

BES502481

Creating an Electrical Analytical Model in Revit 2023

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Learning Objectives

- Learn about the Electrical Analytical Load Type Settings.
 - Learn about defining electrical analytical loads.
 - Learn about creating boundaries for area-based loads.
- Learn about the conceptual distribution system.

Description

Revit 2023 software lets users create an electrical analysis model for preliminary design to analyze and plan the connected load in a Revit model before placing physical electrical families. This session will show you how to create an electrical analysis model from a linked architectural model, a 2D DWG™, or a PDF. See how you can get a jump on understanding the electrical demands of your next project before placing components into the model.

Speaker(s)



Mike Massey graduated from Texas A&M University with a degree in architecture. He has 30-plus years of experience working in the architecture, engineering, and construction AEC industry. Mike specializes in Building Information Modeling BIM 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 in 2016. Mike has also been a contributing author for Autodesk Official Training Courseware.

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Introduction

Thank you for joining me for this session. The goal of this session is to show you the new tools inside of Revit 2023 that allow Electrical designers to perform preliminary electrical load analysis using a Revit model, an AutoCAD file, or a PDF. These tools will enable the Electrical Engineers to plan accordingly before the completion of the design or before placing model components into the model.

Preliminary Electrical Load Estimation

Before we get into the new Revit tools, I would like to take a few minutes to discuss the importance of creating a preliminary electrical load estimate and how these are being done outside of Revit.

Electrical Load Estimation is a way of determining the total electrical load that a building will require. This allows the engineer to plan the connection to an upstream network. Knowing the total building loads ensures that the proper amount of power is available and provided. The total building load is required when applications are made to the local power company. An accurate estimate will ensure that the demands are provided.

ELECTRICAL LOAD CALCULATION AND ENERGY CONSUMPTION																
ELECTRICAL PANEL DETAIL																
Total KW	86	Kw	Load On R Phase	462	Amp	Voltage (Phase-Neutral)	230	Initial								
Total KVA	106	Kva	Load On Y Phase	0	Amp	Voltage (R-Y)	348	Load								
Total Load	577	Amp	Load On B Phase	0	Amp	Voltage (Y-B)	378	Met								
MCCB Size	600	Amp	Starting Current	1005	Amp	Voltage (R-B)	410	Actu								
Type	C Type		Full Load Current	462	Amp	Voltage Difference(%)	8	Appr								
Tripping	5774	Amp	Continuous Load	462	Amp	Unbalance Neutral(Amp)	1005	Appr								
			Non Continuous Load	0	Amp	Expected Temp Rise in Phase(°C)	17	Appr								
EQUIPMENT DETAILS																
Sr. No.	Application	1% SPN	Load on Phase	Unit Power (Watt)	Pf	Qty	Type of Load	Demand Factor	Motor Starter	Use	Absorb (Kva)	Full Load Current (Amp)	Starting Current (Amp)	Estimated Power (KW)	Estimated Power (Kva)	Aver Using (Hox)
1	Detail Consumption	1	R	50	0.8	1	Motor	1	Y-Δ	Cent	63	272	815	50	63	11
2	DATA CABLE	1	R	25	0.8	1	Ind Load	1		Cent	44	190	190			
3	ELECTRICAL ENGINEERING PORTAL	1	Y													

In addition to planning for connection to the local utility company, a load estimate allows the engineer to plan for transformer substations and the main switchgear room. Knowing the load ensures that adequately sized equipment is planned for initially. Knowing the equipment sizes will also allow initial budgets to be calculated for the electrical work.

Today, preliminary electrical load estimates are done outside the Revit model. Excel spreadsheets are used to perform the estimates. It is a broken process that is sometimes a guesstimate as opposed to an accurate estimate.

Types of Electrical Load Estimates

There are three main types of electrical load estimates: Space-by-Space Method, Building Area Method, and Area Method. I will briefly explain each one of these types below.

Space-by-Space Method

The space-by-space method divides the building into different spaces based on its function. The load density in W/ft² and/or VA/ft² is prescribed for these different spaces. This method can be used for any building or portion of a building. The Load density for the areas can either be grouped or individual. Group load density has one value covering all lighting, general power, and power loads in W/ft² and/or VA/ft². An Individual Load Density has individual values for lighting and general power loads in W/ft² and/or VA/ft².

Building Area Method

The building area method is used for buildings bigger than what can be handled by the space-by-space process. This method is more straightforward as you estimate the electrical load based on the activity of the whole building. This method offers less flexibility and is typically used for the entire building, single, independent, and separate occupancies.

Area Method

The area method is used for Areal loads, which consist of groups of individual building loads. Buildings are served by the same subdivision of the electrical distribution system. This method is used to design substations and can be groups of individual building loads within an area.

We will use the space-by-space method with the grouped load density for this session. This will allow us to use the tools in Revit to help divide the model into spaces.

Define

Revit 2023 Workflow

New in Revit 2023 are electrical analysis tools that allow engineers to analyze and plan the connected loads in a Revit model before placing physical electrical families. This new functionality allows electrical designers and engineers to capture electrical design requirements natively within Revit, in contrast to workflows reliant on maintaining data in spreadsheets, PDFs, and other disconnected repositories.

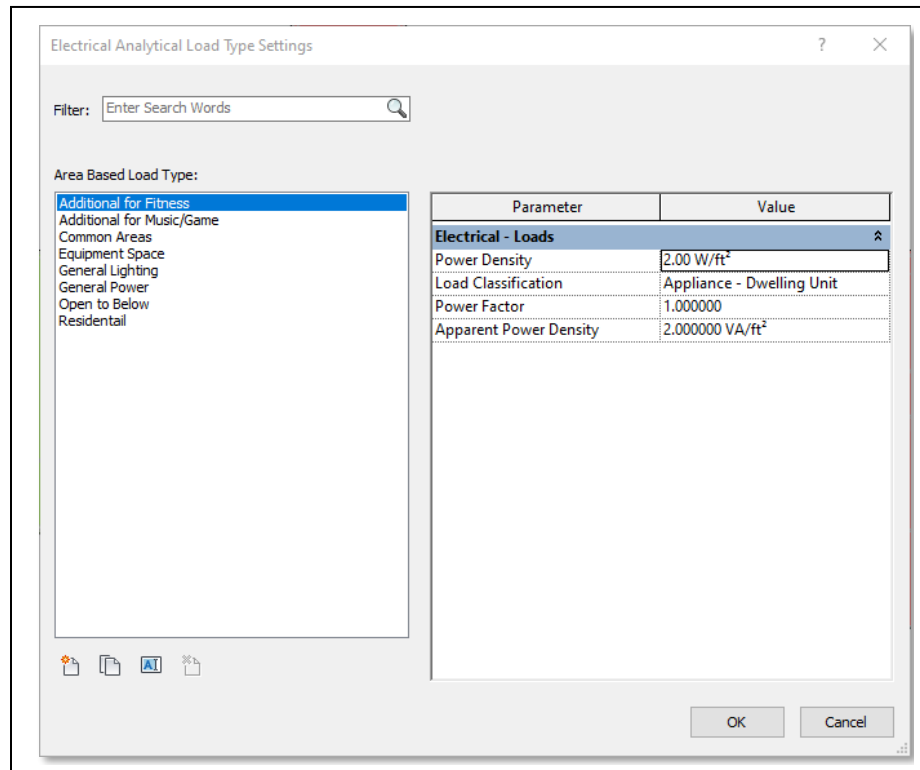
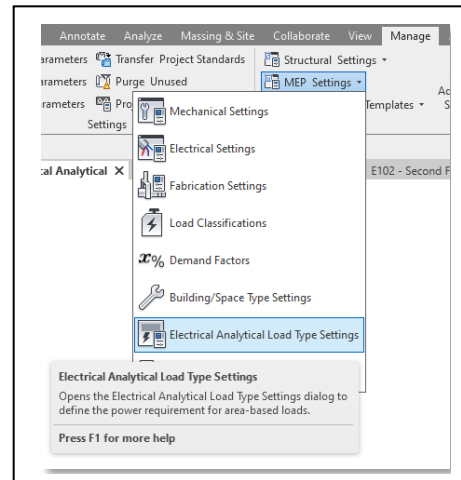


Below is the recommended workflow when using the electrical analysis tools inside of Revit.

- Define electrical analytical load type settings.
- Create electrical analytical loads.
- Apply the loads to the conceptual distribution system.
- Document the electrical load analysis.

Load Type Settings

There are new settings that define the electrical analytical load types. These settings can be accessed on the Manage tab under MEP Settings. You will notice in the dialog that there are two default types. These types are General Lighting and General Power. These types can be used, or new types can be created. Load types should be made for the different areas in the project (*i.e., office, corridor, equipment, mechanical, common*). There are tools to create new types, duplicate types, rename types, or delete types. Common load types used on typical projects can be created in the Revit project template, or specific project load types can be created.

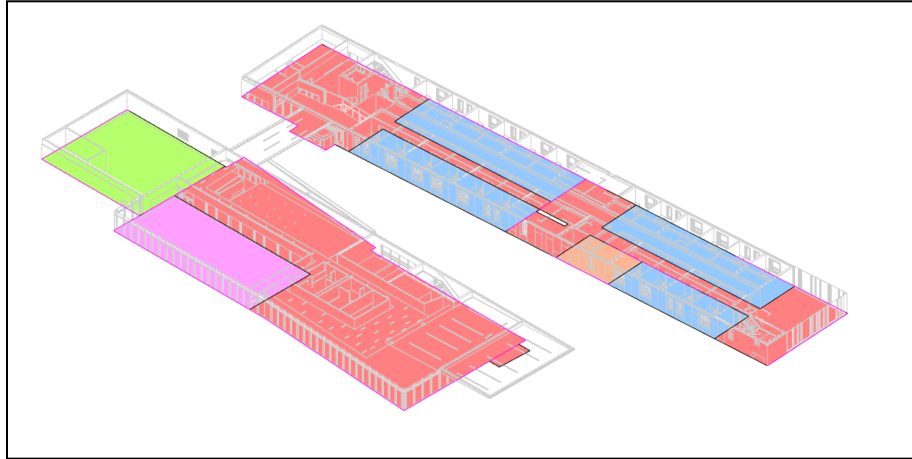


Each load type will define the power requirements used on area-based loads. There are parameters for the power density, load classification, power factor, and apparent power density. Once the Area-Base Loads are created, a load type will be applied to the area in the properties of the area-based loads.

Create

Defining Electrical Analytical Loads

Electrical analytical loads will be defined in Revit by either creating an Area-Base Load or an Equipment Load. Area-Base Loads are created using a closed boundary to define an area within the project. The power requirements are based on a load density defined in the Electrical Analytical Load Type settings.



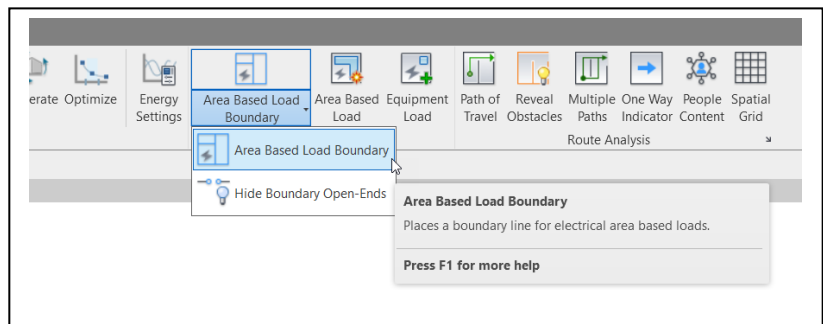
Equipment loads are assigned to major components, such as elevators, chillers, or other components beyond the general power density-based loads. The power requirements for Equipment loads are defined by inputting the apparent load in the properties palette. Both Area-Base Loads and Equipment loads are then assigned to a power source.

Electrical Area-Base Loads

When creating an Area-Base Load, a boundary must first be created. Once the boundary is created, the actual load will be created by selecting the closed boundary. Area-Base Loads can also be divided into smaller areas using the Divide option.

Load Boundaries

A load boundary is created by sketching a closed loop around the area. The Area-Base Load Boundary tool is located on the Analyze tab of the Revit menu. Once the command is started, Revit will go into a conceptual sketch mode. The sketching tools will be used to create the boundary. The boundary needs to be a completely closed-in loop with no overlapping intersections. A toggle is available to indicate open ends with yellow dots to ensure no open ends in the boundary. The open ends toggle is found in the drop-down on the Boundary command on the Analyze tab.



Boundary lines can span multiple levels. In the properties, there are parameters for both the bottom level and the top level. This prevents boundary lines from having to be created on multiple levels if they are in the exact location.

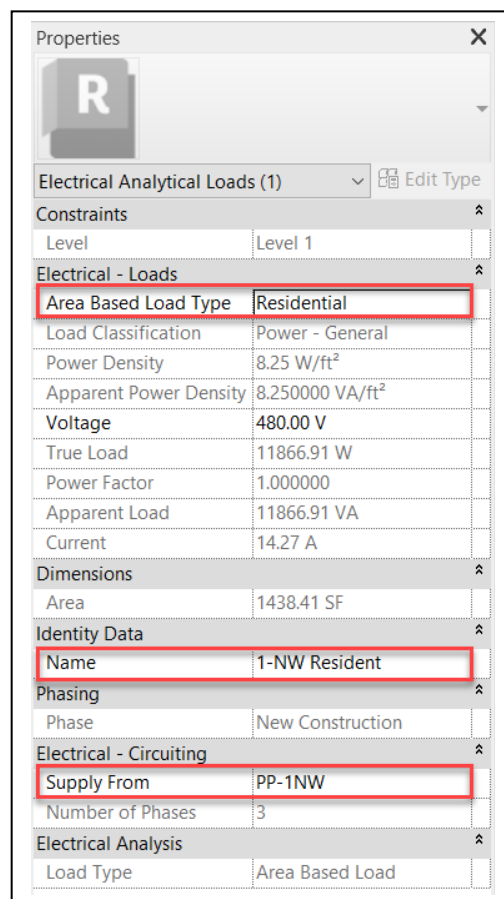
The graphics of the boundary lines use a specific Linestyle. The Linestyle can be modified in the Additional Settings drop-down on the Manage tab.

Area-Base Loads

The Area-Base Load is created using the Area-Base Load tool on the Analyze tab. Once the command is started, a conceptual menu will appear with the options to Add or Remove Load Areas. Once the loads have been created, a finish check mark button must be selected to end the command.

With the Add Load Area selected, an Area Load is created by picking inside a closed boundary. Multiple boundaries can be added to the same load if desired. If an area needs to be removed from the load, select the Remove Load Area button, and pick inside the closed boundary.

After the Area Load has been created, the Area Load can be selected by picking on the plus grip located in the center of the Area Load. The properties of the Area Load can be modified when the Area Load is selected. Three main properties should be defined. The first one is the Area-Base Load type. This will allow users to choose one of the types created back in the Load Type settings. Secondly, a name should be provided to the Area Load. And lastly, the Supply From parameter should be defined to indicate the power source for the Area Load. The Supply From parameter will not be able to be entered until the conceptual distribution system is created (this will be covered below).



Properties	
Electrical Analytical Loads (1) Edit Type	
Constraints	
Level	Level 1
Electrical - Loads	
Area Based Load Type	Residential
Load Classification	Power - General
Power Density	8.25 W/ft²
Apparent Power Density	8.250000 VA/ft²
Voltage	480.00 V
True Load	11866.91 W
Power Factor	1.000000
Apparent Load	11866.91 VA
Current	14.27 A
Dimensions	
Area	1438.41 SF
Identity Data	
Name	1-NW Resident
Phasing	
Phase	New Construction
Electrical - Circuiting	
Supply From	PP-1NW
Number of Phases	3
Electrical Analysis	
Load Type	Area Based Load

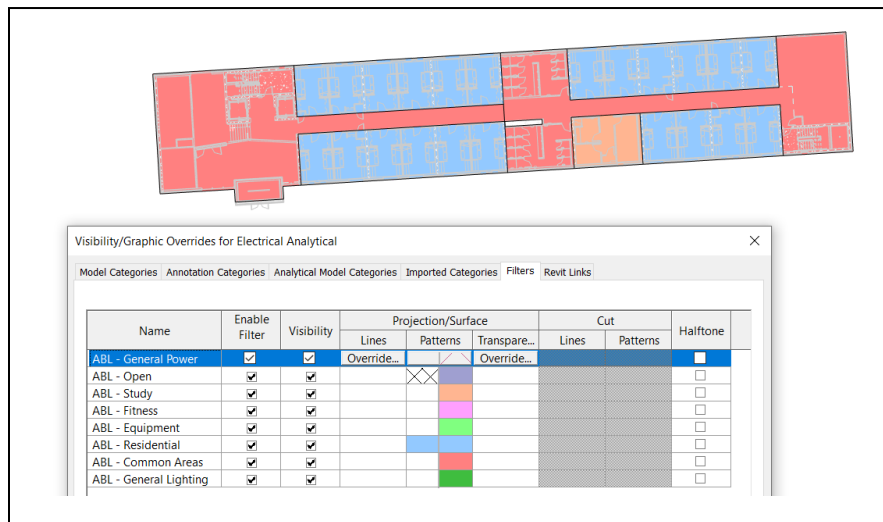
Divide an Electrical Area-Base Load

An Area-Base Load can be subdivided into smaller areas using the Divide option. Before using the Divide option, additional boundaries will need to be created. To divide an area, first select the Area-Base Load, then the Divide Boundary option will appear on the conceptual menu. Select the new boundary that is within the original boundary to divide. A new Area-Base Load will be created, which can be assigned different properties.

Creating Filters

All Area-Base Loads will graphically appear the same once they are created. It is recommended to take advantage of Filters to help distinguish one area from another. Filters can be created to correspond with the Electrical Analytical Load Types. The Electrical Analytical Load category should be used when creating the Filters. The rule should be Area-Base Load Type = Load Type Name.

Filters can then be assigned to views and/or view templates, and different color fills can be used for the filters. This will improve the ability to see the Area-Base Loads visually.

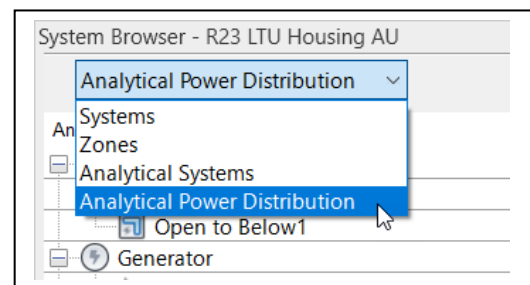


Apply

Next, we will move into the Apply section. This section will show how to apply the loads to a distribution system. Before doing this, we must first create the distribution system using the System Browser.

The System Browser

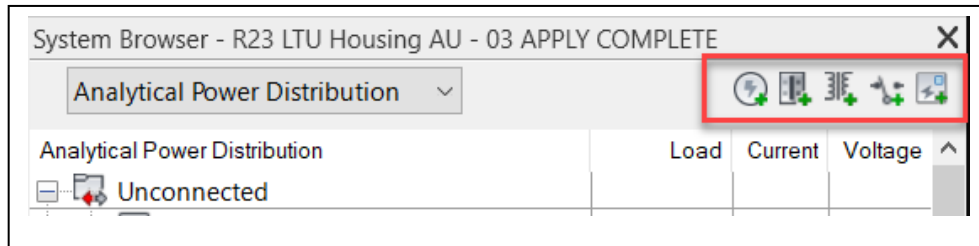
The System Browser is not a new feature; it has been around for many years. Typically, the System Browser is used to see the connected electrical devices in a Revit project. The new feature in Revit 2023 is the ability to use it for an Analytical Power Distribution. This can be done using the drop-down at the top of the browser.



Initially, all that will be indicated in the browser are the Unconnected loads. You will see all the Area-Base Loads previously created if the Unconnected folder is expanded. These loads will be moved out of the Unconnected folder and assigned to a Power Source once the distribution system has been created.

Creating the Conceptual Distribution System

At the top of the System Browser are tools that will be used to create the devices in our distribution system. Below is a list of the tools and what they are used for.



- Electrical Analytical Power Source
 - The Power Source represents the utility or supply to the building. It can also be used for generators if used in the project.



- Electrical Analytical Bus
 - The Bus can be used for panels, switchboards, buses, motor control centers, etc. The loads created will all be supplied from a Bus type of device.



- Electrical Analytical Transformer
 - The Transformer is used for transformers.



- Electrical Analytical Transfer Switch
 - The Transfer Switch is used for transfer switches. The transfer switch is unique because it will have two power sources (a primary and a secondary).



- Electrical Equipment Load
 - The Equipment Load is used for large equipment like chillers or elevators that have a load more significant than what is included in the Area-Base Loads.

As the distribution system is created, ensure that the hierarchy is correct and that the power flows from the power source to the end load.

System Browser - R23 LTU Housing AU

Analytical Power Distribution

Analytical Power Distribution	Load	Current	Voltage
Unconnected			
Open to Below	0 VA	0 A	480 V
Open to Below1	0 VA	0 A	480 V
Generator	14600 VA	18 A	480 V
EDP-TS	14600 VA	18 A	480 V
EDP	14600 VA	18 A	480 V
Elevator 1	7300 VA	9 A	480 V
Elevator 2	7300 VA	9 A	480 V
Utility	742014 VA	893 A	480 V
Campus MSB	742014 VA	893 A	480 V
X-LTUH1	742014 VA		
Main Switchboard	742014 VA	893 A	480 V
EDP-TS	14600 VA	18 A	480 V
EDP	14600 VA	18 A	480 V
Elevator 1	7300 VA	9 A	480 V
Elevator 2	7300 VA	9 A	480 V
PP-1EQ	2215 VA	3 A	480 V
1-Equipment Space	2215 VA	3 A	480 V
PP-1NE	21199 VA	25 A	480 V
1-NE Resident	11980 VA	14 A	480 V
1-NE Resident1	8026 VA	10 A	480 V
1-NE Study	1193 VA	1 A	480 V
PP-1NW	52277 VA	63 A	480 V
1-NW Common	28589 VA	34 A	480 V
1-NW Resident	11867 VA	14 A	480 V
1-NW Resident1	11821 VA	14 A	480 V

Adding Equipment-Based Loads

To add equipment, use the Equipment Load button in the System Browser. Confirm that the correct power source is selected before picking the Equipment Load button to ensure it has the right source.

Once the Equipment has been added, the properties for the Equipment should be filled out in the Properties Palette. The equipment can be given a name, as well as assigning the load classification, the voltage, the power factor, and the apparent load. Also, confirm that the Supply From parameter is correct.

Properties

R

Electrical Analytical Loads (1) Edit Type

Constraints

Level Level 1

Electrical - Loads

Load Classification Elevator

Voltage 480.00 V

True Load 7300.00 W

Power Factor 1.000000

Apparent Load 7300.00 VA

Current 8.78 A

Identity Data

Name Elevator 1

Electrical - Circuiting

Supply From EDP

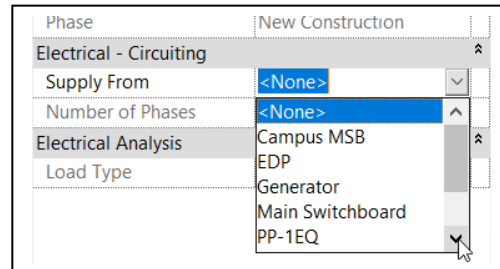
Number of Phases 3

Electrical Analysis

Load Type Equipment Load

Assigning Area-Base Loads Supply

The Area-Base Loads need to have a power source. Now that we have a Distribution system created with power sources, this can be assigned. To assign a power source to an Area-Base Load, select the Area-Base Load by choosing the grip in the center of the load. With the load selected, use the Supply From parameter in the Properties to assign the power source. As power sources are assigned, the distribution system will automatically be updated to move the loads from the Unconnected folder to the assigned power source.

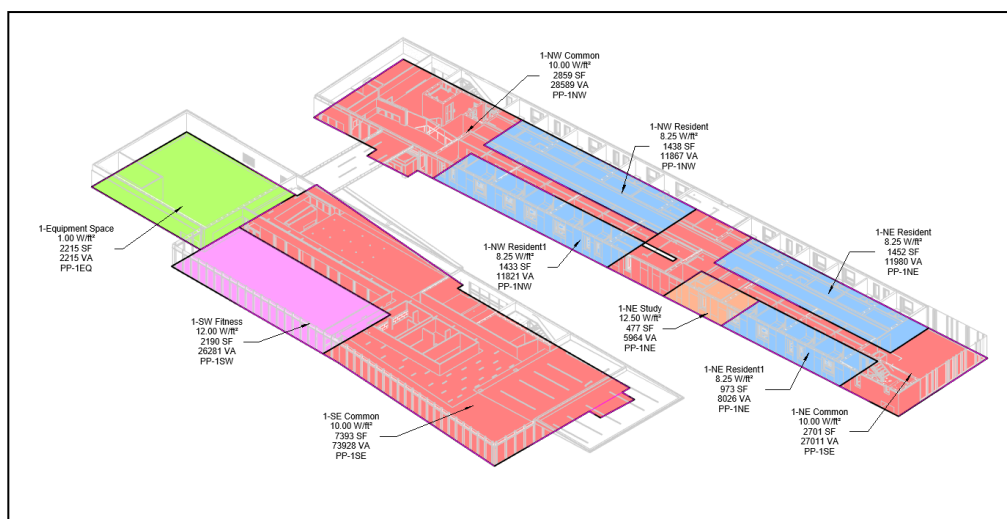


Document

This last section focuses on documenting the Electrical Analytical Loads. Documenting the Electrical Analysis lets you see the loads and their connected power sources.

Tagging

The Area-Base Loads can be tagged using either the Tag by Category command or the Tag All command. The Area-Base Loads will be tagged with a tag assigned to the Area-Base Loads category. The tags can be customized to include the load name, load density, apparent load, area, supply from, or other parameters.



Schedules

Five new schedule categories in Revit 2023 can be used for the electrical analysis. A loads schedule can be used to list out the loads and can be sorted and filtered by many methods. In addition to a load schedule, schedules can be created for power sources, Bus, Transformers, or Transfer switches.

Electrical Analytical Load Schedule									
Name	Supply From	Area Based Load Type	Power Density	Power Factor	Area	Apparent Load	Voltage	Number of Phases	Current
Level 1									
1-Equipment Space	PP-1EQ	Equipment Space	1.00 W/R ²	1	2215 SF	2215 VA	480 V	3	3 A
1-NE Resident	PP-1NE	Residential	8.25 W/R ²	1	1452 SF	11980 VA	480 V	3	14 A
1-NE Resident1	PP-1NE	Residential	8.25 W/R ²	1	973 SF	8026 VA	480 V	3	10 A
1-NE Study	PP-1NE	Music/Game	12.50 W/R ²	1	477 SF	5964 VA	480 V	3	7 A
1-NW Common	PP-1NW	Common Areas	10.00 W/R ²	1	2859 SF	28589 VA	480 V	3	34 A
1-NW Resident	PP-1NW	Residential	8.25 W/R ²	1	1438 SF	11867 VA	480 V	3	14 A
1-NW Resident1	PP-1NW	Residential	8.25 W/R ²	1	1433 SF	11821 VA	480 V	3	14 A
1-NE Common	PP-1SE	Common Areas	10.00 W/R ²	1	2701 SF	27011 VA	480 V	3	32 A
1-SE Common	PP-1SE	Common Areas	10.00 W/R ²	1	7393 SF	73928 VA	480 V	3	89 A
1-SW Fitness	PP-1SW	Fitness	12.00 W/R ²	1	2190 SF	26281 VA	480 V	3	32 A
Grand total: 10					23131 SF	207682 VA			250 A

Conclusion

The new Electrical Analysis tools in Revit 2023 will allow users to estimate their project's electrical demands before placing content into the models. This workflow changes the way Electrical designers begin the preliminary work on a project. These tools are a great addition to the software.

I want to thank you for joining me for this session. Feel free to contact me if you have any questions or want to follow up on anything covered in this session. I hope you see the value in the new Electrical Analysis tools and encourage you to begin using them on your next project by **Defining** the load types, **Creating** the loads, **Applying** the loads to a distribution system, and **Documenting** the analysis.