

ES123709

## **Pesky Electrical Settings in Revit 2018**

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### **Learning Objectives**

- Know how to create powerful electrical schedules
- Know how to define the circuit path in Revit 2018
- Know how to work and configure electrical panel schedules
- Know how load classifications and demand factors are applied

### **Description**

Revit MEP software for electrical engineering is all about coordination. Yes, it does modeling in 3D; but the biggest benefit for electrical is not that it can model 3D lights. Rather, it's that it produces a coordinated model with the assurance that everything is circuited and documented correctly. Setting up Revit MEP for electrical can be painful. There are many pesky settings and things that just do not work the way you want them to work. Come to this class to discuss the major items that keep electrical engineers up at night trying to configure Revit MEP to work the way they want it to. We'll tackle problems such as editing panel schedules, changing graphics of nested families, creating circuit paths, developing powerful electrical schedules, working with hosted fixtures, and working with load classifications. Don't let Revit MEP get the best of you. Learn how to fix these pesky settings before they drive you crazy.

### **Speaker(s)**

Mike Massey graduated from Texas A&M University with a degree in architecture. He has 27-plus years of experience working in the architecture, engineering, and construction (AEC) industry. Since joining Applied Software Technology, Mike has been specializing in Building Information Modeling (BIM) implementation for architects and MEP (mechanical, electrical, and plumbing) engineers. Mike is an Autodesk Certified Instructor with Professional Certifications in Revit Architecture, Revit MEP (Electrical) and Revit MEP (Mechanical). Mike is a repeat speaker at Autodesk University and won the Top Speaker award at Autodesk University 2016. Mike has also been a contributing author for Autodesk Official Training Courseware.

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## Introduction

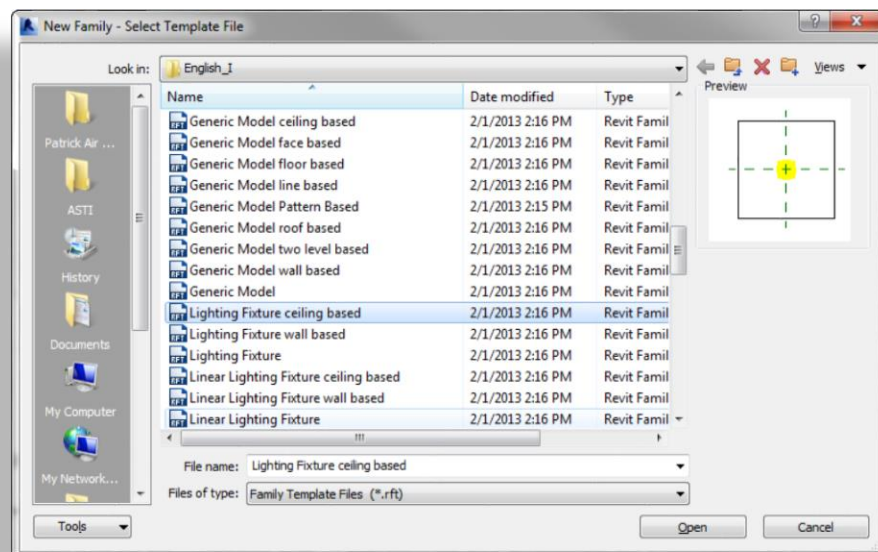
For an Electrical Engineer, Revit not only produces construction documents, it should also be used to assist as a design tool. Revit has many tools built into the program to assist in coordinating circuits, panels, and schedules to ensure that the entire project is coordinated. To begin using Revit effectively, certain steps must be taken to ensure that the program is using the correct graphics or standards to match the firm's standards. Most of the settings that will be discussed in this session can and should be set up in a Revit template file so each project is started with the correct settings.

Throughout my career, I have assisted many Electrical Engineers in setting up Revit to work effectively for their specific firm. I have come across many questions in this process that are essential in this process and that is what this class is all about. This class will discuss and show how to solve some of the many questions that I have been asked while I was assisting in setting up Revit for different firms.

## Working with Light Fixtures

### Converting a ceiling hosted family to a face hosted family

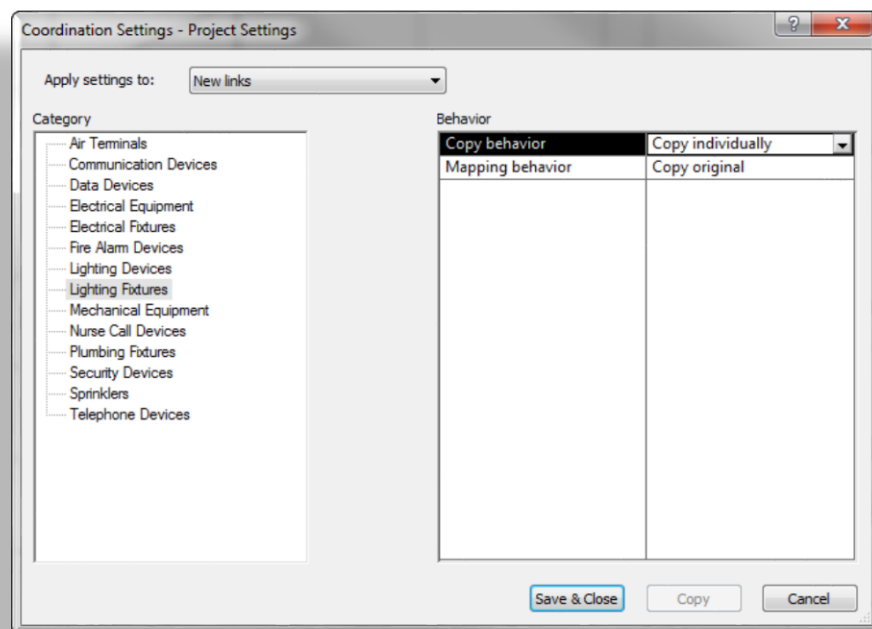
When families are created, a family template is chosen to begin the family. There are multiple family templates that can be chosen when the family is started. The family templates are either hosted or non-hosted. If the family is hosted, then the family must be attached to another object in the model. The hosted family templates can be Wall, Floor, Ceiling, Roof, or Face hosted. If a wall, floor, ceiling, or roof is used then the family must be attached to a live wall, floor, ceiling, or roof. The family will not recognize a linked wall, ceiling, floor or roof. Most of the time Electrical Engineers will be attaching families to faces inside a linked architectural model. Typically Electrical Engineers will not have live walls, ceilings, floors, or roofs; they simply use the linked architectural model to represent the walls, floors and roofs.



The face hosted family templates allow the family to be inserted onto any face. A face is simply a surface. A surface could be live in the MEP model or could be inside the architectural linked model. This allows families to be attached to any surface. It is preferable to have all hosted MEP families to be face hosted as opposed to wall, ceiling, floor or roof hosted.

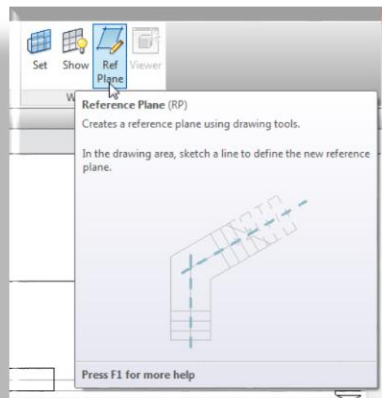
Most of the out of the box hosted families that come with Revit are created using a face as the host, so they can be hosted to linked surfaces. When content is downloaded from the internet, this is not always the case. It is not an easy change if a hosted family needs to be changed from being hosted from a wall, ceiling, floor or roof to a face based host. The recommend fix is to recreate the family using a face based template.

There is an easier fix, one that I actually discovered by accident. If the family is copied into your project by using the **Copy/Monitor** command, it will change the host to a face based hosted family. This can be done by creating a file and inserting the family hosted to a wall, ceiling, floor or roof and then linking that file into another project using the **Link Revit** command. Once the file is linked, perform a **Copy/Monitor** command and copy the desired family. Once the family is copied, it becomes a face base hosted family. The family can then be saved out as a new family.

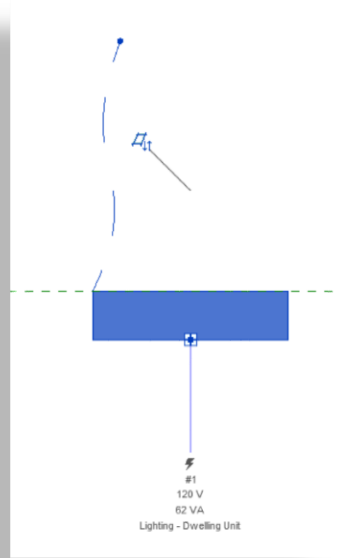


## Placing Hosted Lights without a Face (Ceiling)

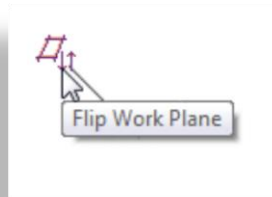
Even with Face hosted fixtures, a surface is required. If the need arises where a fixture needs to be placed prior to the surface being modeled, or if a fixture needs to go into an area without a surface (as in an exposed structure ceiling), this can be accomplished by using the place on a **Work Plane** option. A **Work Plane** is created by either a **Level Line** or a **Reference Plane**. A **Reference Plane** can be added by going into a Section or Elevation View and using the **Ref Plane** command.



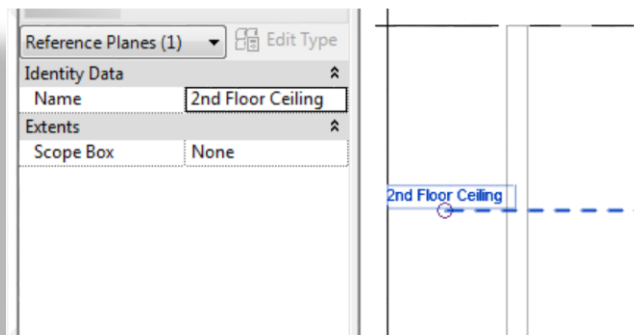
The **Ref Planes** inside of Revit have a top and a bottom associated with them, although it is not called out as you create it. If a Reference Plane is created by drawing the plane from left to right, the top will be on the bottom. The correct procedure is to draw the **Reference Plane** from right to left. This will put the top on the top. If the plane is drawn incorrectly the lights that are hosted to the **Reference Plane** will be attached upside down.



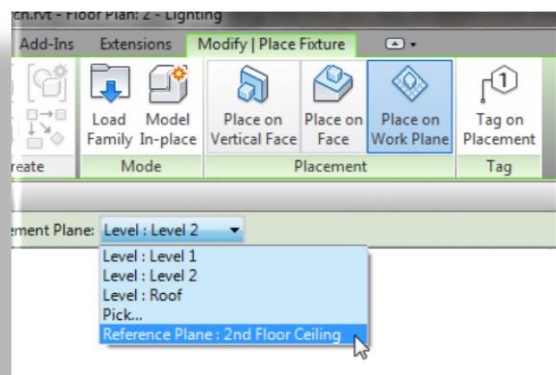
If the lights are upside down, the light fixture family has a flip grip that can be clicked to flip the light to be right side up. It is important to ensure that the lights are right side up so the light shines into the space below.



Reference Planes can be named as well. It is important to name the Reference Plane so it can be identified when trying to select it when the light fixture is being placed.



To use the place on **Work Plan** option for a hosted fixture family, you can select it off of the ribbon once the Light Fixture command is started. Once you pick **Place on Work Plane**, you can then use the drop down on the **Options Bar** to select the Reference Plan by name.

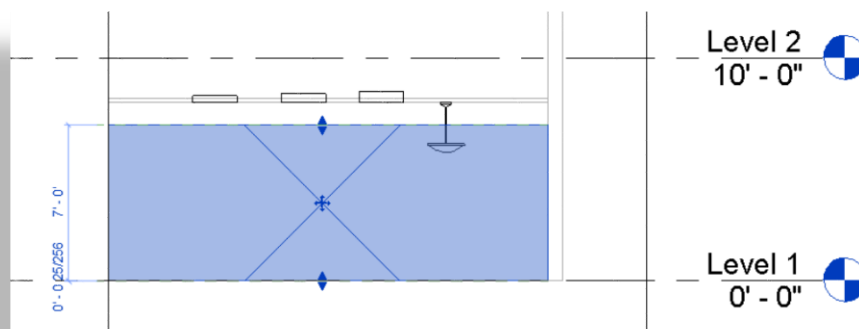


The light fixture will then be hosted to the **Reference Plane** and will have the same elevation as the Reference Plane.

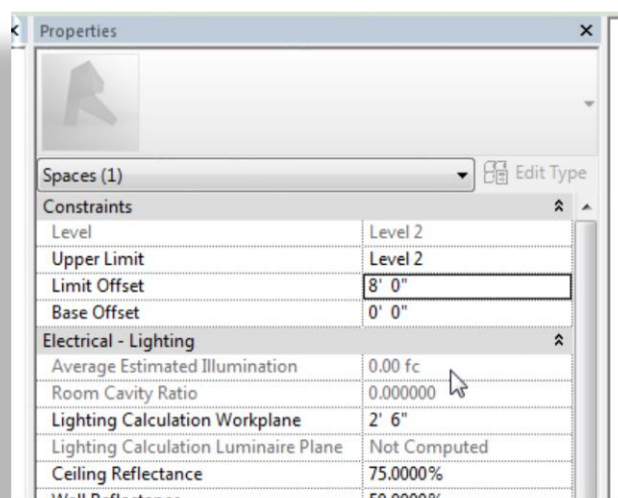
## Space not Calculating Foot Candles

When light fixtures are placed into spaces, the space will calculate the average Foot candles for the space based on the lights in the space. The calculation is automatically done as long as the lights are in the space. The space will not calculate the Foot Candles if the lights are outside the Space or if the lights are linked into the Revit model.

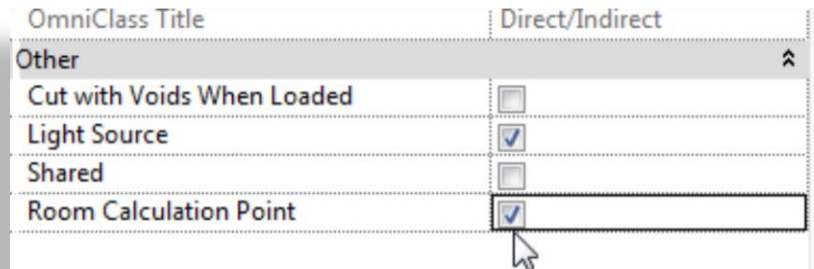
It is important to understand that Spaces are 3-dimensional spaces. The heights of Spaces are set by assigning a height to the **Limit Offset** parameter. The default height for spaces is 8'-0". If the ceiling is higher than 8'-0", this should be changed to match the ceiling height. To determine the height of the ceiling, a section can be cut through the space.



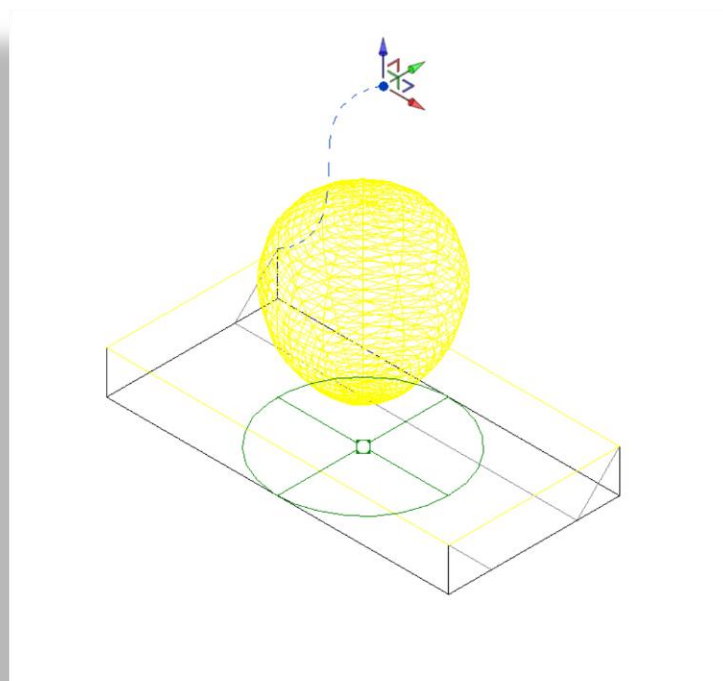
Once the ceiling height is determined, the **Limit Offset** can be assigned, or the top grip of the space can be dragged above the ceiling to raise the height of the space up. The ceiling is a **Room Bounding** object, so the space will stop at the ceiling even if the top grip is raised higher than the ceiling. Once the space height is changed, the Foot Candle load should be indicated in the properties of the space.



Another way to ensure that all lights are in the space is to use the **Room Calculation Point** in the family of the light fixture. The **Room Calculation Point** is now in all families (which is a new feature) but is turned off by default. To turn on the **Room Calculation Point**, the family needs to be opened and then the check box checked in the **Properties** for **Room Calculation Point**.



Once the **Room Calculation Point** is turned on, a movable point will be indicated in the family. This point can be moved to the underside of the light fixture so that when loaded into the project it is in a space. When the light fixture is loaded back into the project with the **Room Calculation Point** turned on, the space will calculate the Foot Candles as long as the **Room Calculation Point** is inside of the space. This will allow lights to be outside of the space, but have the Foot Candles be calculated.

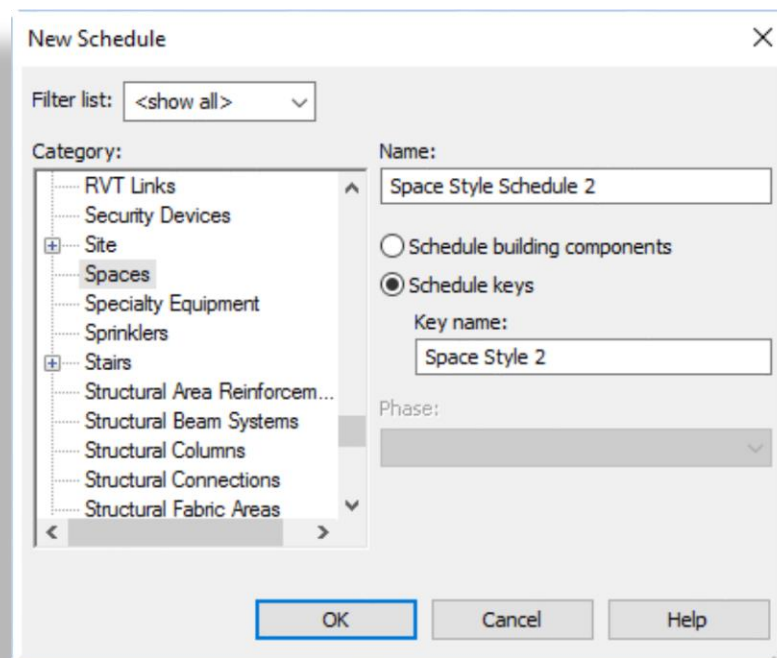




## Creating Key Schedules for Lighting Loads

A **Key Schedule** is defined as a schedule set of keys that will be used in another schedule. A good way to assist in determining if enough light has been provided in a particular space is to set up a **Key Schedule** of common space types with desired foot candle levels.

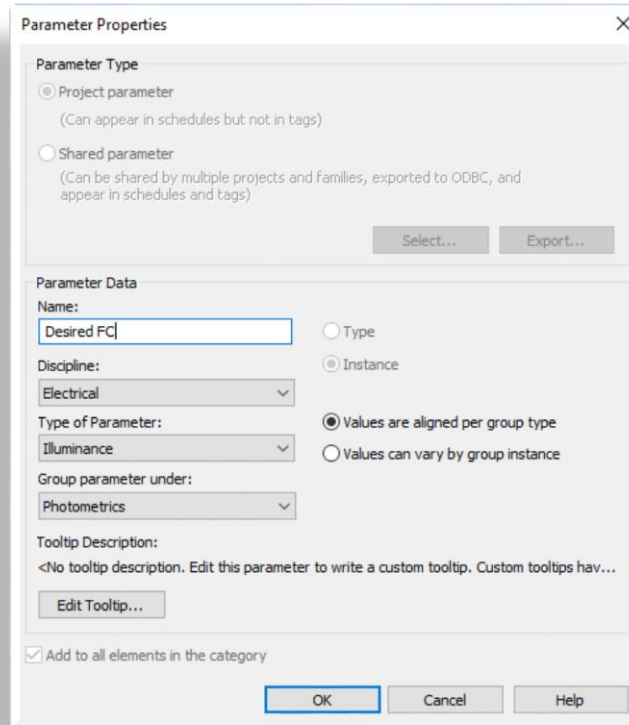
A **Key Schedule** can be created by starting a new **Schedule/Quantity**. **Spaces** will need to be selected as the **Category**. Then change the radio button to **Schedule Keys**. Verify the **Key Name**, this will be used later in the space schedule once the **Key Schedule** is complete. Then select **OK** to begin making the schedule.



On the **Fields** tab, you will notice that the **Key Name** is already been assigned to the **Schedule Fields** section. One additional field will need to be created by using the **New Parameter** button in the center of the dialog.



The new parameter can be named **Desired FC**. The **Discipline** needs to be set to **Electrical** and the **Type of Parameter** set to **Illuminance**. Then select **OK** to finish creating the parameter.



The image shows the 'Parameter Properties' dialog box in Revit. The 'Parameter Type' section has 'Project parameter' selected. The 'Parameter Data' section shows 'Name' as 'Desired FC', 'Discipline' as 'Electrical', 'Type of Parameter' as 'Illuminance', and 'Group parameter under' as 'Photometrics'. The 'Values are aligned per group type' radio button is selected. The 'Add to all elements in the category' checkbox is checked. The 'OK' button is highlighted.

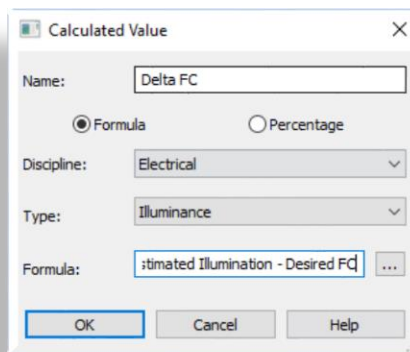
No other settings need to be changed in the **Schedule Properties**. Select **OK** to let Revit build the schedule.

The Schedule does not initially have any data rows. Data rows can be added by clicking the **Insert Data Row** button on the **Modify Schedule/Quantities** tab. Insert enough data rows for the desired number of typical space types. Then type over the **Key Names** values for the desired typical space names. Type in the **Desired FC** for each space type.

<Space Style Schedule>	
A	B
Key Name	Desired FC
Clinical	100 fc
Exam	75 fc
Public	60 fc
Storage	50 fc
Toilet	60 fc

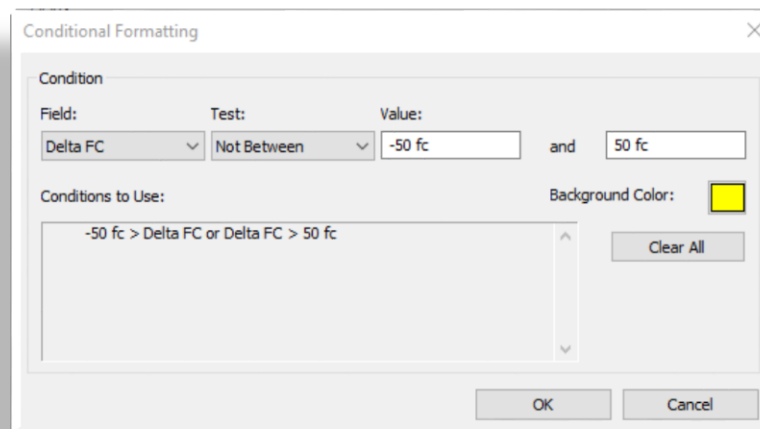
The **Key Schedule** will be used in a **Space** schedule. To create the **Space** schedule, select the **Schedules** button on the **View** tab and then select **Schedule/Quantity**. **Spaces** will need to be selected as the **Category**. Verify the radio button is set to **Schedule Building Components**. Then select **OK** to begin building the schedule.

On the **Fields** tab, add the following parameters; **Level, Number, Name, Space Style, Area, Average Estimated Illumination, and Desired FC**. Then select the **Add Calculated Value** button in the center of the dialog to create a new calculated value parameter. Type in **Delta FC** as the name of the parameter. The **Discipline** needs to be set to **Electrical** and the **Type of Parameter** set to **Illuminance**. For the **Formula**, type in **Average Estimated Illumination – Desired FC** and then select **OK** to finish creating the calculated value.



On the **Sorting/Grouping** tab, change the **Sort** by to **Number**.

On the **Formatting** tab, select the **Delta FC** parameter and then pick the **Conditional Format** button. In the **Conditional Formatting** dialog, change the **Test** to **Not Between** and type in the values of **-50 fc** and **50 fc**. Pick on the **Background** color button and select **Yellow** as the color. Select **OK** to finish the **Conditional Formatting**.

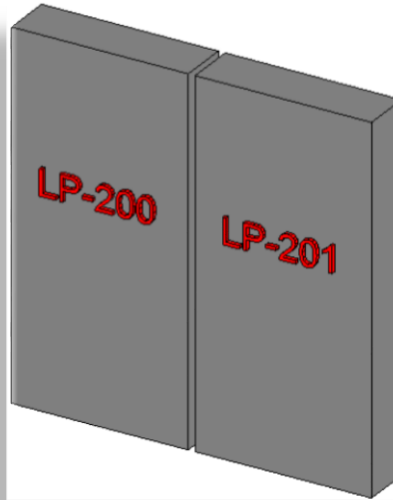


Select the **OK** button to finish building the schedule. Verify that the **Delta FC** for all spaces that are not between **-50 fc** and **50 fc** are highlighted **Yellow**.

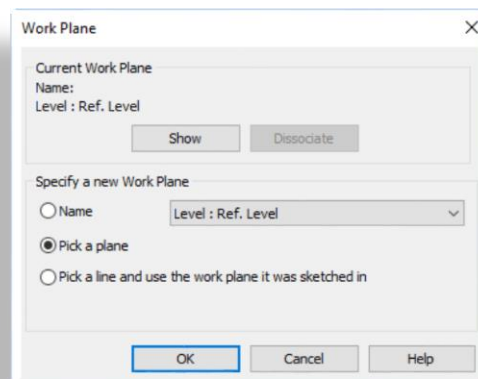
## Working with Equipment Families

### Adding Panel Names to 3D Views

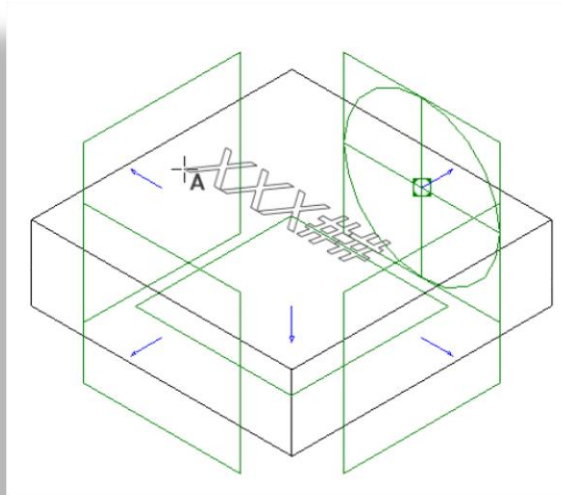
Adding the panel or equipment name to the face of equipment families can be beneficial when viewing the model in 3D or when exporting the model to Navisworks. This will make it easy to know exactly what the equipment name is without having to tag it or look at its properties. To accomplish this, Model Text can be added to the family that automatically calls out the Panel Name.



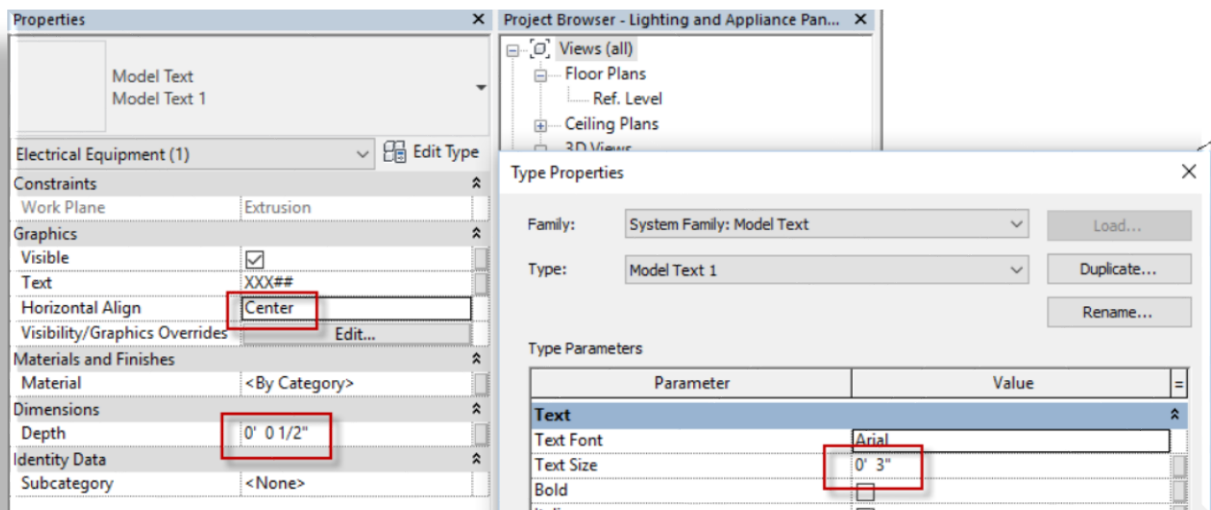
Begin by selecting an electrical equipment and then selecting the **Edit Family** button on the **Modify** tab. This will open the family for editing. In the family, switch to a **3D** view and zoom up on the face of the equipment where you want to place the **Model Text**. On the **Create** tab, select the **Set** button to set the work plane to the face of the equipment. In the **Work Plane** dialog choose **Pick a Plane** and then select **OK**. Then select the face that you would like to use to place the **Model Text**.



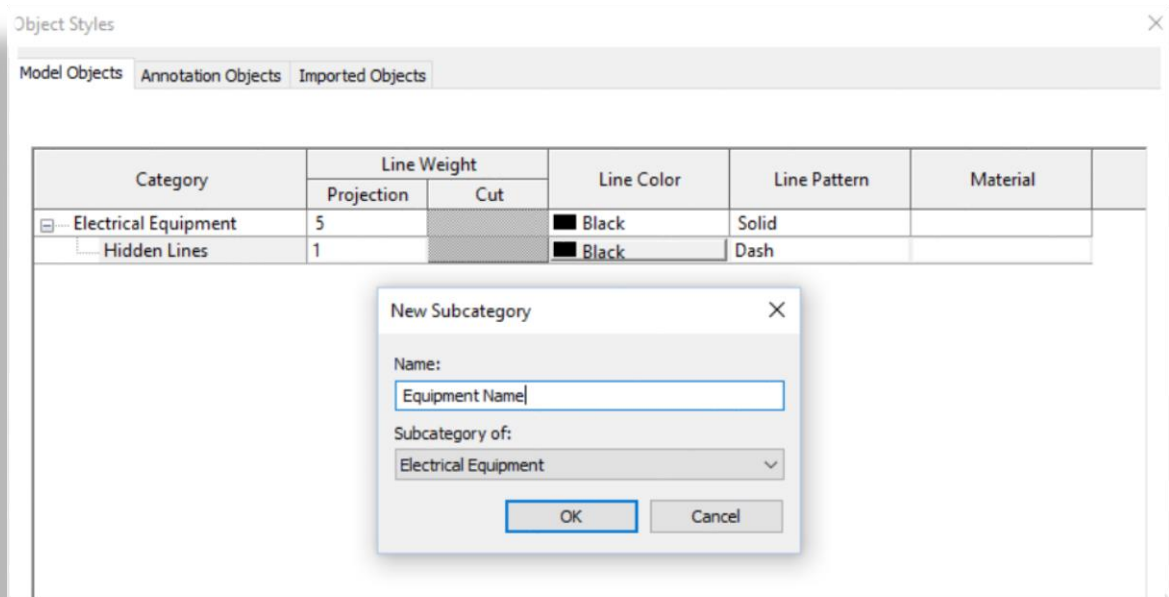
On the **Create** tab, select the **Model Text** button. Type in a set of characters to represent the number of characters that will be in the **Panel Name** and then select **OK**. Place the **Model Text** by picking the face of the equipment.



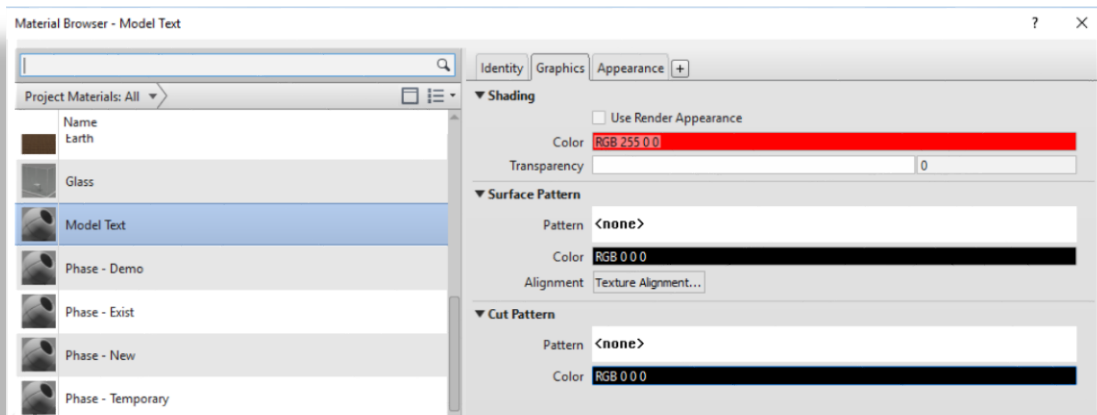
Once placed, select the **Model Text** to change its properties. With it selected, change the **Depth** to  $\frac{1}{2}$ " and change the **Horizontal Align** to **Center**, then select **Edit Type** to open the **Type Properties**. In the **Type Properties** dialog, change the **Text Size** to **3"** and select **OK** to close the **Type Properties** dialog.



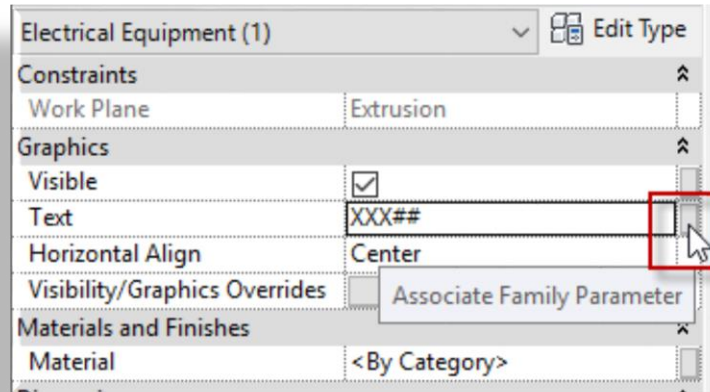
On the **Manage** tab, select the **Object Styles** button. In the **Object Styles** dialog, select the **New** button to create a new **Subcategory**. Type in **Equipment Name** as the new **Subcategory** and select **OK** twice to close both dialogs. Select the **Model Text** and in the **Properties**, change the **Subcategory** to **Equipment Name**.



In the **Material** parameter, select the little ... button to open the **Material Browser**. Duplicate the **Default** material by right clicking on it and picking **Duplicate**. Right click on the new duplicate copy of **Default** and select **Rename**. Type in **Model Text** as the name. On the **Graphics** tab of the **Material Browser**, select the **Color** for **Shading**, choose **Red** as the color and then select **OK** twice to close both dialogs.



Select the **Model Text** and in the **Properties**, select the **Associate Parameter** button next to the **Text** parameter to open the **Associate Family Parameter** dialog.

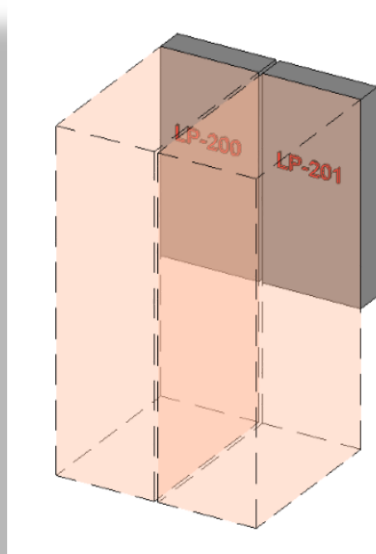


In the **Associate Family Parameter** dialog, select the **Panel Name** parameter as the parameter to associate with the **Text** and then select **OK** to close the dialog.

On the **Create** tab, select the **Load into Project and Close** button to save and load the family back into your project.

## Creating Clearance Zones

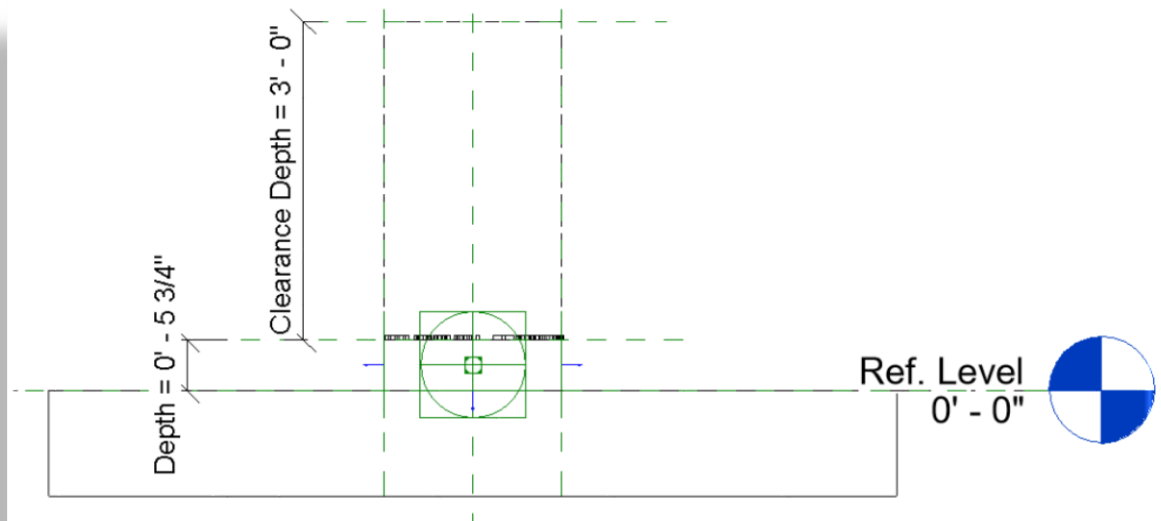
**Clearance zones** are open areas around the equipment to maintain free from other objects for working on the equipment. Building **Clearance Zones** into equipment families is needed to ensure that nothing interferes with the clearance when performing **Clash Detections**.



We will use a wall hosted panel as the example. Begin by selecting an electrical panel and then selecting the **Edit Family** button on the **Modify** tab. This will open the family for editing. Since a panel is a face hosted panel, we will need to switch to the **Front Elevation** view to see the top view of the panel family.

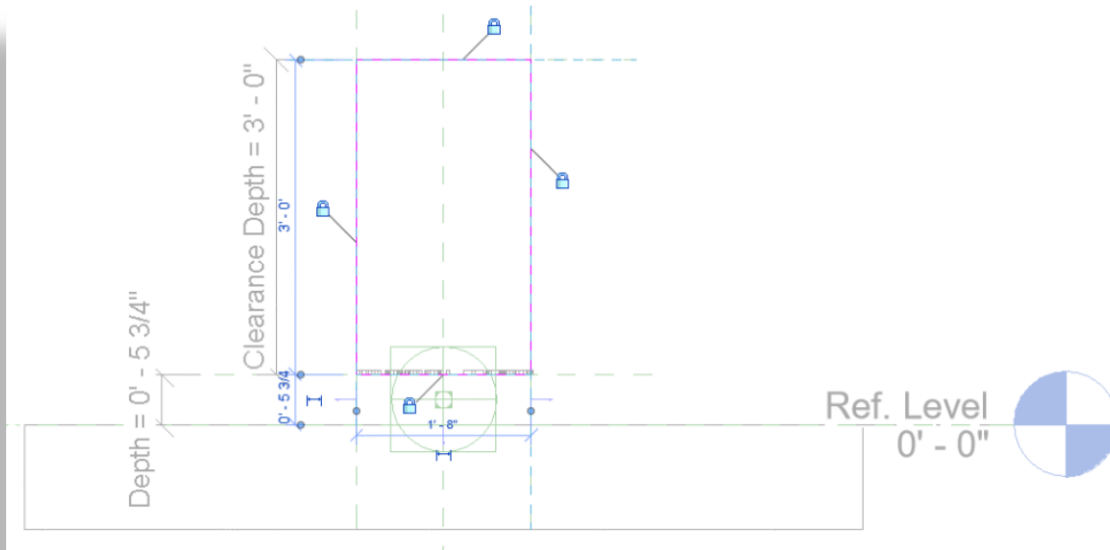
In the **Front Elevation** view, select the **Reference Plane** button on the **Create** tab. Draw a **Reference plane** in front of the panel (the exact distance away does not matter). On the **Annotate** tab, select the **Align Dimension** button and place a dimension from the front face reference plane to the newly created reference plane.

Select the **Dimension** and on the **Modify** tab, pick the **Create Parameter** button on the **Label Dimension** section of the tab. In the **Parameter Properties** dialog, type in **Clearance Depth** as the name of the **Parameter** and change the **Type** to **Instance** by selecting the **Instance** radio button, then select **OK** to close the **Parameter Properties** dialog.

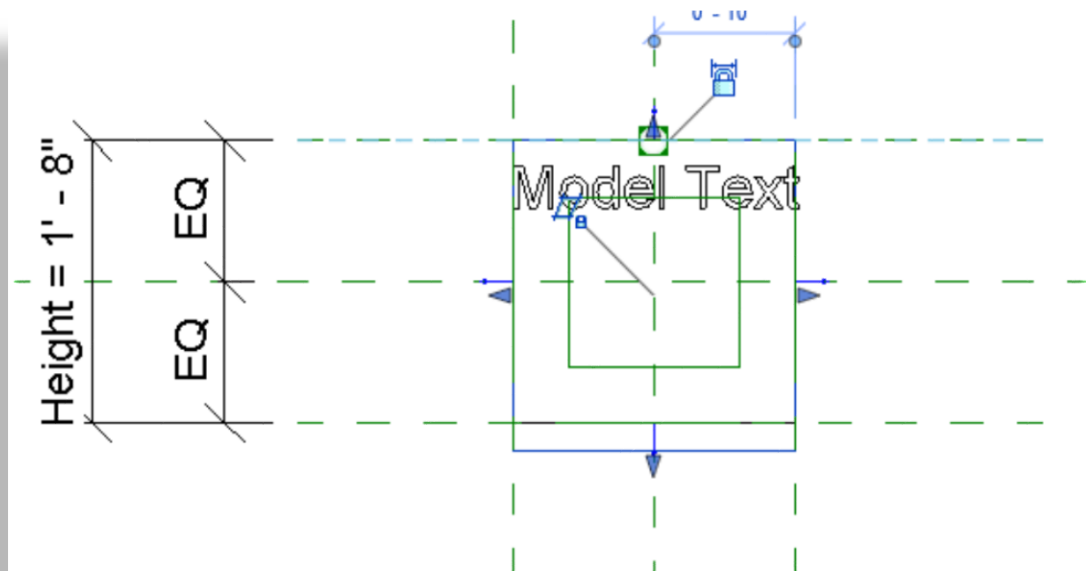




On the **Create** tab, select the **Extrusion** button to begin making an extrusion. In the **Edit Extrusion** sketch, change the drawing tool to a **Rectangle**. Draw a **Rectangle** sketch by snapping to the corner of the panel and then snapping to the intersection of the **Clearance** reference plane and the right side reference plane. After drawing the rectangle, select on all four **Padlocks** to lock the sketch to the reference planes. Select the **Green Check Mark** on the **Modify** tab to finish the **Extrusion** sketch.

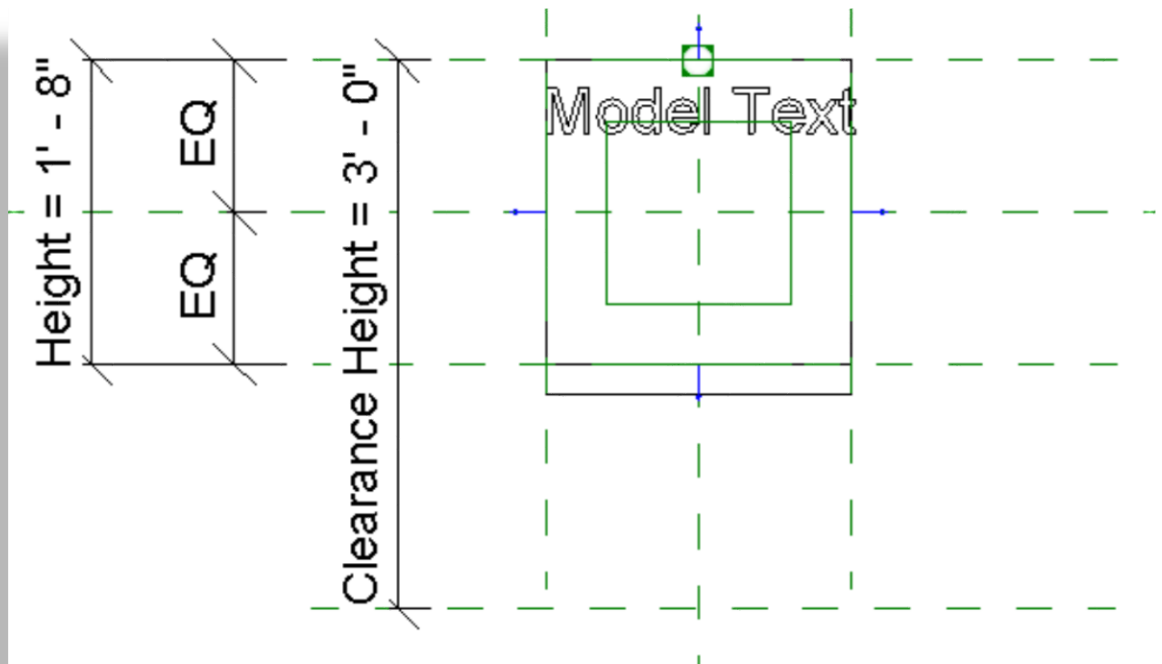


In the **Project Browser** switch to the **Ref. Level** floor plan. Select the newly created extrusion and use the grips to pull the top of the extrusion to align with the top reference plane representing the top of the panel. Select the **Padlock** to lock the top edge to the reference plane.



Select the **Reference Plane** button on the **Create** tab. Draw a **Reference** plane below the bottom edge of the panel (the exact distance away does not matter). On the **Annotate** tab, select the **Align Dimension** button and place a dimension from the top edge reference plane to the newly created reference plane.

Select the **Dimension** and on the **Modify** tab pick the **Create Parameter** button in the **Label Dimension** section of the tab. In the **Parameter Properties** dialog, type in **Clearance Height** as the name of the **Parameter** and change the **Type** to **Instance** by selecting the **Instance** radio button, then select **OK** to close the **Parameter Properties** dialog.

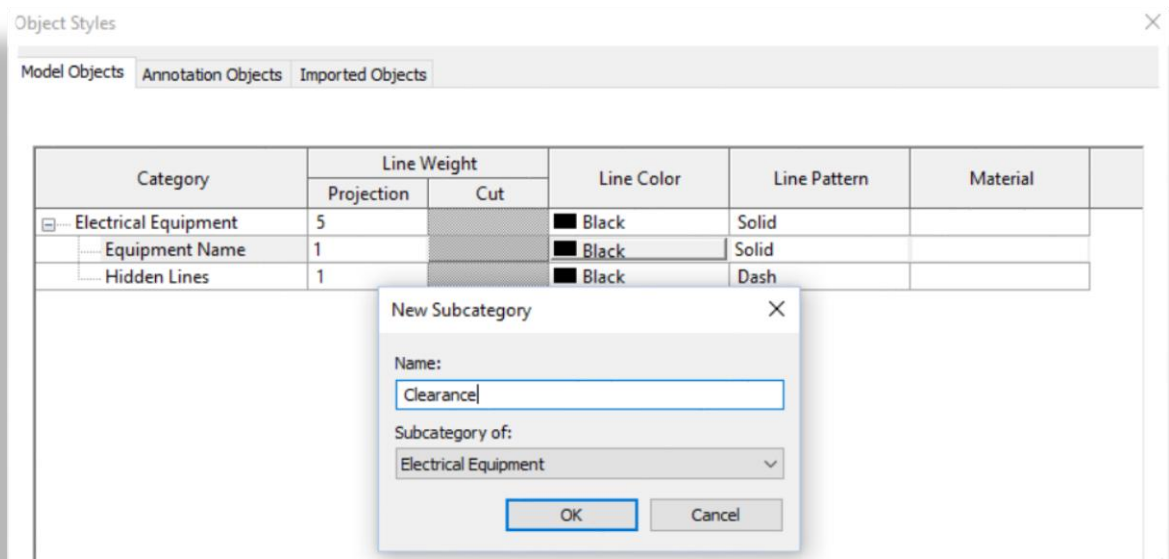


On the **Modify** tab, use the **Align** command to align the bottom edge of the **Clearance** extrusion to the newly created **Reference** plane. Pick the **Padlock** to lock the extrusion to the **Reference** plane.

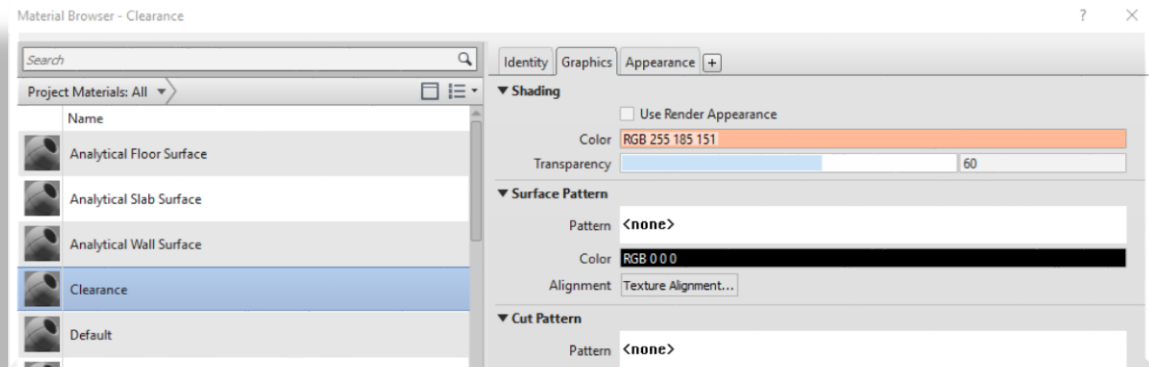
On the **Create** tab, select the **Family Types** button to open the **Family Types** dialog. In the **Family Types** dialog, type in **3'-0"** for the **Clearance Depth**. We will use a formula for the **Clearance Height**. In the **Formula** for **Clearance Height** type in **Default Elevation + (Height / 2)**. Select **OK** to close the **Family Types** dialog.

Parameter	Value	Formula	
<b>Constraints</b>			
Default Elevation	4' 0"	=	<input checked="" type="checkbox"/>
<b>Electrical</b>			
Load Classification	Other	=	
Voltage		=	
Wattage		=	
<b>Dimensions</b>			
Clearance Depth (default)	3' 0"	=	<input type="checkbox"/>
Clearance Height (default)	4' 10"	= Default Elevation + (Height / 2)	<input checked="" type="checkbox"/>
Width	1' 8"	=	<input checked="" type="checkbox"/>
Height (default)	1' 8"	= if(Max #1 Pole Breakers > 12, if(	<input checked="" type="checkbox"/>
Depth	0' 5 7/8"		<input type="checkbox"/>

On the **Manage** tab, select the **Object Styles** button. In the **Object Styles** dialog, select the **New** button to create a new **Subcategory**. Type in **Clearance** as the new **Subcategory** and select **OK** to close the **New Subcategory** dialog. Change the **Line Pattern** for the **Clearance Subcategory** from **Solid** to **Hidden**. Select **Ok** to close the **Object Styles** dialog. Select the **Clearance** extrusion, and in the **Properties** change the **Subcategory** to **Clearance**.



In the Material parameter, select the little ... button to open the Material Browser. Duplicate the Default material by right clicking on it and picking Duplicate. Right click on the new duplicate copy of Default and select Rename. Type in Clearance as the name. On the Graphics tab of the Material Browser, select the Color for Shading and choose a soft orange color as the color and select OK to close the Color dialog. Change the Transparency of the Shading to 60 by dragging the Transparency bar to the right and then select OK to close the Material Browser dialog.



On the **Create** tab, select the **Load into Project and Close** button to save and load the family back into your project.

## Using Copy/Monitor on Mechanical Equipment

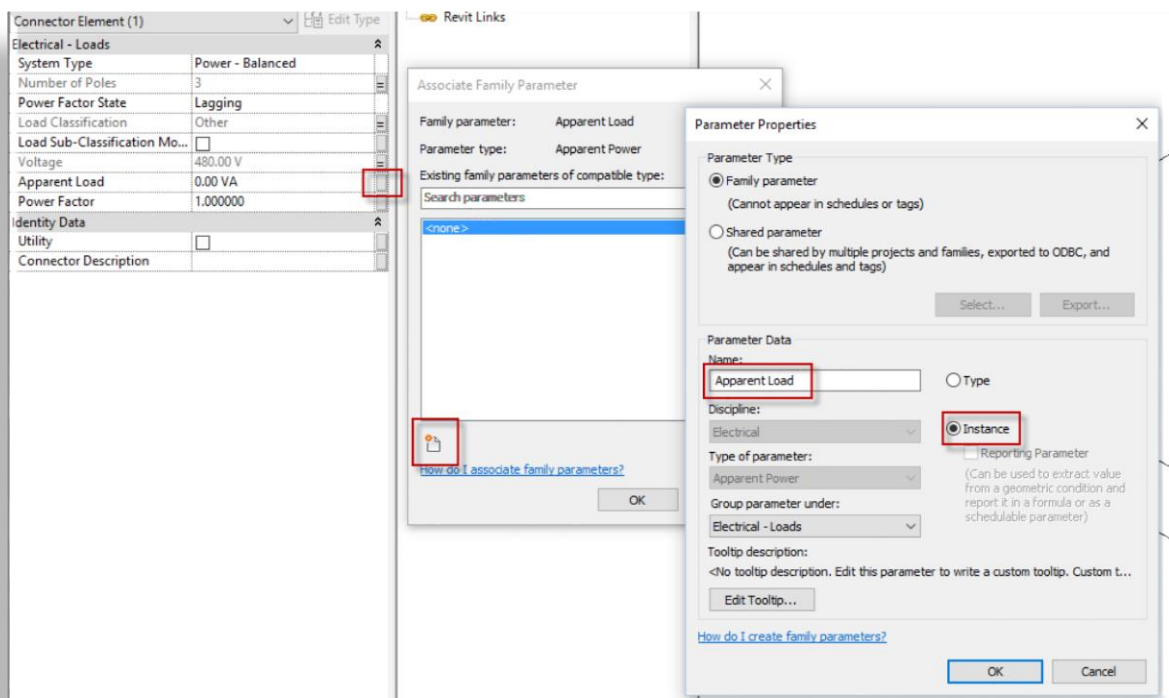
As an Electrical Engineer, you are expected to supply power to the **Mechanical Equipment** that the Mechanical Engineer designs. Typically, this is a coordination nightmare because you have to work with equipment that is provided to you in a link Revit model. Until Revit allows us to create electrical circuits through linked files, this coordination issue will continue.

One possible solution is to take advantage of the **Copy/Monitor** tool inside of Revit. You can use the **Copy/Monitor** tool to copy and specify a **Type Mapping** of the equipment so you can create electrical circuits of the equipment. Typically Electrical Engineers want to show some sort of symbol for the mechanical equipment, like a motor symbol. This can be accomplished by using an **Electrical Connector** family and including a **Motor Annotation** symbol as the graphics. To accomplish this, the **Electrical Connector** family needs to be created and loaded into the project. The out of the box Electrical Connector family can be modified.



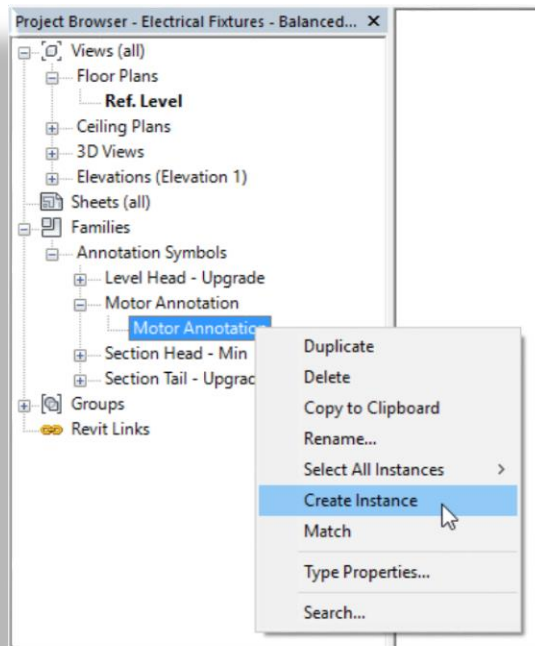
Begin by opening the out of the box **Electrical Connector** family in the library. The **Electrical Connector** family is found in the **Electrical/MEP/Connectors** folder. You can either use **Electrical Fixture – Balanced Power Connector.rfa** or the **Electrical Fixture – Unbalanced Power Connector.rfa**. In both of the families, most of the parameters on the electrical connector are set to have associated parameters that can be changed in the project. The exception is the **Apparent Load** parameter. To associate the **Apparent Load** parameter, select the green **Electrical Connector** and in the **Properties**, select the **Associate Parameter** button next to the **Apparent Load** parameter to open the **Associate Family Parameter** dialog.

In the **Associate Family Parameter** dialog, select the **New Parameter** button to create a new parameter. In the **Parameter Properties** dialog, type in **Apparent Load** as the name of the **Parameter** and change the **Type** to **Instance** by selecting the **Instance** radio button, then select **OK** to close the **Parameter Properties** dialog.

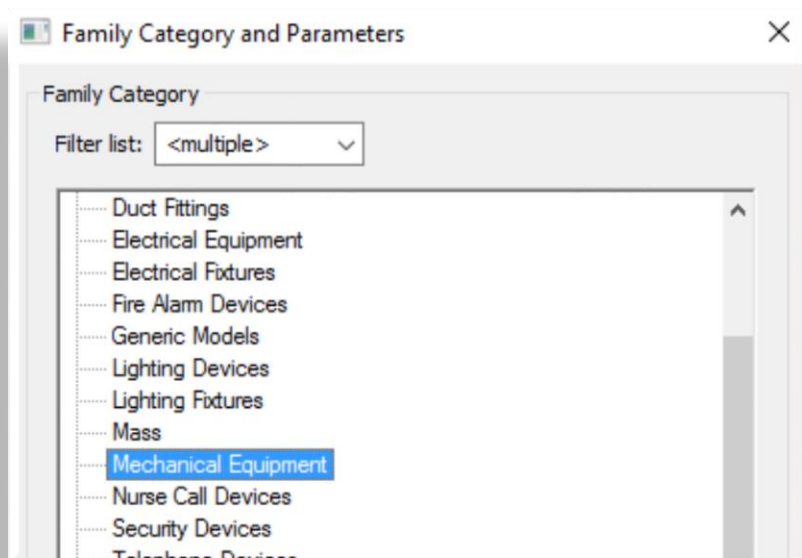


Next we will load the **Motor Annotation** symbol by clicking **Load Family** on the **Insert** tab. Browse to the **Motor Annotation** symbol in the **Annotations/Electrical** folder. Select the **Motor Annotation.rfa** and then pick the **Open** button.

Place the **Motor Annotation** symbol by switching to the **Ref. Level** floor plan in the **Project Browser**. Then in **Project Browser**, expand **Families**, and **Motor Annotation** by clicking on the plus signs. Right Click on **Motor Annotation** and select **Create Instance**. Then place the symbol at the intersection of the two reference planes.



On the **Create** tab, select the **Family Category and Parameters** button. Change the **Family Category** to **Mechanical Equipment** and select **OK** to close the dialog.



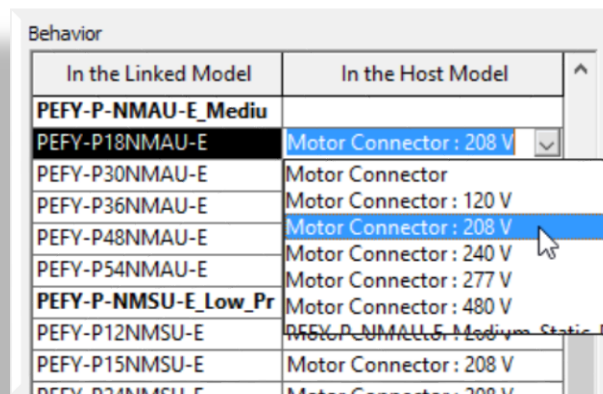
On the **File** tab, select **Save As** then **Family** and save the family with the name **Motor Connector**. Then use the **Load into Project and Close** button to load the family back into your project.

Back in your project, if you don't have the Mechanical model linked in, use the **Link Revit** command to link the Mechanical model into your project. Once it is loaded select the **Copy/Monitor** button on the **Coordinate** tab and then select **Use Link**. With your mouse, select the linked in Mechanical model as the link to **Copy/Monitor** from.

On the **Copy/Monitor** tab, select the **Coordination Settings** button. In the **Coordination Settings** dialog, select **Mechanical Equipment** and change the **Copy Behavior** to **Allow Batch Copy** and the **Mapping Behavior** to **Specify Type Mapping**.



Click on the plus sign next to **Mechanical Equipment** to select the **Type Mapping**. In the **Type Mapping**, change the **In The Host Model** to map to the **Motor Connector** family. There will be different voltages to choose from. This can be changed later but if you know which voltage, select the correct one. Select the **Save & Close** button to close the dialog.



On the **Copy/Monitor** tab, select the **Batch Copy** button. In the **Fixtures Found** dialog, select **Copy the Fixtures**. In the **Levels not set** dialog, select **Continue Copying Fixtures**.

On the **Copy/Monitor** tab, select the **Green Check Mark** to finish the **Copy/Monitor** command. Verify that the **Motor Annotation** symbol was placed in the view where there is Mechanical Equipment. Select the **Motor Annotation** symbol, and type in the **Apparent Load** and the **Mark** (the desire name to be used) in the **Properties**.

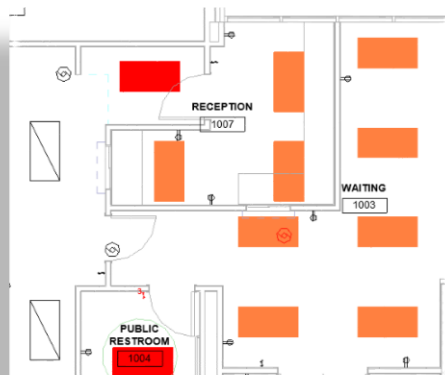
The Linked Mechanical model can be turned off in **Visibility Graphics**. The **Motor Annotation** symbols can be circuited to panels by selecting the symbols and the selecting the **Power** button on the **Modify** tab.



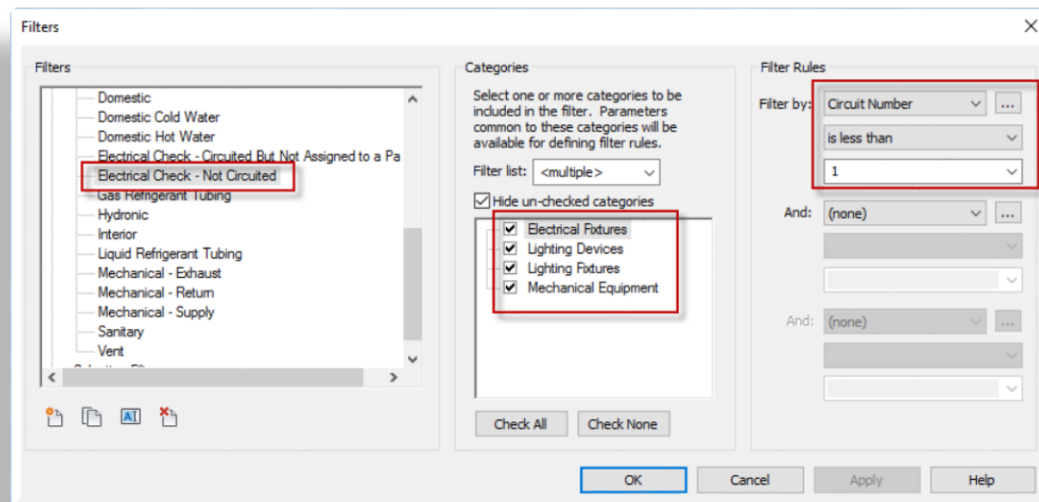
## Creating Electrical Circuits

### Using Filters to Show Un-Circuited Devices

One of the more powerful benefits of using Revit for Electrical is the built in coordination. Tags and schedules will be coordinated and you can verify that all devices/fixtures have been circuited. There are several ways to verify if all devices/fixtures have been circuited. The **System Browser** and the **Show Disconnects** can be used. Another way is to create a color coded plan to color all devices/fixtures that are not circuited or circuited but not assigned to a panel. This will allow you to easily visualize what needs to be connected. **Filters** can be created to achieve this color coded plan.

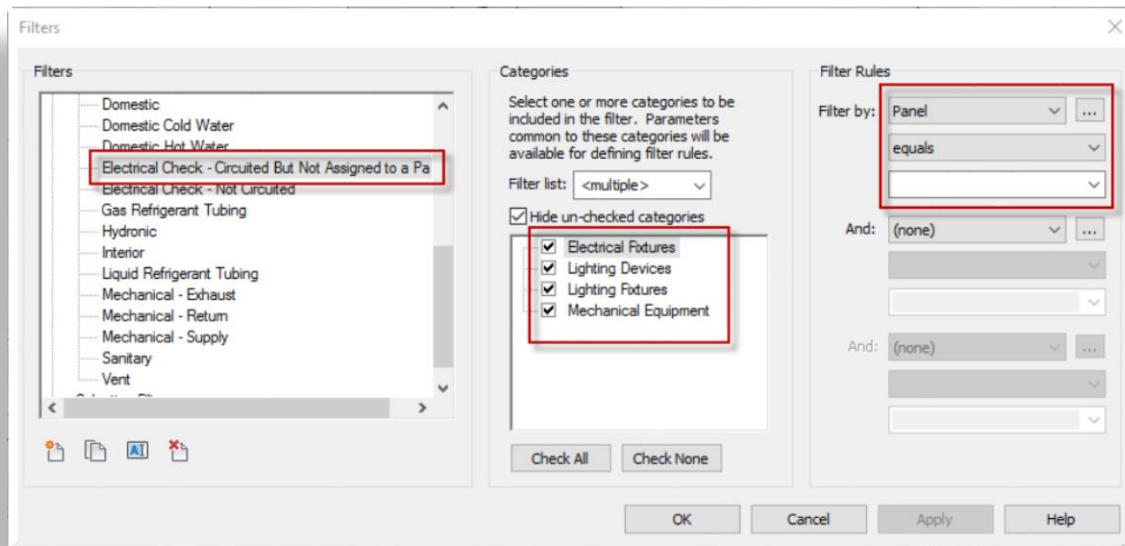


To create the filters, select the **Filters** button on the **View** tab. In the **Filters** dialog, two filters will be created. Select the **New** button and type in *Electrical Check – Not Circuited* as the name and select **OK** to close the **Filter Name** dialog. In the **Categories** section, Check the **Electrical Fixtures, Lighting Devices, Lighting Fixtures, and the Mechanical Equipment** categories. In the **Filter Rules**, change the **Filter By** to **Circuit Number**, **Is Less Than**, and type in **1** as the value.



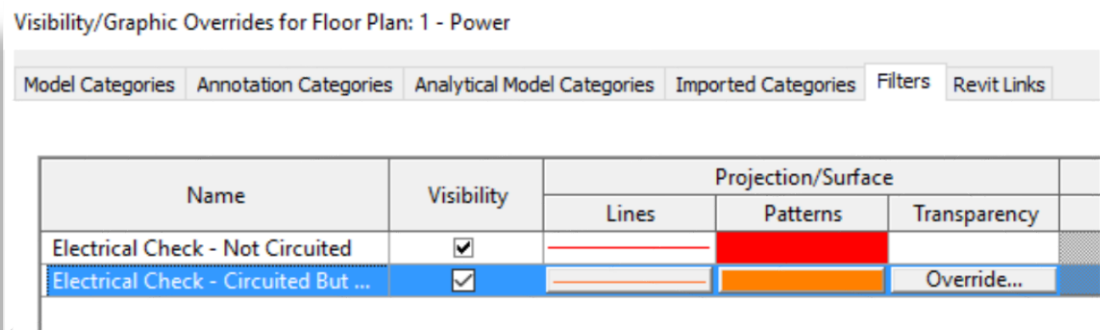


Select the **Duplicate** button, and then select the **Rename** button. Rename the duplicate filter to **Electrical Check – Circuited but not assigned to a Panel** and select **OK** to close the **Filter Name** dialog. In the **Filter Rules**, change the **Filter by** to **Panel**, **Equal**, and leave the value empty. Select **OK** to Close the **Filter** dialog.



Next the Filters will be assigned to the view. This is done by selecting **Visibility/Graphics** on the **View** tab. In the **Visibility/Graphics** dialog, select the **Filter** tab. On the **Filter** tab, select the **Add** button. In the **Add Filters** dialog, select both **Electrical Check** filters and select **OK** to close the **Add Filters** dialog.

Change the color for both filters by selecting the **Override** button for **Lines** and **Patterns**. Choose a color and the solid pattern. Select **OK** to close the **Visibility/Graphics** dialog.



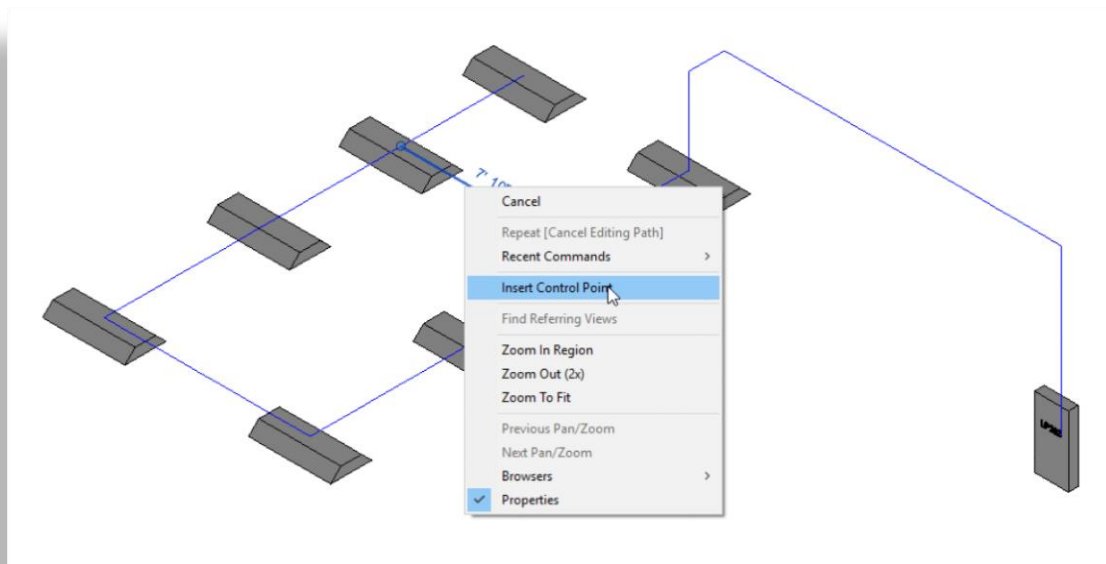
## Viewing and Modifying Circuit Paths

Revit has always created a **Length** parameter for circuits. This **Length** parameter is used in the **Voltage Drop** calculation. The problem has been you were not able to see the path that it was taking to calculate the length of the circuit. New in 2018 is the ability to view AND modify the circuit path. Any modifications to the path will automatically update the **Circuit Length** and the **Voltage Drop** calculation.

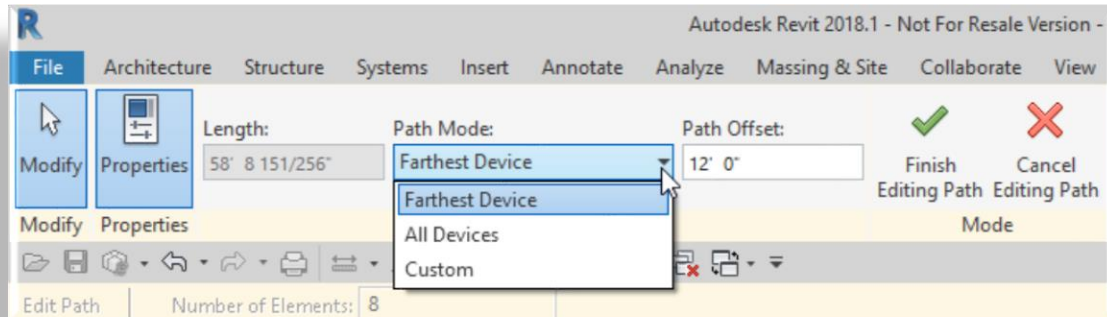
To view the circuit path, the circuit must be selected. To do this, select one device/fixture that is part of an existing circuit. With it selected, switch to the **Electrical Circuits** tab on the menu. With the **Electrical Circuits** tab selected the **Properties Palette** automatically changes and shows the properties of the circuit, where you can view the **Circuit Length** and the **Voltage Drop** parameters.

Voltage	120.00 V
Voltage Drop	1.45 V
Power Factor	0.950000
Power Factor State	Lagging
Balanced Load	<input type="checkbox"/>
Length	58' 8 151/256"
Wire Type	THWN
Wire Size	1-#12, 1-#12, 1-#12

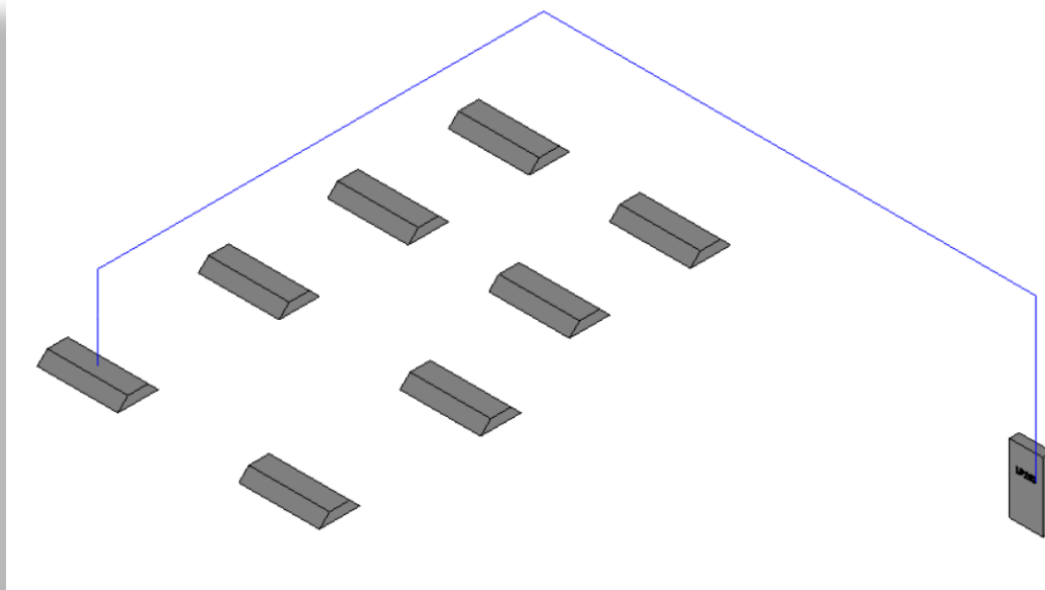
On the **Electrical Circuit** tab, select the **Edit Path** button. This will display the default path, which is defaulted to show the path going to **All Devices**. You can modify this default path simply by selecting on a path line and moving it, changing the elevation of the path line. Additional **Control Points** can be added or removed by right clicking on a path line.



If desired, you can change the path calculation from **All Devices** to **Farthest Device**. This will draw the path from the panel to the farthest away device. This path can be modified as well.



When finished viewing or modifying the path, click the **Finish Editing Path** check mark. The updated path will be used in the **Circuit Length** and the **Voltage Drop** calculation.



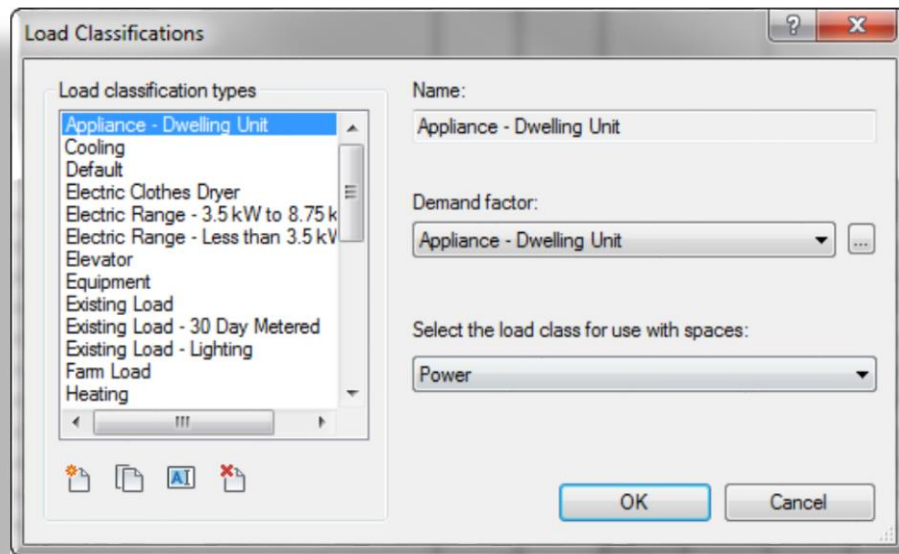
## Working with Panel Schedules

### Load Classifications and Demand Factors

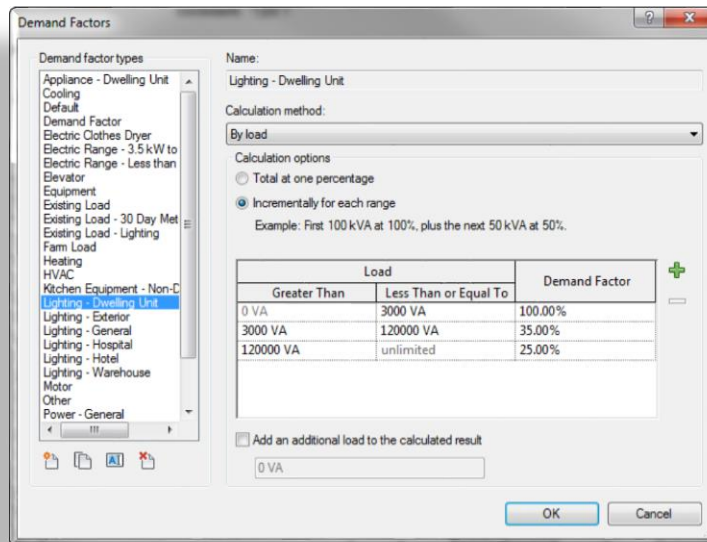
Panel schedules will calculate the **Total Est. Demand** for the panel based on **Load Classifications** and **Demand Factors**. The load is calculated automatically on the default template. It is important to understand how this is calculated to ensure that the load is correct.

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Lighting - Dwelling Unit	960 VA	100.00%	960 VA		
Receptacle	1440 VA	100.00%	1440 VA	<b>Total Conn. Load:</b>	20400 VA
Power	18000 VA	100.00%	18000 VA	<b>Total Est. Demand:</b>	20400 VA
				<b>Total Conn.:</b>	57 A
				<b>Total Est. Demand:</b>	57 A

To understand how Revit calculates the **Total Est. Demand**, there are two settings that need to be reviewed. These are the **Demand Factors** and the **Load Classifications**. Both of these settings can be found on the Manage tab in the **MEP Settings** drop down. Let's first look at the **Demand Factors** and then we will look at the **Load Classifications**.



The **Demand factors** allows you to add, delete, or rename demand factors. The factors that are in the template initially are based off of the NEC. Each of the demand factors can calculate the demand based on **Constant**, **By quantity**, or **By load**. These can be modified to meet your specific project needs.



The **Load Classifications** are similar in name to the **Demand Factors**. Each **Load Classification** can be modified to point to use a particular **Demand Factor**. The **Load Classification** also assigns whether the load is a lighting load or a power load. The **Load Classifications** can be renamed, deleted, or new ones can be created.

The **Load Classifications** are then assigned to electrical devices or fixtures. All electrical devices or fixtures will have a **Type Parameter** that will allow you to specify which **Load Classification** that type is assigned to. Once the **Load Classification** is assigned to the device or family, the default schedule will automatically begin calling out the loads and calculating the loads based on the **Demand Factor**.

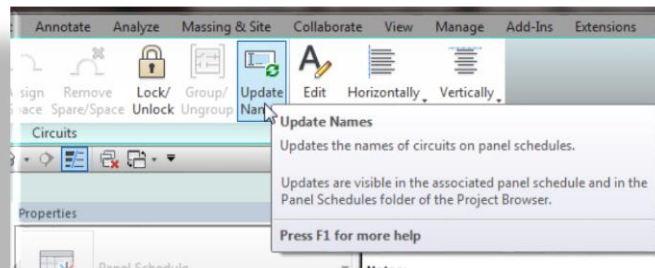
Light Box Material	< By Category >
Grid Material	< By Category >
Diffuser Material	< By Category >
<b>Electrical</b>	
Load Classification	Lighting - Dwelling Unit
Lamp	T5
Ballast Voltage	120.00 V
Ballast Number of Poles	1
Wattage Comments	
<b>Electrical - Loads</b>	
Apparent Load	80.00 VA

## Load Names in Panel Schedule

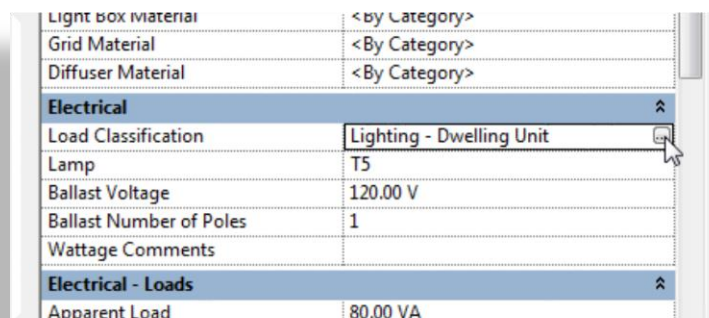
When creating circuits in Revit, Revit will automatically give the circuit a **Load Name** in the panel schedule in the **Circuit Description**. The default load name is defined by the **Load Classification**, the **Space Name** and the **Space Number**.

CKT	Circuit Description	Tri
1	Lighting Space 1	20.
3	Lighting Space 1	20.
5	Receptacle Space 1	20.
7		
9		

If the space name or number is changed after the circuit has been made, the **Load Name** can be updated by using the **Update Names** button on the ribbon when in the **Panel Schedule** view. If the circuit spans across multiple spaces, the **Load Name** will use the **Load Classification** and the **Space Numbers**. If the rooms have the same name, then the **Space Name** will be included in the **Load Name**. If desired, the entire **Load Name** can be typed over to use the name of your choice.



The **Load Classification** is assigned in the **Type Properties** of the fixture or device. Revit comes with many **Load Classifications** to choose from. Additional **Load Classifications** can be added by adding them to the settings in the **MEP Settings**.



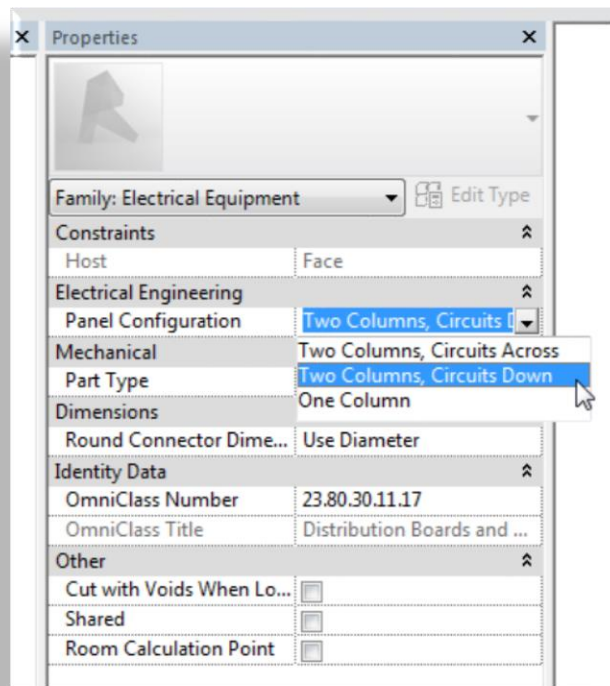


## Getting Panels to Number down instead of across

By default the electrical panel numbers the circuits across as opposed to down. This method is acceptable by many but some would prefer have the circuit numbers go down. If you look at the electrical settings and examine the Panel Templates you will not find a way to change the numbering system.

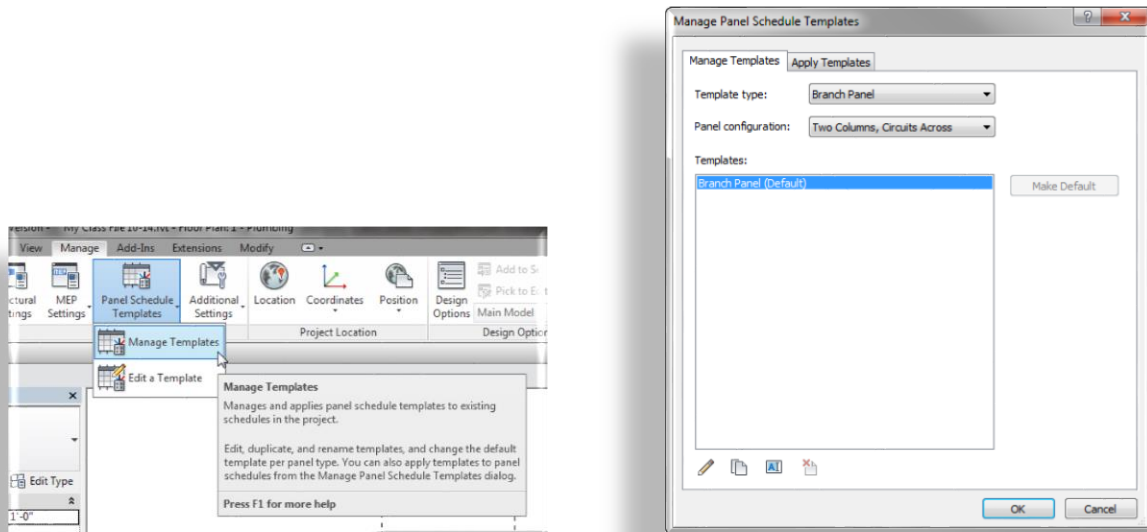
CKT	Circuit Description	Trip	Poles
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

It is a very simple change once you know how. To change the numbering system you need to open the family of the electrical panel. Once the family is opened, you will see a **Panel Configuration** parameter in the properties. Use the drop down next to this parameter and change it to **Two Columns, Circuits Down** and reload the family back into your project. It will automatically change the numbering system for the panel schedule. If this is your preferred method, you should modify the electrical panel and load this panel back into your **Project Template** so every project is set up to number the circuits down.



## Panel Schedule Templates

When creating an electrical panel you can use the default template select from the list of templates, or a customized template. The templates in your project are managed by the **Template manager**. This is where you can define which template is your current default. You can also create new templates or copy an existing template to make a new one.



If you need to edit a template you can select **Edit** and it will open up the **Panel Schedule Template**. Modifying the template is similar to working in Excel. You can create new columns or rows, and assign them to use certain parameters. You also have complete control over the graphics, fonts, and spacing of the cells. There are a multitude of items that can be changed to meet your company standards.

CKT	Circuit Description	Trip	Poles	A	
1	<Load Name>	<Ratin	<Numb	<Val>	<Val>
3	<Load Name>	<Ratin	<Numb		
5	<Load Name>	<Ratin	<Numb		
7	<Load Name>	<Ratin	<Numb	<Val>	<Val>
9	<Load Name>	<Ratin	<Numb		
11	<Load Name>	<Ratin	<Numb		
13	<Load Name>	<Ratin	<Numb	<Val>	<Val>
15	<Load Name>	<Ratin	<Numb		
17	<Load Name>	<Ratin	<Numb		



One of the common questions I have been asked is "how do you create a double panel for an 84 circuit panel?" The simple answer is Revit cannot do that, but... like other limitations in the program, there are workarounds to make Revit do what you want it to do. Revit will allow you to have as many circuits as you desire. The problem is that many people want to create the second panel schedule with the numbers starting at 43 (having the first 42 on the first panel). Revit will not allow you to begin the numbering system with anything other than 1.

**Branch Panel:**

Location: Space 1  
 Busbar Type: 100/200 VAC  
 Main Type: 100 A  
 Main Rating: 100 A  
 Main Rating: 100 A

Notes:

Ckt	Circuit Description	Tripp	Phase	A	B	C	Phase	Tripp	Circuit Description	Ckt
1	Lighting - Drawing Unit Space 1	30 A	1	NB VA						2
2										3
3										4
4										5
5										6
6										7
7										8
8										9
9										10
10										11
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38										39
39										40
40										41
41										42

**Section 2**

Ckt	Circuit Description	Tripp	Phase	A	B	C	Phase	Tripp	Circuit Description	Ckt
43	Lighting - Drawing Unit Space 1	30 A	1	NB VA						44
44										45
45										46
46										47
47										48
48										49
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96										97
97										98
98										99
99										100

Total Load: 100 VA 100 VA 100 VA  
 Total Amps: 0 A 0 A 0 A

Legend:

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals
Lighting - Drawing Unit	100 VA	100.00%	100 VA	Total Connected: 100 VA
				Total Estimated Demand: 100 VA
				Total Connected: 0 A
				Total Estimated Demand: 0 A

Notes:

There may be other workarounds, but the one that I have found to work the best is to create two customized panel templates and then when the panels are placed onto the sheet, one panel would be placed inside of the other panel.

The first custom panel needs to be set so that the number of slots shown is variable. This can be set in the template settings. You then need to add 3 blank rows between the last circuit and the branch totals. The first blank row will be used to place text indicating the second panel. The second blank row will be used to call out the column headers for the second panel. The third blank row will be used to as a place holder for the second panel when the panels are placed onto the sheets. The third row needs to be modified to change the height of the row. The height needs to be set to the height of the 24 circuit rows. You can do the math to multiple the height of 1 row times 24 to get the height.

The second custom panel needs to be set to a constant value of 84 circuits. This panel will require more changes than the first panel. You will need to delete the bottom rows that are defining the Load Calculations. You will then need to change the graphics of the first 42 circuit rows to be white in color. The headers of the rows can be changed to use a ghost font. A ghost font is a font that is not visible. You can download a ghost font off of the internet if you do not have one available. Essentially we are trying to create a schedule that calls out only the circuit rows of the last 42 circuits and nothing else.

You can now go ahead and create the panel schedule for the first panel using the first template. Prior to creating the schedule you need to select the panel and change the **Max #1 Pole Breakers** to 48. This will allow you to create a three circuit connection of the second panel on circuits following 42. A circuit needs to be created from the second panel to the first. This circuit needs to be moved to circuits 42, 45 and 47. Once it is moved, the circuits should be locked so they do not move.

The second panel schedule is created using **Default** template. We will change this to use the second template after we lock down the first 42 circuits. To lock the first 42 circuits you will need to assign spares to the first 42 circuits. This will make the first available circuit be 43. Once the spares have been assigned, you will apply the second template to this schedule. When the second template is assigned the first 42 circuits become ghosted. The panels are now ready to be placed onto the sheets. You will place the first panel and then place the second panel. The second panel will need to be moved to occupy the blank space in the first panel. Panels do not have snaps, so this will have to be done by zooming up and nudging the panel into place.

The first panel is picking up the loads from the second panel. The first panel is adding the loads and giving the total demand from both circuits. This is a 'workaround' but it works nicely once it is set up. As with most custom configurations, I recommend that this is done inside of your Project Template so it is set up and ready to be used on all projects.

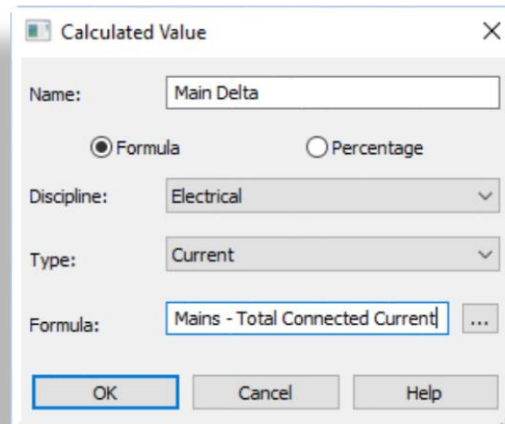
## Using Schedules to check if Main is Sized Correctly

Revit does a great job in keeping items coordinated. One of the few things Revit does not do is ensure that the **Mains** on electrical panels are sized correctly. Electrical panels have a parameter called **Mains** that the users are supposed to type in once the panel size is known. It would be nice if Revit could look at the load on the panel and size the main accordingly, but it does not do that. One way to assist in making sure the Mains are sized correctly is to use **Conditional Formatting** on an electrical equipment schedule.

F	G	H
Mains	Total Connected C	Main Delta
100 A	280 A	-180 A
300 A	133 A	167 A
100 A	0 A	100 A

Begin by selecting **Schedules** and then **Schedules/Quantities** on the **View** tab to create a new schedule. In the **New Schedule** dialog, select **Electrical Equipment** as the **Category**. Verify or change the **Name** of the schedule and select **OK** to begin building the schedule.

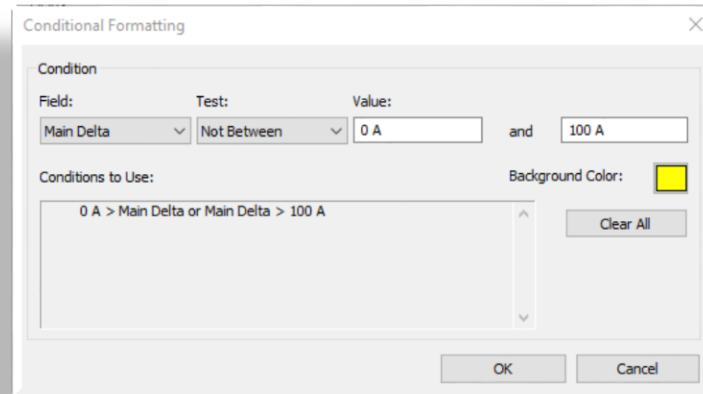
In the **Schedule Properties** on the **Fields** tab, add the following fields: **Family**, **Panel Name**, **Supply From**, **Electrical Data**, **Total Connected**, **Total Connected Current**, and **Mains**. Then select the **Add Calculated Value** button in the center of the dialog to create a new calculated value parameter. Type in **Main Delta** as the name of the parameter. The **Discipline** needs to be set to **Electrical** and the **Type of Parameter** set to **Current**. For the **Formula**, type in **Mains – Total Connected Current** and then select **OK** to finish creating the calculated value.



On the **Filter** tab, use a filter to filter out electrical equipment that are not panels by using a common parameter. One possible filter is to **Filter By: Panel Name Contains P**.

On the **Sorting/Grouping** tab, change the **Sort By:** to **Family**.

On the **Formatting** tab, select the **Main Delta** parameter and then select the **Conditional Formatting** button. In the **Conditional Formatting** dialog, change the **Test** to **Not Between** and set the values to be **0 A** and **100 A**. Select the **Background Color** button and select **Yellow** as the color. Select **Ok** to close the **Conditional Formatting** dialog. Select **OK** to close the **Schedule Properties** dialog.

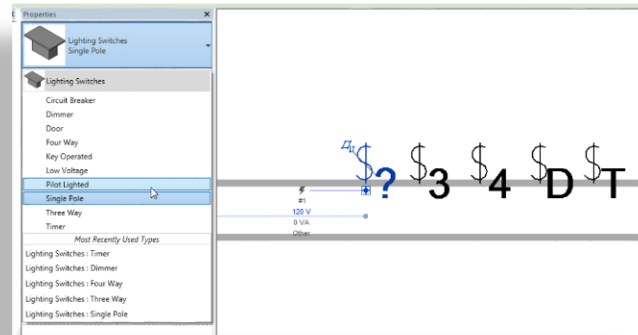


## Working with Nested Families

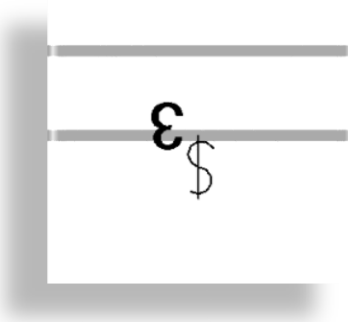
Nested families are used for many of the electrical devices in Revit. A nested family is simply a family that has another family inside of it. Many of the devices that are 'out of the box' are created this way. The nested family is usually a Symbol Family that shows the 2D graphic representation of the device that we see in a plan view. It is specifically a symbol family because symbol families will change scales based on the scale of the view that they are visible in. This allows our symbolic graphic to always be legible and not just a tiny dot, or too large as we change the scale.

## Correcting Upside down Switch Labels

The most asked question that I have received is about the Lighting Device symbol. When using this symbol, there are multiple types to indicate what type of light switch is needed to be shown. Some of the types included with the family are: Single Pole, 3 way, 4 way, Dimmer, Timer, etc...

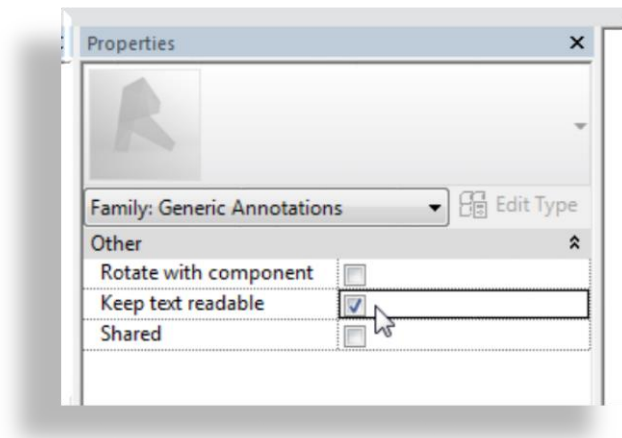


The family uses a label to indicate which type is being used. The question that I am typically asked is about the label when the family is inserted onto a wall, and the switch is facing down in a plan view. The label is upside down. How do you rotate the label so it is not upside down?



This is a simple fix once it is understood that the label is part of a nested symbol family. To correct this, simply click on the switch family and then select **Edit Family** from the **Modify** tab. This will open up the family in the family editor. Once inside the switch family, change your view to the **Ref. Level** plan view. In the plan view, the symbolic nested family will be visible. Select the nested symbolic family and then select **Edit Family** from the **Modify** tab again to open up the nested family.

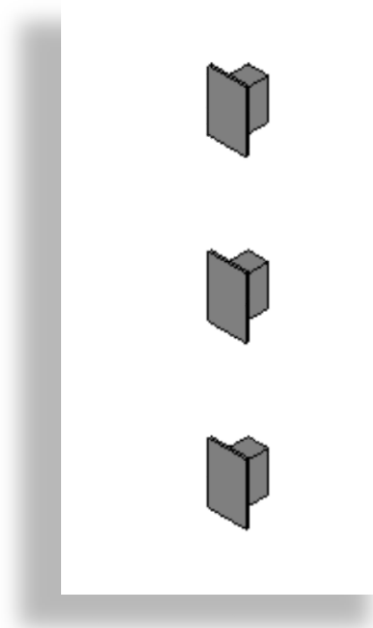
Inside the nested symbolic family, all that needs to be changed to fix the problem is a check box in the properties. Check the box for the parameter "**Keep Text Readable**".



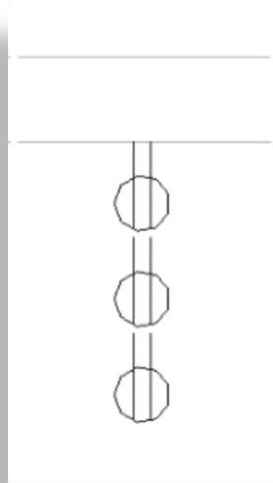
Once the check box is checked, all that is remaining is to load the families back into each other and then load the family back into your project. Since it is a nested family, be sure to first load it back into the Lighting Switch family first, and then load the Lighting Switch family back into your project.

### Creating Stacked Devices

Another common question I receive concerning nested symbol families is how to show multiple devices that are in the same location in plan view but are stacked above or below other devices. For example, multiple receptacles that are at different elevations.



In the CAD world, this would be indicated by moving the receptacle symbol out from the wall with a height adjacent to the symbol to call out the elevation height. The big difference between CAD and BIM is that in BIM you need to model the receptacle in the correct location to allow for clash detection, so you cannot just move the symbol.



This can be accomplished by modifying the nested symbol family to allow for the graphics of the symbol to be moved while keeping the 3D geometry of the receptacle in the correct location. To do this you will need to add a location parameter that is associated with a dimensional parameter to move the graphical symbol away from the wall.

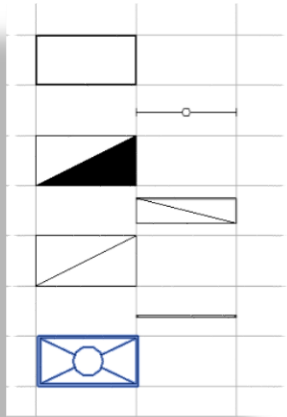
Family Types		
Name:		
Parameter	Value	Formula
<b>Constraints</b>		
Plan Symbol Vertical Location (default)	1.000000	=
Plan Symbol Horizontal Location (default)	1.000000	=
<b>Other</b>		
Vertical Offset (default)	0' 0"	= (Plan Symbol Vertical Location - 1) * 0' 0 3/16"
Horizontal Offset (default)	0' 5"	= 0' 5" + (Plan Symbol Horizontal Location - 1) * 0' 0 3/16"
<b>Identiv Data</b>		

The label on the symbol family can be used to indicate the height of the receptacle. This will keep your receptacle family readable and allow stacked devices.

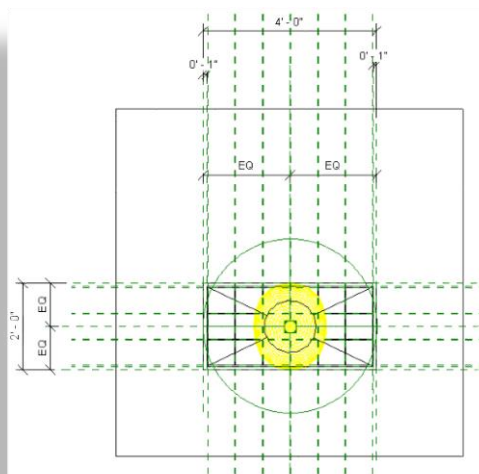
## Additional Topics

### Changing the Graphics of a Light Fixture

Light fixtures are indicated on plans by using a symbol in plan view to distinguish them from other light fixtures. The graphics that represent the light fixture often need to be customized to match office or project standards. To change the graphics of a light fixture, it is important to understand that the light fixture families are created with four main parts.



All light fixture families consist of 3D geometry, a light source, an electrical connector, and 2D line work. The 3D geometry is what is seen if you are viewing the fixture in 3D, section, or elevation. It is typically parametric in that it allows the dimensions to be modified to create multiple types and sizes.



The light source is the intelligent information that is used to indicate the type of lamp and the photometric of the fixture. Manufacturers can typically supply a photometric file in the form of an .ies file. All light fixture families point to the appropriate photometric file to indicate the correct light source information.

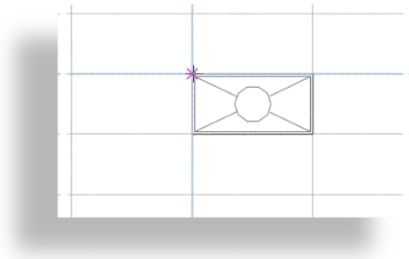


The electrical connector contains the information that is needed to circuit the light fixture. The electrical connector will have both load information and voltage. The load and voltage can be changed to meet your project needs.

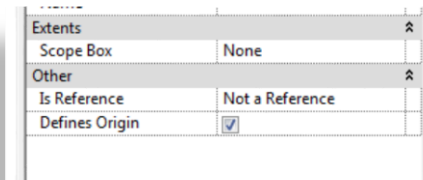
Finally, the 2D geometry is the linework that is indicated on plans and reflected ceiling plans. If the 2D geometry needs to be changed to meet office standards, this can be done without having to change the 3D geometry. If the family is edited, the 2D linework can be seen in either the plan view or the ceiling view. The linework can be deleted and/or new linework can be added. When modifying the 2D linework it will not affect the 3D geometry. The 2D linework will probably need to be locked to the reference planes so it will flex with the family when new sizes are required.

## Changing the Origin of a Light Fixture

Going back to my CAD days, I always taught my users to make the insertion point for blocks in the lower left corner of the block. This would keep consistency when inserting the blocks and allow you to snap to intersections to locate them correctly. Moving to the BIM world, the same logic applies. It is important to create consistency when creating families, by making the insertion point in the lower left corner of the family.



The insertion point of families is defined by defining the origin of the family. When a family is started from using a family template, the family will start with two reference planes. The intersection of these two reference planes defines the origin, or the insertion point. If the family is created with the intersection of the reference planes in the center of the family, then the insertion point will be in the center of the family. If the family is created using the reference planes as the lower left corner, then the insertion point will be the lower left corner.

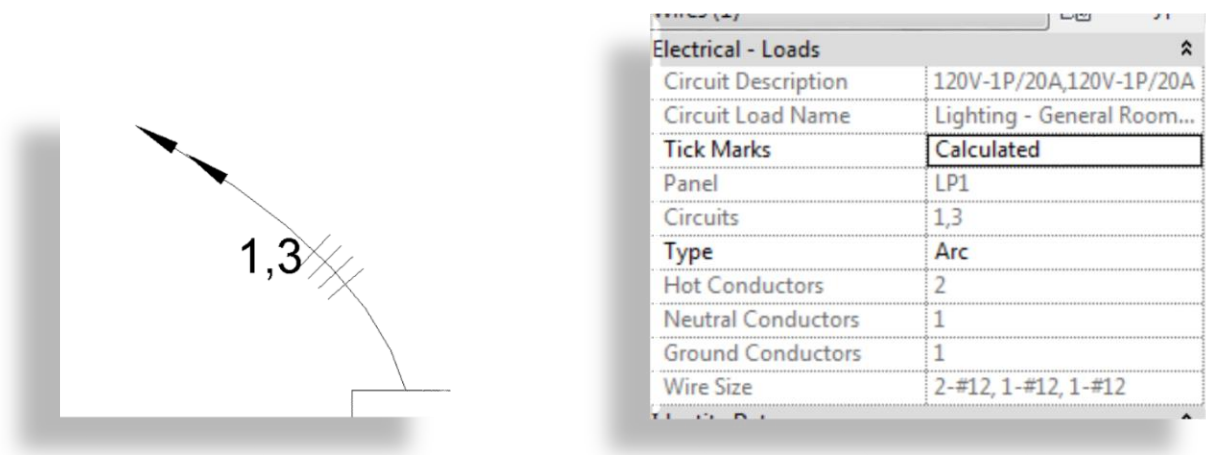


Existing families can be modified to change the origin by modifying the family. Reference planes can be selected. When they are, one of the parameters in the properties is **Defines Origin**. If a reference plane does not exist where the desired origin needs to be defined, then a new reference plane can be drawn, and the **Defines Origin** parameter can be checked to define the new reference plane as the origin. If reference planes do exist where the desired origin is required, then the reference plane can be selected and the **Defines Origin** check box can be checked to change to origin to the new plane. Both the horizontal and the vertical reference plane need to have the **Defines Origin** check box checked to define the intersection of the two reference planes as the origin. Reference planes should be dimensioned or locked to the geometry so the planes will move if the family is modified to a new size.

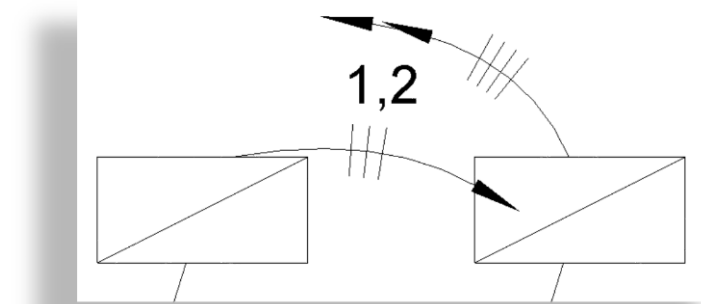
## Double Homeruns

Circuits are created by creating a **Power System** for the electrical devices or fixtures, and then selecting the electrical panel that will host the circuit. Once the circuit is created, wires can be drawn to indicate the wiring layout for the circuit. The wires do not make the circuit. The circuit is made by creating the **Power System**. Wires do not have to be drawn if they are not needed. If wires are drawn, **Homeruns** can be indicated for the circuit by drawing a wire from a circuited device or fixture and then picking a point other than another device or fixture. **Homeruns** can also be tagged to indicate the circuit number and/or the electrical panel name.

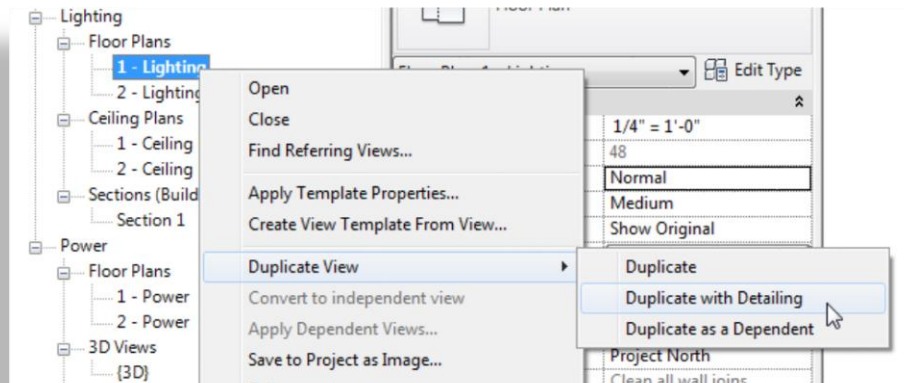
If a **Double Homerun** needs to be indicated, this can be done by dragging a homerun from one circuit to a fixture or device on a different circuit. As soon as the home run has been dragged to the other fixture or device, the home run on the second circuit will change and indicate the double home run by adding an additional arrow head to the home run, and adding an additional tick mark. If the home run is tagged, the tag will be updated to call out both circuits.



In previous releases of Revit, there was a graphical error that bothered many users. The homerun that was dragged to the fixture or device on the other circuit would keep the initial arrow head as opposed to removing the arrow head.



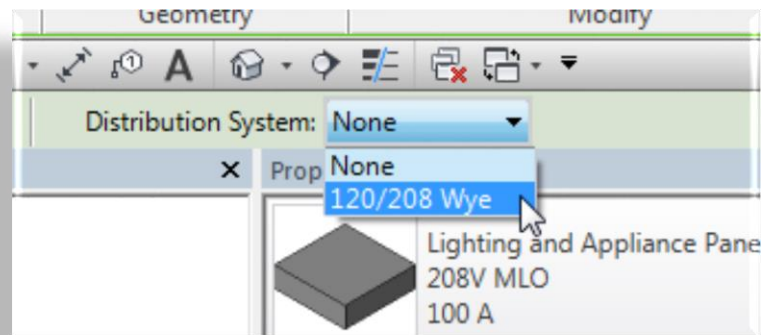
This graphical error could be fixed by duplicating the view with detailing. Once the view is duplicated, the extra arrow head on the first circuit is deleted. This workaround works for releases prior to 2014.



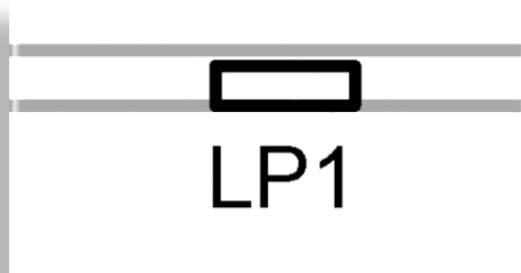
In 2014, it appears that this has been fixed. Performing the same steps in 2014, the extra arrow head is not indicated on the first circuit. This fix is undocumented and occasionally does not work. So if, you need to delete the unwanted arrow head, you can fix it by duplicating the view with detail.

### 3 Most Important Parameters when Inserting Panels

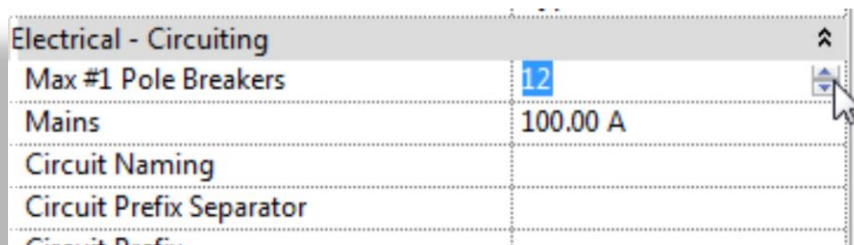
There are three important parameters that should be checked or changed when inserting an electrical panel. One of these is mandatory prior to creating circuits on the panel. After inserting a panel, the **Distribution System** must be assigned. Revit will not allow anything to be connected to the panel until the **Distribution System** has been assigned. The **Distribution Systems** are defined in the **Electrical Settings**. The **Distribution System** is assigned by using the drop down on the **Options Bar**. By default it is initially set to **None**.



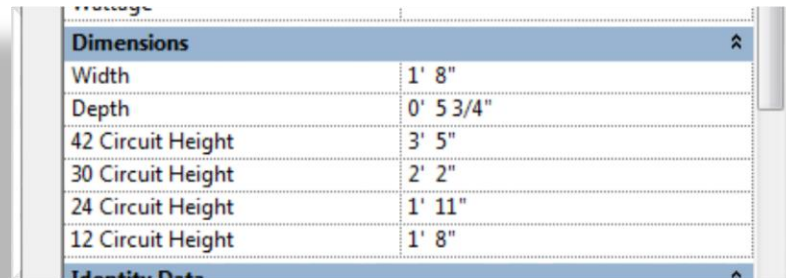
The second parameter that should be changed is the **Panel Name**. This parameter is found in the properties of the panel. Once the **Panel Name** is added, the panel can be tagged to indicate the Panel Name.



The third parameter that is recommended to change is the **Max #1 Pole Breakers**. The initial value is set to 12. If this is left alone, the panel can only hold 12 circuits. When the 13<sup>th</sup> circuit is created, the panel will not be able to be selected for the circuit.



The **Max #1 Pole Breakers** also defines the height of the panel box. As the number of circuits is changed, the height of the panel is changed. This is indicated in the **Type Properties** of the panel.



Dimensions	
Width	1' 8"
Depth	0' 5 3/4"
42 Circuit Height	3' 5"
30 Circuit Height	2' 2"
24 Circuit Height	1' 11"
12 Circuit Height	1' 8"

## Conclusion

Using Revit for electrical is extremely powerful. As I stated in the beginning, it is not the fact that it is modeling in 3D that is important to electrical, it is the coordination that it does to ensure that our documents are picking up everything.

Can you use Revit right out of the box? The answer to this would be determined if you are able to accept the default graphics, settings, and content. Many engineers do use it without any customization, but knowing how to customize it to fit your company standards makes Revit even more powerful.

Most everything that has been discussed in this class can and should be set up in your project template so it is available in all projects that are started. The Project Template is never finished. I have heard some companies hesitant to start using Revit until their Project Template is complete. New settings, standards, and content always need to be added to your template. The Project Template is a work in progress.

I hope you have picked up a new tip, trick, or idea from this class. Revit is a powerful tool and knowing how to use it correctly is important.