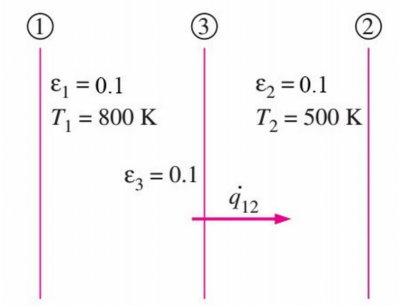
#Week 6 _Wang Yijin

TASK1：

Considering the same example you solved in the previous assignment (radiative heat transfer between two paralle 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?



$$\dot{q}_{net_{1-2}} = \frac{\dot{Q}_{net_{1-2}}}{A} = \frac{A\sigma\,(T_2^4 - T_1^4)}{\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1} \div A = \frac{\sigma\,(T_2^4 - T_1^4)}{\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1} = \frac{5.67\times10^{-8}\times(800^4 - 500^4)}{\frac{1}{0.1} + \frac{1}{0.1} - 1}\frac{W}{m^2} \approx 1035.82\frac{W}{m^2}$$

The new heat transfer rate should be 1% of the $\dot{q}_{net_{1-2}}$

$$i.e., \dot{q}_{net_{1-2}} = \dot{q}_{net_{1-2},nshields} = \frac{1}{100}\times \dot{q}_{net_{1-2}},$$

$$\dot{q}_{net_{1-2},nshields} = \frac{\dot{Q}_{net_{1-2},nshields}}{A} = \frac{A\sigma(T_2^4 - T_1^4)}{(\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1) + (\frac{1}{\varepsilon_{3,1}} + \frac{1}{\varepsilon_{3,2}} - 1) + \ldots + (\frac{1}{\varepsilon_{n,1}} + \frac{1}{\varepsilon_{n,2}} - 1)} \div A$$

$$\frac{\sigma(T_2^4 - T_1^4)}{(\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1) + (\frac{1}{\varepsilon_{3,1}} + \frac{1}{\varepsilon_{3,2}} - 1) + \ldots + (\frac{1}{\varepsilon_{n,1}} + \frac{1}{\varepsilon_{n,2}} - 1)}$$

$$Autem, \varepsilon_1 = \varepsilon_2 = \varepsilon_3 = \ldots = \varepsilon_n$$

$$substitute \quad \varepsilon_1, \varepsilon_2, \varepsilon_3, \ldots, \varepsilon_n,$$

And introduce to the equation:

$$\dot{q}_{net_{1-2},n,shields} = \frac{\sigma(T_2^4 - T_1^4)}{(n+1)(\frac{1}{\varepsilon} + \frac{1}{\varepsilon} - 1)} = \frac{1}{n+1}\times\frac{\sigma(T_2^4 - T_1^4)}{\frac{1}{\varepsilon} + \frac{1}{\varepsilon} - 1}$$

$$q'_{net_{1-2}} = q'_{net_{1-2,n,shields}} = \frac{1}{100} \times q'_{net_{1-2}} = \frac{1}{100} \times \frac{\sigma(T_2^4 - T_1^4)}{\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1} = \frac{1}{100} \times \frac{\sigma(T_2^4 - T_1^4)}{\frac{1}{\varepsilon} + \frac{1}{\varepsilon} - 1}$$

Since *i.e.*, $\frac{1}{n+1} \times \frac{\sigma(T_2^4 - T_1^4)}{\frac{1}{\varepsilon} + \frac{1}{\varepsilon} - 1} = \frac{1}{100} \times \frac{\sigma(T_2^4 - T_1^4)}{\frac{1}{\varepsilon} + \frac{1}{\varepsilon} - 1}$

$$n = 99$$

To have the new heat transfer rate be 1% of the previous rate without any shields, we need 99 shields with epsilon=0.1.

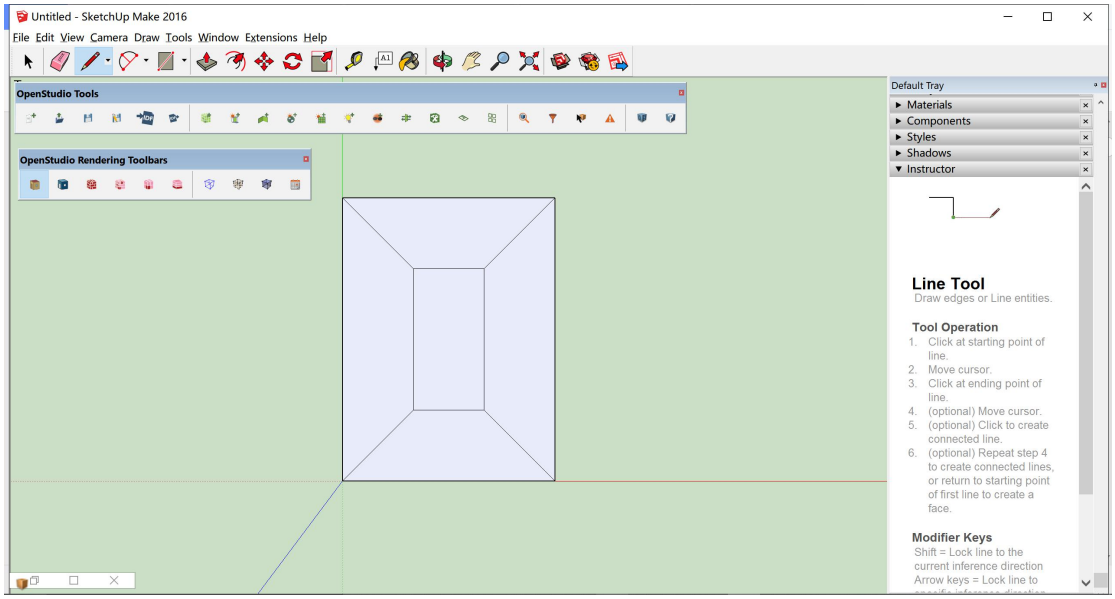
TASK2:

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

Steps:

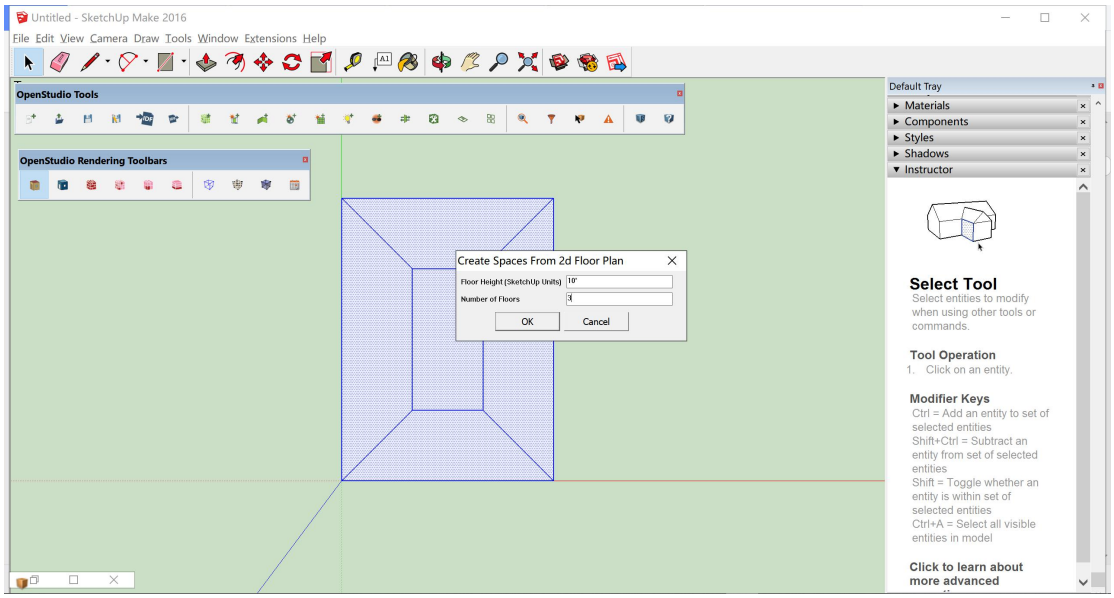
1. Geometry Creation

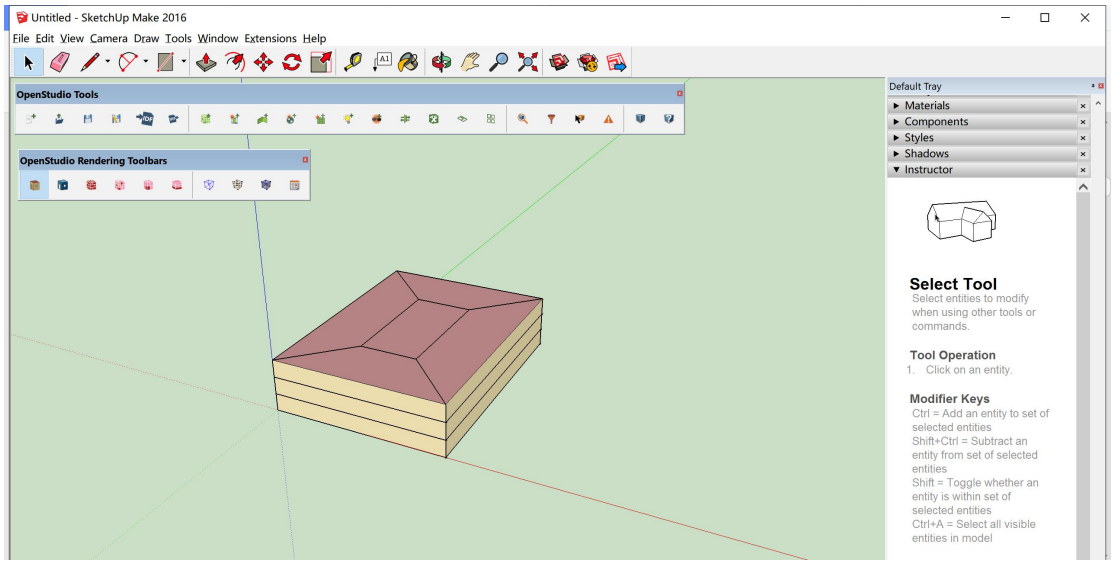
Create in Sketch up a 30m x 40m rectangle.



2. Spaces creation.

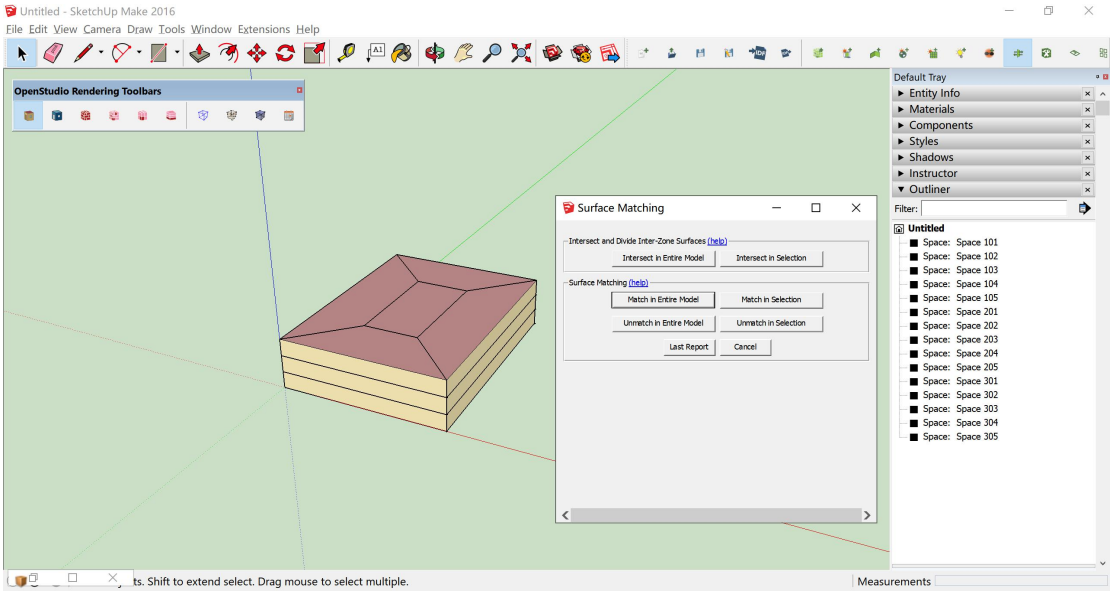
Using the Create Spaces tool we have to create 3 levels.



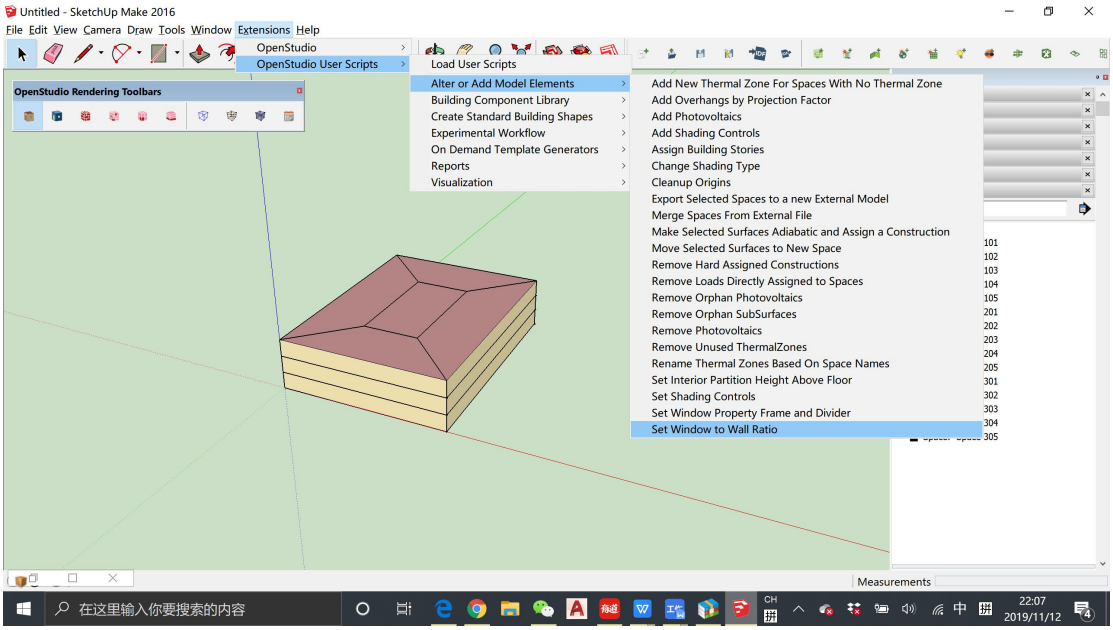


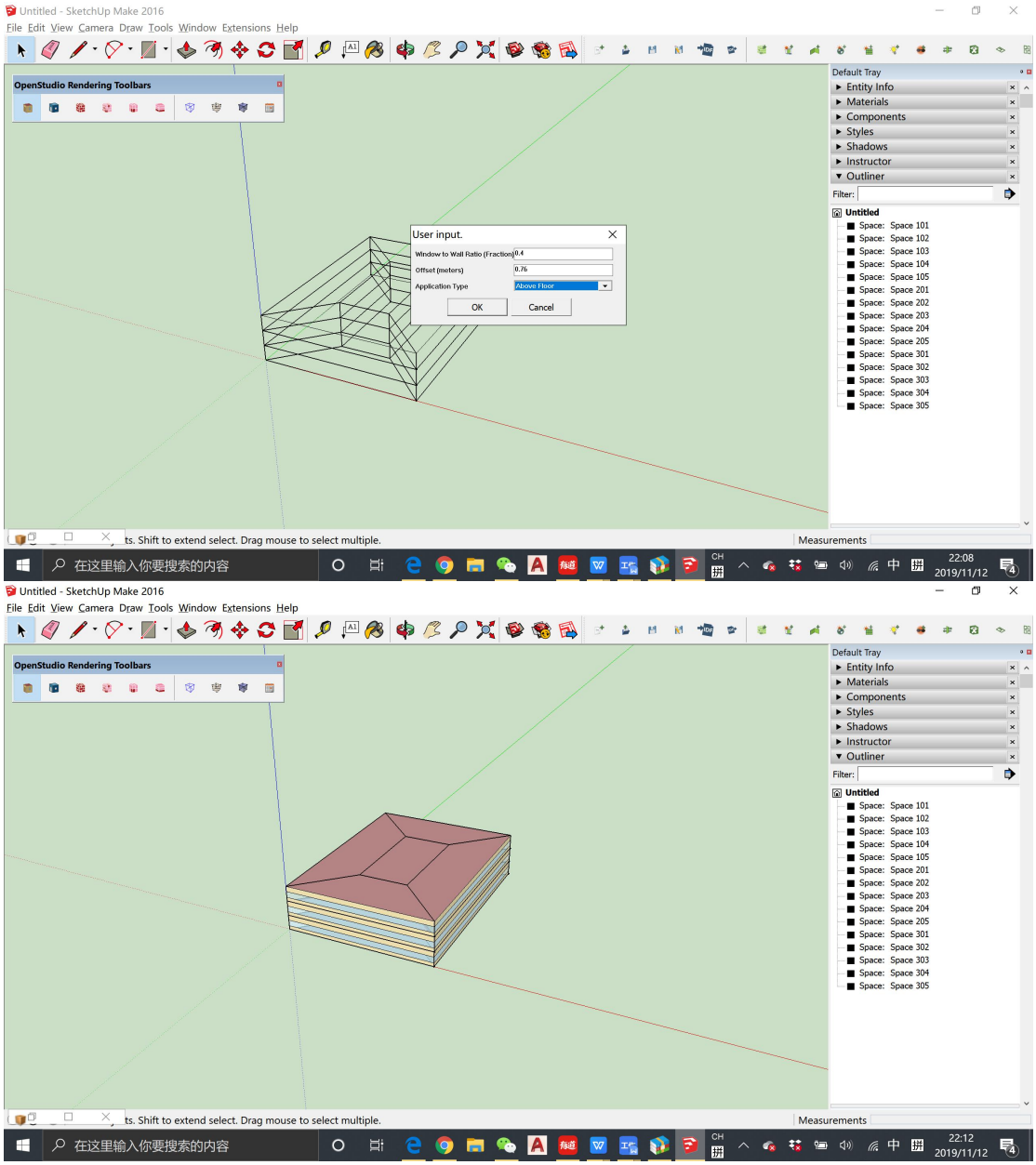
3. Match the model.

Using the surfaces matches tool we have to match the entire model. This step is mandatory to be able to create the windows.



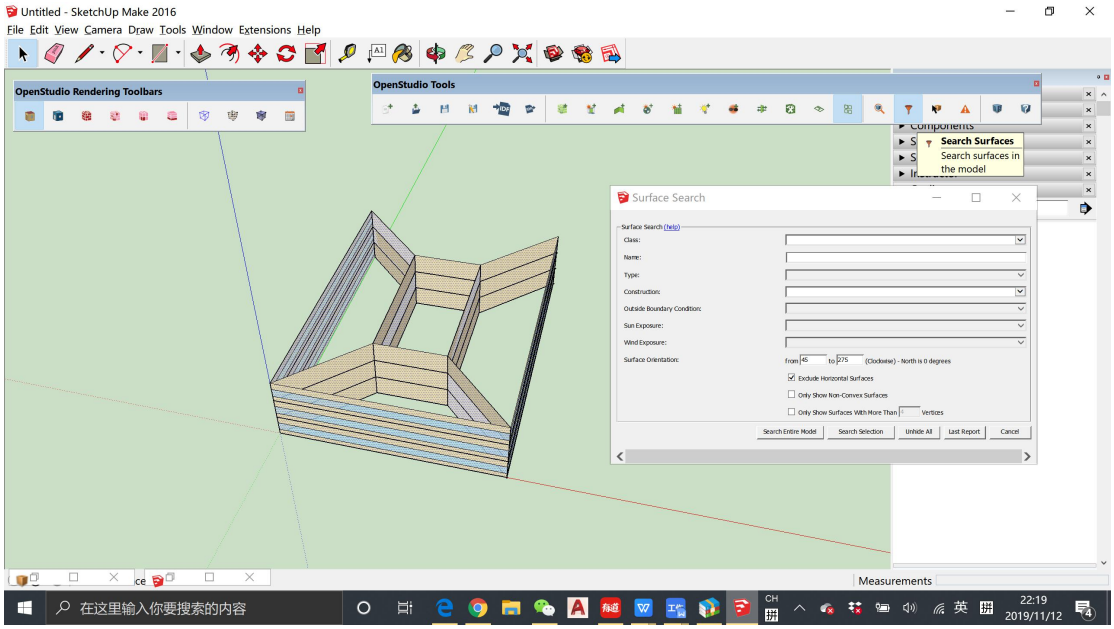
3. Windows placements.



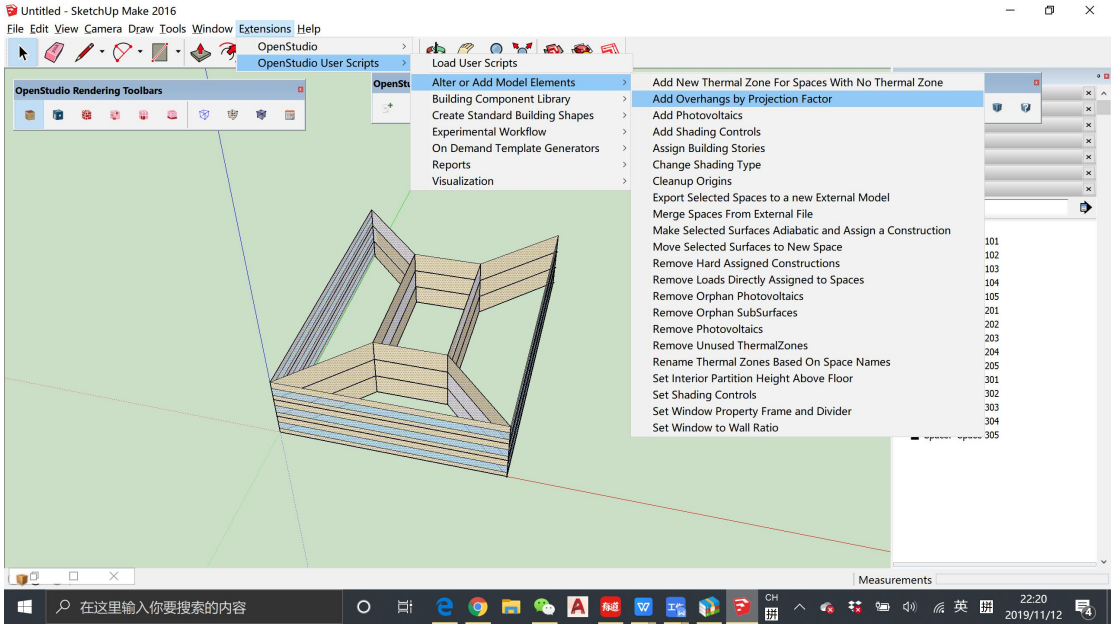


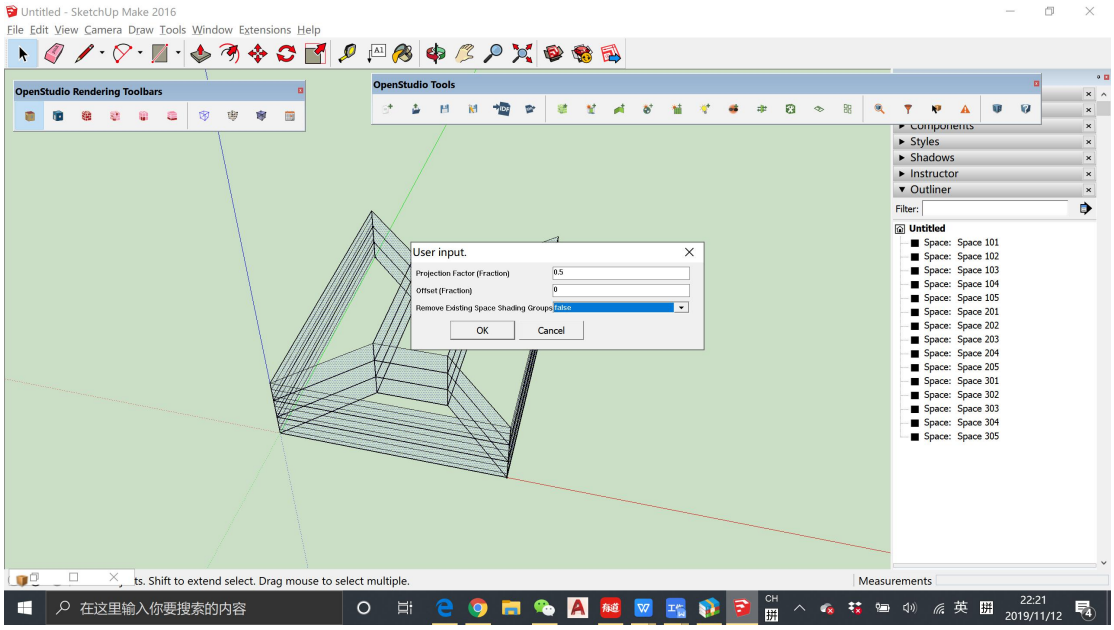
4. Selection.

Using the Search Surfaces tool we have to select all the facades except the north one.

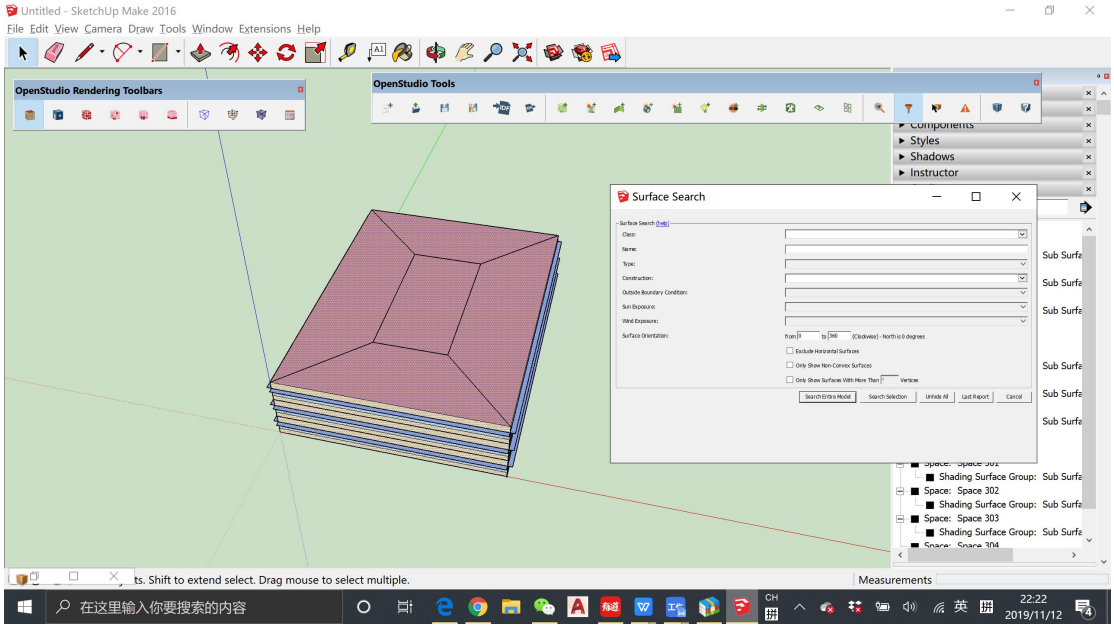


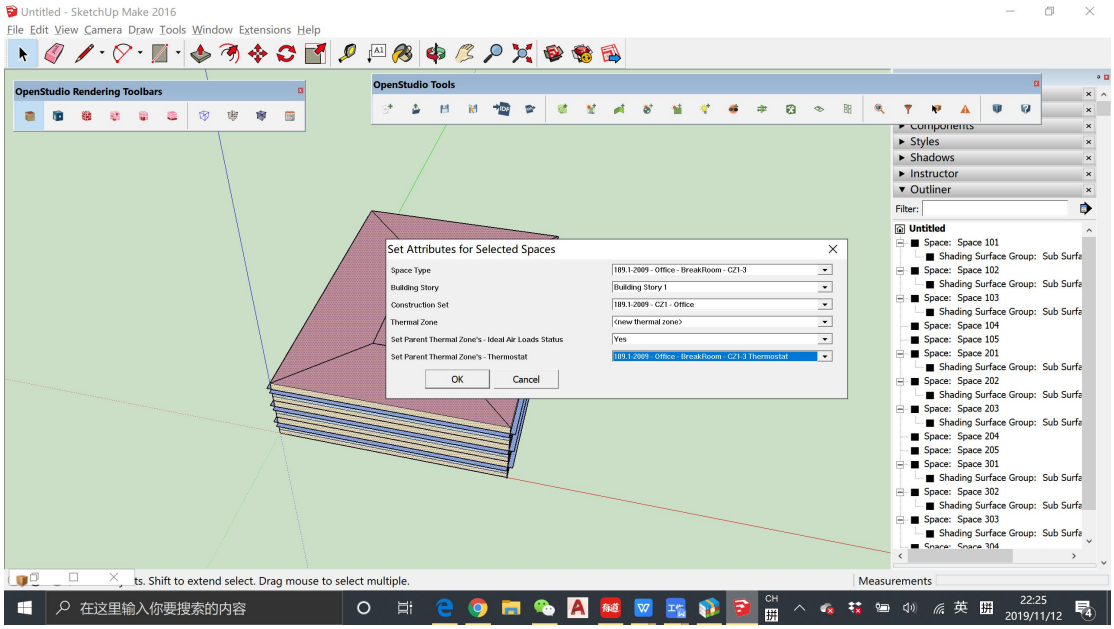
5. External shading addition.





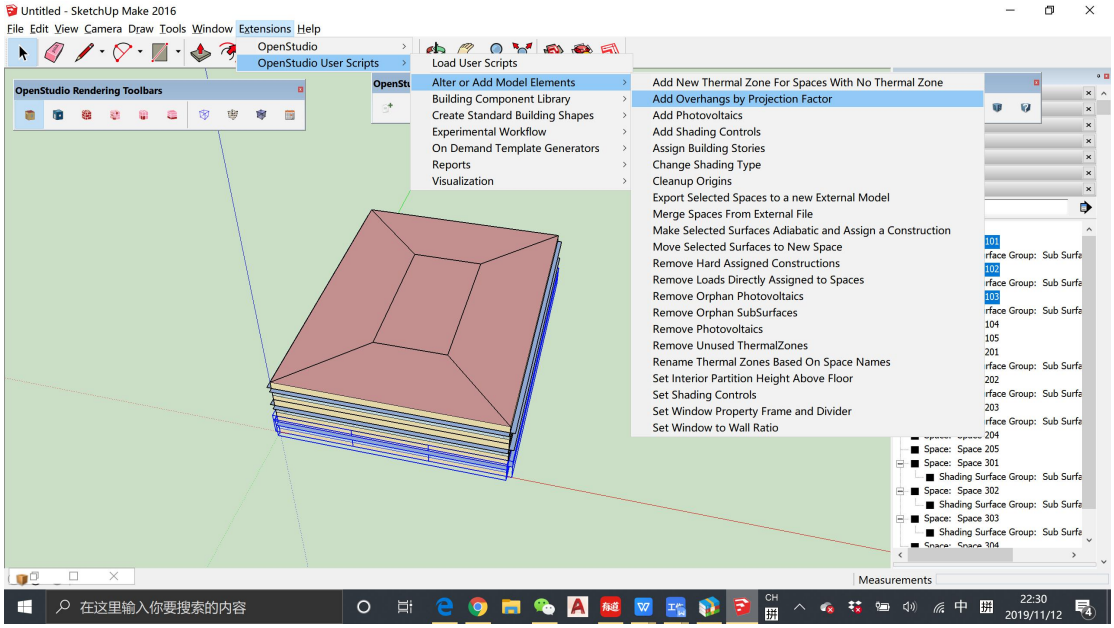
Using the search surfaces tool and applying 0 to 360 parameters we can visualize again the entire model.

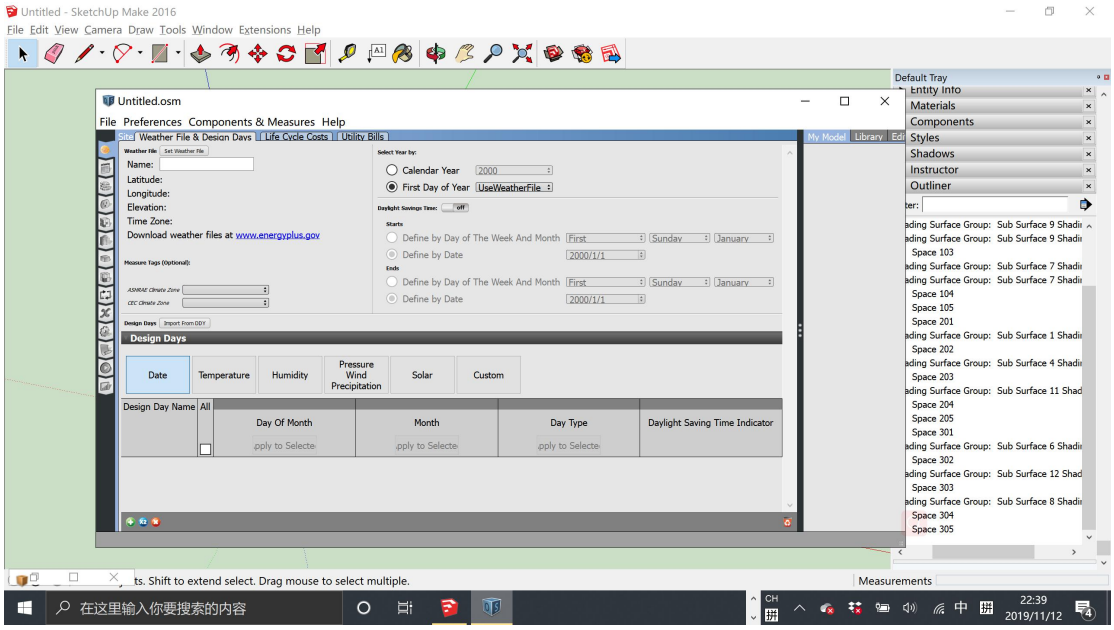




6. Adding of specifications.

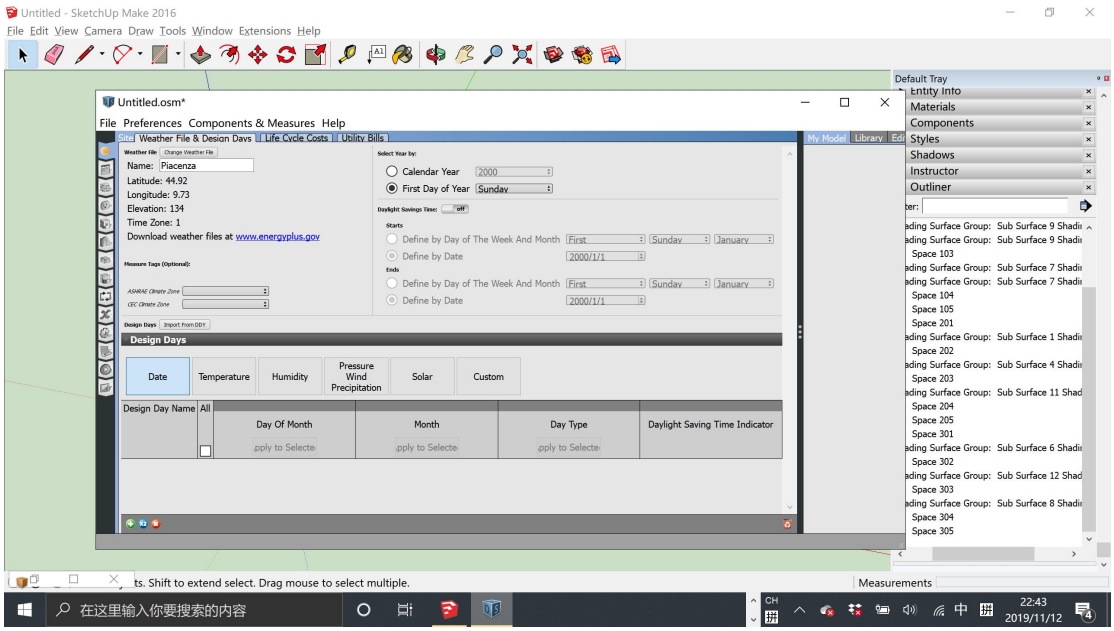
Choosing each thermal zone, we have to add the specifications.

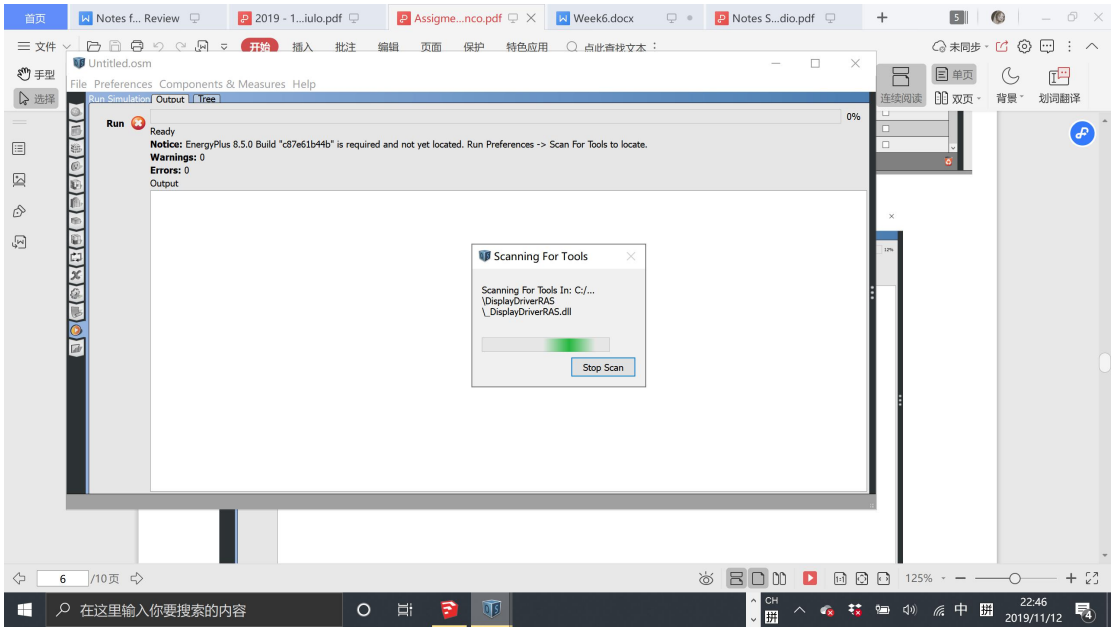




7. OpenStudio launching.

Launch open studio and add the weather file and run the model.





8. Result reviews.