ES11341

Design and Manage Electrical Installation in Revit

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Learning Objectives

- Learn how to design and manage electrical installations in Revit MEP
- Learn how to create electrical systems
- Learn how to manage electrical families
- Learn how to manage electrical parameters in Revit

Description

In this class we will present how to define your electrical design in Revit software. We will explore the advantages of using a Building Information Modeling (BIM) model for an electrical installation, and address electrical families and connectors, electrical systems, light calculation, and documentation.

Your AU Experts

Product manager in ALPI, an European software editor in the field of Electrical design, Marseille Beltrey is an expert in Electrical design in BIM models. He uses to speak in differences conferences in Europe, to spread the word on Alpi and Autodesk offering. He provides BIM implementation and training for the company’s engineering design software, including Autodesk Revit, AutoCAD MEP, and AutoCAD Electrical. He has 10 years of experience in both the electrical design and Autodesk VAR, spending 6 years working as an instructor consultant for ALPI’s solutions based on the Autodesk building design product. After his first experience as an Autodesk Speaker in Las Vegas in 2012, proposing a class on electrical design on revit; Marseille, has also contributed in 2013, as an author to an official French treaty book, outlining the different aspects of the ongoing revolution in the building.

Yannick Poupon is an Electrical Engineer based in Boston, Massachusetts. He has over nine years of electrical engineering, design and project management experience working for multi-discipline engineering contractors. Responsible for providing technical guidance to engineering with regard to complex risk, alternative analysis studies and conceptual design.
Manage electrical parameters in Revit

The most common method of designing electrical systems in Revit MEP is to work within a linked architectural building model. In this project, you will use a project file that has already been linked to two architectural DWG files used to create a little demo project. Space components have already been placed in the areas throughout the model.

**Define the basic parameters**

Before started to create electrical system in Revit, make sure that you’ve already define the basic parameters.

In **Electrical settings** specify:

The voltages, power distribution systems, Wiring, and demand factors you will use in your project.

When you will place components and create circuits in your electrical model, Revit MEP will check to assure that those components are compatible with voltages and distribution systems that you specify here.
Wiring Types.
In the Electrical Settings dialog select as shown “Wiring Types”

Click Add to create the new type of wire XHHW

Specify the following parameters for this wire type as follows:

<table>
<thead>
<tr>
<th>Wire Type</th>
<th>Parameter</th>
</tr>
</thead>
<tbody>
<tr>
<td>XHHW</td>
<td>Name</td>
</tr>
<tr>
<td>Copper</td>
<td>Material</td>
</tr>
<tr>
<td>60</td>
<td>Temperature Rating</td>
</tr>
<tr>
<td>XHHW</td>
<td>Insulation</td>
</tr>
<tr>
<td>2000</td>
<td>Max Size</td>
</tr>
<tr>
<td>1</td>
<td>Neutral Multiplier</td>
</tr>
<tr>
<td>selected</td>
<td>Neutral Required</td>
</tr>
<tr>
<td>Hot Conductor size</td>
<td>Neutral Size</td>
</tr>
<tr>
<td>Non-Magnetic</td>
<td>Conduit Type</td>
</tr>
</tbody>
</table>
**Voltage Definitions.**
The Voltage Definitions table is where you specify a range of voltages that will be used with your Voltage Definitions. For example, if you create a component intended for use in a 120V circuit are rated anywhere from 110V to 130V.

Select ADD
The voltages, power distribution systems, Wiring, and demand factors you will use in your project.
When you will place components and create circuits in your electrical model, Revit MEP will check to assure that those components are compatible with voltages and distribution systems that you specify here.

Click Add to create the voltage definition below:

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>120</td>
<td>120.00 V</td>
<td>110.00 V</td>
<td>130.00 V</td>
</tr>
<tr>
<td>208</td>
<td>208.00 V</td>
<td>200.00 V</td>
<td>220.00 V</td>
</tr>
<tr>
<td>277</td>
<td>277.00 V</td>
<td>260.00 V</td>
<td>280.00 V</td>
</tr>
<tr>
<td>480</td>
<td>480.00 V</td>
<td>460.00 V</td>
<td>490.00 V</td>
</tr>
</tbody>
</table>
**Distribution Systems.**

Click Distribution Systems,
The Distribution Systems had to correspond to the equipment that you plan to associate them. Example: If the voltage parameter of the family’s connector is define on 120V, the equipment won’t be connected with a Panel if his distribution Systems is 480/277.

Select **ADD**

Create the distribution systems with the following parameters.

<table>
<thead>
<tr>
<th>Name</th>
<th>Phase</th>
<th>Configuration</th>
<th>Wires</th>
<th>L-L Voltage</th>
<th>L-G Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 120/208 Wye</td>
<td>Three</td>
<td>Wye</td>
<td>4</td>
<td>208</td>
<td>120</td>
</tr>
<tr>
<td>2 480/277 Wye</td>
<td>Three</td>
<td>Wye</td>
<td>4</td>
<td>480</td>
<td>277</td>
</tr>
</tbody>
</table>

Distribution systems can be deleted only if they are not currently assigned to any devices.
Defining Required Lighting Levels
Let specify the lighting levels that are required for the two different spaces within the demo project.

You have to create a new Project Parameter **Required Lighting Level**

- Under Parameter Data, enter Required Lighting Level for Name.
- For Discipline, select Electrical.
- For Type, select Illuminance.
- For Group, select Electrical-Lighting.
- Select Instance.
- Under Categories, select Spaces.

Click OK, and check the In the Element Properties, the new parameter is now listed.
Create a key schedule
To associate a space to a lighting level

This name will appear as the title for the resulting schedule.

Lighting Levels is added as a new instance parameter for the space component. The value that you specify for each Key Name in the schedule will be used to determine the required lighting level for each space type.

Click Add Parameter to create a new field:
Required Lighting level
In the parameter properties, fill the parameters as shown

![Parameter Properties dialog box]

- **Parameter Type**
  - Project parameter (Can appear in schedules but not in tags)
  - Shared parameter (Can be shared by multiple projects and families, exported to ODBC, and appear in schedules and tags)

- **Parameter Data**
  - **Name:** Requirement Lighting Level
  - **Discipline:** Electrical
  - **Type of Parameter:** Illuminance
  - **Group parameter under:** Photometrics
  - **Tooltip Description:** <No tooltip description. Edit this parameter to write a custom tooltip. Custom tooltips ha...>

- Options:
  - Values are aligned per group type
  - Values can vary by group instance

- **Add to all elements in the category**

- Buttons:
  - OK
  - Cancel
  - Help
In Schedule Properties window the new parameter appear

The key schedule displays in the drawing area. You can double-click column dividers to auto-fit column width to its content.
Enter lighting level requirements in the key schedule

Click Insert Data Row 2 times to add 2 rows in the key schedule, one for each type of space in the building. The new rows are added the default Key Names.

The key schedule displays in the drawing area. You can double-click column dividers to auto-fit column width to its content.

You can also Enter a space type in the Key Name column and a corresponding lighting level in the Required Lighting Level column for the different types of spaces in the project.
Assigning Space Color Fills According to Required Lighting Levels

Activate color fill

Definition of the color scheme

1. In the Project Browser, expand Views (Discipline) ➤ Electrical ➤ Lighting ➤ Floor Plans, double-click the 1 - Lighting floor plan to make it the active view.

2. In Architecture Tab ➤ select Color Schemes.

3. In the Edit Color Scheme dialog, select Spaces for Category, and click (Duplicate).

4. In the New Color Scheme dialog, for Name, enter Required Lighting, and click OK.

5. In the Edit Color Scheme dialog, for Title, enter Required Lighting Levels.

6. For Color, select Required Lighting Level, and click OK to dismiss the alert message.

7. Click OK.

8. In Analyze tab, select Color Fill Legend

9. In the Choose Color Scheme dialog:
   - For Space Type, select Spaces,
   - For Color Scheme, select Required Lighting

10. Click OK.
Color fill plans can be useful as design documents and as communication documents to show other team members design intent while the project is in the design phases. Color fills can be applied for any parameter that already exists for spaces, or for any parameter that you want to create for a space.
**Check Required Lighting Levels with a space schedule**

You can create a space lighting analysis schedule that you will use as a check document rather than as a construction document. Your schedule will compare the actual lighting levels in each space against the required lighting levels that you specified before. As you place lighting fixtures in the spaces in your project, you will refer to the schedule to assure that the lighting level falls within the +/- 55 lx range specified in the schedule.

**Create space lighting analysis schedule**

1. In Analyze tab ➤ Schedule/Quantities.

2. In the New Schedule dialog:
   - Under Category, select Spaces.
   - For Name, enter Space Lighting Analysis.
   - Verify that Schedule building components is selected.
   - Click OK.
3 On the Fields tab of the Schedule Properties dialog, scroll down the Available fields list, Double-click the following fields to add them to the Scheduled fields as shown:

![Schedule Properties dialog](image)

Create a new schedule parameter

![Luminaire Flx](image)

4 In the middle of the Schedule Properties dialog, click Calculated Value
The Lighting Delta parameter is added to the Scheduled fields list. Click Add and put it in the Scheduled fields.

5 In the Calculated Value dialog:
- For Name, enter Lighting Delta.
- For Discipline, select Electrical.
- For Type, select Illuminance.
- For Formula, enter 
  \[ \text{Average Estimated Illumination} - \text{Required Lighting Level} \].

6 Click OK.
The Lighting Delta parameter is added to the Scheduled fields list.
7 Set the parameters On the Sorting/Grouping tab to define the behavior of the Schedule.

- For Sort by, select Number.
- Verify that Ascending is selected.
- Verify that Itemize every instance is selected.

8 On the Formatting tab, under fields, select Lighting Delta.

9 Click Conditional Format.

10 In the Conditional Formatting dialog:

- For Field, select Lighting Delta.
- For Test, select Not Between.
- For Value, enter -55 lx and 55 lx in the text boxes.

11 Click the Background Color chip.
In the Conditional Formatting dialog:
■ For Field, select Lighting Delta.
■ For Test, select Not Between.
■ For Value, enter -55 lx and 55 lx in the text boxes.

11 Click the Background Color chip.
12 In the Color dialog, under Basic colors, click the red color chip.
13 Click OK twice.

14 On the Formatting tab, under Fields, select Ceiling Reflectance, and click Field Format.
15 In the Format dialog:
■ Clear Use default settings.
■ For Units, verify that Fixed is selected.
■ For Rounding, select 2 decimal places.
16 Click OK.
17 Using the same method, specify rounding to 2 decimal places for the Wall Reflectance and Floor Reflectance fields.

18 Click OK.
19 Results

The schedule that you have just created shows the Average Estimated Illumination level for all of the spaces as 0. This is because you have not yet added lighting fixtures to any of the spaces.

You can also see that the Lighting Delta has been calculated for each of the occupied spaces, and in every case the Lighting Delta field is red. This is because the value is not within the range that you specified in the Conditional Formatting dialog.
Designing and manage Electrical System

Place the initial lighting fixture

In the Project Browser, and double-click Space Lighting Analysis and Elec floor plan then arrange the windows as shown.
**Place the initial lighting fixture**

1. In the Systems tab, then in the Electrical group select Lighting Fixture 2 in the Properties pallet select

   ![Properties Palette](image)

   - **New Lighting Fixtures**
   - **Constraints**
     - **Host**: <not associated>
     - **Elevation**: 0.0
     - **Offset**: 2800.0
   - **Electrical - Lighting**
     - **Calculate Coefficient**: ✓
     - **Coefficient of Utilization**:
     - **Switch ID**:
   - **Electrical - Loads**
     - **Panel**
     - **Circuit Number**
   - **Identity Data**
     - **Image**
     - **Comments**
     - **Mark**
   - **Electrical - Circuiting**
     - **Electrical Data**: 277 V/1-62 VA
   - **Other**
     - **Schedule Level**

2. Click to place the lighting in Zone 01. On the Modify / place Fixture select Place on Work Plane.

![Floor Plan](image)
Place the lighting in the drawing as shown. The Average Estimated Illumination for zone 01 now nearer the required lighting level target of 300 lx, we can only put 5 lighting fixtures to match with the Requirement Lighting Level.

Implant zone 02 respecting the Requirement Lighting Level.
Place switches in spaces

1 In the Systems tab, then in the Electrical group select Device
2 In the Properties pallet select M_Lighting Switches: M_Single Pole. And insert in the model as shown

2 in the Properties pallet select M_Lighting Switches: M_Single Pole. And insert in the model as shown
Place wall-hosted receptacles

1. In the Systems tab, then in the Electrical group select Electrical Fixture.

2. In the Properties pallet select M_Duplex Receptacle: Standard And insert in the model as shown.
Add a panel

Continuing in the same plan, elec Floor Plan (Generally it’s better to separate Floor views and Ceiling views or power and Lightings view by creating dedicated views.

1. In the Systems tab, then in the Electrical group select Electrical Equipment.

2. In the Properties palette select MM_Lighting and Appliance Panelboard 480V MCB - Surface: 100 A:

   Insert it in the model as shown.

3. Select the panel you just placed.
4. On the Options Bar, for Distribution Sys select 480/277 Wye.
5. With the panel still selected, click .
6. In the Element Properties dialog, under Instance Parameters, scroll down to the Electrical - Loads category, and for Panel Name, enter MSB, to Main Switch Board.

The Distribution System Types parameter is also accessible in the Element Properties dialog. Right-click the panel, click Element Properties, scroll down the Instance Parameters and, under Electrical - Loads, select 480/277 Wye for Distribution System Types.
Add a transformer

7 On the Electrical tab select Electrical Equipment
In the Type Selector, select M_Dry Type Transformer - 480-208Y-120 - NEMA Type 2: 45kVA, and place the transformer in the plan as shown.

On the Options Bar, for Distribution Sys, select 480/277 Wye.
Since this is a transformer, you must also specify a Secondary Distribution System parameter into the properties pallet.
Add another panel

1. In the Systems tab, then in the Electrical group select Electrical Equipment.

2. In the Type Selector, select M_Lighting and Appliance Panelboard – 208 V MLO - Surface : 100 A and place it in the plan as shown.
Creating Circuits

Learn methods for creating power circuits (circuit groups). Circuits are used for power, lighting, and data systems. The concept of grouping similar functions into systems is used to show logical connections between different components in the system.

The System Browser

When you are managing electrical design system in Revit make sure that the System Browser is Display. Is the better way to follow and control the distribution.
Manage Panel Circuits, Connecting Panel to Panel.

To connect a Panel to another panel, or equipment to a circuit, the connector of the equipment must match with the tension defined in the distribution system.

**Distribution system**

Verify the connector of the equipment

Select an Equipment in the model, click on Edit Family.

In the family editor select the connector and verify in the pallet properties the electrical parameters of the connector then close the Family editor.
Create Circuits to connect the panels

To create a new circuit or to supply an equipment or a fixture to a panel:
- Select the equipment TR01 in a plan view.
- When is selected, a new ribbon appears with the “Power” tool.

- Click on “Power”
Then a new tool “Select Panel” appears.
Click on Select Panel, and then select the MSB in the plan.

TR01 is connected with MSB or TR01 is supply by MSB.

Temporary circuit indicates that the TR01 has been connected to the MSB.

Click on Arc Wire to generate the annotation of the circuit.

Do the same operation to connect the P01 to the main switch board MSB.

In the system browser

You can see that 2 systems have been created.

You can also control the unsigned equipment.
**Create Circuits to connect the fixtures**
- Create 2 lights circuits one for the zone 01 and a second for the zone 02 connected to MSB
- Create 2 sockets circuits one for the zone 01 and a second for the zone 02 connected to P01

The focus of this project is not to create a big and real installation but to explain the Principe to create connection Panel to Panel, Panel to components.
In Analyze Ribbon click on Panel Schedules to Generate Panel report.

Click on Rebalance Loads to make the load as equal as possible on each phase. By selecting a circuit on schedules view, you can also move the circuit to the same row on the opposite side of the panel. This command is only available when the circuit can physically be moved directly across to the opposite-facing slot (phase).