

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 ?

First,

$$\epsilon_1 = 0.2, \epsilon_2 = 0.7, \dot{Q}_{\text{no shield}} = 3625.67 \frac{W}{m^2}$$

$$\text{So, } 1\% \text{ of } 3625.67 = \frac{\sigma(T_1^4 - T_2^4)}{\left(\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1\right) + \left(\frac{1}{\epsilon_3} + \frac{1}{\epsilon_3} - 1\right) * N}$$

$$\frac{3625.67}{100} = \frac{5.67 * 10^{-8} (800^4 - 500^4)}{\left(\frac{1}{0.2} + \frac{1}{0.7} - 1\right) + \left(\frac{1}{0.1} + \frac{1}{0.1} - 1\right) * N}$$

$$36.2567 = \frac{19680.57}{5.429 + 19N}$$

N= 28.3 ≈ 28 shields

$$\text{Now, } \dot{Q} = \frac{\sigma(T_1^4 - T_2^4)}{\left(\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1\right) + \left(\frac{1}{\epsilon_3} + \frac{1}{\epsilon_3} - 1\right) * N} = \frac{5.67 * 10^{-8} (800^4 - 500^4)}{\left(\frac{1}{0.2} + \frac{1}{0.7} - 1\right) + \left(\frac{1}{0.1} + \frac{1}{0.1} - 1\right) * 28} = 36.62 \frac{W}{m^2}, \text{ which is } 1\% \text{ of the earlier heat trasfer rate}$$

Secondly,

$$\epsilon_1 = 0.1, \epsilon_2 = 0.1, \dot{Q}_{\text{no shield}} = 1035.81 \frac{W}{m^2}$$

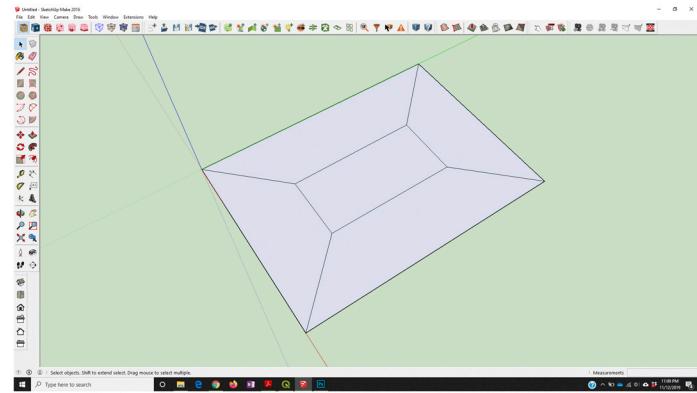
$$\dot{Q}_{N \text{ number of shields}} = \frac{1}{N+1} \dot{Q}_{\text{no shield}}$$

$$1\% = \frac{1}{N+1} 100\%$$

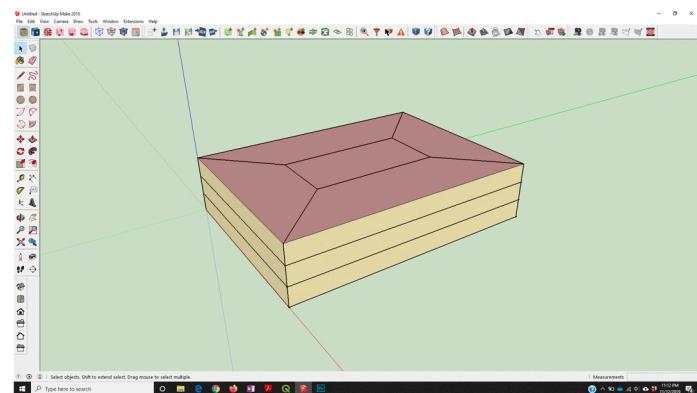
$$N = \frac{100\%}{1\%} - 1$$

N= 99 shields

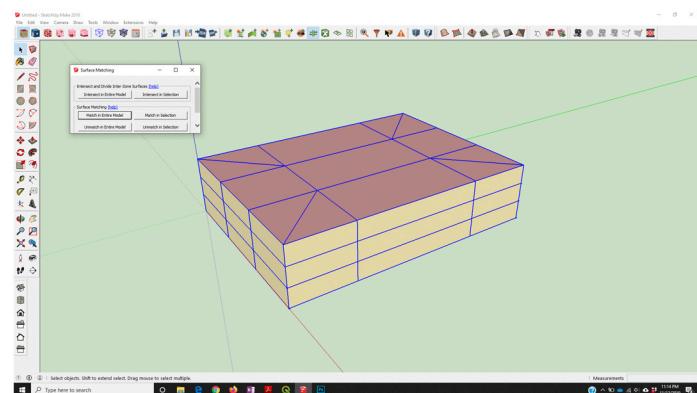
$$\text{So, } \dot{Q}_{99} = \frac{\sigma(T_1^4 - T_2^4)}{\left(\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1\right) + (N+1)} = \frac{5.67 * 10^{-8} (800^4 - 500^4)}{99+1 + \left(\frac{1}{0.1} + \frac{1}{0.1} - 1\right)} = 10.36 \frac{W}{m^2}, \text{ which is } 1\% \text{ of the earlier heat trasfer rate}$$



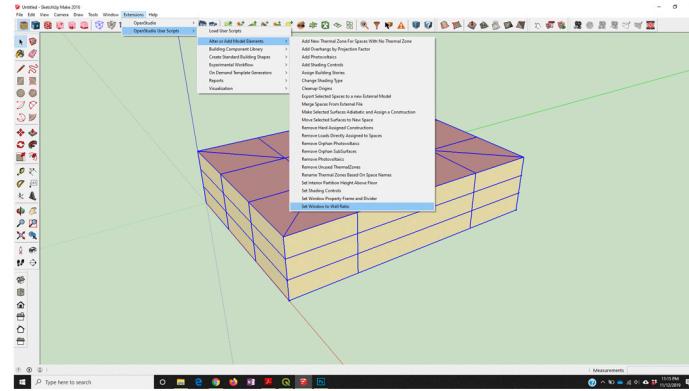
At first, I drew a square of 30X40m in sketchup and offset it by 10 m.
Then joined the 4 corners.



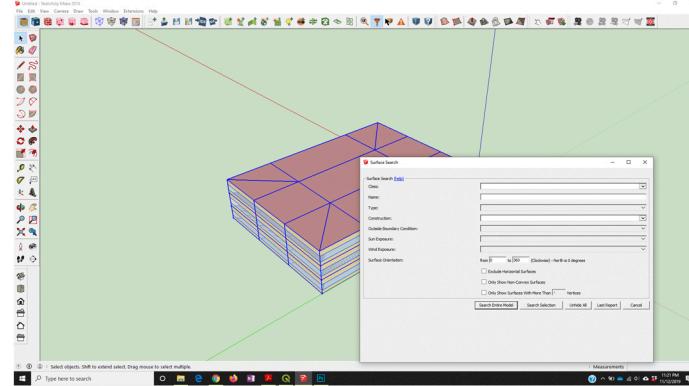
Then, I selected the whole rectangle and clicked the icon
“create spaces for diagram” to build the building of 3 floors.



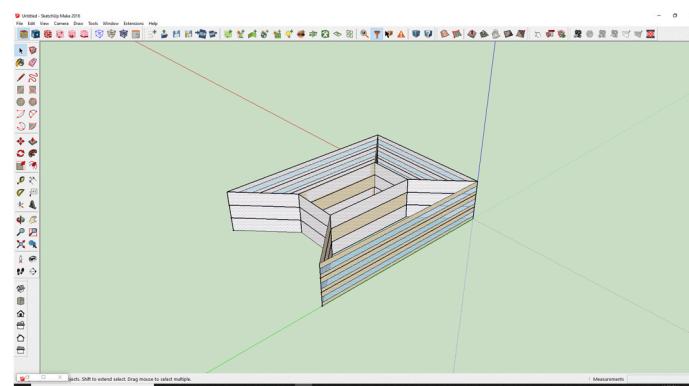
Then, I selected the whole building and clicked the icon
“surface matching tool” to match the interior and exterior surfaces.
Otherwise the windows will not be properly made.



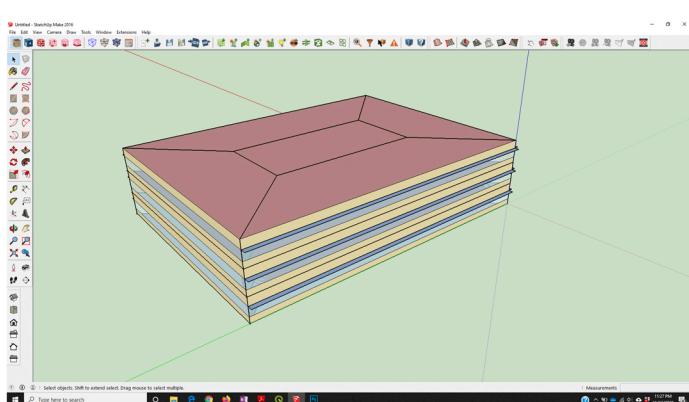
Then, I made windows using the tool “set window to wall ratio” to create some windows.



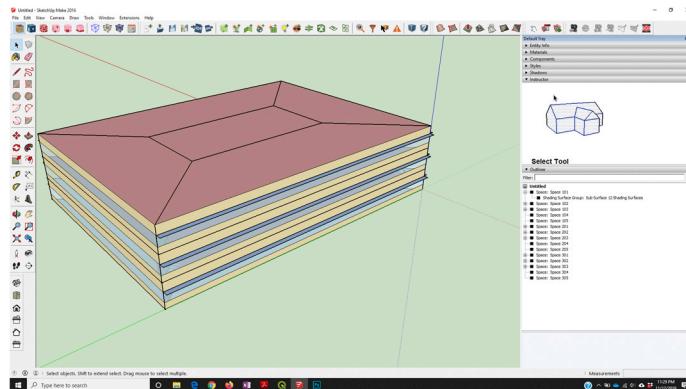
Now, I selected all the surfaces except for the north surface to add overhang.



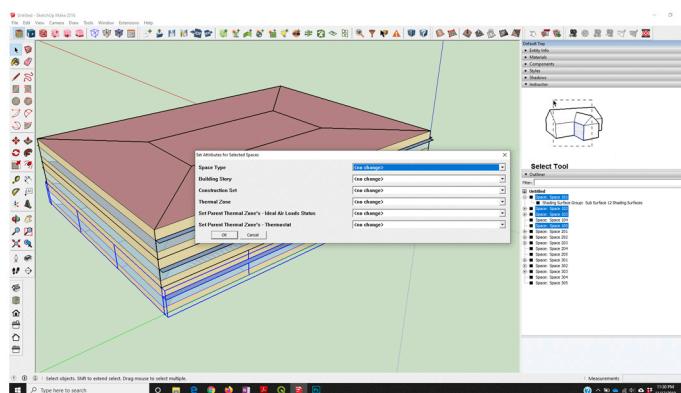
This is showing the selected surfaces for making overhang.



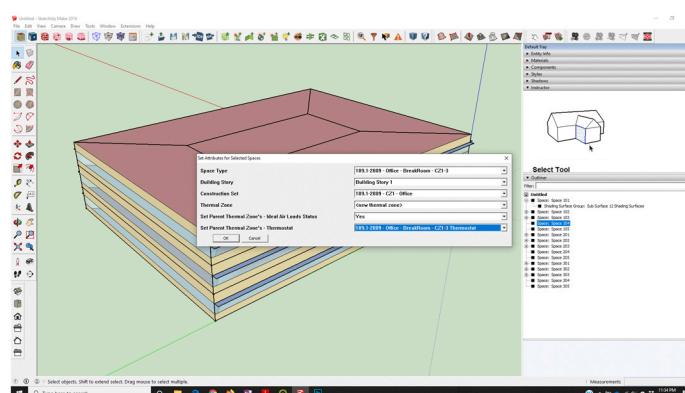
The overhang is made except for the north surfaces.



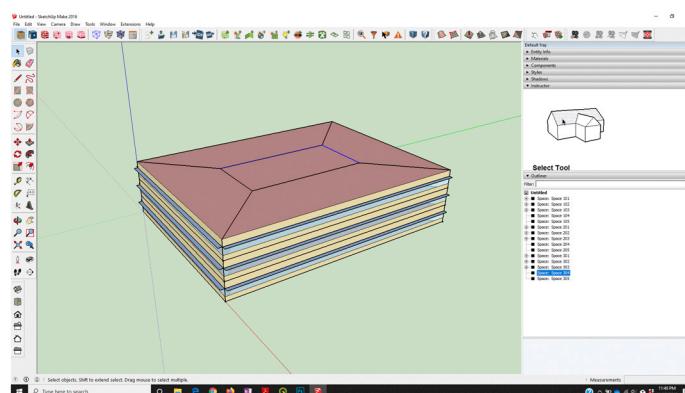
Then I opened the outliner tray in my windows.



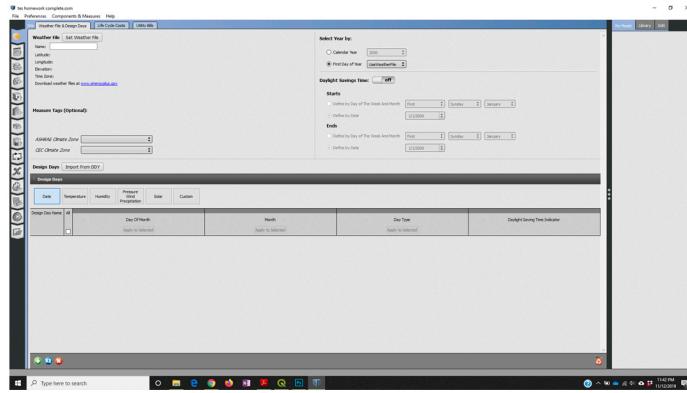
Then I selected the surfaces and clicked “set attributes for selected spaces” and filed the blank spaces for open office.



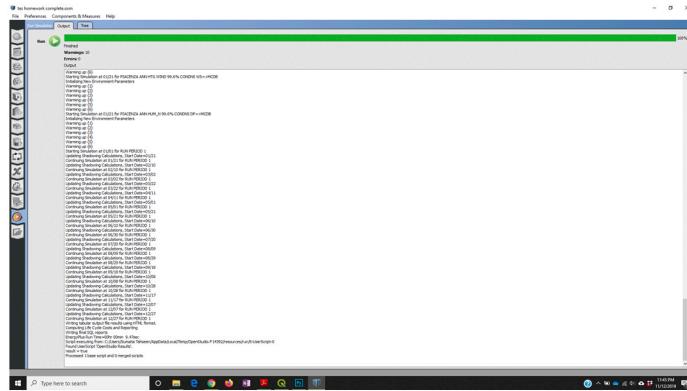
Then I repeated the same thing for other surfaces and filed the blank spaces for breakrooms.



I completed the same step for all the surfaces.



I opened the openstudio completed file in Openstudio software and put the weather data.



Finally I ran the application to get the result!