440 VA	1260 VA		1	20 A	Power	2
3	PP3	20 A	3		512 VA					4
5	--	--	--			0 VA				6
7	--	--	--	0 VA						8
9										10
11										12
13										14
15										16
17										18
19										20
21										22
23										24
25										26
27										28
29										30
31										32
33										34
35										36
37										38
39										40
41										42

		A	B	C
THIS SECTION TOTAL:	Total Load:	2700 VA	512 VA	0 VA
	Total Amps:	23 A	5 A	0 A
TOTAL LOAD CONNECTED TO FEED THROUGH LUGS:	Total Load:	0 VA	0 VA	0 VA
	Total Amps:	0 A	0 A	0 A
PANEL GRAND TOTALS:	Total Load:	2700 VA	512 VA	0 VA
	Total Amps:	23 A	5 A	0 A

Legend:

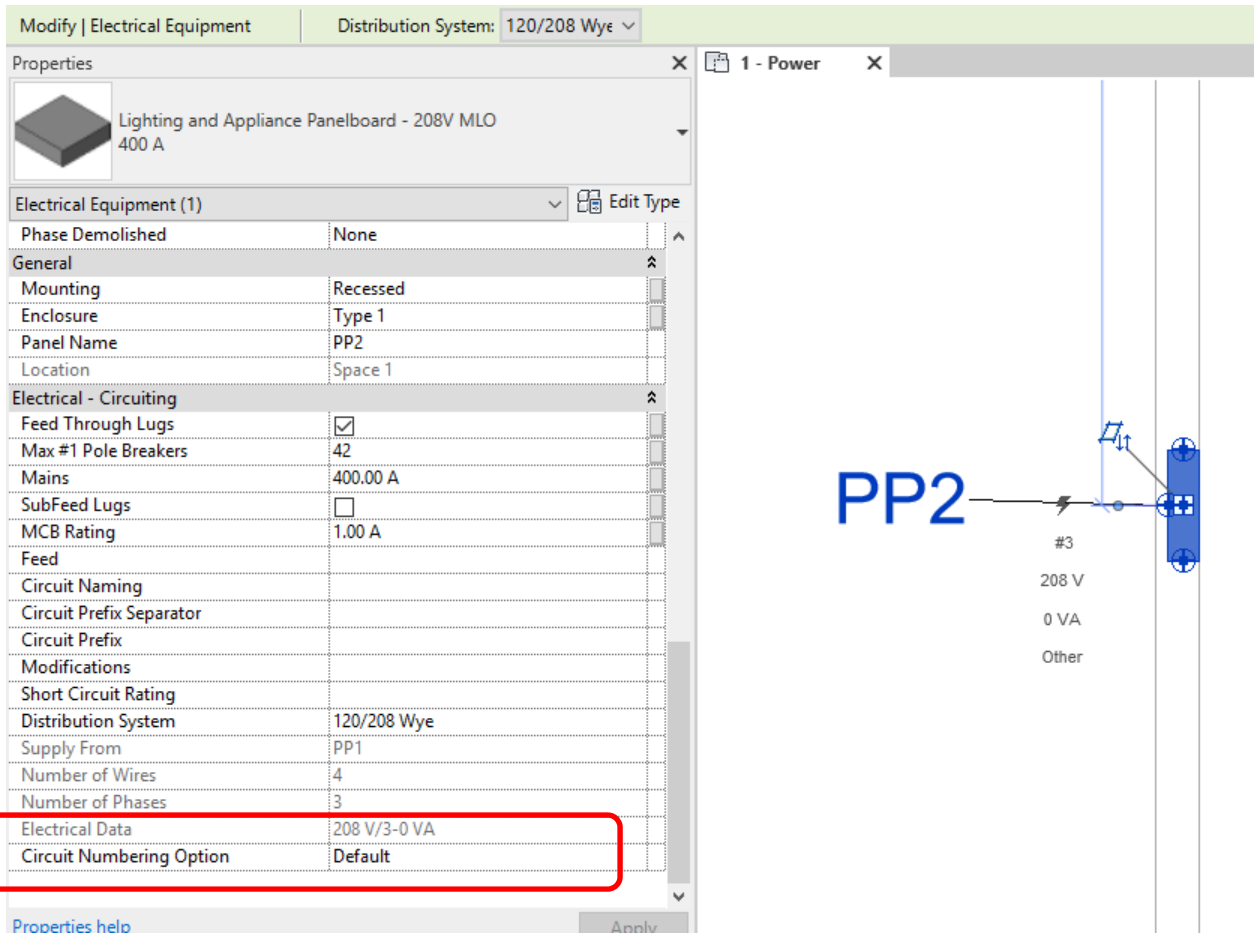
Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Power	2700 VA	100.00%	2700 VA		
Lighting	512 VA	100.00%	512 VA	Total Conn. Load:	3212 VA
				Total Est. Demand:	3212 VA
				Total Conn.:	9 A
				Total Est. Demand:	9 A

Notes:

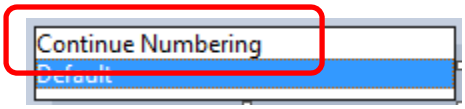
Setting the Numbering Options

Now that we've covered how to create the connection, let's review how we can set the panel circuits to be correctly numbered.

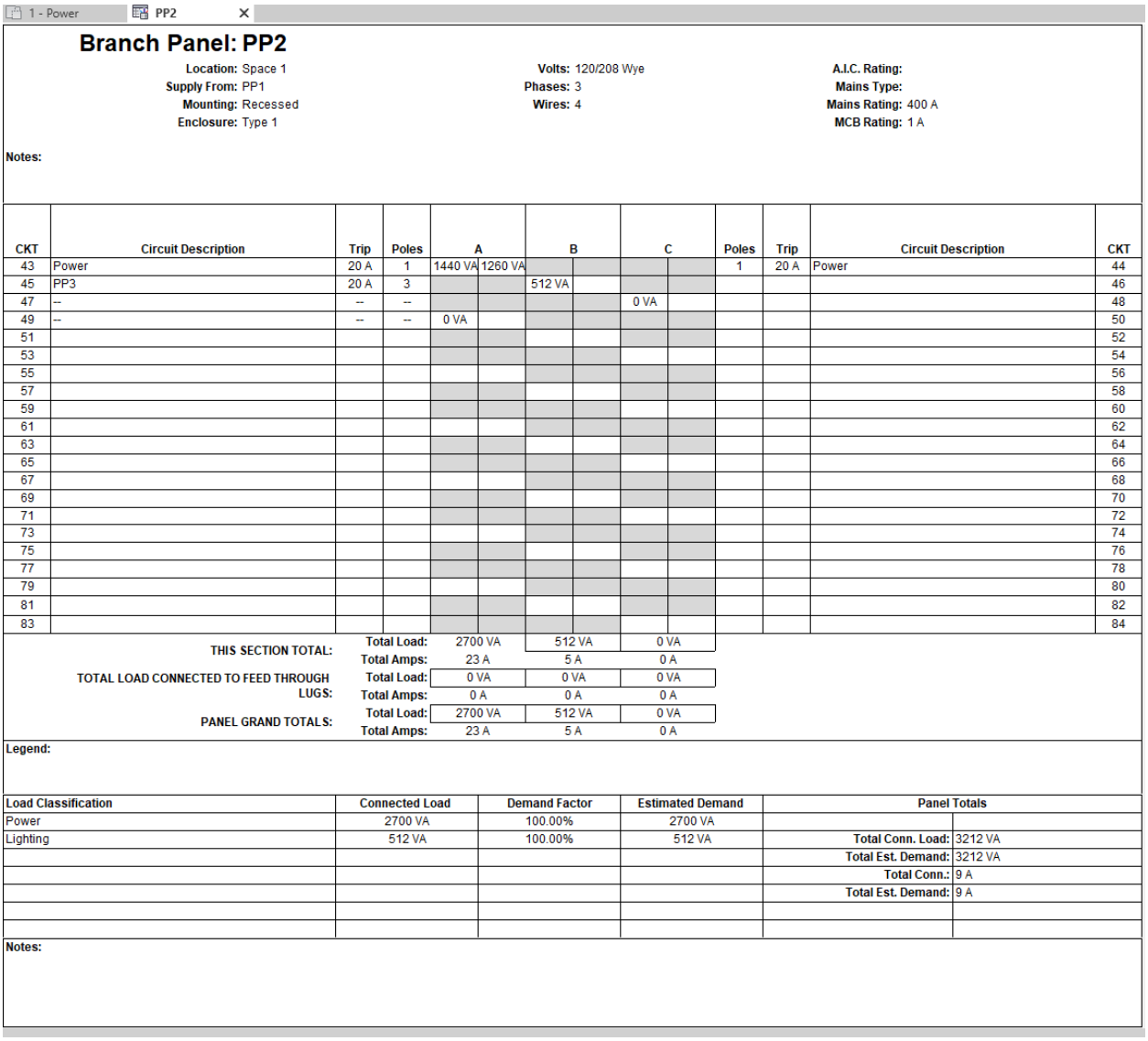
1. Make sure you have the **FTL Panels – 2020 – Part Two.rvt** file open, have the **1-Power** view set current. Select panel **PP2** and review the **properties** palette – locate the **Circuit Numbering Option** under **Electrical – Circuiting**:



2. This option is set to **Default**, which allows each panel to use individual circuit numbers specific to the panel. But what if you want to continue the panel numbering onto the next panel? Change this setting to **Continue Numbering**:



3. After making the change, open the **Panel Schedule** for panel **PP2**, and review the change:



1 - Power | PP2

Branch Panel: PP2

Location: Space 1
Supply From: PP1
Mounting: Recessed
Enclosure: Type 1

Volts: 120/208 Wye
Phases: 3
Wires: 4

A.I.C. Rating:
Mains Type:
Mains Rating: 400 A
MCB Rating: 1 A

Notes:

CKT	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	CKT
43	Power	20 A	1	1440 VA	1260 VA					1	20 A	Power	44
45	PP3	20 A	3			512 VA							46
47	--	--	--					0 VA					48
49	--	--	--	0 VA									50
51													52
53													54
55													56
57													58
59													60
61													62
63													64
65													66
67													68
69													70
71													72
73													74
75													76
77													78
79													80
81													82
83													84

		A	B	C
THIS SECTION TOTAL:	Total Load:	2700 VA	512 VA	0 VA
	Total Amps:	23 A	5 A	0 A
TOTAL LOAD CONNECTED TO FEED THROUGH LUGS:	Total Load:	0 VA	0 VA	0 VA
	Total Amps:	0 A	0 A	0 A
PANEL GRAND TOTALS:	Total Load:	2700 VA	512 VA	0 VA
	Total Amps:	23 A	5 A	0 A

Legend:

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Power	2700 VA	100.00%	2700 VA		
Lighting	512 VA	100.00%	512 VA	Total Conn. Load:	3212 VA
				Total Est. Demand:	3212 VA
				Total Conn.:	9 A
				Total Est. Demand:	9 A

Notes:

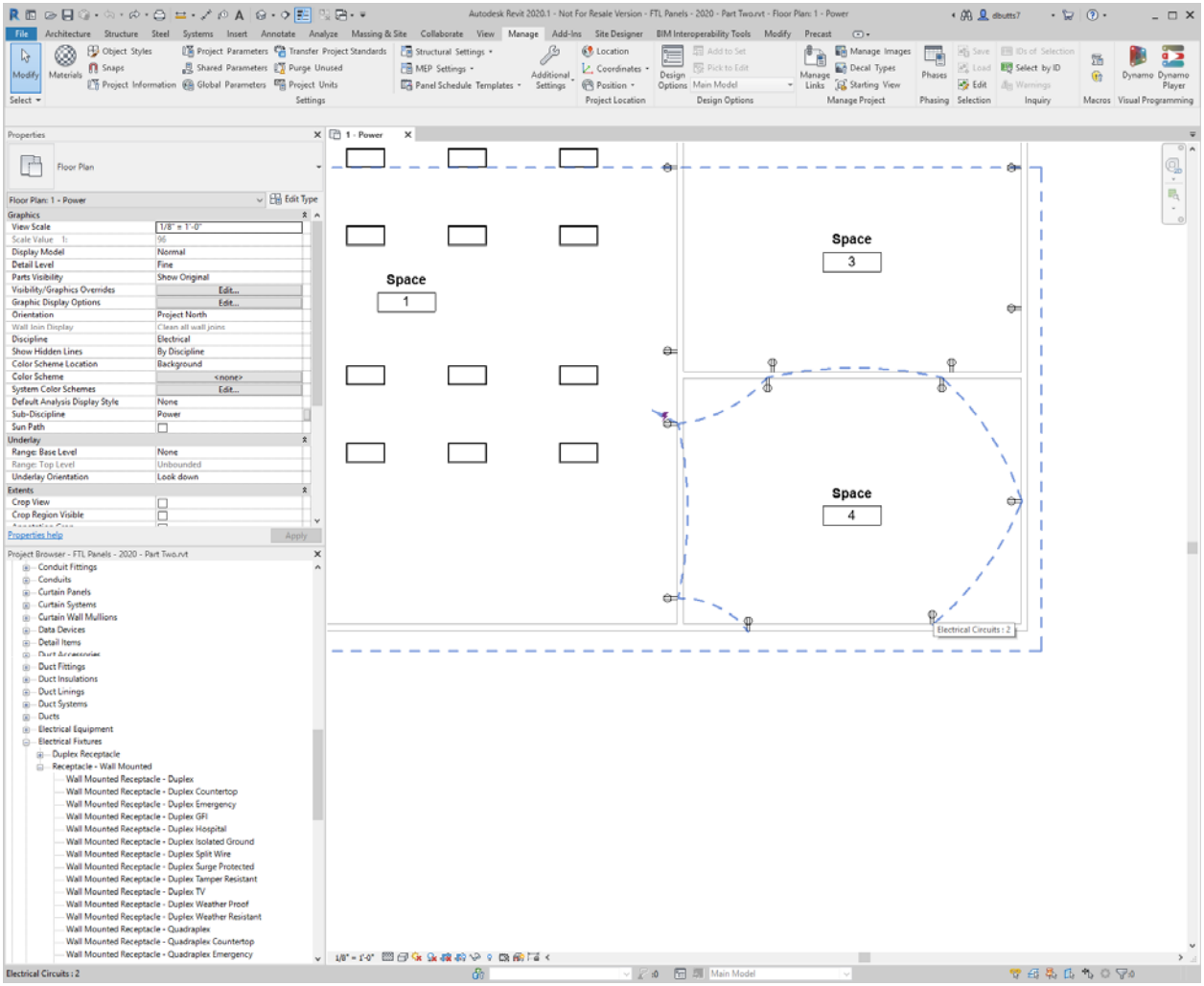
4. The circuit numbers (as well as any tags calling out the numbers on a plan view) will be updated to match this new circuit numbering scheme.

One note: Revit still maintains a 1:1 relationship between the panel and panel schedule, so the functionality to place two panels under one 84 slot schedule is not available…(yet?). But you can have two panels with the same name, with two different schedules, using the continued numbering.

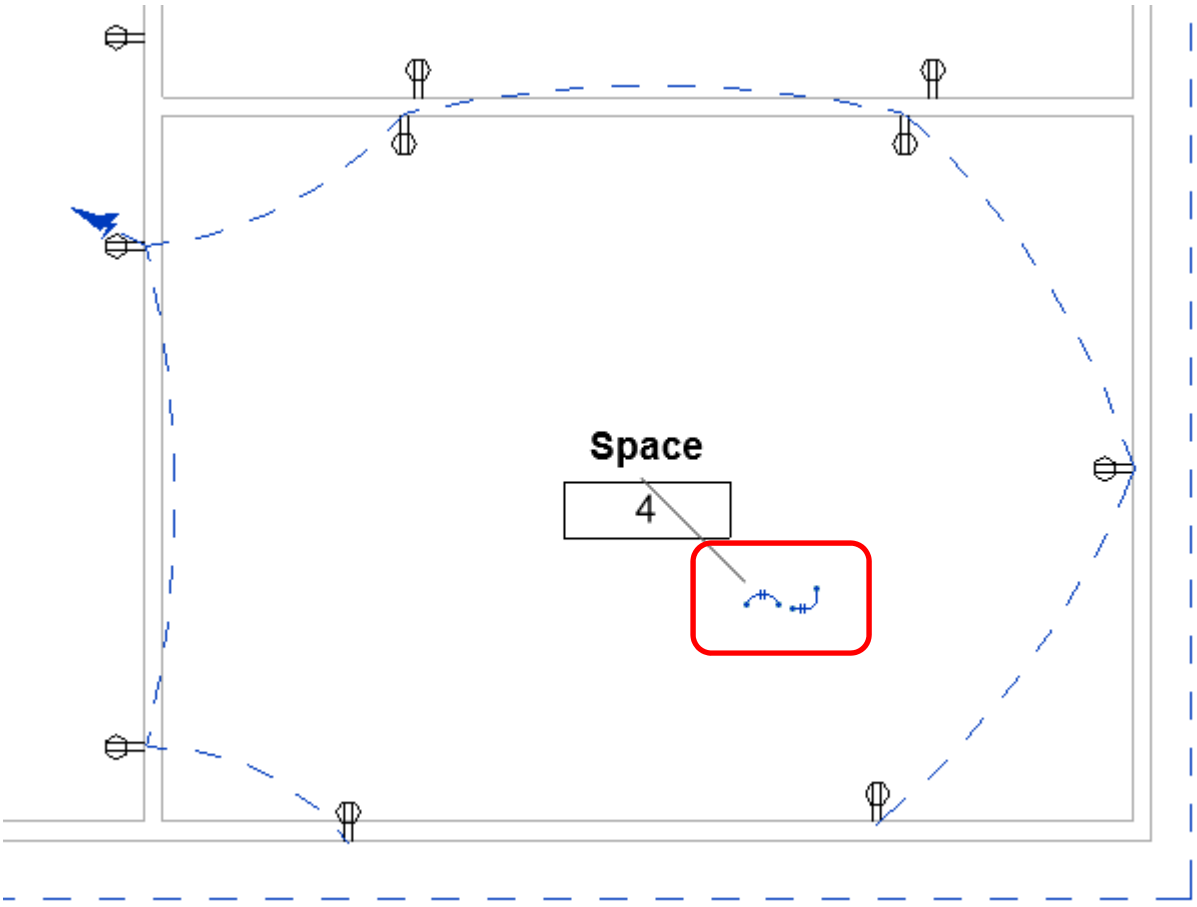
Try these neat tricks for Smoother Revit Electrical skin!

Sometimes it's the little things that drive the drafter in us crazy, so here's a few new features that should make your documents much cleaner. If you're one of the ones that still add wires to a view, take heart. There are several new features to make these work better:

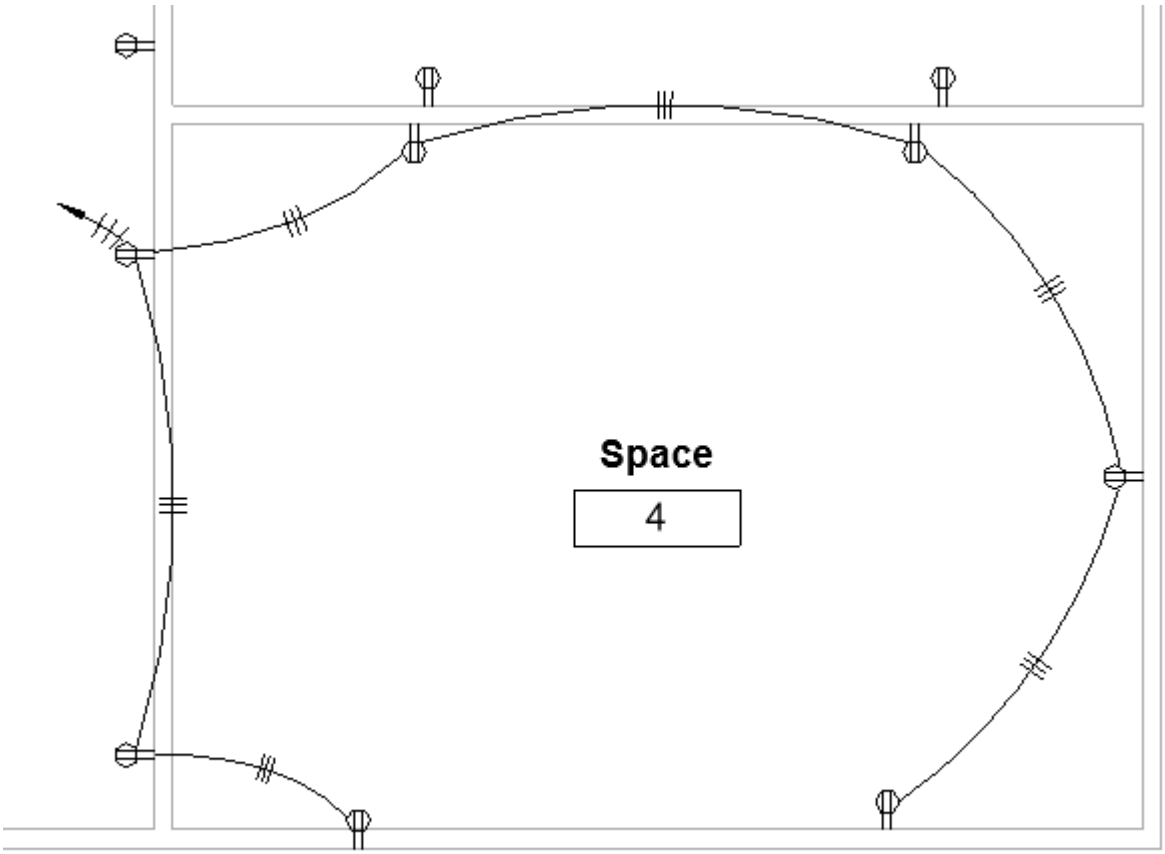
1. The fastest way to add wires is to create the circuit first, and then use the **tab** selection to pick everything on the circuit. *Hover the cursor* over a **receptacle** in **Space 4**:



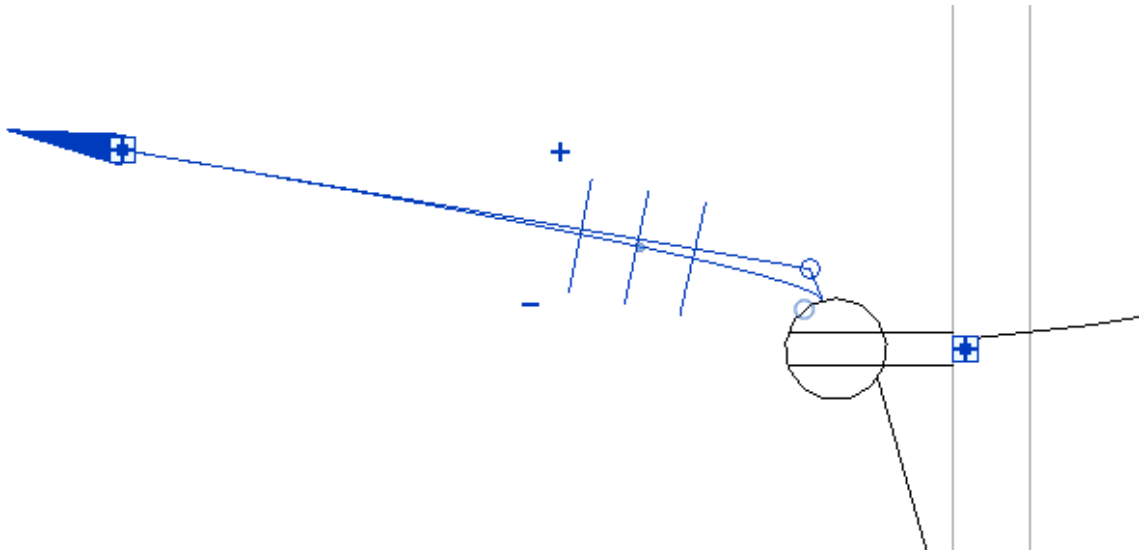
2. A **preview** of all of the devices will appear – take care not to move the mouse, as once you move it, the preview disappears. Once you see the preview, **left click**:



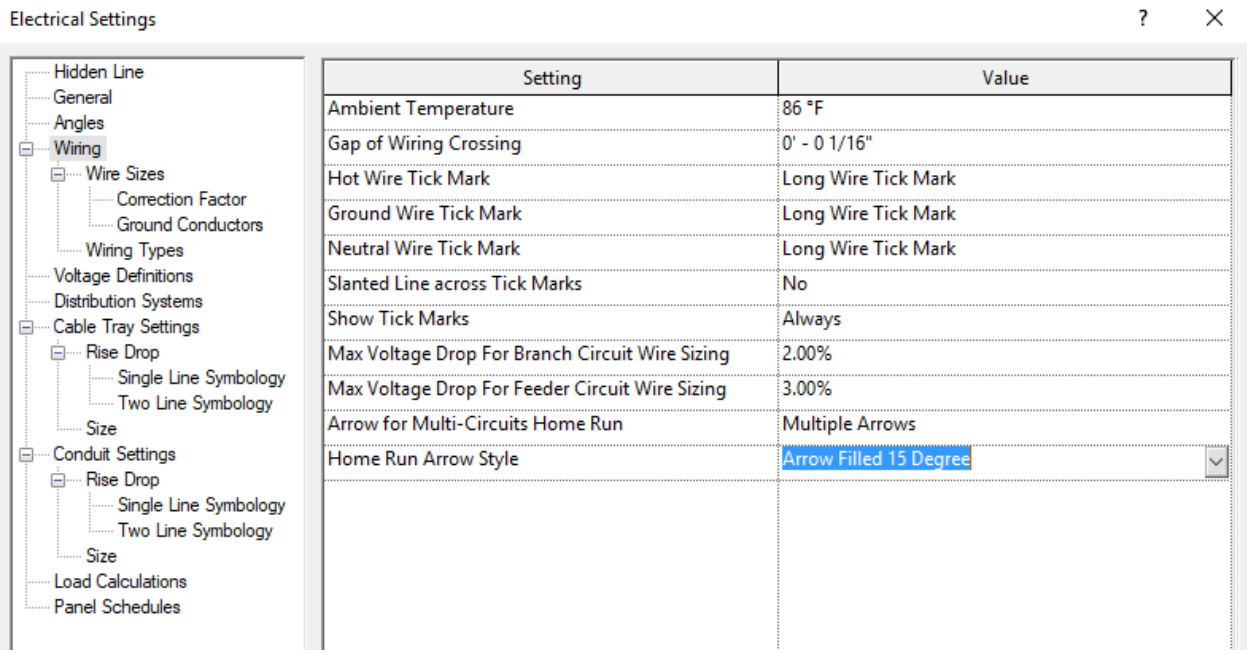
3. This starts the **add wire** command, where you can select either the **arc** grip or **chamfer** grip to add the wire. Select the **arc** grip to add the wire:



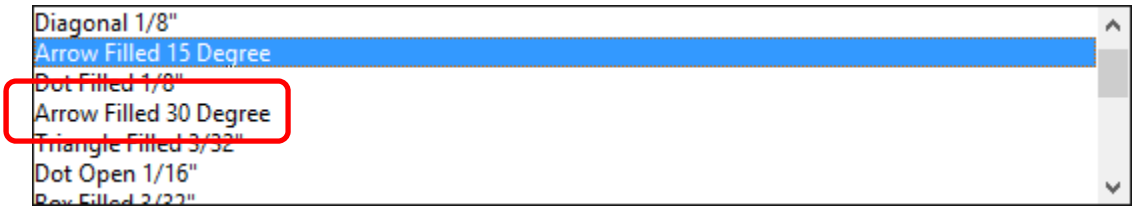
4. Now that the wire is added, here's where the new features are. The old **home run wire** might be stretching across the building, the parking lot, into the street and across the road. The new **default length** (a built-in value that's not editable) shortens the wire up to where it's closest to the last device circuited, based on the scale of the view. You can still select the home run wire, and use the grips to stretch and edit it:



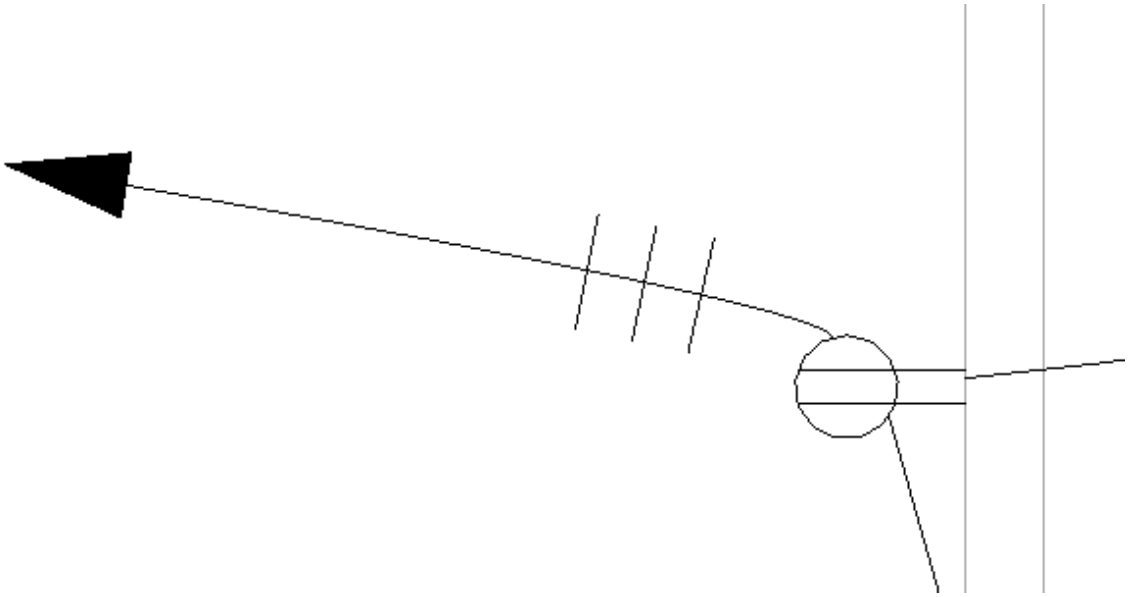
5. Now personally, the leader really is…ugly. With 2020, there are some new **home run styles** you can select from the **Manage** Tab, **Setting** panel, and **MEP Settings**. Select the **electrical settings** to open the dialog, and then select **Wiring**:



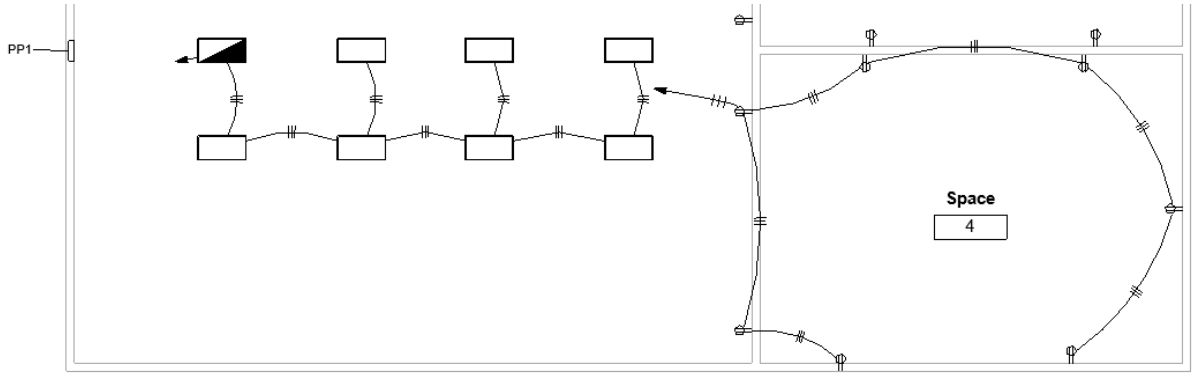
6. Select the **drop down** for the **Home Run Arrow** style, and pick something else (in my case, I'm partial to **the Arrow Filled 30 degree**):



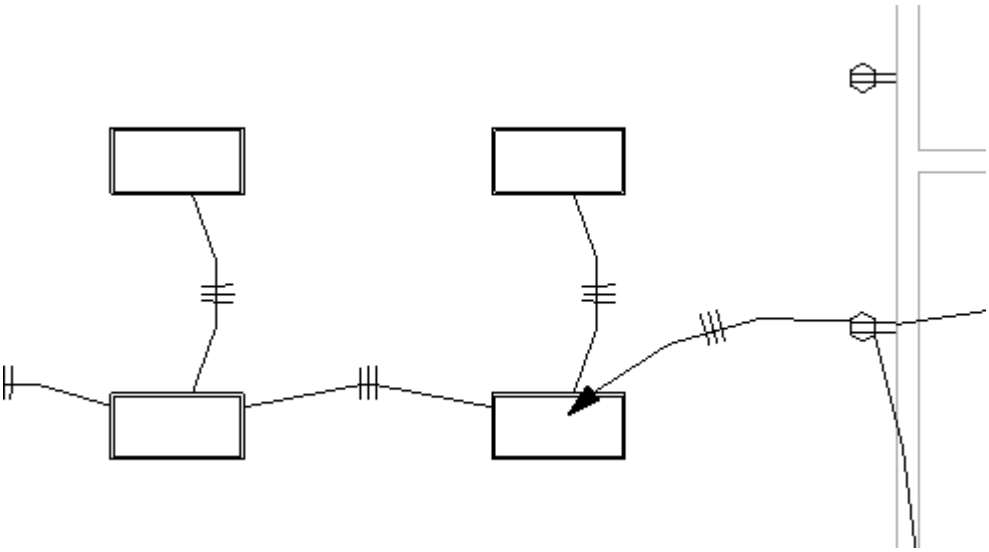
7. After selecting this, click **OK** to close the dialog and return to the view. Now this is nice fat style that's easier to see:



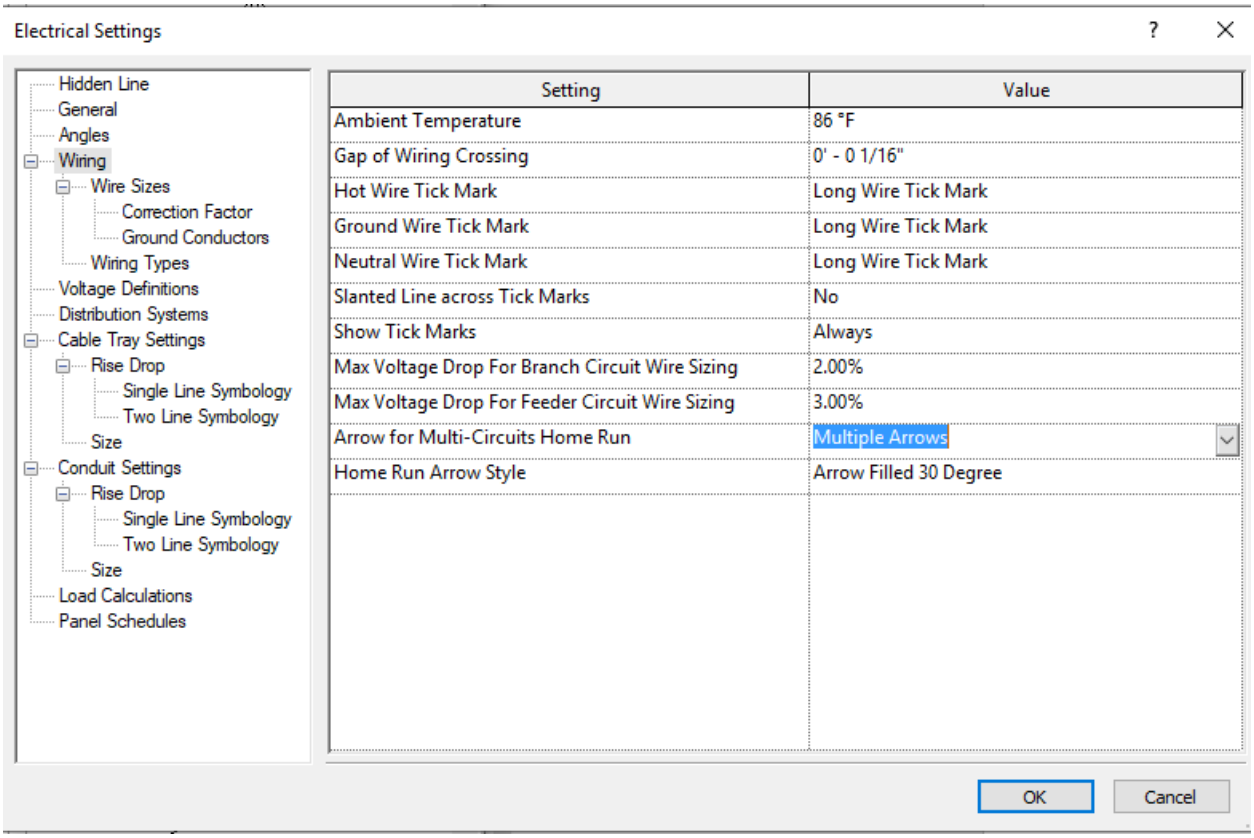
8. To try another feature improvement, select all of the **lights** adjacent to **Space 4**, and create a circuit to panel **PP1**. The preview automatically appears, when the circuit is defined. Click the **arc** grip to add the wires:



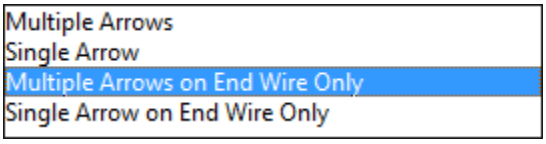
9. Next, let's **delete** both home run arrows. Using the **wire** command, add an **arc wire** from the last *receptacle* on this circuit to a *light fixture* on the new circuit:



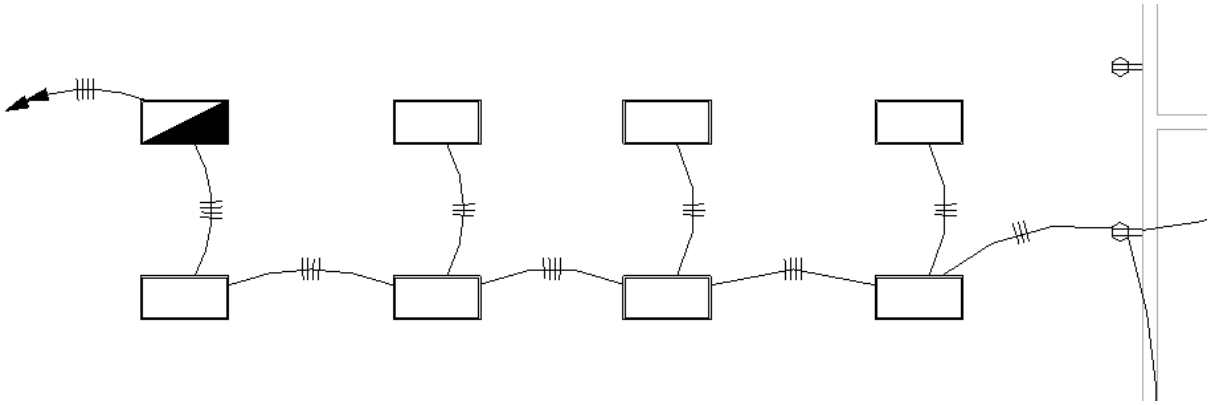
10. This used to drive me nuts, since I didn't want to see the arrow on this wire when trying to create a multi-circuit home run. To fix this, select the **MEP Settings** tool again, **Electrical** settings and then click **wiring** again:



11. Note how the **Arrow for Multi-Circuits Home Run** is set to **Multiple Arrows** – let's change this to **Multiple Arrows on End Wire Only**:



12. Click **OK**. This will fix the first wire and remove the arrow – now let's add the home run back to the last light by adding another arc wire with three points, and the last point in the direction of the panel:



13. IT WORKS! The wiring is actually correctly represented…even the number of tick marks!

Elevating Your Objects, Tags and Schedules

Revit was not originally designed by architects, but by the same developers that created modeling software for equipment. The terminology wasn't really clear, and it definitely took some getting used to. The 2020 version finally improves on this, by adding elevation parameters to help clear up where your content is placed.

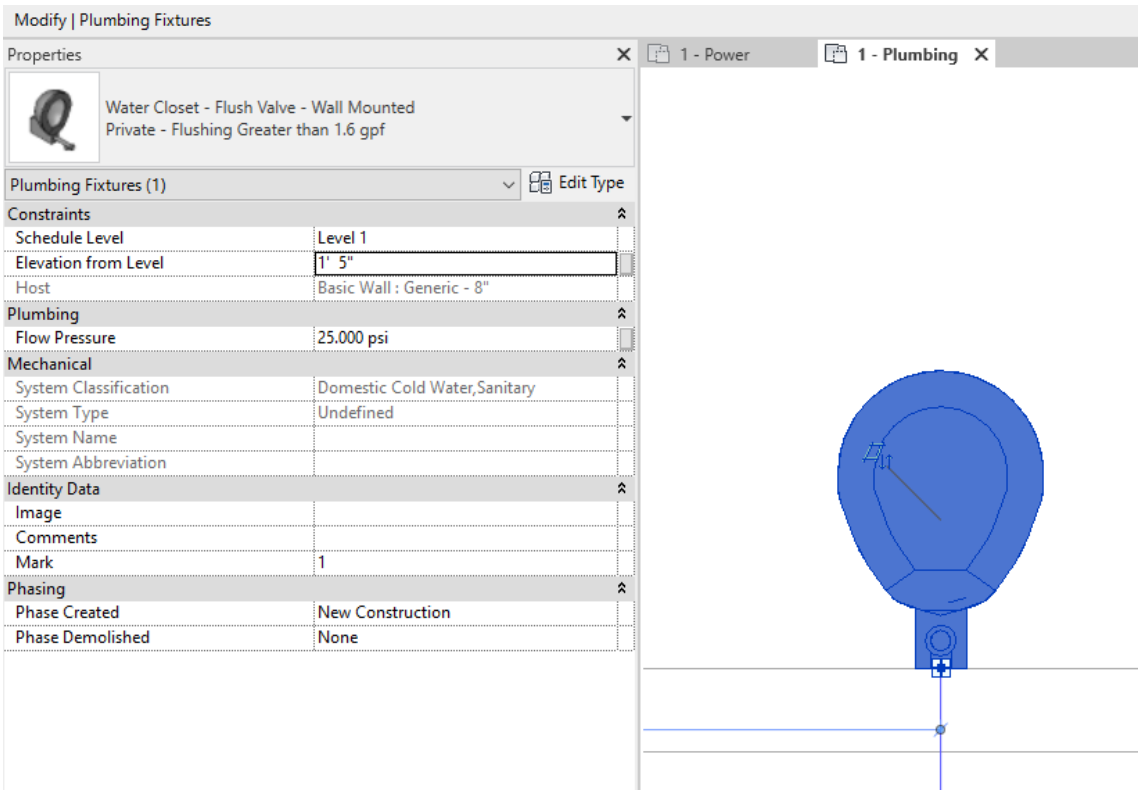
New Labels!

Component families have an improved behavior to locating items in a model. **Elevation** is now a **built-in** parameter for use in tags, schedules, and view filters. This means that you don't have to define a shared parameter for it to be used, but it appears automatically for the following family categories:

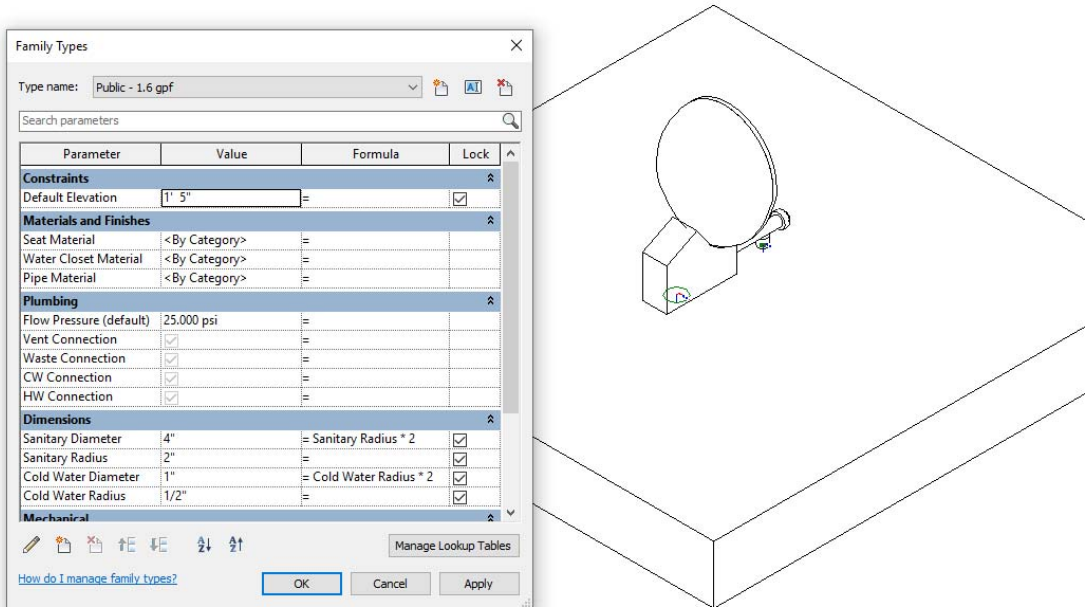
- Air Terminals
- Casework
- Communication Devices
- Data Devices
- Electrical Fixtures
- Electrical Equipment
- Fire Alarm Devices
- Furniture
- Generic Models
- Lighting Devices
- Lighting Fixtures
- Mechanical Equipment
- Nurse Call Devices
- Planting
- Plumbing Fixtures
- Security Devices
- Sprinklers
- Sprinklers
- Specialty Equipment
- Telephone Devices

Let's walk through a basic change to review how this works.

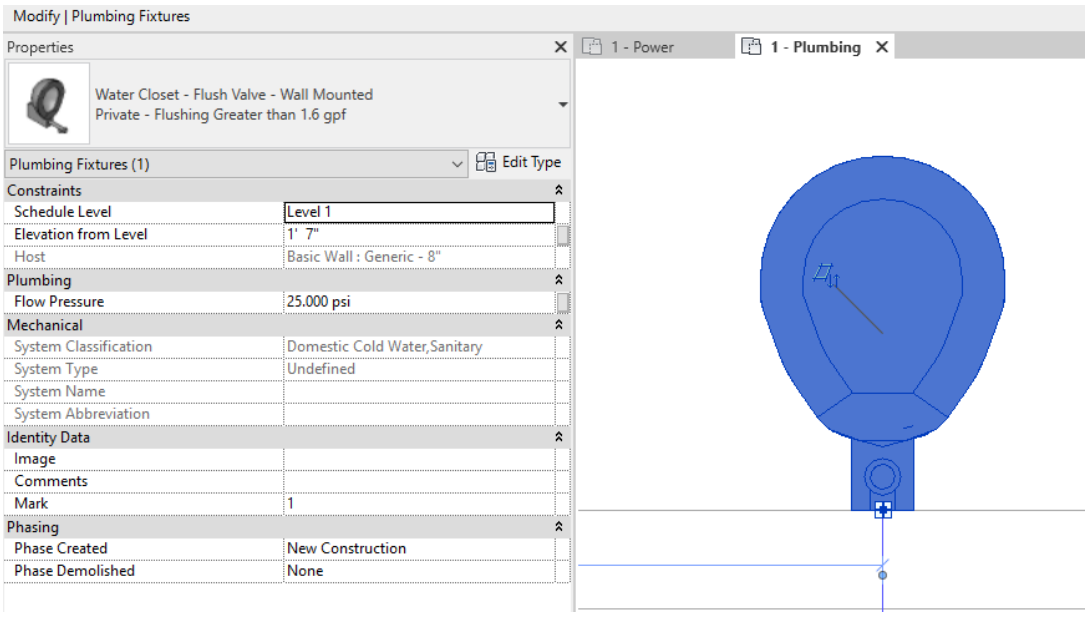
1. From the **Elevations – 2020.rvt** model, start by selecting the **1-Plumbing View** to set it current. Select one of the **wall-hung toilets** in the view:



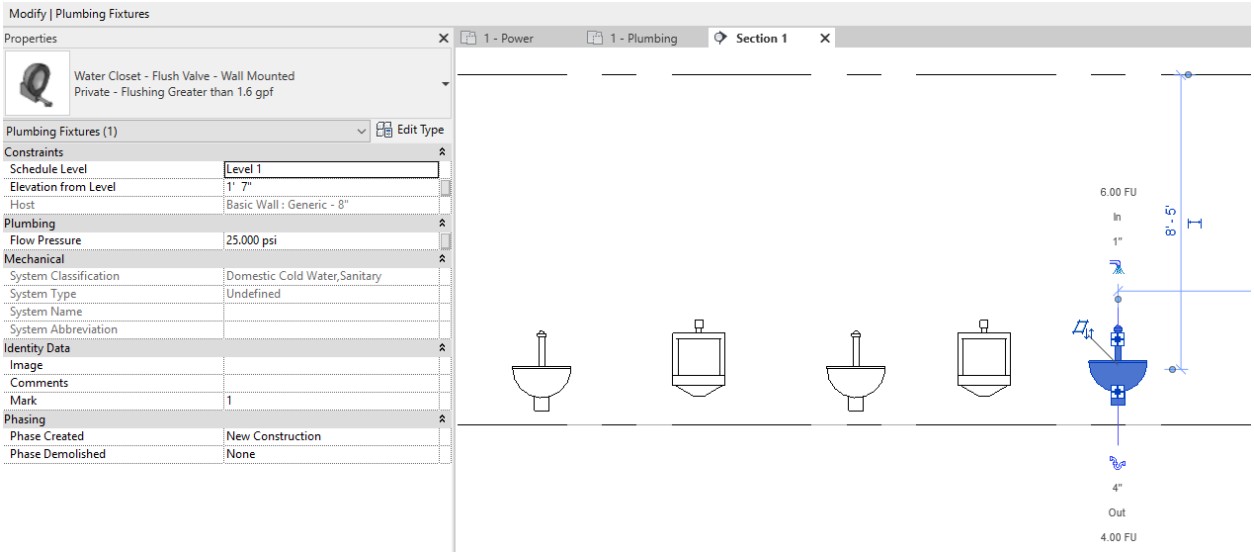
2. Note the new **Elevation from Level** is an *instance parameter* that appears under the **Schedule Level** parameter. This is stating that even though the family is a *hosted item*, associated with the *Generic 8" wall*, it still has an *elevation* value that is relative to the **schedule level** – in this case, it's **1' 5"** from **Level 1**. In the past versions, this was referred to as the **offset**. The value is set within the family – to check it, select the **Edit Family** icon to open the family:



3. Select the **Family Types** icon on the **Create** tab, Properties panel and review the **Constraints** section. The **default elevation** value has **always** been a part of the hosted families, but once the family is loaded, the value is now associated with the **Elevation from Level** parameter. Don't get confused by the different names – it's the *same value and has the same result.*
4. Close the family without saving the changes and return to the **1 – Plumbing** view. Select the fixture and change the **Elevation from Level** value to **1' 7"**:

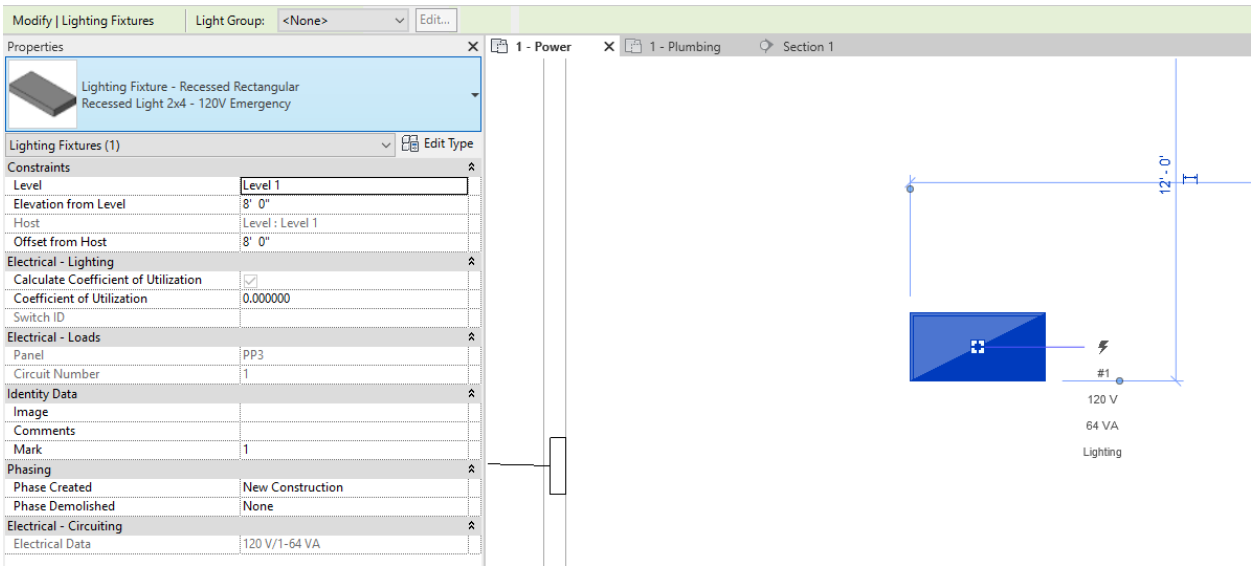


5. Now, create a **section view** that faces the wall with the fixtures:



6. This has always been one of the nice features of Revit – the fact that changing a value in **plan view** also takes effect in the *section, elevation and model view*. By simply selecting the fixture, we know that it's placed at the correct elevation, without having to run a dimension to the device.

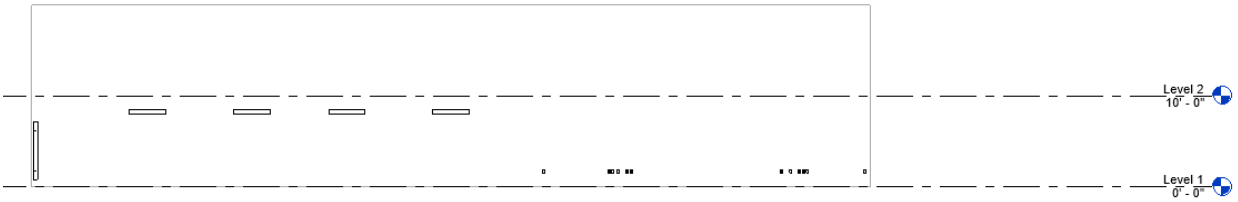
7. Next, change to the **1 – Power** view, and select one of the **light fixtures**:



8. Note the additional *instance property* information – the same **Level and Elevation Level** values are displayed, along with the **"host"** and **offset** values. These are the same values, but also helps clarify something that can easily be confused:

“EVERYTHING IS HOSTED IN REVIT.”

9. With **non-hosted** families, the actual **host** is the **level** the family is associated with – so if the level moves up or down, the values relative to the host stay the same. To test this, go to the **South – Elec Elevation** view:



10. The lights in this model are **non-hosted** but are *associated* with **Level 1**. Select **Level 1**, and edit its properties so the **elevation** is set to **-2’-0**”:

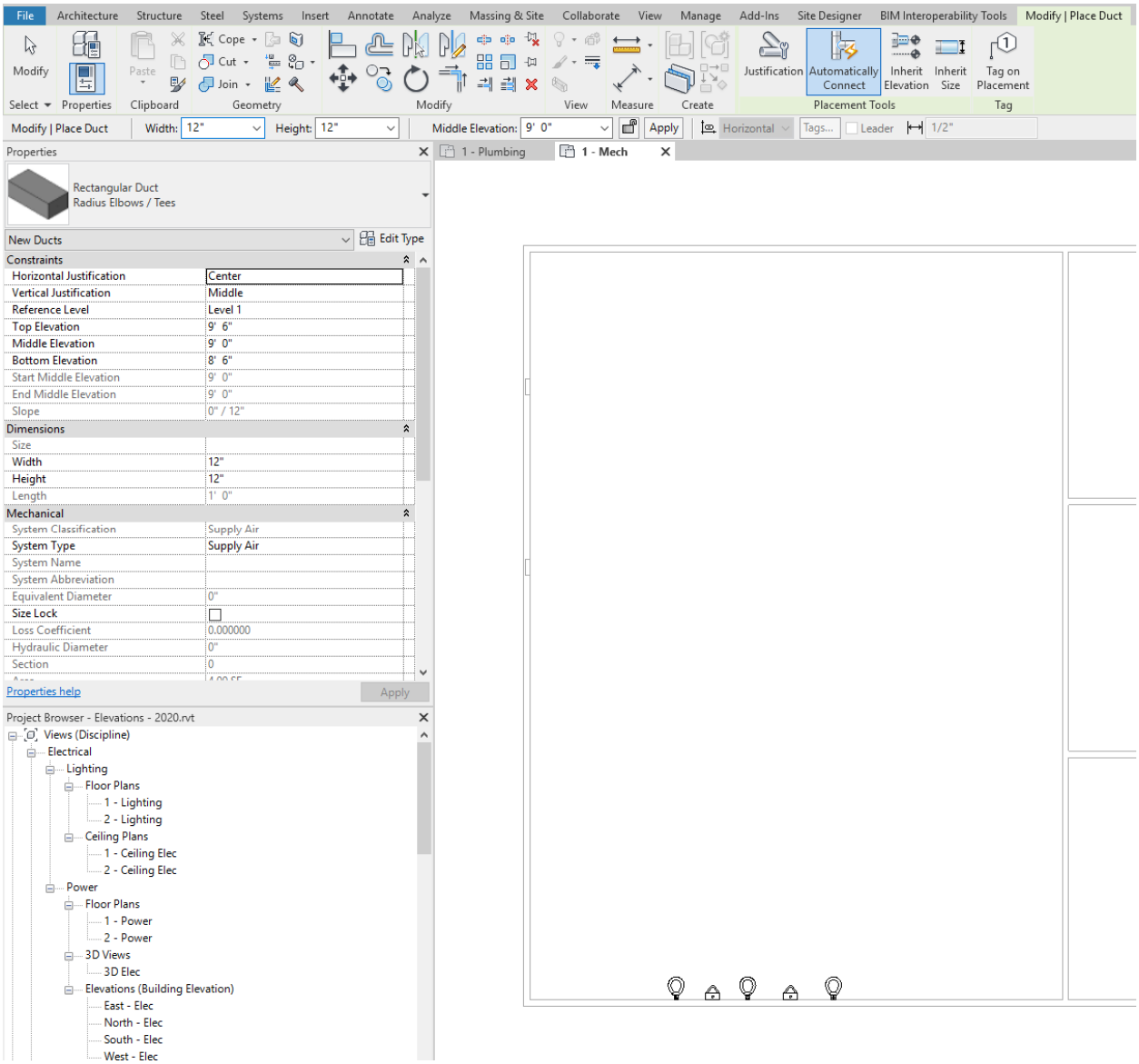
11. Watch as the lights move *down* with the level:

The intent of the new descriptions is intended to help clarify the behavior of component families in Revit.

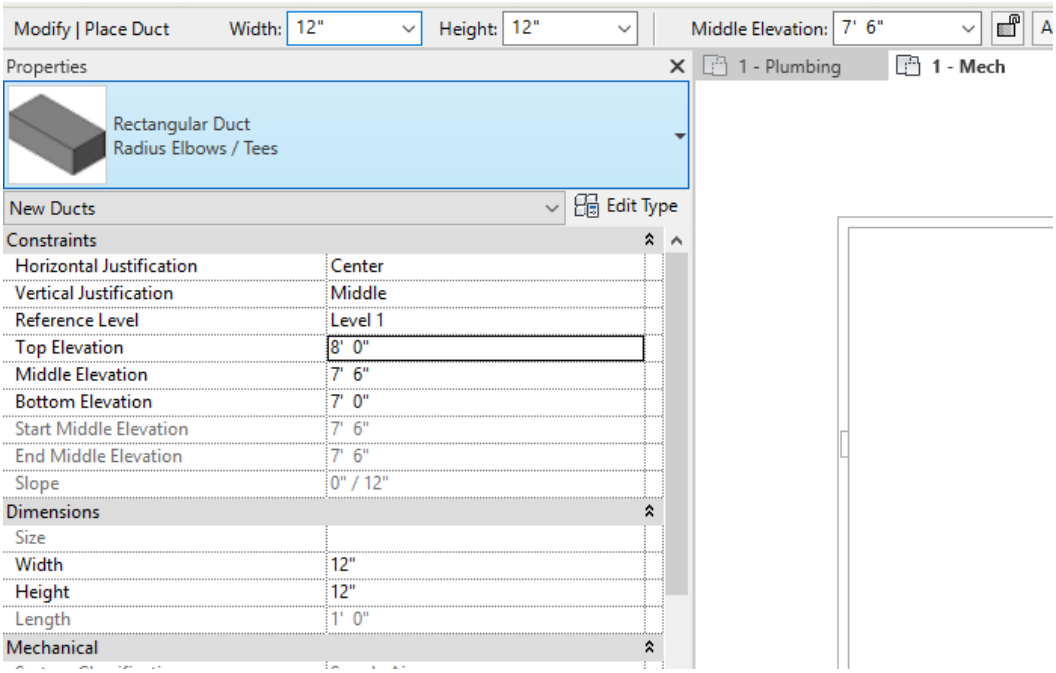
Exposing Elevation Data for System Components

Until the 2020.1 release, Revit did not include a built-in parameter to recognize anything other than the centerline of pipe, duct, conduit and cable tray. Users had to resort to Dynamo or some other custom coding to expose import bottom and top elevations of system-based content. Autodesk has now added more ways to expose top and bottom elevations of duct, pipe, conduit and cable tray. Let's check these out, as well as how to create the tag to read the value.

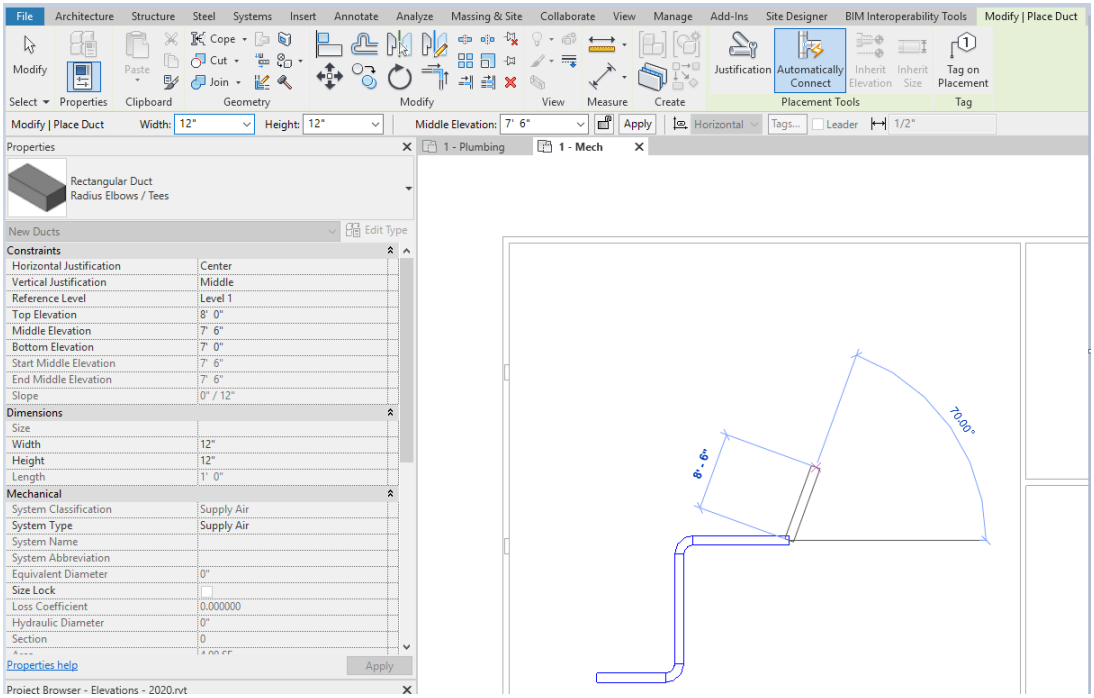
1. From the **Mechanical > HVAC > Floor Plans** section, open the **1 – Mech** view. From the ribbon, **System** tab, select the **Duct** tool:



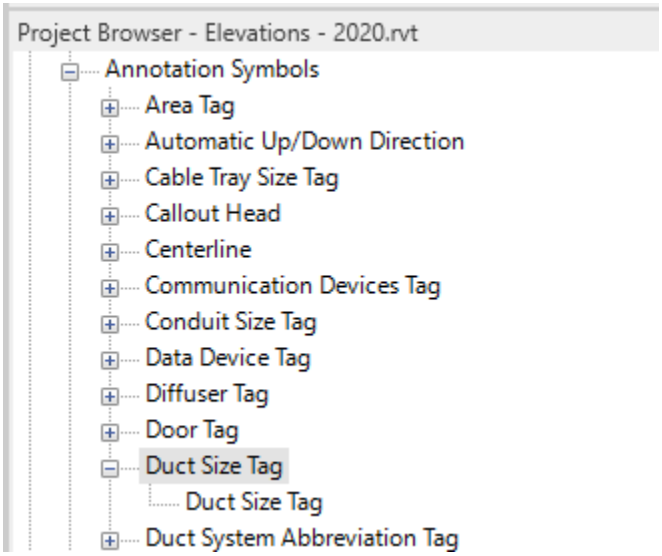
2. Review the parameters that are available – **top, middle and bottom elevation** values are exposed. Select the **Top Elevation** parameter and set it to **8**':



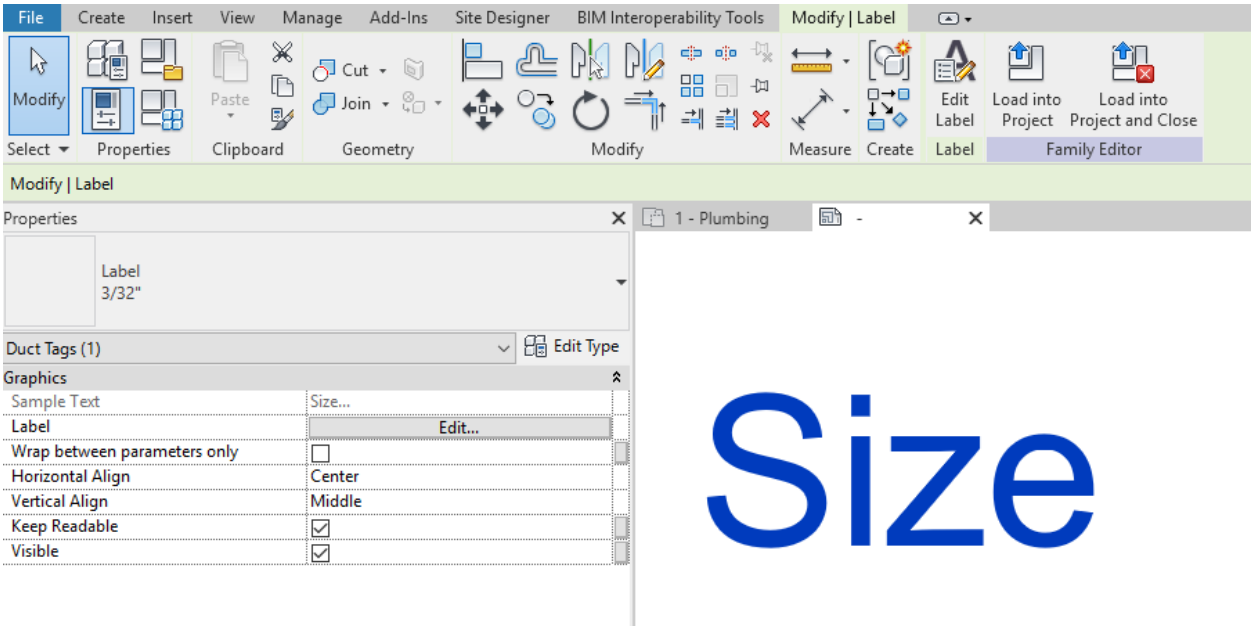
3. Note that all other values updated automatically. Place a few short sections of the duct in the main room as shown:



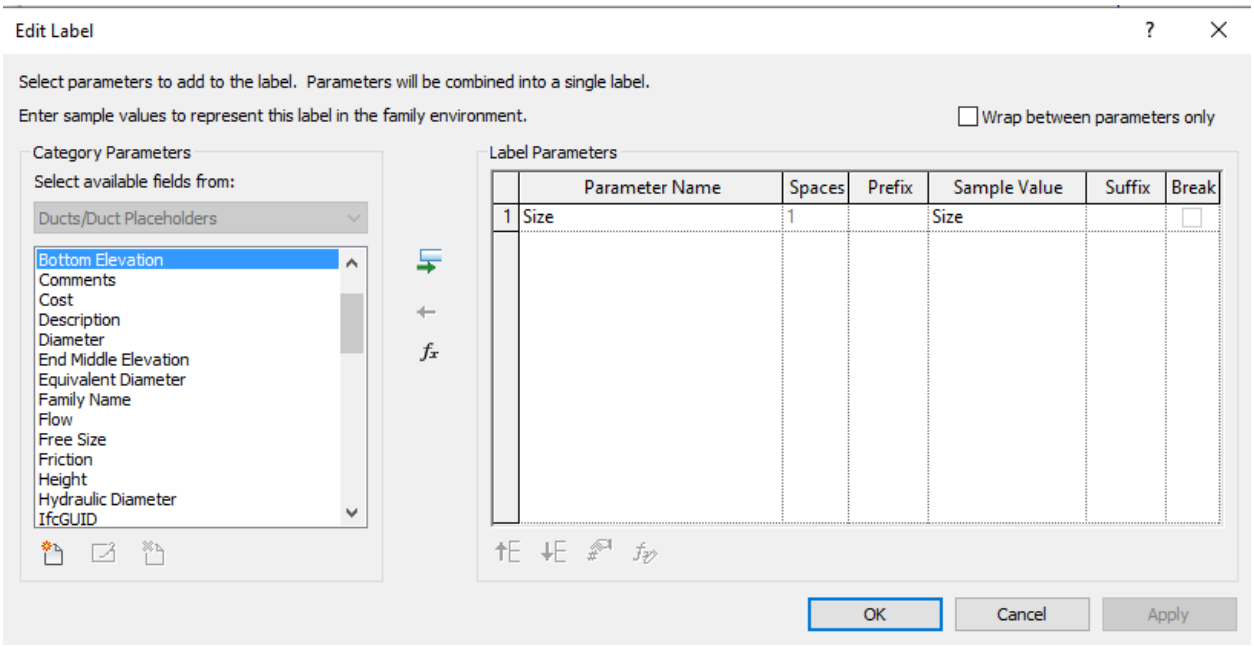
4. Note how the **instance parameters** stay current with the **values** – so the information is now *exposed*. But how can you use this? From the **Project Browser**, locate the **Families** section, and expand **annotation symbols**. Right click on the **Duct Size tag** and choose **Edit** to open the family:



5. Once the file is open, select the **Size** parameter shown in the view. From the **properties** palette, you'll see that this is a **label**, which reads information from the object:

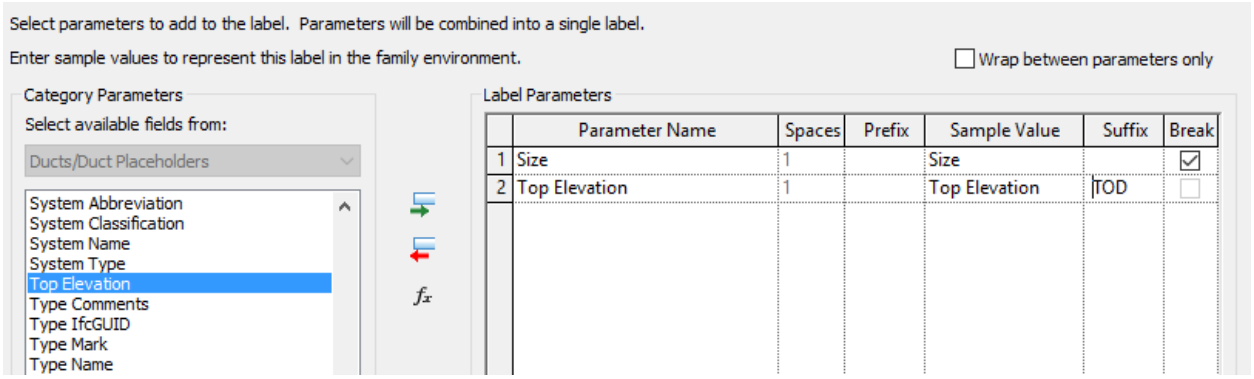


6. From the **label parameter** select **Edit** to open the dialog:



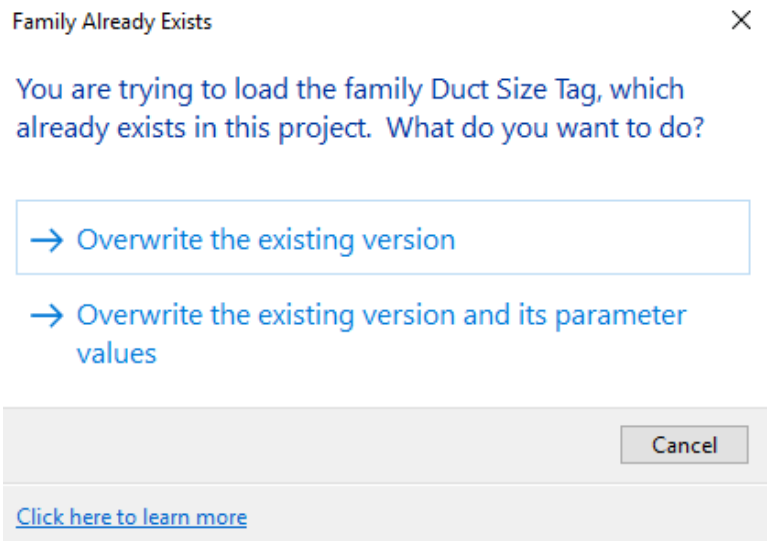
7. Under **Category Parameters**, you can see that there are now several options to add elevation properties to a tag. The built-in parameters now include:
    a. *Bottom Elevation*
    b. *End Middle Elevation*
    c. *Start Middle Invitation*
    d. *Top Elevation*

    Select **Top Elevation**, and then choose the *green arrow* to add the parameter to the label, below **Size**. Select **Break** on the Size line, and then add a **space** with **TOD** as the Suffix:

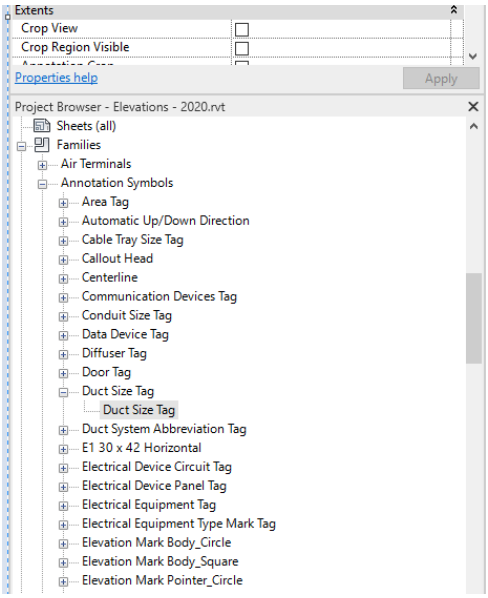


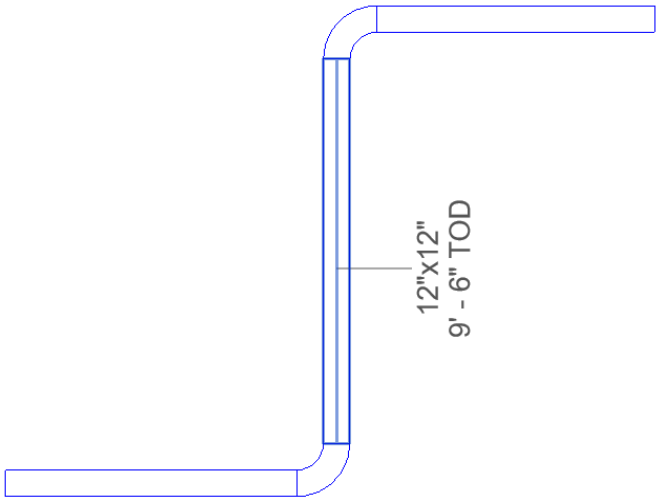
8. This change will add the **top elevation** to the duct tag based on the instance property shown. If you use this with a **datum annotation**, it can also read the top location of a *sloped* duct, based on the **selection point** chosen. Click **OK** to complete the step, and then note the **label** change. Use the **grips** to spread the label out to allow the value to be added without a carriage return:

9. You can save the family if you want to keep it, but for this exercise, select **Load into Project** to replace the existing tag. Make sure you select the option to **override the existing version and its parameter values,** so the label is updated:



10. From the **Project Browser**, *drag and drop* the tag into the **1 – Mech** view and select a duct to label it:





Prior to this change, you had to create a parameter that included a formula to calculate half of the duct height value then add it to the middle elevation value or create a Dynamo programming routine to extract to a separate parameter. Since the parameter is now exposed, it's a simple matter of just adding it to a tag. The same process applies to pipe, conduit and cable tray as well. Now, the elevation values are lot more *useful*.

Improve Engineering Analysis Tool Results with Key Settings and Tips

Autodesk made major improvements to the energy and HVAC load analysis tools with the 2020.1 release. For example, the legacy HVAC and Cooling Loads tool uses the **ASHRAE Radiant Time Series** method that only provided the loads:

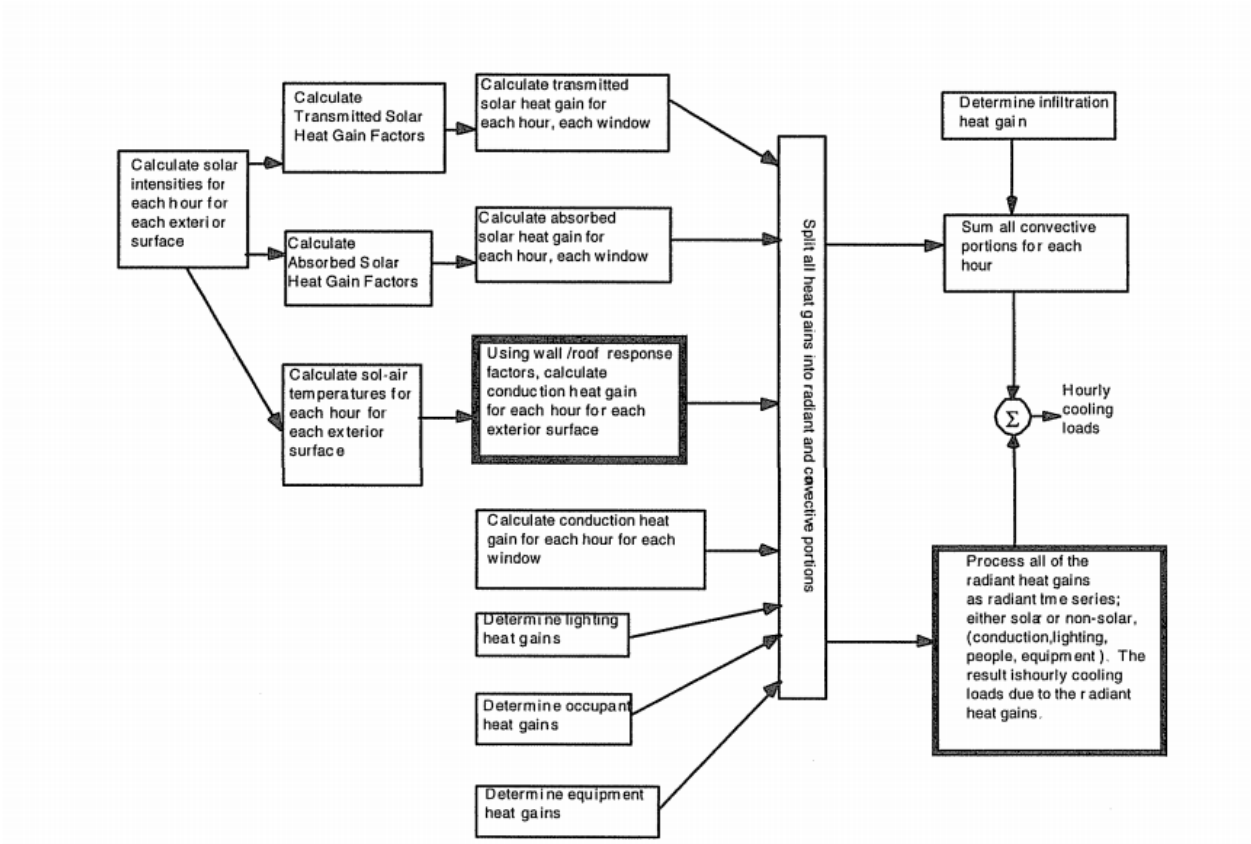


Figure 1 *Overview of the radiant time series method.*

[1]

Around 2013. Autodesk began making investments in EnergyPlus, the US Department of Energy's primary tool for whole building energy analysis. For later reference, check out this article explaining the reasons behind this change:

https://blogs.autodesk.com/insight/why-is-autodesk-investing-in-energy-plus/

[1] Reference: *The Radiant Time Series Cooling Load Calculation Procedure*, Jeffrey D. Spitler, Ph.D., P.E. Member ASHRAE; Daniel E. Fisher, Ph.D. Member ASHRAE; Curtis O. Pedersen, Ph.D. Fellow ASHRAE; Copyright ©1997 ASHRAE, https://hvac.okstate.edu/sites/default/files/pubs/papers/pre_2000/19-Spitler_Fisher_Pedersen_97.pdf

Here's the specific reasons quoted in the link for why Autodesk made the investment:

- "We believe EnergyPlus is the most advanced whole building energy analysis engine available in the market. Sure, there are other engines that are better at specific things, but when you add it all up, we believe EnergyPlus usually comes out on top overall.
- Even though EnergyPlus is very accurate, considering the latest in building science and enabling capabilities like green roofs and natural ventilation, it is slow and very hard to use with BIM applications.
- We thought that Autodesk could address the limitations of EnergyPlus, and do it in such a way to benefit the industry at large. We also did not see anyone else willing to put the effort required to address the limitations of EnergyPlus. We decided if we did not do it, nobody else would and the industry at large would be the worse for it. We have the resources and we know it was the right thing to do. The classic "If not Autodesk, then who? If not now, then when?"
- EnergyPlus has one other very important advantage over almost all other modern engines. It is open source. That means anyone can see the source code and improve upon it. EnergyPlus can be used by researchers all over the world to study how to reduce the impact of buildings on the environment without sacrificing cost or occupant comfort. In the long run, open source core technology has shown to be equal to, if not better than, proprietary products. Obviously, the core technology must be valuable enough to have a community to rally around it. To support that hypothesis, here are just a few examples: Linux, OSX, Android OS, Mozilla, and the list goes on. All of these have open source as their underlying core technology with customized and sometime proprietary UI on top of them."

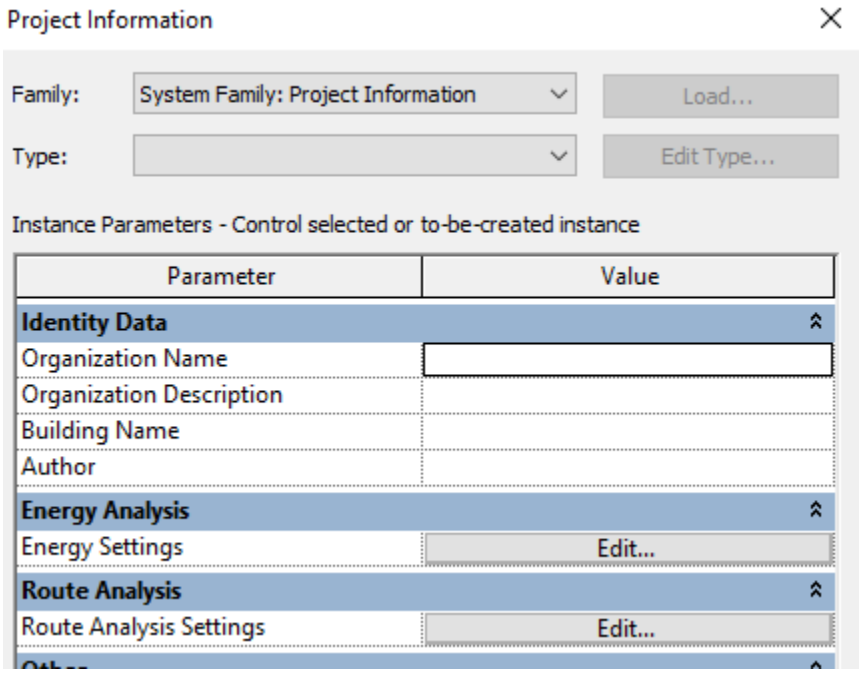
Fast forward to Revit 2020.1 – the first fully integrated version of Revit that leverages the Energy Plus tools is released.

But this section of our lab is NOT about performing the analysis – it's about what happens before the actual analysis takes place. It's about understanding what can cause errors, and how to improve the accuracy of the results.

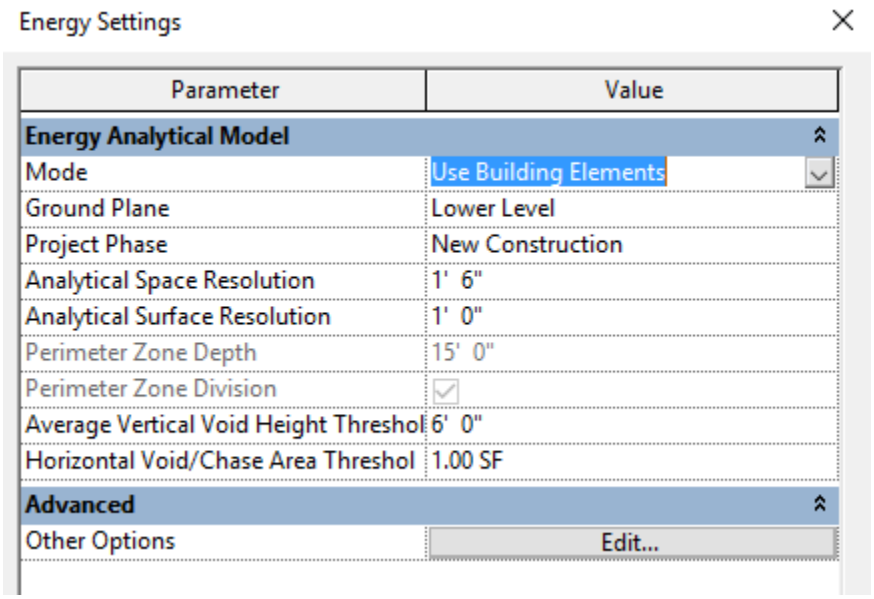
In the Beginning – Energy Model Settings

Making sure you understand how the project settings impact your project is critical to running a successful analysis. For this exercise, make sure you are in the **Analysis Settings_R20.rvt** model.

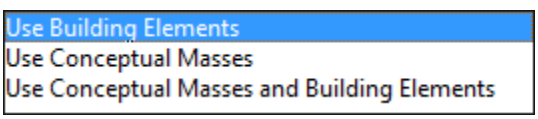
1. To begin, go to the **Manage** tab, **Settings** panel and click **Project Information**. The dialog will appear:



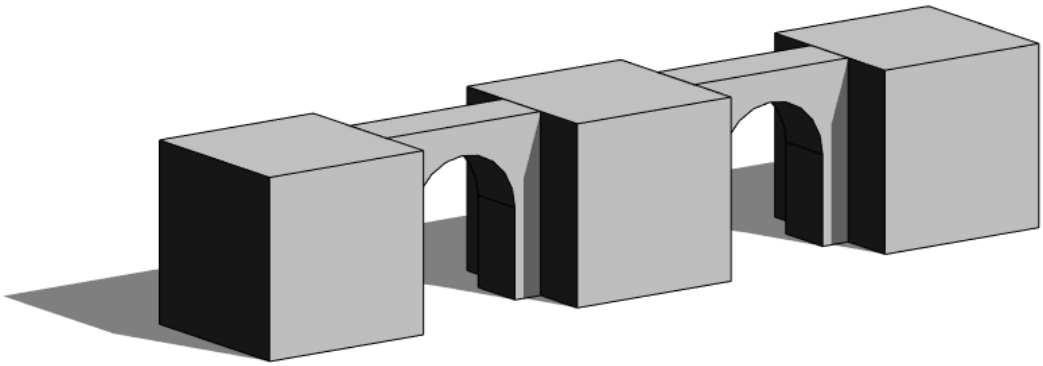
2. Select **Energy Settings** to continue:



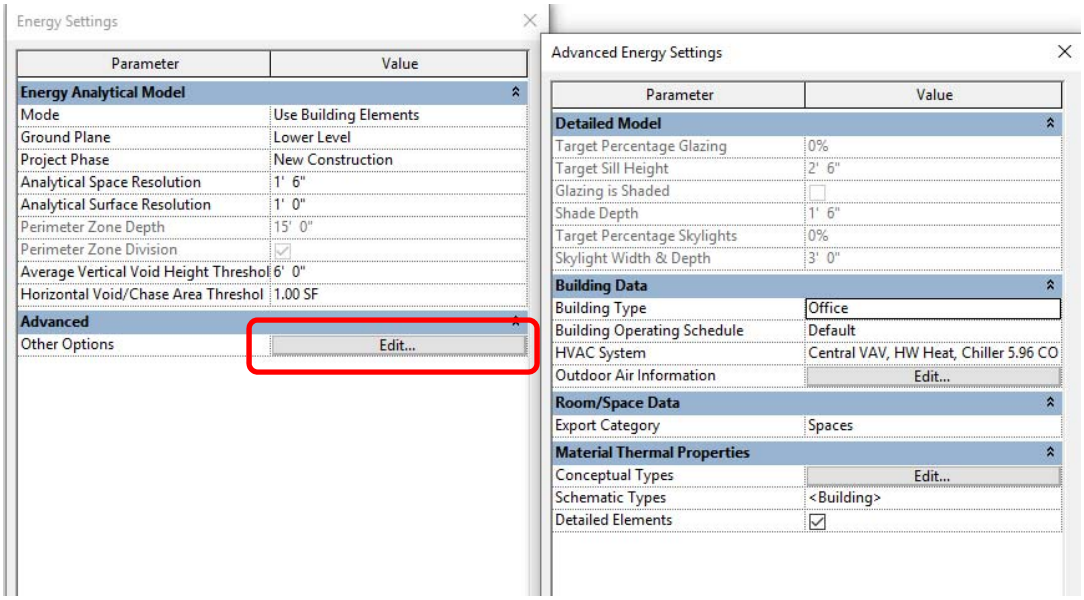
3. Select **Mode** – the most common error that occurs when the incorrect mode is used:



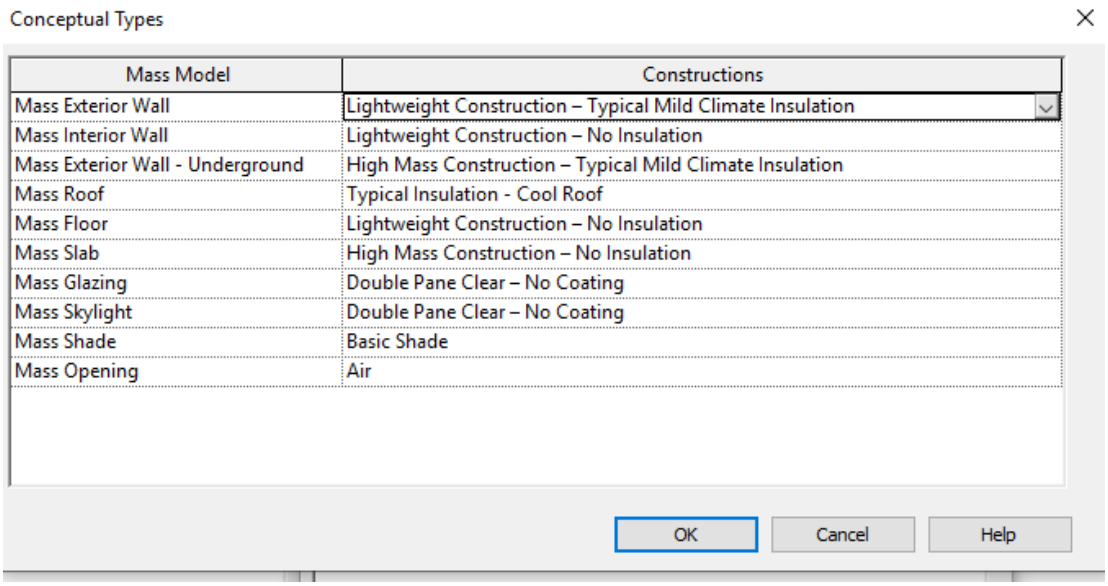
4. If your building doesn't contain mass elements, then this should **ALWAYS** be set to **Use Building Elements**. **Conceptual masses** only apply, for example, in an architectural model, in a very early predesign phase, where the masses represent the concepts of an overall building:



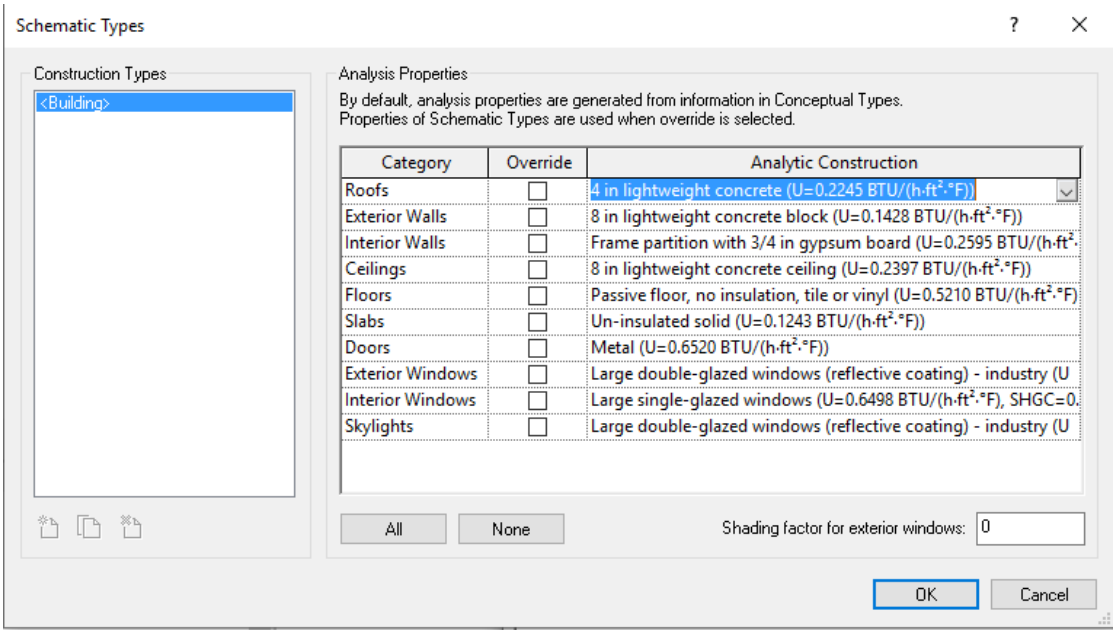
5. However, most of the projects we see in the Autodesk support portal that have issues with energy modeling don't include the masses, so check this first. Next – so if you are using **Building elements**, what does that mean? Revit is using the actual building geometry – *walls, openings (including doors, windows, curtain walls, etc.), floors, roofs, and ceilings* – as the "bounding elements" or envelope that defines the conditions for the energy model. While you are still in the Energy Settings dialog, select **Other Options**, and open the **Advanced Energy Settings** dialog:



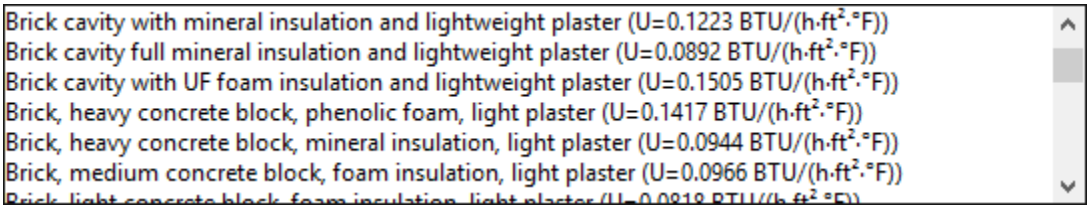
6. Take a look at the Material Thermal Properties section. This area is where Revit settings are defined that tell Revit how to deal with the bounding elements. **Conceptual types** are specific to **Conceptual Masses**. If you select **Edit**, you'll see some basic settings for how Revit can view the masses from a building envelope perspective:



7. **These settings have no impact on any building elements**, so they are used when you have the conceptual mass model as described above. Click Cancel to return to the previous dialog, and click **Schematic Types**:

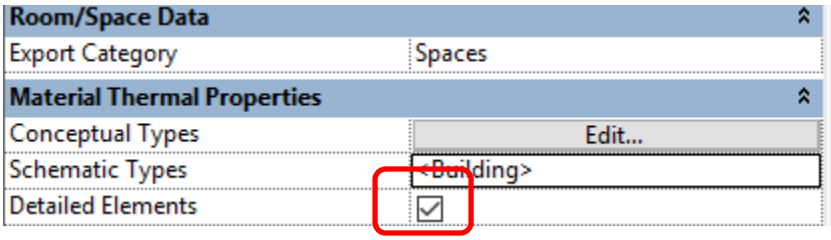


8. If you don't have the **Detailed Elements** option selected in the **Advanced Energy Modeling** dialog, then Revit applies these overall settings to *ALL roofs, exterior and interior walls, ceilings and more*. These are *general assumptions* – so if your model is still in a preliminary stage, even if you are using general object types, you can address the thermal properties by *selecting different Analytic Construction types*. For example, here's a sample of some of the exterior wall constructions:



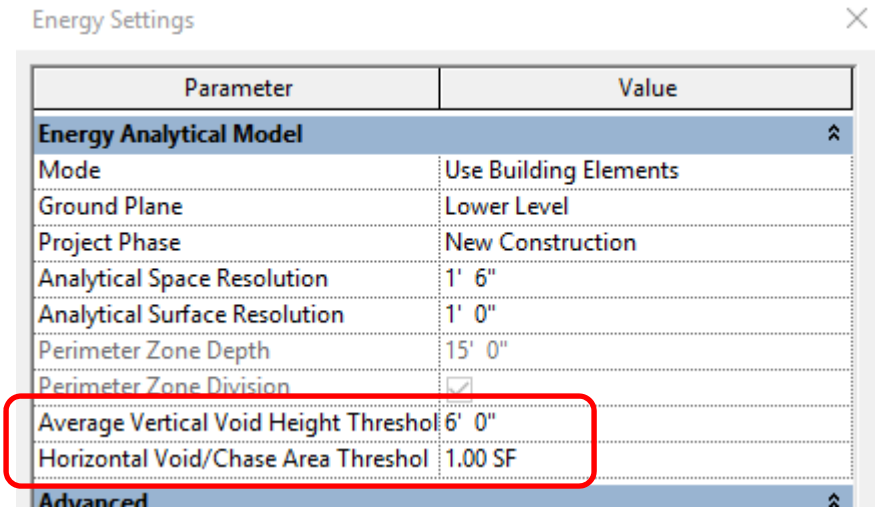
***Super-secret tip**: You can find these settings in the **C:\Program Files\Autodesk\Revit 2020\en-US\Constructions.xml** file, where **en-Us** is the version of Revit you are using. But edit this at your own risk – and make a copy before editing!*

9. But we're still not there yet, if you are looking for even more detail. Click Cancel to exit from the schematic types dialog, and make sure you have Detailed Elements checked:



10. One last step – if you're doing this from an architectural model, change the Export Category to rooms. If you're doing this from a MEP model, *make sure the architect actually added rooms – **correctly** – to their model*. The rooms should be **bound** on all sides in order to get an accurate representation. If they did, make sure you place spaces, and have this option selected. We'll cover the spaces a little further in the class.

11. **Click OK** to exit the **Advanced Energy Settings** and return to the **Energy Settings** dialog. A new feature that was added to the bottom of the **Energy Analytical Model** category – **Average Vertical Void Height Threshold** and **Horizontal Void/Chase Area Threshold:**



12. As modelers, we tend to get lazy. Added a plenum level and spaces to represent interstitial spaces can be a bit tedious. Instead of having the user add these items to the model, the **Vertical Void height** allows Revit to assign these areas to *unconditioned*, and the threshold is set by *dividing the volume by area*.

13. **Horizontal voids** are the same thing – if an area enclosed in the building is *1 square foot or less (for US Imperial units)* as the default setting, then Revit sees this space as *unconditioned*.

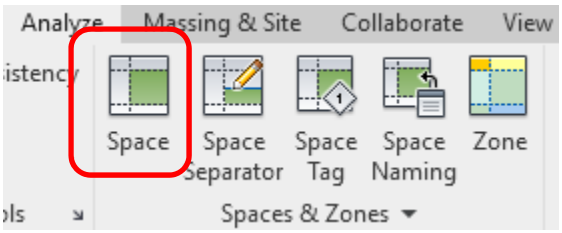
Both of these setting help reduce the time needed to assemble an energy model baseline – you can still do the tasks of adding levels and spaces if you want to raise the accuracy level of the model, but for most use cases, these settings should be sufficient for a preliminary model review.

Resolving Space and Boundary Errors

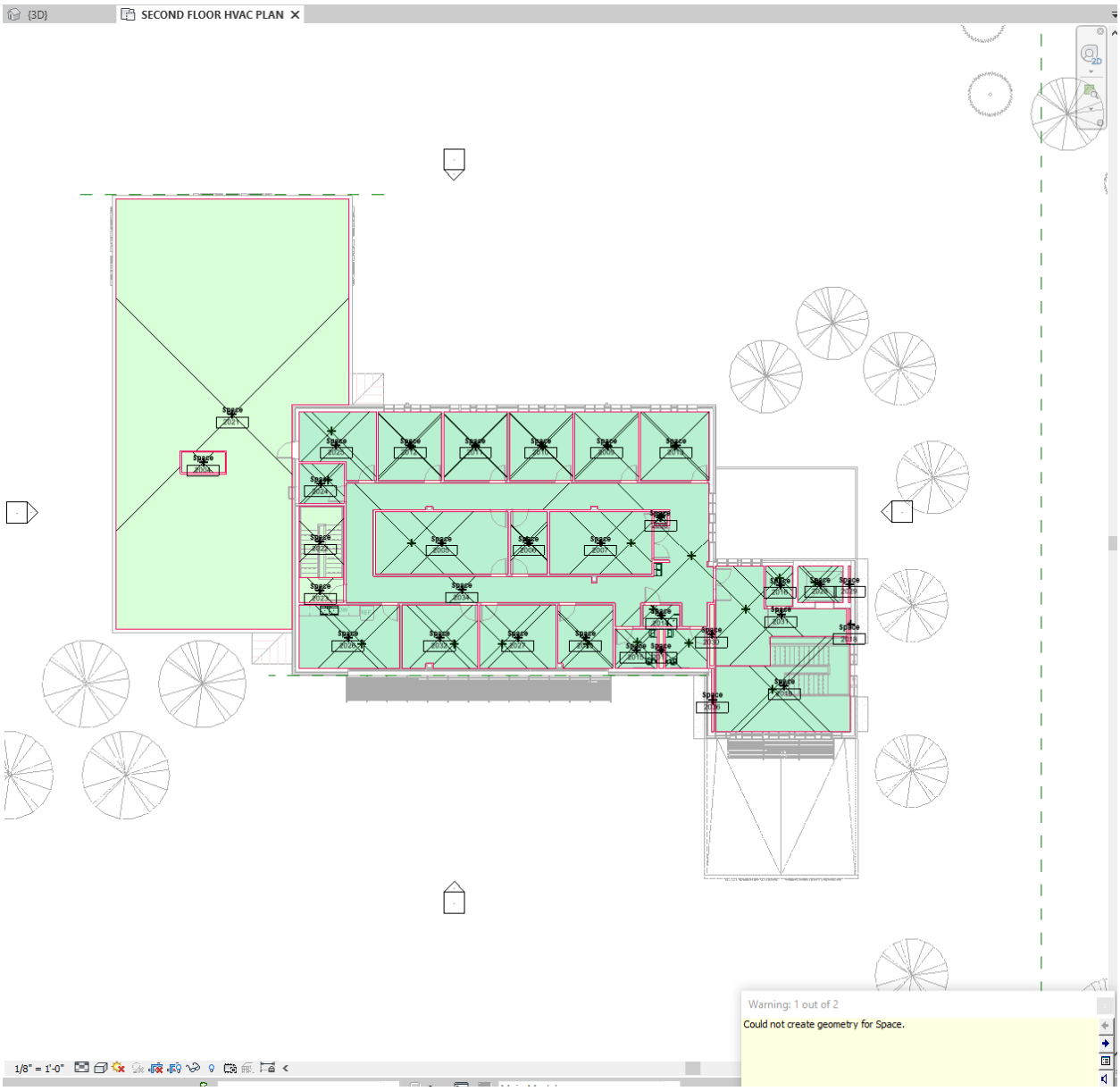
After reviewing the energy settings, there are still several items that can cause an energy analysis model to fail. Knowing how spaces are defined, and how they interact with the bounding elements of the model, is crucial to understanding how to create a well-defined environment. Let's take a look at a few items that are commonly missed.

Make sure you have the **Space Settings_R20.rvt** model open.

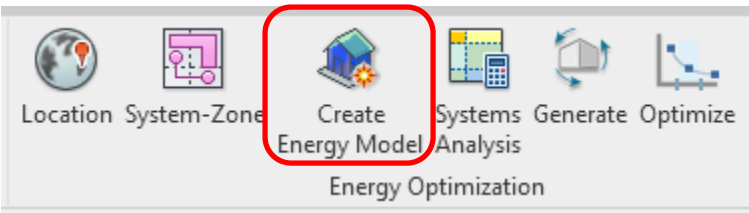
1. Select the **SECOND FLOOR HVAC PLAN** and make sure it is the current view. Adding spaces is a fairly simple exercise – the spaces are needed to create a well-formed energy model, so let's add them quickly to the model. From the **Analyze** tab, **Spaces & Zones** panel, click **Space**:



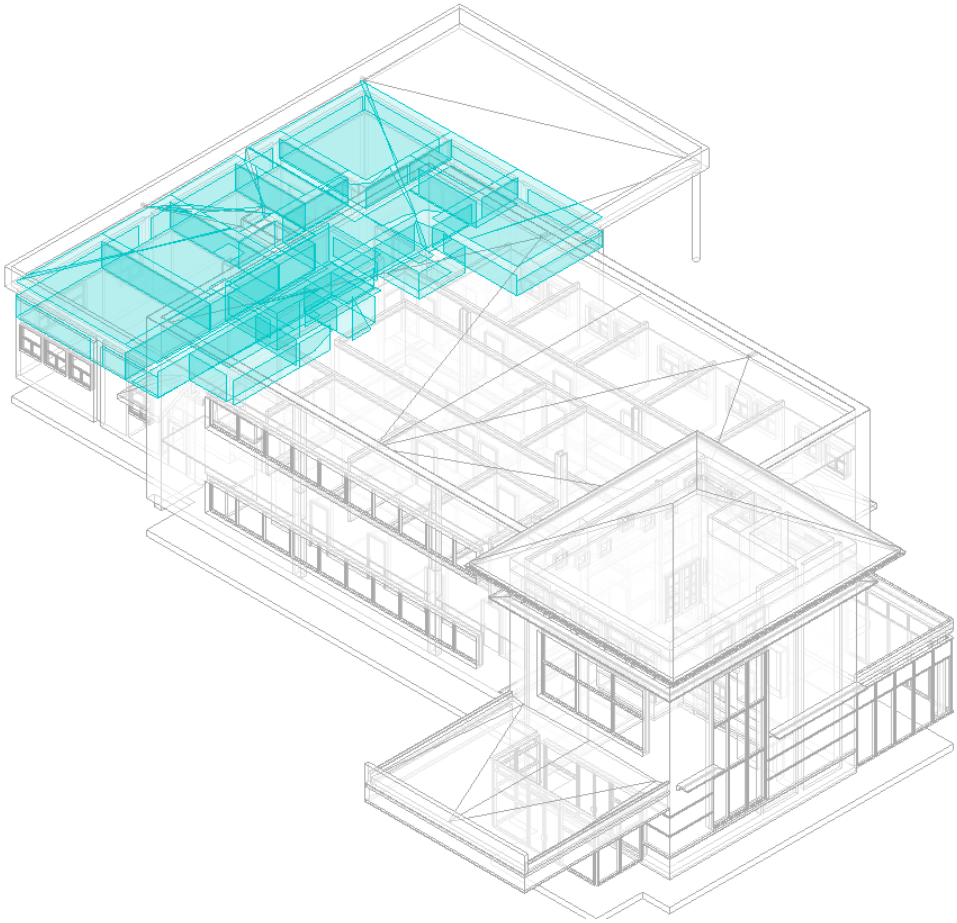
2. After the tool is activated, check the **Space Height** value – the offset is **13'4"** above the **second floor**, so we should not have any issues reaching the ceilings. Click **Place Spaces Automatically**, and the spaces will be added to the model:



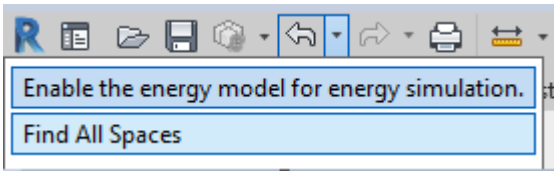
3. You'll get a warning about not being able to create the geometry for the Space, but hey…no worries. Let's get the energy model created and move on. Select the **Create Energy Model** from the **Energy Optimization** tab:



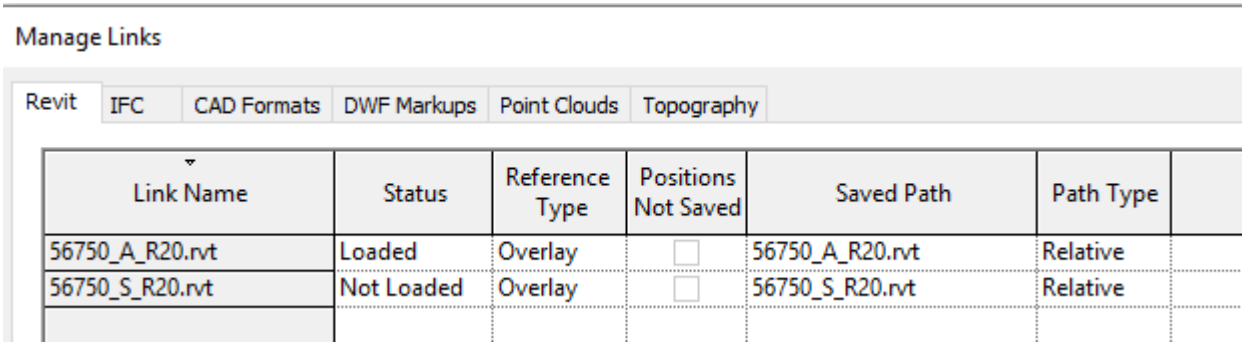
4. The friendly warning about this may take some time will pop up. **Be aware that they mean it.** If you have a 2GB model with 125 linked drawings and 73 linked Revit models that have 16 different phases, then yes – it will take a while. Click **Create the Energy model** to carry on. The model will take a few seconds in this case, and when it finishes, we should get a nice model view showing the analytical spaces…but we get this instead:



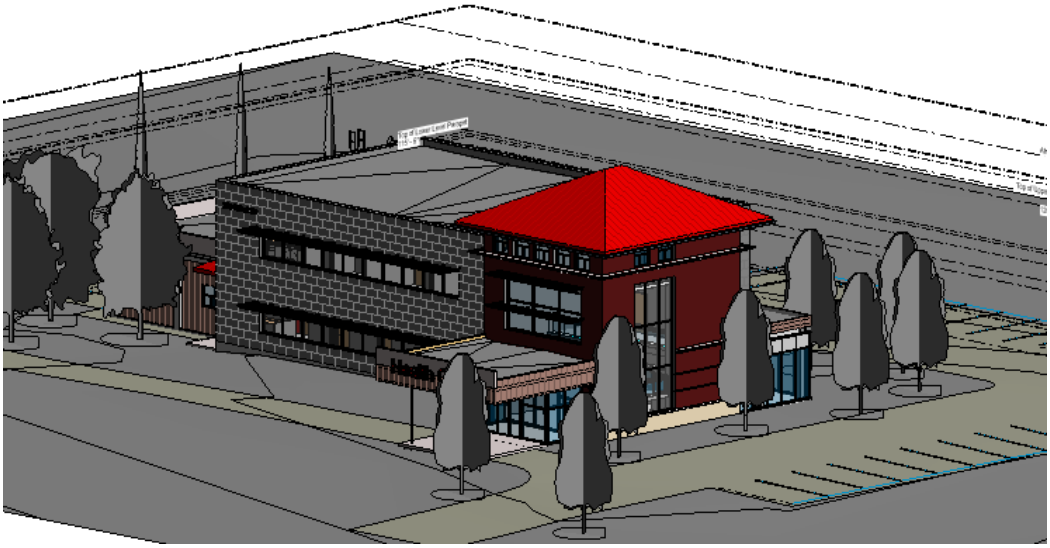
5. Only a handful of spaces appear, and it's a direct result of poor modeling practice. In order for analytical spaces to be correctly defined, they have to be ***completely bound*** – on all sides – by bounding elements that are also correctly defined. There are no shortcuts here – **the poorer the quality of the model, the less likely you will get a good energy model result**.
6. To fix this – where are the missing bounding elements? Let's get the model back to where we started. From the **UNDO drop down**, select the **Find All Spaces** command, which was used to add the spaces to the model:



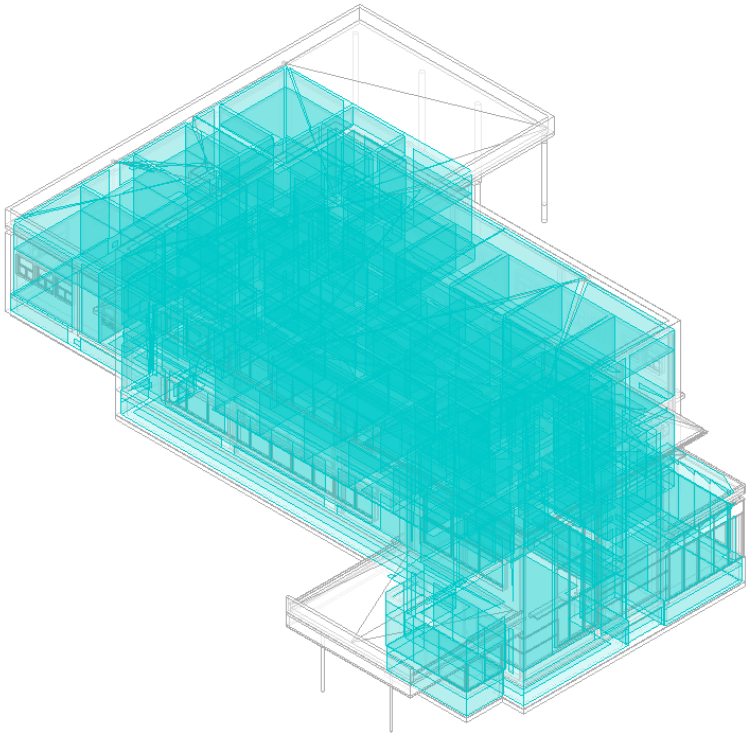
7. Next, from the **Insert** tab, go to the **Link** tab and select the **Manage Links** tool. Note that the **56750_S_R20.rvt** model is *unloaded*:



8. Select the **link name** and pick **reload**. **Click OK** to complete the command, and the structural model will be linked back into the model:



9. Back in the **SECOND FLOOR HVAC PLAN** – go back to the **Analyze** tab, **Spaces & Zones** panel, and repeat the steps to add the spaces back to the model. Once the spaces are added, run the **Create Energy Model** tool again. After the tool is finished, take a look at the **Space Analysis model view** again:

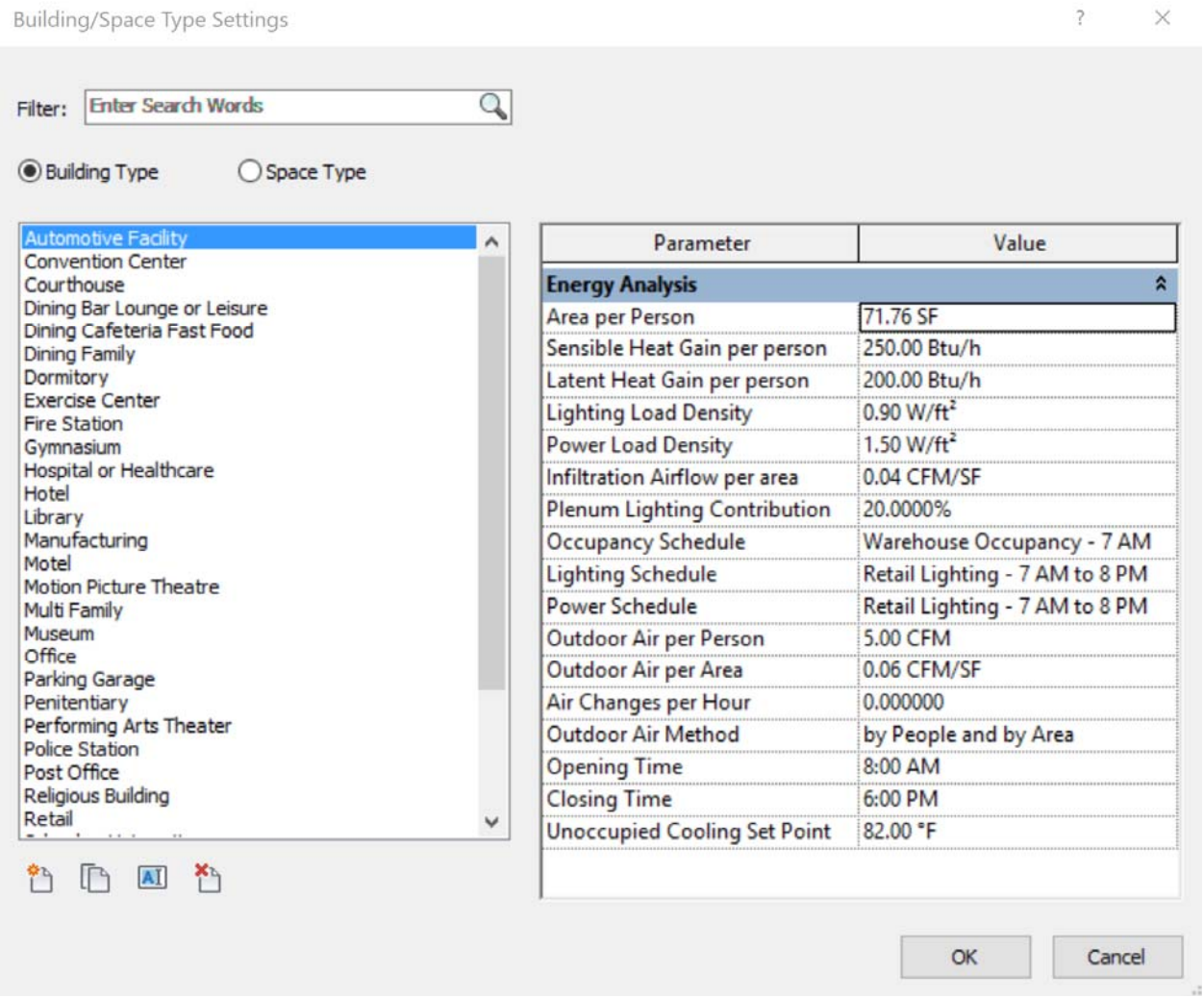


Now the model is much better formed than the previous – because even within linked models, the bounding elements must be well-formed. Don't make the mistake of assuming the architectural model will be the single source of energy modeling content for the model, but instead get back to your BIM PEP, and clearly identify not only who owns the model elements, but whether they need to be room bounding as well.

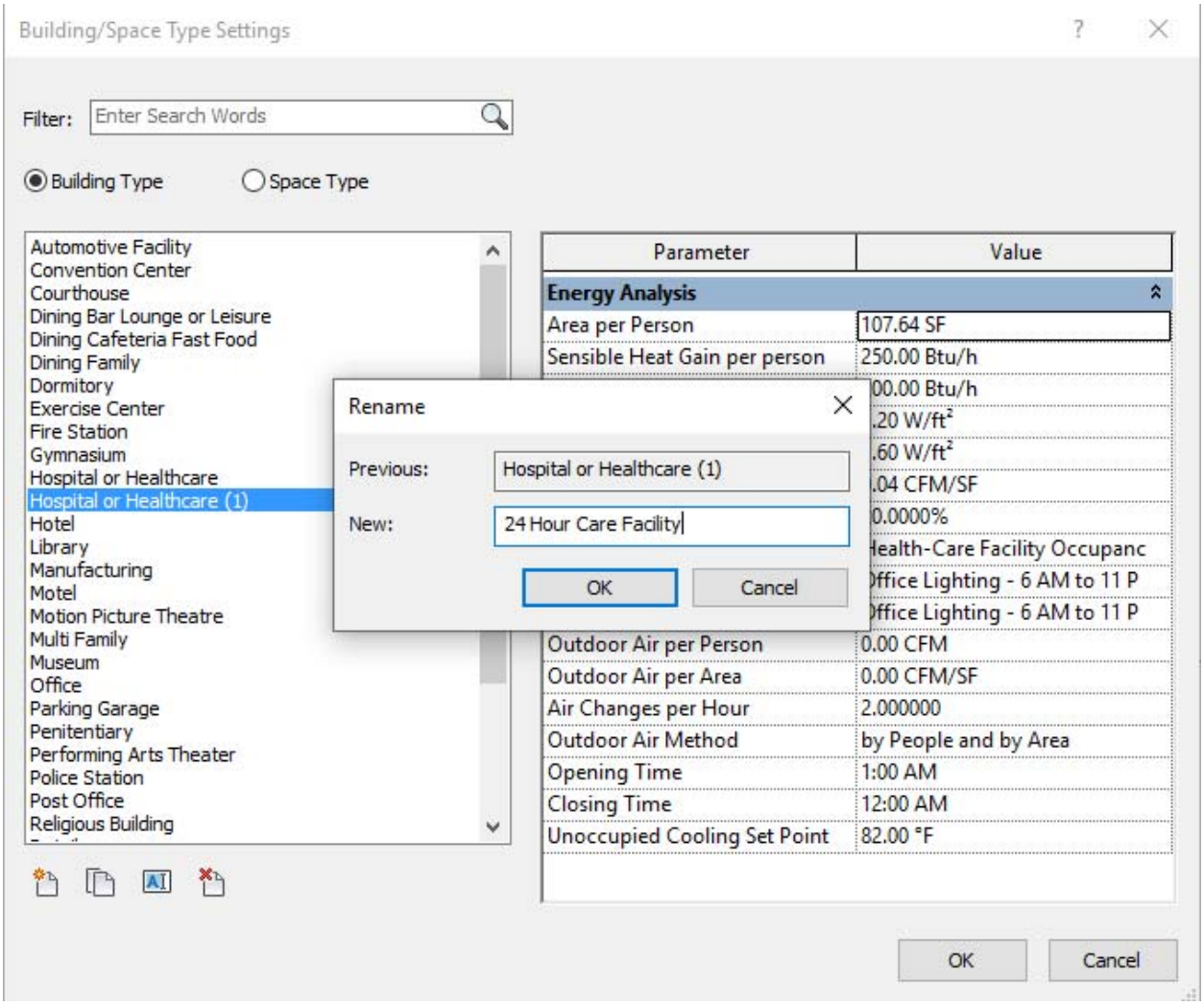
The Space and Building Types Are Better…for your Model!

In addition to making sure you have a well-formed model, it's important to review the building and space types that are applied to the project. These items store critical energy modeling data in regard to occupancy, operations, air flow and power/lighting density loads.

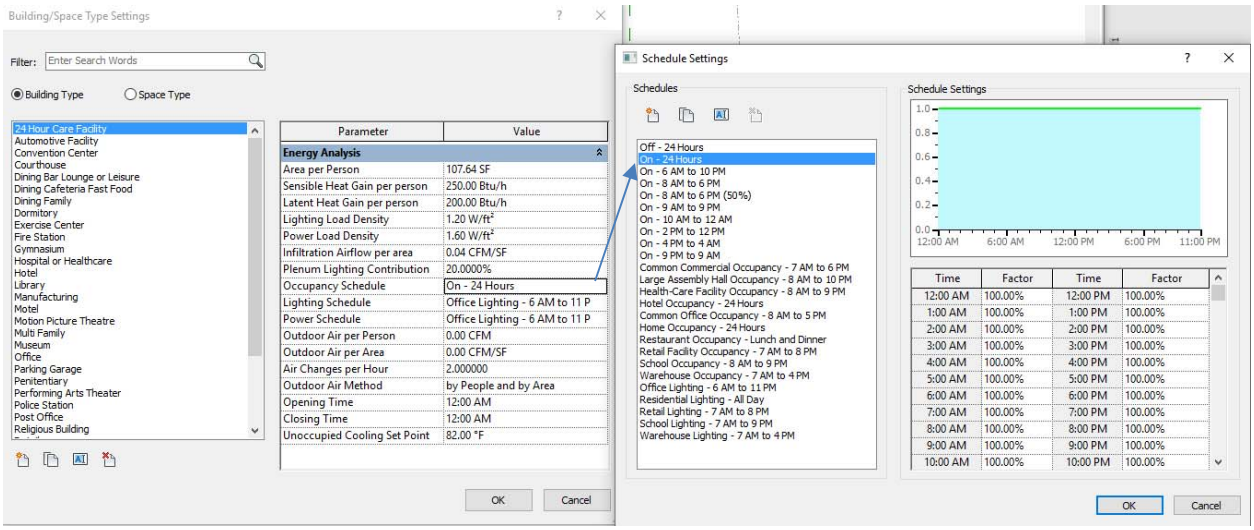
1. To access the building and space types, open the **Manage** tab > **MEP Settings** > **Building/Space Type Settings**:



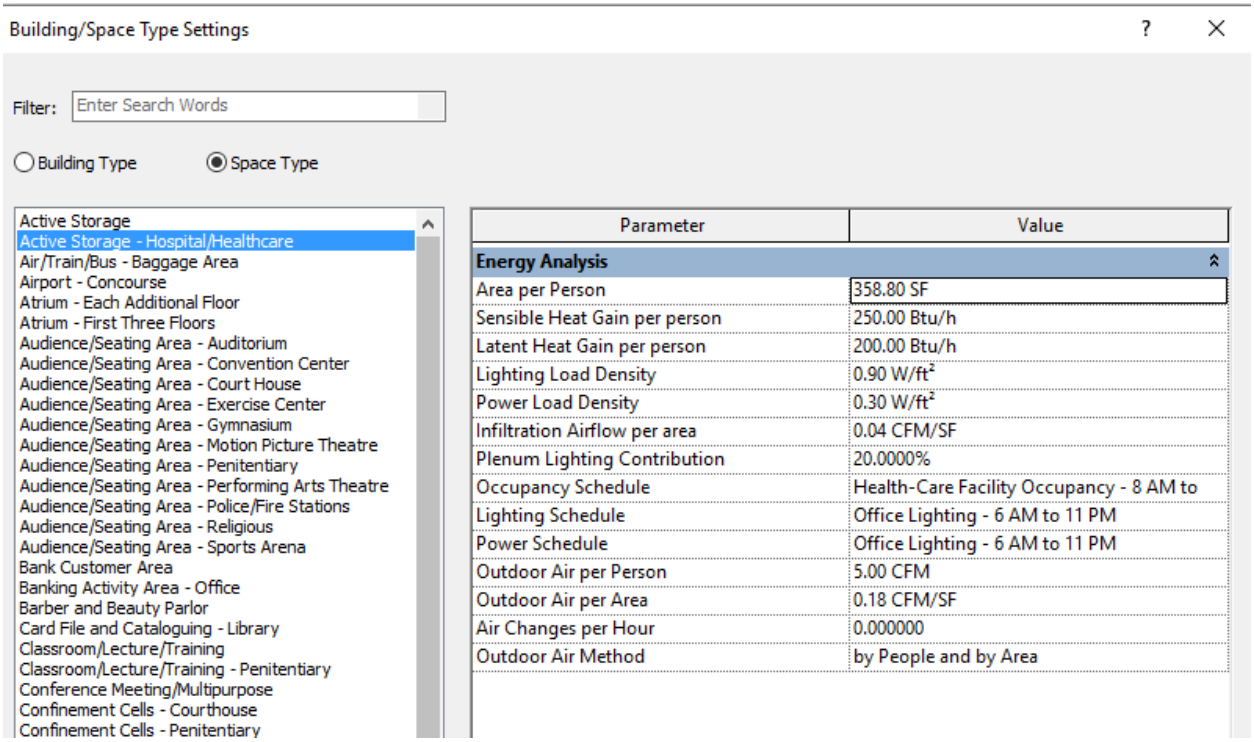
2. The default **building types** that come with Revit are based on the **ASHRAE 90.1** building types. Each type includes *heat gain, density and scheduling data* that's needed to determine the overall use of the building. Review the new settings – with EnergyPlus as the core modeling engine now, additional settings can be defined. You can adjust **Opening and Closing times** directly in addition to the occupancy schedules. To leverage today's managed heating and cooling systems you can also set the **Unoccupied Cooling Set Point** for the entire building.
3. At the bottom of the dialog, select the **Hospital or HealthCare** building type. Once it's selected, select the **Duplicate** icon at the bottom of the screen – this will create a new type with a (1) in the suffix. Rename the type to **24 Hour Care Facility**:



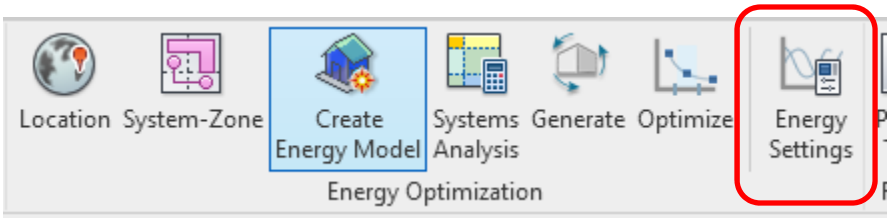
4. You can use any existing to create new variations that may have subtle differences and allow for a more accurate analysis. Set the opening time to **12:00am** and the closing time to **12:00am** to represent a 24-hour cycle.



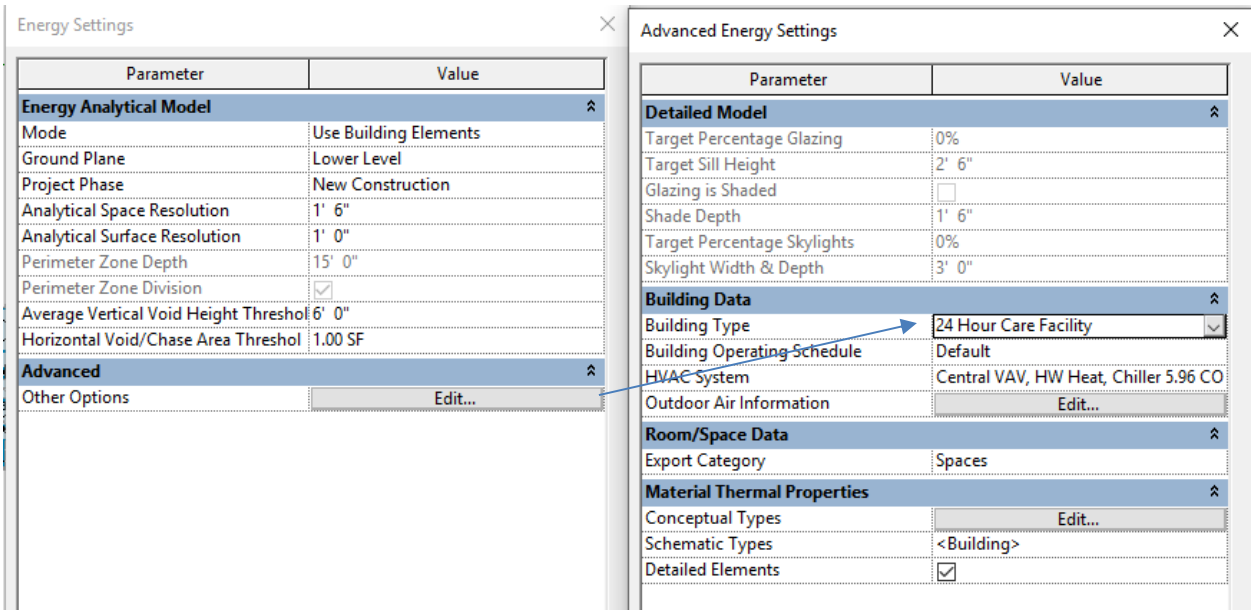
5. You can also set the **Occupancy Schedule** to **On – 24 Hours** to represent a full occupancy at all times. This helps generate a worst-case scenario for heating and cooling conditions. After adjusting the occupancy schedule, click OK to save the changes and close the dialog.
6. Next, change the dialog option to **Space Type** by selecting the button at the top of the dialog:



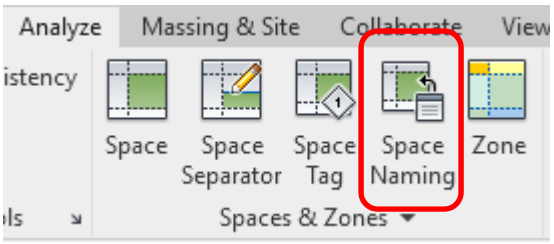
7. It's a good idea to edit the default space types in your template – as well as define a template based on the type of construction or building you are modeling. The space types override the building types at the individual areas of the model. This helps provide greater detail for the heat gains, density and schedule data. Review the settings for **Active Storage – Hospital/Healthcare** and **Office - Enclosed**. Click Ok to close the dialog when you're finished.
8. To apply the **building type**, open the **Energy Settings** shortcut from the **Analyze** tab > **Energy Optimization** panel:



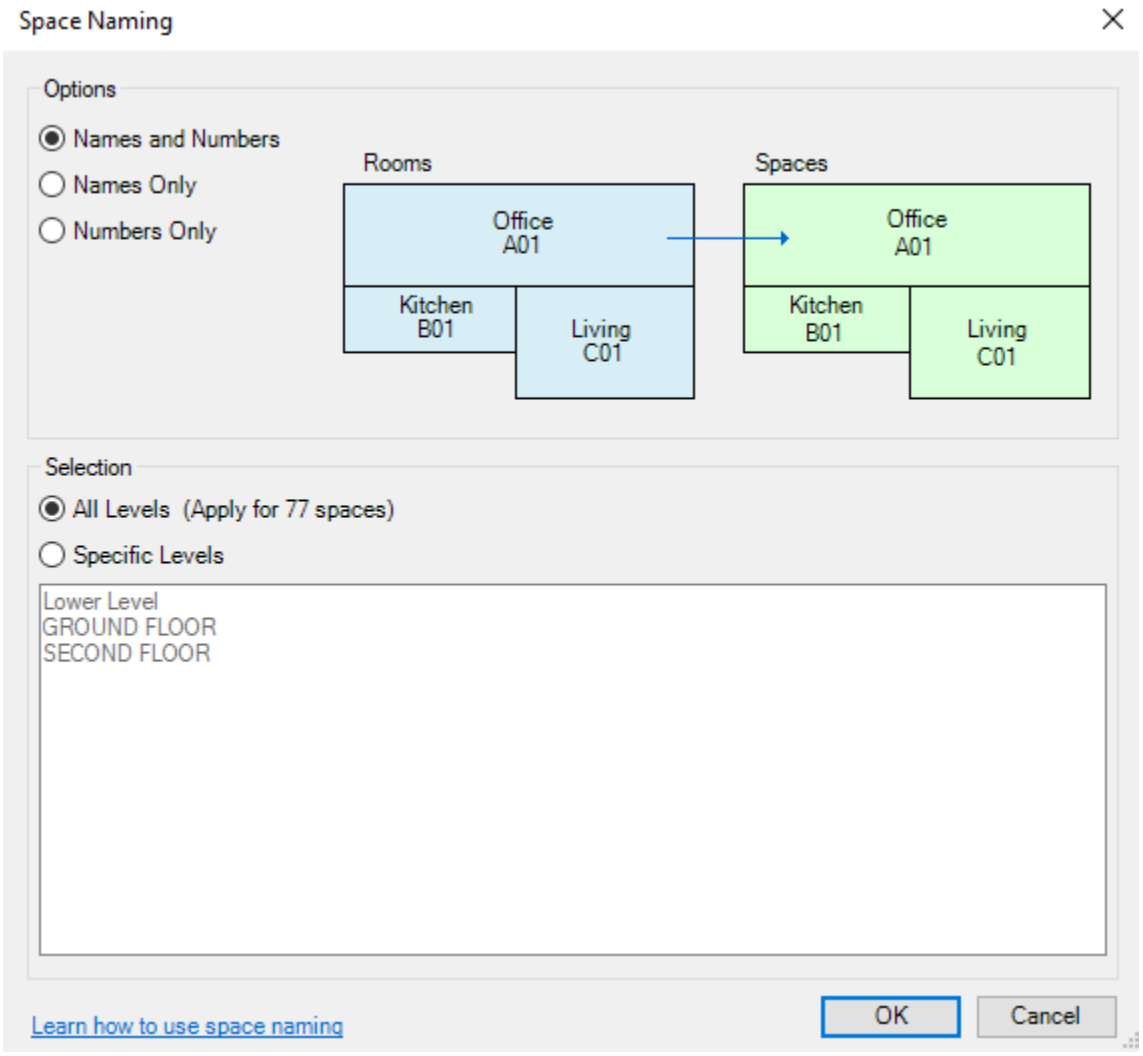
9. This will open the **Energy Settings** dialog – select the **Other Options** > **Edit** icon to open the **Advanced Energy Settings**. Now that you have the new **24-hour Care Facility** type defined, you can select it as the default **building type**:



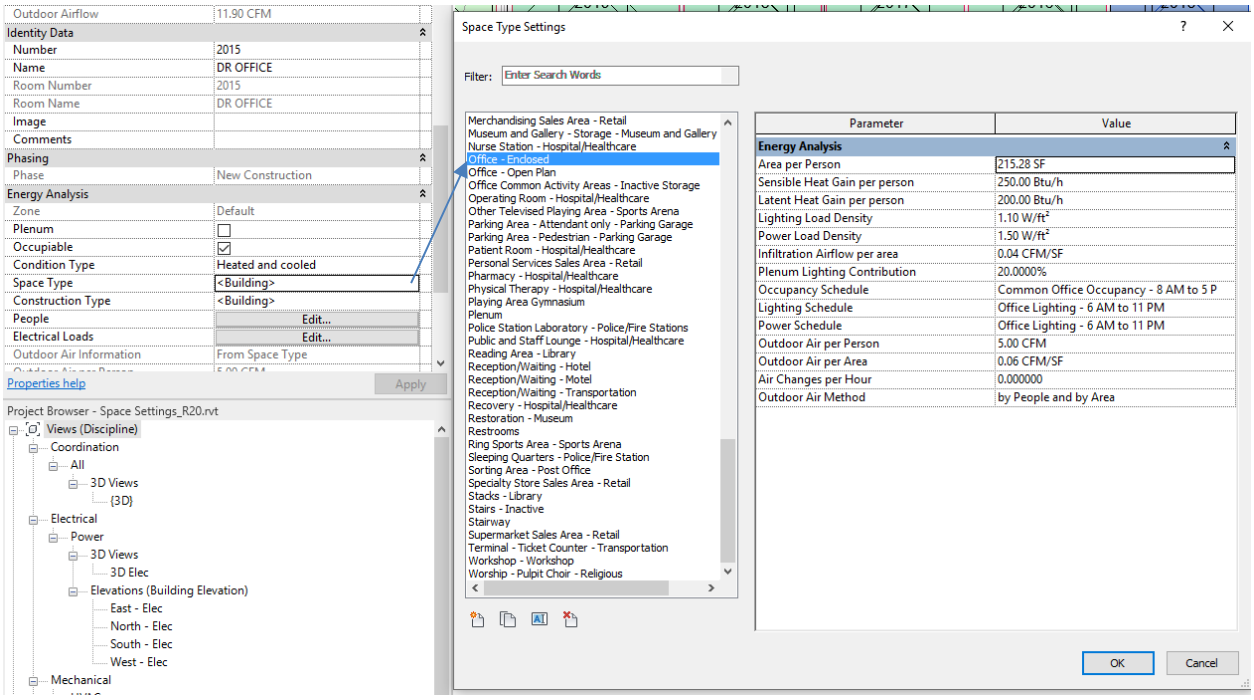
10. Click OK twice to exit the dialogs and return to the project. Make sure you have the **SECOND FLOOR HVAC PLAN** open. Now that you've added the spaces, update the names so they match the rooms from the architectural model. From the **Analyze** tab, click **Space Naming**:



11. When the dialog appears, the tool will default to **updating all spaces for all levels** – **click OK** to complete this step.



12. Now that the names are displayed, select one of the **DR OFFICE** spaces, and review the **Properties** palette. Locate the **Energy Analysis** section and note that the **Space Type** is set to **<Building>**. Select this line to change this to a specific **space type**:



13. By assigning the space type, you're providing more detail for the analysis model.

*BIG TIP – create a **space schedule** for your model, so you can see all of the spaces – open the one that is already defined in this project. It's a lot easier to make these changes from the schedule, as well as see any spaces that are not well-formed (and delete the from the project):*

SECOND FLOOR HVAC PLAN | Space Schedule

<Space Schedule>

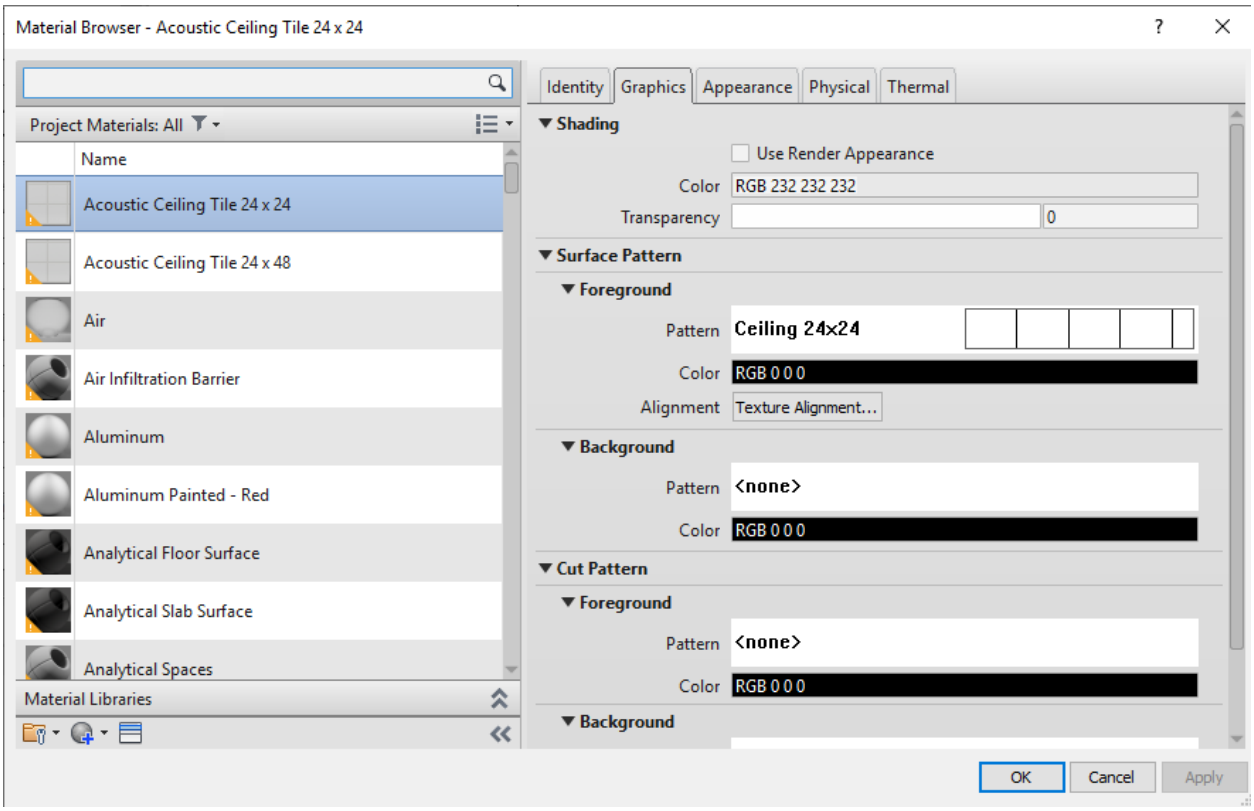
A	B	C	D	E	F
Level	Number	Name	Volume	Area	Space Type
Lower Level	1500	OUTPATIENT CENT	3978.18 CF	442 SF	Lobby
Lower Level	1502	PHARMACY	2575.92 CF	286 SF	Pharmacy - Hospital/Healthcare
Lower Level	1503	LAB	2049.69 CF	228 SF	Laboratory - Office
Lower Level	1504	XRAY DEVELOPIN	381.17 CF	42 SF	Office - Enclosed
Lower Level	1505	XRAY	1247.81 CF	139 SF	<Building>
Lower Level	1506	DR SCRUB	804.24 CF	89 SF	<Building>

This is one of the steps that's commonly ignored but can bring a ton of benefits to the analytical model. Don't skip these settings – make sure you review them after you get your spaces defined.

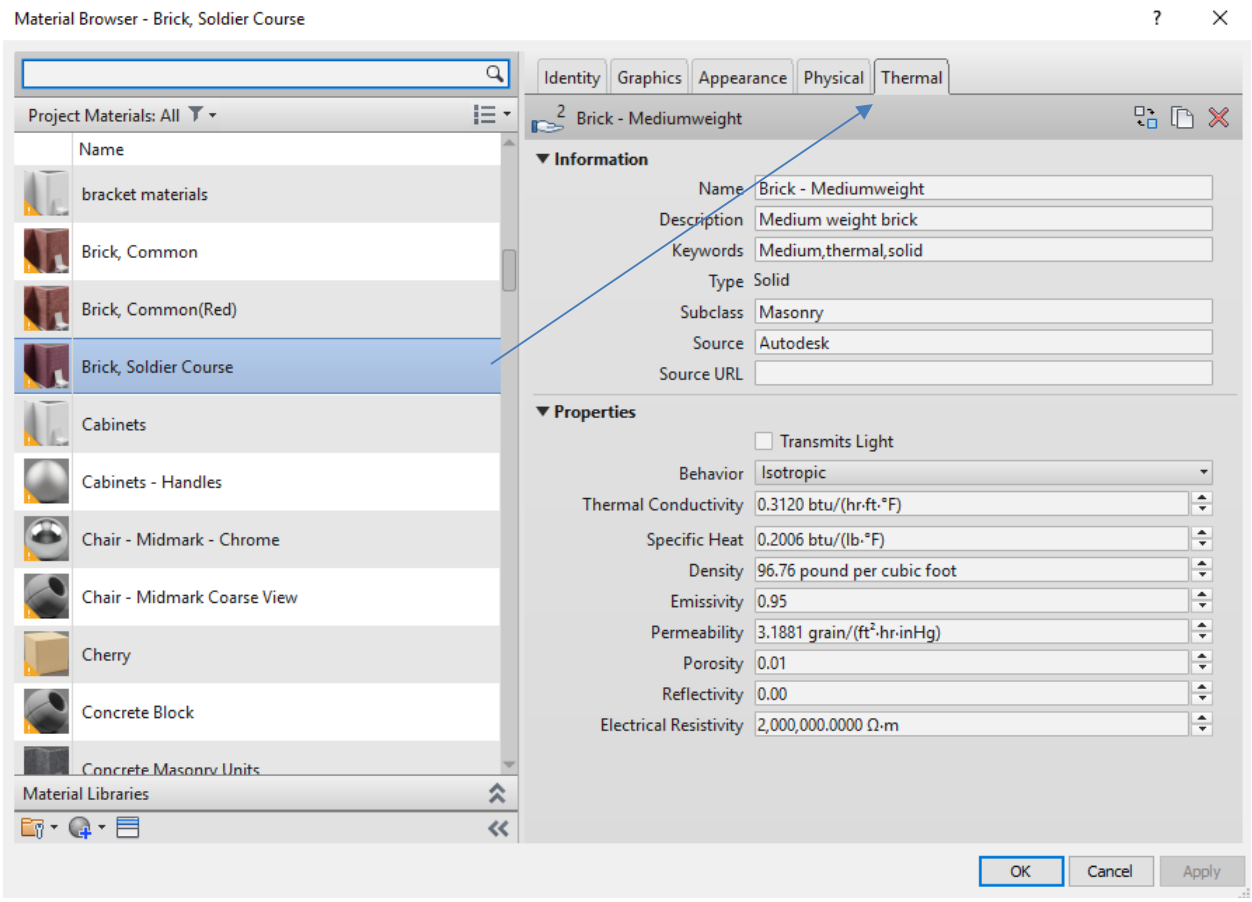
It's a Material Thing

The last feature we're covering is the most ignored benefit that Revit can provide, and both architects and engineers are guilty of skipping it. Material definitions that are assigned to bounding elements – walls, openings, floors, roofs, etc. – can include thermal properties in addition to pretty images and hatch patterns. There are some of the most critical settings that can impact the model when the Detailed Elements option is selected. We will use the Material Editor to review some of the common materials and make sure they are correctly assigned to wall types.

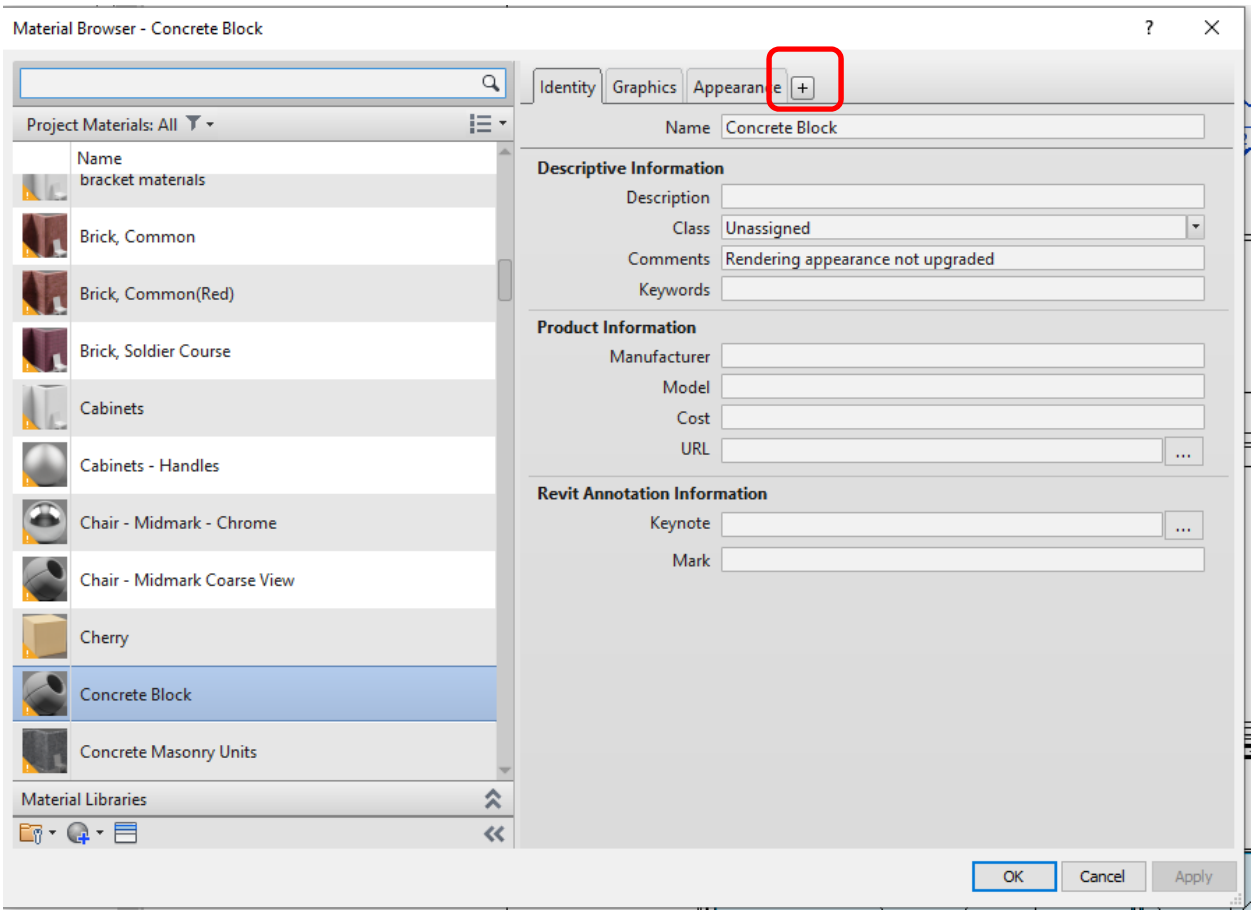
1. Open the **Detailed Architectural Elements.rvt** model. From the **Manage** tab > **Settings** panel, click **Materials**.



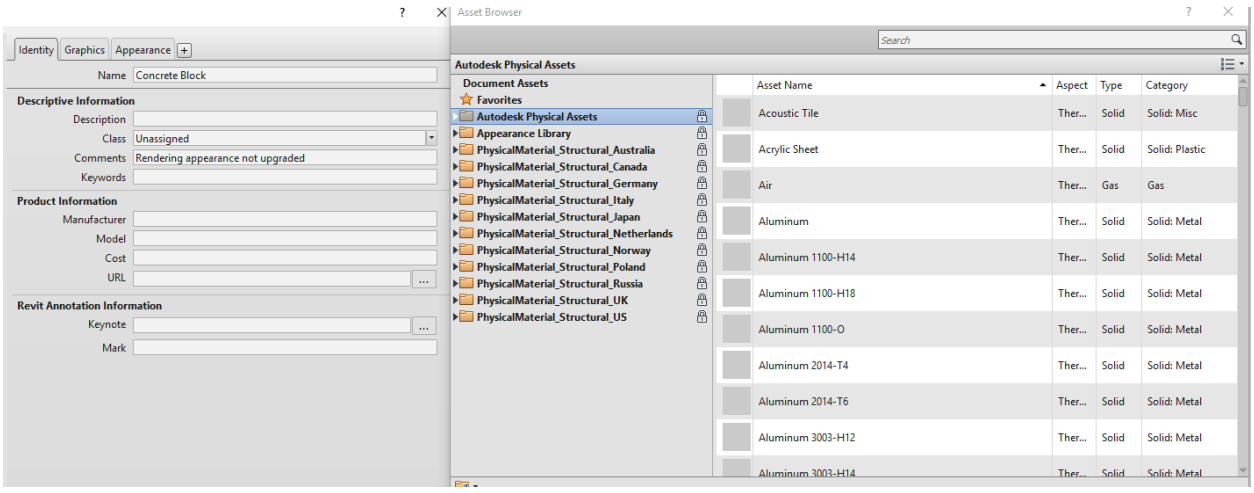
2. When the dialog is first opened, a list of materials that are *stored in the project* is displayed. Scroll through the list and select the **Brick, Soldier Course**. Select the **Thermal** tab, to display the information and properties:



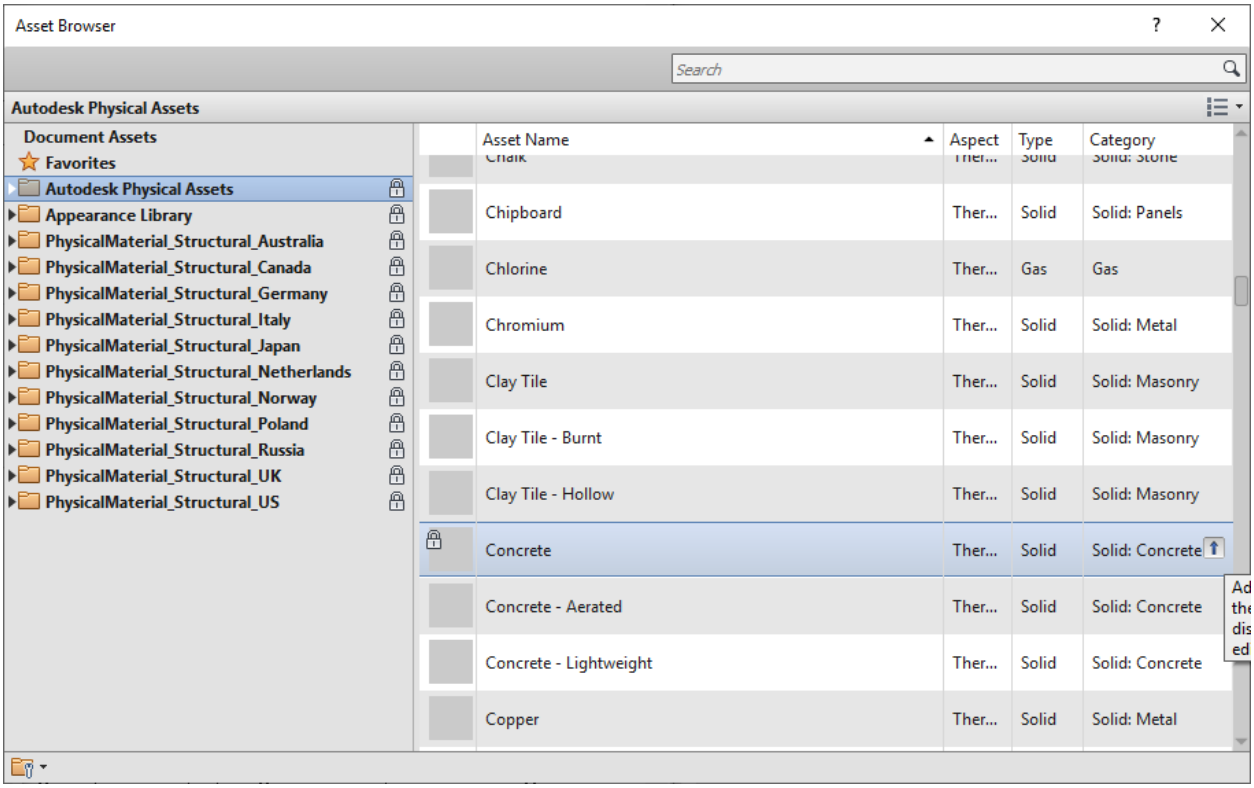
3. The properties define the **thermal** characteristics of the material – including *behavior, conductivity, specific heat, density* and more. Scroll down and select **Concrete Block**:



4. Not all materials include thermal properties. If you want to use the material and add the thermal properties, select the **plus sign** tab – the **Asset Browser** will appear:



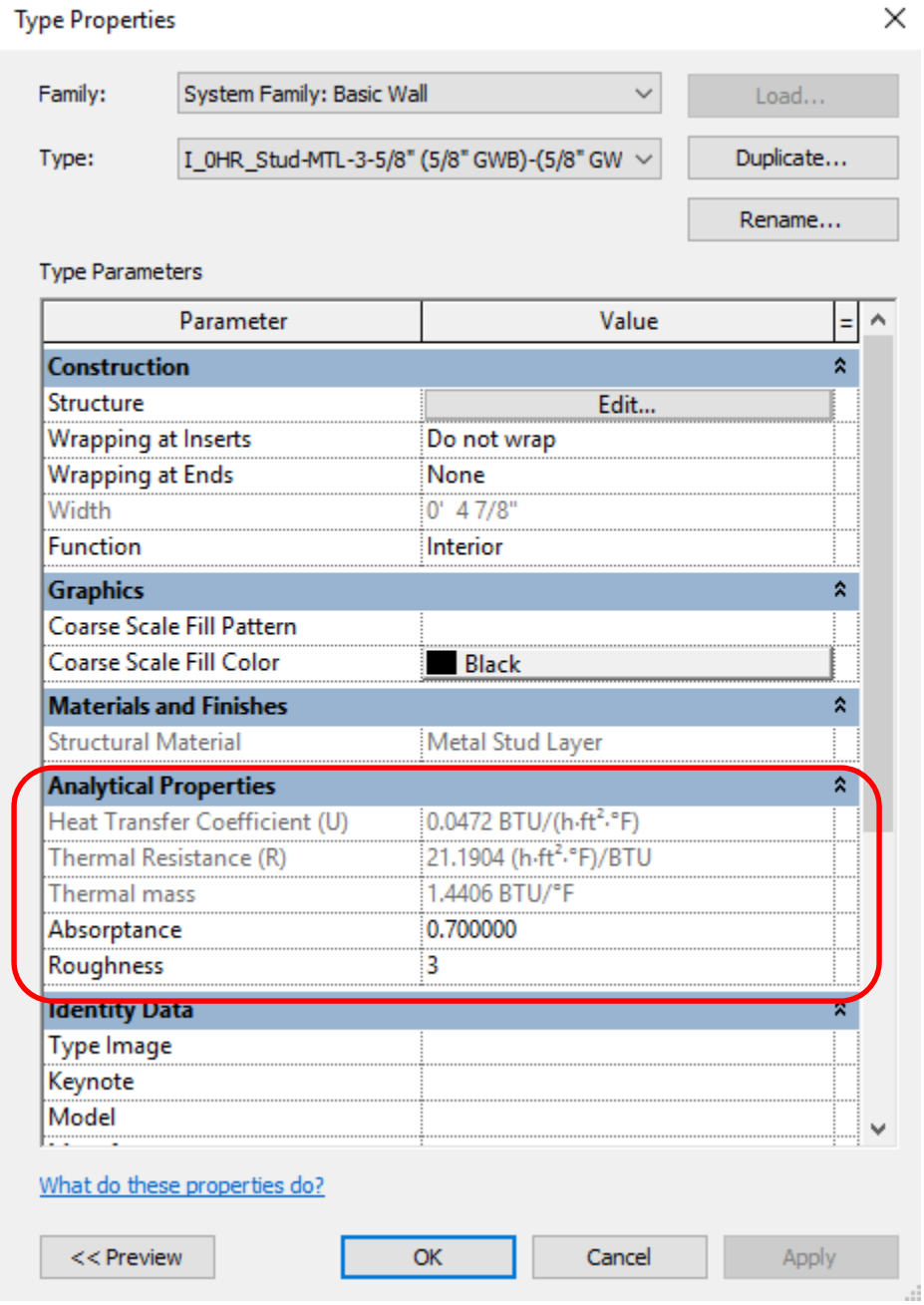
5. Autodesk ships several libraries with Revit, including materials of other regions across the world. The default library that includes thermal properties is **the Autodesk Physical Assets** library. By selecting the **Thermal** option, the list is automatically filtered to display predefined options. Scroll through the list and locate **Concrete**. Select the **arrow** to load this asset to the current material, **concrete**, in the Revit project:



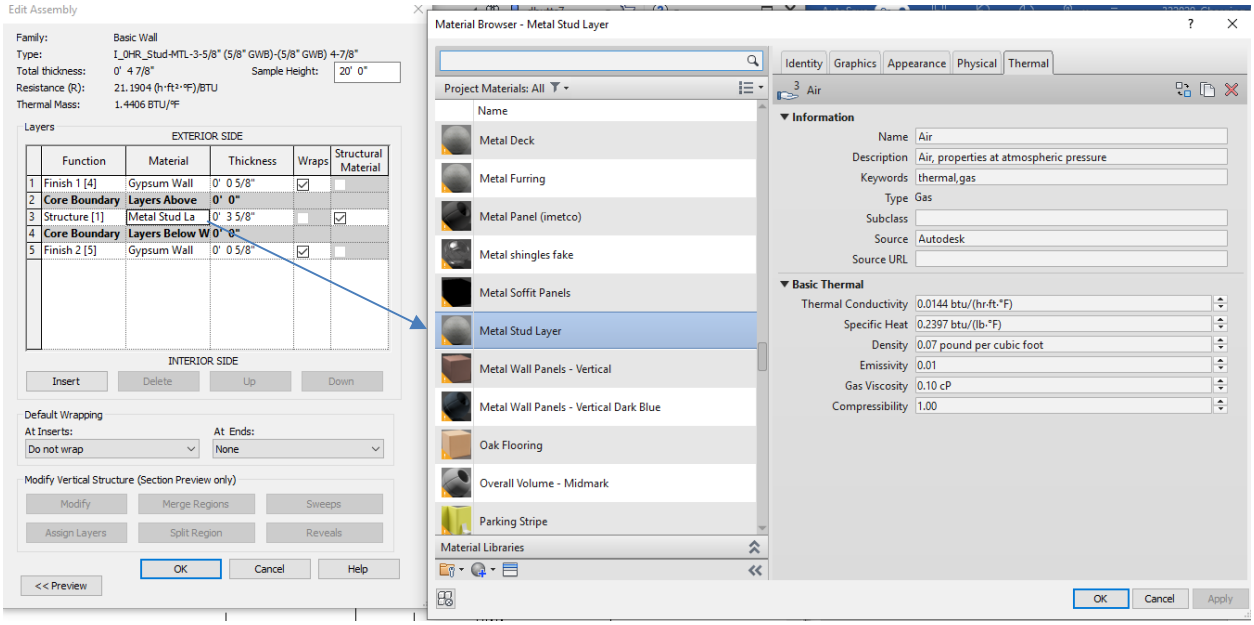
6. Once the material is loaded, a **double arrow** will appear. If the material is modified incorrectly, you can select the option to **replace** the asset in the project with the material from the library:

7. Once the asset has been added to the material in the project, you can return to the **Material Browser** and edit the **properties**, including the *name, description* and other thermal properties.
8. After adding the material, the last critical step is to make sure the material is **assigned**. The best way to handle this is to assign it the system family (such as a wall) or component family (such as a door or window). *If you want these items to appear for every project, make sure you add them to your template*. If it's a component family, you can **associate** a material with the **3Dsolids** used to define the component, such as the door panel, window sash and more. For example, if you select a wall, you can select the **Edit Type** option and review the properties. This particular example of an interior wall

shows the analytical properties – they are "*greyed out*" because the materials assigned the structure define the thermal properties:



9. To edit the default value, select the **Edit** button for **Structure**:



In this case, the thermal properties are assigned by the material as listed in the **Edit Assembly** tab. As long as the materials are using Thermal properties, and the analysis model is being told to use **Detailed Elements**, these properties will be used as part of the energy model analysis.

Last Words on Energy Modeling…

Keep these rules about energy and load analysis handy – you'll be much happier with the results.

1. These tools are always best used at the START of a project, when detail levels are low. The more geometry you have in a project model – including furniture, equipment, highly complex assemblies and more – the longer and less effective the tool is. The purpose is to help you in the early stages of a project determine what options you have available, and how they can affect the overall energy consumption of the building or structure you are working in.
2. Energy modeling is a TEAM effort. All of the players – architectural, structural and MEP have to buy-in to setting up their models correctly and including the correct assignments from the materials up to the building type. But Revit is also forgiving and will let you use default overrides in the MEP model settings.
3. Remember that the model must be properly bound – this includes walls, openings, floors, roofs and ceilings. Rooms and spaces must also be included. Don't skip steps or cut corners here – without these, you won't get a good analysis. This also applies to linked models – make sure they are set to be room bounding.
4. Avoid "over bounding" – not every item in a room needs to be set to room bounding. Column enclosures are a great example – they have little impact on the overall energy model.

5. Check your energy settings – understand the differences between conceptual masses and building elements and when to use each, or both.
6. Assign your building and space types appropriately.
7. Review the materials and their thermal properties if using the Detail Elements option.
8. Keep your DWG's out of the model!!

In the End…Schematics in Revit

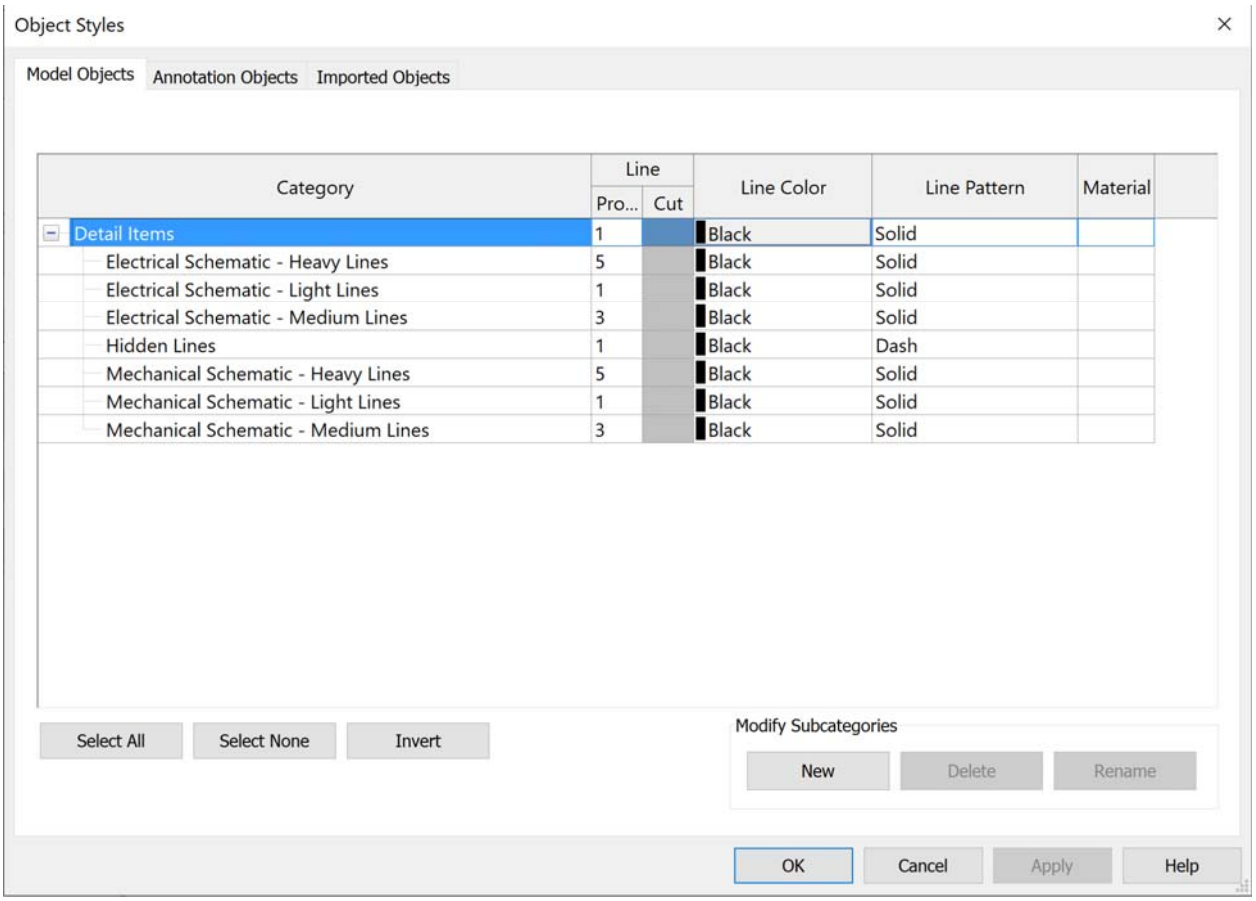
Most firms are still dependent on AutoCAD for creating schematic diagrams, such as process and instrumentation, electrical and plumbing risers, and process flow diagrams. But even then, you still need some level of customization over base AutoCAD to make it efficient. AutoCAD MEP and Plant 3D both contain schematic layout tools, but not all users have these licenses in a collection.

So how do you get AutoCAD out of the loop – and start doing things in Revit? It begins with some understanding of detail families, annotation families, and nested family behavior. We'll start by examining the detail items first.

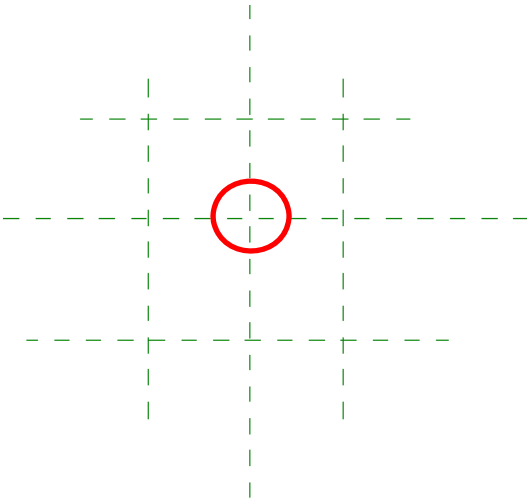
The Symbol

There's only going to be one rule that applies to schematics – everything needs to be produced at 1:1 scale. If you can stick to this rule, life will be good. Detail items are best used for schematic linework that represent the symbol itself. To get the symbols right, it's best to set up a schematic family template that contains the line styles and types you need.

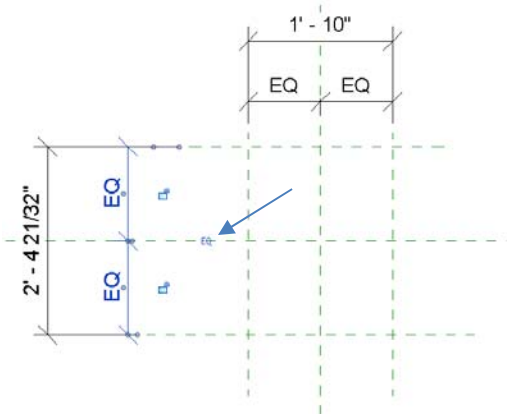
1. Make sure you have the family, **Schematic Symbol.rfa** open. This file contains examples of **line patterns** you can use to create your own library, but detail families require that you add subcategories to the Detail Items category that defines this family. From the **Manage** tab, select **Object Styles**:



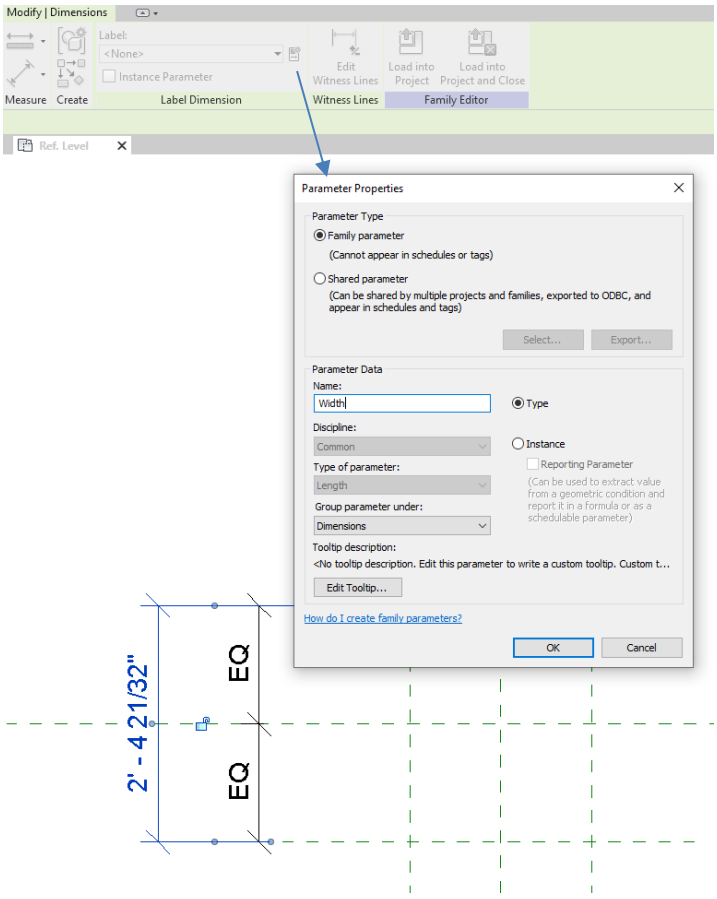
2. This example shows how you can use **object style subcategories** to define the linework. You can edit the properties of the subcategory from the **Object Styles** tool, under **Model Objects, Detail items** after the family is loaded into a project. Detail families do **not** support the creation of line styles, so this is where the linework needs to be defined. This family already includes examples of subcategories you can use.
3. Next, create **reference planes** that can be used to align linework associated with a symbol. From the **Create** tab**, Datum** panel**,** click **Reference plane**. Draw four reference planes as shown:



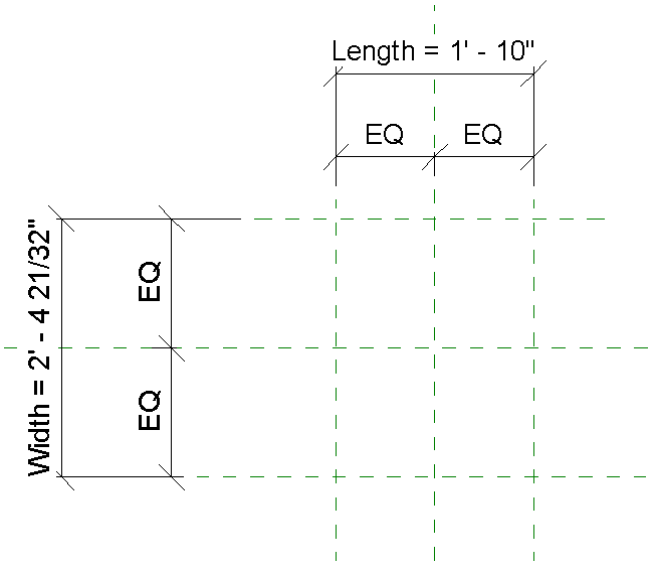
4. In this example, you are adding **four planes** around the **insertion point**, so the part will be placed from the **center** of the primary center front back and center left right planes. Next, add dimensions to allow the user to set the width and length of the box:



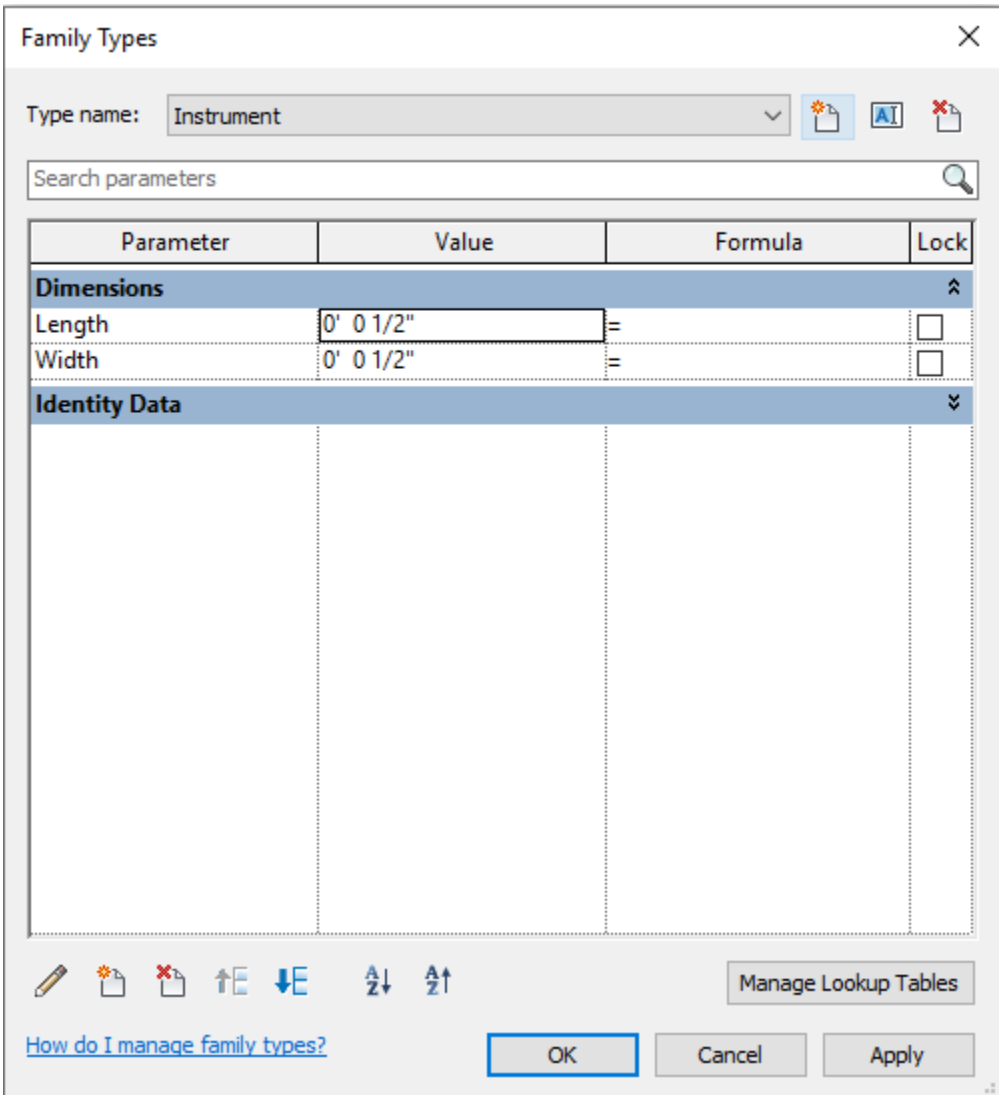
5. To create the **EQ** dimension as shown, run a string of dimensions from an outside reference plane, to the center plane, and then the opposite plan. You can select the dimension and use the **EQ** grip to create equidistant spacing. After placing all of the dimensions, select the overall dimensions (indicated by having a distance) and add two labels, length and width as shown:



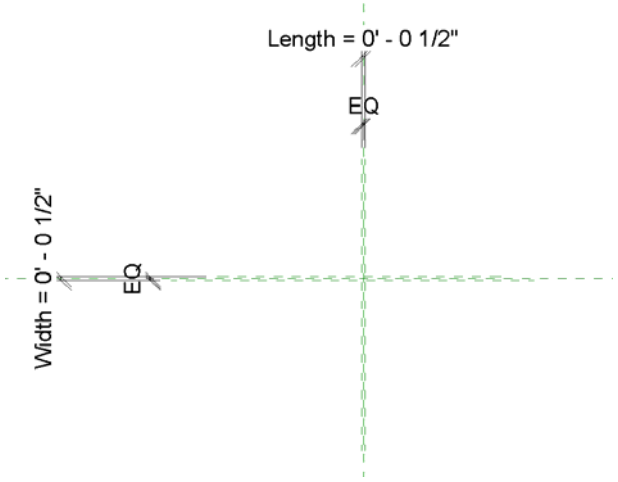
6. After the **labels** are assigned, your family should appear like this:



7. Next, select the **Family Types** dialog from the **Properties** panel to edit the default values:

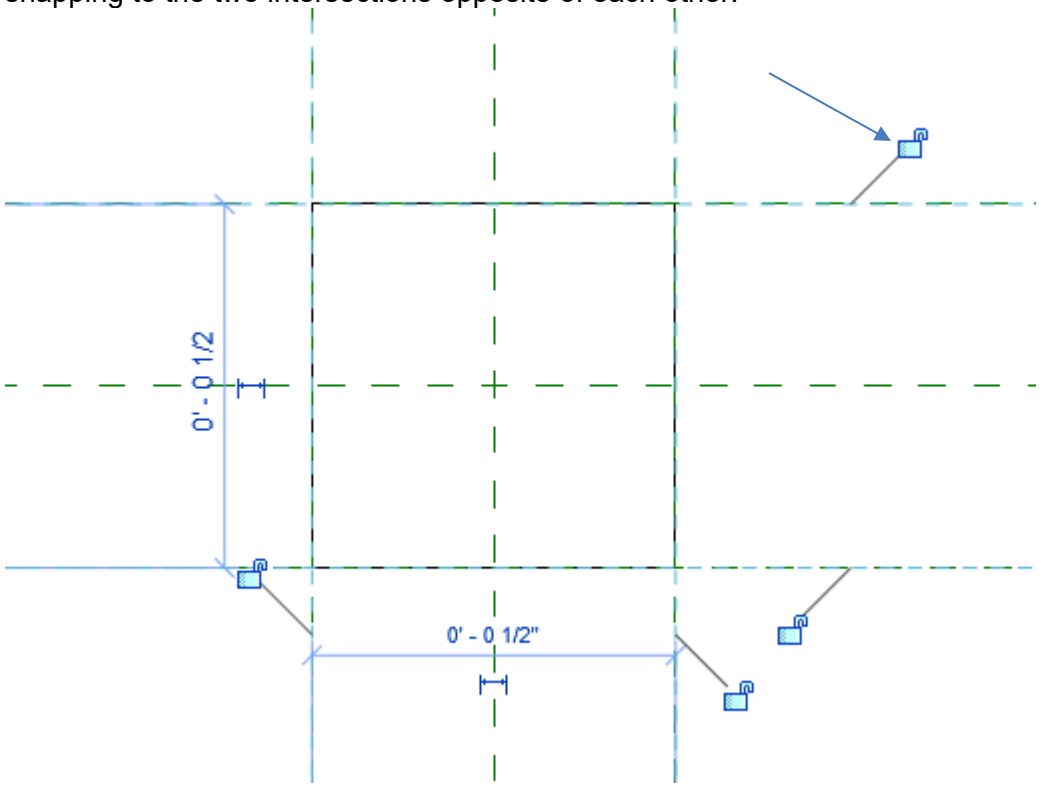


8. Don't skip steps here – make sure you **name** your type. If not, the type in the project will take on the name of the family itself, and if you have multiple types in one family, you need to define each type within the family first. This example was named **Instrument**, and the **length and width values were set to ½"**. Click **OK** after making these changes, and the symbol should look like this:

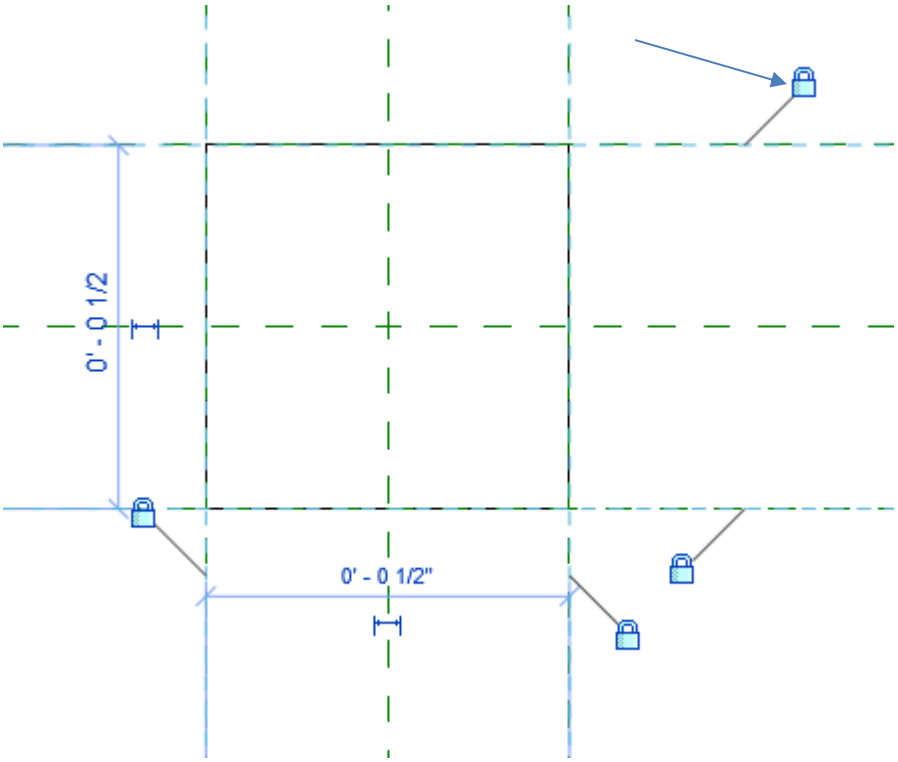


Tip – set the SCALE for the view to 12" = 1'-0" to see the dimensions at the same scale that you want to load the family. Scale will still be determined by the detail view, but you can edit scale to allow annotations to resize in the model – the detail item will remain at the defined size, since it is not annotative.

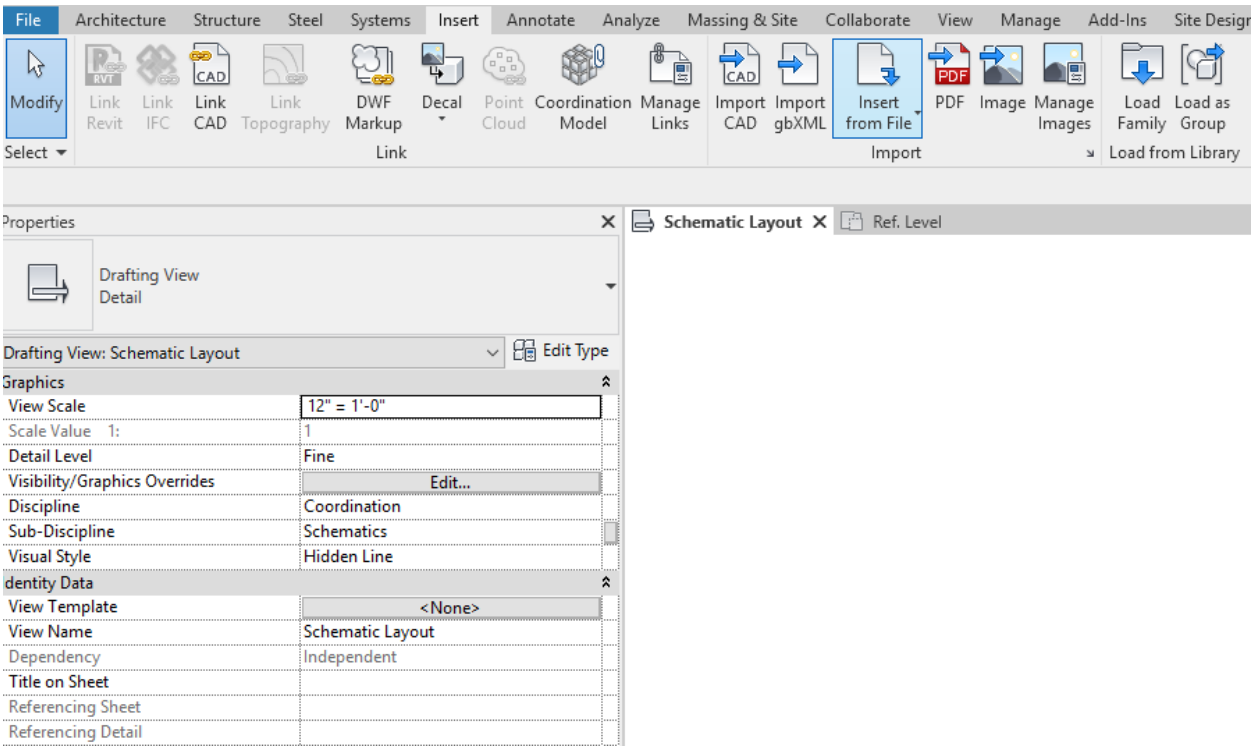
9. Now that the frame is defined, zoom into the center of the family to add the linework. From the **Create** tab, click **Line** to start the line tool. Set the **subcategory** to **Electrical Schematic – Medium Lines**, and use the **Rectangle** option to create the lines, snapping to the two intersections opposite of each other:



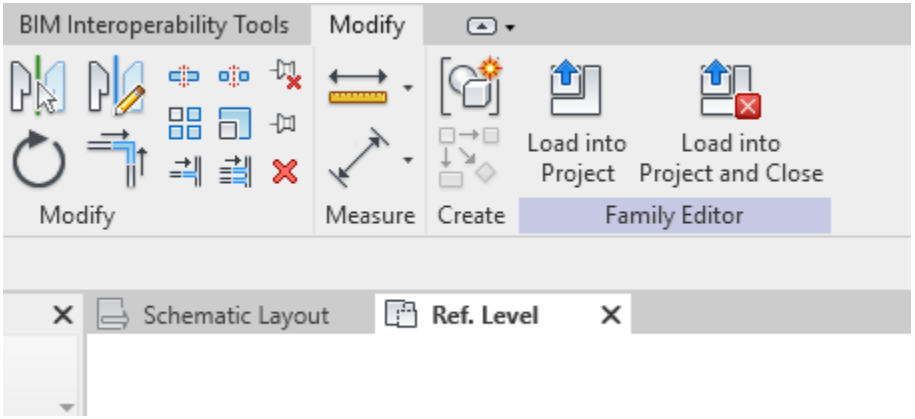
10. The advantage to using a rectangle is that all 4 constraints needed to look all four lines to the reference planes appear at once – click each one to lock them immediately to the reference planes:



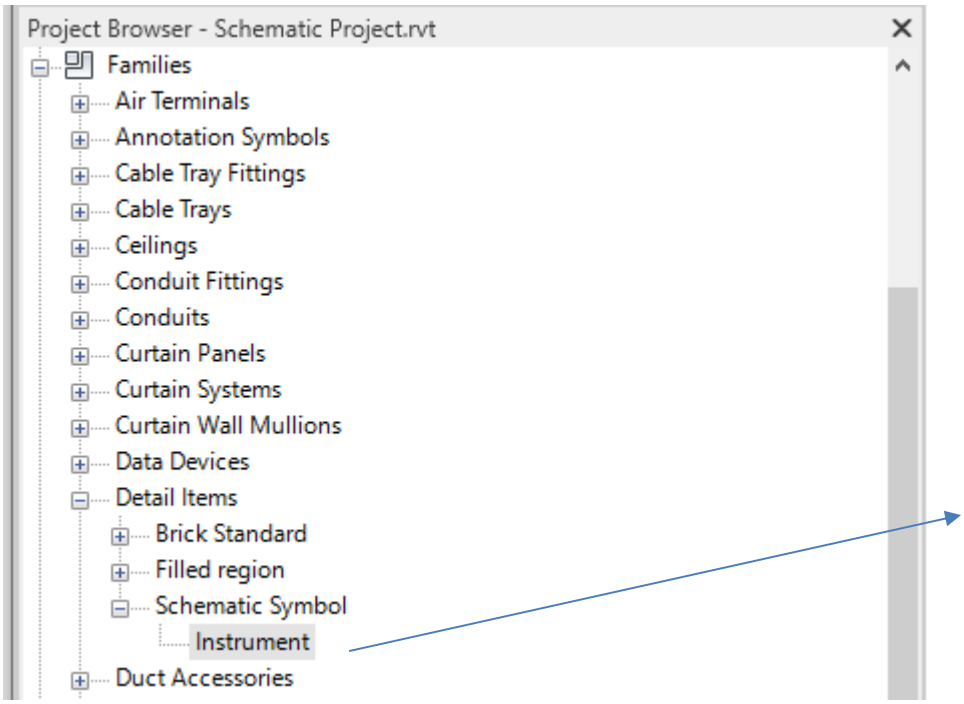
11. Now that the lines are added, save the family. Next, open the **Schematic Project** model and make sure you have the **Schematic Layout** drafting view open:



12. Switch back to the **ref level** view for the **schematic symbol** family, and choose **Load into project** from the **Modify** tab:



13. Once the family is loaded, you can **drag and drop** the symbol by expanding the **project browser** to the **Detail Items** section, and expanding the family to show the **instrument** type:

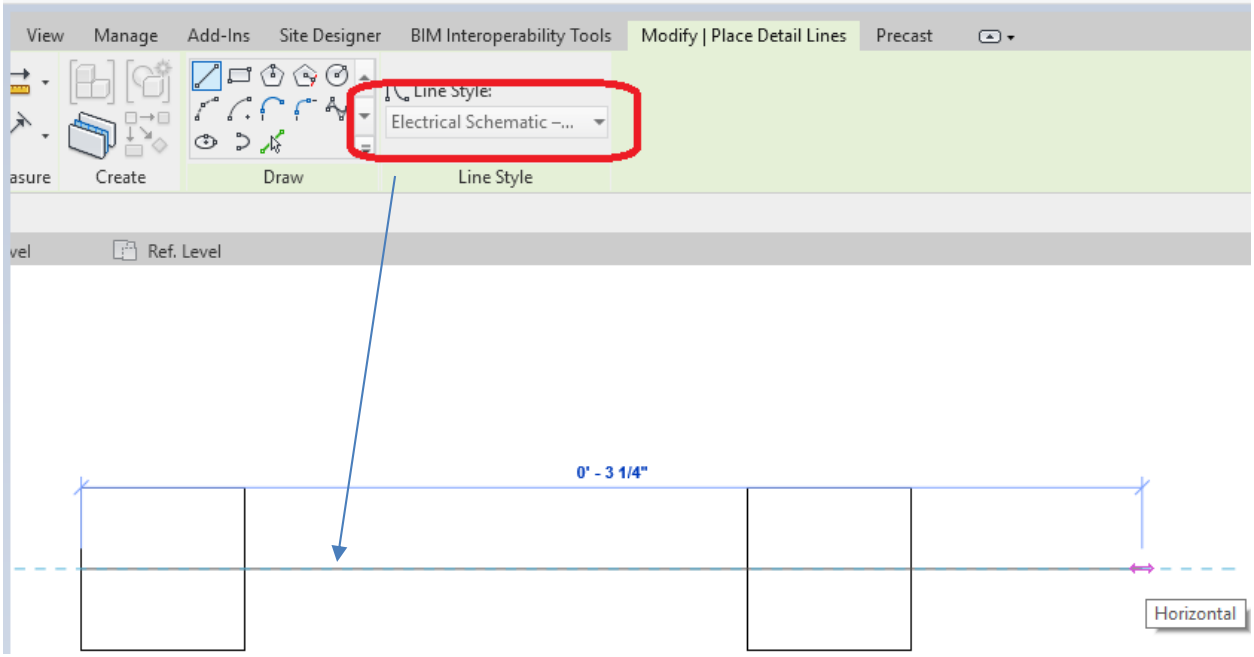


After getting symbols defined, you can now start creating a schematic layout

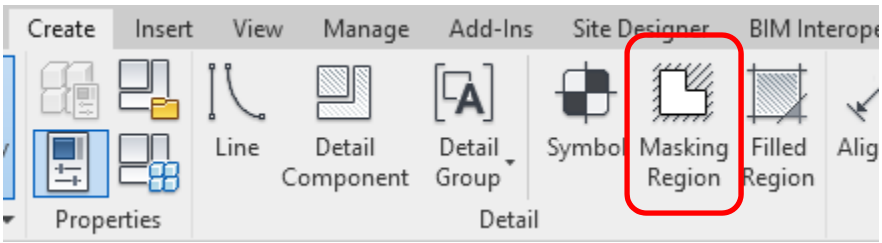
Adding the Schematic lines

Once the symbols are loaded into the project, you can add detail lines easily. It's just a simple step, but you also need to know how to get the linework to interact with the symbols. This includes having the symbol hide a line and anchoring the symbol to the line, so it moves when the lines moves. Let's continue from our last steps to see how this works.

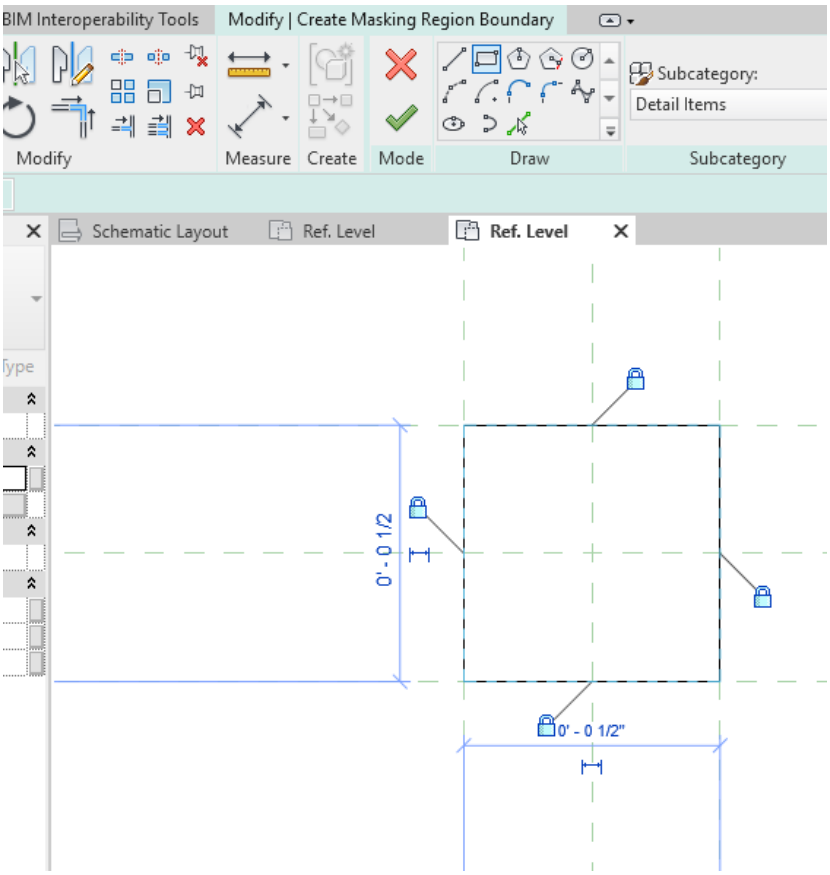
1. After placing a couple of symbol examples in the **Schematic Project**, from the **Annotate** tab, **Detail** panel, click **Line**. This project already includes the schematic line styles (added from the **Manage tab > Settings panel > Additional Settings > Line Styles**). Select **Electrical Schematic – Medium Lines** for the line style used to create the linework:



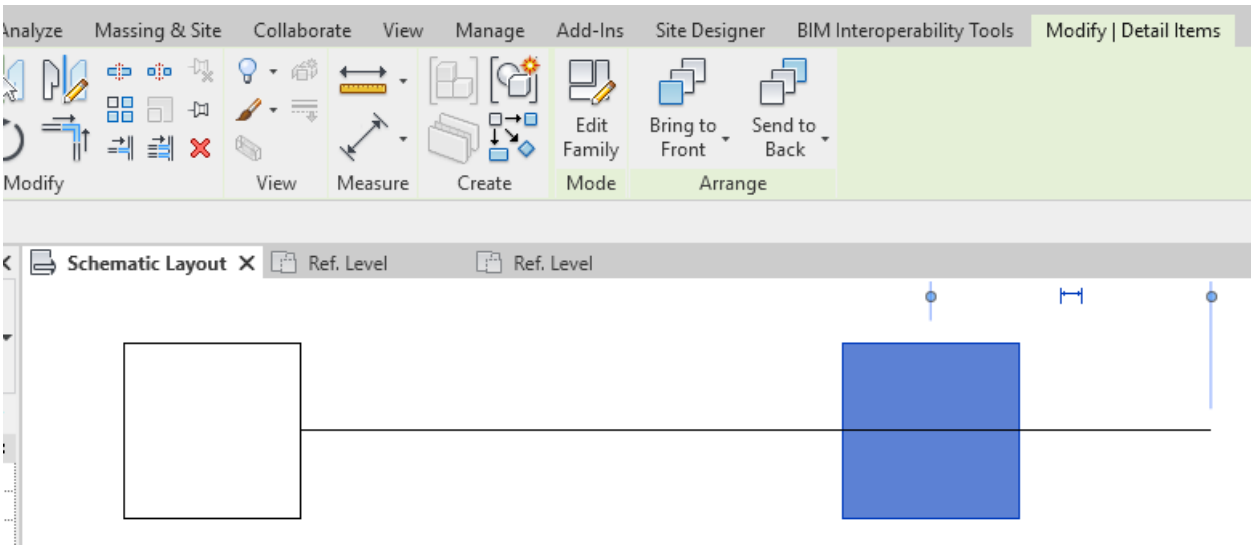
2. This adds a line that goes over the symbols. But what if you want the symbol to *mask* the line? Add a **masking region** to the symbol family. Switch back to the **Schematic Symbol** family. From the Ref Level view, **Create** tab, **Detail** panel, click **Masking Region**:



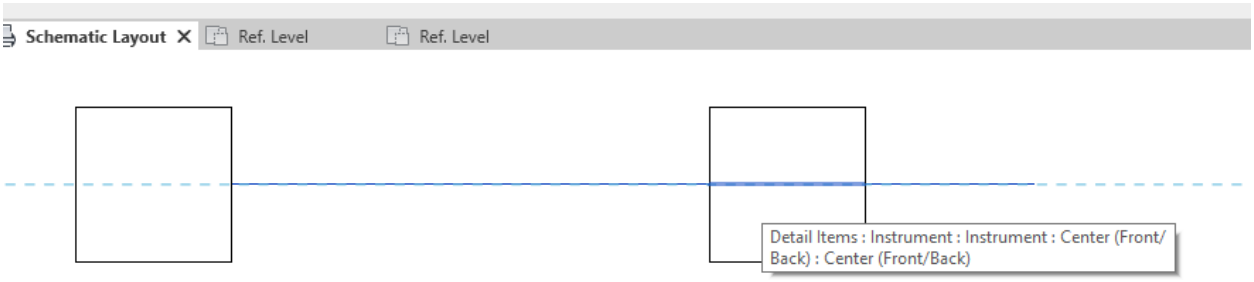
3. Using the same tools used to create the lines, add a **rectangle** to define the outline of the masking region, snapping to the **lower left** and **upper right** intersections. Make sure you click the **lock grips** to lock the masking region to the linework:



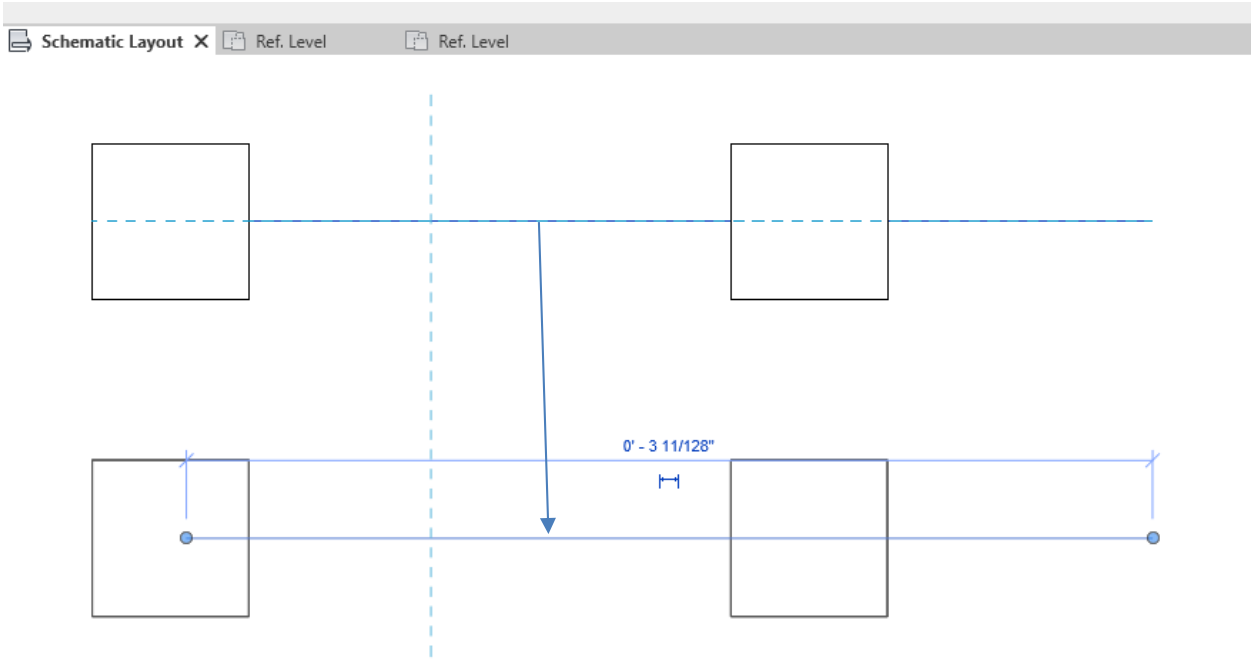
4. Click the **green check** to complete the step. Save the family, and then select **Load into Project** to load it into the Schematic Project. When prompted, *overwrite the existing family*. After it's loaded, select the symbol if the line is not masked immediately, select **Bring to Front** to pull the symbol in front of the line:



5. Once the option is selected, the line will be hidden. You can **constrain** the **symbol** to the **line** by using the **Align** tool. Select **Align** from the modify tab, then select the **linework** first. Next, select the **reference line** *within* the **Schematic Symbol** to complete the task:



6. Select the **lock grip** when it appears to create the alignment constraint. Now the symbol will move with the line.

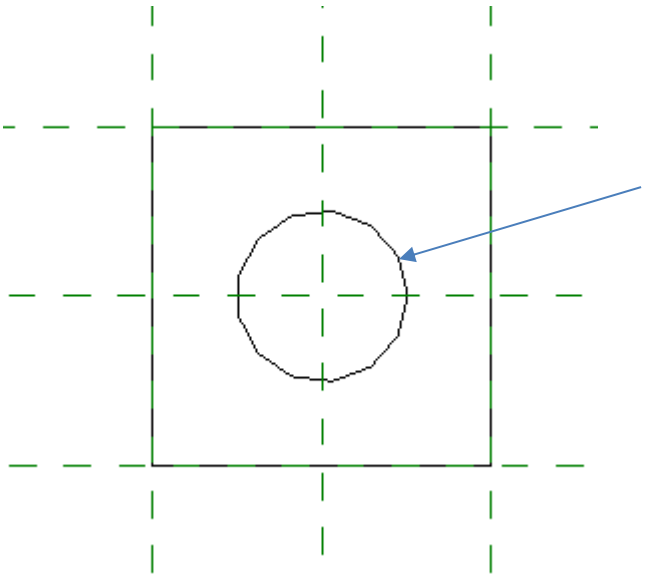


Now that the line and symbol are related to each other, the next step is to control what you see in the schematic.

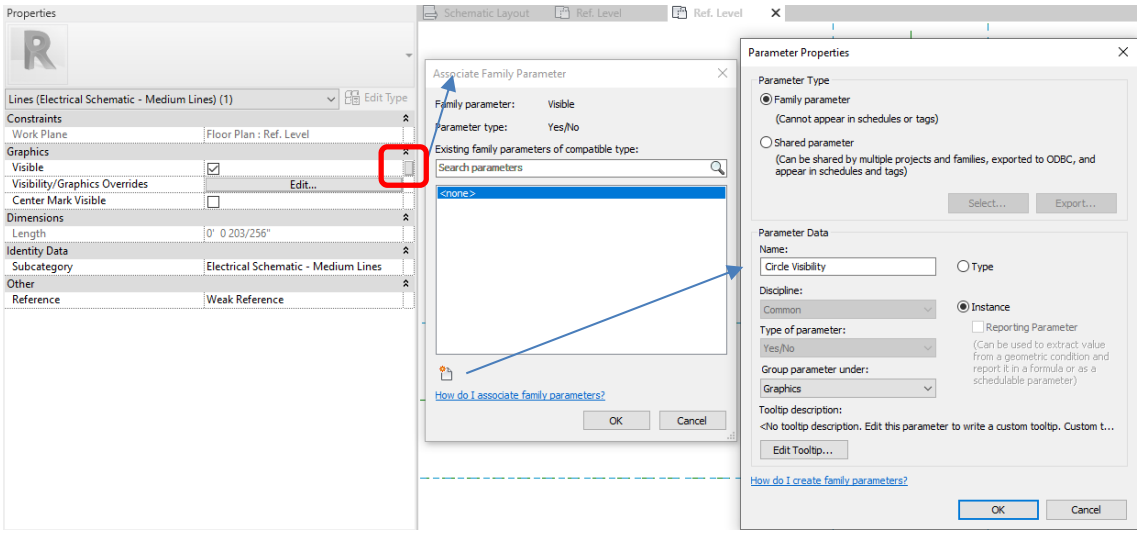
Using Yes/No Parameters for Linework Visibility

Old school AutoCAD drafters are all about their block libraries. A dynamic block in AutoCAD allows you to incorporate drop downs that allow you to swap out symbols through out the drawing. Revit has the same behavior with yes/no parameters that can be associated with a specific instance or type within a family. This example demonstrates how to add the visibility control to an instance of a symbol.

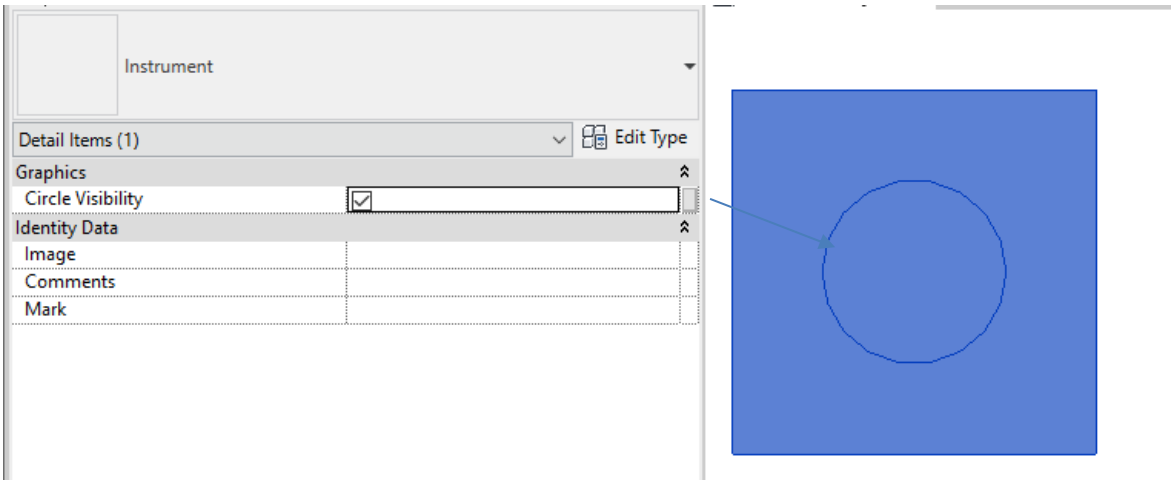
1. To include additional linework, return to your symbol family, and add a circle as shown:



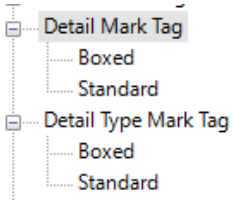
2. In this case, a **1/8" radius circle** was added. To control linework visibility with an on/off switch, select the circle. From the **Properties** palette, select the **Associate Family Parameter** button, then select **New**. Create a new **Yes/No** parameter named **Circle Visibility**. Make it **instance based**, and group the parameter under **Graphics**:



3. Click **OK twice** to get out of the dialogs. Save the family and reload it into the project. Make sure you select to **override the parameters** since you added a new parameter. After placing an example, select the family. The switch is now available under the instance properties of the family, allowing you to turn it on and off for each instance placed in the project:



4. If you want to include text for a symbol, you can **tag** the detail item using a detail tag (there's one included in the Schematic Project named **Detail Mark Tag** (for instance-based mark values) or **Detail Type Mark Tag** (for type based values):



Wrapping up on some basics for creating schematic symbols. Here are a few rules:

1. Avoid using annotation families the respond to scale. One of the biggest issues is that you cannot snap to linework in an annotation family, so it's precluded from be using to creating anchored symbols.
2. Model based detail families have their own issues – if you add them to the same project where you have the actual model elements, the model elements are counted…and tracked. I saw a recent presentation where Arup had created several diagrams using model elements, but the schematics were housed in a different project model than the actual physical equipment representations. Looking down the road, you might be able to create some plan views using links and schedule items in the linked model, but the extra work may not be worth the effort,
3. Use your detail items like you do dynamic blocks – create a master file for a primary item like motors, AHU's, fire alarm symbols. Create different types with each detail item family and use the visibility controls to control visibility by type. This helps reduce the amount of families you need to define, and help you organize your library in a much simpler manner.

Conclusions

There's a lot going for Revit MEP, as Autodesk refocuses their efforts on MEP product development. For some recommended classes at this year's AU that expand on these topics, check out these related classes and labs from some great instructors:

CES320823 - Revit for P&IDs: A New Perspective on Design Synchronization for Water Projects – by Brian Melton:

https://autodeskuniversity.smarteventscloud.com/connect/sessionDetail.ww?SESSION_ID=320823

BES321498 - Plumbing Revit MEP: Drop and Go—Let the Information Flow – by Ronal Balmer and Setah Burford

https://autodeskuniversity.smarteventscloud.com/connect/sessionDetail.ww?SESSION_ID=321498

BES323529 - Revit Systems Analysis Features and Framework: An Introduction – Ian Malloy

https://autodeskuniversity.smarteventscloud.com/connect/sessionDetail.ww?SESSION_ID=323529

Thanks for attending and have a great Autodesk University!