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# Electrical Distribution Systems in Revit Using layoutFAST

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## Learning Objectives

- Understand how distribution systems are established in a Revit model, and why they are important
- Select appropriate equipment throughout the design phases of a project
- Quickly make changes to design by adding or modifying equipment and devices
- Extract useful information from the model and systems

## Description

This class will teach the basics of establishing distribution systems in Revit using criteria-based equipment selection via the layoutFAST plugin. We will look at how real world equipment families can be easily inserted into a Revit model, and how to establish distribution systems. We will also cover the importance of circuit data within a model and how that data can be utilized for design decisions and efficient project completion.

## Speaker(s)

Don Bokmiller has over 20 years of experience working in the AEC industry, beginning as a CAD technician and working his way up to Electrical designer. Don has worked with Revit MEP since its first release, and participated as a co-author of the Mastering Autodesk Revit MEP book series from 2011 – 2015. He currently works for Schneider Electric as a BIM Specialist, providing support to customers and internal engineers on BIM and the use of LayoutFAST. When not working with the team at Schneider to help lead the electrical design and construction community in their BIM/VDC workflows, Don is probably out riding his Harley.

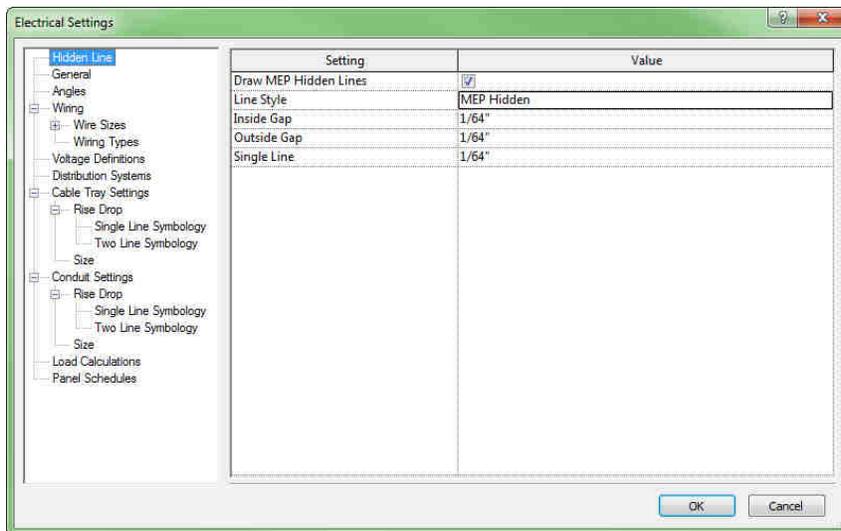
## The Big Question

You may ask “Why should I bother to build distribution systems into my Revit model?” Perhaps you track load information by some other means. As an engineer or designer wouldn’t you like to know that your model is a true reflection of the design you are creating? As a contractor, wouldn’t it make your deliverable that much more valuable if the owner could extract circuit information directly from your model for use in facility maintenance?

The real answer to the initial question depends on your BIM goals. If you are satisfied with simply creating a 3D model then you are truly missing out on the real value of BIM, the information.

## It Starts with Settings

The key to being establishing distribution systems in your project is to have the appropriate Electrical Settings defined in you project. This can be done in a template file, which saves time by removing repetitive work and ensures that each project you start will be consistent. Once you have the desired Electrical Settings established, you can place equipment and make the connections needed to define your electrical distribution systems.

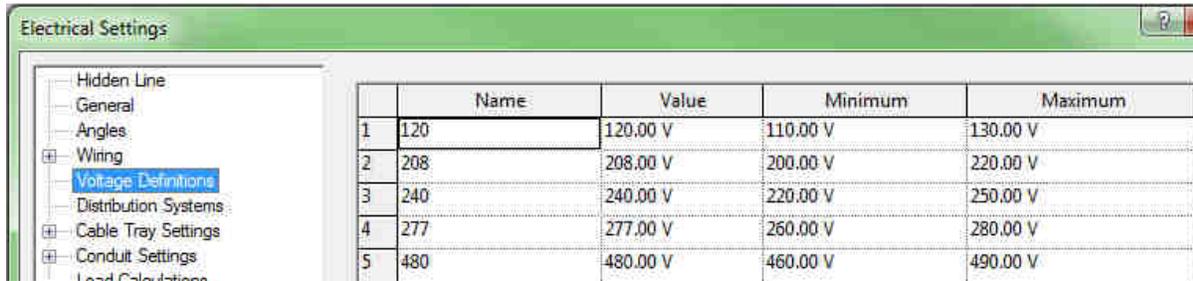


*ELECTRICAL SETTINGS DIALOG BOX (FOUND ON THE MANAGE TAB UNDER MEP SETTINGS)*

There are many settings you can define in your template. The two most important for distribution systems are Voltage Definitions and Distribution Systems.

## Voltage Definitions

In Voltage Definitions section of the Electrical Settings you simply define the voltages that will be available for use in your project. You can give a minimum and maximum value to establish the allowable range within a defined voltage. If you create a ‘custom’ voltage, keep in mind that any components you wish to use must be set to that voltage. For example: if you have 380V defined in your project and you want to connect components in your project using that voltage, the voltage value of the connectors in the components must be set to 380V.

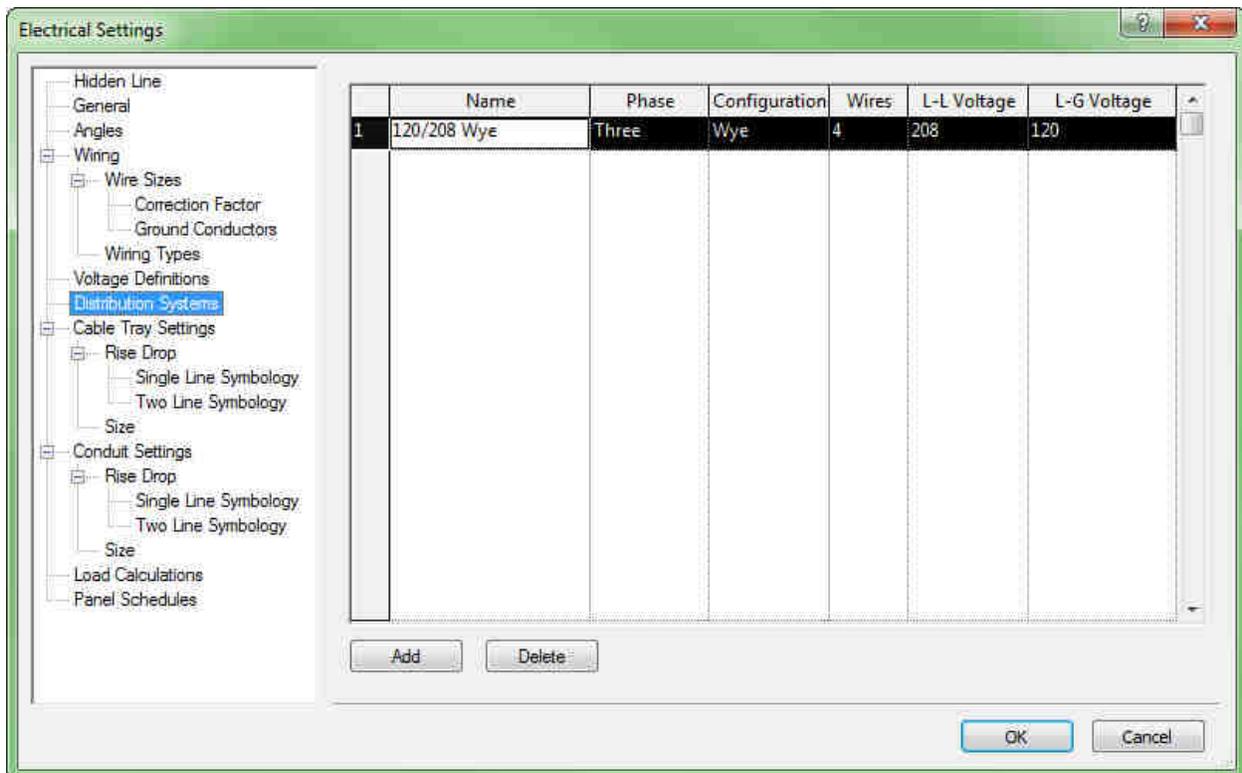


	Name	Value	Minimum	Maximum
1	120	120.00 V	110.00 V	130.00 V
2	208	208.00 V	200.00 V	220.00 V
3	240	240.00 V	220.00 V	250.00 V
4	277	277.00 V	260.00 V	280.00 V
5	480	480.00 V	460.00 V	490.00 V

*VOLTAGE DEFINITIONS IN ELECTRICAL SETTINGS*

## Distribution Systems

Once you have defined voltages in your settings, you can begin to build the definitions of your distribution systems. This is not actually creating any systems but is merely defining their behavior.



	Name	Phase	Configuration	Wires	L-L Voltage	L-G Voltage
1	120/208 Wye	Three	Wye	4	208	120

*DISTRIBUTION SYSTEMS SETTINGS IN THE ELECTRICAL SETTINGS DIALOG BOX*

To create a distribution system, click the Add button. Give the system an appropriate name (one that clearly describe its function) and choose the Phase, Configuration, Wires, Line-to-Line Voltage and Line-to-Ground Voltage.

The available voltages in the last two columns come from what has been defined in the Voltage Definition settings.

	Name	Phase	Configuration	Wires	L-L Voltage	L-G Voltage
1	120/208 Wye	Three	Wye	4	208	120
2	120/240 Single	Single	None	3	240	120
3	480/277 Wye	Three	Wye	4	480	277

Be aware that this means that it is possible to assign a voltage that is incorrect for the system you are defining.

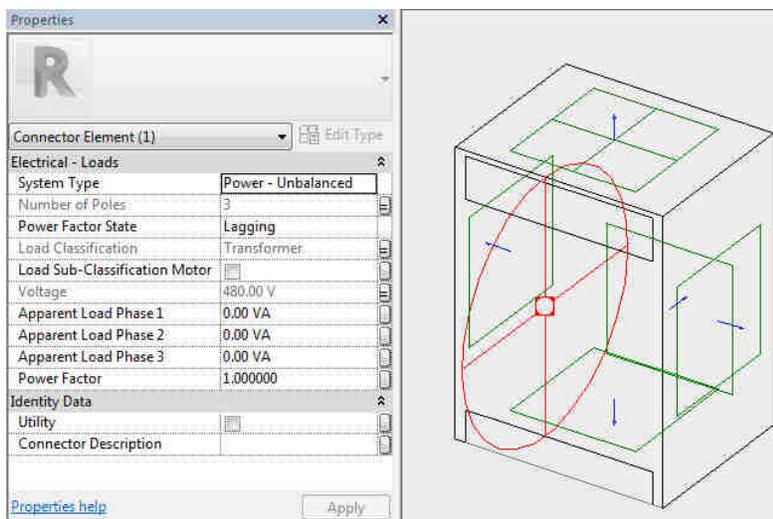
*ASSIGNING A LINE-TO-GROUND VOLTAGE TO A SYSTEM*

It is important to note when defining distribution systems, the voltage of a connector within a component must match the value of the defined voltage for a system if that component is going to be assigned a distribution system. Even though a range is defined for a voltage, values that fall within the range will not be recognized when establishing distribution systems. For example, if you have a piece of equipment that has a 460V connector, you would not be able to assign it to the 480/277 Wye system shown above. You would, however, be able to connect that equipment to another object that is 480V.

Once you have established the Voltage Definitions and Distribution Systems settings in your project you can create electrical systems by connecting components and creating circuits. Before we move forward in describing this process, let's take a look at the components.

### Component Connectors

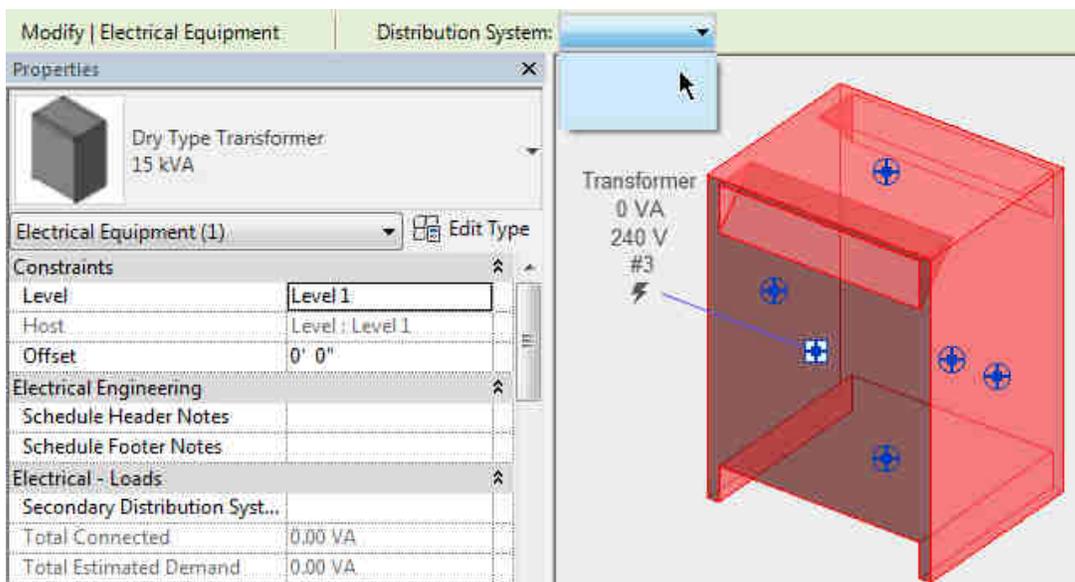
In an electrical component family, it is the connector that carries the electrical system information of the object.



*CONNECTOR PROPERTIES IN A TRANSFORMER FAMILY*

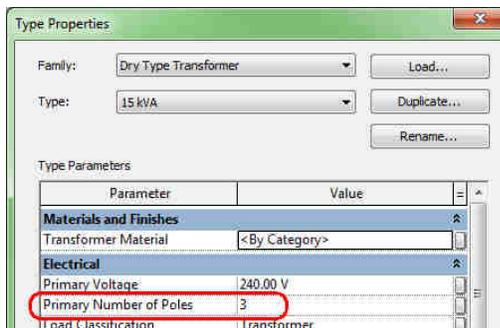
The image above shows that the electrical properties are held within the connector, not the family itself. Notice that some of the connector properties can be associated with family properties for easy family type creation and modification. In this example, the voltage of the connector is defined by a parameter in the family. If this voltage value matches one that is defined in the project then the family can be made a part of a distribution system, or a circuit can be assigned to it.

When it comes to the connector properties, *Voltage* is not the only parameter that determines if a component fits into a distribution system. The *Number of Poles* parameter is also important. The combination of these two parameters must fit into the definition of the Distribution System defined in the project.



Here we have a 240V component but there is no distribution system available in the project to assign to it. If we look at the Voltage Definitions in the project we will see that 240V is one of the options. We also see that a Distribution System of 120/240 Single has been defined. So why can't we assign this component to a system? The answer lies in the component itself.

If we look at the properties of the connector, we see that the Number of Poles is set to "3".



#### CONNECTOR PROPERTIES

Based on the configuration of the Distribution System defined in the Electrical Settings, we cannot connect a 3-pole, 240V component to the system. The settings require that the number of poles be set to “2”.

	Name	Phase	Configuration	Wires	L-L Voltage	L-G Voltage
1	120/208 Wye	Three	Wye	4	208	120
2	120/240 Single	Single	None	3	240	120
3	480/277 Wye	Three	Wye	4	480	277

So, this demonstrates that it is not only Voltage that is important when working with components, and that you need to be careful when creating content to ensure that the connector properties will make the component useful in your project environment.

Later in this document we will see how using the LayoutFAST app can make equipment selection easy, and how the appropriate settings can be applied to select the right components.

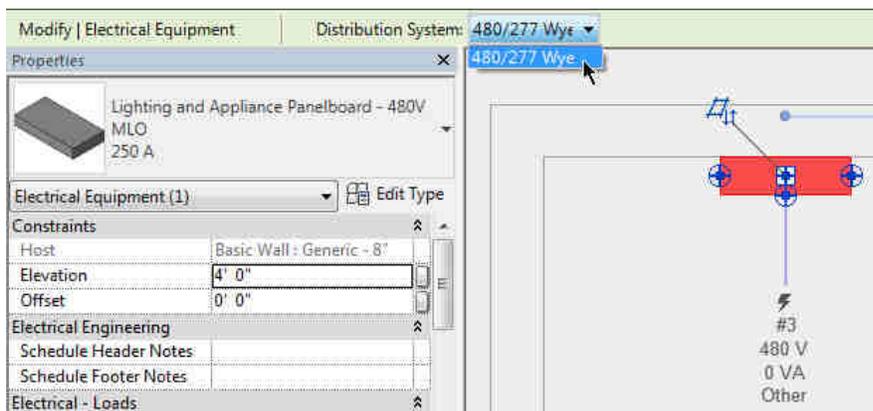
## Placing Components and Building a Distribution System

From this point forward we will be referring to a distribution system as the connectivity of electrical equipment and components. If you establish the order of connections in your project, you can track circuit information from a component all throughout the system.

Placing a component is as simple as loading the desired family and placing it in the appropriate location in the model. If you intend to establish distribution systems between your electrical equipment, it is a good idea to define the distribution system for electrical equipment when you place it. This will keep you from having to go back later to do it when you are creating circuits.

When you place a component that is categorized as equipment, you will get a drop-down on the Options Bar that allows you to set the Distribution System of the equipment. Note that only systems that coincide with the connector settings in the component will be available in the list. This keeps you from connecting items to incorrect system types.

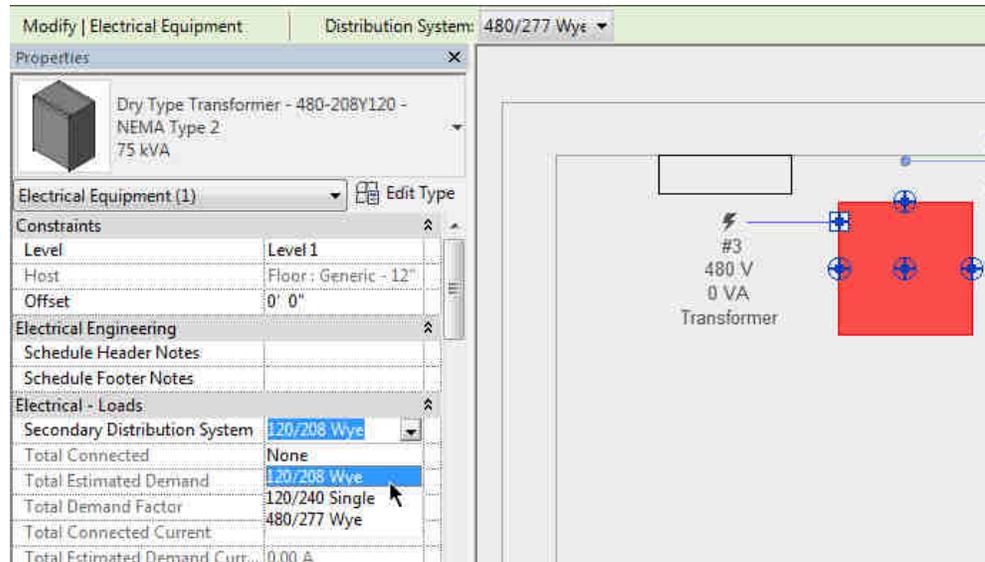
*Note: Versions of Revit newer than 2015 will assign a distribution automatically if possible, but it is always a good idea to check!*



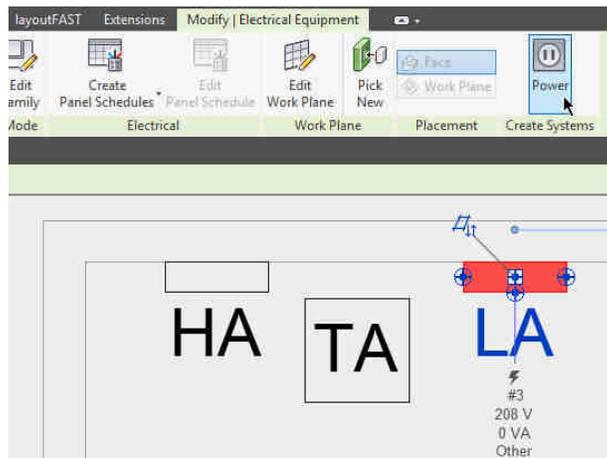
ASSIGNING A DISTRIBUTION SYSTEM TO ELECTRICAL EQUIPMENT

For transformers, the system selected in the drop-down is for the primary system. You need to also set the secondary system by accessing it in the properties of the transformer family.

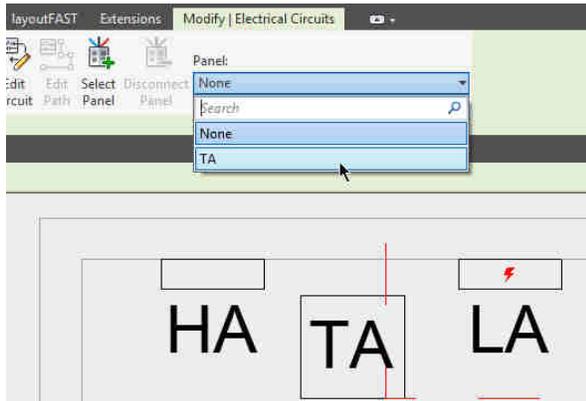
*SETTING THE SECONDARY DISTRIBUTION SYSTEM FOR A TRANSFORMER*



Once you have the desired equipment in place you can begin to build your distribution system in the project. Start by selecting the equipment that is furthest “downstream” (in this case it is the branch panel). Click the button on the Create Systems panel to create a circuit for the equipment.



In the Modify|Electrical Circuits tab of the user interface ribbon you can click the Select Panel button to manually select equipment that will feed the selected component, or you can use the drop-down to select the equipment by name.

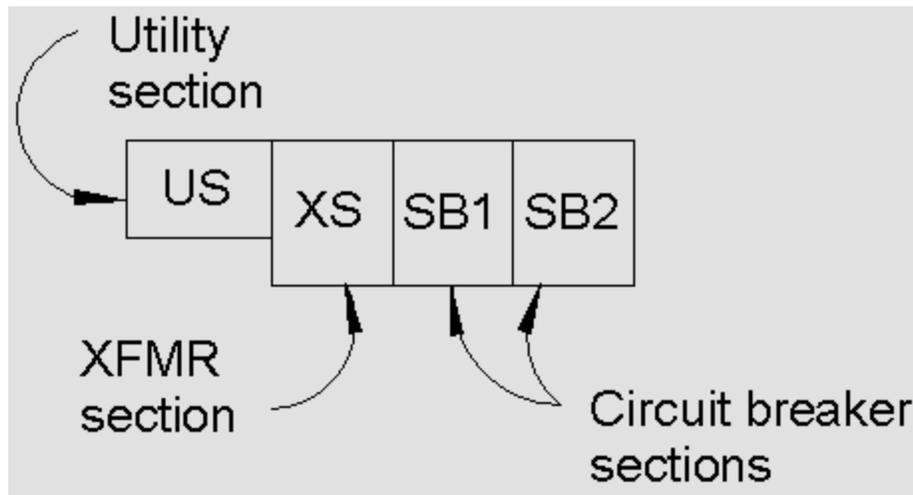


Note that only equipment that shares the same Distribution System type will appear in the drop-down. The panel is 120/208 Wye, so the only thing it can connect to is the secondary side of the transformer. Using this method to select equipment is useful when you are choosing components on a different building level or in another area of the building.

Once you have chosen the equipment that feeds the component, select that equipment and repeat the process of creating a circuit and then selecting equipment that feeds the component. For this example, you would select the transformer and click the button on the Create Systems tab. Choose the distribution panel (HA) as the panel for the circuit.

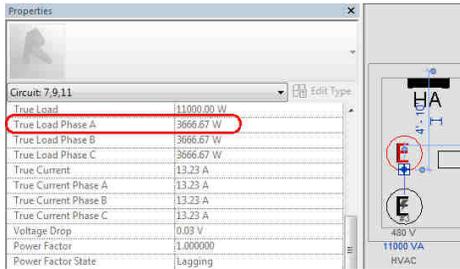
Now we have a distribution system where panel LA is fed from transformer TA, which is fed from panel HA. You can continue the distribution as far upstream as necessary for you to track circuit information.

The same steps can be followed to build a distribution system through a switchboard or switchgear. As you place the modular components, assign a distribution system and create circuits for each one, feeding it from the appropriate equipment upstream. Here we see a switchboard set up and the distribution system created so that SB1 & SB2 are fed from XS, which is fed from US.



So, if panel HA is fed from SB1, load information from HA will be shown all the way through to US.

With a properly built distribution system you can see load information from all of the connected devices within your model. You may not like the panel schedules that come with Revit or choose to use them on your construction documents, but they do tell the story of what is connected within your design.



**Branch Panel: HA**  
 Location: Supply From: SB1 Mounting: Surface Enclosure: Type 1  
 Volts: 480/277 Wye Phases: 3 Wires: 4

CKT	Circuit Description	Trip	Poles	A	B	C	Pt
1,3,5	TA	20 A	3	1128 VA	228 VA	228 VA	
7,9,11	HVAC	20 A	3	3667 VA	3667 VA	3667 VA	
13							
15							
17							
19							
21							
23							
25							
27							
29							
31							
33							
35							
37							
39							
41							
<b>Total Load:</b>				4795 VA	3895 VA	3895 VA	
<b>Total Amps:</b>				17.31 A	14.06 A	14.06 A	

**Branch Panel: HA**  
 Location: Supply From: SB1 Mounting: Surface Enclosure: Type 1  
 Volts: 480/277 Wye Phases: 3 Wires: 4  
 A.I.C. Rating: Mains Type: Mains Rating: 400 A

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals
HVAC	11685 VA	100.00%	11685 VA	
RECEPT	900 VA	100.00%	900 VA	
				<b>Total Conn. Load: 12585 VA</b>
				<b>Total Est. Demand: 12585 VA</b>
				<b>Total Conn.: 15.1 A</b>
				<b>Total Est. Demand: 15.1 A</b>

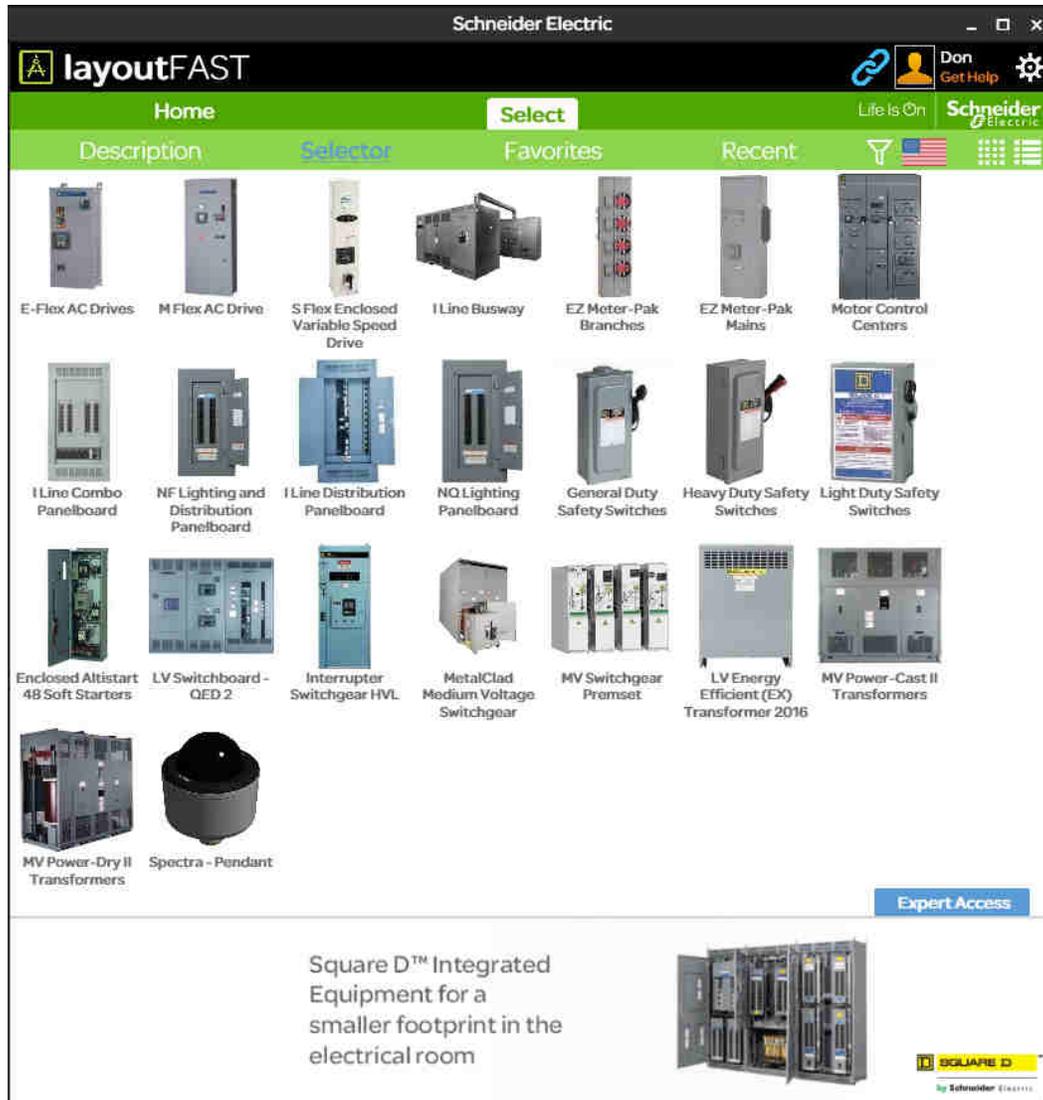
**Switchboard: SB1**  
 Location: Supply From: XS Mounting: Enclosure:  
 Volts: 480/277 Wye Phases: 3 Wires: 4  
 A.I.C. Rating: Mains Type: Mains Rating: MCB Rating: 600 A

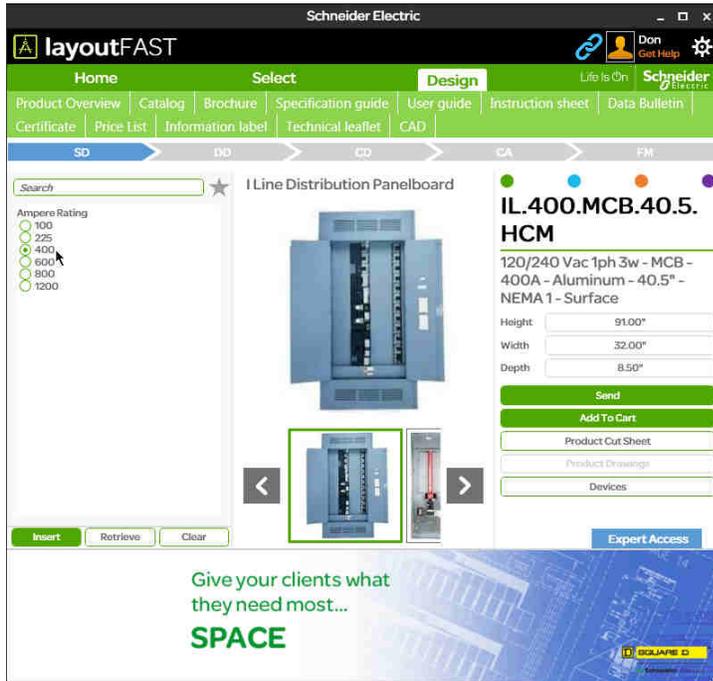
CKT	Circuit Description	# of Poles	Frame Size	Trip Rating	Load	Remarks
1	HA	3	30 A	30 A	12585 VA	
2						
3						

## LayoutFAST

The LayoutFAST add-in for Revit allows you to select equipment families based on your design criteria. The helps you make decisions about your distribution systems and enables you to select the appropriate equipment without having to create custom families or make changes to generic content to suit your needs.

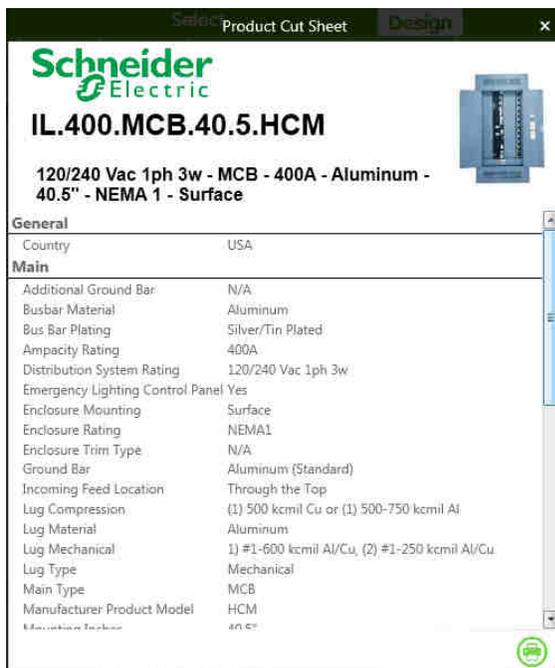
By using LayoutFAST you will be sure that the components in your model are accurate not only from a geometry standpoint, but also the electrical data.





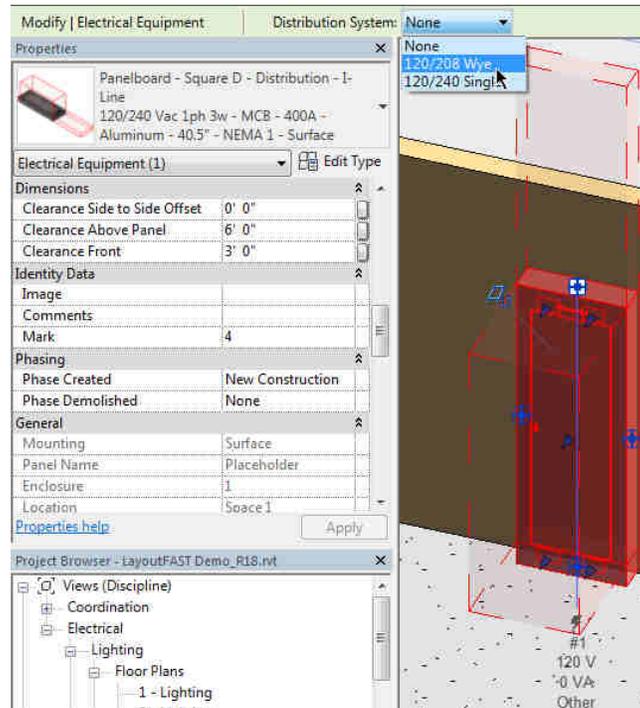
When you choose the type of component to insert into your model, you are taken to a screen where you can input the design criteria for the element.

This can be done at any stage of the design. The SD selection screen is very simple and requires limited information to select the appropriate equipment. The DD and CD selection screens require more input to allow you to increase the level of detail of the component you are selecting.



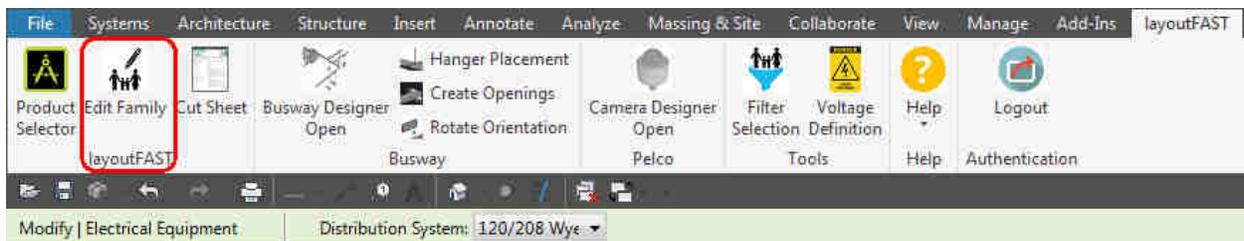
Once you have input the design criteria you can view detailed information about your selection by clicking the Product Cut Sheet button. This displays the product information directly within the app.

After entering the design criteria, click the Insert button to load the family into your project. Once you place the component in your model, it is still necessary to assign a distribution system to it.



*ASSIGNING A DISTRIBUTION SYSTEM TO EQUIPMENT*

Components that are placed using the SD design phase will act as placeholder objects in the model. The function as normal Electrical Equipment with the exception of their name. Later in the design lifecycle you may want to update the equipment. This is easily done with items that have been placed using LayoutFAST. You simply select the item and click the Edit Family button on the LayoutFAST tab of the Revit interface.

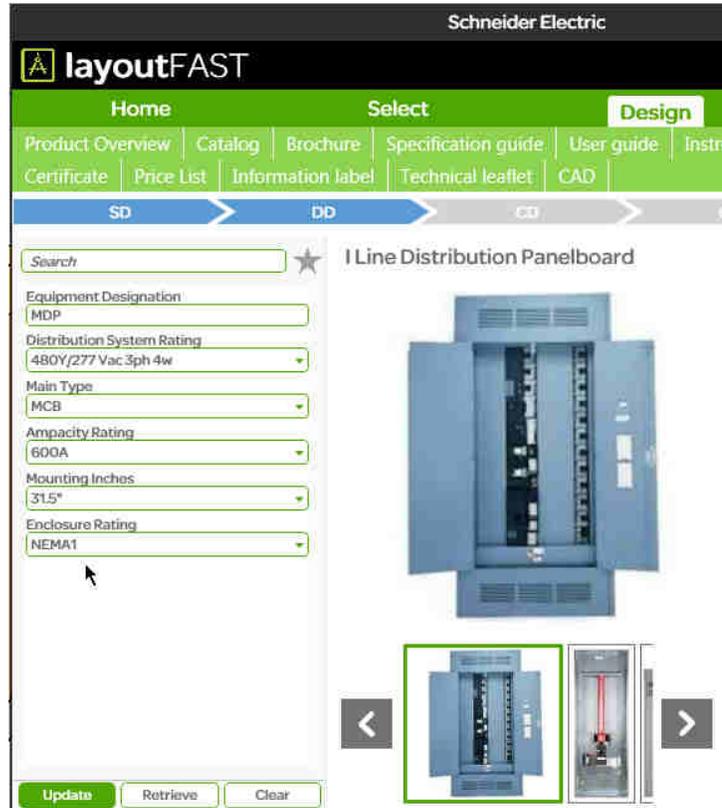


This will bring you back to the selection you initially made. You can then switch to a different design phase and provide the appropriate information.

Once you have provided the additional information required by the design phase, you can click the Update button to update the selected equipment in the model.

This simply updates the item without having to replace it. Keep in mind that the new information you provide may mean a change in the geometry of the item.

In phases other than SD, it is important to remember to give your equipment a name. You will be prompted to do so when you click the Insert or Update button.



## Workflow

LayoutFAST can be used outside of Revit if necessary. The installation provides the Revit plug-in and a standalone desktop app.

The main difference is that in the app you don't have the option to "Insert" your selection. Instead, you can save it as a .LYF file that can be shared with other LayoutFAST users. There is even a Send feature that allows you to send a configuration directly through the app.

This allows for the workflow where a non-Revit user, such as an engineer, can make the engineering decisions to properly select the appropriate equipment and then provide that selection to the modeler.

By using manufacturer specific content that is based on your design input, you can quickly develop electrical models with the level of information that are truly utilizing the power of BIM.

For more information on LayoutFAST and Schneider Electric's BIM offerings visit our booth here at AU, or go to [www.schneider-electric.us/layoutfast](http://www.schneider-electric.us/layoutfast)