

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:

$$q_{12} = \frac{Q_{12}}{A} = \frac{A\sigma (T_1^4 - T_2^4)}{\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1} \div A = \frac{5.67 \times 10^{-8} \times (800^4 - 500^4)}{\frac{1}{0.2} + \frac{1}{0.7} - 1} \approx 3625.3491 \text{W}$$

$$\begin{aligned} q'_{12\text{shield}} &= \frac{Q_{12\text{shield}}}{A} \\ &= \frac{A\sigma (T_1^4 - T_2^4)}{\left(\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1\right)\left(\frac{1}{\epsilon_{3.1}} + \frac{1}{\epsilon_{3.2}} - 1\right) \dots \left(\frac{1}{\epsilon_{n.1}} + \frac{1}{\epsilon_{n.2}} - 1\right)} \div A \\ &= \frac{\sigma (T_1^4 - T_2^4)}{\left(\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1\right)\left(\frac{1}{\epsilon_{3.1}} + \frac{1}{\epsilon_{3.2}} - 1\right) \dots \left(\frac{1}{\epsilon_{n.1}} + \frac{1}{\epsilon_{n.2}} - 1\right)} \end{aligned}$$

$$\epsilon_1 = \epsilon_2 = \epsilon_3 = \dots = \epsilon_{n-1} = \epsilon_n = 0.1$$

$$\begin{aligned} q'_{12\text{shield}} &= \frac{\sigma (T_1^4 - T_2^4)}{\left(\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1\right)\left(\frac{1}{\epsilon_{3.1}} + \frac{1}{\epsilon_{3.2}} - 1\right) \dots \left(\frac{1}{\epsilon_{n.1}} + \frac{1}{\epsilon_{n.2}} - 1\right)} \\ &= \frac{\sigma (T_1^4 - T_2^4)}{(n+1)\left(\frac{1}{0.1} + \frac{1}{0.1} - 1\right)} = \frac{1}{100} \times \frac{\sigma (T_1^4 - T_2^4)}{\left(\frac{1}{0.2} + \frac{1}{0.7} - 1\right)} \end{aligned}$$

$$\rightarrow n = 28$$

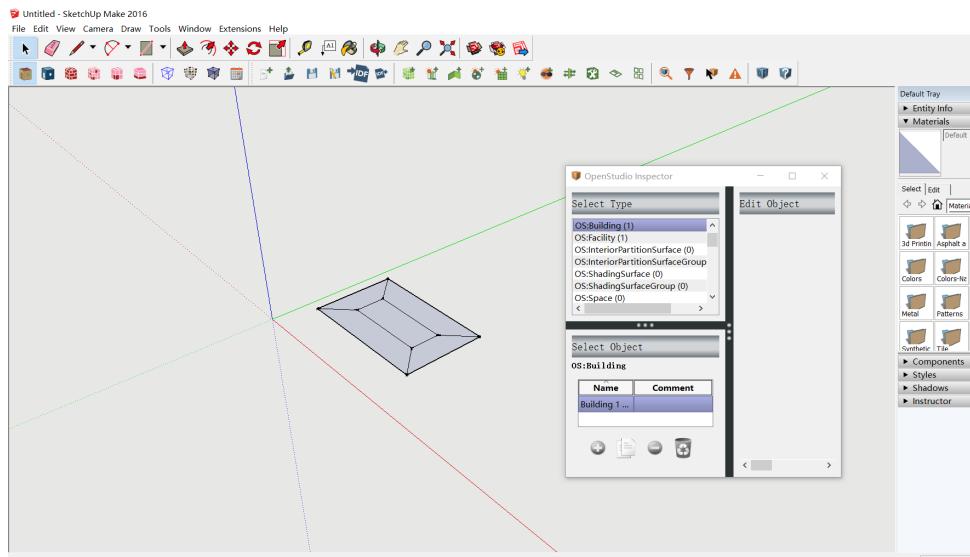
So we need 28 shields with epsilon=0.1 in order to have the new heat transfer rate to be 1% of the case without shields.

Task2:

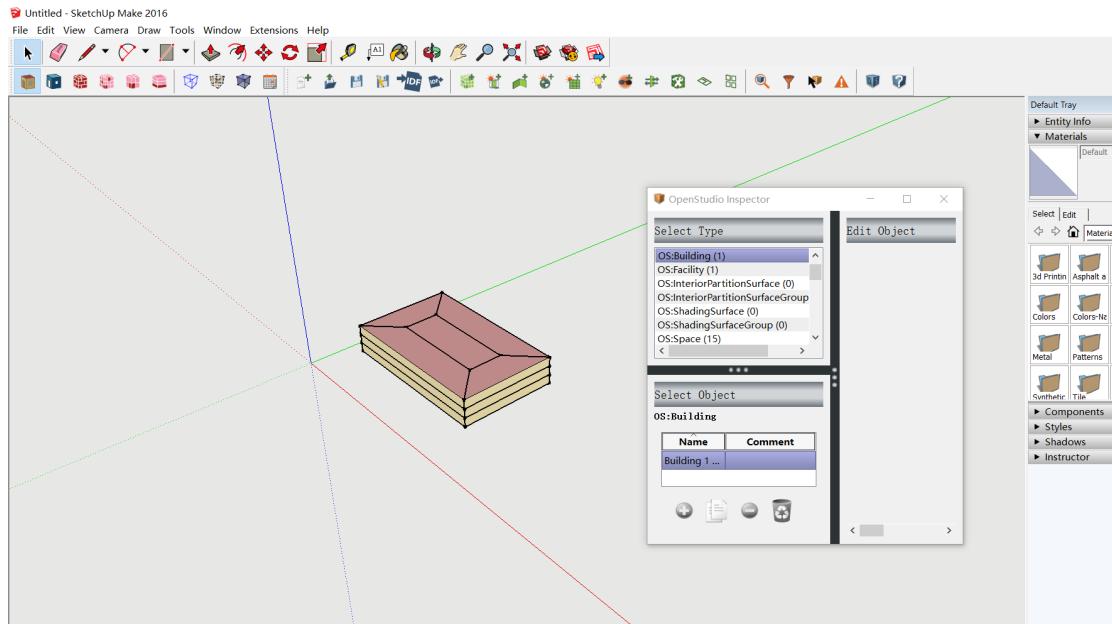
You should create a pdf file with screenshots of all the steps we went through (clearly from your own file) and explain briefly the reason behind the use of each step (in your own words)

Answer:

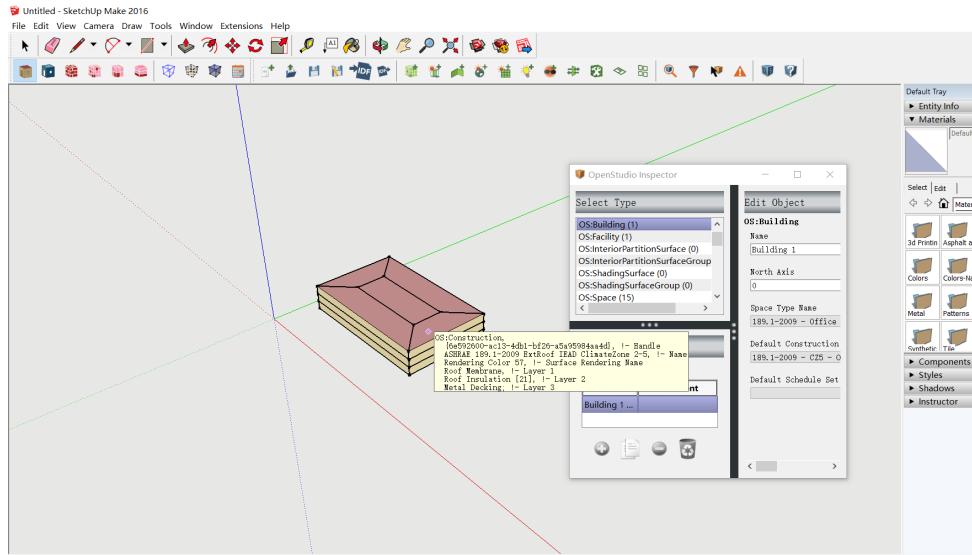
1. At first, draw the outline and shape of the building in Sketchup.



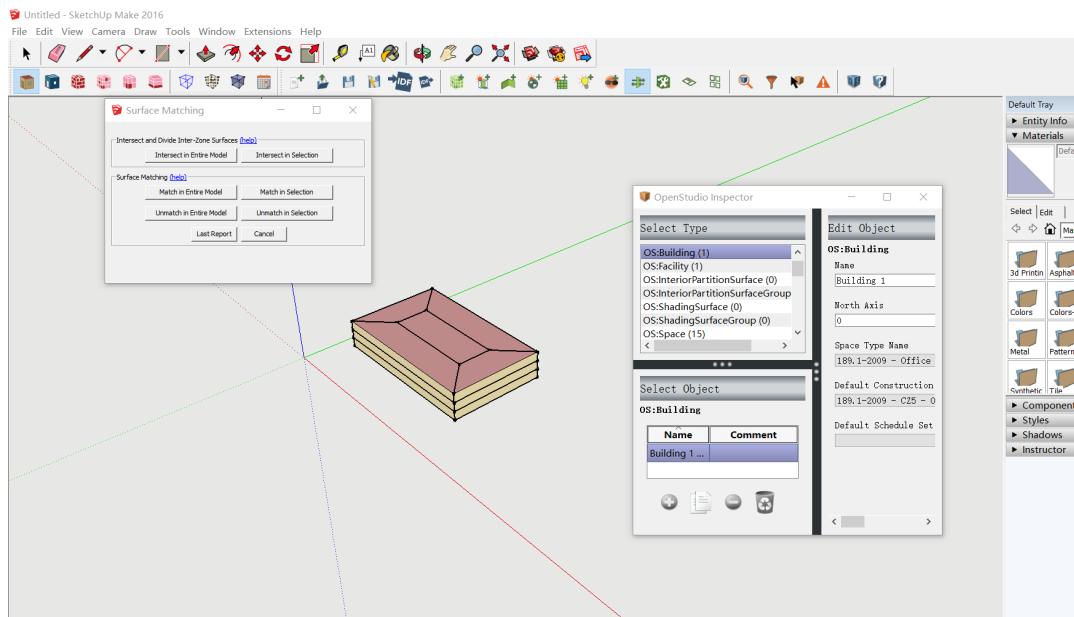
2. Use the command “Create spaces from diagram” to create a three floors building.



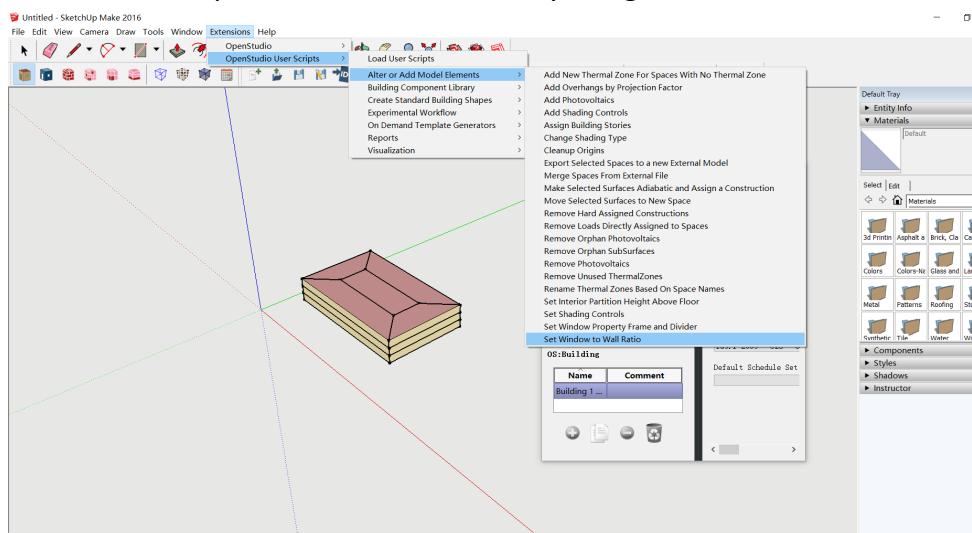
3. By using the command “Info tool”, you can see the material information about the building.

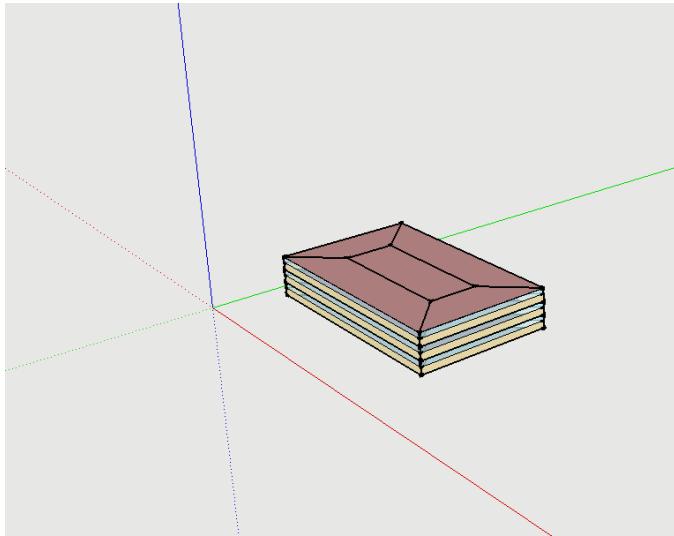


4. Then click the command “Surface matching”.

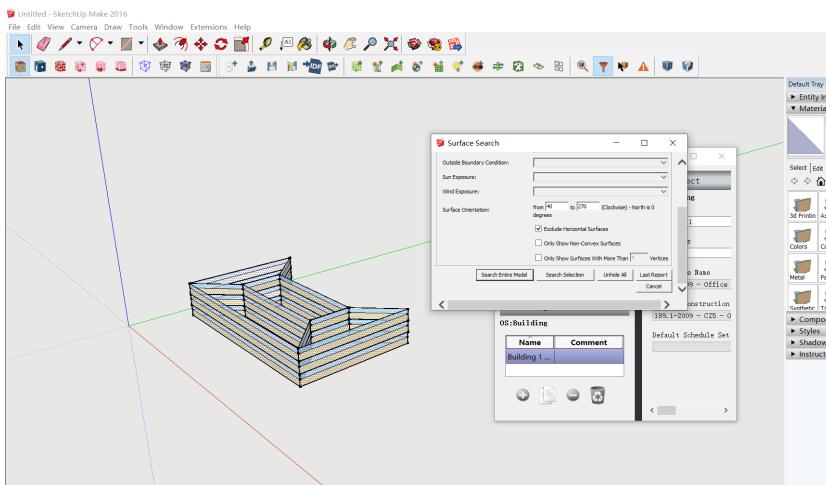


5. Find “User input” and build windows by using “Windows to Wall Ratio”.

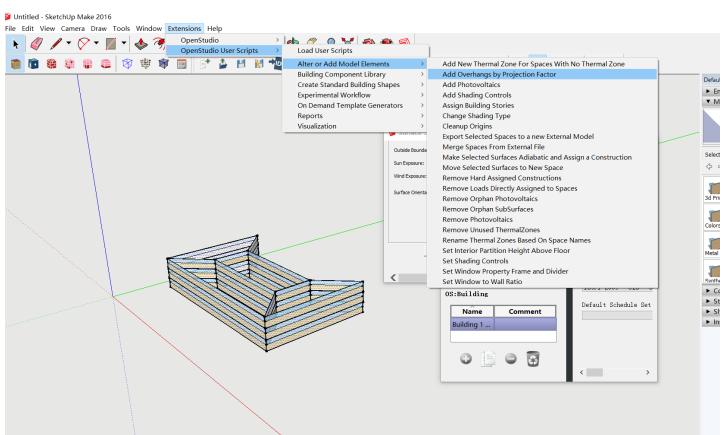


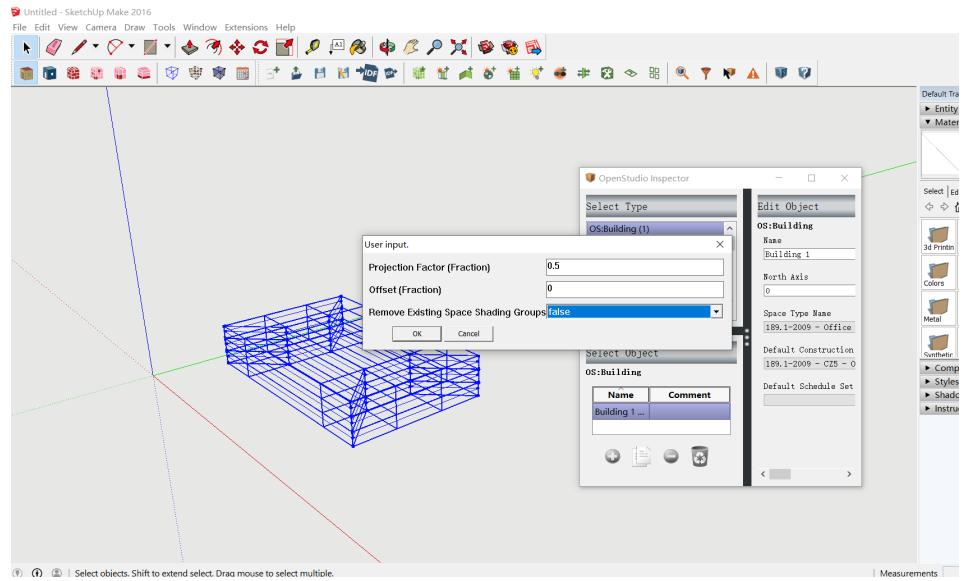


6. Find “Surface search”, you can use Surface Orientation to build the windows on other side.

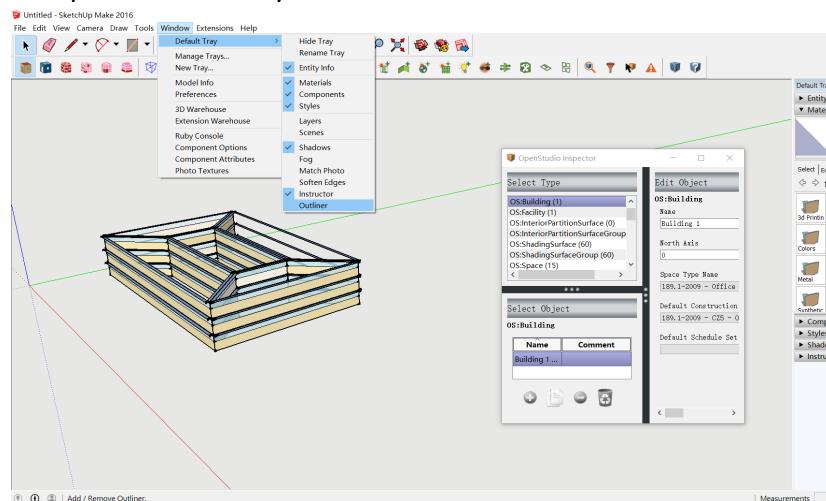


7. Next step is make overhangs by using “Projection Factor” .

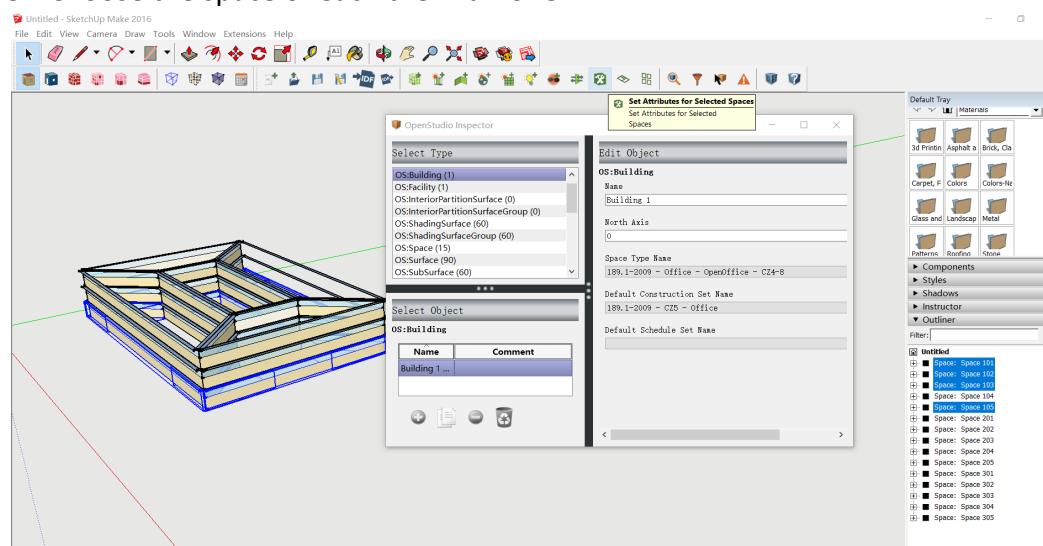




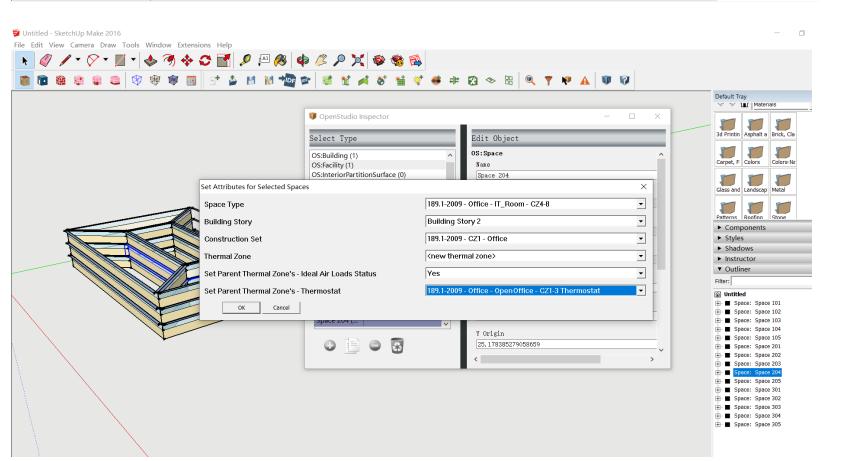
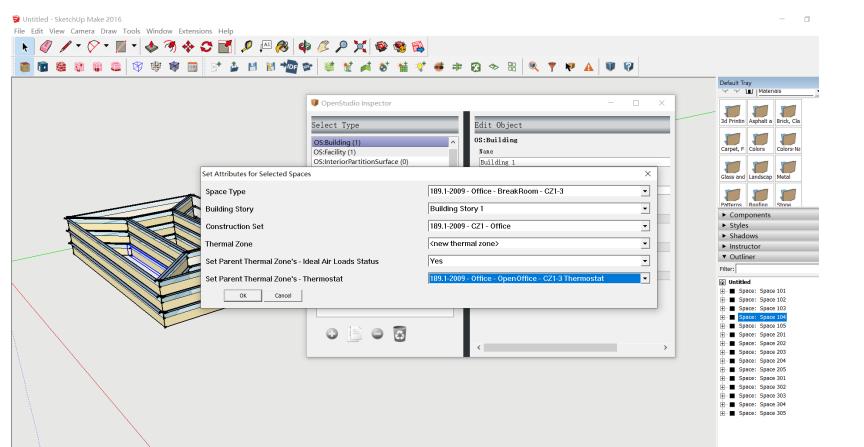
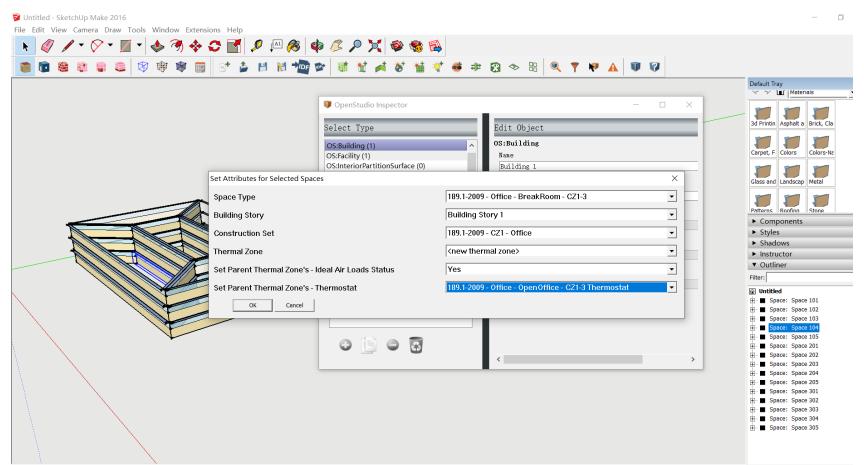
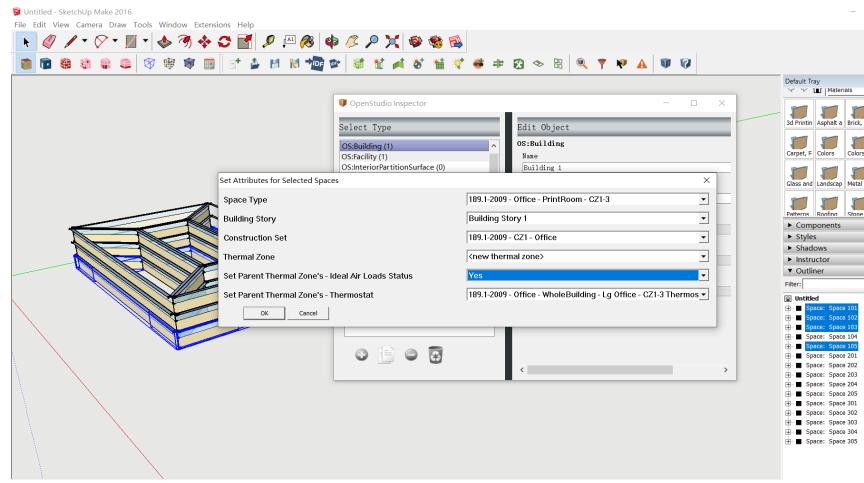
8. Open“Default Tray”.

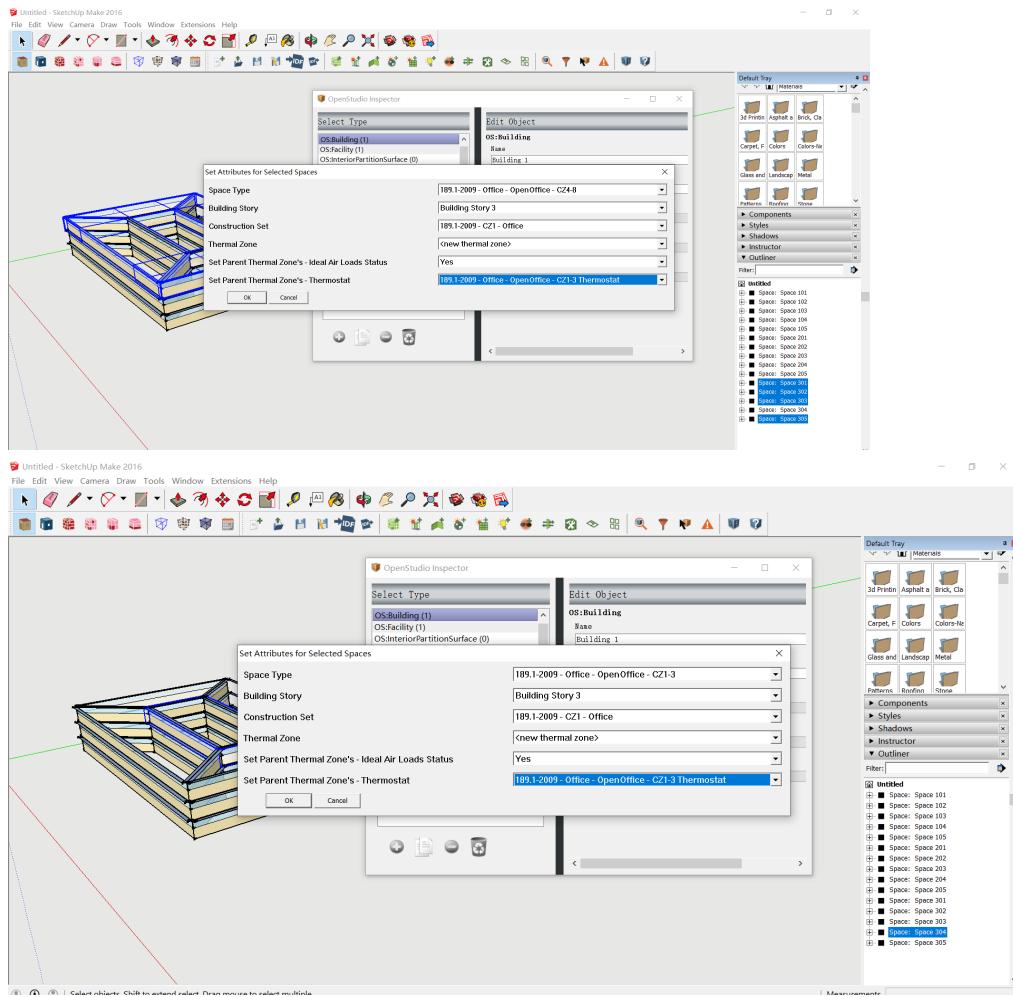


9. Choose the space of each thermal zone .

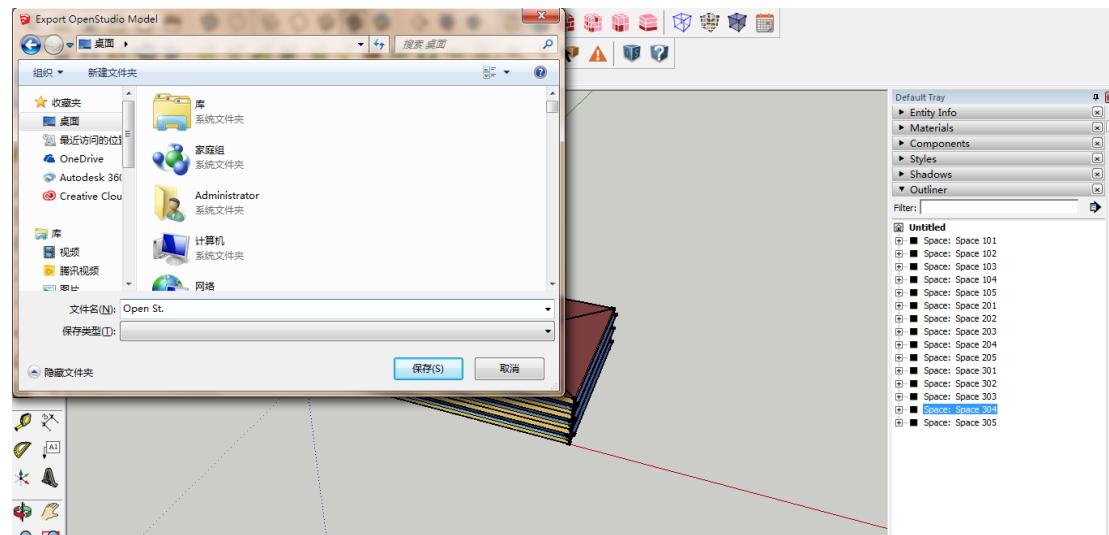


10. Using “ Set Attributes for Selected Spaces” to set parent thermal zone's thermostat.

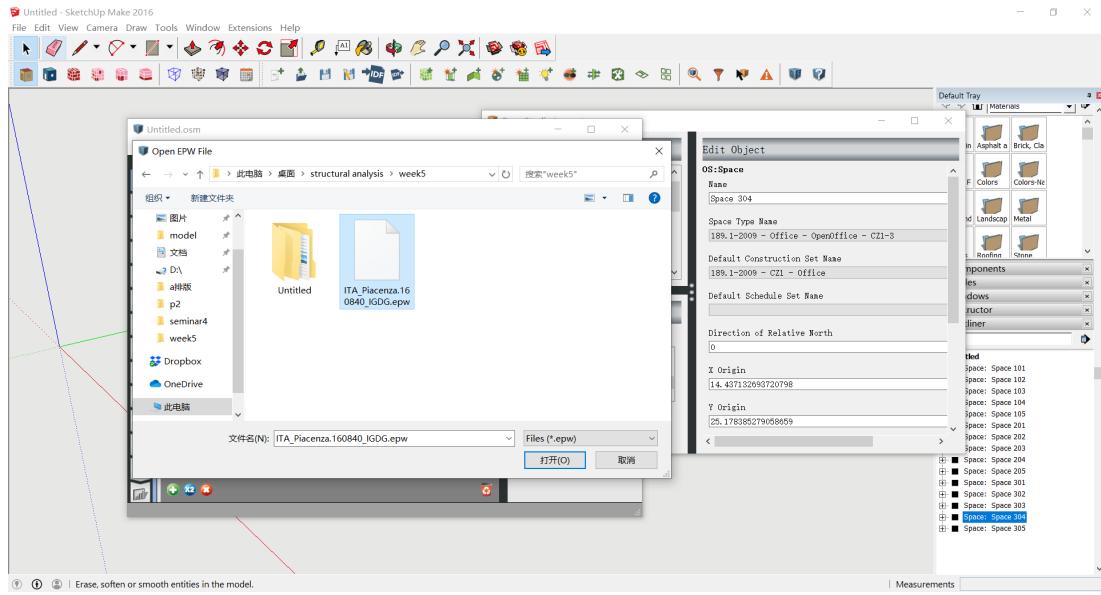




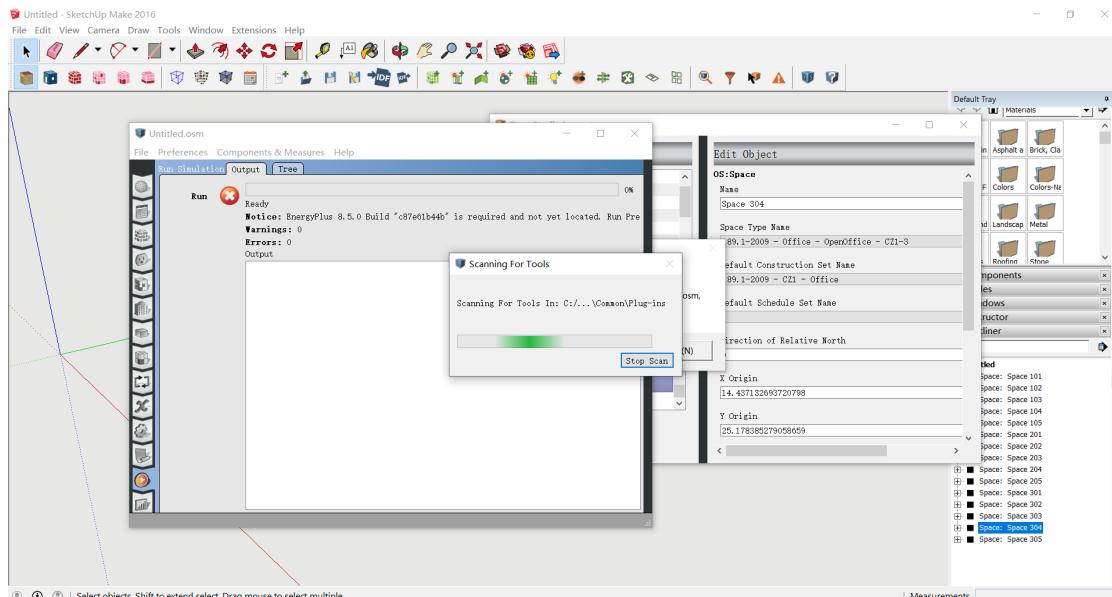
11. Saving the model.

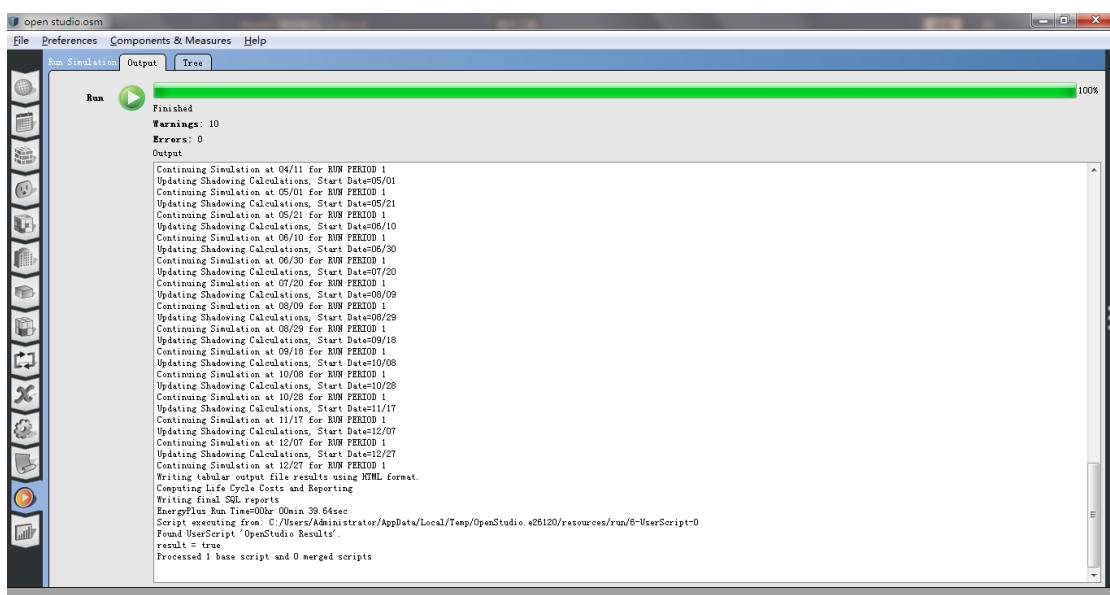
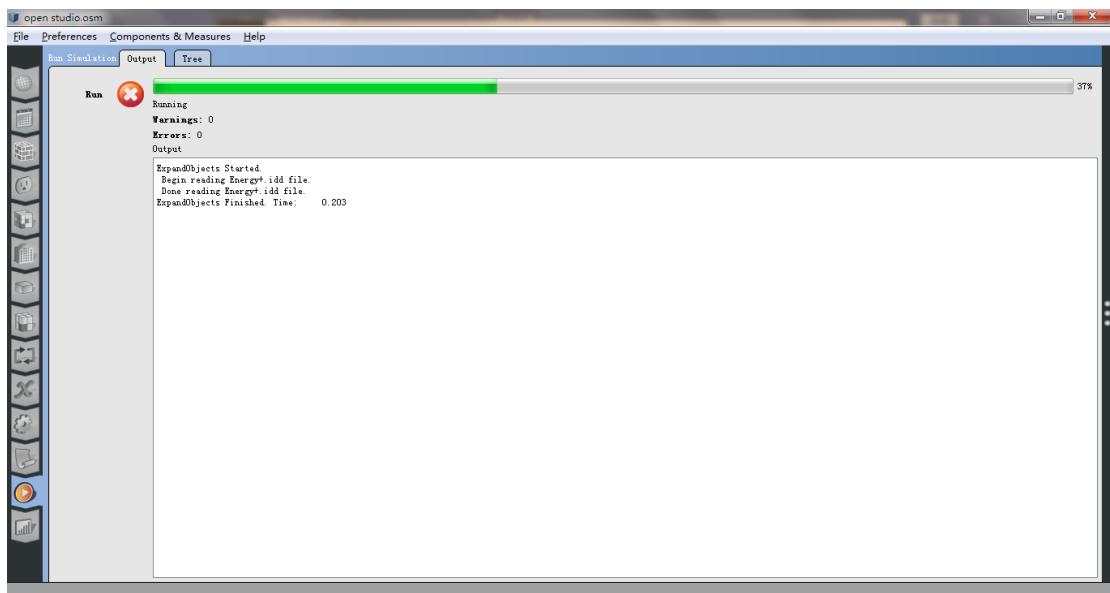


12. Run the “Launch Open Studio” and add the design date .



13. Click the “Run Simulation” .





14. You can see the Result Summary .

File Preferences Components & Measures Help

Results Summary

Reports: EnergyPlus Results **Open ResultsViewer for Detailed Reports**

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m ²]	Energy Per Conditioned Building Area [MJ/m ²]
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

File Preferences Components & Measures Help

Results Summary

Reports: OpenStudio Results **Open ResultsViewer for Detailed Reports**

End Use - view table

Energy Use - view table

- Model Summary
- Annual Overview**
- Monthly Overview
- Utility Bills/Rates
- Envelope
- Space Type Breakdown
- Space Type Summary
- Interior Lighting Summary
- Plug Loads Summary
- Exterior Lighting
- Water Use Equipment
- HVAC Load Profiles
- Zone Conditions
- Zone Overview
- Zone Equipment Detail
- Air Loops Detail

File Preferences Components & Measures Help

Results Summary

Reports: OpenStudio Results **Open ResultsViewer for Detailed Reports**

EUI - Electricity - view table

EUI - Gas - view table

- Model Summary
- Annual Overview**
- Monthly Overview
- Utility Bills/Rates
- Envelope
- Space Type Breakdown
- Space Type Summary
- Interior Lighting Summary
- Plug Loads Summary
- Exterior Lighting
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