

## WEEK ASSIGNMENT 6

### Question 1

Considering the same example you solved in the previous assignment (radiative heat transfer between two parallel plates), how many shields with epsilon = 0.1 should you add in order to have the new heat transfer rate to be 1% of the case without shields ?

$$\varepsilon_1=0.1$$

$$\varepsilon_2=0.1$$

$$\sigma=5.670*10^{-8} \text{W/m}^2\text{K}^4$$

When the  $\varepsilon_1=\varepsilon_2=0.1$ ;

$$\dot{Q}_{12} = \frac{A\sigma(T_1^4 - T_2^4)}{\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1} = A * 5.67 * 10^{-8} * \frac{800^4 - 500^4}{\frac{1}{0.1} + \frac{1}{0.1} - 1} = A * 1035.72 \text{ W/m}^2$$

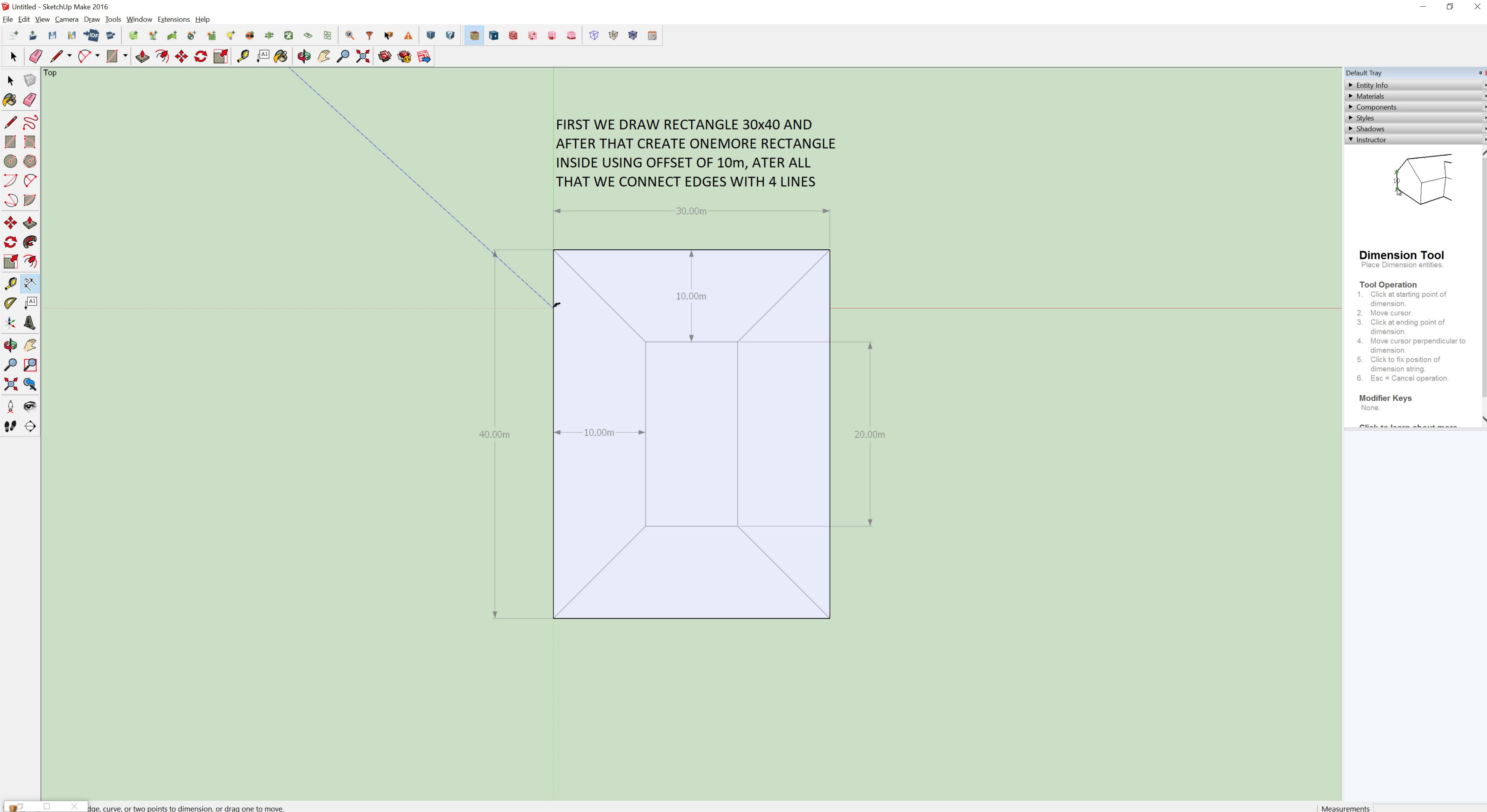
$$\dot{Q}_{N \text{ shields}} = \frac{A\sigma(T_1^4 - T_2^4)}{(N+1)\frac{1}{\varepsilon} + \frac{1}{\varepsilon} - 1} = \frac{1}{N+1} * \dot{Q} \text{ no shields}$$

$$\dot{Q}_{12} \text{ from previous case} = 1035.72 \text{ W/m}^2$$

$$1\% \text{ of } \dot{Q}_{12} - 36.25 \text{ W/m}^2$$

$$10.36 = \frac{1}{N+1} * 1036$$

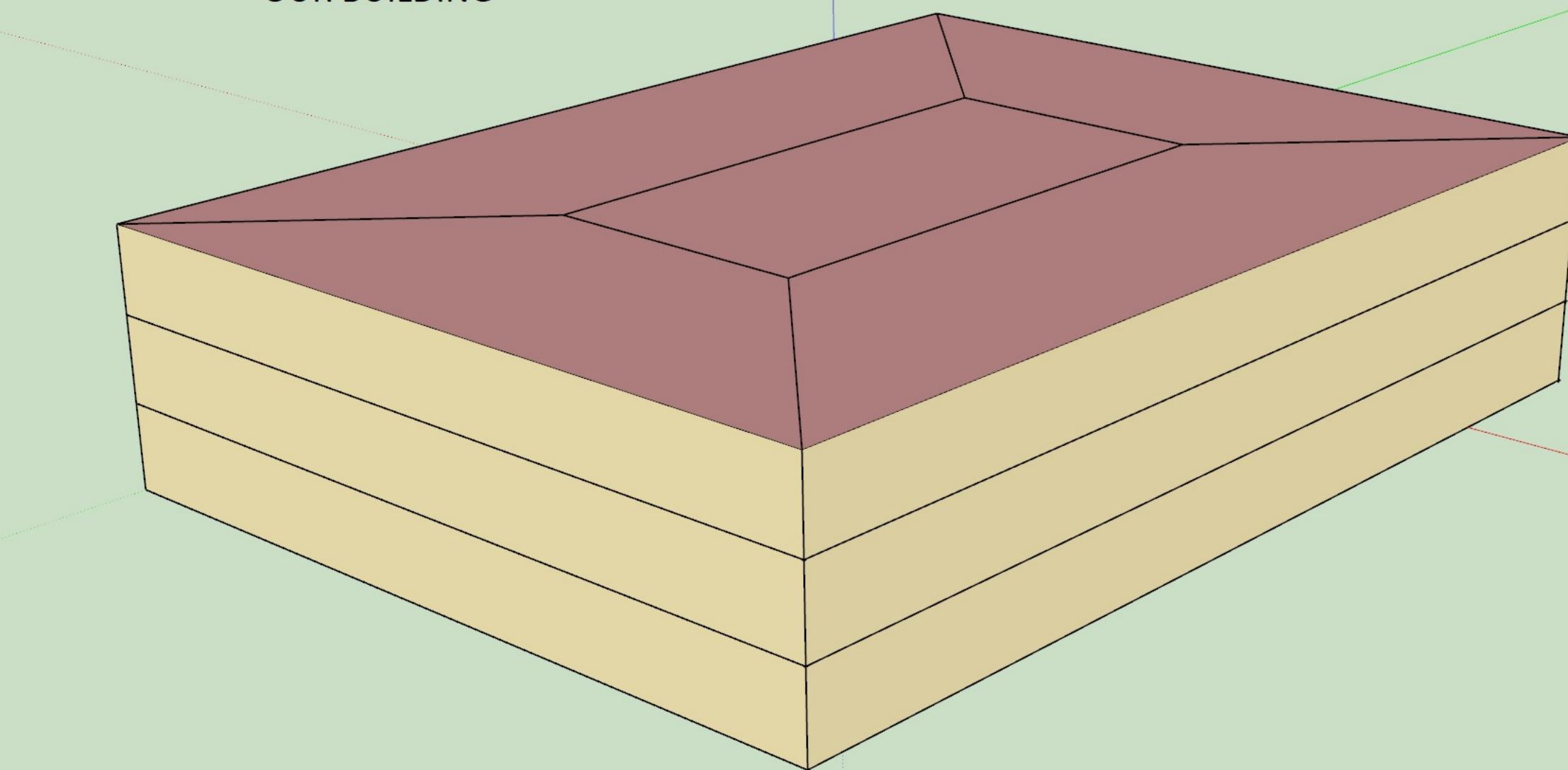
$$N=99 \text{ shields}$$





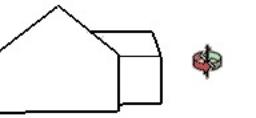
WE CREATED BUILDING BY  
SELECTING DIAGRAM AND  
USING CREATE SPACES  
FROM DIAGRAM TOOL

WITH INFO TOOL WE HAVE  
POSSIBILITY TO SEE ALL THE  
INFORMATIONS REGARDING  
OUR BUILDING



Default Tray

- Entity Info
- Materials
- Components
- Styles
- Shadows
- Instructor



Orbit Tool

Rotate camera about model.

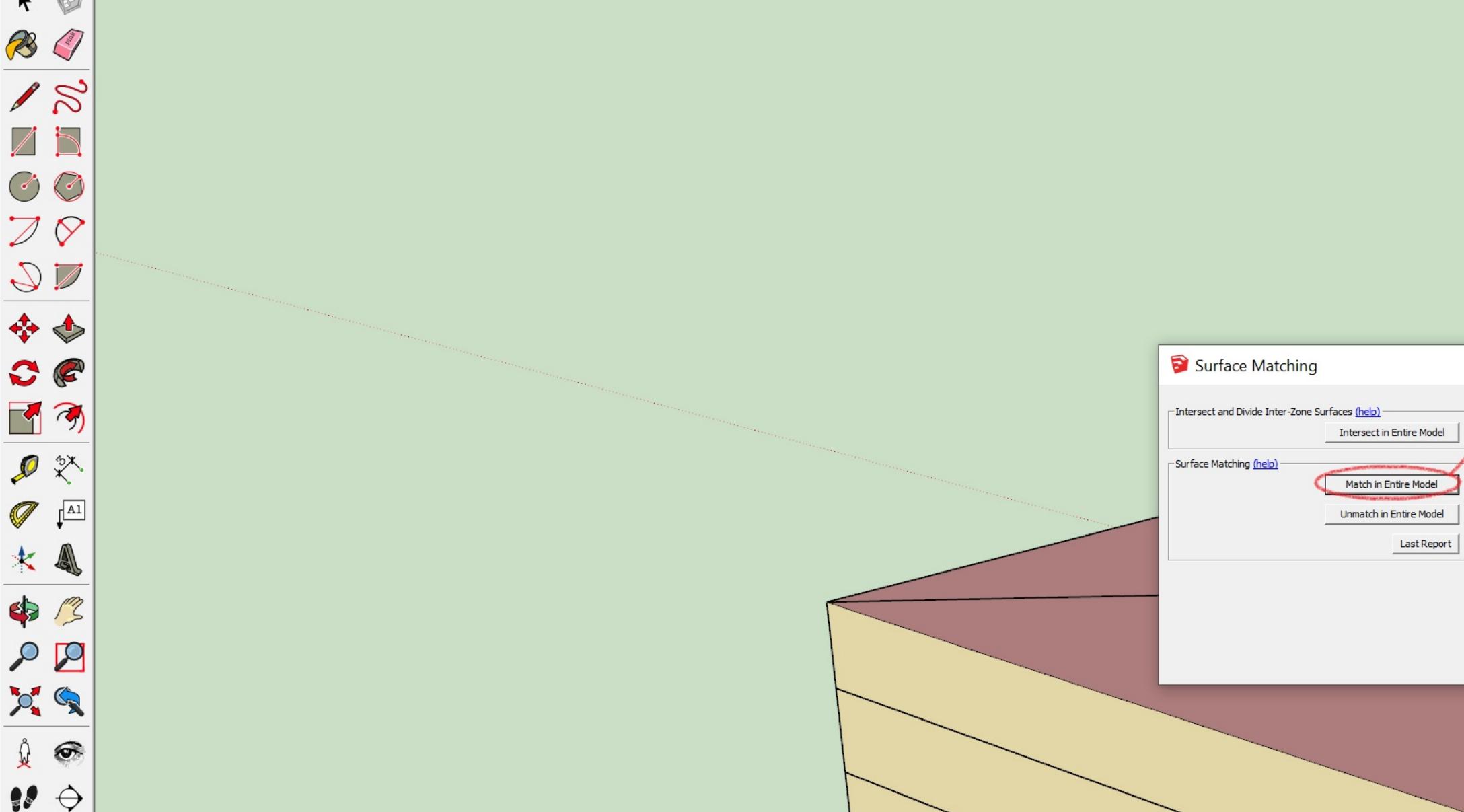
Tool Operation

1. Click anywhere in drawing area.
2. Move cursor in any direction to rotate around center of drawing area.

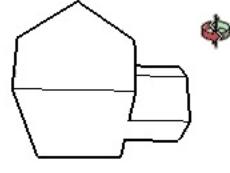
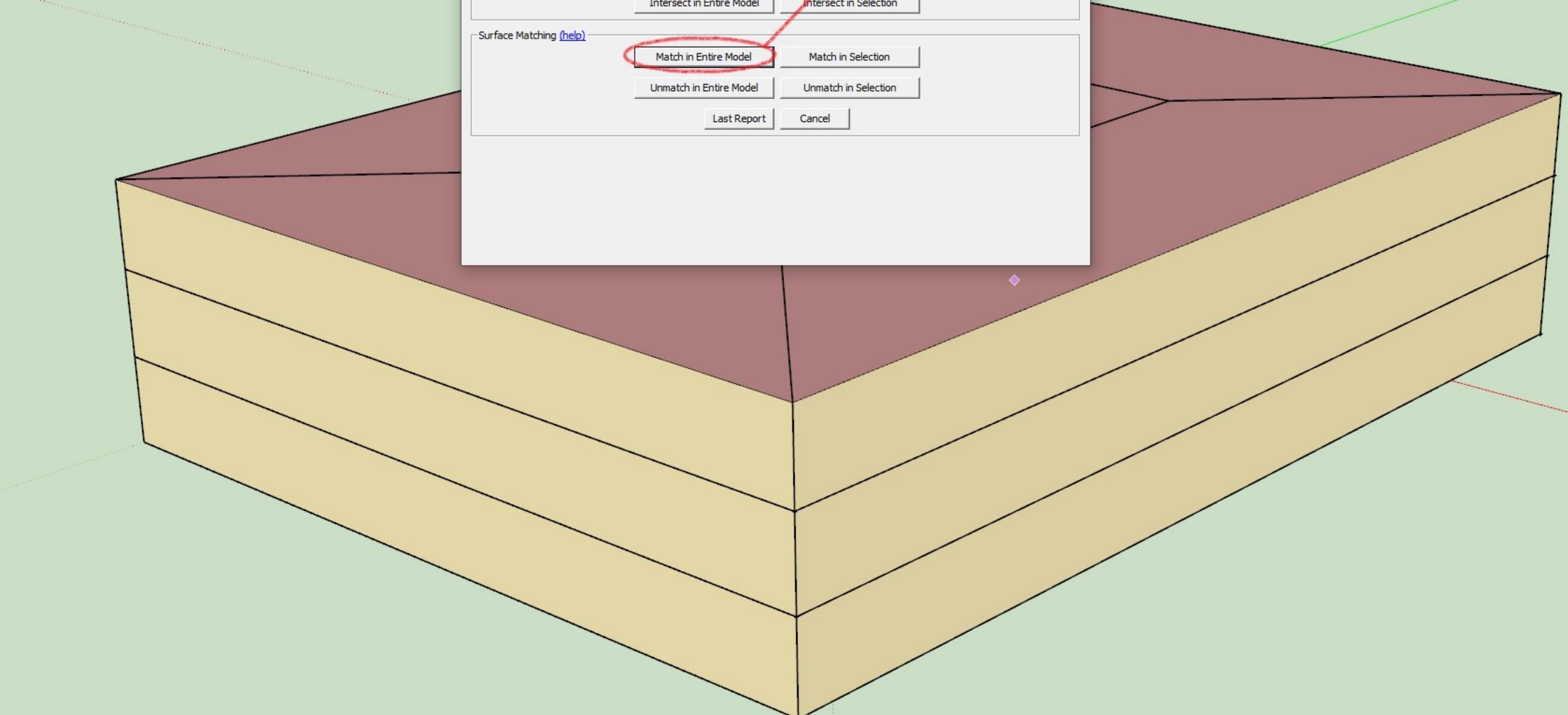
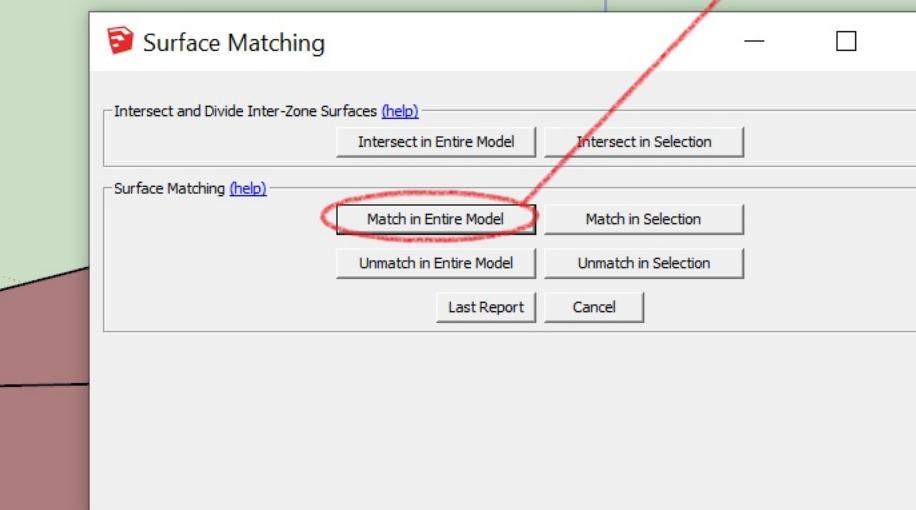
Modifier Keys

Shift = Pan Tool  
Ctrl = Suspend gravity (do not try to keep vertical edges up and down)

Click to learn about more advanced operations...



IN ORDER TO NOT HAVE  
WINDOWS INSIDE OUR  
BUILDING WE NEED TO  
USE SURFACE MEETING  
TOOL



### Orbit Tool

Rotate camera about model.

#### Tool Operation

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Click to learn about more advanced operations...

Untitled - SketchUp Make 2016

File Edit View Camera Draw Tools Window Extensions Help

OpenStudio  
OpenStudio User Scripts >

Load User Scripts

Alter or Add Model Elements >

- Add New Thermal Zone For Spaces With No Thermal Zone
- Add Overhangs by Projection Factor
- Add Photovoltaics
- Add Shading Controls
- Assign Building Stories
- Change Shading Type
- Cleanup Origins
- Export Selected Spaces to a new External Model
- Merge Spaces From External File
- Make Selected Surfaces Adiabatic and Assign a Construction
- Move Selected Surfaces to New Space
- Remove Hard Assigned Constructions
- Remove Loads Directly Assigned to Spaces
- Remove Orphan Photovoltaics
- Remove Orphan SubSurfaces
- Remove Photovoltaics
- Remove Unused ThermalZones
- Rename Thermal Zones Based On Space Names
- Set Interior Partition Height Above Floor
- Set Shading Controls
- Set Window Property Frame and Divider
- Set Window to Wall Ratio

Default Tray

- Entity Info
- Materials
- Components
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Orbit Tool

Rotate camera about model.

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Measurements

ENG US 9:31 PM 11/12/2019



WITH SURFACE SEARCH  
WE CHOOSE ALL THE  
SURFACES, EXCLUDING  
THE NORTH

The image shows a 3D model of a building with multiple colored faces (brown, blue, yellow, light blue) representing different materials or layers. A red arrow points from the 'Surface Search' tool icon in the toolbar to the 'Search Selection' button in the 'Surface Search' dialog box.

**Surface Search**

Surface Search (help)

Class: [dropdown]

Name: [dropdown]

Type: [dropdown]

Construction: [dropdown]

Outside Boundary Condition: [dropdown]

Sun Exposure: [dropdown]

Wind Exposure: [dropdown]

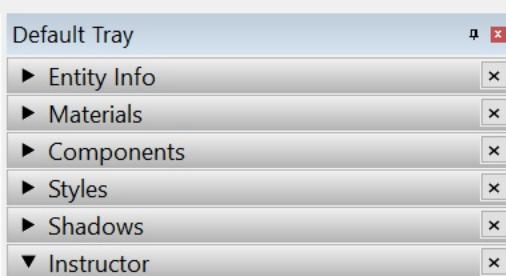
Surface Orientation: from 90 to 270 (Clockwise) - North is 0 degrees

Exclude Horizontal Surfaces

Only Show Non-Convex Surfaces

Only Show Surfaces With More Than 4 Vertices

Search Entire Model | **Search Selection** | Unhide All | Last Report | Cancel

**Select Tool**

Select entities to modify when using other tools or commands.

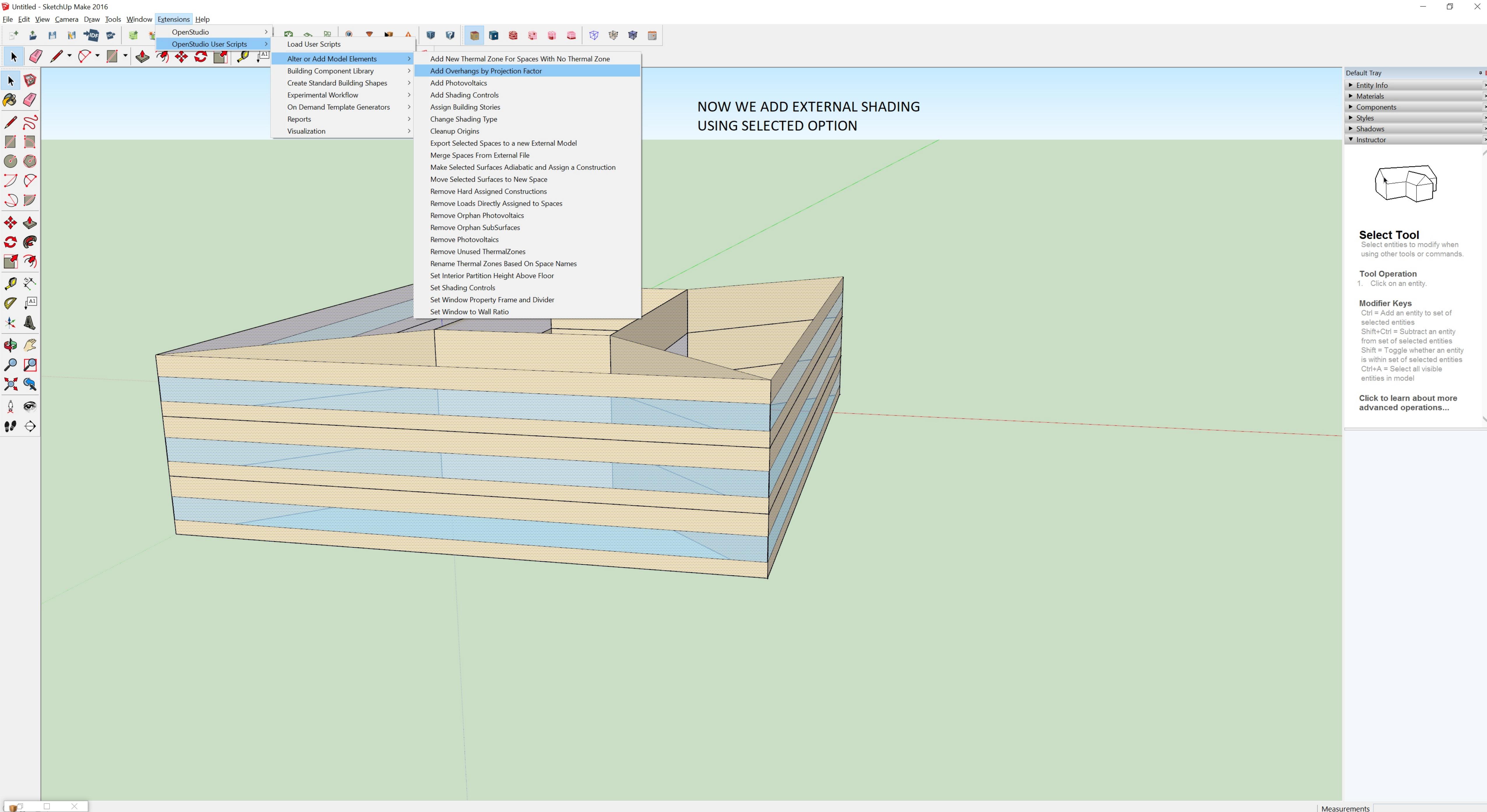
**Tool Operation**

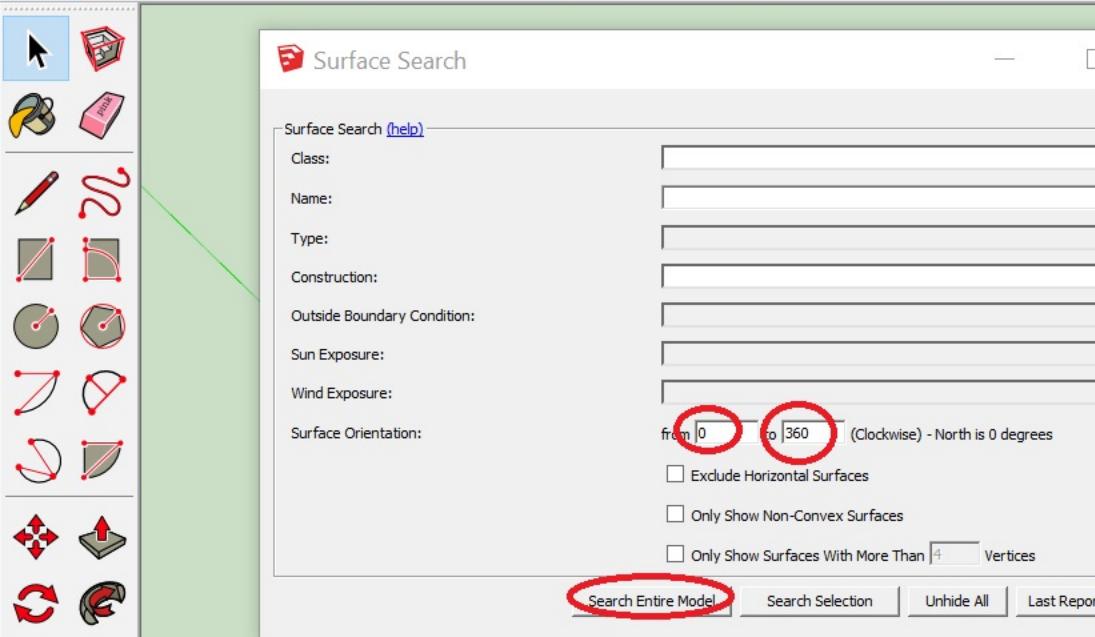
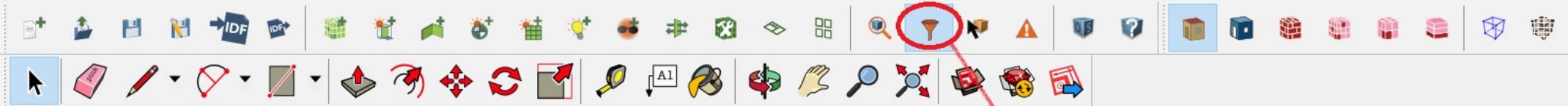
1. Click on an entity.

**Modifier Keys**

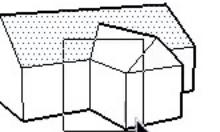
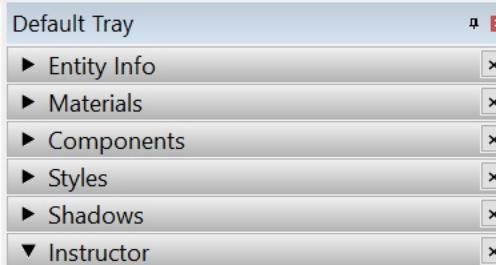
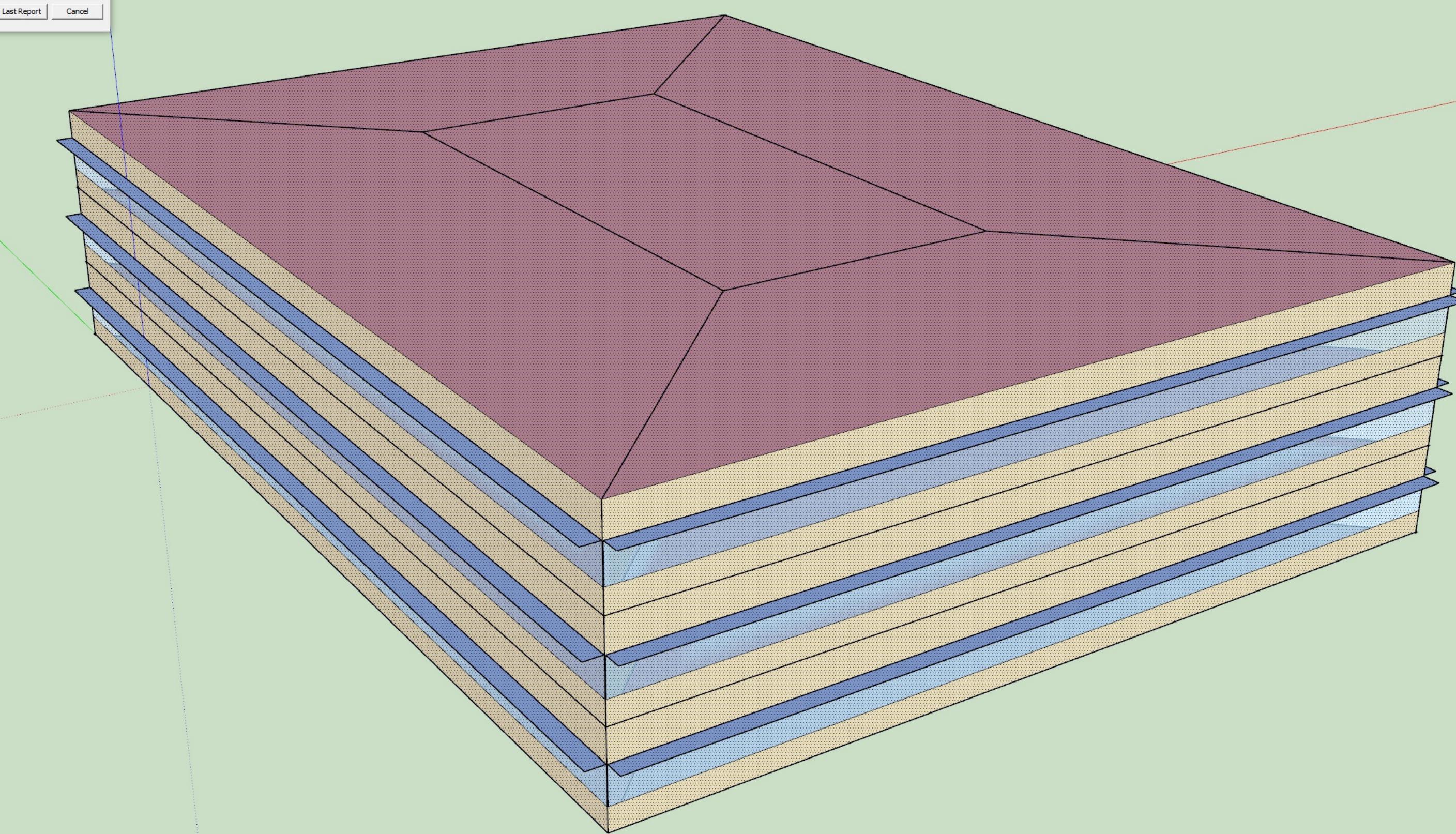
Ctrl = Add an entity to set of selected entities  
Shift+Ctrl = Subtract an entity from set of selected entities  
Shift = Toggle whether an entity is within set of selected entities  
Ctrl+A = Select all visible entities in model

Click to learn about more advanced operations...





OUR NEXT STEP IS TO GO  
BACK TO PREVIOUS  
SELECTION BY CHOOSING  
0-360 SURFACES



### Select Tool

Select entities to modify when using other tools or commands.

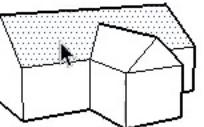
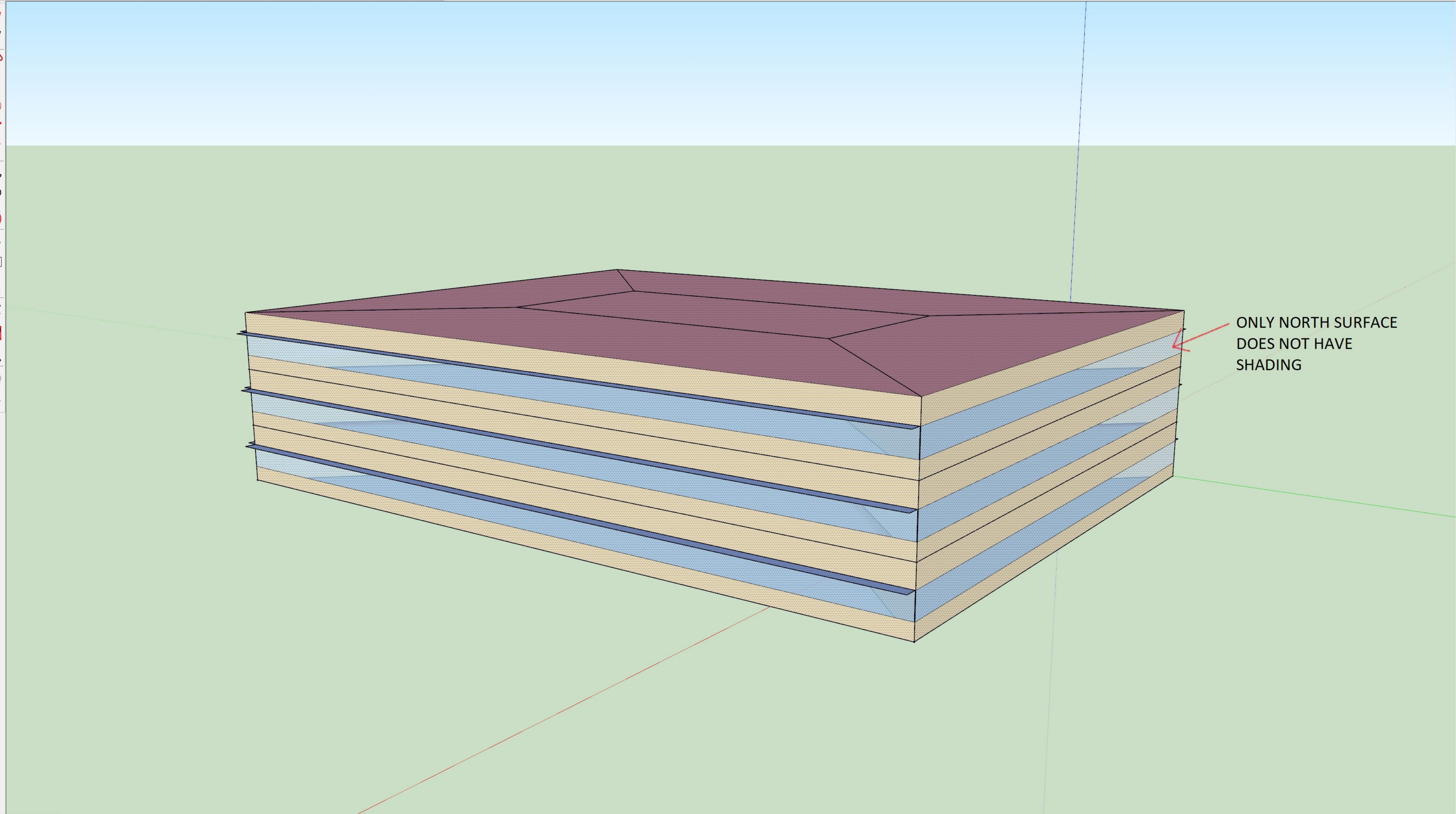
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Click to learn about more advanced operations...

**Select Tool**

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Click to learn about more advanced operations...



OUR NEXT STEP IS TO CHOOSE SPACES OF EACH THERMAL ZONE AND TO ADD CURRENT SPECIFICATIONS

Set Attributes for Selected Spaces

Space Type: 189.1-2009 - Office - OpenOffice - CZ1-3

Building Story: Building Story 1

Construction Set: 189.1-2009 - CZ1 - Office

Thermal Zone: <new thermal zone>

Set Parent Thermal Zone's - Ideal Air Loads Status: Yes

Set Parent Thermal Zone's - Thermostat: 189.1-2009 - Office - OpenOffice - CZ1-3 Thermostat

OK Cancel

Outliner

Space: Space 101

Space: Space 102

Space: Space 103

Space: Space 104

Space: Space 105

Space: Space 201

Space: Space 202

Space: Space 203

Space: Space 204

Space: Space 205

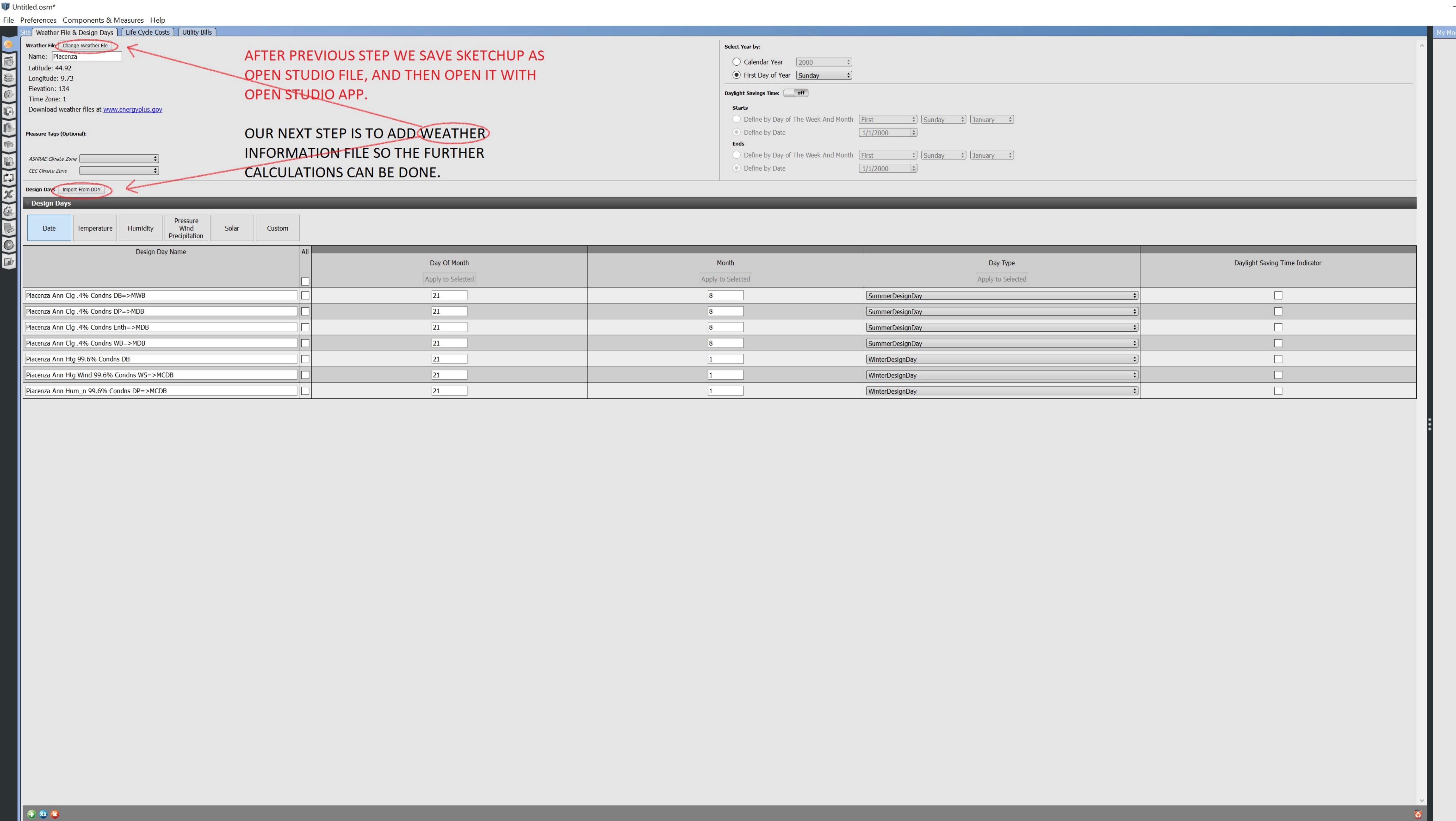
Space: Space 301

Space: Space 302

Space: Space 303

Space: Space 304

Space: Space 305



Untitled.osm  
File Preferences Components & Measures Help

Run Simulation Output Tree 100%

Run Finished  
Warnings: 24  
Errors: 0  
Output

Warming up {5}  
Warming up {6}  
Starting Simulation at 08/21 for PIACENZA ANN CLG .4% CONDNS DP=>MDB  
Initializing New Environment Parameters  
Warming up {1}  
Warming up {2}  
Warming up {3}  
Warming up {4}  
Warming up {5}  
Warming up {6}  
Starting Simulation at 08/21 for PIACENZA ANN CLG .4% CONDNS ENTH=>MDB  
Initializing New Environment Parameters  
Warming up {1}  
Warming up {2}  
Warming up {3}  
Warming up {4}  
Warming up {5}  
Warming up {6}  
Starting Simulation at 08/21 for PIACENZA ANN CLG .4% CONDNS WB=>MDB  
Initializing New Environment Parameters  
Warming up {1}  
Warming up {2}  
Warming up {3}  
Warming up {4}  
Warming up {5}  
Warming up {6}  
Starting Simulation at 01/21 for PIACENZA ANN HTG 99.6% CONDNS DB  
Initializing New Environment Parameters  
Warming up {1}  
Warming up {2}  
Warming up {3}  
Warming up {4}  
Warming up {5}  
Warming up {6}  
Starting Simulation at 01/21 for PIACENZA ANN HTG WIND 99.6% CONDNS WS=>MCDB  
Initializing New Environment Parameters  
Warming up {1}  
Warming up {2}  
Warming up {3}  
Warming up {4}  
Warming up {5}  
Warming up {6}  
Starting Simulation at 01/21 for PIACENZA ANN HUM\_N 99.6% CONDNS DP=>MCDB  
Initializing New Environment Parameters  
Warming up {1}  
Warming up {2}  
Warming up {3}  
Warming up {4}  
Warming up {5}  
Warming up {6}  
Starting Simulation at 01/01 for RUN PERIOD 1  
Updating Shadowing Calculations, Start Date=01/21  
Continuing Simulation at 01/21 for RUN PERIOD 1  
Updating Shadowing Calculations, Start Date=02/10  
Continuing Simulation at 02/10 for RUN PERIOD 1  
Updating Shadowing Calculations, Start Date=03/02  
Continuing Simulation at 03/02 for RUN PERIOD 1  
Updating Shadowing Calculations, Start Date=03/22  
Continuing Simulation at 03/22 for RUN PERIOD 1  
Updating Shadowing Calculations, Start Date=04/11  
Continuing Simulation at 04/11 for RUN PERIOD 1  
Updating Shadowing Calculations, Start Date=05/01  
Continuing Simulation at 05/01 for RUN PERIOD 1  
Updating Shadowing Calculations, Start Date=05/21  
Continuing Simulation at 05/21 for RUN PERIOD 1  
Updating Shadowing Calculations, Start Date=06/10  
Continuing Simulation at 06/10 for RUN PERIOD 1  
Updating Shadowing Calculations, Start Date=06/30  
Continuing Simulation at 06/30 for RUN PERIOD 1  
Updating Shadowing Calculations, Start Date=07/20  
Continuing Simulation at 07/20 for RUN PERIOD 1  
Updating Shadowing Calculations, Start Date=08/09  
Continuing Simulation at 08/09 for RUN PERIOD 1  
Updating Shadowing Calculations, Start Date=08/29  
Continuing Simulation at 08/29 for RUN PERIOD 1  
Updating Shadowing Calculations, Start Date=09/18  
Continuing Simulation at 09/18 for RUN PERIOD 1  
Updating Shadowing Calculations, Start Date=10/08  
Continuing Simulation at 10/08 for RUN PERIOD 1  
Updating Shadowing Calculations, Start Date=10/28  
Continuing Simulation at 10/28 for RUN PERIOD 1  
Updating Shadowing Calculations, Start Date=11/17  
Continuing Simulation at 11/17 for RUN PERIOD 1  
Updating Shadowing Calculations, Start Date=12/07  
Continuing Simulation at 12/07 for RUN PERIOD 1  
Updating Shadowing Calculations, Start Date=12/27  
Continuing Simulation at 12/27 for RUN PERIOD 1  
Writing tabular output file results using HTML format.  
Computing Life Cycle Costs and Reporting  
Writing final SQL reports  
EnergyPlus Run Time=00hr 00min 7.02sec  
Script executing from: C:/Users/Ira Kovinic/AppData/Local/Temp/OpenStudio.y27308/resources/run/6-UserScript-0  
Found UserScript 'OpenStudio Results'.  
result = true  
Processed 1 base script and 0 merged scripts

THEN WE RUN THE MODEL

Reports:	EnergyPlus Results
Program Version: EnergyPlus, Version 8.5.0-c87e61b44b, YMD=2019.11.12 23:16	
Tabular Output Report in Format: HTML	
Building: Building 1	
Environment: RUN PERIOD 1 ** Piacenza - ITA IGDG WMO#=160840	
Simulation Timestamp: 2019-11-12 23:16:57	
Report: Annual Building Utility Performance Summary	
For: Entire Facility	
Timestamp: 2019-11-12 23:16:57	
Values gathered over 8760.00 hours	

Open ResultsViewer  
for Detailed Reports[Table of Contents](#)

IN LAST TAB WE SEE THE  
RESULT!

## Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	1417.50	472.50	472.50
Net Site Energy	1417.50	472.50	472.50
Total Source Energy	4018.10	1339.37	1339.37
Net Source Energy	4018.10	1339.37	1339.37

## Site to Source Energy Conversion Factors

	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613
Steam	0.300
Gasoline	1.050
Diesel	1.050
Coal	1.050
Fuel Oil #1	1.050
Fuel Oil #2	1.050
Propane	1.050
Other Fuel 1	1.000
Other Fuel 2	1.000

## Building Area

	Area [m2]
Total Building Area	3000.00
Net Conditioned Building Area	3000.00
Unconditioned Building Area	0.00

## End Uses

	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	0.00	0.00	0.00	0.00	356.80	0.00
Cooling	0.00	0.00	0.00	298.57	0.00	0.00
Interior Lighting	371.18	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	390.95	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00	0.00	0.00