


Unit 7) Building Envelope: Assemblies and Material Generation Exercise: Embodied Energy Calculations

Embodied Energy

Analysis type:	Software required:	Starting Point Dataset:
 Tabular analysis report	Revit® MEP 2008 or Revit® Architecture 2008 Athena® Environmental Impact Estimator	Unit 7_i_Start.rvt (adapted from <i>Convention Center Extensions.rvt</i>)

Although working with analysis tools to understand how design can impact operational energy use is important, sustainable design also requires that you look at the Life Cycle costs of the building. These costs include not only the operating costs, but also, among other things, the energy required to:

- Create the materials used in the building (Embodied Energy = how much energy is used to create a material).
- Maintain the material over the life of the building (How much paint is required over a 40-year building life span? What is the embodied energy of the paint? Is it more cost-effective to use paint or a brick material with a greater embodied energy, but lower maintenance costs over the lifetime of the building?).
- Remove and dispose of the building after its life is complete.

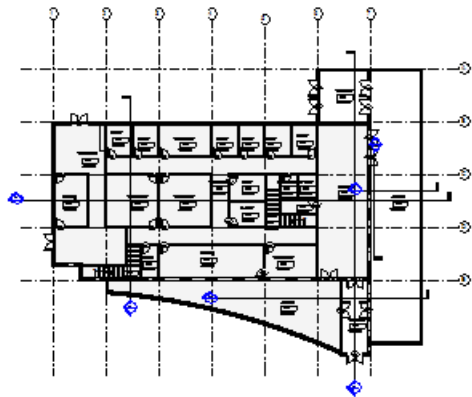
When performing a Life Cycle Analysis (LCA) of a building, you must consider all of these energy costs. As with the energy analysis packages, there are many different software packages that enable you to analyze these aspects of building design. This type of analysis is not difficult. In fact, you can perform much of it using only a spreadsheet. However, data created this way has a limited usefulness; adding it to objects in the building information model is very difficult. The single greatest challenge of this type of analysis is finding LCA data on the prospective construction materials. This exercise uses the Athena Environmental Impact Estimator because the software includes LCA data for many different construction materials.

This exercise outlines how to translate data from a building information model into a new project in Athena Environmental Impact Estimator so you can study the embodied energy costs of the building. Athena is not model-based software. In order to enter the necessary values, such as square footage of walls and roof, you must first create schedules using the Revit platform. Use these schedules to find the required square footages for Athena EIE. After you've successfully established the project in Athena EIE, generate a graph of the embodied energy for the building.

Athena EIE works with assemblies and is written in a way that you could input each floor and each wall in a building. For the purpose of this exercise, to discover the embodied energy of the building, shortcut this process and include all of the areas into one assembly if possible.

This exercise consists of the following tasks:

- Generating schedules for the exterior walls, interior walls, roof, and floors.
- Creating a new project in Athena EIE and setting the project location information.
- Adding the assemblies to the Athena project, and translating the square footages from the Revit software platform to the Athena EIE project.

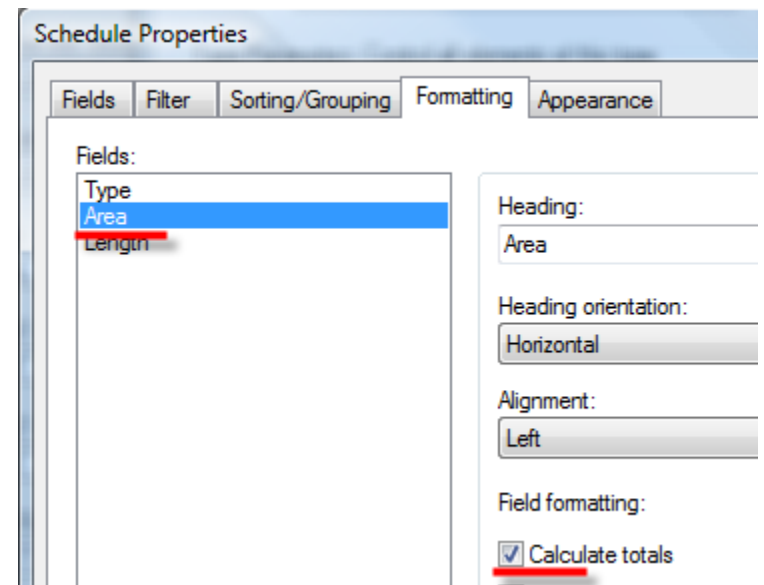
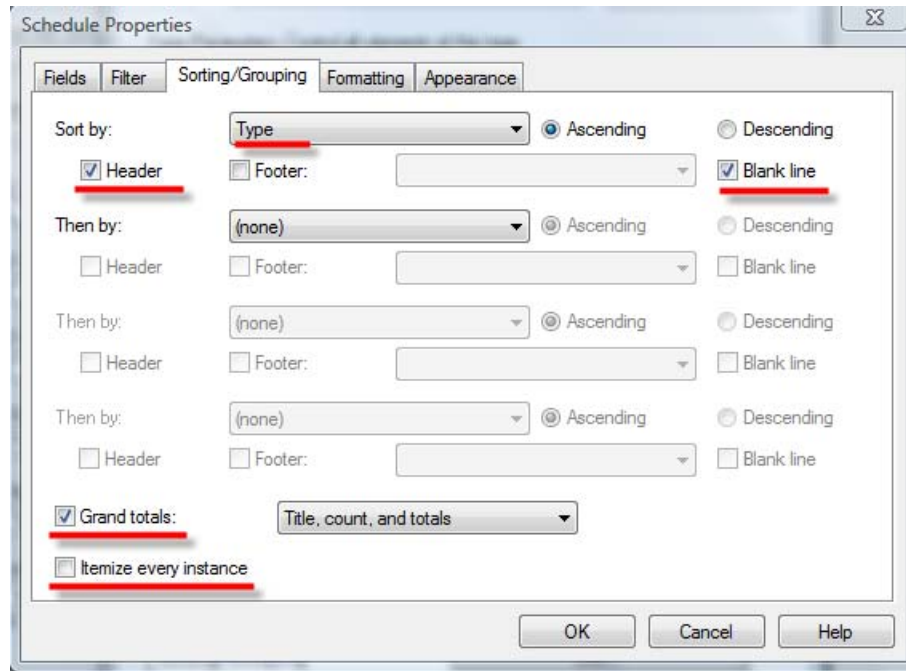


Before: **Unit 7_i_Start.rvt**

1

Generate Schedules to Find Total square Footages of the roof, exterior Walls, Interior Walls, and Floor Systems

To generate the schedules, use the filter.



To generate a new wall schedule, on the Views design bar, click Schedule/Quantity. Add fields Type, Area, and Length. On the tabs listed below, follow the bulleted suggestions:

- Filter: Filter By = None.
- Sorting/Grouping: As shown in the screen capture above.
- Formatting: Click Calculate totals for both Area and Length.

Wall Schedule		
Type	Area	Length
Exterior - Brick on Mtl. Stud		
Exterior - Brick on Mtl. Stud	13656 SF	454' - 3 15/16"
Exterior - Brick on Mtl. Stud 2		
Exterior - Brick on Mtl. Stud 2	960 SF	41' - 10 1/32"
Exterior - Brick on Mtl. Stud 3		
Exterior - Brick on Mtl. Stud 3	637 SF	28' - 4 9/32"

The resulting schedule illustrates the total square footage for each of the wall types, enabling you to access the square footage of each wall by assembly for entry into Athena EIE.

Roof Schedule	
Type	Area
Steel Truss - Insulation on Metal Deck - EPDM	
Steel Truss - Insulation on	4192 SF
Steel Truss - Insulation on	1764 SF
Steel Truss - Insulation on	9495 SF
Steel Truss - Insulation on	259 SF
Grand total: 4	15709 SF

Floor Schedule		
Type	Area	Level
LW Concrete on Metal Deck		
LW Concrete on Metal Deck	10562 SF	1st Level
LW Concrete on Metal Deck	7943 SF	2nd Level
LW Concrete on Metal Deck	7097 SF	3rd Level
Grand total: 6	25602 SF	

Repeat this process to create schedules for roofs and floors.

2 ***Start a New Project in Athena Environmental Impact Estimator***

To create a new project, click File menu > New. In the General Description dialog box, fill in your building details. For this lesson, skip Operating Energy Consumption because it does not relate to the Embodied energy of a building.

3 ***Add Floor Assemblies to the Project***

Use the Add Assembly menu to add floors to the project. Set type to OWSJ & Steel decking & Concrete topping.

Using Athena EIE, you can enter each floor as a separate assembly. Because the floor shape is irregular, use the schedule in conjunction with the

Assembly dialog box to adjust floor width and span to match the area of the floor of the project.

Floor Schedule		
Type	Area	Level
LW Concrete on Metal Deck		
LW Concrete on Metal Deck	10562 SF	1st Level
LW Concrete on Metal Deck	7943 SF	2nd Level
LW Concrete on Metal Deck	7097 SF	3rd Level
Grand total: 6	25602 SF	

Because this exercise focuses only on embodied energy, you can take a shortcut by adjusting the floor width and span, but the span is limited to 69 feet. When you add floor 2 and 3, it totals 15,040 SF. Adjusting the floor width and span to total this number should yield the same results.

4

Repeat, Adding the Assemblies for the Roof and Walls

For the roof, use the same assembly as for the floors, but exclude the topping.

For the walls, create one assembly to represent all of the interior walls. The total square footage is 17238 sf.

For the exterior walls, add the total square footage of the walls to another assembly (15253 SF). Next, select Extra Envelope Materials – Cladding from the list. Click Add. Enter the same square footage in a brick entry.

5

Generate Graph Reports

Under Graphs by, generate the summary measurements and absolute value graphs of the embodied energy effects.

Exercise Complete.