

TES Technical Environmental System

Week # 6 Assignment

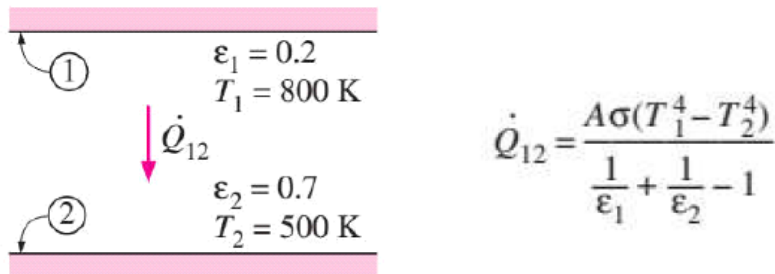
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Professor: Dr. Behzad Najafi

Date: 09/11/2019

Task 1: 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 ?

A diagram showing two single plates with the absence of a shield.



Given:

$A = 1.5 \text{ m}^2$; $\epsilon_1 = 0.2$; $\epsilon_2 = 0.7$; $T_1 = 800 \text{ K}$; $T_2 = 500 \text{ K}$

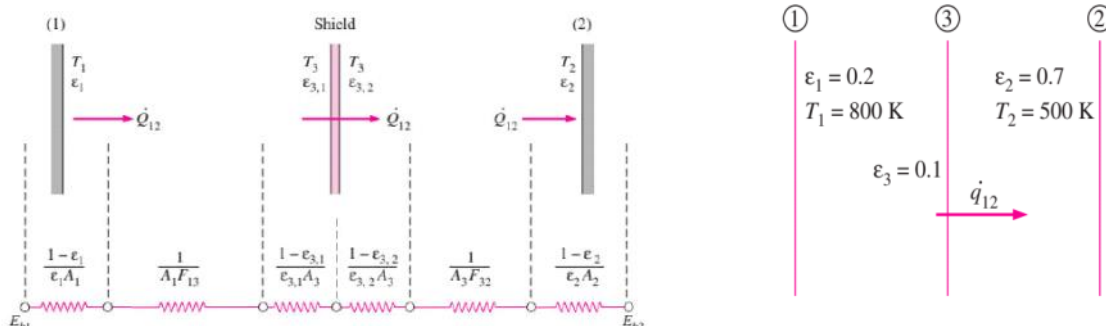
$$\dot{Q} = (1.5 \times 5.67 \times 10^{-8} \times (800^4 - 500^4)) / ((1/0.2) + (1/0.7) - 1) = 5,438.0522 \text{ W}$$

{This calculation needed to be done because it was wrong in the previous assignment, and I am correcting it in this assignment}

Please note, that in order to solve the task of assignment week #6, we should consider that ϵ_1 and ϵ_2 are equal to 0.1 (not as the picture is showing, referring to the assignment of last week)

$$\dot{Q} = (1.5 \times 5.67 \times 10^{-8} \times (800^4 - 500^4)) / ((1/0.1) + (1/0.1) - 1) = 1,553.7292 \text{ W}$$

With emissivity $\epsilon_1 = \epsilon_2 = 0.1$, We notice that the amount of radiative heat transfer from surface one to surface is reduced, and very small compared to the previous calculation when $\epsilon_1 = 0.2$ and $\epsilon_2 = 0.7$. We note that low emissivity material are less radiative than the ones with higher emissivity.



$$\dot{Q}_{12, N \text{ shields}} = \frac{A\sigma(T_1^4 - T_2^4)}{\left(\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1\right) + \left(\frac{1}{\epsilon_{3,1}} + \frac{1}{\epsilon_{3,2}} - 1\right) + \dots + \left(\frac{1}{\epsilon_{N,1}} + \frac{1}{\epsilon_{N,2}} - 1\right)}$$

$$\dot{Q}_{12, \text{ one shield}} = \frac{A\sigma(T_1^4 - T_2^4)}{\left(\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1\right) + \left(\frac{1}{\epsilon_{3,1}} + \frac{1}{\epsilon_{3,2}} - 1\right)}$$

A diagram showing two single plates with the presence of one shield in between.

In order to make the new heat transfer 1% of the last calculated heat transfer, we should multiply \dot{Q} by 0.1.

$$\dot{Q} = (1.5 \times 5.67 \times 10^{-8} \times (800^4 - 500^4)) / ((1/0.1) + (1/0.1) - 1) = 1,553.7292 \text{ W}$$

$$\dot{Q} \times 0.1 = 1553.7292 \times 0.1 = 155.37292 \text{ W}$$

$$\epsilon_{3,1} = \epsilon_{3,2} = 0.1$$

$$\dot{Q}_{12, N \text{ shields}} = \frac{A\sigma(T_1^4 - T_2^4)}{(N+1)\left(\frac{1}{\epsilon} + \frac{1}{\epsilon} - 1\right)} = \frac{1}{N+1} \dot{Q}_{12, \text{ no shield}}$$

$$Q_{12} \text{ with } N \text{ number of shields} = 155.37292 \text{ W} = 1/(N+1) \times 1553.7292$$

$$1/(N+1) = 155.37292/1553.7292 = 0.1$$

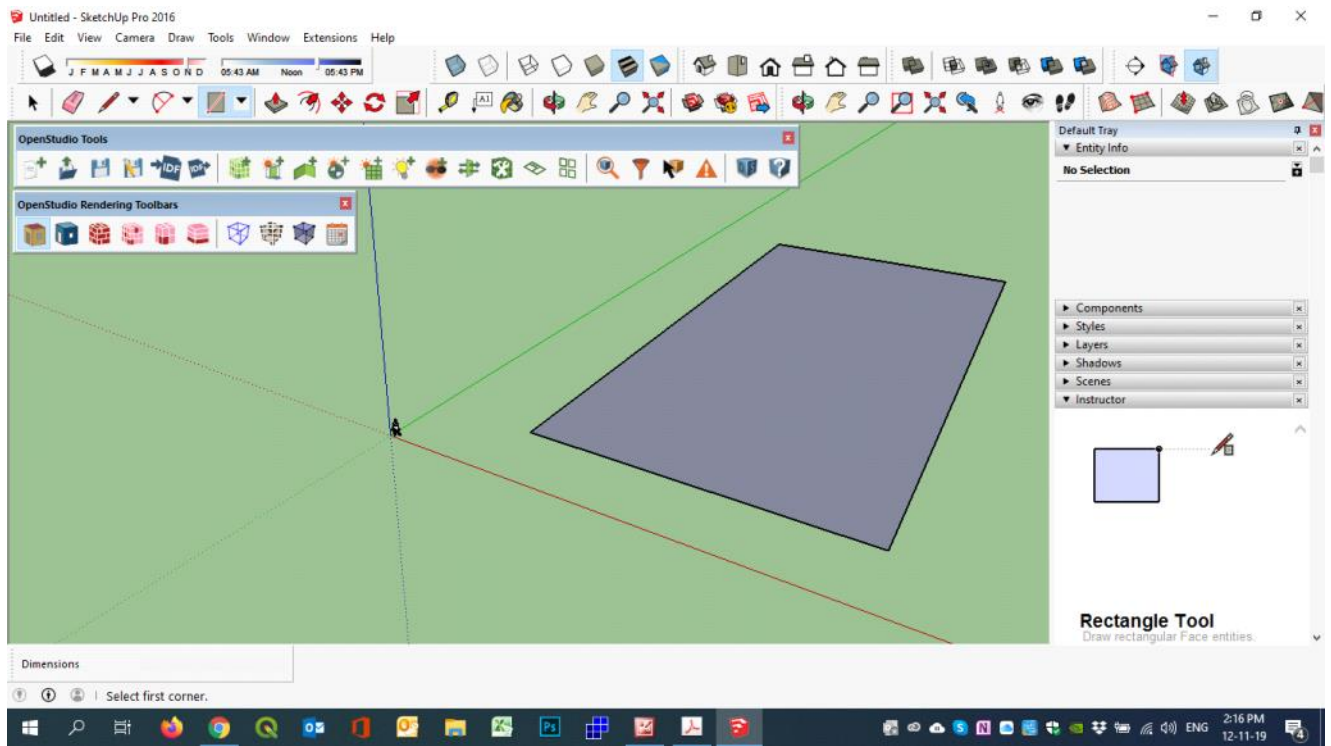
$$N+1 = 1/0.1 = 10$$

$$N = 9$$

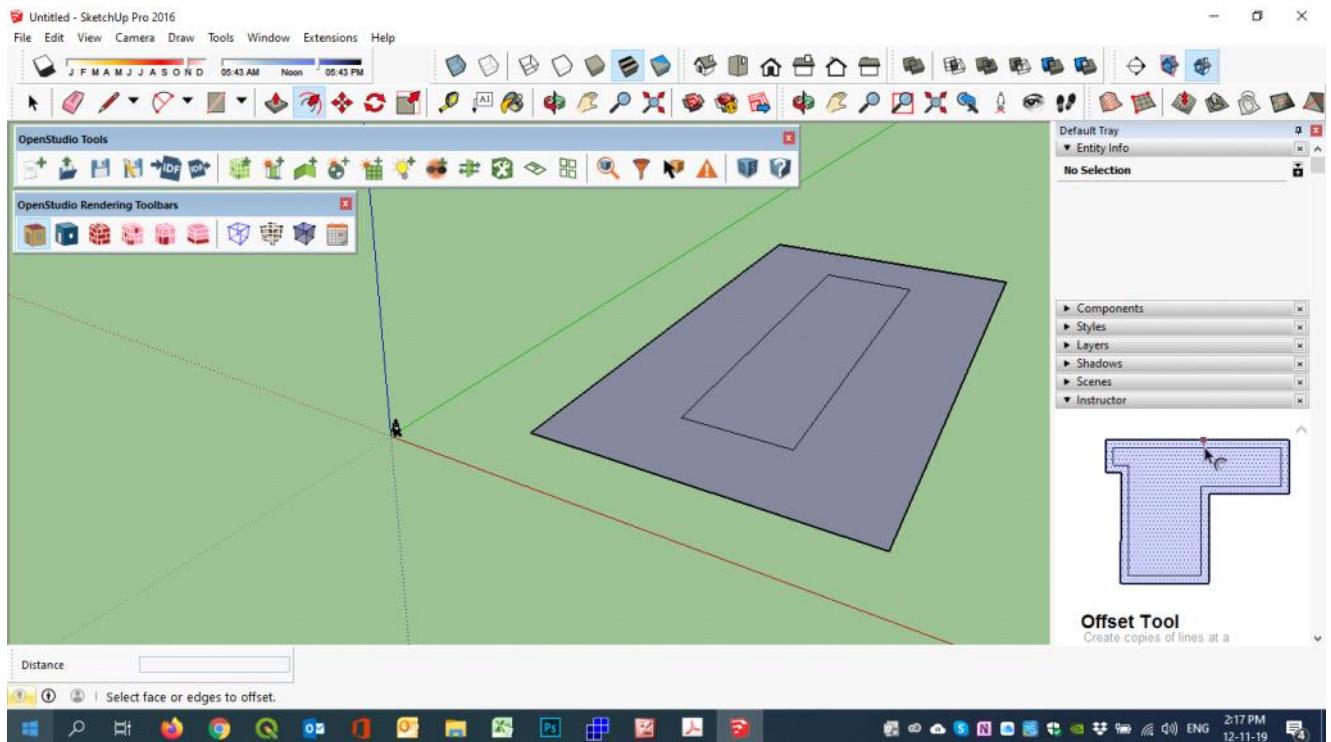
So in order to get a new heat transfer rate to be 1% of the case without shields with epsilon = 0.1, we should 9 shields

Task 2: You should create a pdf file with screenshots of all of the steps we went through and explain briefly the reason behind the use of each step.

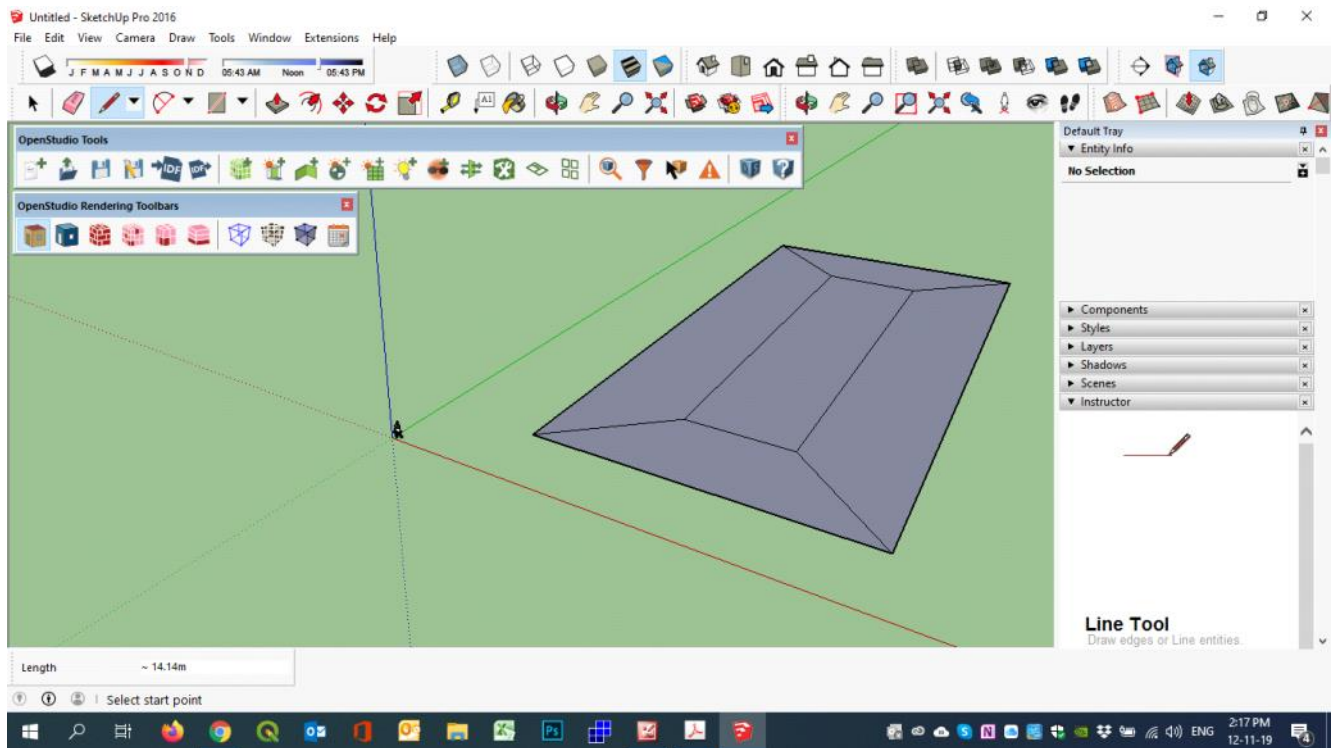
Step 1: Draw a rectangle 30 x 40 meters



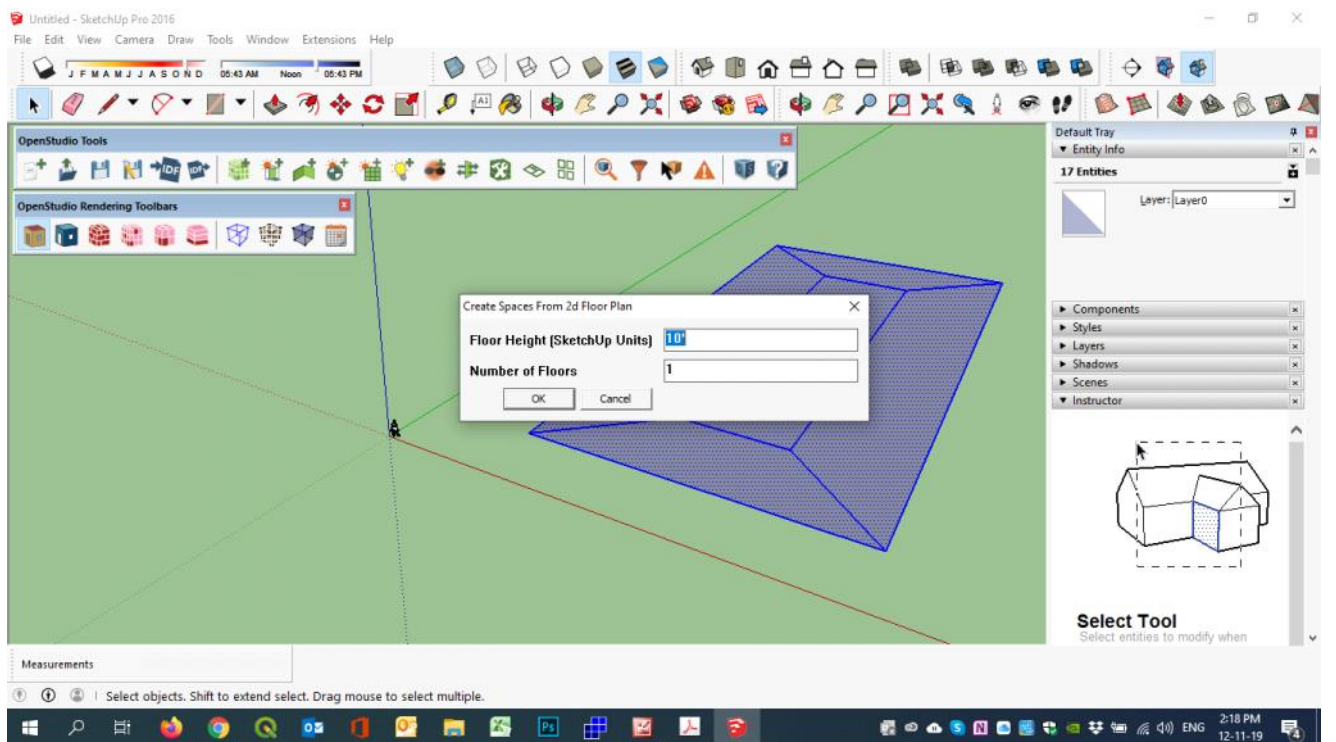
Step 2: Offset by 10 meters

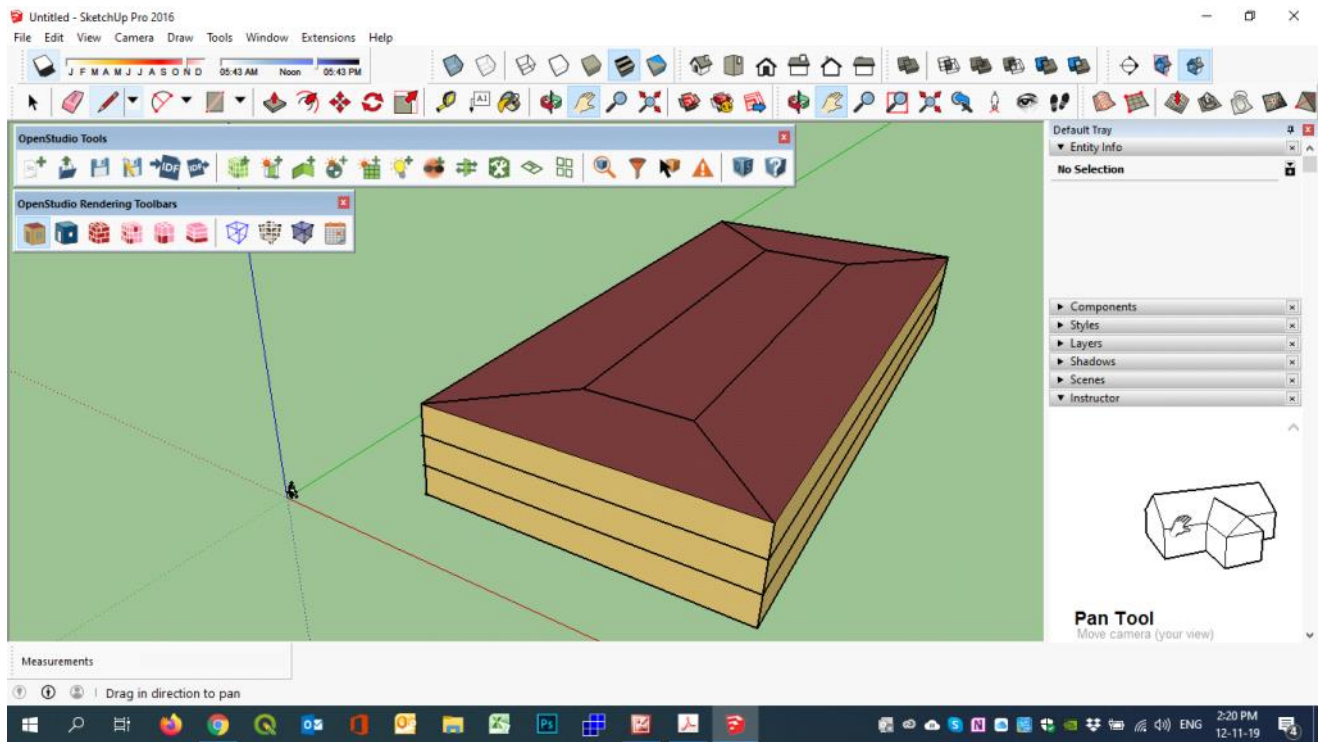


Step 3: join the two rectangles with lines

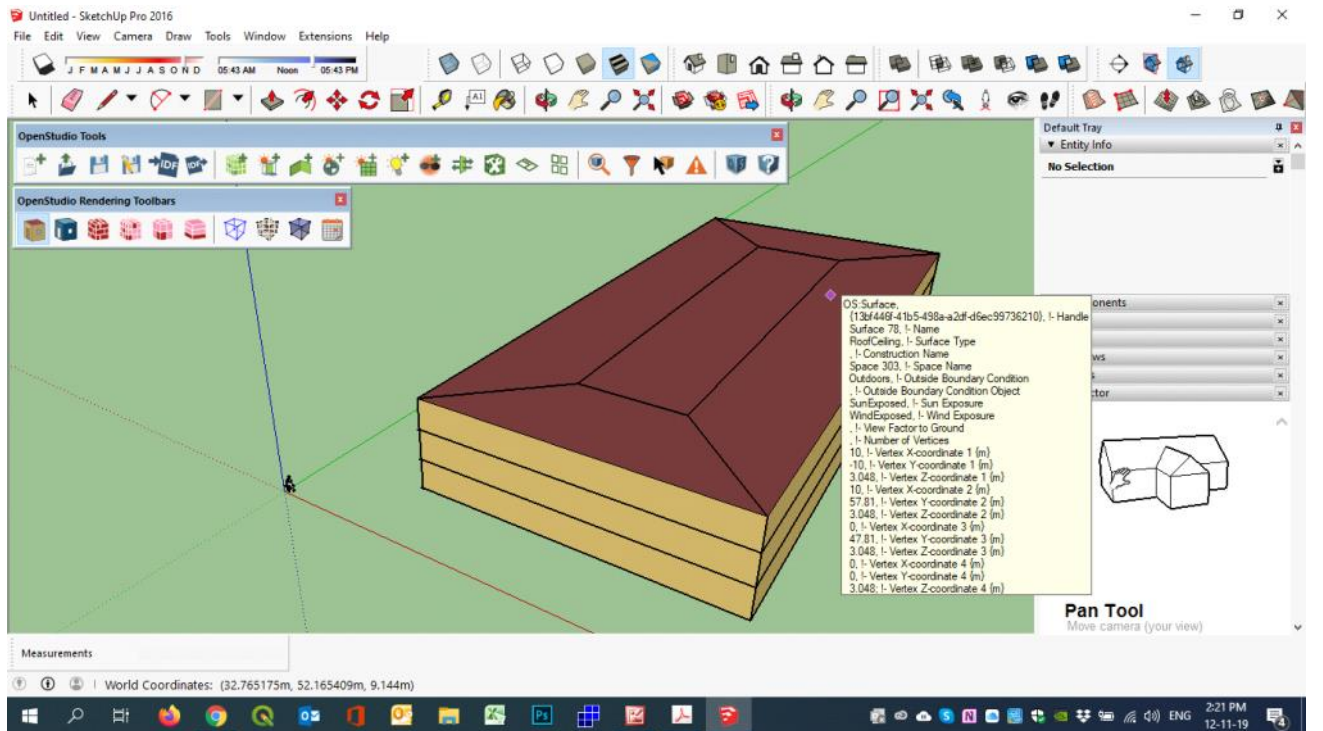


Step 4: Select the model, click on "Create Spaces from Diagram" in OST bar, Keep Floor Height 10', and Number of Floors for 3.

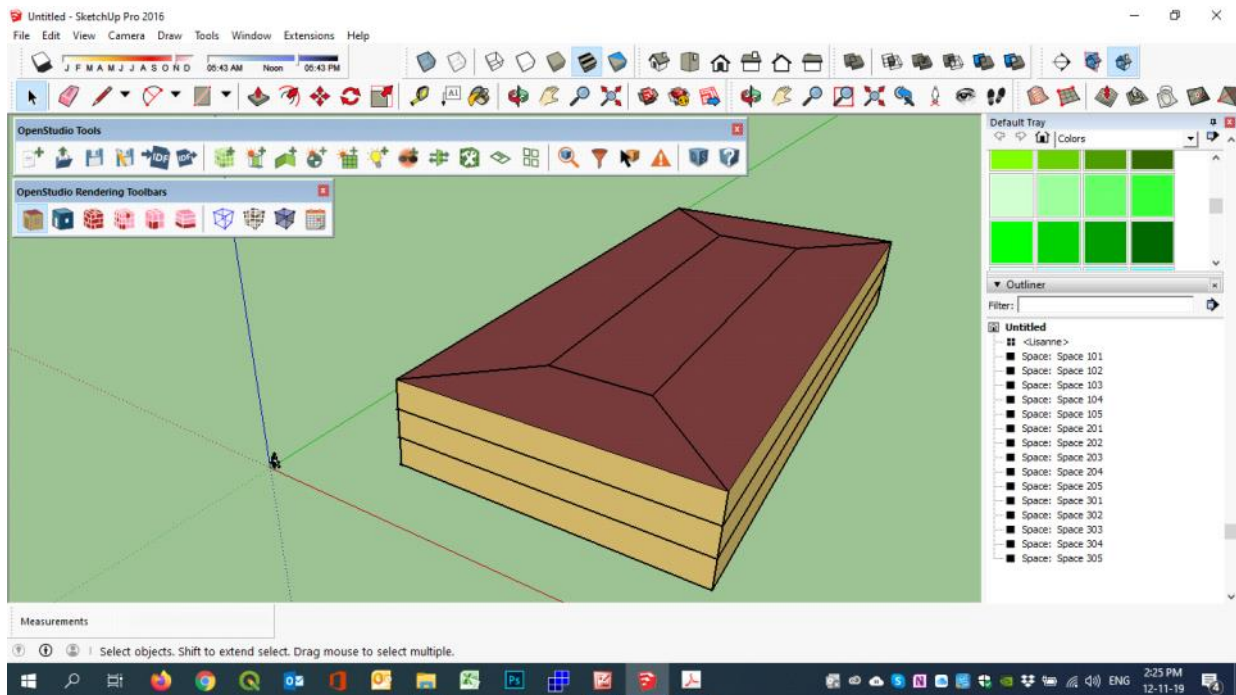




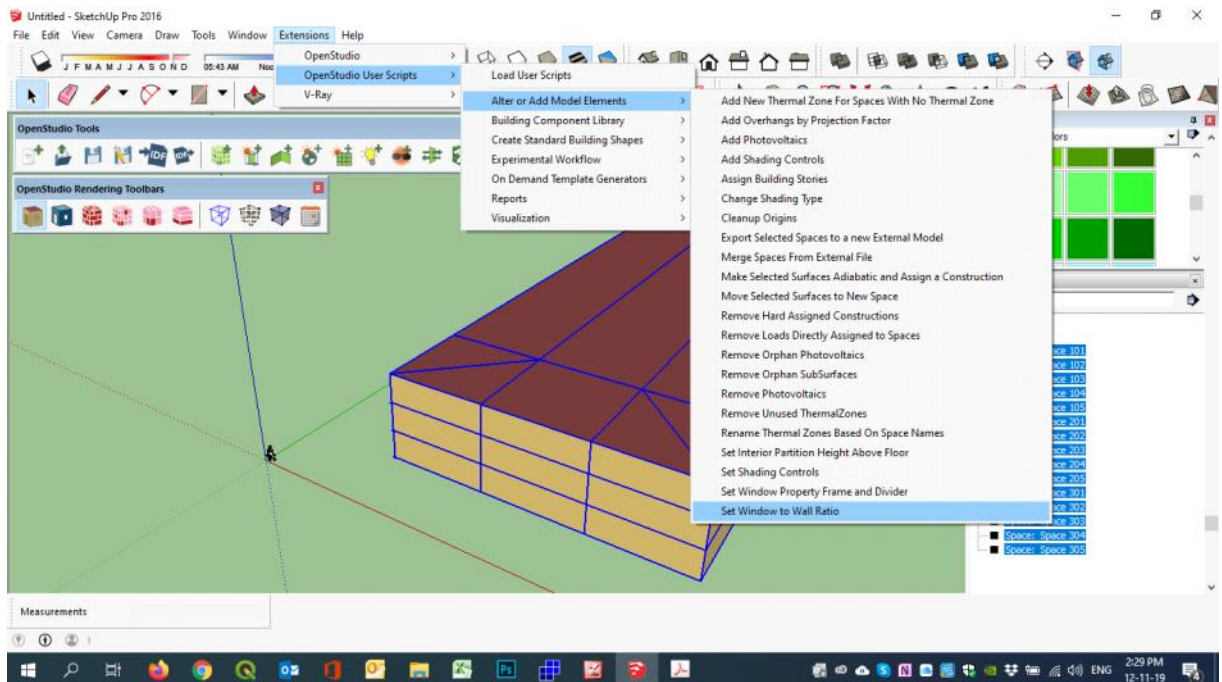
Step 5: click on "info Tool" in OST bar, than drag it above any surface, it gives you infos about each surface.

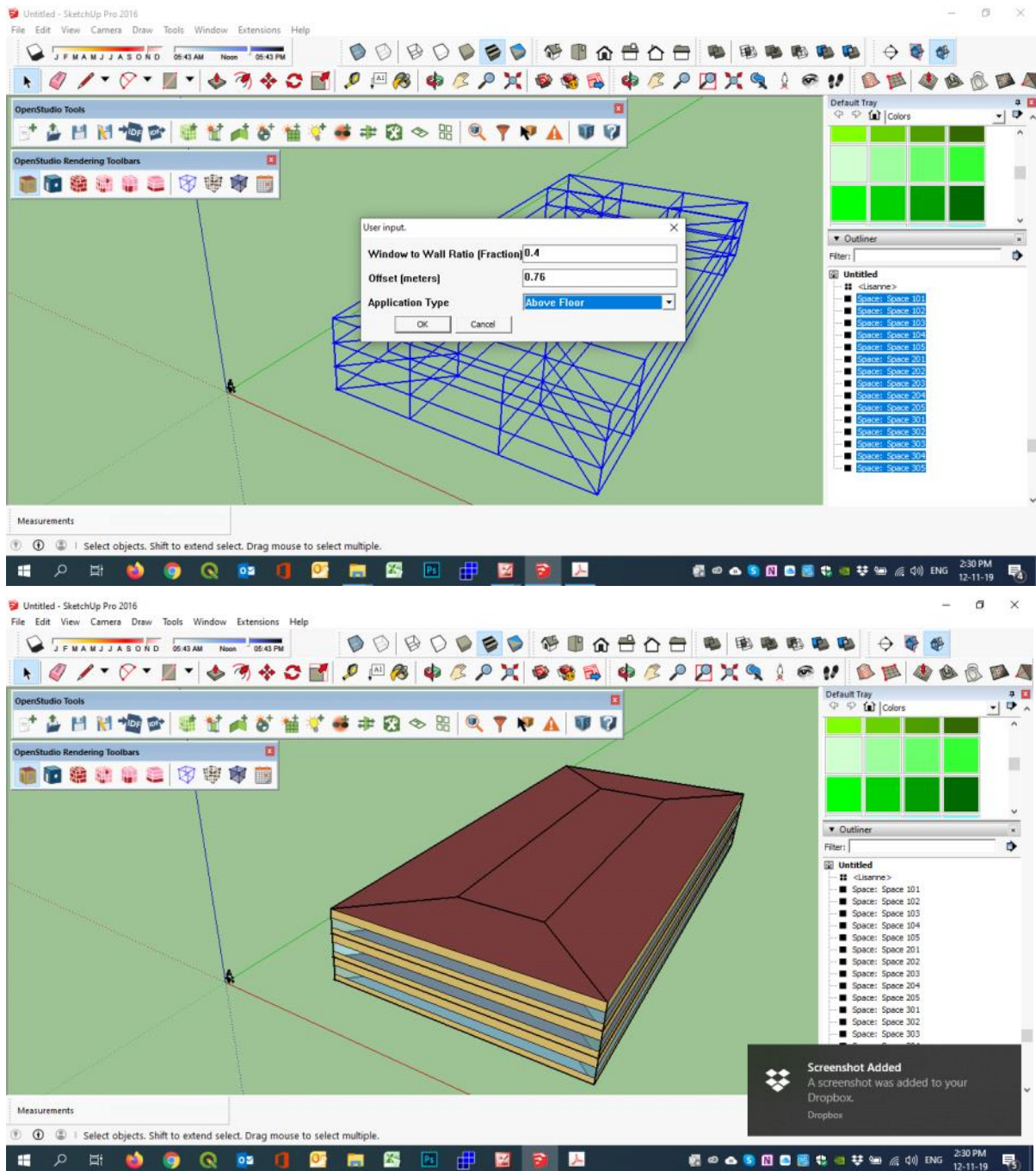


Step 6: In OST bar, click on " Surface Matching" while selecting the model.



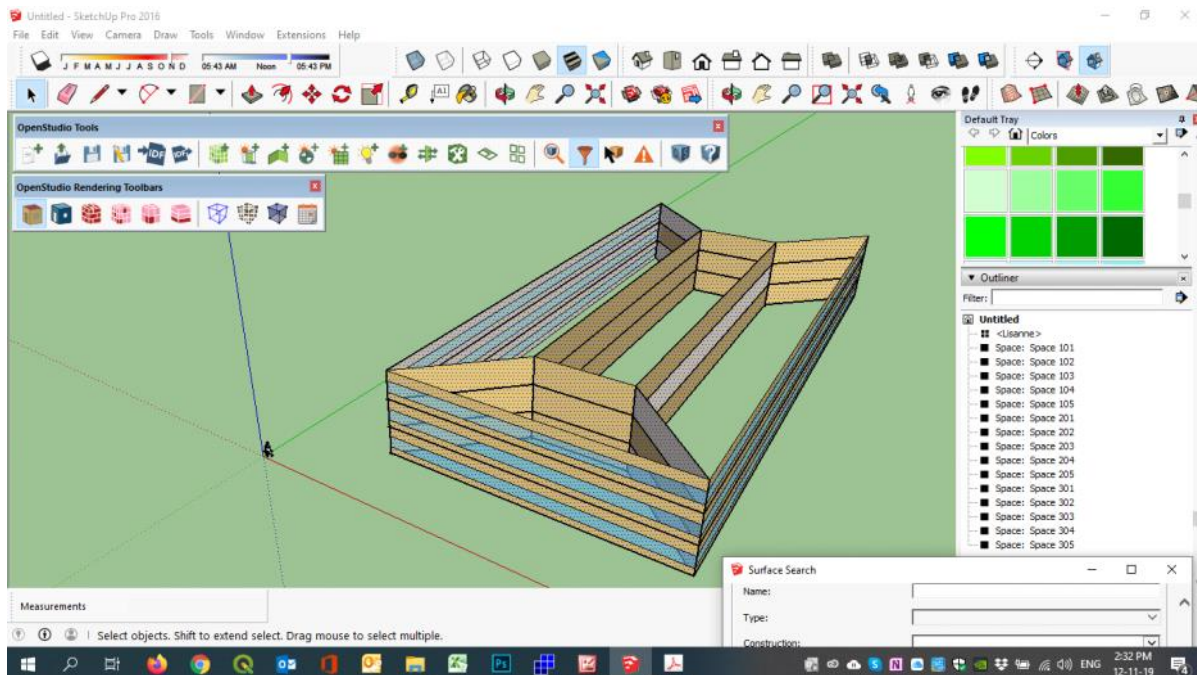
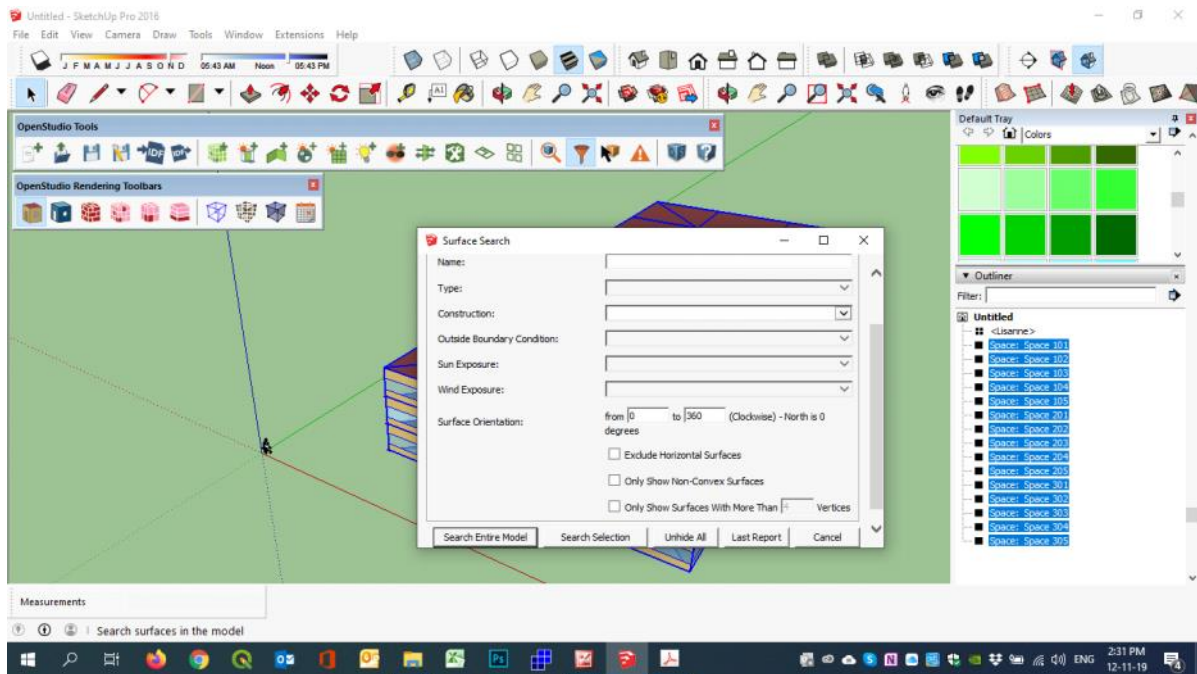
Step 7: in order to create windows, click Extensions, than Alter or Add Model Elements, than Set Window to wall Ratio.



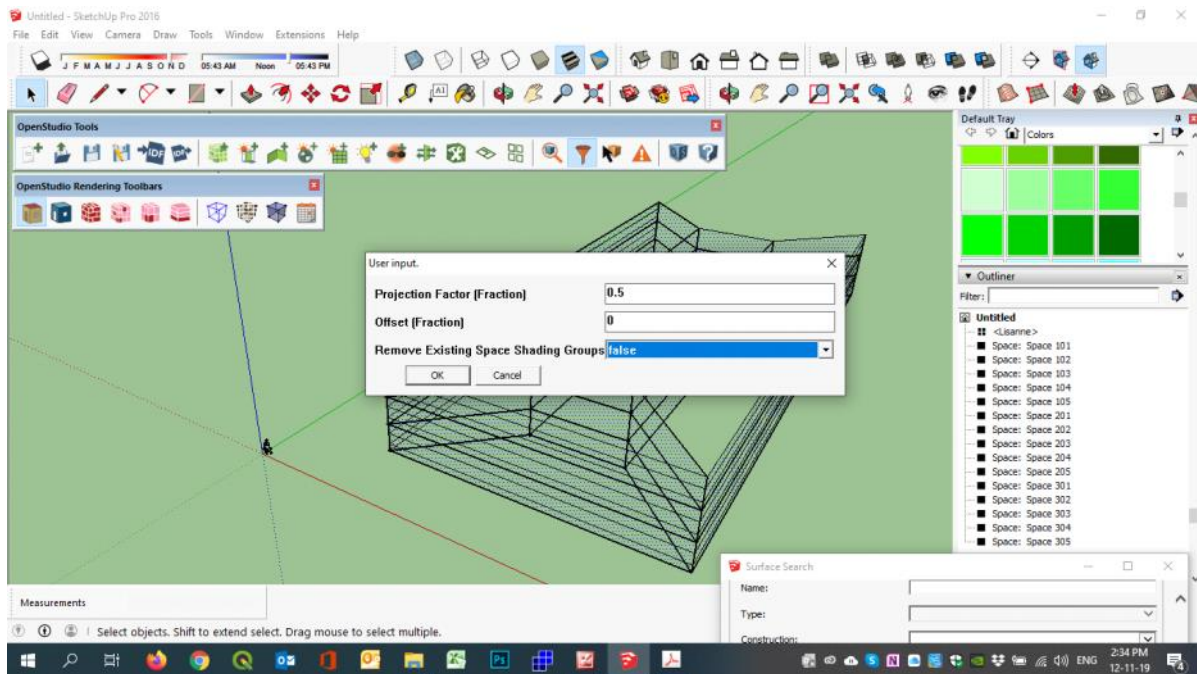


Step 8: We need to add overhangs, we first have to select the desired elevations.

In OST bar, click "search Surfaces", fill from "45" to "270", in order to select all the elevation except North.



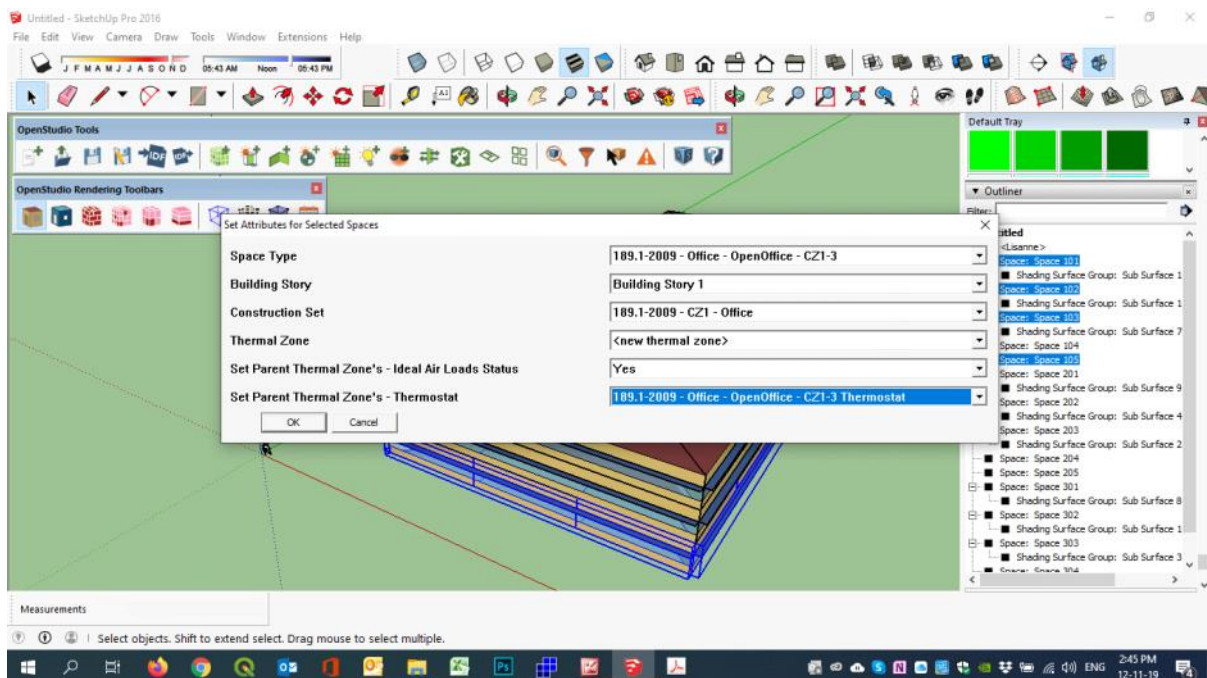
Without deselecting!!! click Extensions, than OpenStudio User Scripts, Alter or Add model Elements, Add overhangs by projection factor.



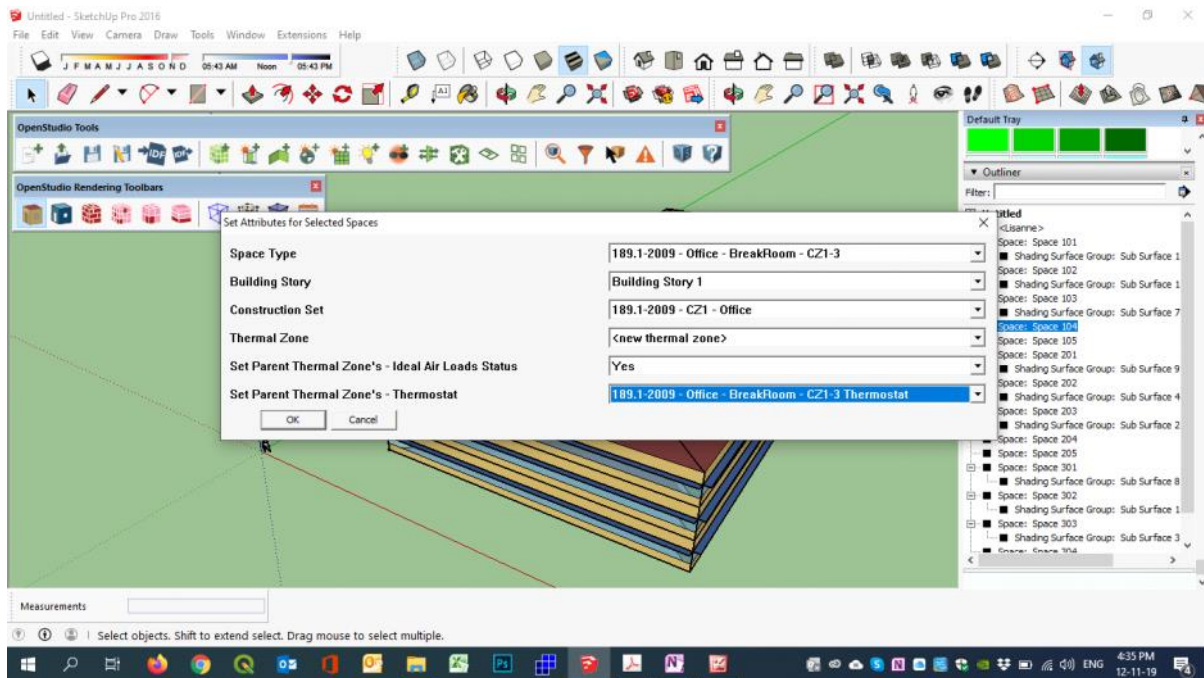
Than to unable the hiding effect, refill in the search surface (not closed!!!!) from "0" to "360".

Step 9: we need to choose the specifications for each space.

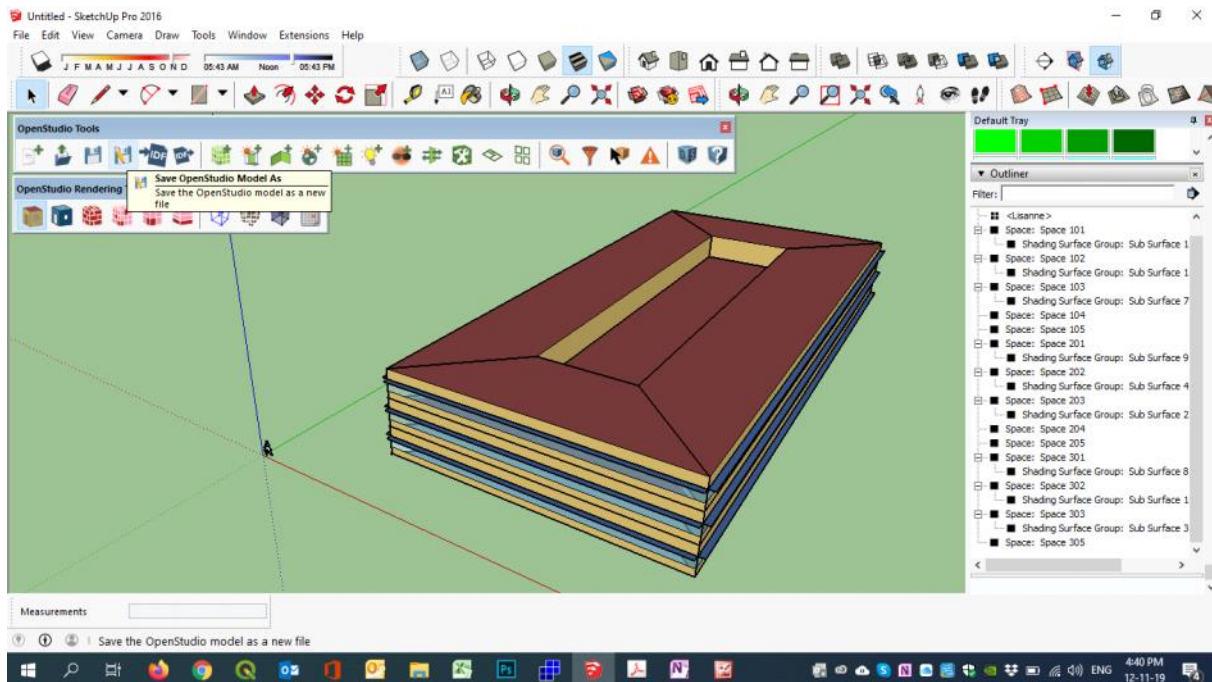
In the outliner window on the right, select object number (101, 102, 103, and 105), in the OST bar, click "Set attributes for selected Spaces", fill the specified data below. And repeat the task for (201,202,203, 205), and (301,302,303, and 305) while replace "Building Story 1" by "Building Story 2" and "Building Story 3".



In the outliner window on the right, select object number (104), in the OST bar, click on "Set for selected Spaces", fill the specified data below. And repeat the task for (204), and (304), while "Building Story 1" by "Building Story 2" and "Building Story 3".



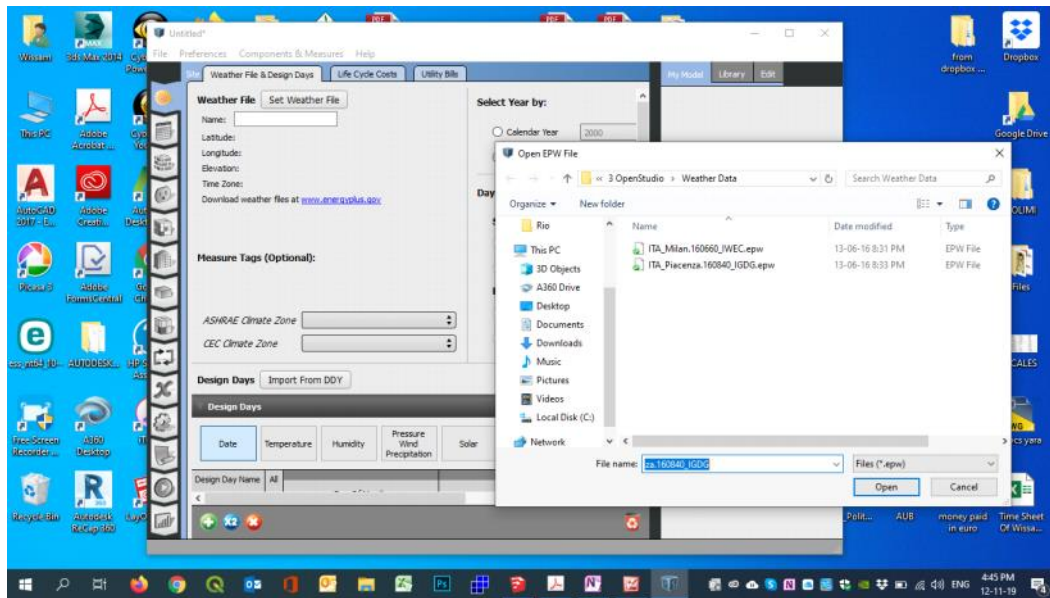
Step 10: Save the File. Be careful!!!!!! Its not a sketch up file to save normally. In the OST bar, click on "save open Studio Model As".



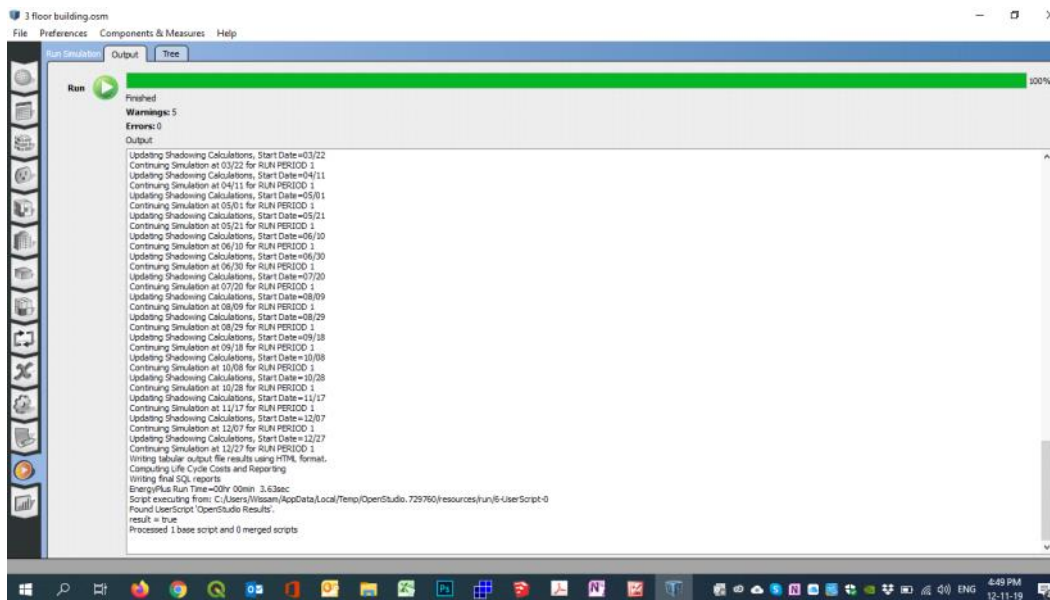
Step 11: Open "Open Studio" Software.

Open the file you saved previously, the when it asks you, Click Discard!!!!!!

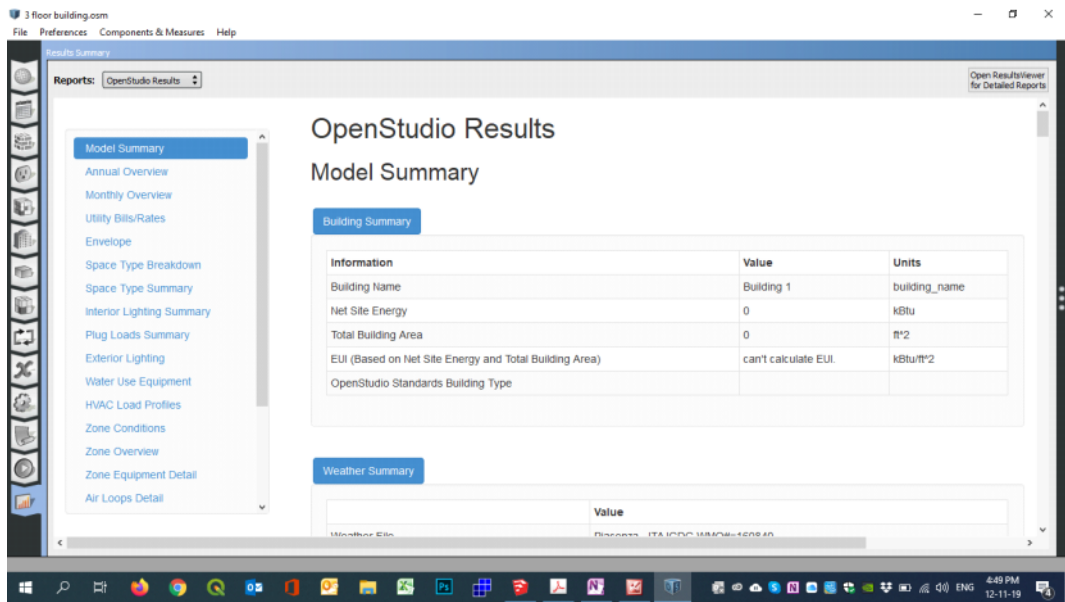
Assign "Piacenza weather Data" for weather file , and Design Days.



Then we Run the test.



Then we check the results.



Thank you.