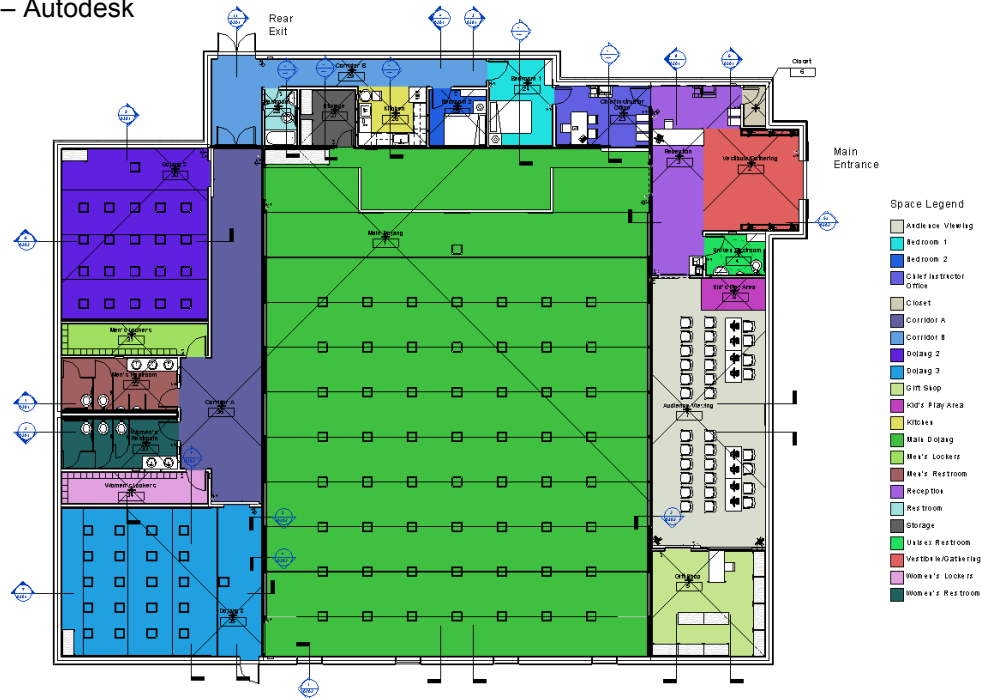


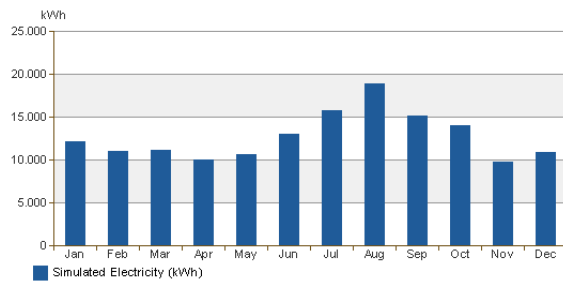


# AB4961 - Energy Analysis for Revit – A How to Guide

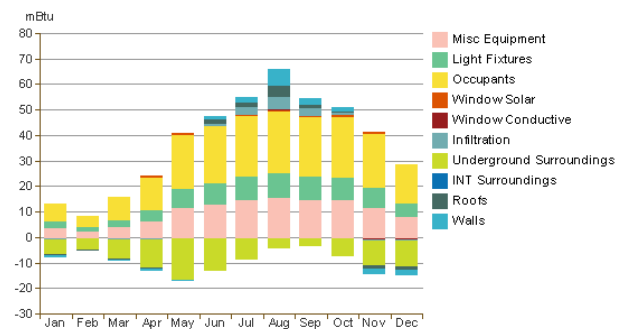
Dzan Ta – Repro Products  
Joe Gould – Autodesk



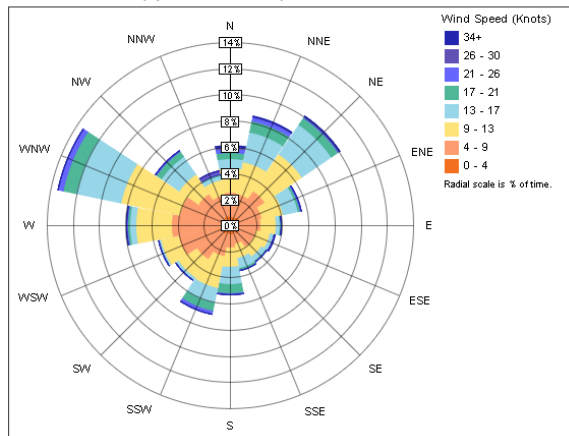
Monthly Electricity Consumption



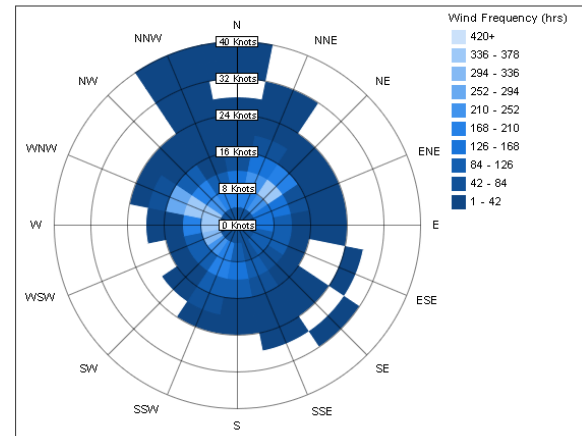
Monthly Cooling Load



Annual Wind Rose (Speed Distribution)



Annual Wind Rose (Frequency Distribution)





## AB4961 - Energy Analysis for Revit – A How to Guide

Dzan Ta – Repro Products

Joe Gould – Autodesk

**AB4961** In this class, you will learn how to set up your Revit model for Energy Analysis within Revit and as well as exporting out for analysis within Autodesk Green Building Studio. Learn what and where to go to set up the BIM information you need to generate a complete Energy Analysis. If time permits, we will look at Revit Energy Analysis from within the cloud.

### Learning Objectives

At the end of this class, you will be able to:

- You will learn the Energy Analysis Settings (BIM Data) needed for performing the analysis
- You will learn the basics of Energy Analysis...Rooms/Spaces/Zones
- You will learn how to export the data out for GBS usage (gbXML format)
- You will learn how to perform the analysis in the cloud

### About the Speaker



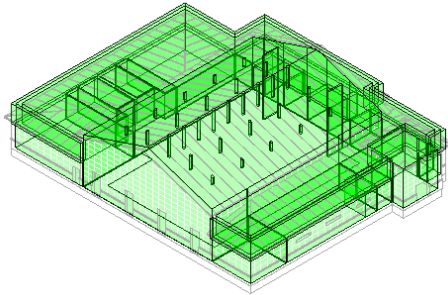
*I graduated from FIU and an Autodesk Revit Architecture and AutoCAD 2010-2014 Certified Associate and Professional as well as Autodesk Certified Instructor in both. I have been in the Architectural industry for 20+ years and worked as both an I.T. Network Administrator and CAD Manager for over 10 years. I am currently an Application Engineer providing support, mentoring and training of Autodesk Products at Repro Products since 2008. In addition to Revit Architecture, I also provide expertise on AutoCAD, AutoCAD Architecture, Revit MEP and Structure, Navisworks, Sketchbook, Buzzsaw, AutoCAD MEP, Showcase, 3ds Max Design, etc. Lastly, I am an Adjunct Professor for the Art Institute of Atlanta teaching BIM/Revit.  
Email: [dta@reproproducts.com](mailto:dta@reproproducts.com)*

## About the Co-Speaker



*As a 6 year member of the AEC Technical Sales Specialist team focused on aligning with our Territory Sales team to develop solutions around today's demanding business challenges, Joe was, and remains, a key member of a core team that helped to develop and implement the assets and strategy used in the Business Process Assessment (BPA) model approach within AEC. Along with the BPA core team, Joe has been instrumental in creating an organized asset toolkit that is repeatable in each BPA engagement and can be found on One Team Source.*

## Energy Analysis in Autodesk Revit



### Project Summary

Location and Weather	
Project	Ta's House of Choi
Address	1234 Main Street NW Future City, KR
Calculation Time	Tuesday, July 15, 2014 9:33 AM
Report Type	Standard

### Building Summary

Inputs	
Summer Dry	
Summer Wet	
Winter Dry Bt	
Mean Daily Bt	
Building Type	Exercise Center
Area (SF)	14,290
Volume (CF)	210,522.45
Calculated Results	
Peak Cooling Total Load (Btu/h)	429,860.2
Peak Cooling Month and Hour	August 3:00 PM
Peak Cooling Sensible Load	Zone Summary - Default
Peak Cooling Latent Load (Bt	
Maximum Cooling Capacity (	
Peak Cooling Airflow (CFM)	
Peak Heating Load (Btu/h)	
Peak Heating Airflow (CFM)	
Checkouts	
Cooling Load Density (Btu/h	
Cooling Flow / Load (CFM/ton)	
Cooling Area / Load (SF/ton)	
Heating Load Density (Btu/h	
Heating Flow Density (CFM/ton)	
Heating Area / Load (SF/ton)	
Peak Cooling Total Load (Btu/h)	429,860.2
Peak Cooling Month and Hour	August 3:00 PM
Peak Cooling Sensible Load (Btu/h)	345,555.9
Peak Cooling Latent Load (Btu/h)	84,304.3
Peak Cooling Airflow (CFM)	15,948
Peak Heating Load (Btu/h)	19,803.8
Peak Heating Airflow (CFM)	4,812
Peak Ventilation Airflow (CFM)	0
Checkouts	
Cooling Load Density (Btu/h-ft <sup>2</sup> )	30.31
Cooling Flow Density (CFM/ft <sup>2</sup> )	1.10
Cooling Area / Load (SF/ton)	405.20
Heating Load Density (Btu/h-ft <sup>2</sup> )	1.38
Heating Flow Density (CFM/ft <sup>2</sup> )	0.36
Ventilation Density (CFM/ft <sup>2</sup> )	0.00
Ventilation / Person (CFM)	0

In today's AEC Industry, Owners want top value for their projects. Gone are the days of just asking the Architect for a set of drawings. Owners now want a complete 3D Revit Model to accompany their final as-built set of construction documents. They want a model which contains not just the CD's to build the project but all the rich metadata that is included in the Model; specifically, BIM data for Energy Analysis. Why are Owner's asking for this information? So they can get a full handle on lifecycle costs of their project. They want to know how much gas, electricity, water, carbon emissions, etc. it will cost to own their building and also want to find ways to make their building more efficient in usage for the long run.

Architects, MEP and even Structural Engineers are now heavily engaged in utilizing Revit to work with Energy Analysis to obtain the goals sought by Owners. To fulfill these requirements, a complete understanding of how to build the Revit Model specifically for Energy Analysis is needed.

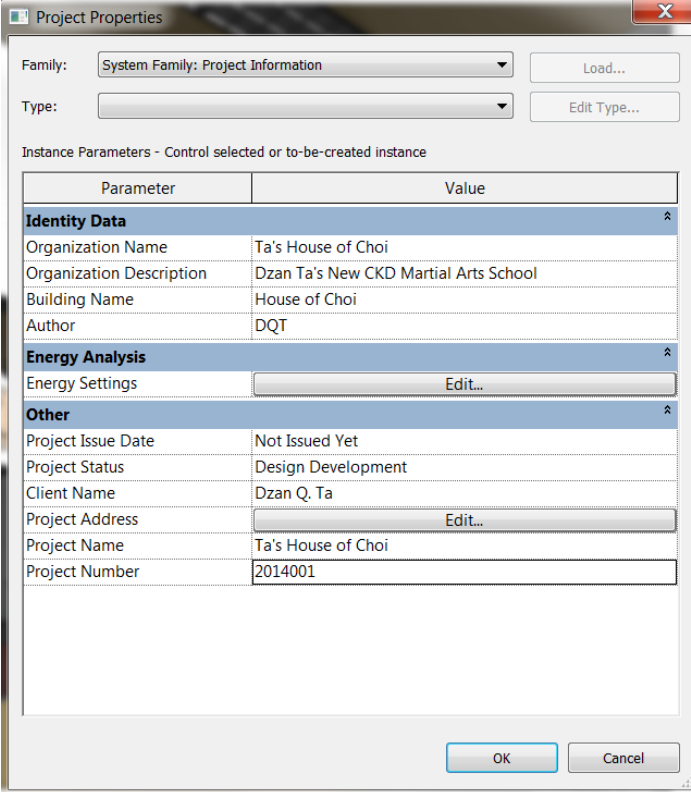
The steps involved in preparing a Revit Model for Energy Analysis are as follows:

1. Input BIM Data for Analysis
  - a. Project Information
  - b. Energy Settings
  - c. Materials
2. Input Rooms/Spaces/Zones
  - a. Define Space Limits
3. Define Analysis Information
  - a. Reports
  - b. Schedule Data
  - c. Details
4. Run Heating and Cooling Load Analysis
5. Export to gbXML for Autodesk Green Building Studio
6. Run Energy Simulation via Subscription/Cloud

## 1. Input BIM Data for Analysis

### Project Information

The basic project information needed in your Revit model include Organization name, Description, Building Name, Author, Project Issue Date, Status, Client Name, Project Address, Name and Number. In addition to these, Energy Settings need to be adjusted as well.

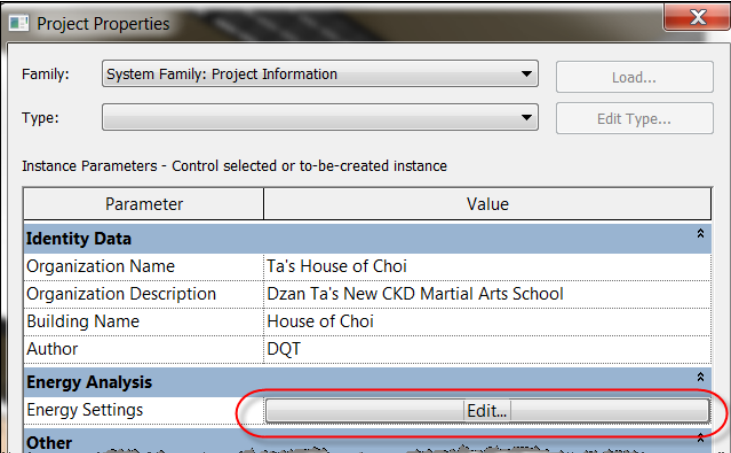


The screenshot shows the 'Project Properties' dialog box. At the top, 'Family' is set to 'System Family: Project Information' and 'Type' is empty. Below this, the 'Instance Parameters' section contains a table with two columns: 'Parameter' and 'Value'.

Parameter	Value
<b>Identity Data</b>	
Organization Name	Ta's House of Choi
Organization Description	Dzan Ta's New CKD Martial Arts School
Building Name	House of Choi
Author	DQT
<b>Energy Analysis</b>	
Energy Settings	Edit...
<b>Other</b>	
Project Issue Date	Not Issued Yet
Project Status	Design Development
Client Name	Dzan Q. Ta
Project Address	Edit...
Project Name	Ta's House of Choi
Project Number	2014001

At the bottom of the dialog are 'OK' and 'Cancel' buttons.

### Energy Settings



This screenshot is identical to the one above, but with a red circle highlighting the 'Edit...' button next to the 'Energy Settings' parameter in the 'Energy Analysis' section.

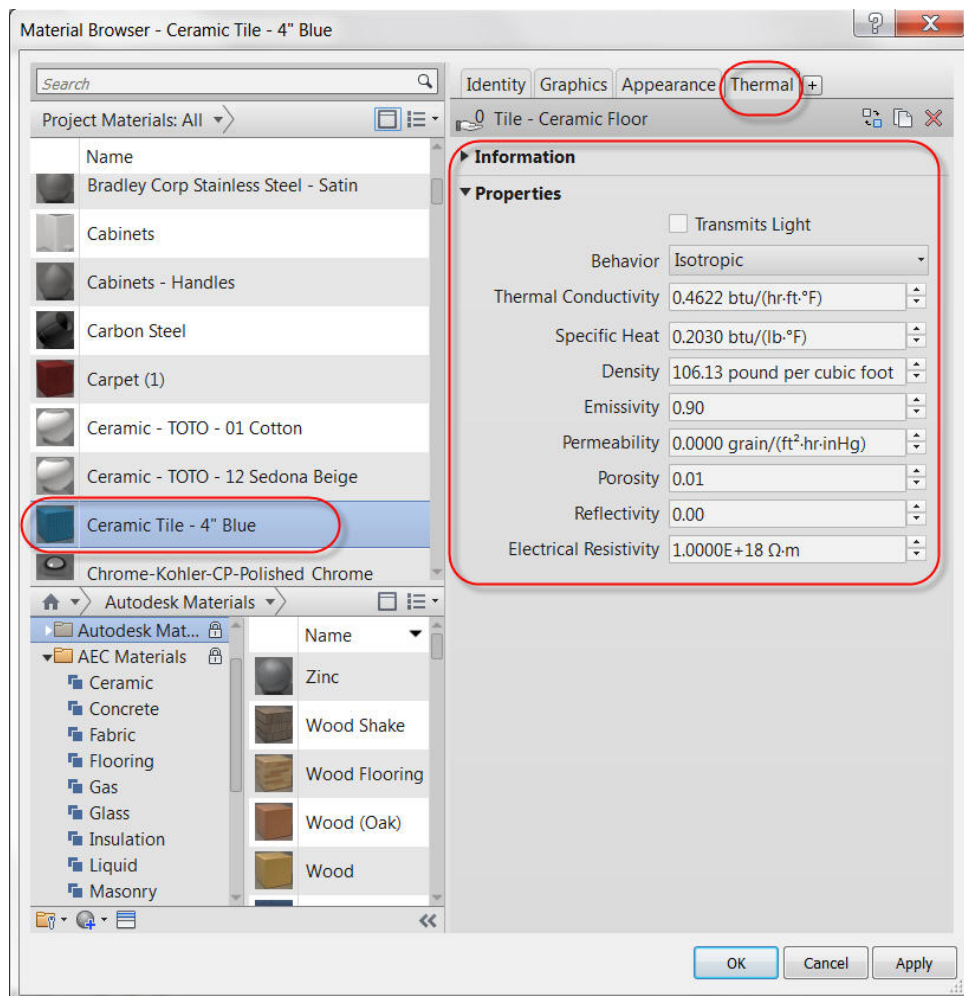
Parameter	Value
<b>Common</b>	
Building Type	Exercise Center
Location	36.0195274353027,129.58088684082
Ground Plane	Fin.Flr. Lvl 1
<b>Detailed Model</b>	
Export Category	Rooms
Export Complexity	Complex with Mullions and Shading Surfaces
Include Thermal Properties	<input checked="" type="checkbox"/>
Project Phase	New Construction
Sliver Space Tolerance	1' 0"
Building Envelope	Use Function Parameter
Analytical Grid Cell Size	3' 0"
<b>Energy Model</b>	
Analytical Space Resolution	1' 6"
Analytical Surface Resolution	1' 0"
Core Offset	12' 0"
Divide Perimeter Zones	<input checked="" type="checkbox"/>
Conceptual Constructions	Edit...
Target Percentage Glazing	15%

OK Cancel

Energy Settings provide the necessary information to ensure proper analysis is performed on the energy model. Settings such as Building Type, Export Complexity, Sliver Space Tolerance and Building Envelope play a vital role in producing quality analysis results. See Step 3 Define Analysis Information for further explanation.

## Materials

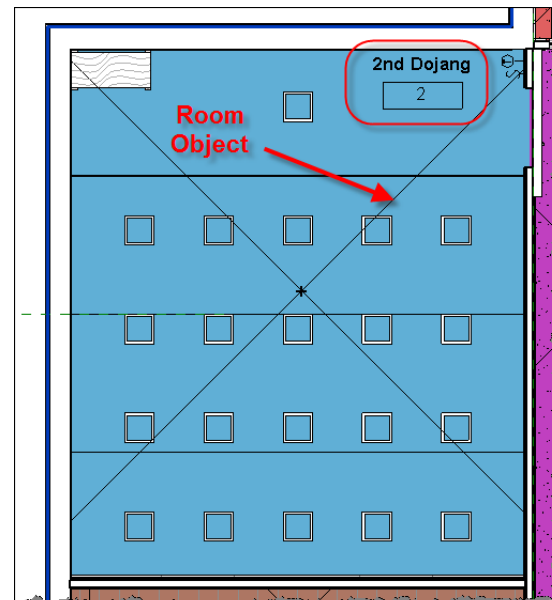
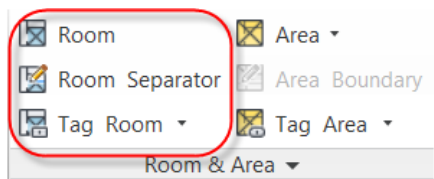
All the materials contained in a Revit model are not just for showing off the design. The materials play a key role in how the energy transfers through the building envelope. Materials help define R-Value within system families such as Walls, Floors, etc.



## 2. Input Rooms, Spaces and Zones

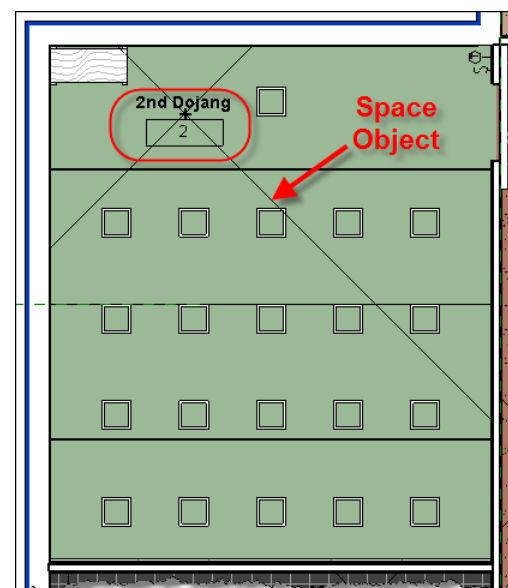
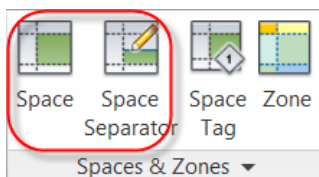
### Rooms

Room objects within Revit, which are similar to Space objects, help define the name and number of the area in which it is contained firstly. It provides basic information as to area and volume as well. Used mainly by the Architects, it helps to facilitate Room finishes, requirements, area and volume calculations, etc. Although it contains valuable data for the Architect, space objects are more powerful.



### Spaces

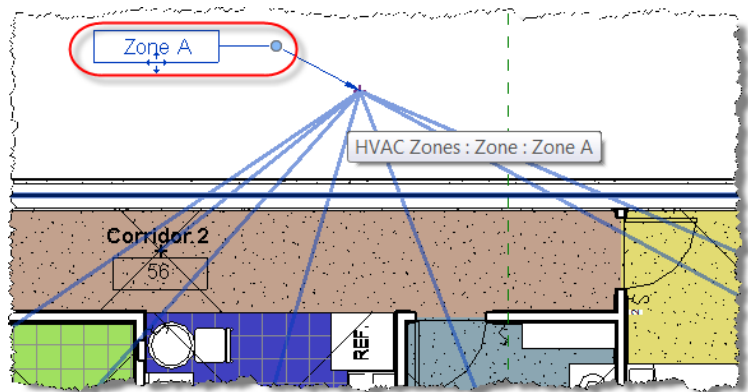
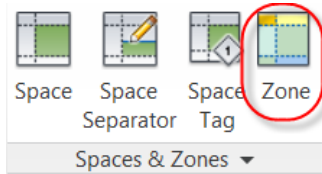
Space objects, which are similar to Room objects, are even more useful to the MEP Engineers. They contain not just the name and number of the space, but also hold the area, volume, CFM rates and Zones needed for proper energy calculations.



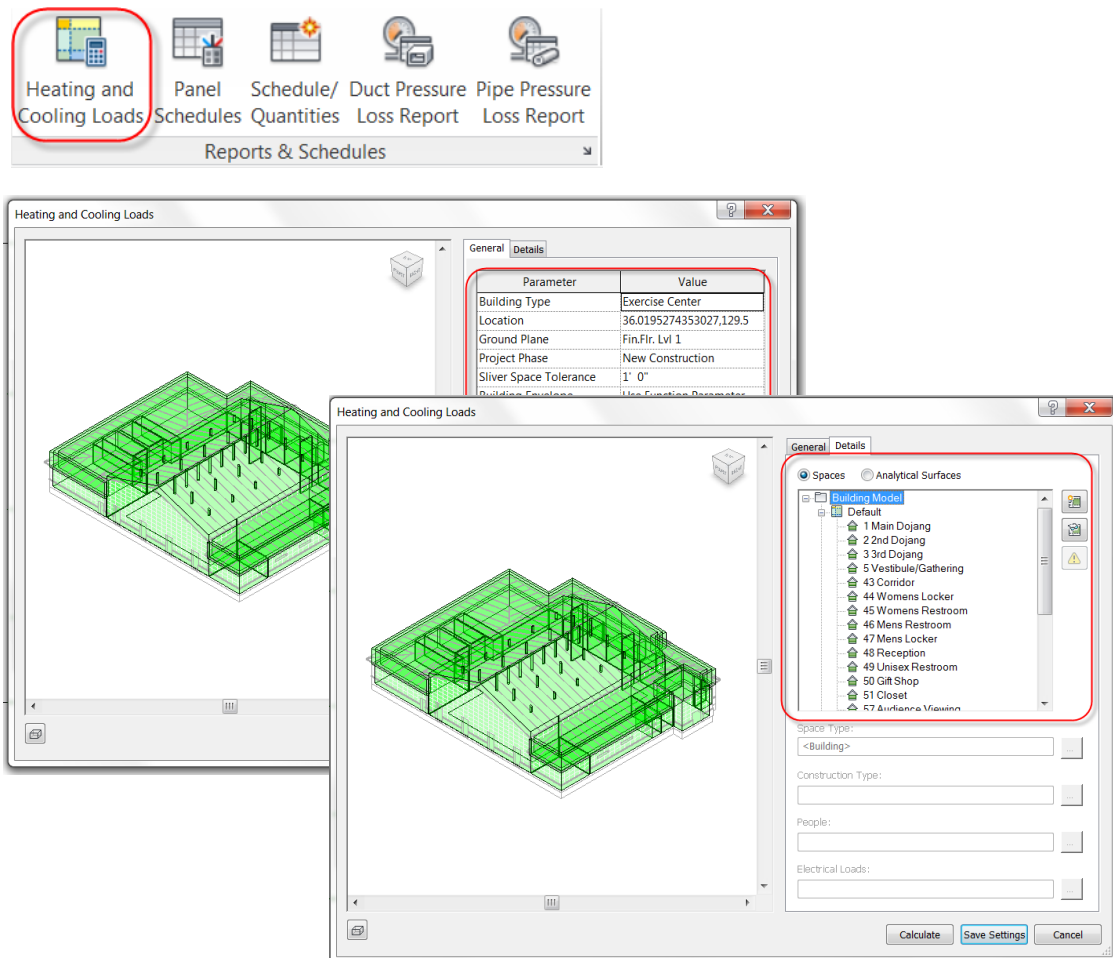


## Zones

Zones define groups of Spaces within your Revit model. They allow for proper air conditioning of the spaces via specific areas of the building.



### 3. Define Analysis Information



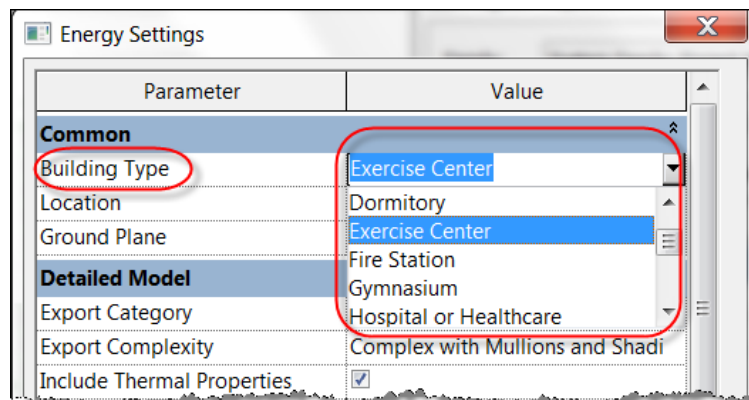
In the process of defining Analysis information, **Reports, Schedules, Details** can be looked at in several key areas: *Common Settings, Detailed Model Settings, Energy Settings and Building Type Settings.*

### Common Settings

**Building Type:** This defines what type of building you are creating (i.e. Office, Museum, Police Station, etc.)...define this accordingly.

**Location:** Define the location using the Internet Mapping Service or Default City List

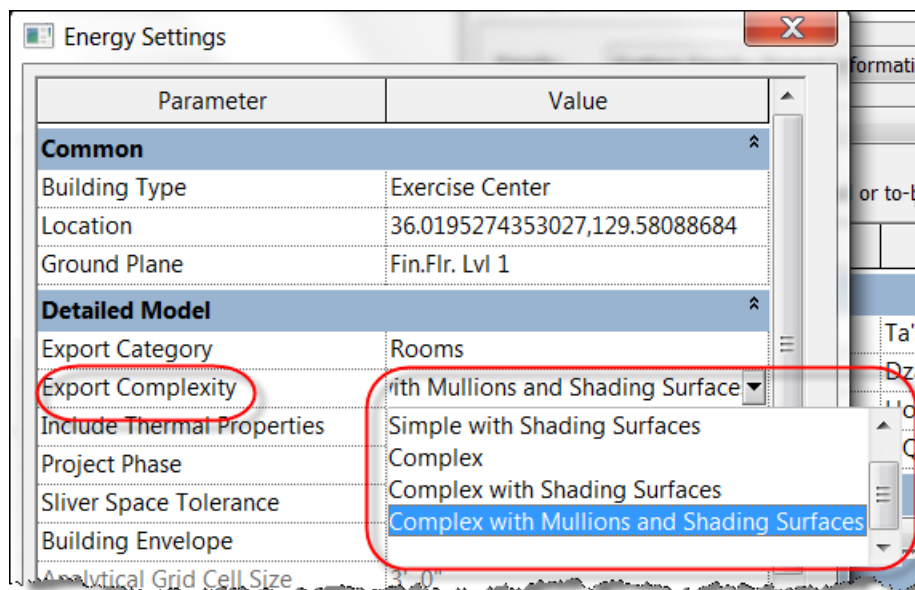
**Ground Plane:** This specifies the level that is considered the ground plane for the project. All elements below this level are considered underground.



### Detailed Model Settings

**Export Category:** Choose spaces or Rooms

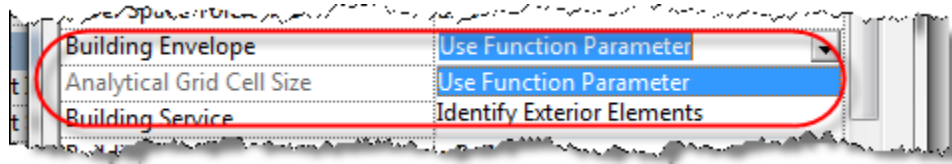
**Export Complexity:** This controls how much detailed information is needed for the analysis. You can choose from Simple to Complex with Mullions and Shading Surfaces



**Project Phase:** Specify the phase of the project for this analysis

**Sliver Space Tolerance:** Specify the opening size of shafts, etc.

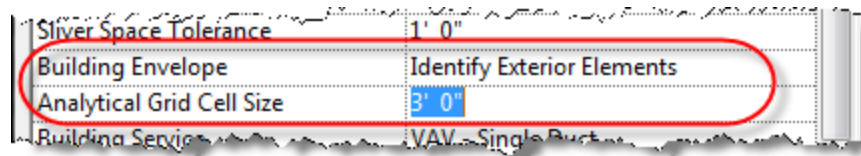
**Building Envelope:** Specify Use Function Parameter or Identify Exterior Elements



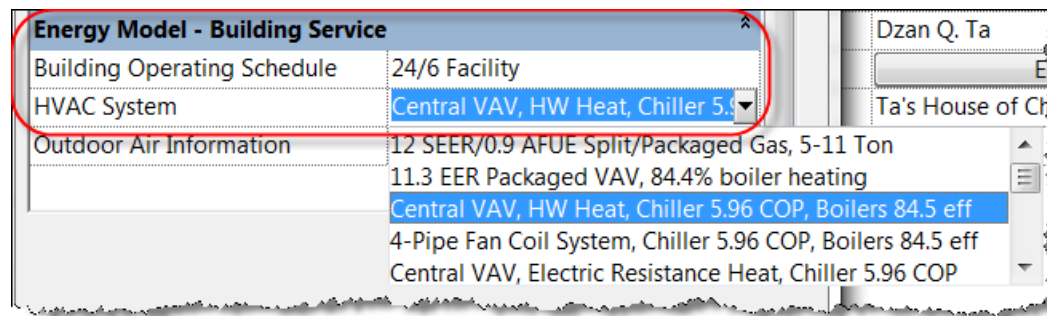
*Use Function Parameter.* This method uses the Function type parameter of Walls, Floors and Building Pads to determine the building elements considered to be part of the building envelope. This is the default and is the legacy option.

*Identify Exterior Elements:* This method uses a combination of ray-casting and flood-fill algorithms in order to identify the building elements that are exposed to the outside of the building, the building envelope.

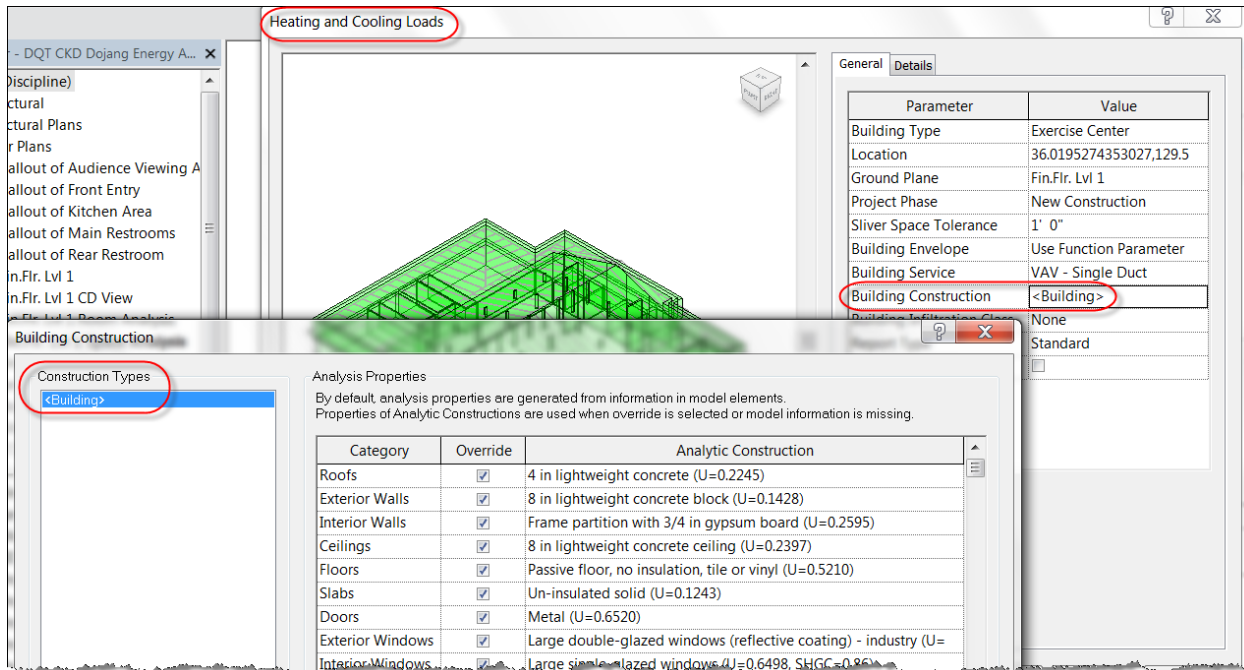
**Analytical Grid Cell Size:** Specify the cell size for the uniform cubical grid used when Building Envelope is set to Identify Exterior Elements. This is the base size of the 3D grid cells, or cubes, used to divide the building shell bounding box into a uniform cubical 3D grid.



**Building Service:** Specifies the type of heating and cooling service used in the building



**Building Construction:** By default, the materials of the model elements provide the information needed for analysis but you can add overrides if necessary.



**Building Infiltration Class:** This indicates how much outdoor air leaks into the building envelope. *Loose, Medium, Tight* and *None* are the choices (.076, .038, or .019 cfm/sqft)

**Export Default Values:** For gbXML export only. When cleared, only user-specified values are exported. When selected it also includes default values for *People and Electrical Loads, Occupancy, Lighting and Power Schedules*, and building/space type *Construction Types*.

**Report Type:** Specifies the amount of information in the heating and cooling loads report. You can select Simple, Standard or Detailed.

**Energy Model** (Note: Most of these settings are grayed out unless *Conceptual Mass Mode* is used)

**Analytical Space Resolution:** Specify the size of the largest gap (between two Revit elements) through which analytic spaces will not “leak.” If you run an energy simulation and a message displays that the model is too large, increase this setting and rerun the energy simulation. The default is 18” (457.2mm)

**Analytical Surface Resolution:** Specifies, in combination with the Analytical Space Resolution, how accurately the boundaries of analytical surfaces match the ideal boundaries. In general, reducing the Analytical Surface Resolution results in analytic surfaces with more accurate boundaries, but this also limits how accurately analytic surfaces are modeled.

The default is 1 foot (304.8mm). If you run an energy simulation and a message displays that the model is too large, increase this setting and rerun the energy simulation.

**Core Offset:** Specify the distance to measure inward from the exterior walls to define the core zone. The core of a building has heating and cooling loads that differ from the perimeter because it is not exposed to any direct thermal influence or daylight through the walls or windows. A typical core offset is 12 – 15 feet (4 – 5m).

**Divide Perimeter Zones:** Select this option to divide the building into 4 separate thermal zones (Northeast, Southeast, Northwest and Southwest). Perimeter zones result in more accurate energy consumption estimates.

**Conceptual Constructions:** Specifies the constructions to use for different types of mass surfaces.

**Target Percentage Glazing:** Specifies the percentage of exterior walls to be glazed openings (windows). It is also known as window-to-wall ratio (WWR). The default is 40%.

**Target Sill Height:** Specifies the distance from the floor to the bottom of the window. The total height of the window directly influences the shade depth required to protect the window from solar gain. Taller windows require deeper shades.

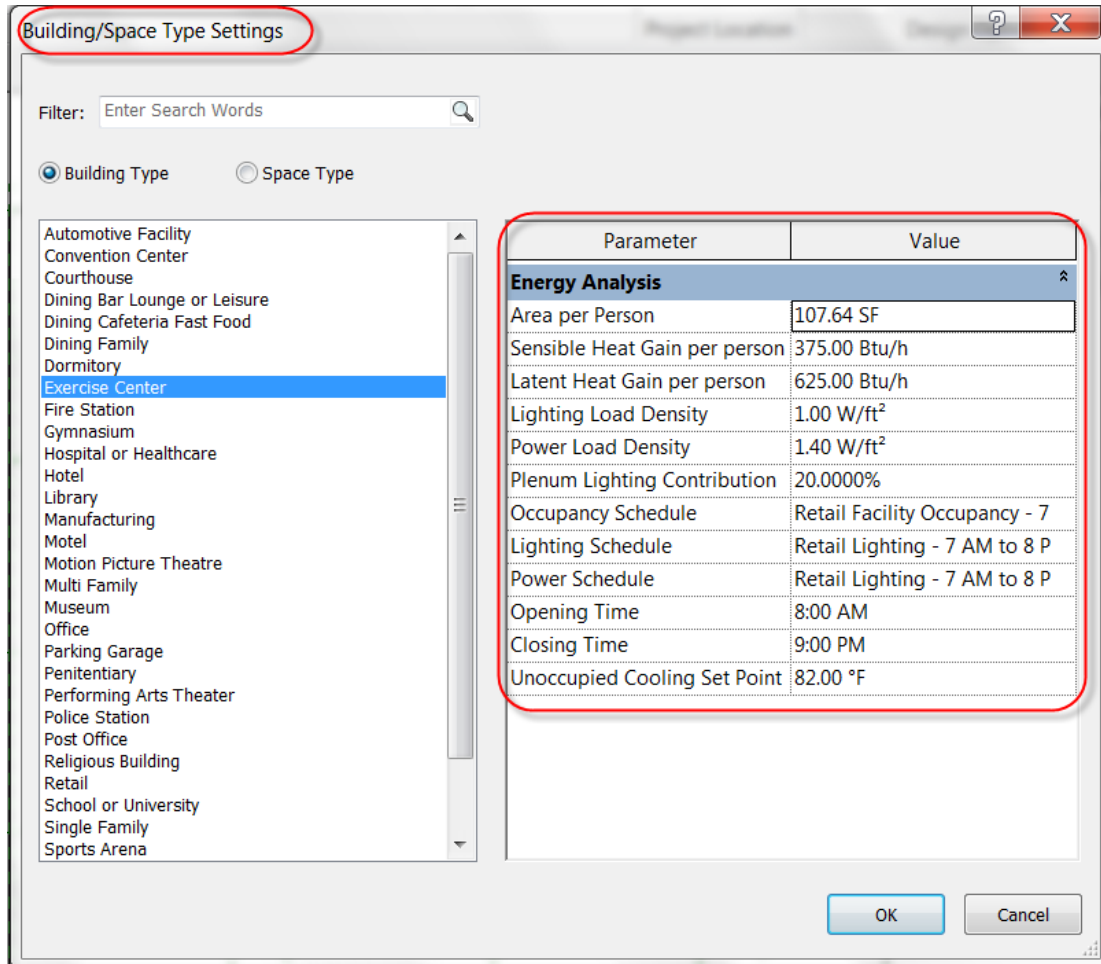
**Glaze is Shaded:** Select this setting if you want light shelves to shade the windows for conceptual energy analysis.

**Target Percentage Skylights:** Specify the percentage of roofs that should be skylights. This value is also known as the skylight-to-roof ratio (SRR). The default is 0%.

**Skylight Width & Depth:** Use this option to specify the size of the skylights when you specify a value for Target Percentage Skylights. Enter a dimension defining the width and depth of the skylights. For example, enter 4' to specify skylights that are 4' wide by 4' deep.

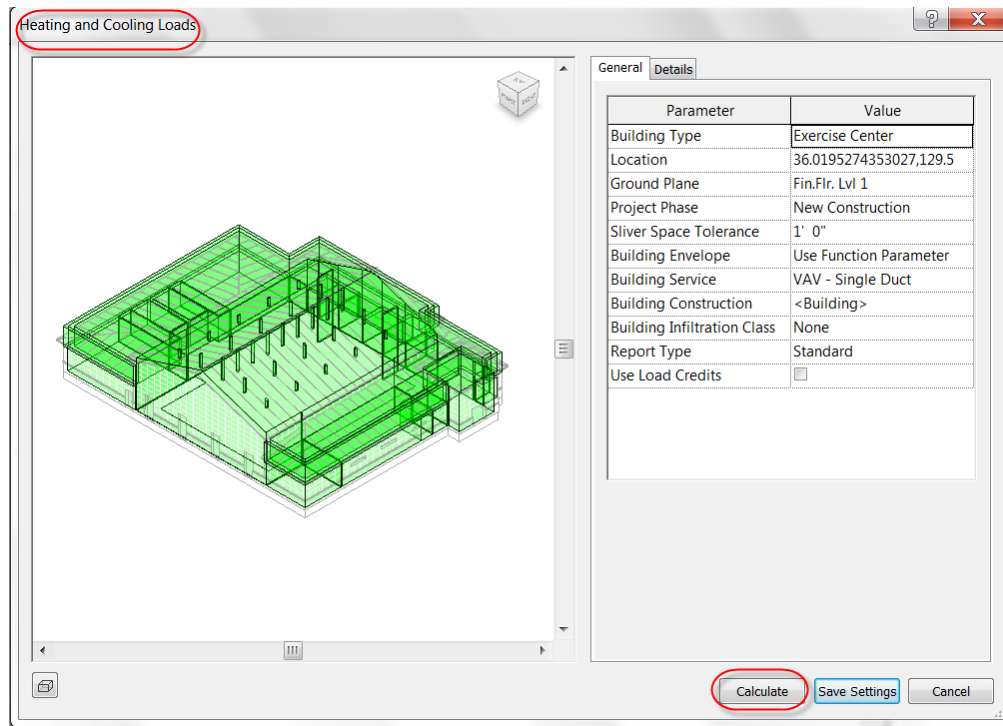
### ***Building Type Settings***

The settings of building types can be managed in the Building/Space and Types dialog box. For each type of building or space you can specify energy analysis information such as the number of people and expected heat gain per person, schedules and times the building is occupied as well as running.



## 4. Run Heating and Cooling Load Analysis

### Review Results



### Project Summary

Location and Weather	
Project	Ta's House of Choi
Address	1234 Main Street NW Future City, KR
Calculation Time	Tuesday, July 15, 2014 9:33 AM
Report Type	Standard
Latitude	36.02°
Longitude	129.58°
Summer Dry Bulb	86 °F
Summer Wet Bulb	79 °F
Winter Dry Bulb	29 °F
Mean Daily Range	10 °F

### Building Summary

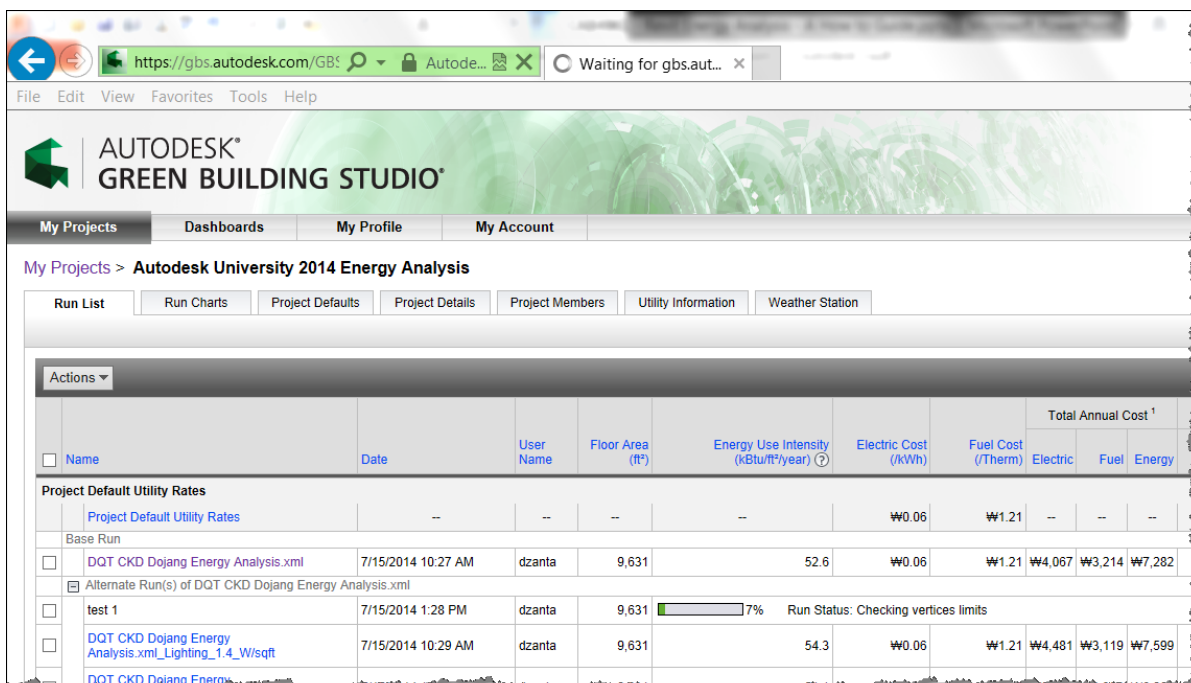
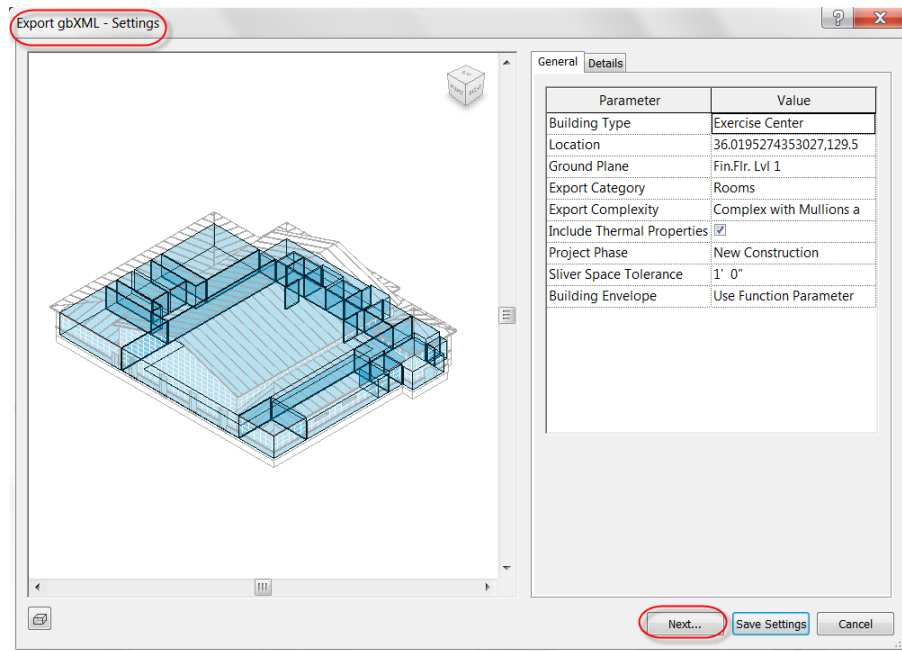
Inputs	
Building Type	Exercise Center
Area (SF)	14,290
Volume (CF)	210,522.45
Calculated Results	
Peak Cooling Total Load (Btu/h)	429,860.2
Peak Cooling Month and Hour	August 3:00 PM
Peak Cooling Sensible Load (Btu/h)	363,479.3
Peak Cooling Latent Load (Btu/h)	66,380.8
Maximum Cooling Capacity (Btu/h)	429,860.2
Peak Cooling Airflow (CFM)	16,785
Peak Heating Load (Btu/h)	160,655.7
Peak Heating Airflow (CFM)	5,167
Checksums	
Cooling Load Density (Btu/(h-ft²))	30.08
Cooling Flow Density (CFM/SF)	1.17
Cooling Flow / Load (CFM/ton)	468.56
Cooling Area / Load (SF/ton)	398.93
Heating Load Density (Btu/(h-ft²))	11.24
Heating Flow Density (CFM/SF)	0.36



## 5. Export to gbXML for GBS

### gbXML

When exporting to gbXML for energy analysis, the process is the same as running the internal heating and cooling load analysis, except that you create a gbXML file that can then be imported into Autodesk Green Building Studio analysis software. gbXML stands for Green Building Extensible Markup Language.

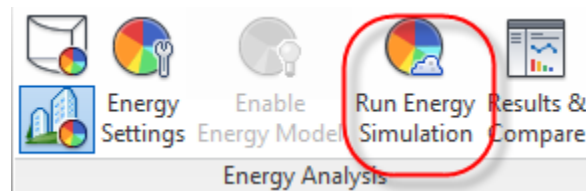


## Steps to Import into Autodesk GBS

The follow are steps needed to follow in order to take your Revit model and data into Autodesk Green Building Studio for analysis.

1. Model your Project  
You have already completed this step
2. Export the data to gbXML file format  
You have already completed this step
3. Sign into Green Building Studio and Create a Project
4. Import the gbXML into green Building Studio
5. Analysis Processing (automated process...wait for it!)
6. Review Results

Alternatively, you can click the Run Energy Simulation Command within the Energy Analysis Panel of the Analyze Tab of the Ribbon.

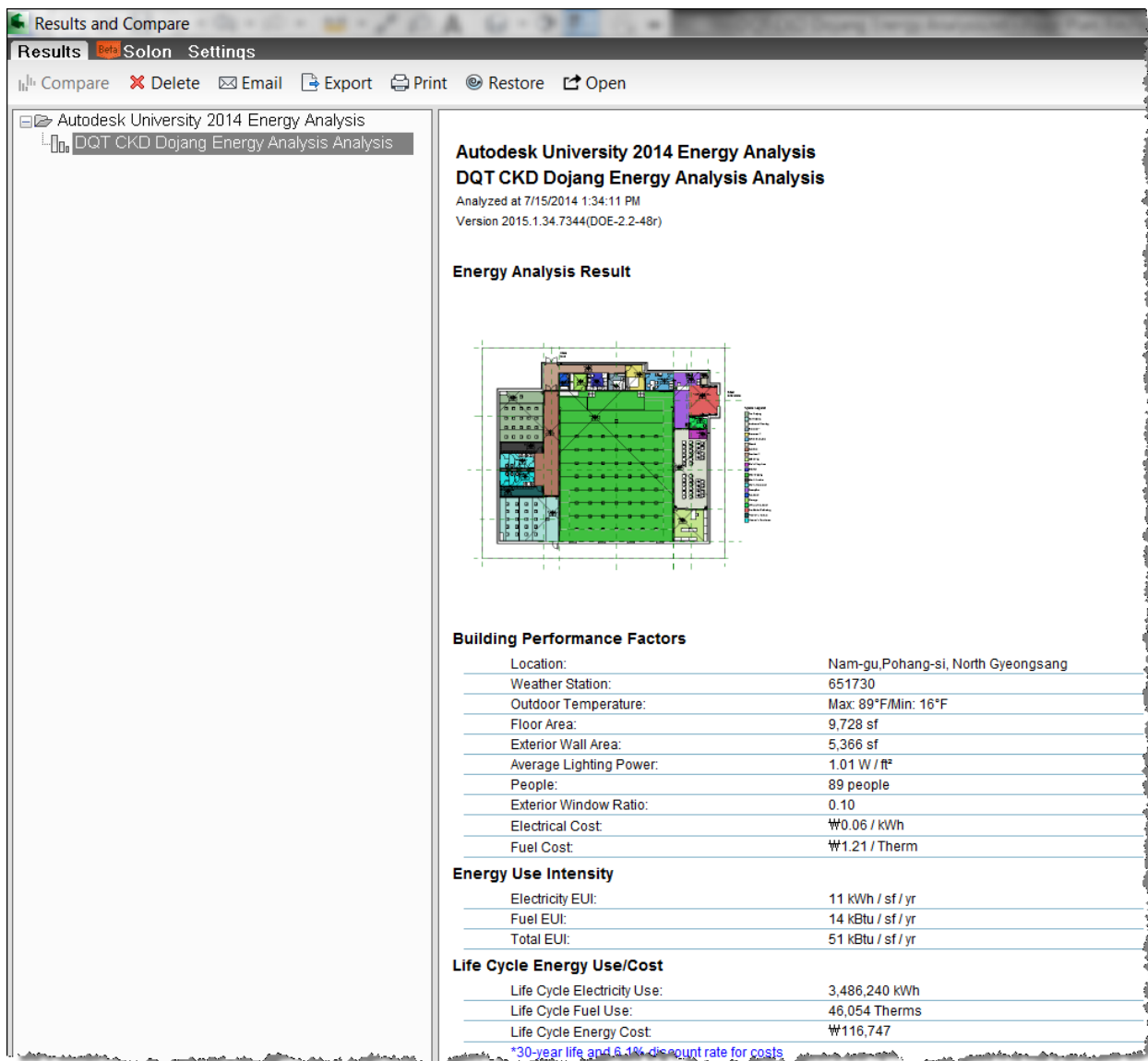


If we have time in class, I will walk thru this feature.

## 6. Analysis in the Cloud

### Energy Simulation via Subscription/Cloud

You can enable the energy model directly in the Revit software and run energy simulations in the cloud using Autodesk 360 Subscription Services. This can be done early during the Conceptual Modeling Phase or building elements without the spaces in place. When finished, you can compare the results of different runs within the software. If time permits, I will walk thru this feature as well.



## This is the Solon (Beta) Synopsis of an Energy Analysis Report

### Energy Analysis Result (Default Revit Dashboard)

