Week6 Assignment

Task1：

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?

Answer:

$$\dot{q}_{12}=\frac{\dot{Q}_{12}}{A}=\frac{A\sigma\left(T_1^4-T_2^4\right)}{\frac{1}{\varepsilon_1}+\frac{1}{\varepsilon_2}-1}\div A=\frac{5.67\times10^{-8}\times\left(800^4-500^4\right)}{\frac{1}{0.2}+\frac{1}{0.7}-1}\approx 3625.3491\mathrm{W}$$

$$\dot{q}'_{12shield}=\frac{\dot{Q}_{12shield}}{A}$$

$$=\frac{A\sigma\left(T_1^4-T_2^4\right)}{\left(\frac{1}{\varepsilon_1}+\frac{1}{\varepsilon_2}-1\right)\left(\frac{1}{\varepsilon_{3.1}}+\frac{1}{\varepsilon_{3.2}}-1\right)\cdots\left(\frac{1}{\varepsilon_{n.1}}+\frac{1}{\varepsilon_{n.2}}-1\right)}\div A$$

$$=\frac{\sigma\left(T_1^4-T_2^4\right)}{\left(\frac{1}{\varepsilon_1}+\frac{1}{\varepsilon_2}-1\right)\left(\frac{1}{\varepsilon_{3.1}}+\frac{1}{\varepsilon_{3.2}}-1\right)\cdots\left(\frac{1}{\varepsilon_{n.1}}+\frac{1}{\varepsilon_{n.2}}-1\right)}$$

$$\varepsilon_1=\varepsilon_2=\varepsilon_3=\cdots=\varepsilon_{n-1}=\varepsilon_n=0.1$$

$$\dot{q}'_{12shield}=\frac{\sigma\left(T_1^4-T_2^4\right)}{\left(\frac{1}{\varepsilon_1}+\frac{1}{\varepsilon_2}-1\right)\left(\frac{1}{\varepsilon_{3.1}}+\frac{1}{\varepsilon_{3.2}}-1\right)\cdots\left(\frac{1}{\varepsilon_{n.1}}+\frac{1}{\varepsilon_{n.2}}-1\right)}$$

$$=\frac{\sigma\left(T_1^4-T_2^4\right)}{(n+1)\left(\frac{1}{0.1}+\frac{1}{0.1}-1\right)}=\frac{1}{100}\times\frac{\sigma\left(T_1^4-T_2^4\right)}{\left(\frac{1}{0.2}+\frac{1}{0.7}-1\right)}$$

$$\rightarrow n=28$$

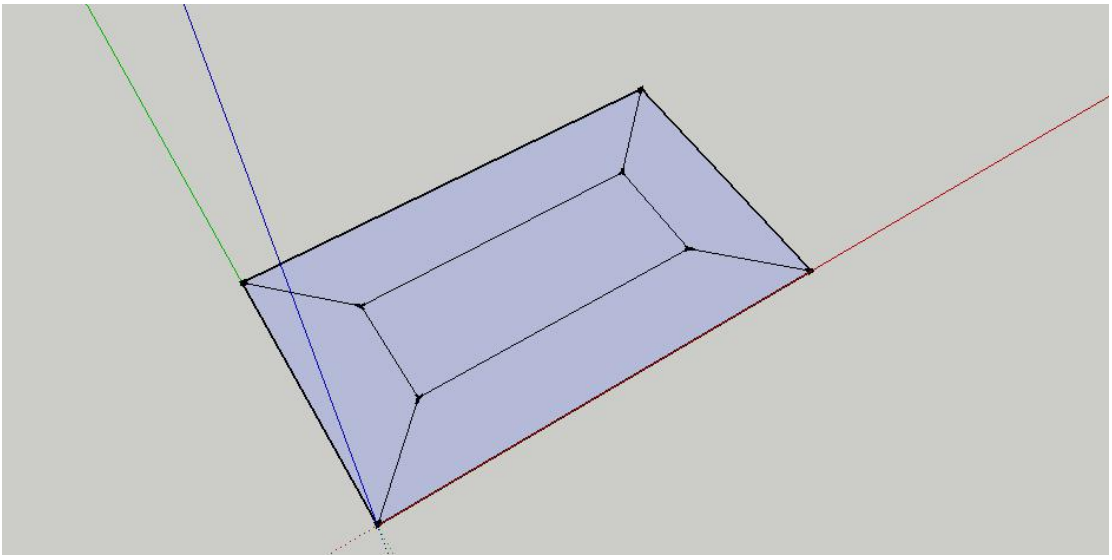
So we need 28 shields with epsilon=0.1 in order to have the new heat transfer rate to be 1% of the case without shields.

Task2：

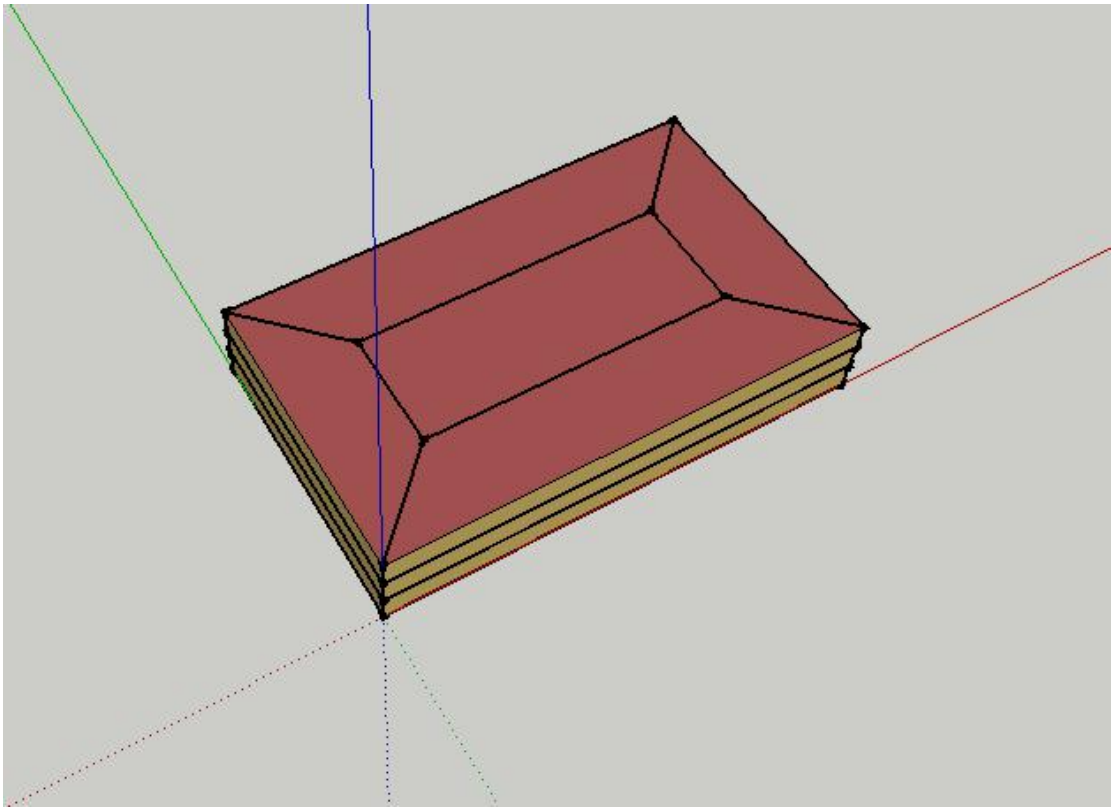
You should create a pdf file with screenshots of all the steps we went through (clearly from your own file) and explain briefly the reason behind the use of each step (in your own words)

Answer:

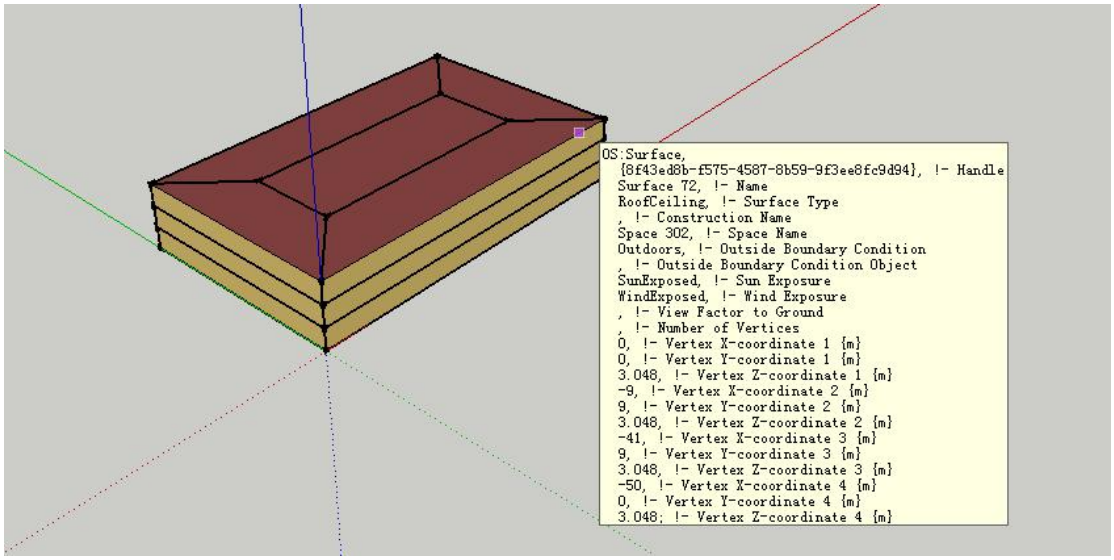
1. At first, draw the outline and shape of the building in Sketchup.



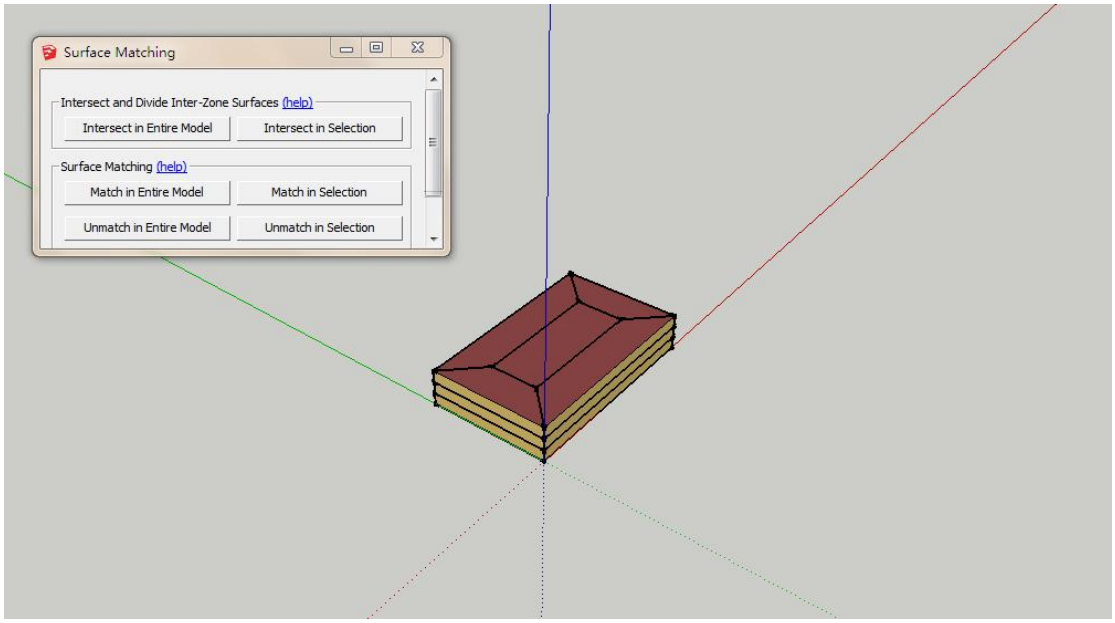
2. Use the command “Creat spaces from diagram” to creat a three floors building.



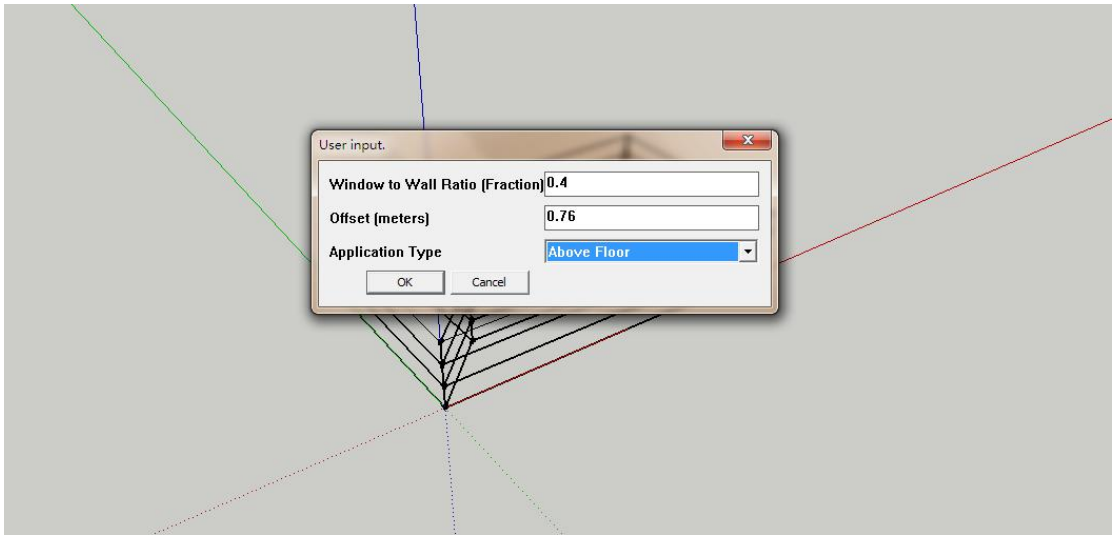
3. By using the command “Info tool”, you can see the material information about the building.



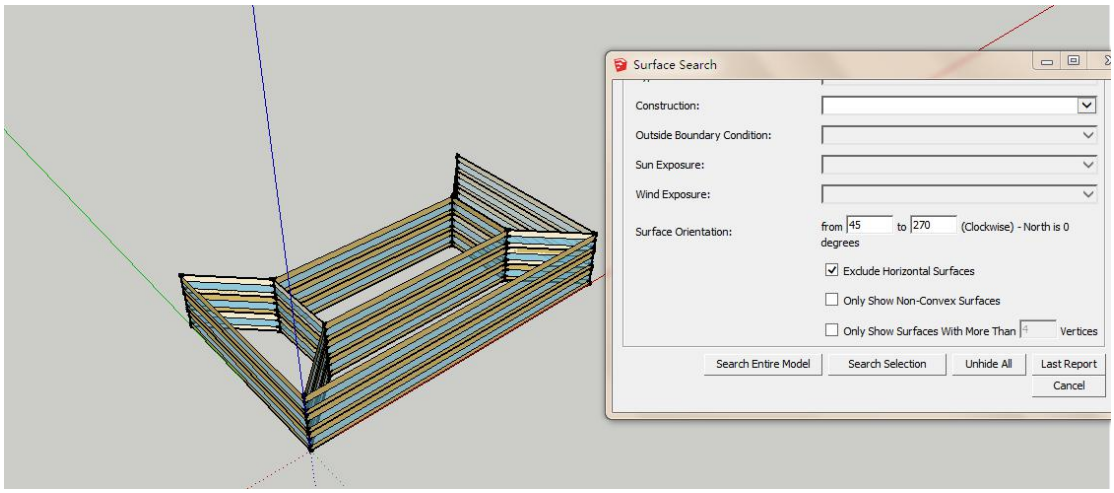
4. Then click the command “Surface matching”.



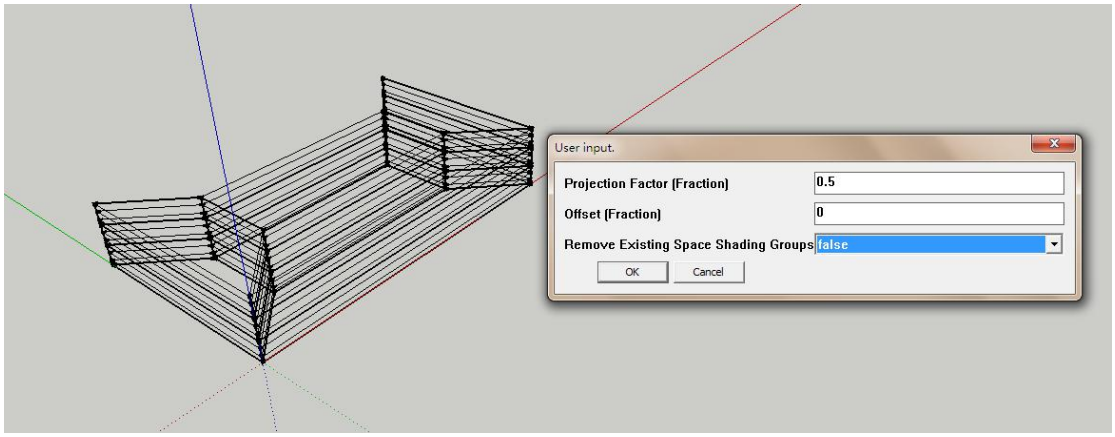
5. Find “User input” and build windows by using “Windows to Wall Ratio “.

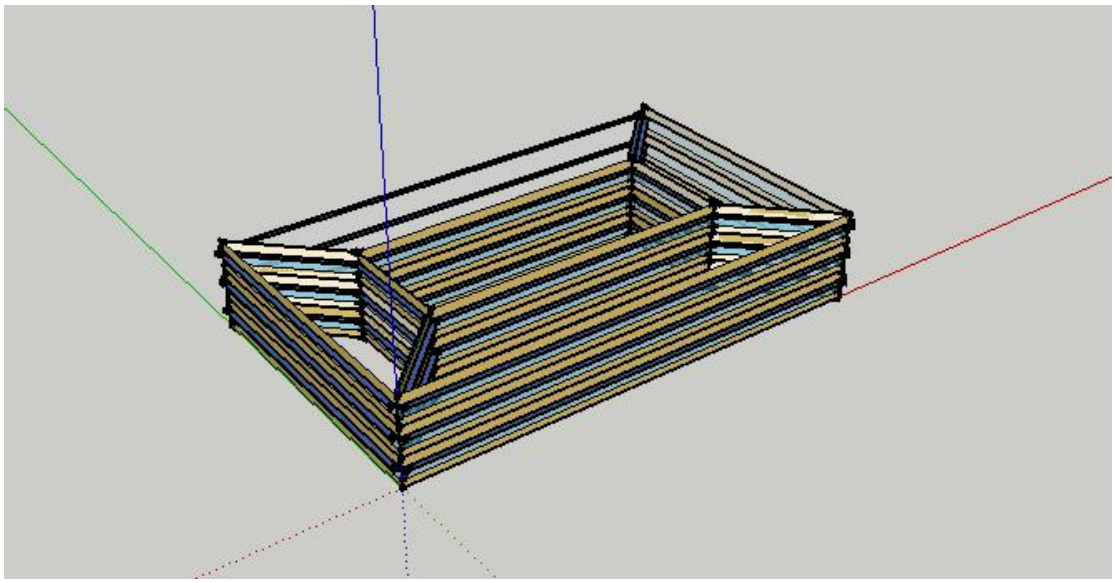


6. Find “Surface search”, you can use Surface Orientation to build the windows on other side.

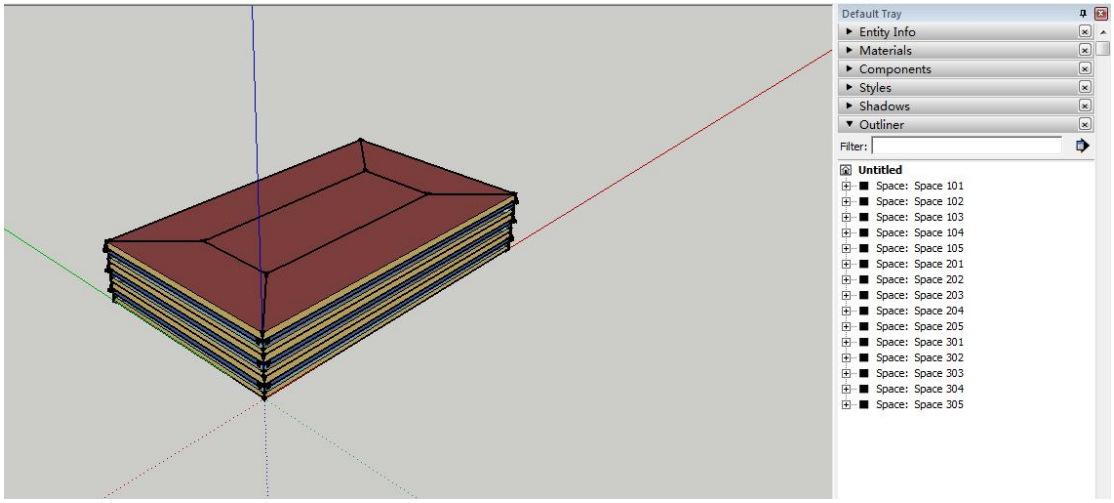


7. Next step is make overhangs by using “ Projection Factor” .

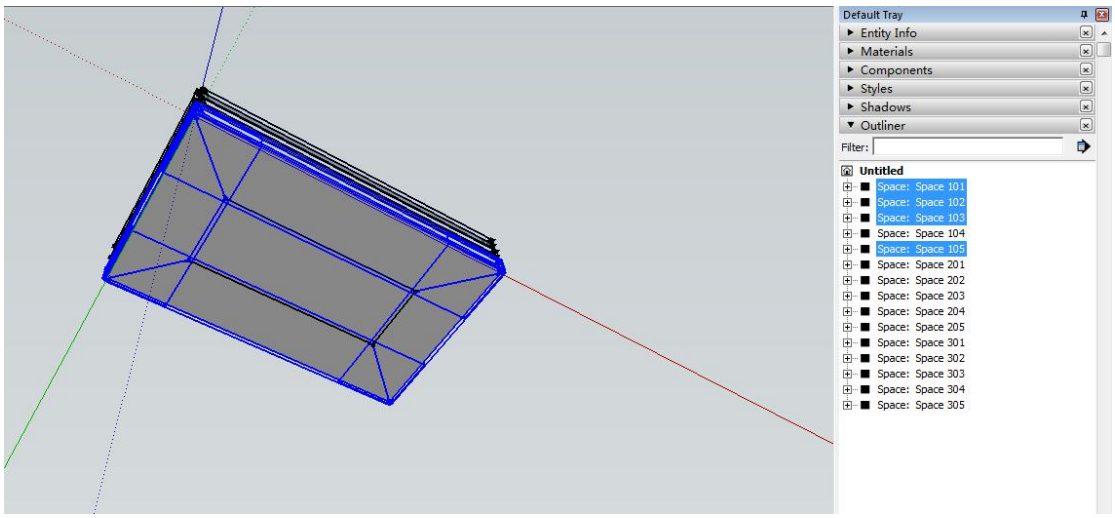




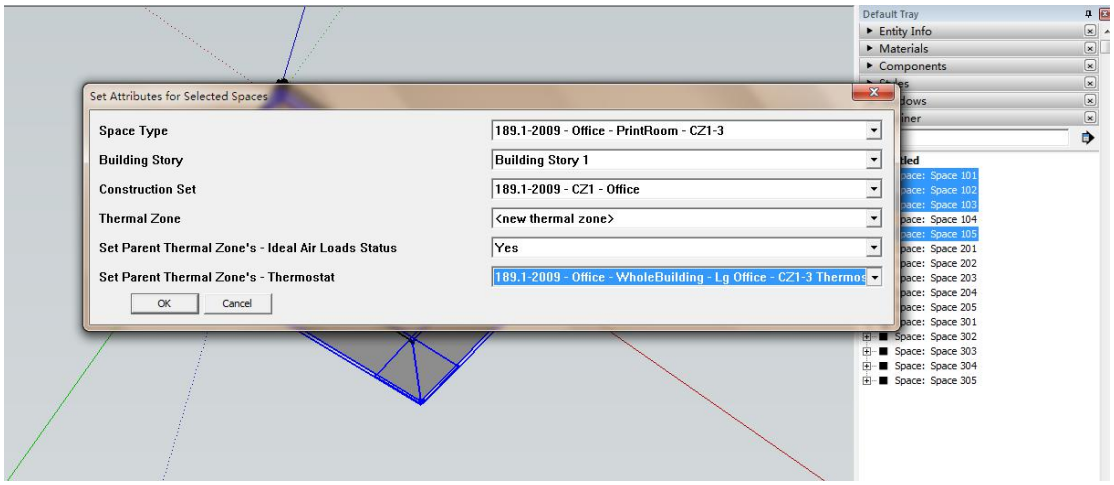
8. Open“Default Tray”.

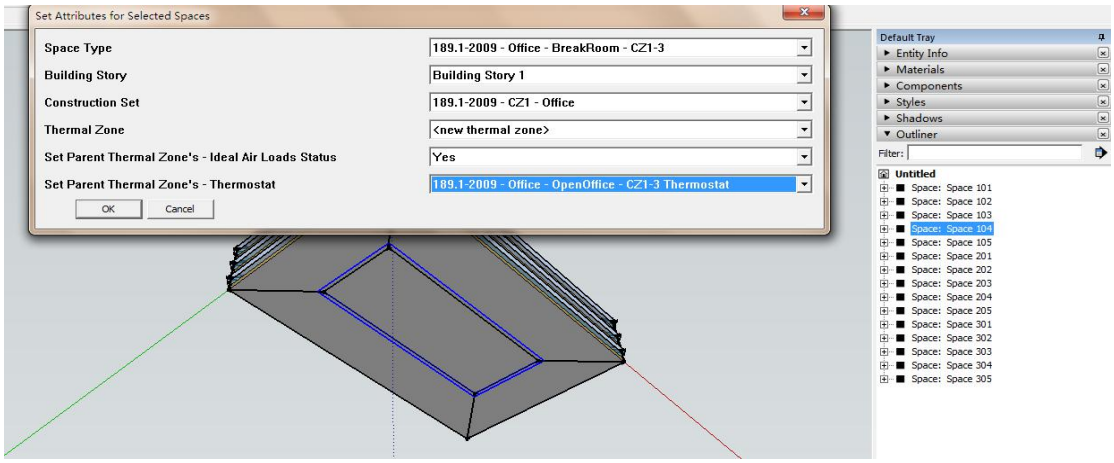


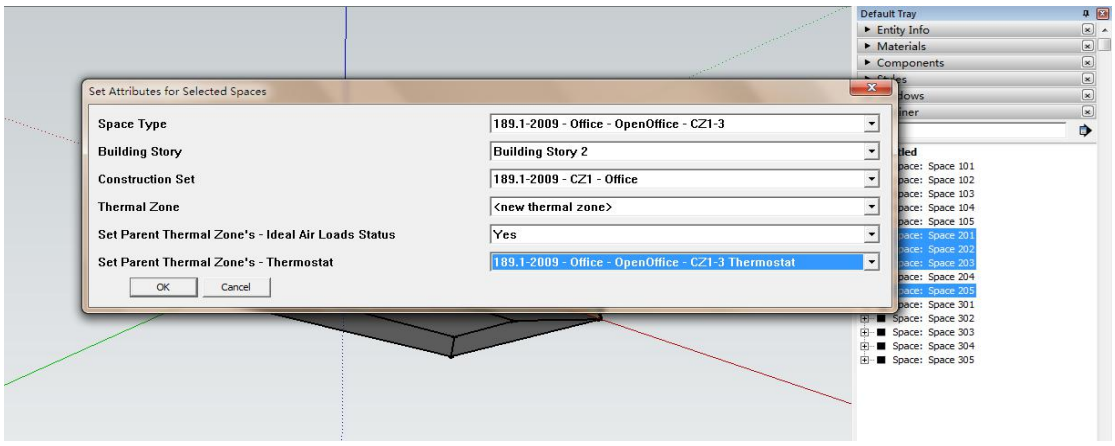
9. Choose the space of each thermal zone .

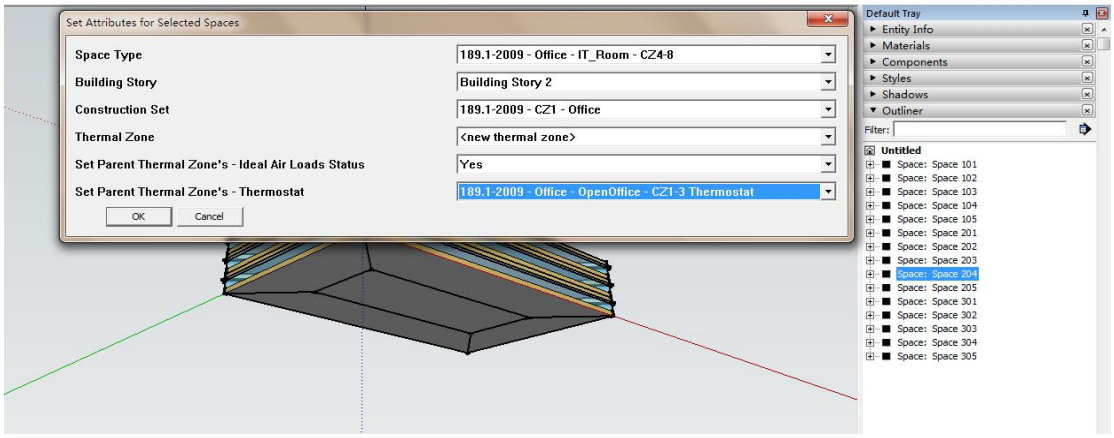


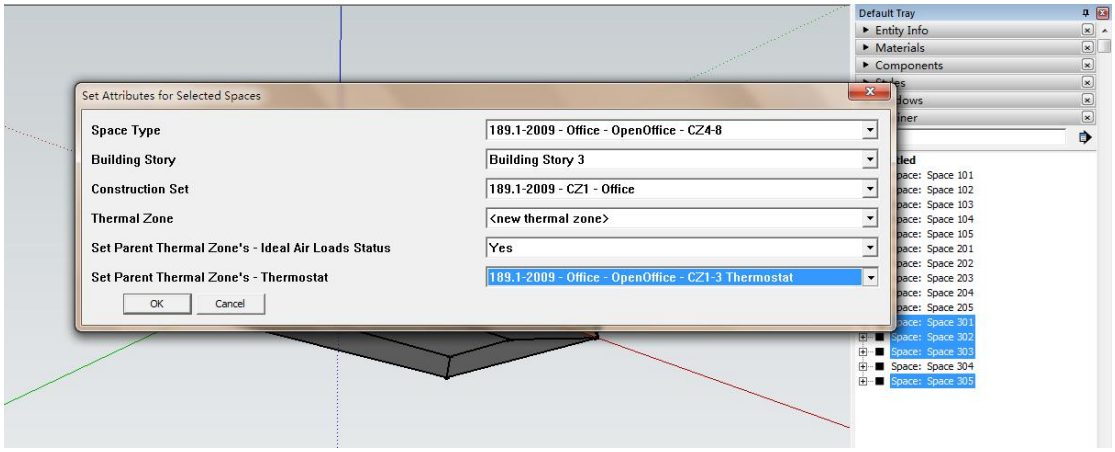
10. Using " Set Attributes for Selected Spaces" to set parent thermal zone's thermostat.

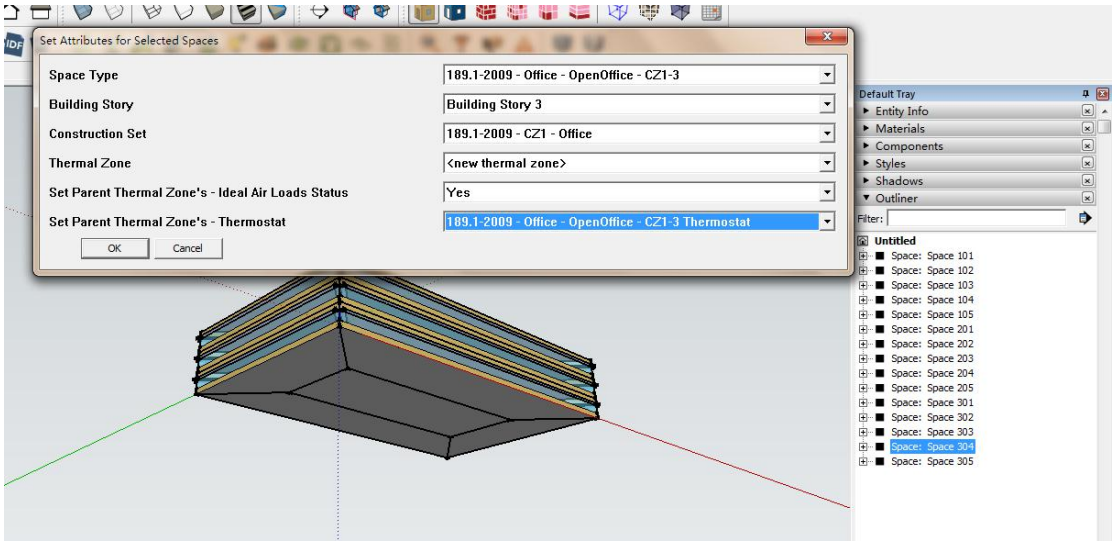



Set Attributes for Selected Spaces
Space Type
189.1-2009 - Office - BreakRoom - CZ1-3
Building Story
Building Story 1
Construction Set
189.1-2009 - CZ1 - Office
Thermal Zone
<new thermal zone>
Set Parent Thermal Zone's - Ideal Air Loads Status
Yes
Set Parent Thermal Zone's - Thermostat
189.1-2009 - Office - OpenOffice - CZ1-3 Thermostat
OK
Cancel
Default Tray
Entity Info
Materials
Components
Styles
Shadows
Outliner
Filter:
Untitled
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

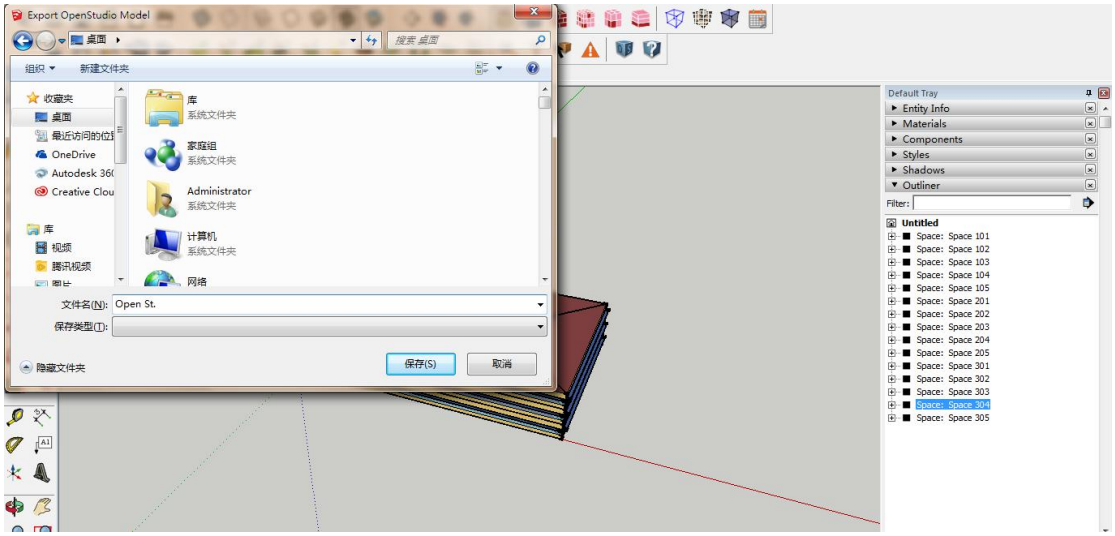

Set Attributes for Selected Spaces
Space Type
189.1-2009 - Office - OpenOffice - CZ1-3
Building Story
Building Story 2
Construction Set
189.1-2009 - CZ1 - Office
Thermal Zone
<new thermal zone>
Set Parent Thermal Zone's - Ideal Air Loads Status
Yes
Set Parent Thermal Zone's - Thermostat
189.1-2009 - Office - OpenOffice - CZ1-3 Thermostat
OK
Cancel
Default Tray
Entity Info
Materials
Components
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


Set Attributes for Selected Spaces
Space Type
189.1-2009 - Office - IT_Room - CZ4-8
Building Story
Building Story 2
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
Entity Info
Materials
Components
Styles
Shadows
Outliner
Filter:
Untitled
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

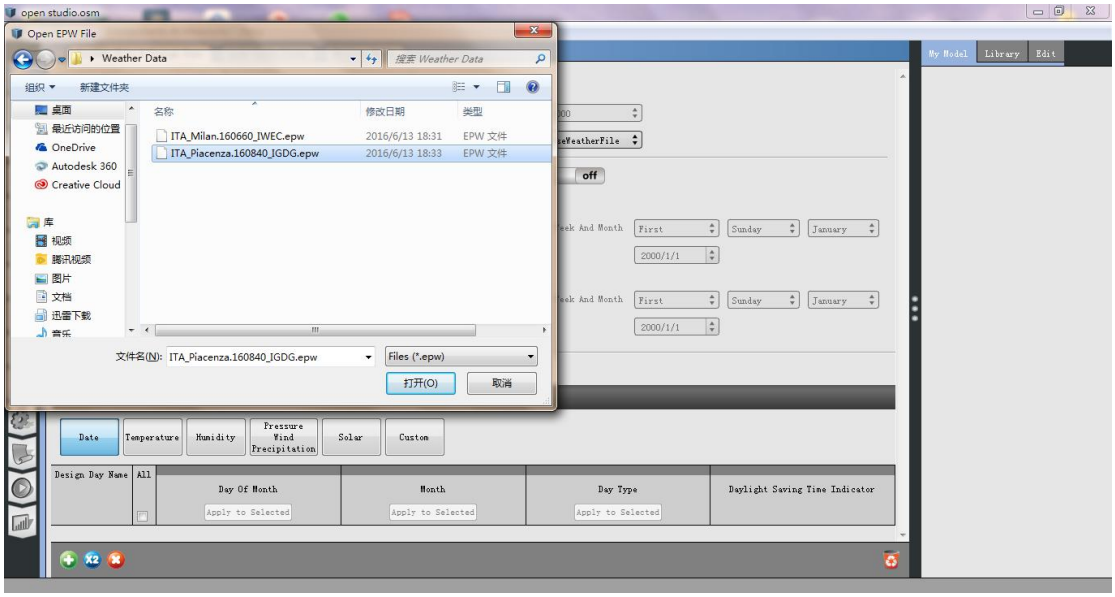

Set Attributes for Selected Spaces
Space Type
189.1-2009 - Office - OpenOffice - CZ4-8
Building Story
Building Story 3
Construction Set
189.1-2009 - CZ1 - Office
Thermal Zone
<new thermal zone>
Set Parent Thermal Zone's - Ideal Air Loads Status
Yes
Set Parent Thermal Zone's - Thermostat
189.1-2009 - Office - OpenOffice - CZ1-3 Thermostat
OK
Cancel
Default Tray
Entity Info
Materials
Components
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



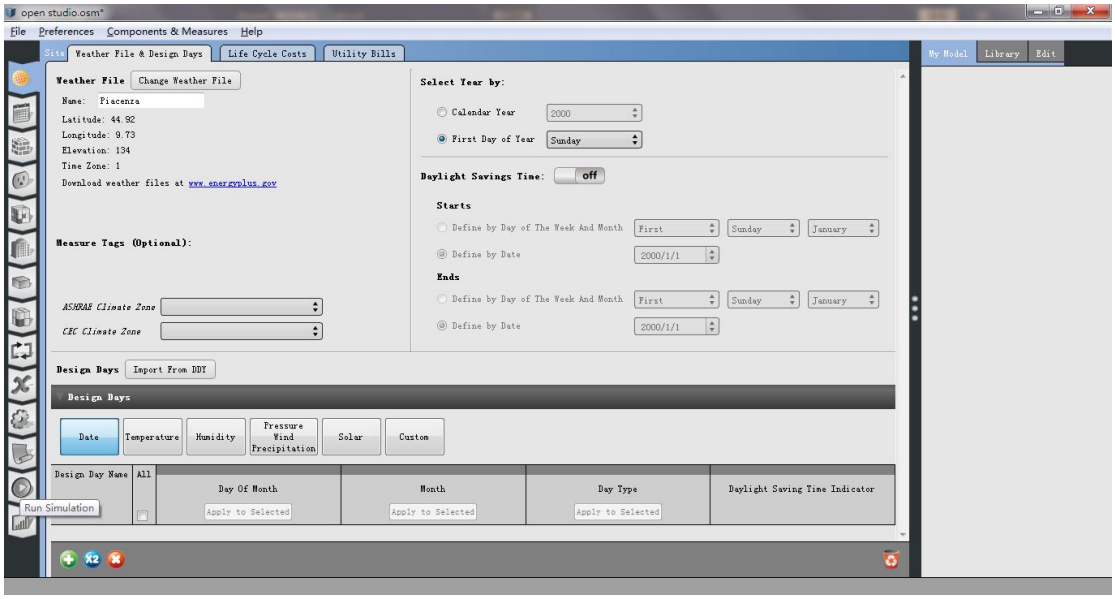
11.Saving the model.

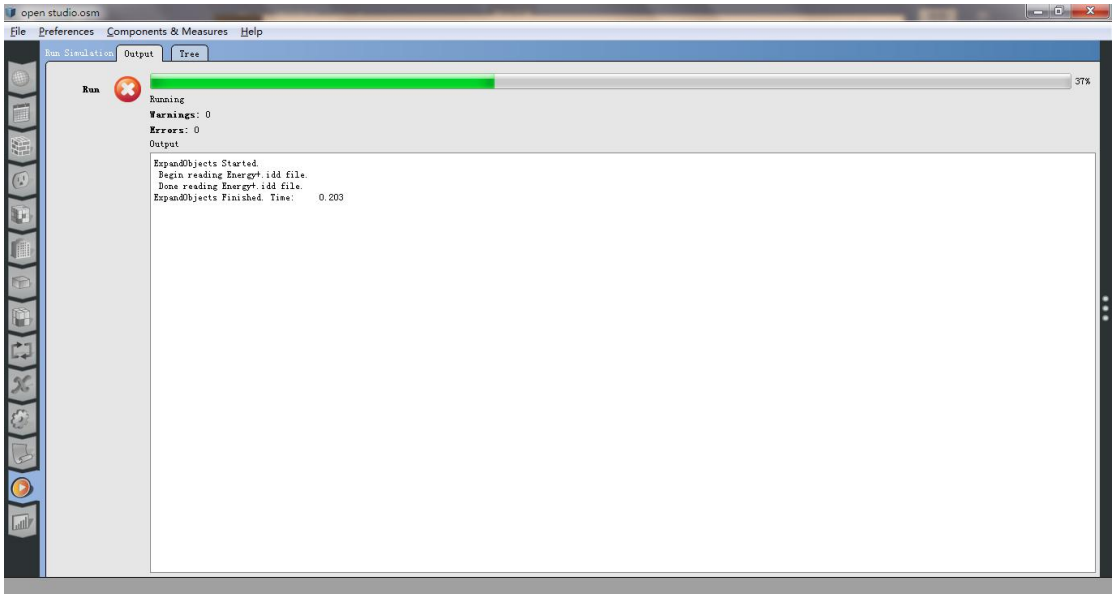


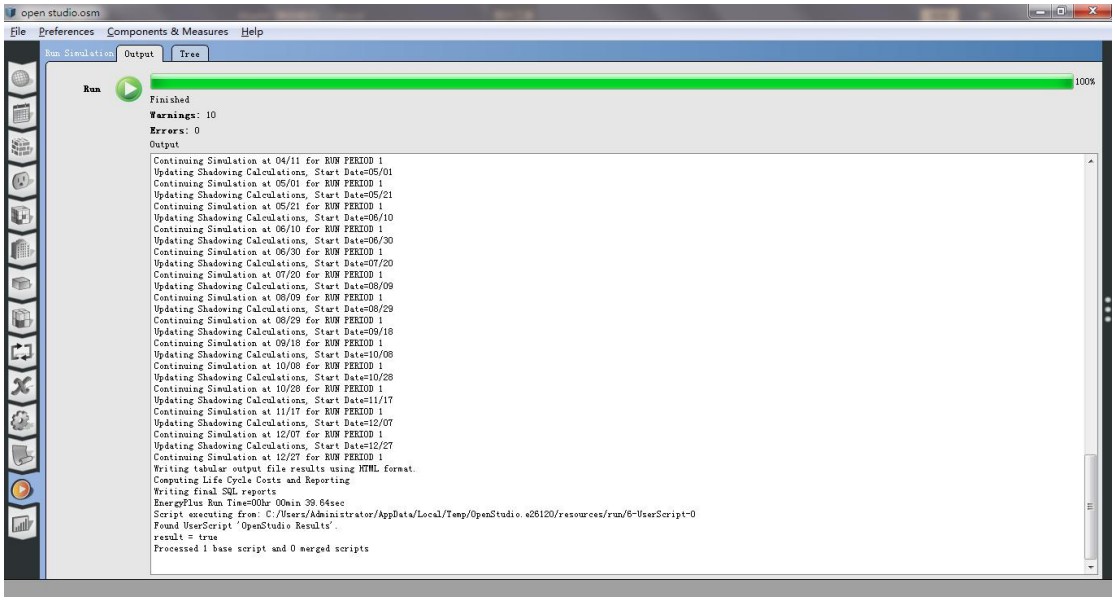
12. Run the " Launch Open Studio" and add the design date .



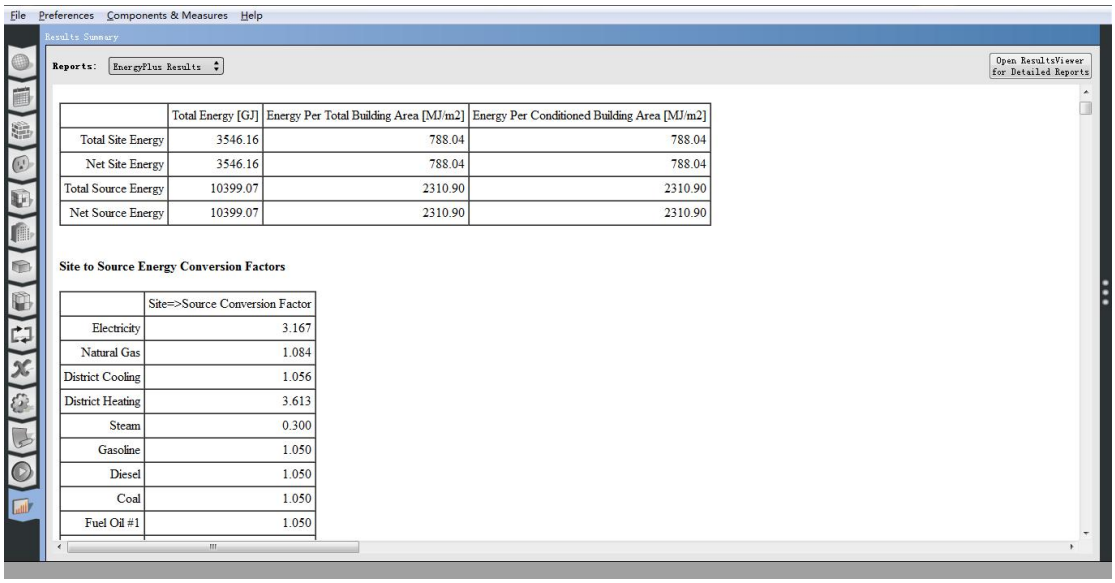
13. Click the " Run Simulation" .


open studio.osm*
File Preferences Components & Measures Help
Site Weather File & Design Days Life Cycle Costs Utility Bills
My Model Library Edit
Weather File Change Weather File
Name: Fiscenza
Latitude: 44.92
Longitude: 9.73
Elevation: 134
Time Zone: 1
Download weather files at www.energyplus.gov
Measure Tags (Optional):
ASHRAE Climate Zone
CEC Climate Zone
Select Year by:
Calendar Year 2000
First Day of Year Sunday
Daylight Savings Time: off
Starts
Define by Day of The Week And Month First Sunday January
Define by Date 2000/1/1
Ends
Define by Day of The Week And Month First Sunday January
Define by Date 2000/1/1
Design Days Import From DDY
Design Days
Date Temperature Humidity Pressure Wind Precipitation Solar Custom
Design Day Name All Day Of Month Month Day Type Daylight Saving Time Indicator
Apply to Selected
Run Simulation


open studio.osm
File Preferences Components & Measures Help
Run Simulation Output Tree
Run
37%
Running
Warnings: 0
Errors: 0
Output
ExpandObjects Started.
Begin reading Energy+.idd file.
Done reading Energy+.idd file.
ExpandObjects Finished. Time: 0.203


open studio.osm
File Preferences Components & Measures Help
Run Simulation Output Tree
Run
100%
Finished
Warnings: 10
Errors: 0
Output
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 39.64sec
Script executing from: C:/Users/Administrator/AppData/Local/Temp/OpenStudio_e26120/resources/run/6-UserScript-0
Found UserScript 'OpenStudio Results'.
result = true
Processed 1 base script and 0 merged scripts

14. You can see the Result Summary .



	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	3546.16	788.04	788.04
Net Site Energy	3546.16	788.04	788.04
Total Source Energy	10399.07	2310.90	2310.90
Net Source Energy	10399.07	2310.90	2310.90

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