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 ?
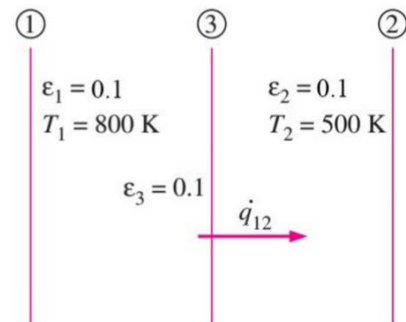
ANSWER:

$\dot{q}_{12,\ \text{no sheilds}} = \dot{q}_{12}$

$$= \frac{\dot{Q}_{12}}{A}$$

$$= \frac{\sigma A(T_1^4 - T_2^4)}{\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1} \div A$$

$\varepsilon_1 = 0.1$
$T_1 = 800\ K$

$\varepsilon_2 = 0.1$
$T_2 = 500\ K$

$\varepsilon_3 = 0.1$

$\dot{q}_{12}$

$$= \frac{\sigma(T_1^4 - T_2^4)}{\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1} = \frac{5.67 * 10^{-8} * (800^4 - 500^4)}{\frac{1}{0.2} + \frac{1}{0.7} - 1}$$

$$= 3625.41 \frac{W}{m^2}$$

  We want 1% heat transfer heat

$\dot{q}_{12} = 3625.41 * 0.01 = 36.254 \frac{W}{m^2}$

$\dot{q}_{12,\ \text{N sheilds}} = \frac{\dot{Q}_{12,\ \text{N sheilds}}}{A}$

$$= \frac{\sigma A(T_1^4 - T_2^4)}{\left(\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1\right) + \left(\frac{1}{\varepsilon_{3,1}} + \frac{1}{\varepsilon_{3,2}} - 1\right) + \cdots + \left(\frac{1}{\varepsilon_{N,1}} + \frac{1}{\varepsilon_{N,2}} - 1\right)}$$

$\div A$

$$= \frac{\sigma(T_1^4 - T_2^4)}{\left(\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1\right) + \left(\frac{1}{\varepsilon_{3,1}} + \frac{1}{\varepsilon_{3,2}} - 1\right) + \cdots + \left(\frac{1}{\varepsilon_{N,1}} + \frac{1}{\varepsilon_{N,2}} - 1\right)}$$

$$= \frac{\sigma(T_1^4 - T_2^4)}{(N+1)\left(\frac{1}{\varepsilon} + \frac{1}{\varepsilon} - 1\right)}$$

$\varepsilon = \varepsilon_1 = \varepsilon_2 = \varepsilon_3 = \cdots = \varepsilon_N = 0.1$

$$36.254 = \frac{5.67 * 10^{-8} * (800^4 - 500^4)}{(N+1)(\frac{1}{0.1} + \frac{1}{0.1} - 1)}$$

$$(N+1) = \frac{5.67 * 10^{-8} * (800^4 - 500^4)}{36.254 * (\frac{1}{0.1} + \frac{1}{0.1} - 1)} \cong$$

N=27.5 $\cong$ 28

So we need 28 shields of which $\varepsilon = 0.1$.

You should create a pdf file with screenshots of all of 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!)

1. Create a 40m*30m rectangle ,then create another rectangle with an offset of 10 m, connect each corner with 4 lines.
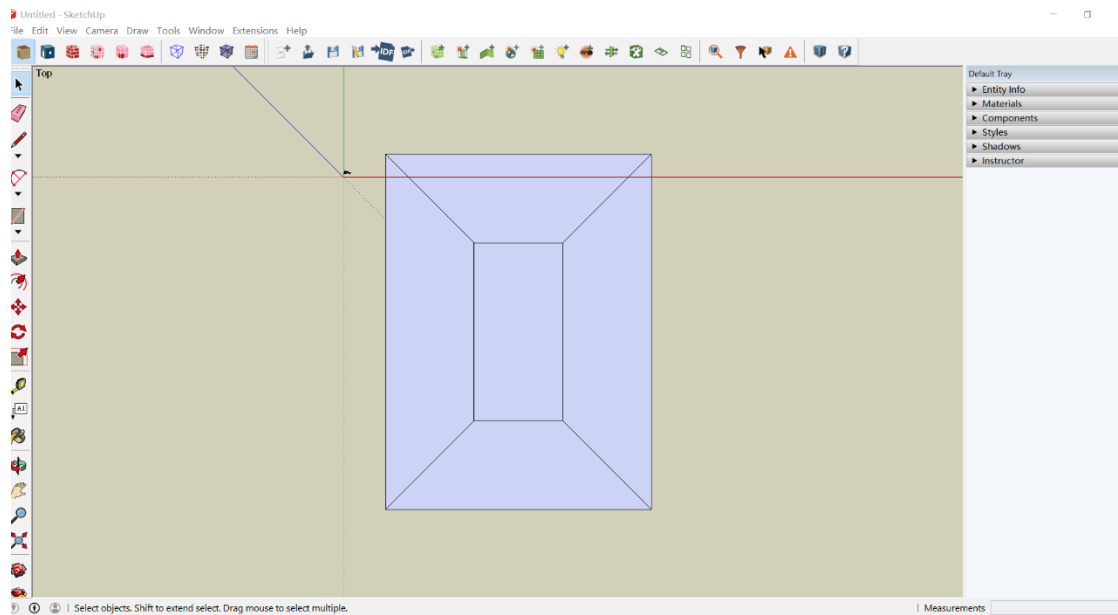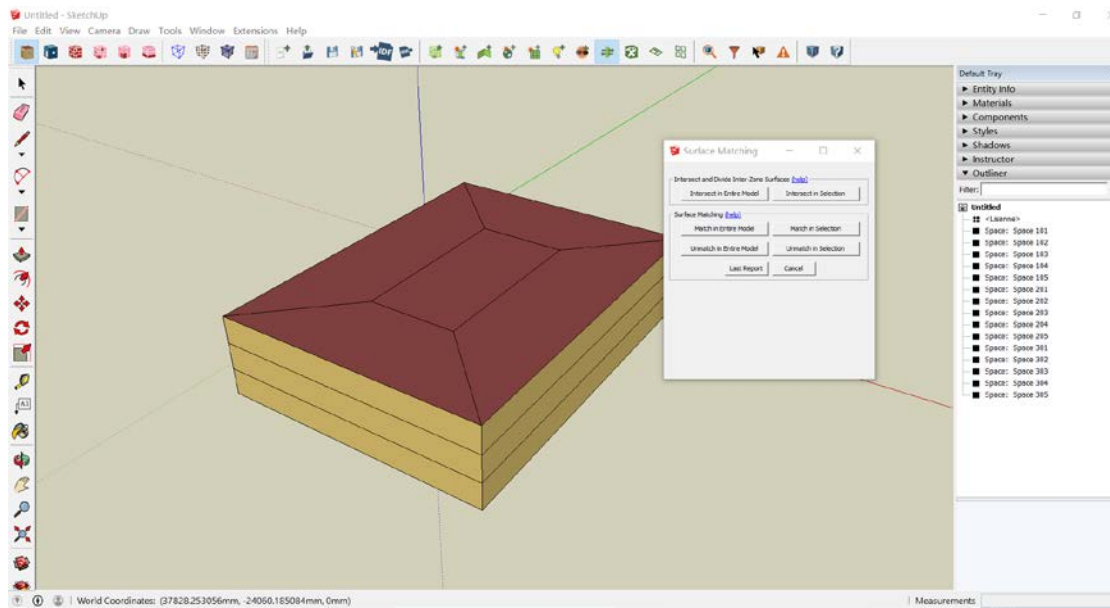
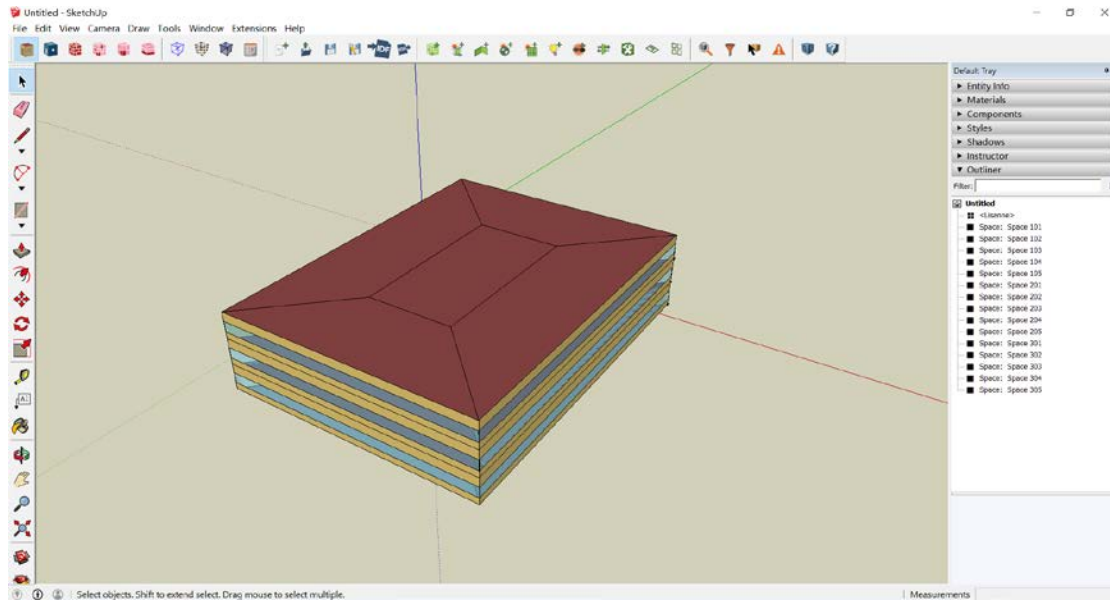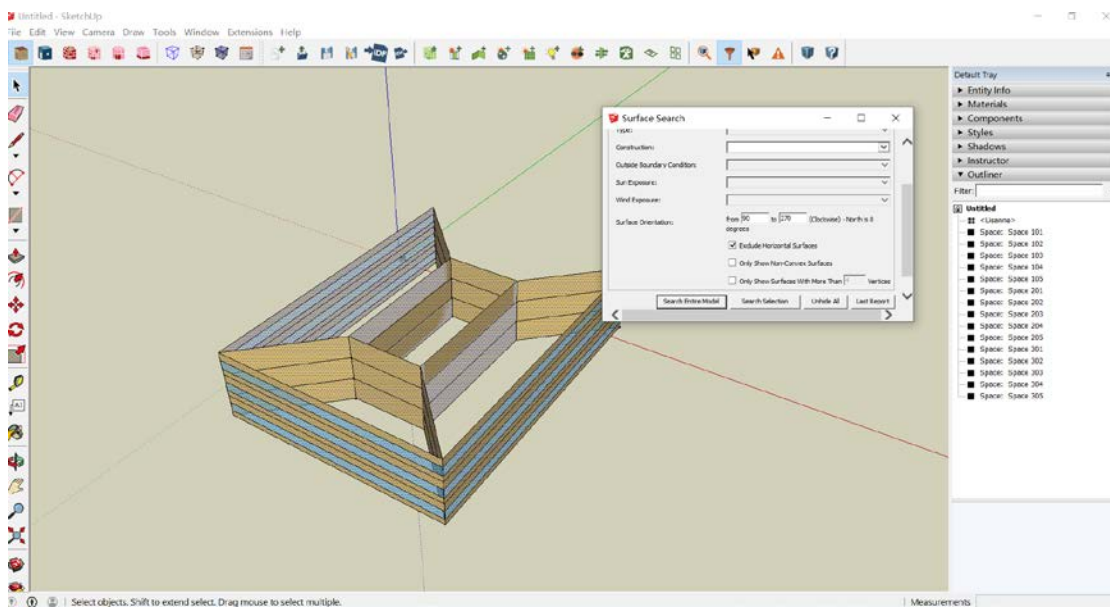2. Use "create spaces from diagram" to set up a building of 3 levels,
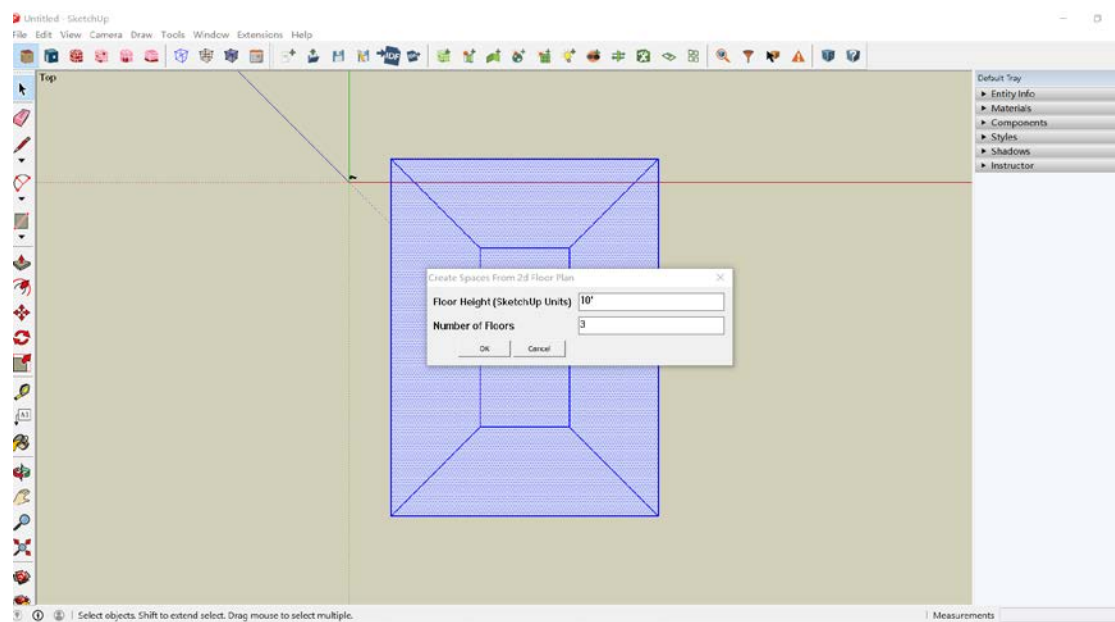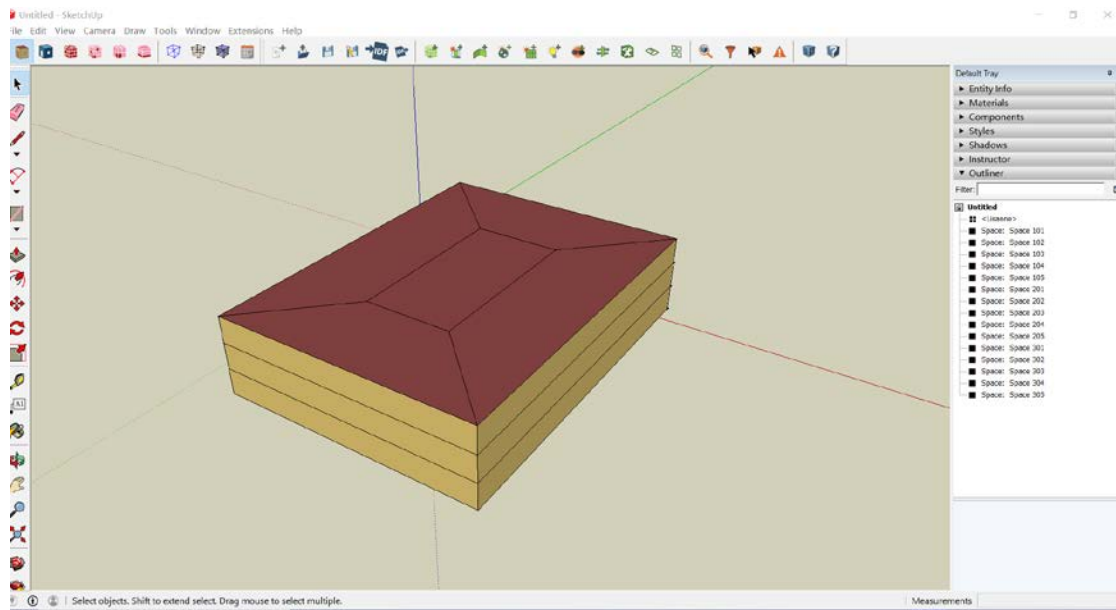
3. Using "surfaces matching" ,this step is mandatory to be able to create the windows.
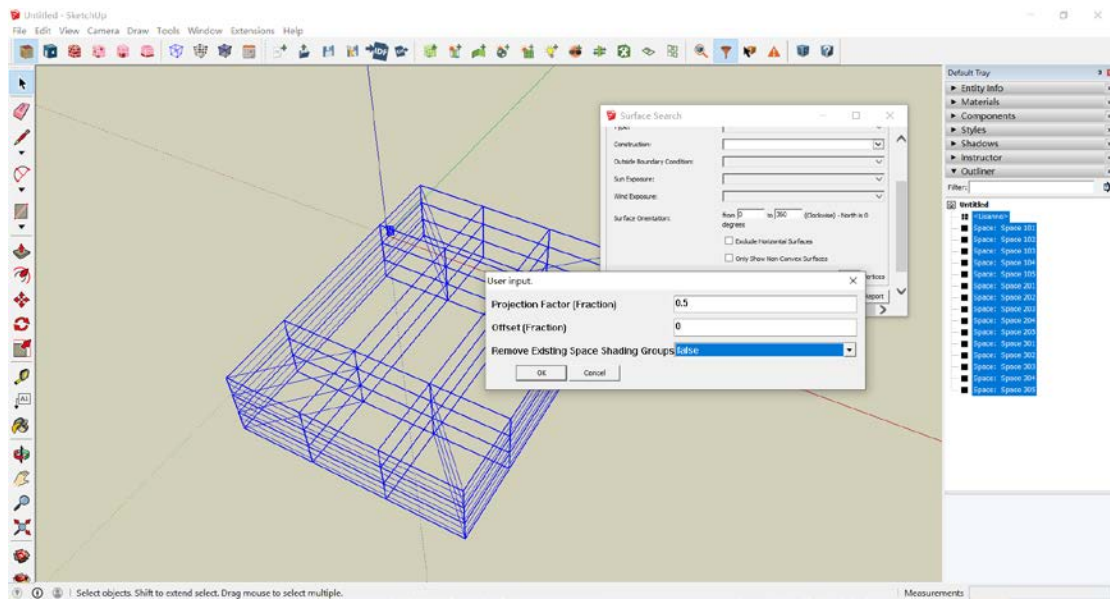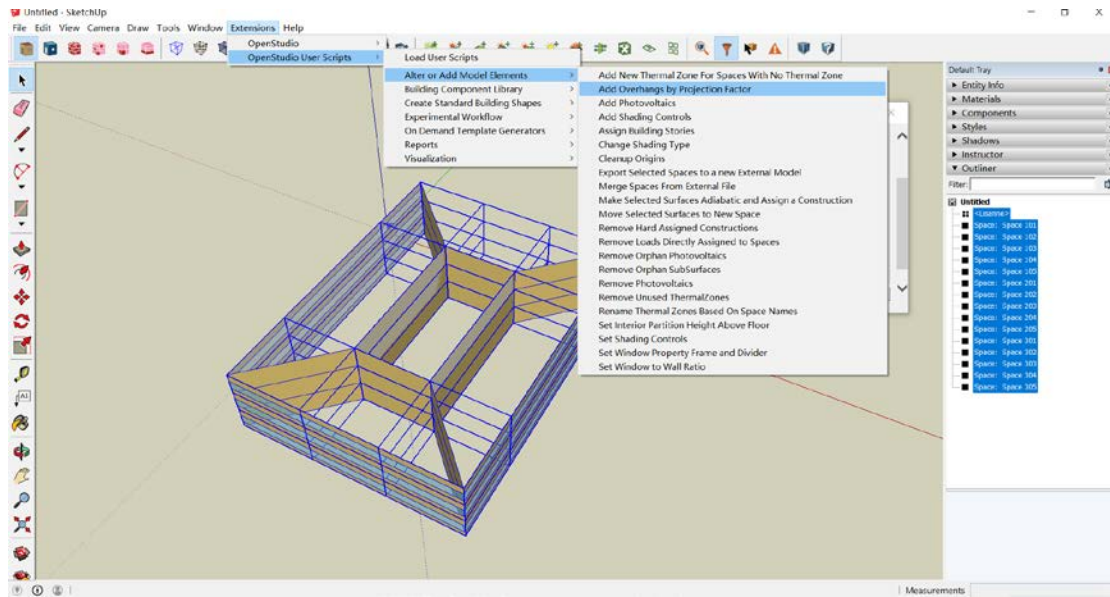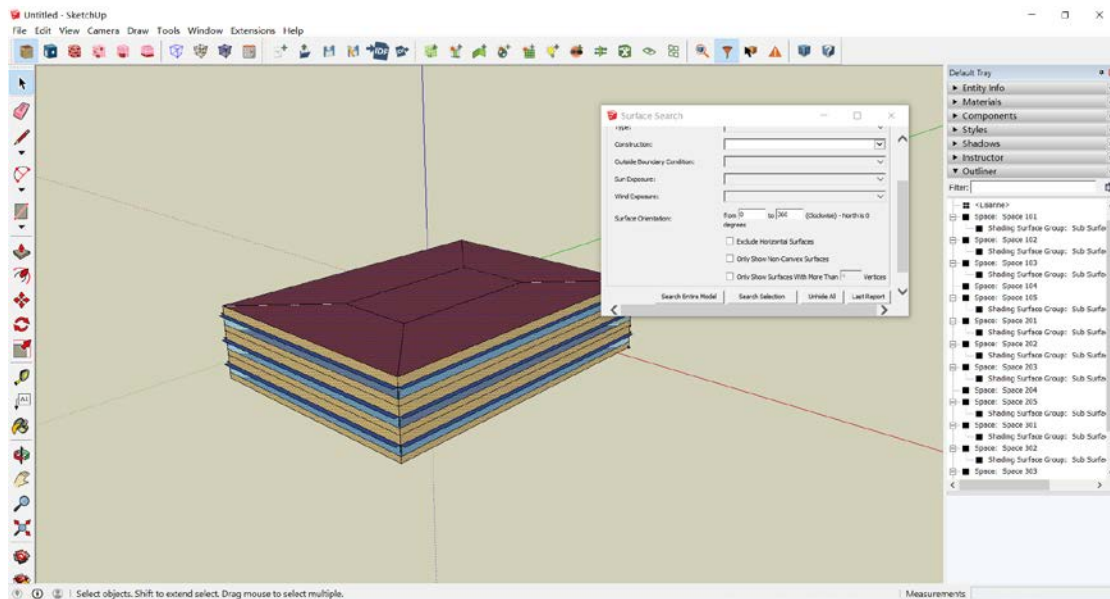

4. Install the windows.

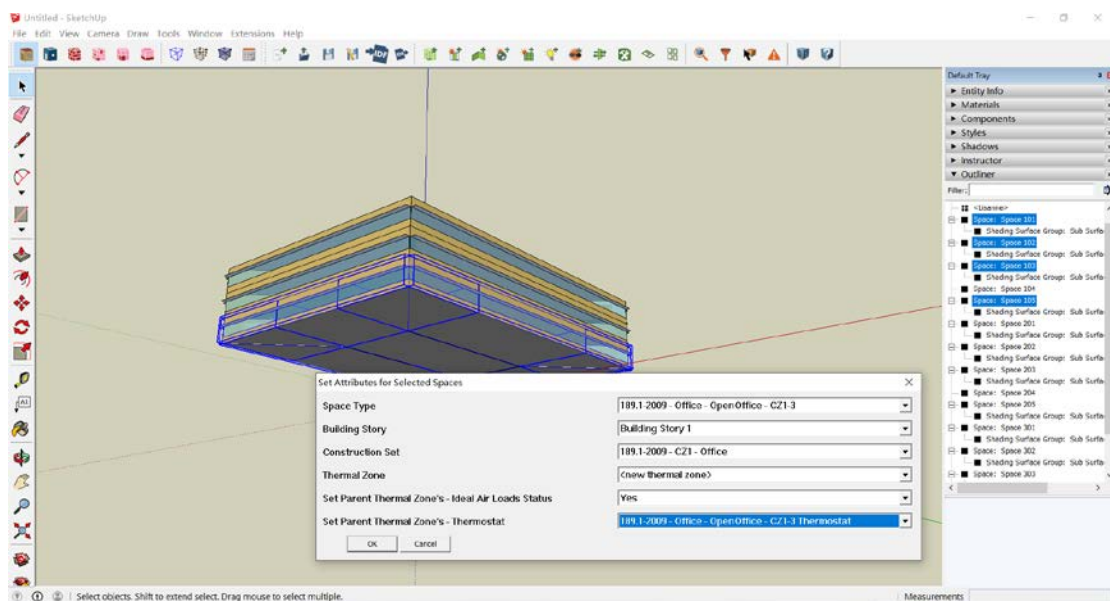5. Using "Search Surfaces" to select all the surfaces except the north one.
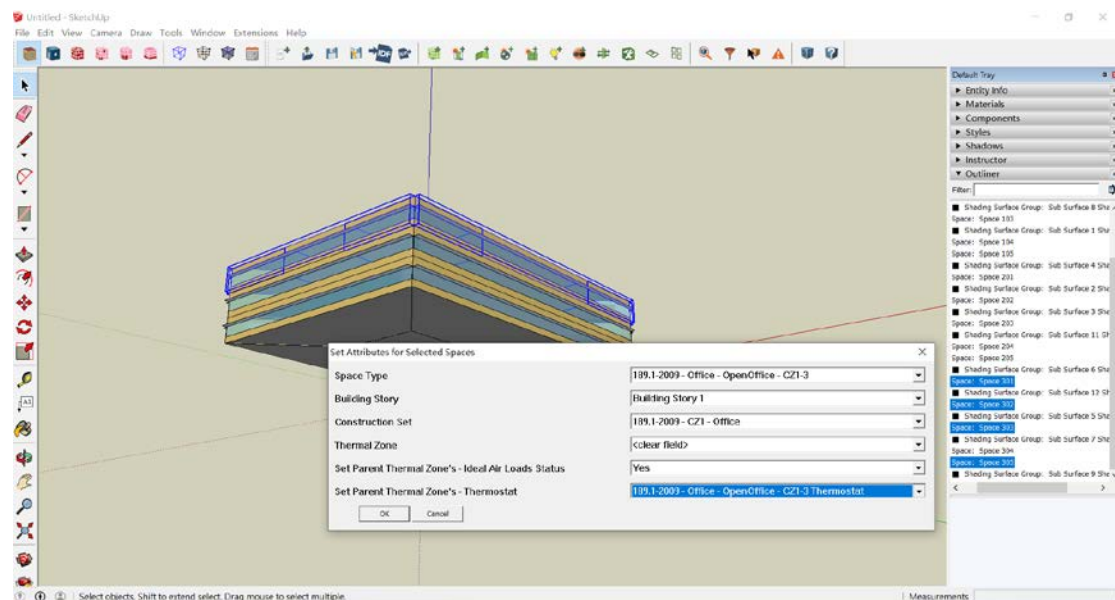

6.Add external shading

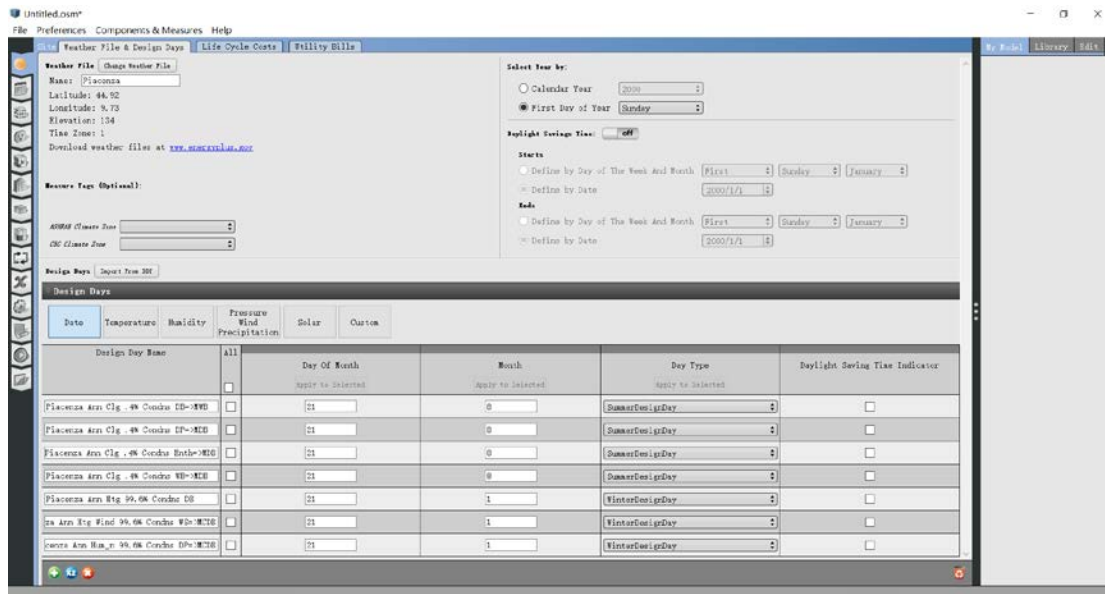Go back to the previous selection to see the entire model again.

7.Use "Set attributes for selected spaces" to choose the spaces of each thermal
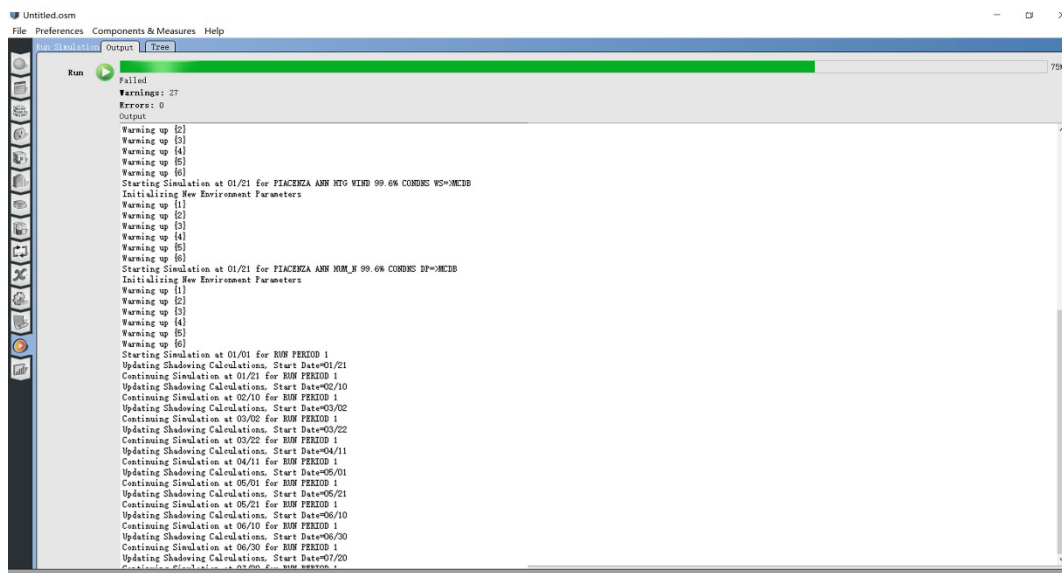
zone and we add specifications.

8. Launch OpenStudio and add the weather data using the "ITA_Piacenza.160840_IGDG.ddy" file .

Run the model analysis.

9.Review the results.

File   Preferences   Components & Measures   Help

Results Summary

Reports: | EnergyPlus Results ↕ |

Open ResultsViewer
for Detailed Reports

Program Version:**EnergyPlus, Version 8.5.0-c87e61b44b, YMD=2019.11.12 22:12**

Tabular Output Report in Format: **HTML**

Building: **Building 1**

Environment: **RUN PERIOD 1 ** Piacenza - ITA IGDG WMO#=160840**

Simulation Timestamp: **2019-11-12 22:12:23**

Report: **Annual Building Utility Performance Summary**

For: **Entire Facility**

Timestamp: **2019-11-12 22:12:23**

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	376.68	376.68	376.68
Net Site Energy	376.68	376.68	376.68
Total Source Energy	1122.02	1122.02	1122.02
Net Source Energy	1122.02	1122.02	1122.02

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

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