Heat transfer per Area $\frac{W}{m^2}$

$\sigma = 5.67 \times 10^{-8}$

$$\dot{Q} = \frac{\dot{Q}}{A} = \frac{\sigma\left(T_1^4 - T_2^4\right)}{\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1} = \frac{\dot{Q}}{A} = 5.67 \times 10^{-8} \frac{800^4 - 500^4}{\frac{1}{0.2} + \frac{1}{0.7} - 1} = 3625.4 \frac{W}{m^2}$$

how many shields with ε = 0.1 should you add in order to have the new heat transfer rate to be 1% of the case without shields ?

In the case with only one shield

$\frac{1}{\varepsilon 1} + \frac{1}{\varepsilon 2} - 1 \rightarrow \varepsilon 1 = \varepsilon 2 = 0.1 \rightarrow =$

$$\frac{\dot{Q}}{A} = 5.67 \times 10^{-8} \frac{800^4 - 500^4}{\frac{1}{0.2} + \frac{1}{0.7} - 1 + 19} = 805.63 \frac{W}{m^2}$$

In order to lower the heat transfer rate in 1% → $\varepsilon = 0.1 \rightarrow \dot{Q} = 36.25$

Net radiation heat transfer in an encloseure with two superfaces:

$$\dot{Q} = \frac{\dot{Q}}{A} = \frac{\sigma\left(T_1^4 - T_2^4\right)}{(N+1)(\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1)}$$

$\varepsilon = 0.1 \rightarrow with\ 5\ shields \rightarrow \frac{1}{\varepsilon 1} + \frac{1}{\varepsilon 2} + \frac{1}{\varepsilon 3} + \frac{1}{\varepsilon 4} + \frac{1}{\varepsilon 5} - 1 = 49$

$$5.67 \times 10^{-8} \frac{800^4 - 500^4}{\frac{1}{0.2} + \frac{1}{0.7} - 1 + 49} = 361.585 \frac{W}{m^2} \dashrightarrow not\ enough.$$

$\varepsilon = 0.1 \rightarrow with\ 10\ shields \rightarrow \frac{1}{\varepsilon 1} + \frac{1}{\varepsilon 2} + \frac{1}{\varepsilon 3} + \frac{1}{\varepsilon 4} + \frac{1}{\varepsilon 5} + \frac{1}{\varepsilon 6} + \frac{1}{\varepsilon 7} + \frac{1}{\varepsilon 8} + \frac{1}{\varepsilon 9} + \frac{1}{\varepsilon 10} - 1 = 99$

$$5.67 \times 10^{-8} \frac{800^4 - 500^4}{\frac{1}{0.2} + \frac{1}{0.7} - 1 + 99} = \frac{19680.57}{5.428 + 99} = 188.459 \frac{W}{m^2} \dashrightarrow not\ enough.$$

$\varepsilon = 0.1 \rightarrow with\ 15\ shields \rightarrow 149$

$$5.67 \times 10^{-8} \frac{800^4 - 500^4}{\frac{1}{0.2} + \frac{1}{0.7} - 1 + 149} = \frac{19680.57}{5.428 + 149} = 127.44 \frac{W}{m^2} \dashrightarrow not\ enough.$$

$\varepsilon = 0.1 \rightarrow with\ 20\ shields \rightarrow 199$

$$5.67 \times 10^{-8} \frac{800^4 - 500^4}{\frac{1}{0.2} + \frac{1}{0.7} - 1 + 199} = \frac{19680.57}{5.428 + 199} = 96.27 \frac{W}{m^2} \dashrightarrow not\ enough.$$

$\varepsilon = 0.1 \rightarrow with\ 25\ shields \rightarrow 249$

$$5.67 \times 10^{-8} \frac{800^4 - 500^4}{\frac{1}{0.2} + \frac{1}{0.7} - 1 + 249} = \frac{19680.57}{5.428 + 249} = 77.352 \frac{W}{m^2} \dashrightarrow not\ enough.$$

$\varepsilon = 0.1 \rightarrow with\ 30\ shields \rightarrow 299$

$$5.67 \times 10^{-8} \frac{800^4 - 500^4}{\frac{1}{0.2} + \frac{1}{0.7} - 1 + 299} = \frac{19680.57}{5.428 + 299} = 64.647 \frac{W}{m^2} \dashrightarrow not\ enough.$$

$\varepsilon = 0.1 \rightarrow with\ 35\ shields \rightarrow 349$

$$5.67 \times 10^{-8} \frac{800^4 - 500^4}{\frac{1}{0.2} + \frac{1}{0.7} - 1 + 349} = \frac{19680.57}{5.428 + 349} = 55.527 \frac{W}{m^2} \dashrightarrow not\ enough.$$

$\varepsilon = 0.1 \rightarrow with\ 40\ shields \rightarrow 399$

$$5.67 \times 10^{-8} \frac{800^4 - 500^4}{\frac{1}{0.2} + \frac{1}{0.7} - 1 + 399} = \frac{19680.57}{5.428 + 399} = 48.662 \frac{W}{m^2} \dashrightarrow not\ enough.$$

$\varepsilon = 0.1 \rightarrow with\ 45\ shields \rightarrow 449$

$$5.67 \times 10^{-8} \frac{800^4 - 500^4}{\frac{1}{0.2} + \frac{1}{0.7} - 1 + 449} = \frac{19680.57}{5.428 + 449} = 43.308 \frac{W}{m^2} \dashrightarrow not\ enough.$$

$\varepsilon = 0.1 \rightarrow with\ 50\ shields \rightarrow 499$

$$5.67 \times 10^{-8} \frac{800^4 - 500^4}{\frac{1}{0.2} + \frac{1}{0.7} - 1 + 499} = \frac{19680.57}{5.428 + 499} = 39.015 \frac{W}{m^2} \dashrightarrow not\ enough.$$

$\varepsilon = 0.1 \rightarrow with\ 55\ shields \rightarrow 549$

$$5.67 \times 10^{-8} \frac{800^4 - 500^4}{\frac{1}{0.2} + \frac{1}{0.7} - 1 + 549} = \frac{19680.57}{5.428 + 549} = 35.49 \frac{W}{m^2} \dashrightarrow almost..$$

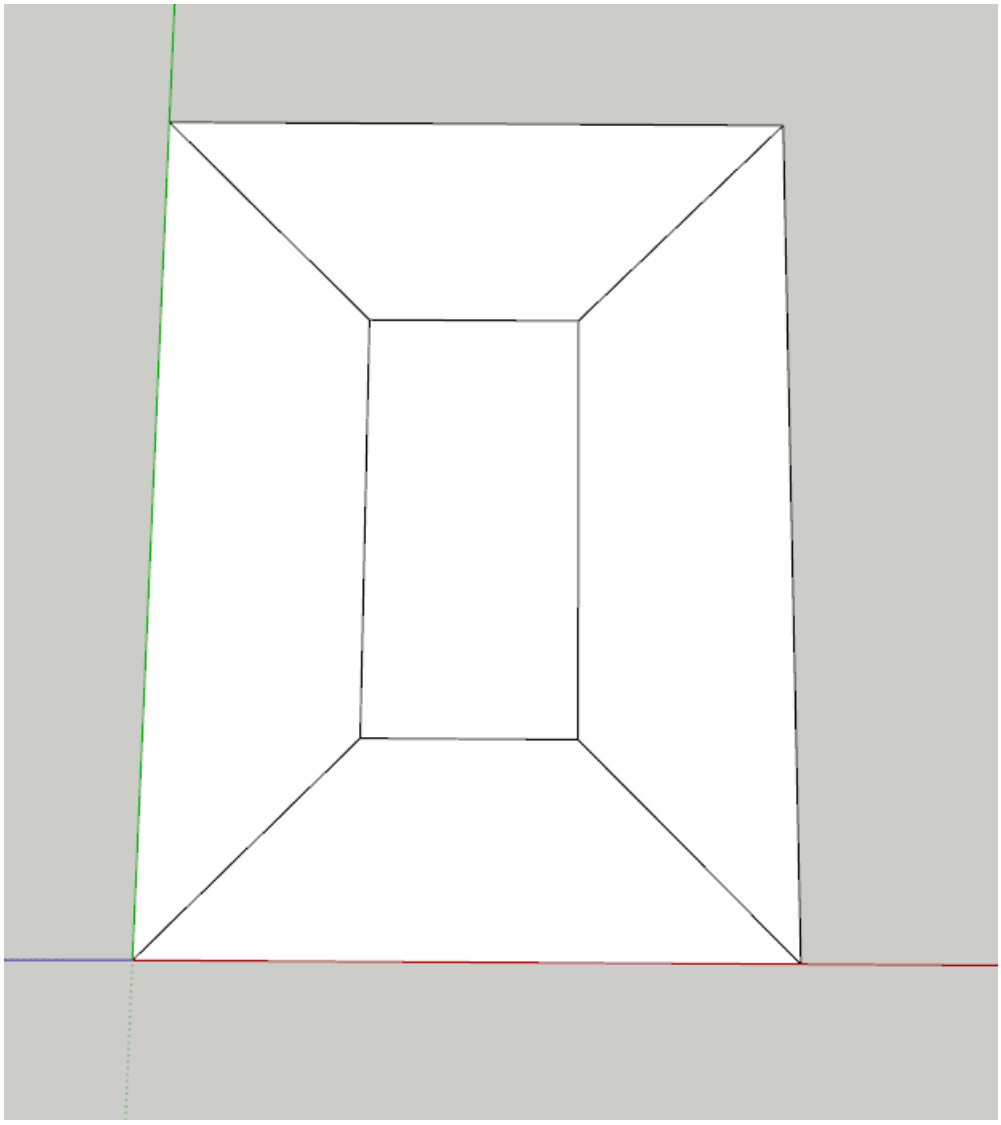
$\varepsilon = 0.1 \rightarrow with\ 54\ shields \rightarrow 539$

$$5.67 \times 10^{-8} \frac{800^4 - 500^4}{\frac{1}{0.2} + \frac{1}{0.7} - 1 + 539} = \frac{19680.57}{5.428 + 539} = 36.149 \frac{W}{m^2} \dashrightarrow almost..$$

$\varepsilon = 0.1 \rightarrow with\ 53\ shields \rightarrow 529$

$$5.67 \times 10^{-8} \frac{800^4 - 500^4}{\frac{1}{0.2} + \frac{1}{0.7} - 1 + 529} = \frac{19680.57}{5.428 + 529} = 36.825 \frac{W}{m^2} \dashrightarrow almost..$$

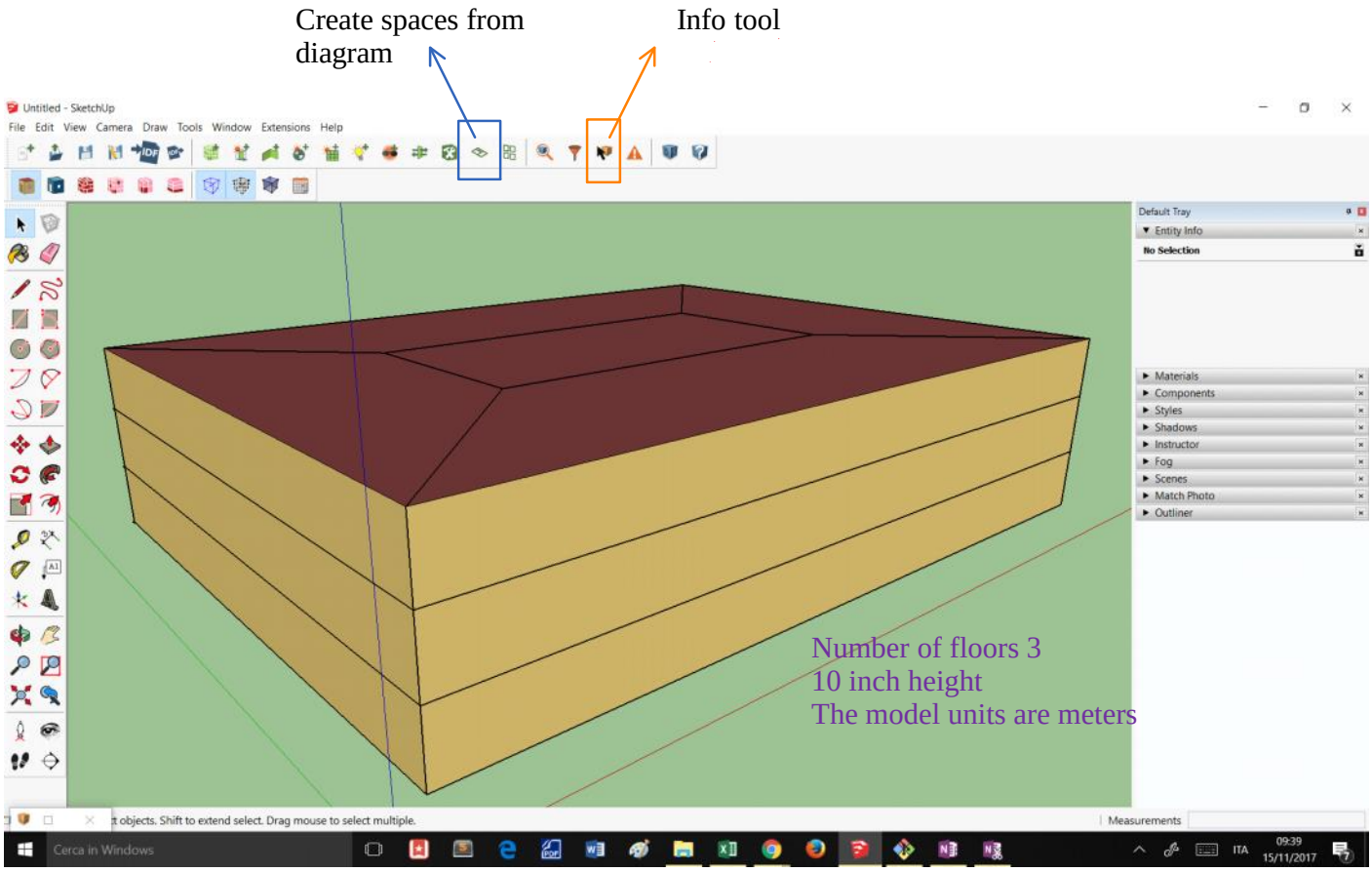
What do we do first:



draw a rectangle 40×30 m and then offset 10 m rectangle inside it
Finally connect the edges with 4 lines

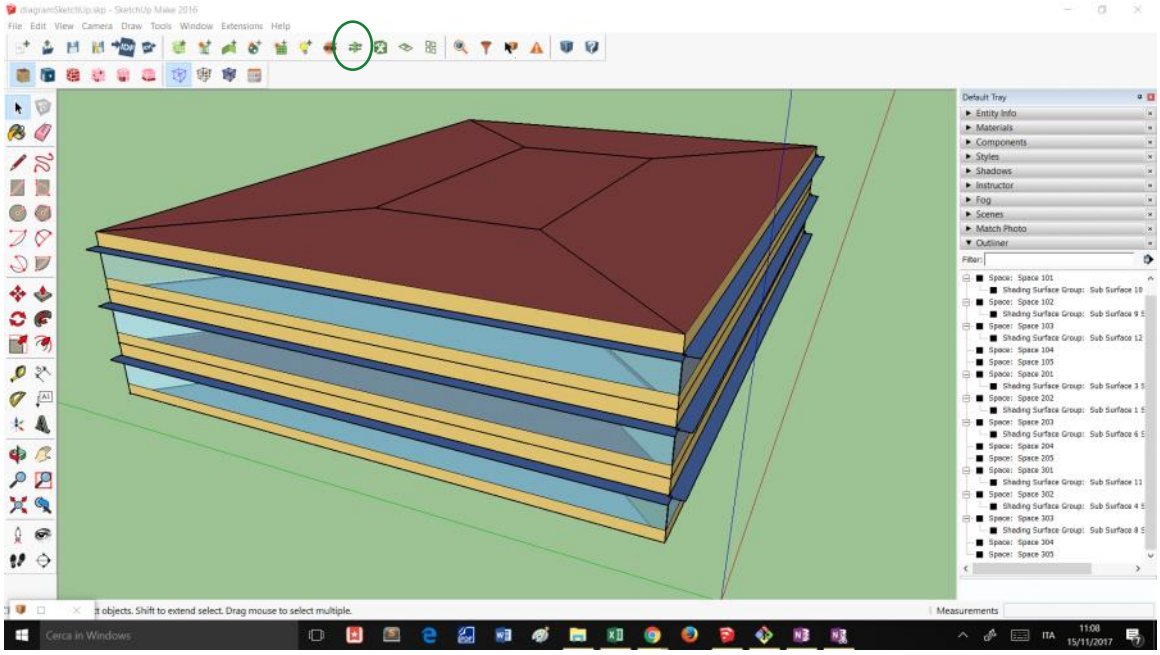
Don’t save it as a skp file - save it as an open studio file:
.osm in the end of the file name. Or save opensudio model.

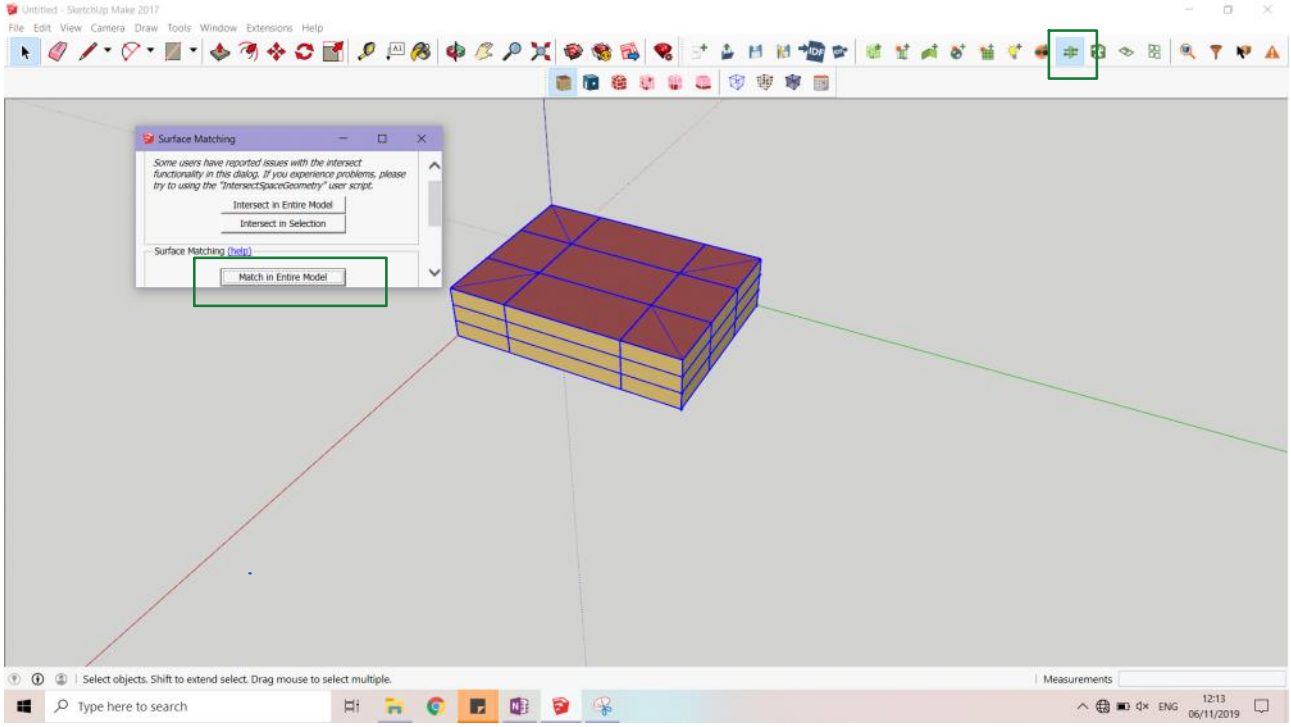
Once you made the diagram, select all of it and then click on: "create spaces from diagram"



Once you created the building you can use info tool to see the properties of each surface, and you will see that the boundary conditions have been automatically assigned.

Doing surface matching:

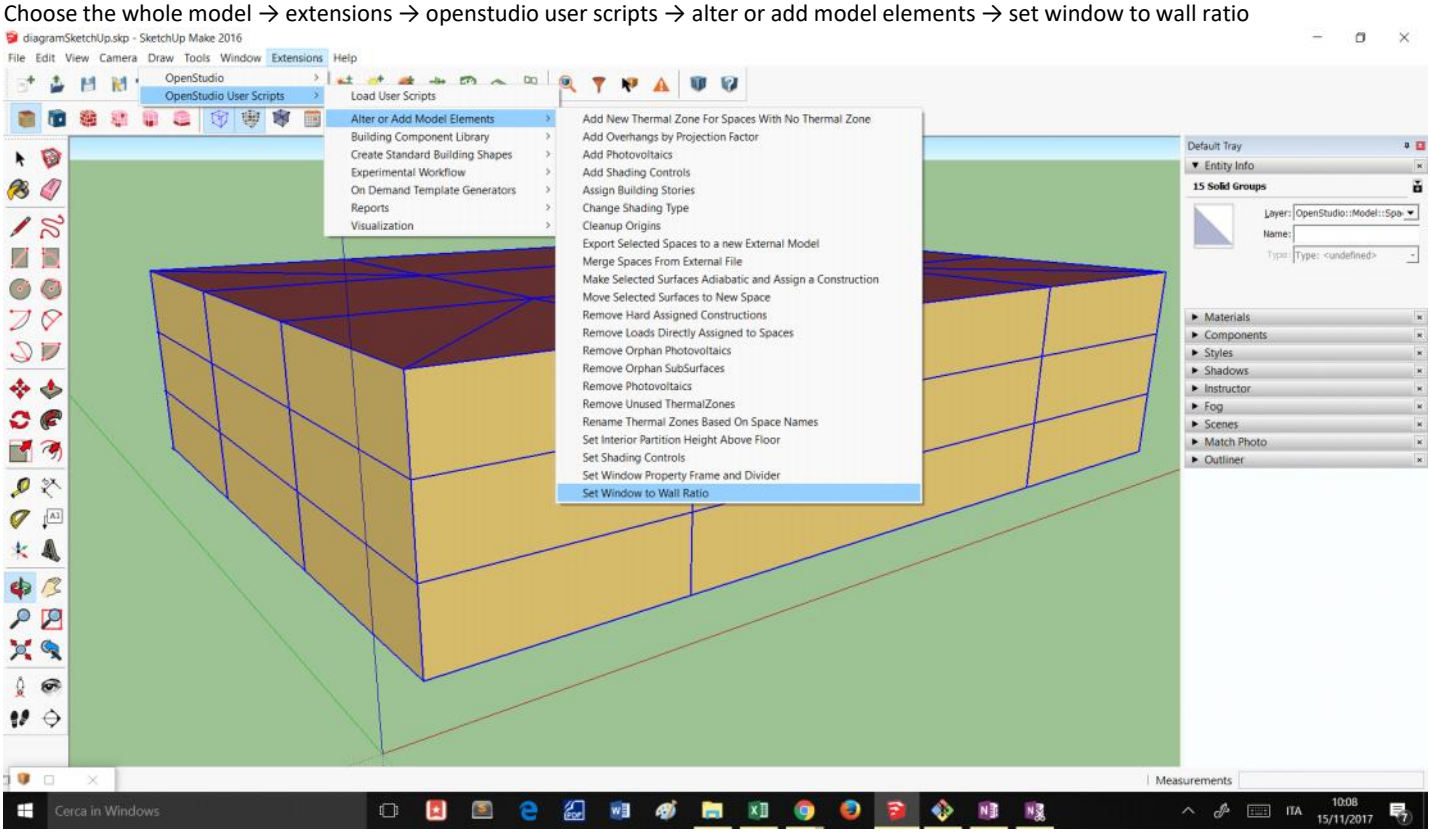


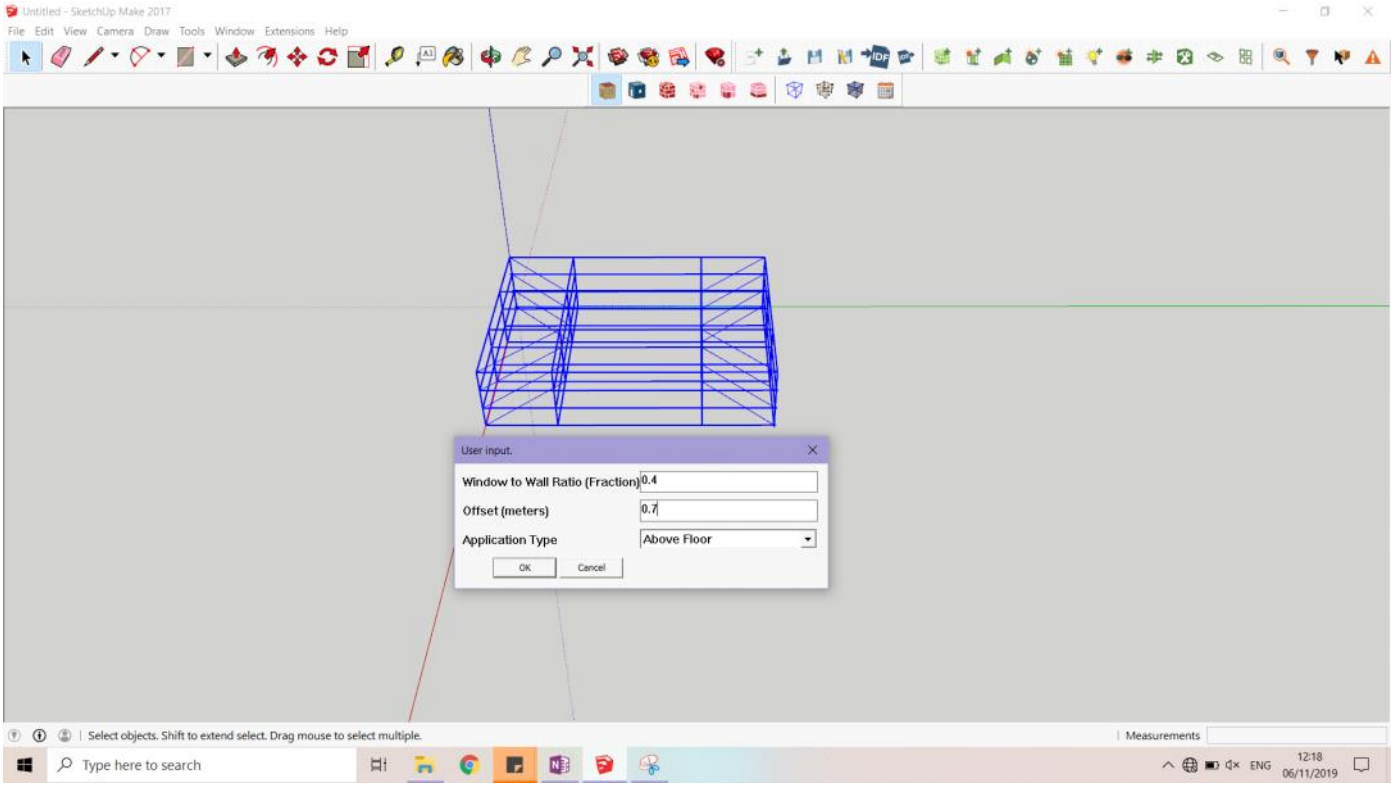


Choose the whole model → Choose surface matching → match the entire model → ok

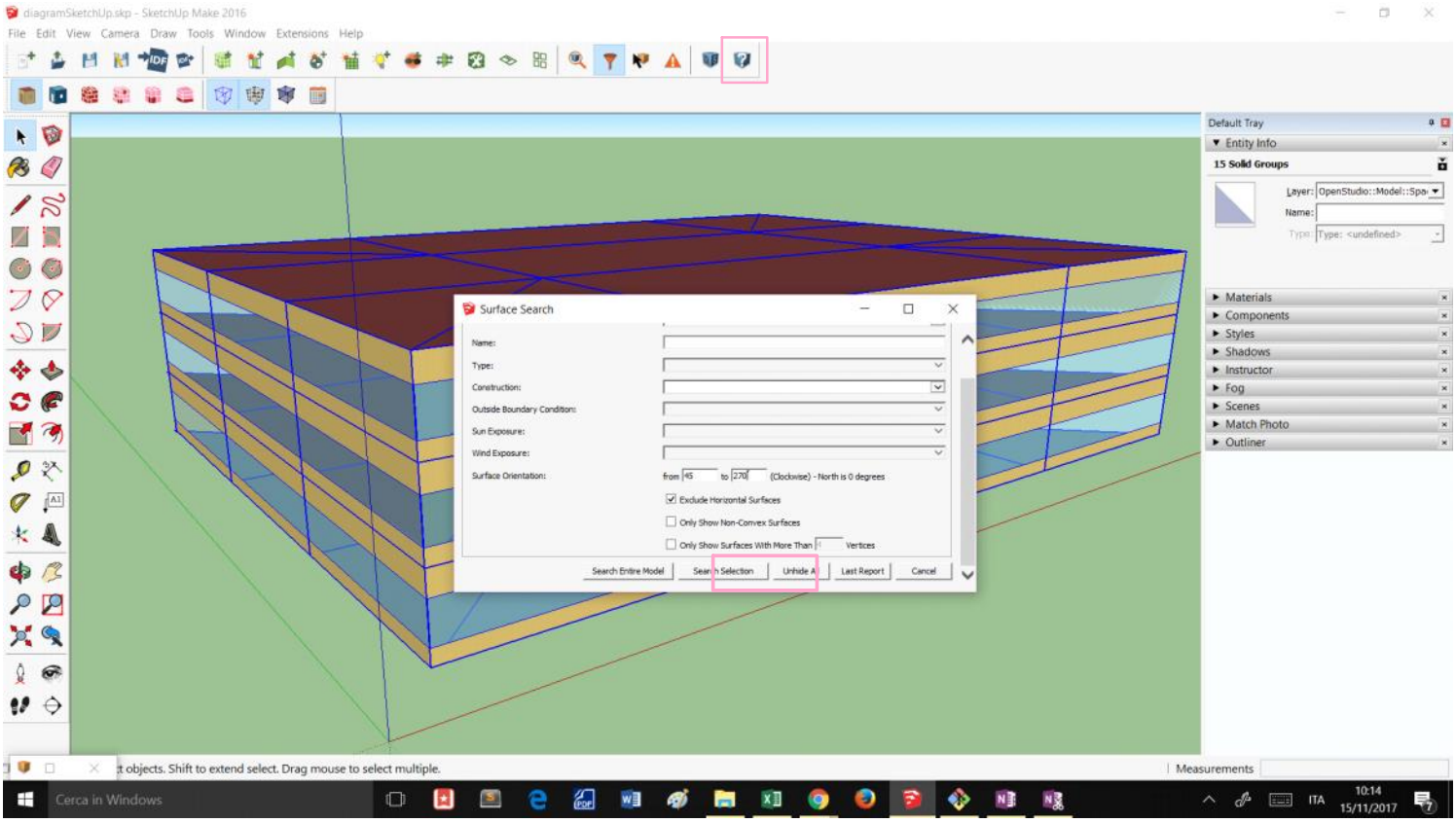
In order to add / create windows:

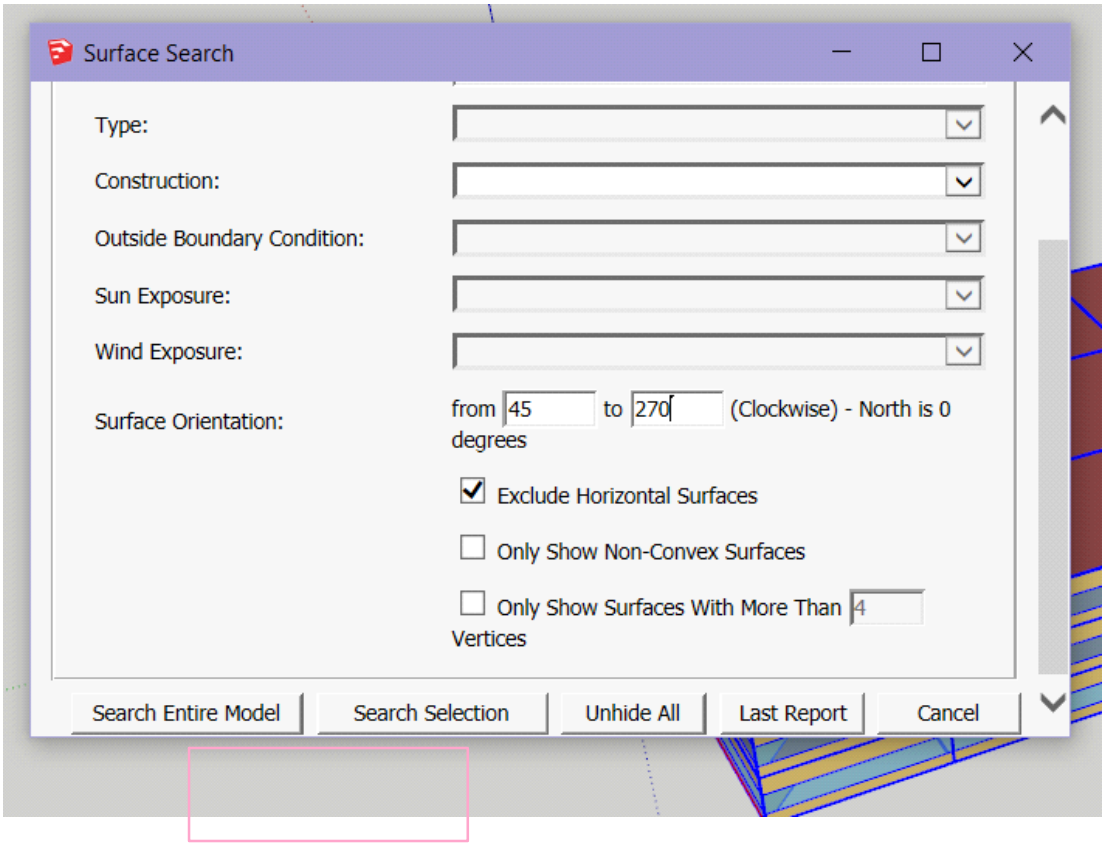
Choose the whole model → extensions → openstudio user scripts → alter or add model elements → set window to wall ratio



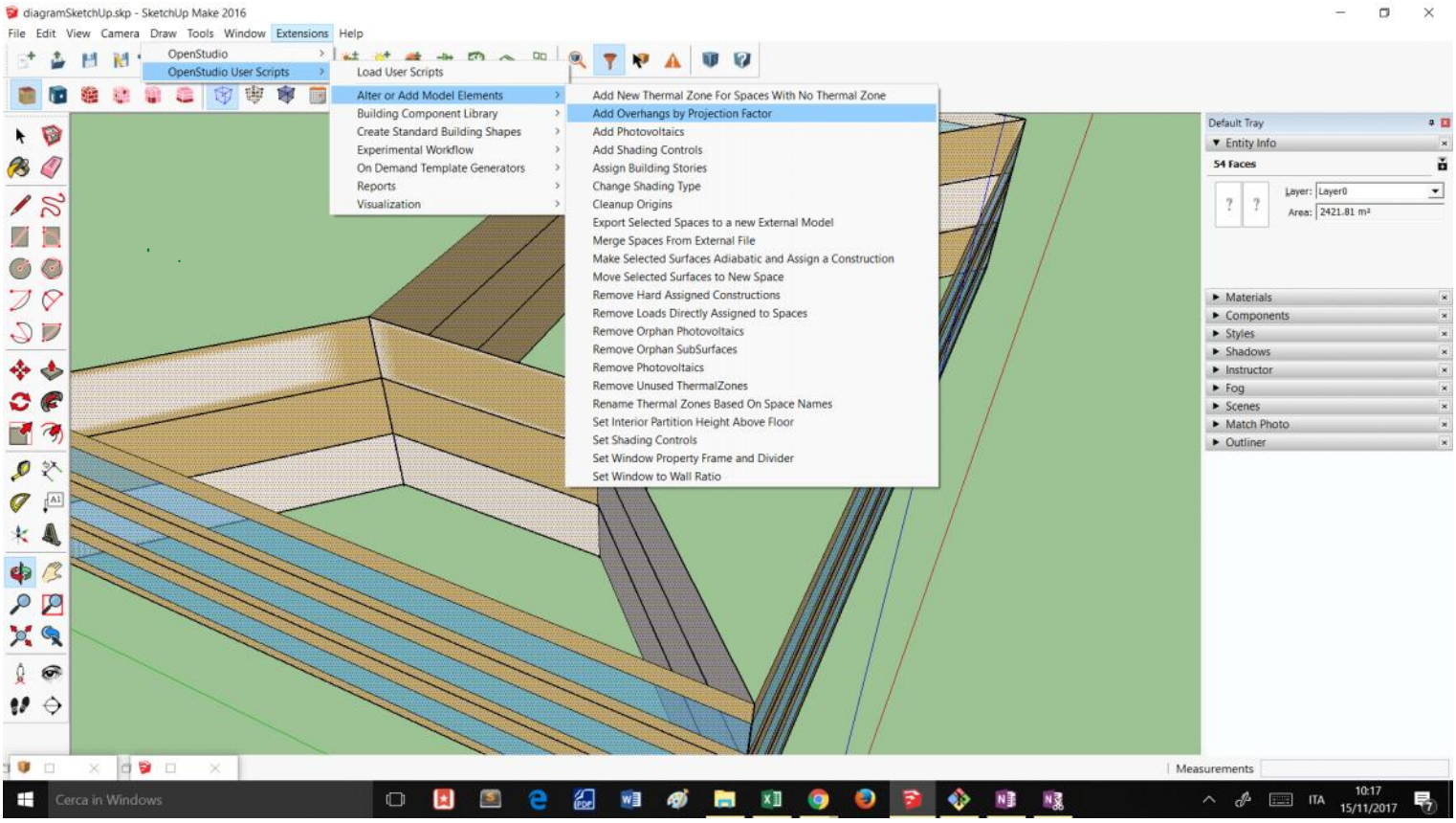


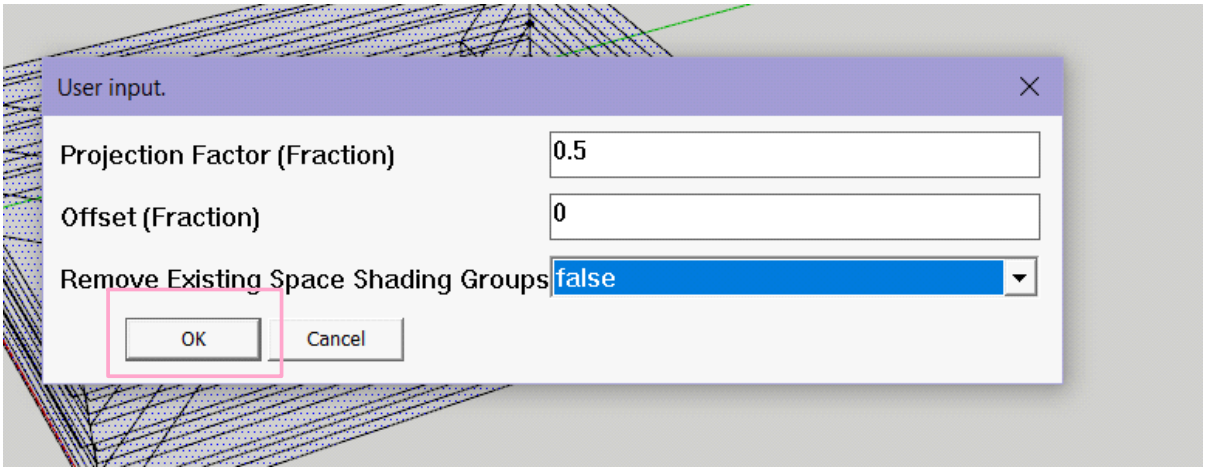
Choose all of the surfaces except the north:





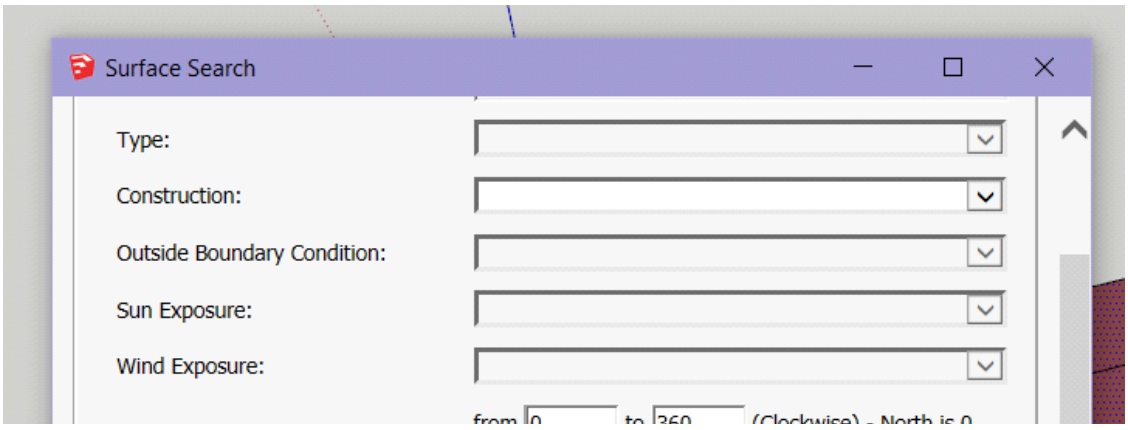
Now that we have selected our desired surfaces , we can add overhang (external shading)
We choose where we want to put the shading on

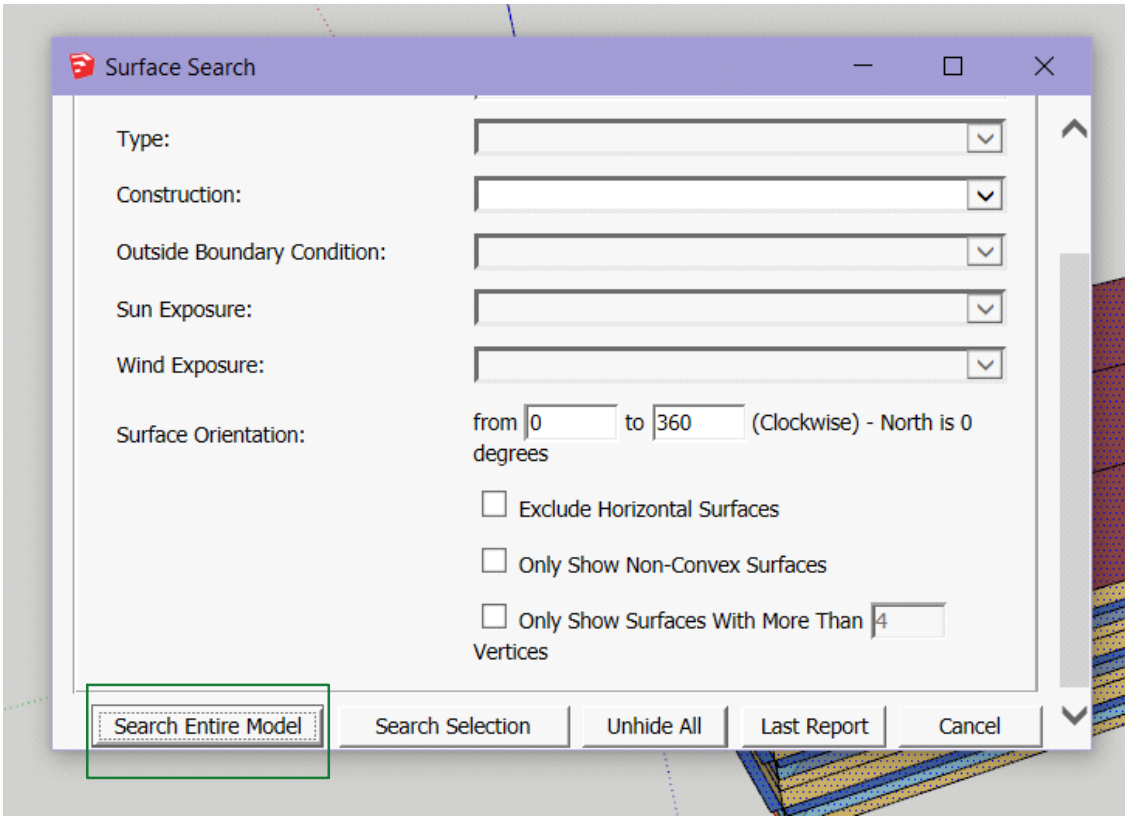


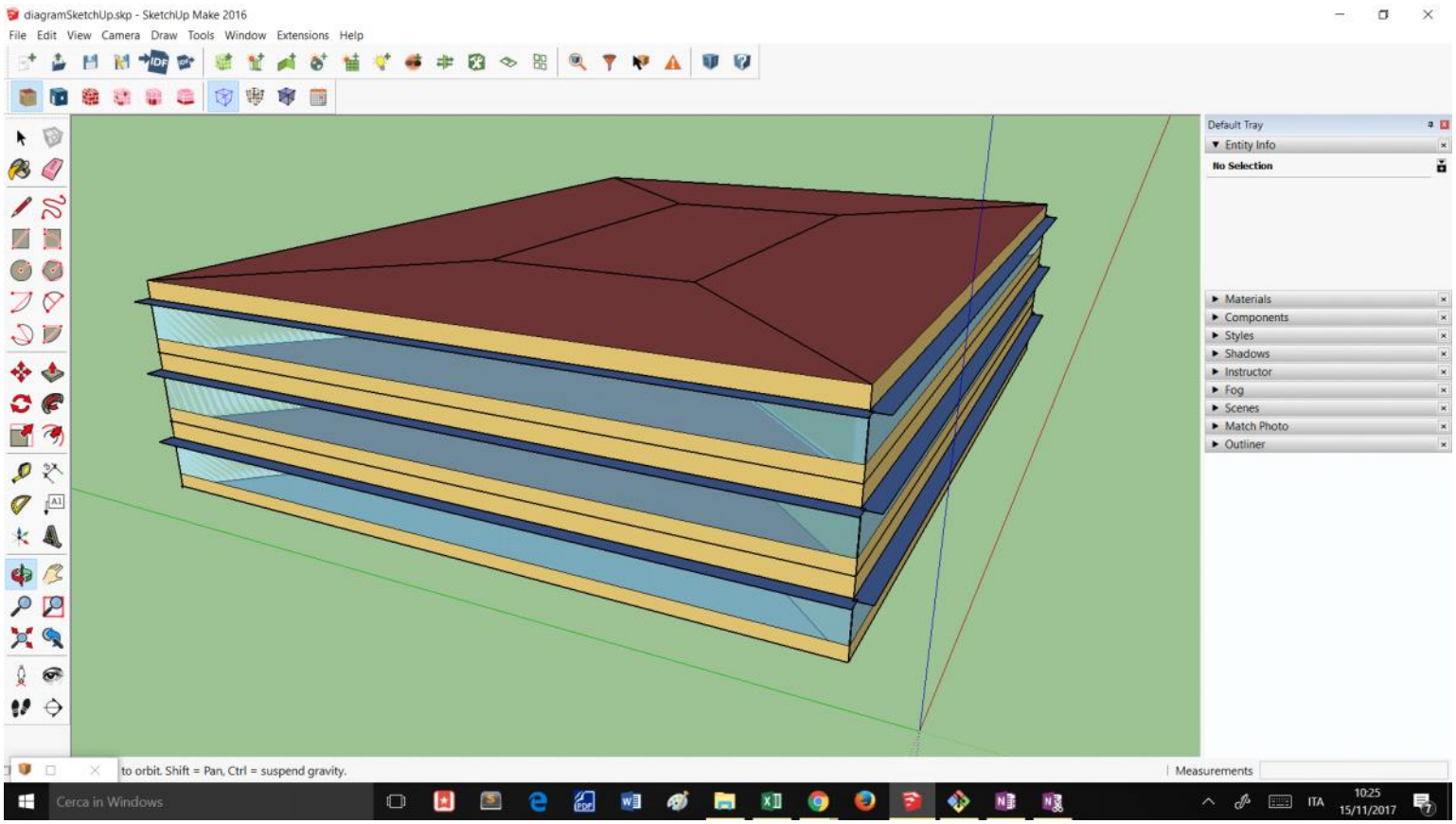


Then you should choose 0-360 surfaces so that you would go back to the previous selection

Choose the whole model → Choose surface matching → match the entire model → ok

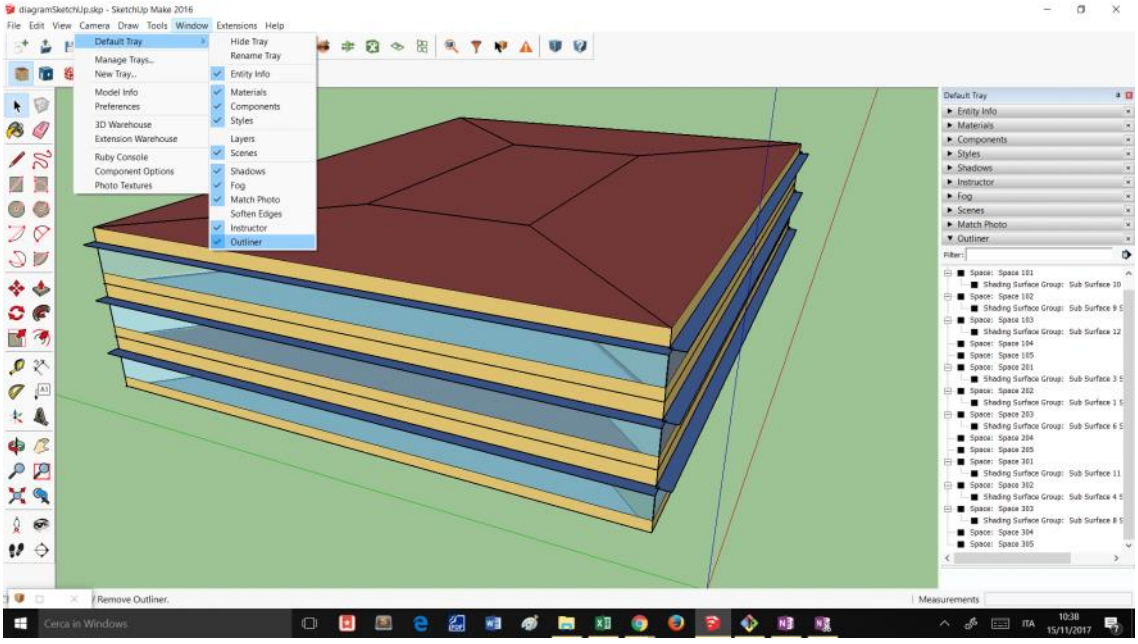



Surface Search
Type:
Construction:
Outside Boundary Condition:
Sun Exposure:
Wind Exposure:
Surface Orientation:
from 0 to 360 (Clockwise) - North is 0 degrees
Exclude Horizontal Surfaces
Only Show Non-Convex Surfaces
Only Show Surfaces With More Than 4 Vertices
Search Entire Model
Search Selection
Unhide All
Last Report
Cancel

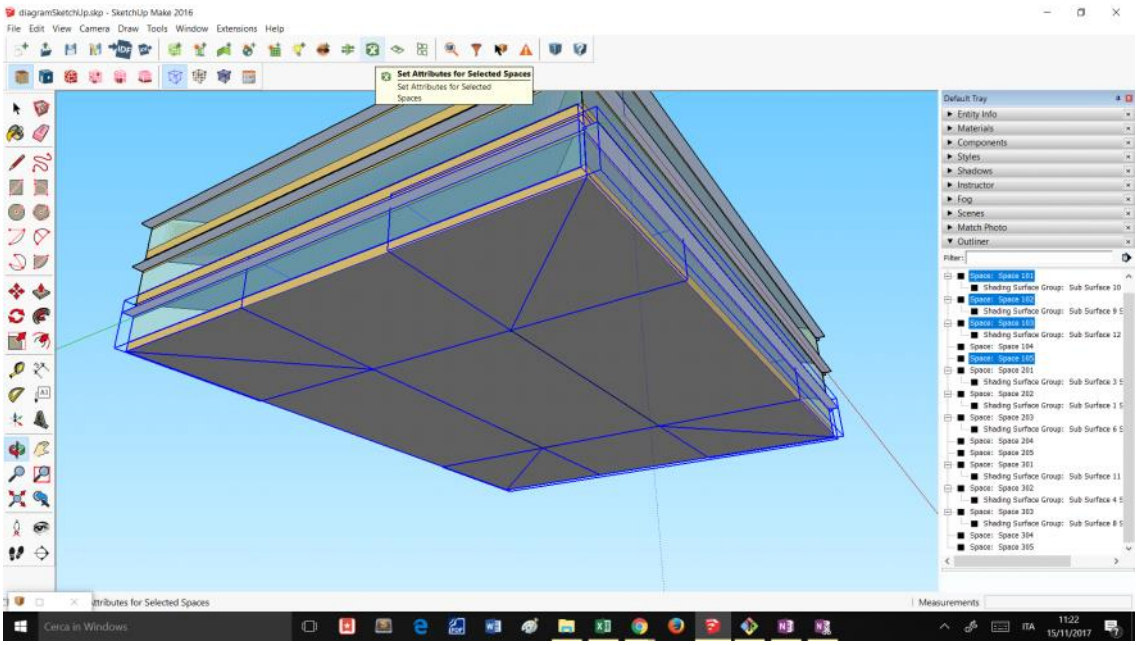

diagramSketchUp.skp - SketchUp Make 2016
File Edit View Camera Draw Tools Window Extensions Help
Default Tray
Entity Info
No Selection
Materials
Components
Styles
Shadows
Instructor
Fog
Scenes
Match Photo
Outliner
to orbit. Shift = Pan, Ctrl = suspend gravity.
Measurements
Cerca in Windows
ITA
10:25
15/11/2017

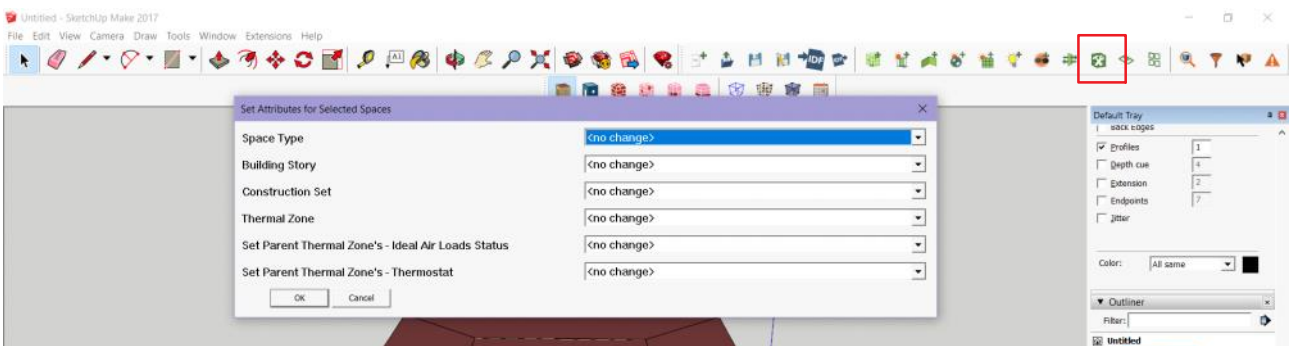
In order to add thermal zones :

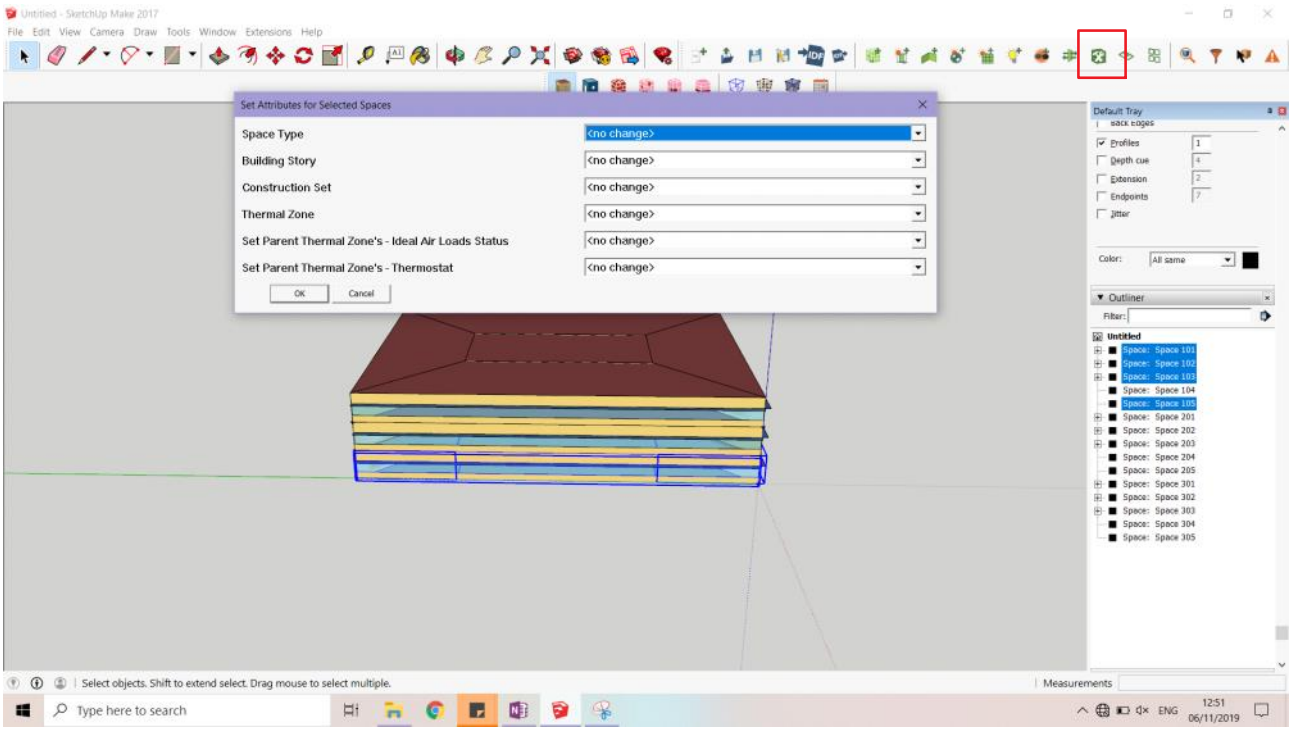
To perform this step you will need to have outliner in your tray:
And choose 101 102 103 105

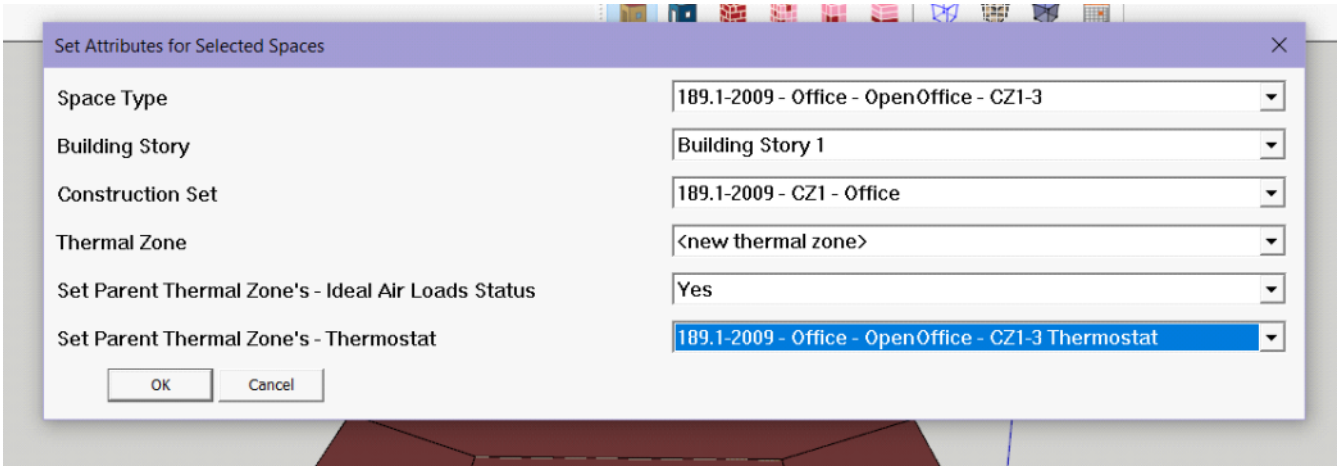


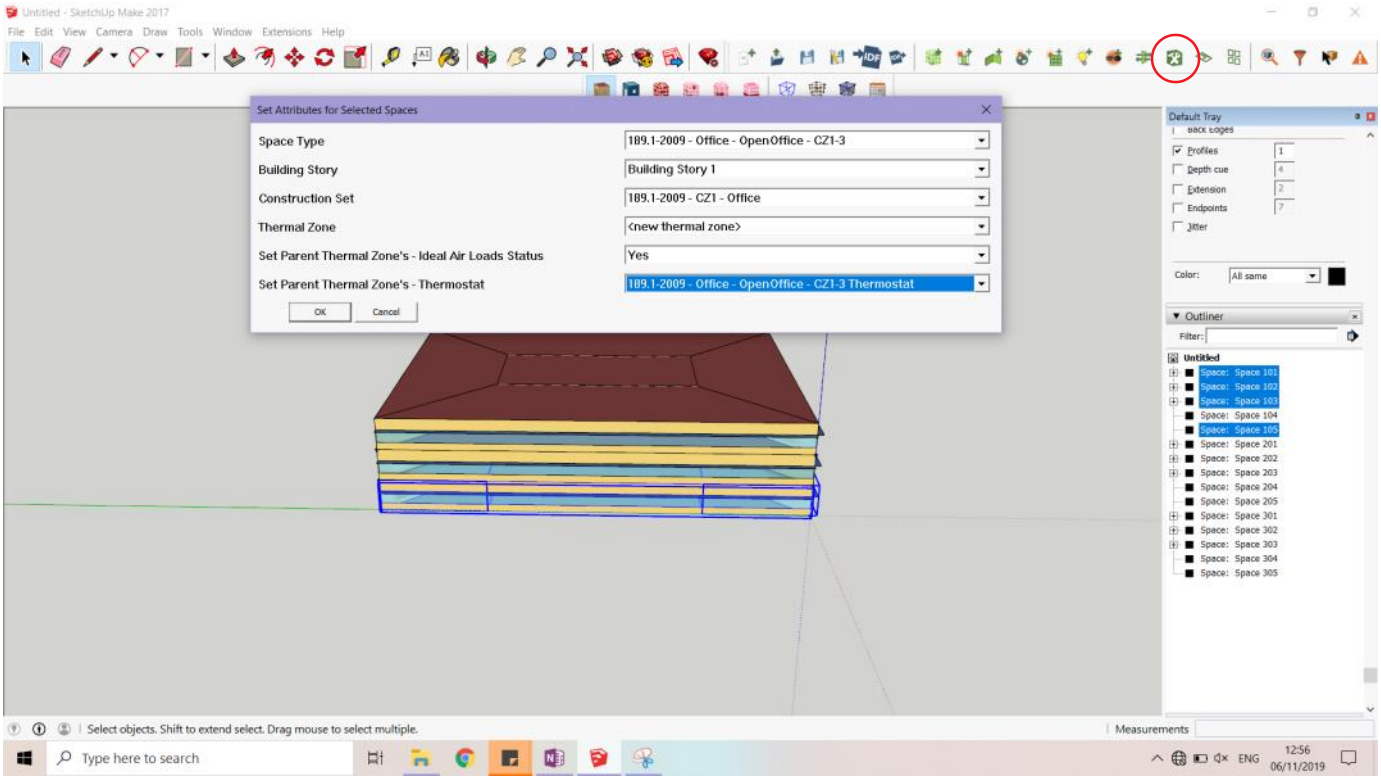
choose the spaces of each thermal zone and we add specifications:



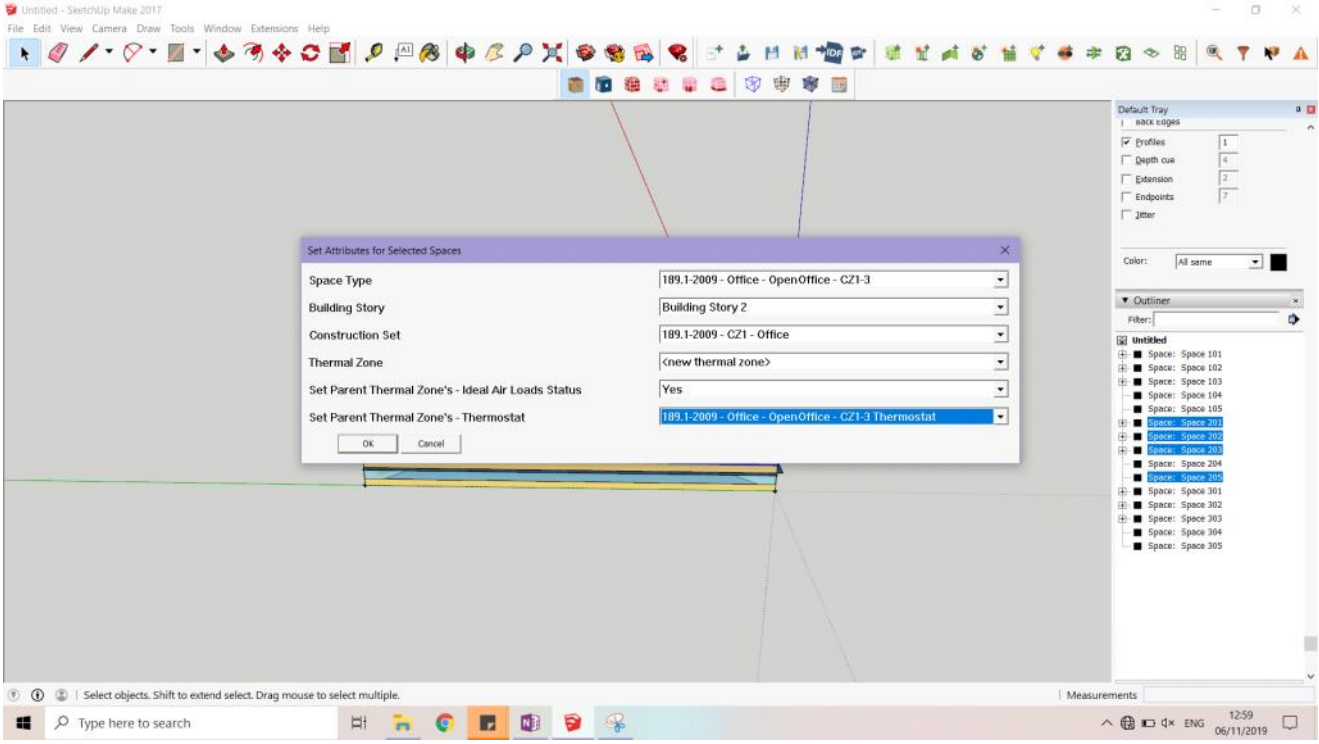



Set Attributes for Selected Spaces
Space Type
<no change>
Building Story
<no change>
Construction Set
<no change>
Thermal Zone
<no change>
Set Parent Thermal Zone's - Ideal Air Loads Status
<no change>
Set Parent Thermal Zone's - Thermostat
<no change>
OK
Cancel
Select objects. Shift to extend select. Drag mouse to select multiple.
Measurements
Type here to search

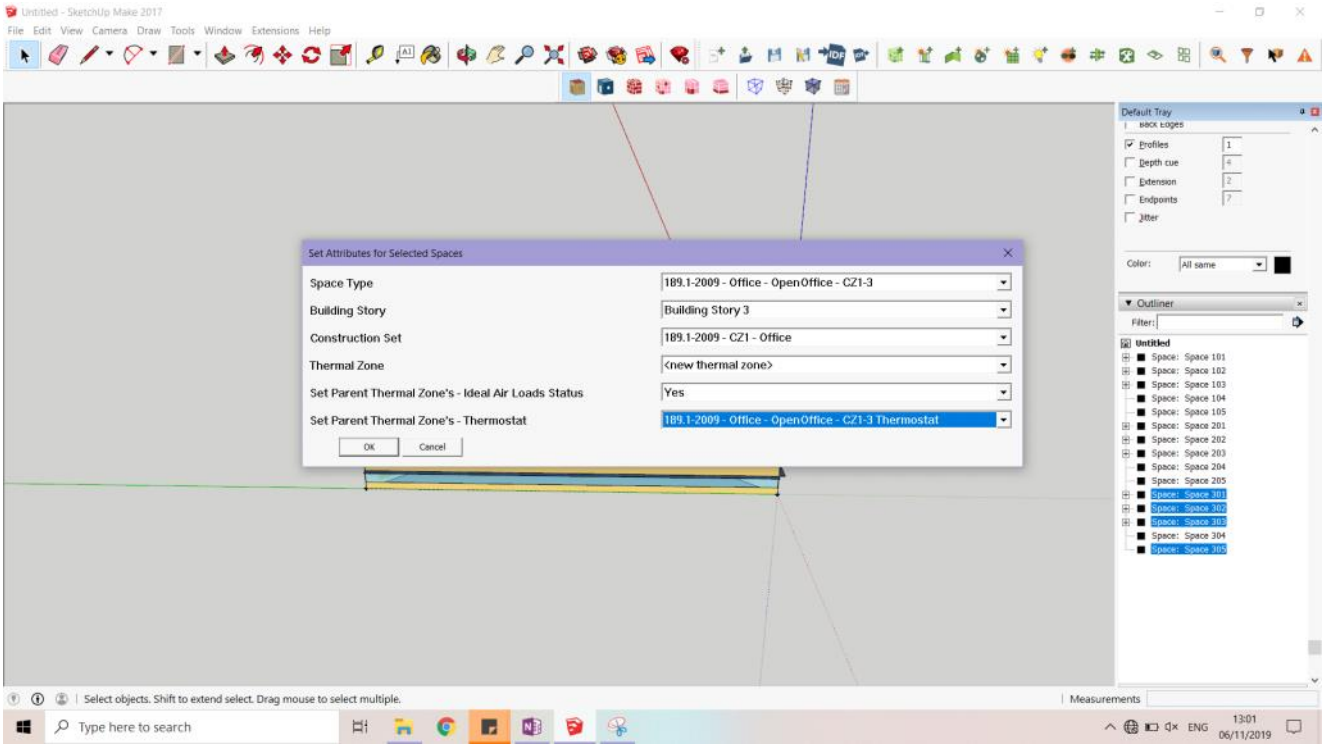

Set Attributes for Selected Spaces
Space Type
189.1-2009 - Office - OpenOffice - CZ1-3
Building Story
Building Story 1
Construction Set
189.1-2009 - CZ1 - Office
Thermal Zone
<new thermal zone>
Set Parent Thermal Zone's - Ideal Air Loads Status
Yes
Set Parent Thermal Zone's - Thermostat
189.1-2009 - Office - OpenOffice - CZ1-3 Thermostat
OK
Cancel

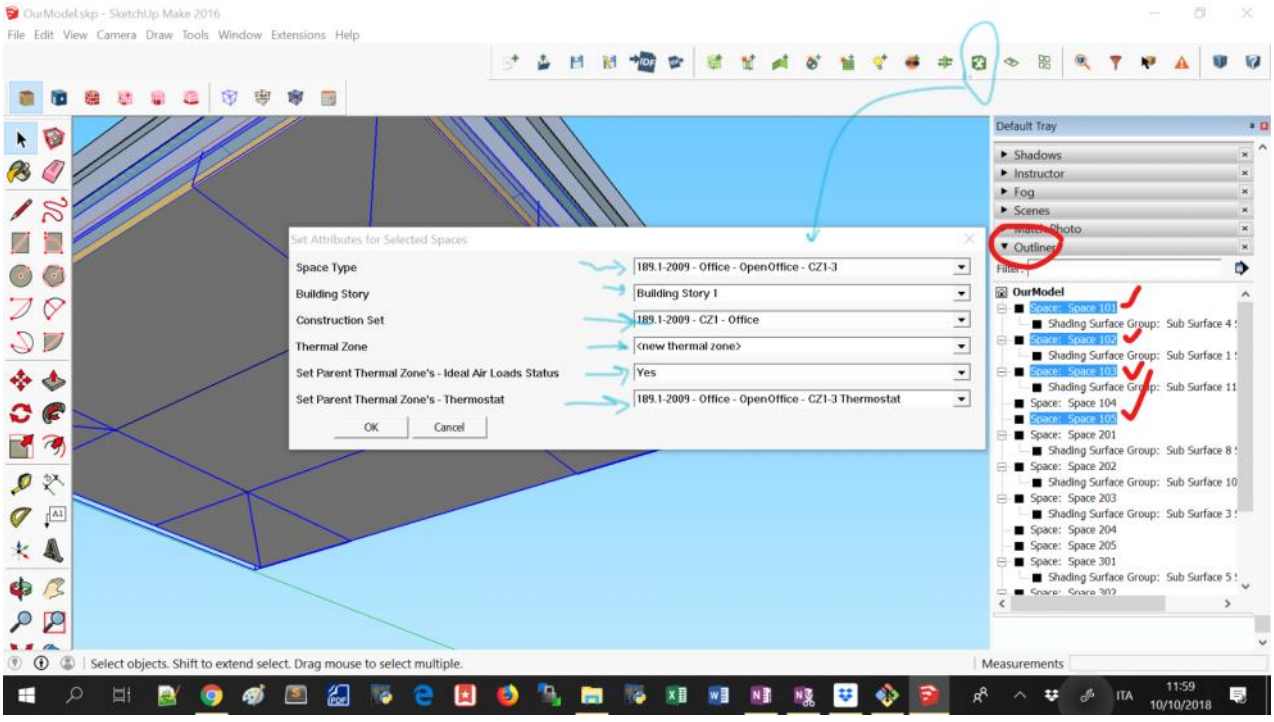


This is just for the first floor. We need to do the same for each floor.
201 202 203 205



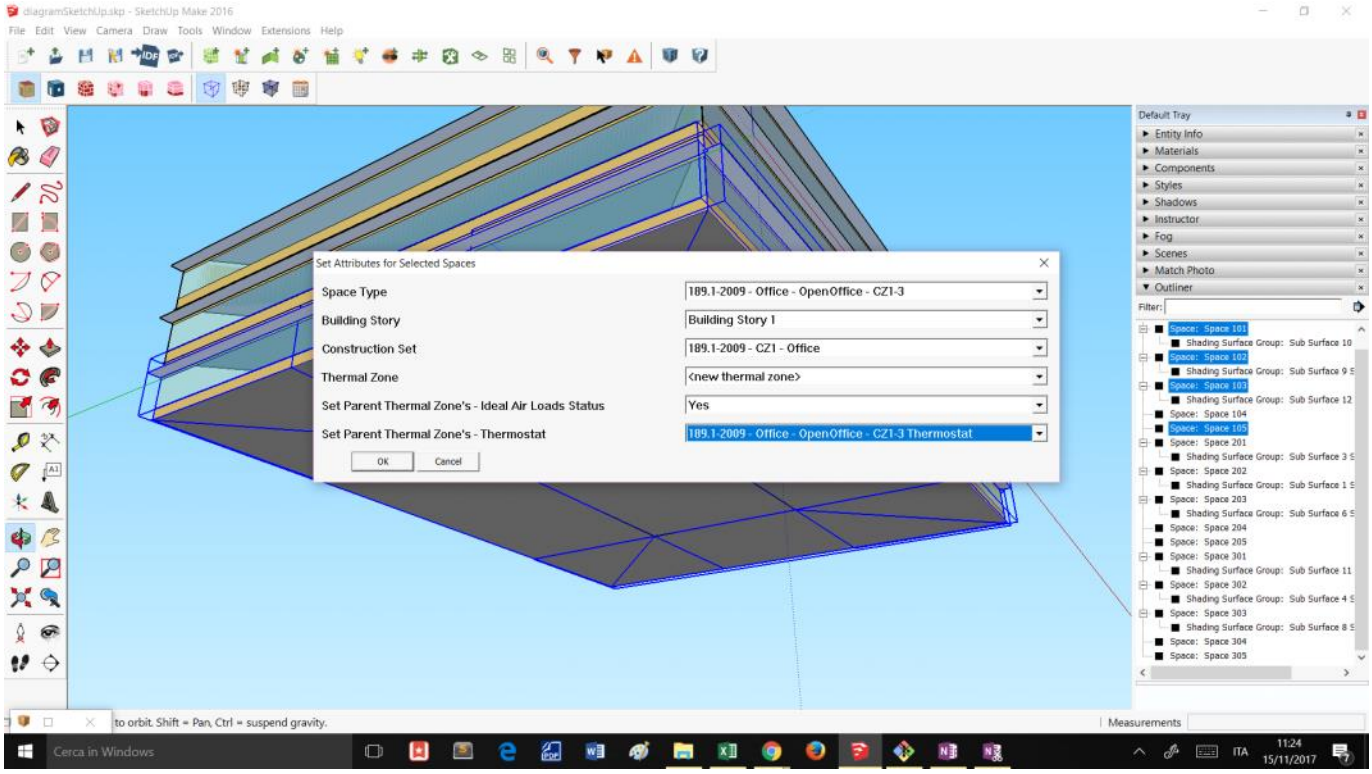
This is just for the first floor. We need to do the same for each floor.
301 302 303 305


Set Attributes for Selected Spaces
Space Type
189.1-2009 - Office - OpenOffice - CZ1-3
Building Story
Building Story 3
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
Default Tray
Outliner
Select objects. Shift to extend select. Drag mouse to select multiple.
Measurements

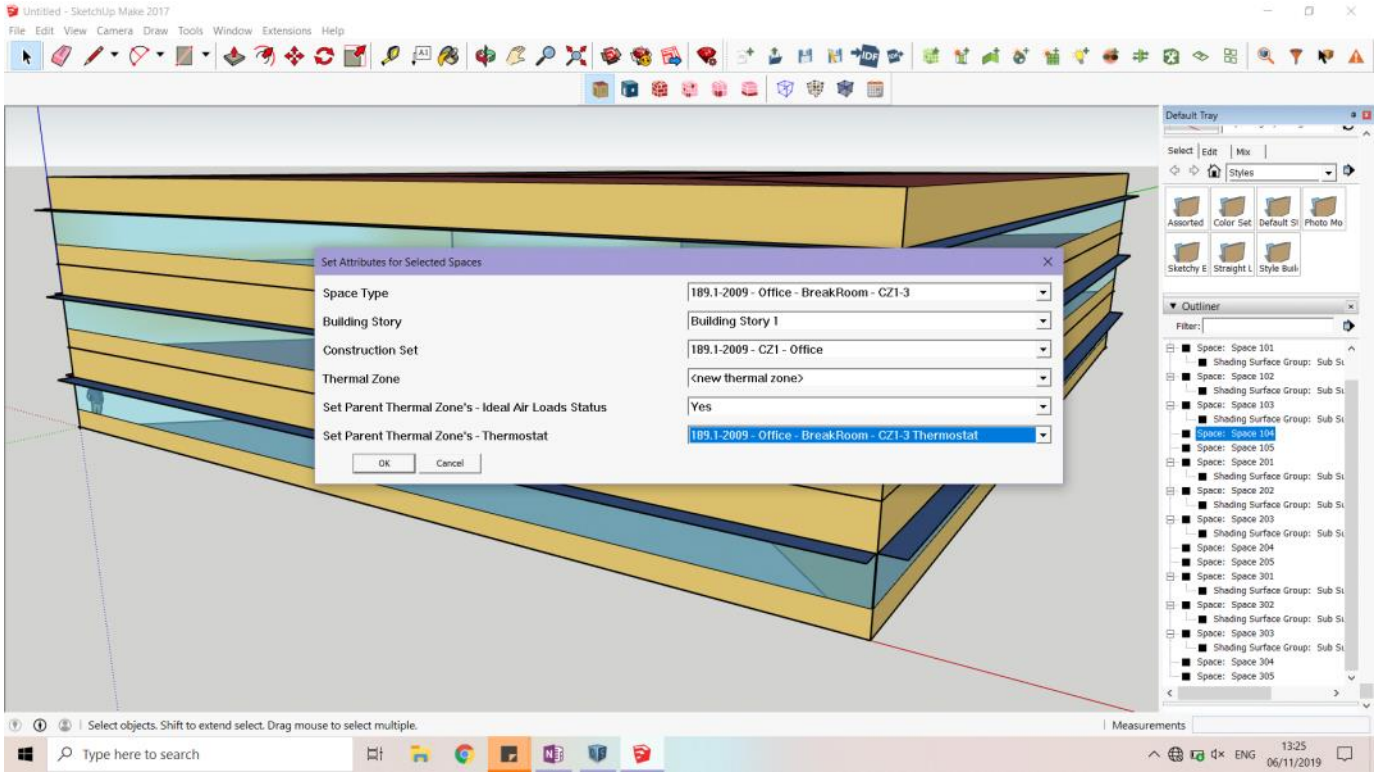

Set Attributes for Selected Spaces
Space Type
189.1-2009 - Office - OpenOffice - CZ1-3
Building Story
Building Story 1
Construction Set
189.1-2009 - CZ1 - Office
Thermal Zone
<new thermal zone>
Set Parent Thermal Zone's - Ideal Air Loads Status
Yes
Set Parent Thermal Zone's - Thermostat
189.1-2009 - Office - OpenOffice - CZ1-3 Thermostat
OK
Cancel
Default Tray
Outliner
OurModel
Select objects. Shift to extend select. Drag mouse to select multiple.
Measurements

1

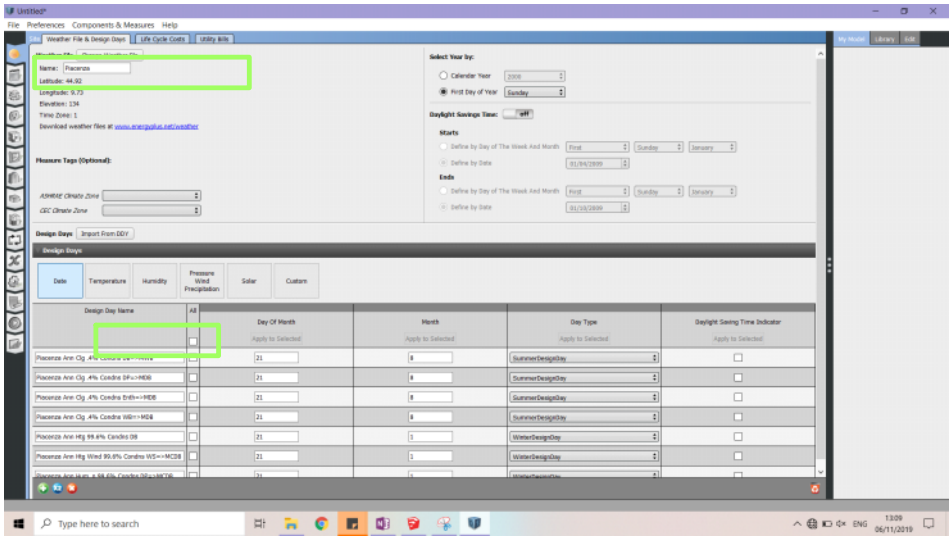
After choosing the mentioned button:

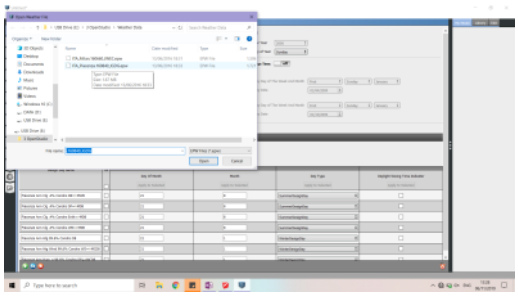


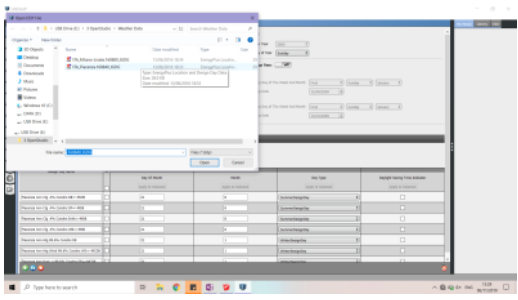
For each floor 104 204 304



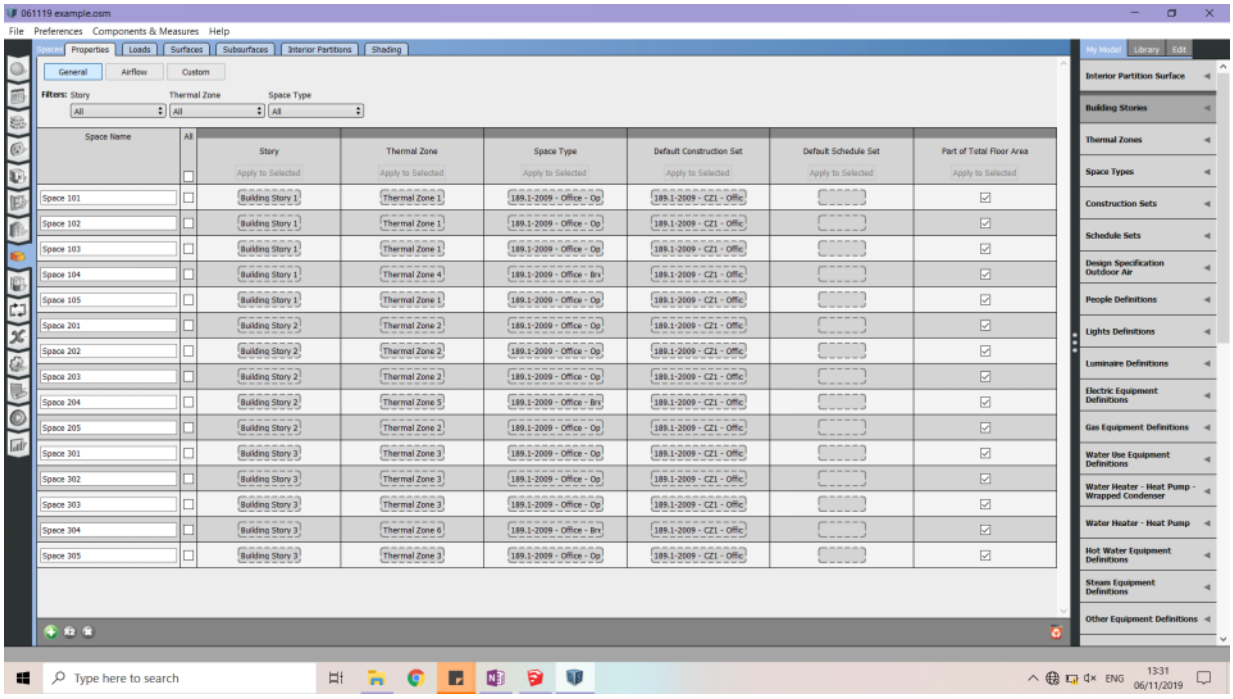
First you will need to launch Openstudio using sketchUpNext you will need to add the weather Data



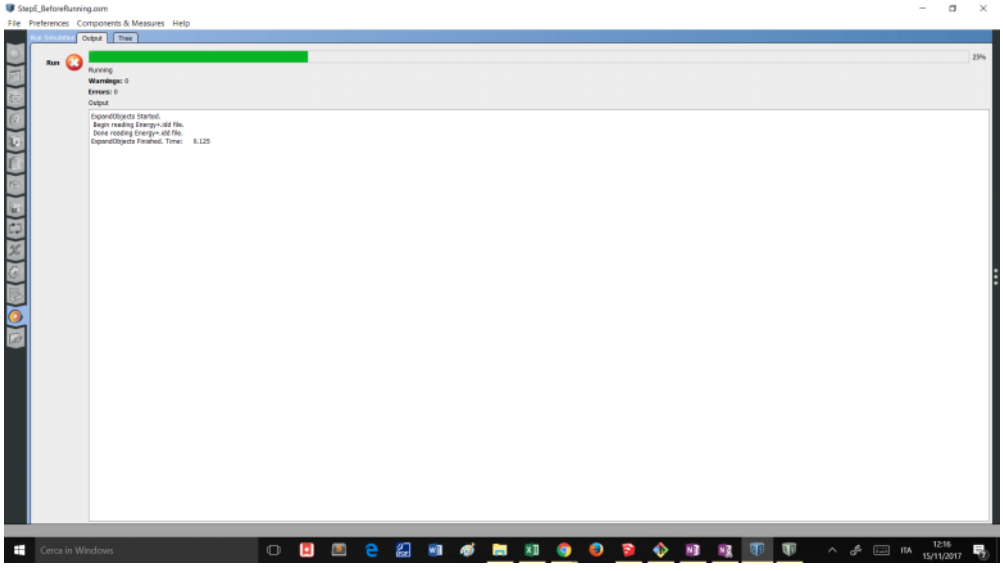




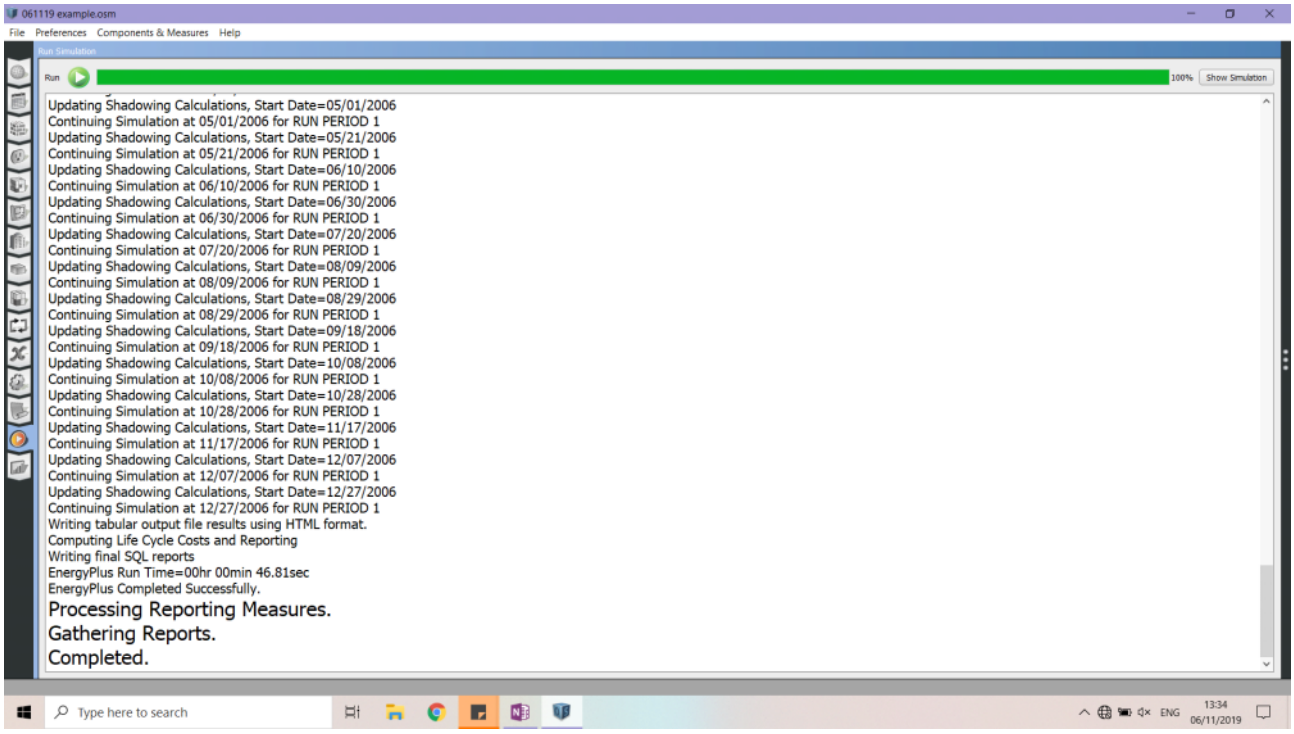
Close the skp file. And open open studio
Load the weather diagrams of piacenza.
When open op select file →open file (the skp file) and then discard and load again the weather data.



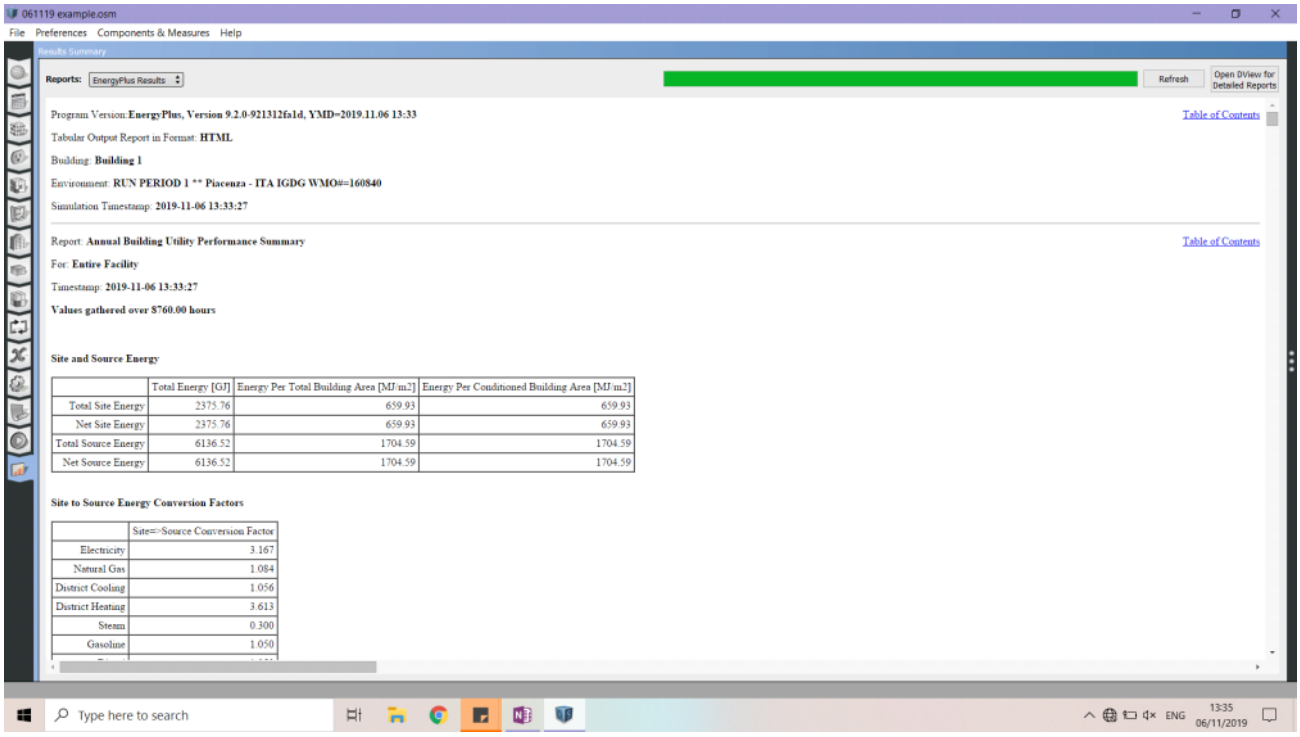
Next you simply run the model:



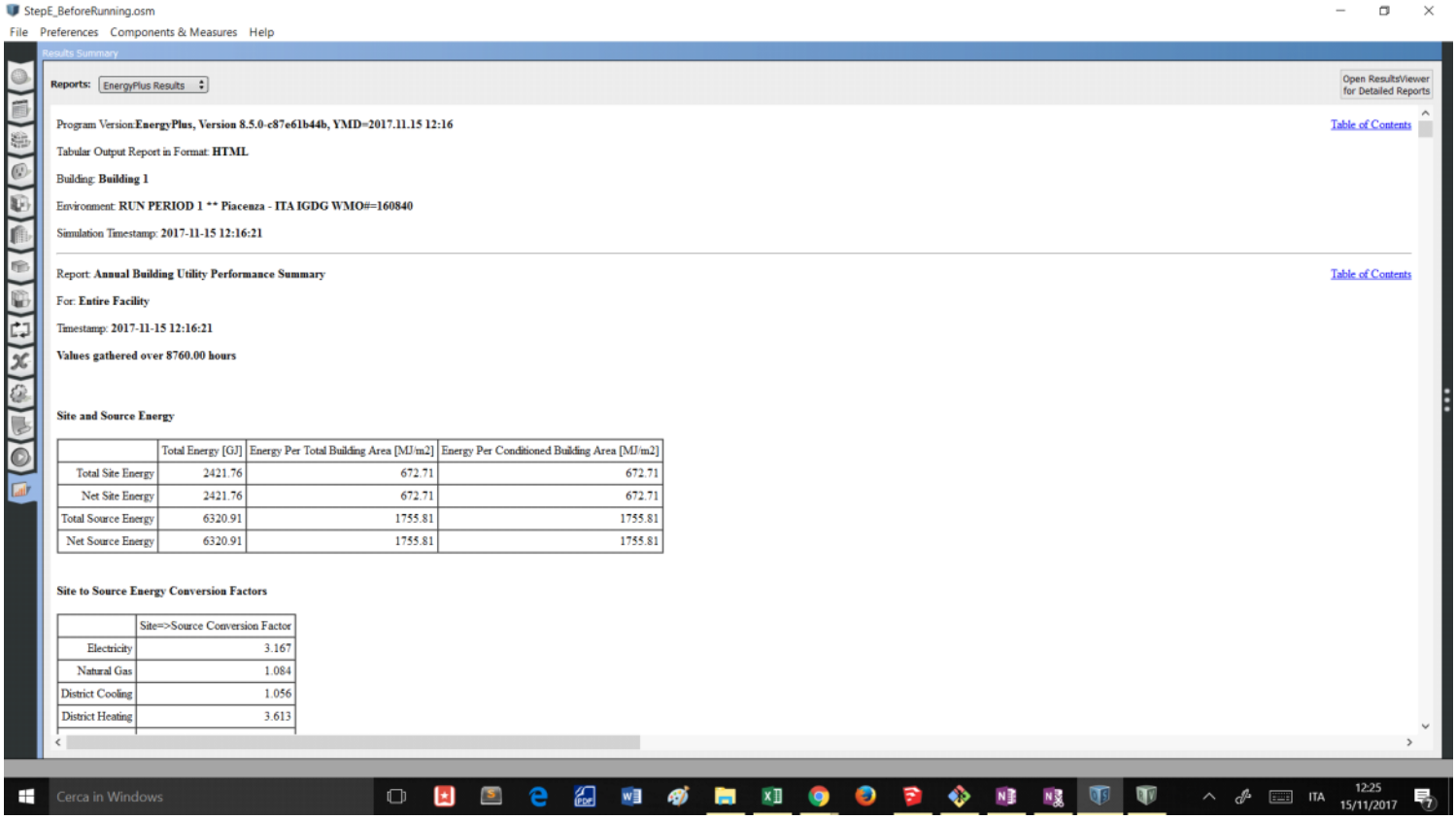
To see the results of the weather data:



After the simulation has finish go to results summery.



Finally you can review your results in the last tab


StepE_BeforeRunning.osm
File Preferences Components & Measures Help
Results Summary
Reports: EnergyPlus Results
Open ResultsViewer for Detailed Reports
Program Version:EnergyPlus, Version 8.5.0-c87e61b44b, YMD=2017.11.15 12:16
Table of Contents
Tabular Output Report in Format: HTML
Building: Building 1
Environment: RUN PERIOD 1 ** Piacenza - ITA IGDG WMO#=160840
Simulation Timestamp: 2017-11-15 12:16:21
Report: Annual Building Utility Performance Summary
Table of Contents
For: Entire Facility
Timestamp: 2017-11-15 12:16:21
Values gathered over 8760.00 hours
Site and Source Energy
Total Energy [GJ] | Energy Per Total Building Area [MJ/m2] | Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy | 2421.76 | 672.71 | 672.71
Net Site Energy | 2421.76 | 672.71 | 672.71
Total Source Energy | 6320.91 | 1755.81 | 1755.81
Net Source Energy | 6320.91 | 1755.81 | 1755.81
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
Cerca in Windows
ITA
12:25
15/11/2017