Week 6 weekly submission

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Task 1

Considering the same example you solved in the previous assignment (radiative heat transfer between two parallel plates), how many shields with Ɛ = 0.1 should you add in order to have the new heat transfer rate to be 1% of the case without shields?

Given: $\varepsilon_1 = 0.2$, $T_1 = 800$ K, $\varepsilon_2 = 0.7$, $T_2 = 500$ K, $\dot{q} = 3625.37 \frac{W}{m^2}$ (without shields)

$$\frac{3625.37}{100} = \frac{\delta (T_1^4 - T_2^4)}{\left(\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1\right) + \left(\frac{1}{\varepsilon_3} + \frac{1}{\varepsilon_3} - 1\right)(Number\ of\ shields)}$$

$$\left(\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1\right) + \left(\frac{1}{\varepsilon_3} + \frac{1}{\varepsilon_3} - 1\right)(N) = \frac{\delta (T_1^4 - T_2^4)}{36.25}$$

$$N = \frac{\frac{\delta (T_1^4 - T_2^4)}{36.25} - \left(\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1\right)}{\left(\frac{1}{\varepsilon_3} + \frac{1}{\varepsilon_3} - 1\right)}$$

$$N = \frac{\frac{5.67\ x\ 10^{-8}\ (800^4 - 500^4)}{36.25} - \left(\frac{1}{0.2} + \frac{1}{0.7} - 1\right)}{\left(\frac{1}{0.1} + \frac{1}{0.1} - 1\right)} = 28\ shields$$

Checking:

$$\dot{q} = \frac{\delta (T_1^4 - T_2^4)}{\left(\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1\right) + \left(\frac{1}{\varepsilon_3} + \frac{1}{\varepsilon_3} - 1\right)(Number\ of\ shields)}$$

$$\dot{q} = \frac{5.67\ x\ 10^{-8}\ (800^4 - 500^4)}{\left(\frac{1}{0.2} + \frac{1}{0.7} - 1\right) + \left(\frac{1}{0.1} + \frac{1}{0.1} - 1\right)(28)} = 36.25\ \frac{W}{m^2}\ (1\%\ of\ 3625.37 \frac{W}{m^2})$$

Given: $\varepsilon_1 = 0.1$, $T_1 = 800$ K, $\varepsilon_2 = 0.1$, $T_2 = 500$ K, $\dot{q} = 1035.81 \frac{W}{m^2}$ (without shields)

$$\dot{q}_{N\ shields} = \frac{1}{N+1}\ \dot{q}_{no\ shields}$$

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

$$(1\%)(N + 1) = 100\%$$

$$N = \frac{100\%}{1\%} - 1 = 99$$

Checking:

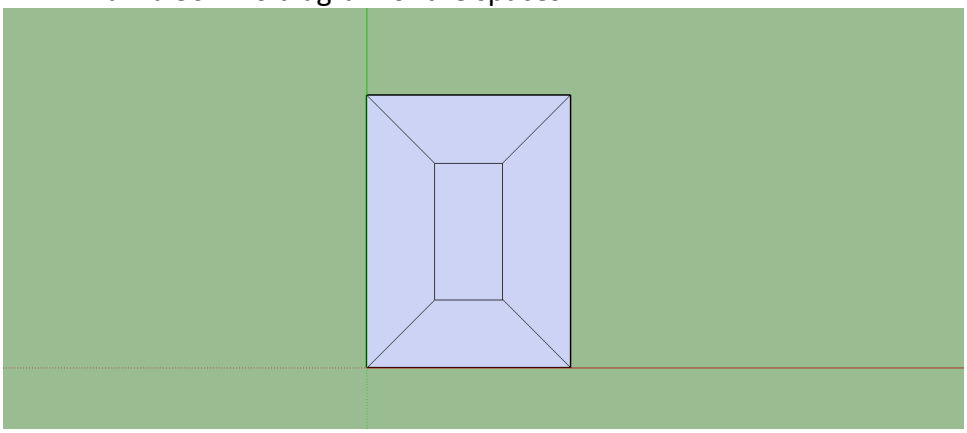
$$\dot{q}_{99\ shields} = \frac{\delta (T_1^4 - T_2^4)}{(N + 1) + \left(\frac{1}{\varepsilon} + \frac{1}{\varepsilon} - 1\right)}$$

$$\dot{q}_{99\ shields} = \frac{5.67\ x\ 10^{-8}\ (800^4 - 500^4)}{(99 + 1) + \left(\frac{1}{0.1} + \frac{1}{0.1} - 1\right)} = 10.36\ \frac{W}{m^2}\ (1\%\ of 1035.81 \frac{W}{m^2})$$

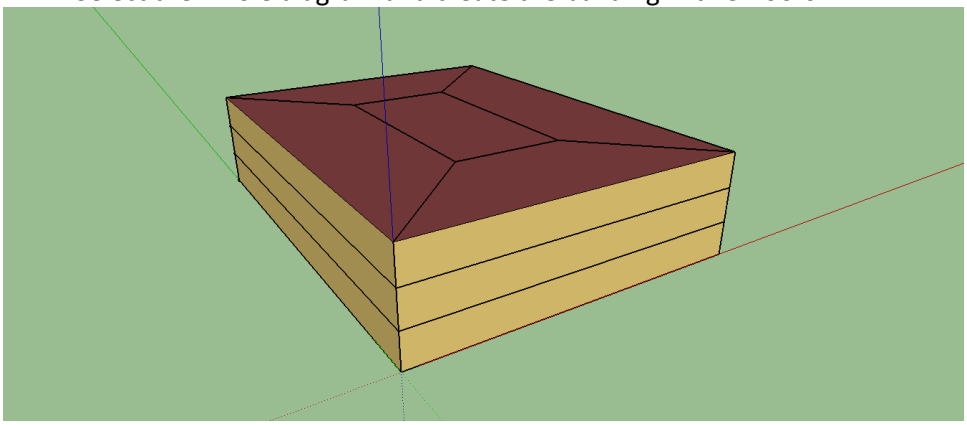
Task 2

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!)

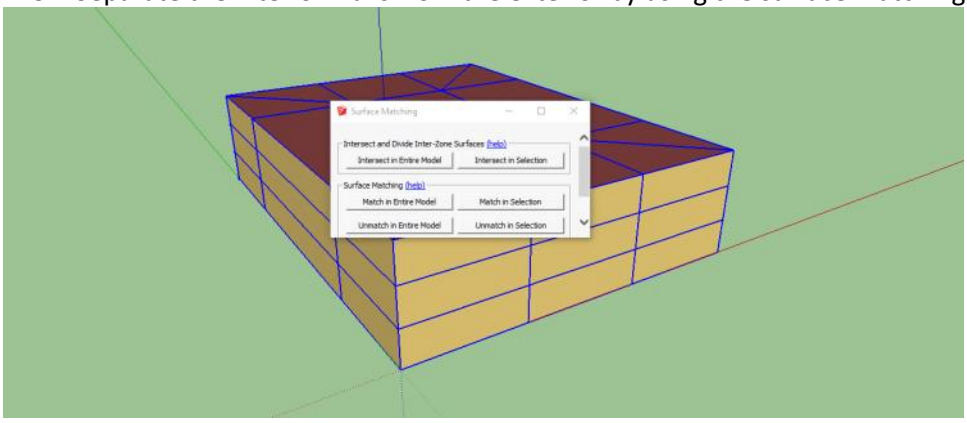
1. Draw a 30 X 40 diagram of the spaces



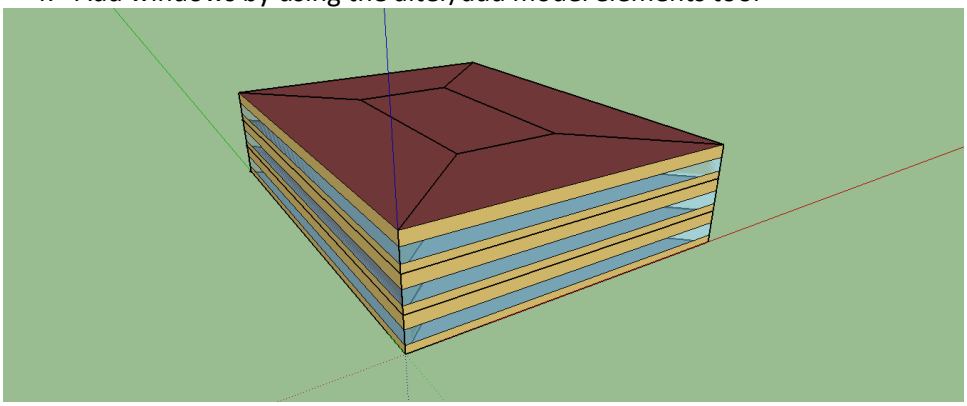
2. Select the whole diagram and create the building with 3 floors



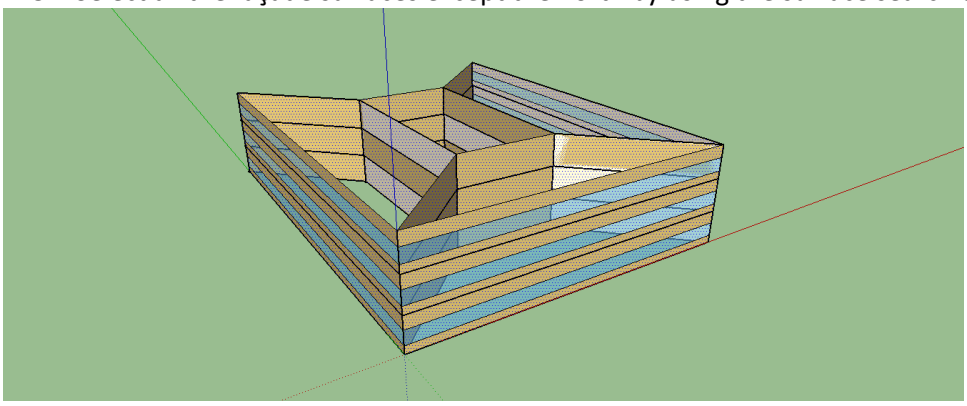
3. Separate the interior walls from the exterior by using the surface matching tool



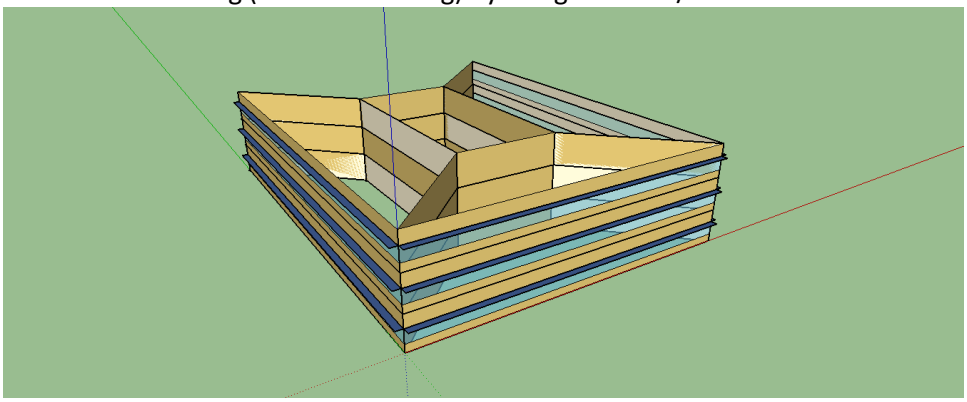
4. Add windows by using the alter/add model elements tool



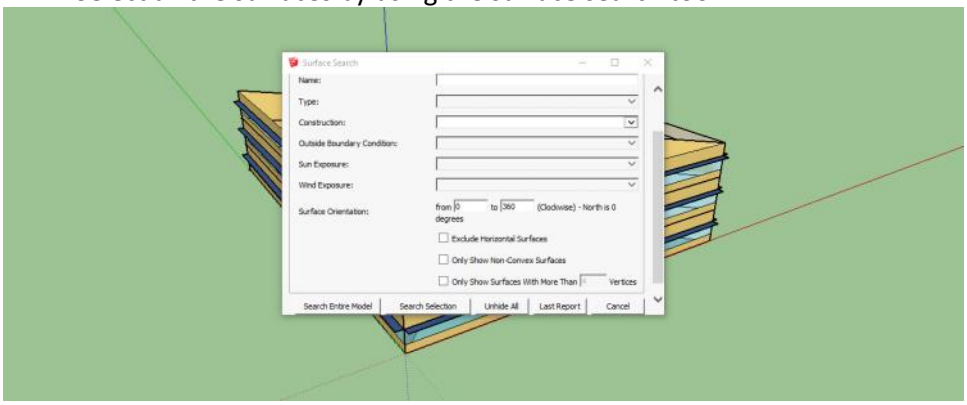
5. Select all the façade surfaces except the north by using the surface search tool



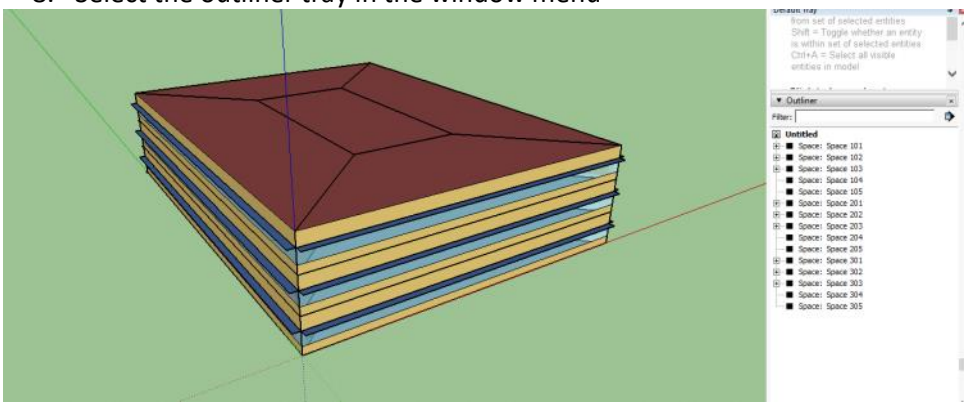
6. Add overhang (external shading) by using the alter/add model element tool



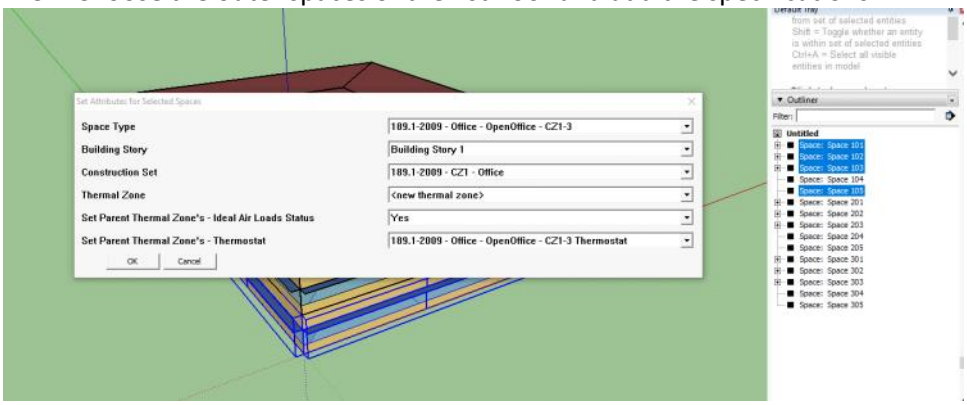
7. Select all the surfaces by using the surface search tool



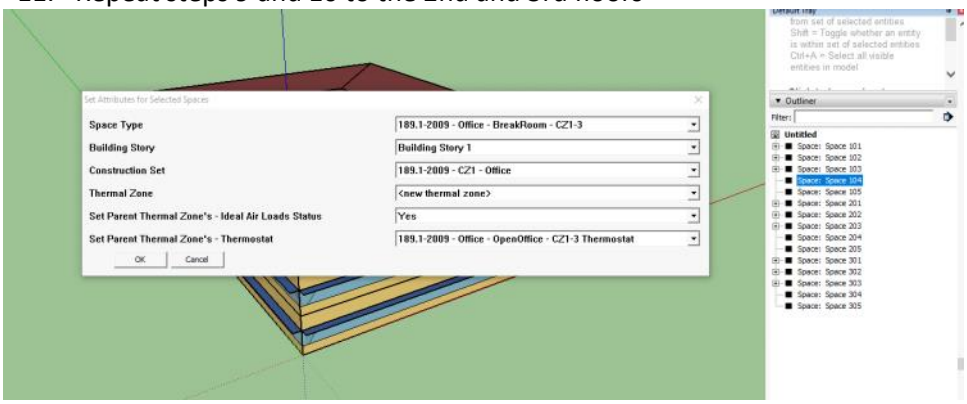
8. Select the outliner tray in the window menu



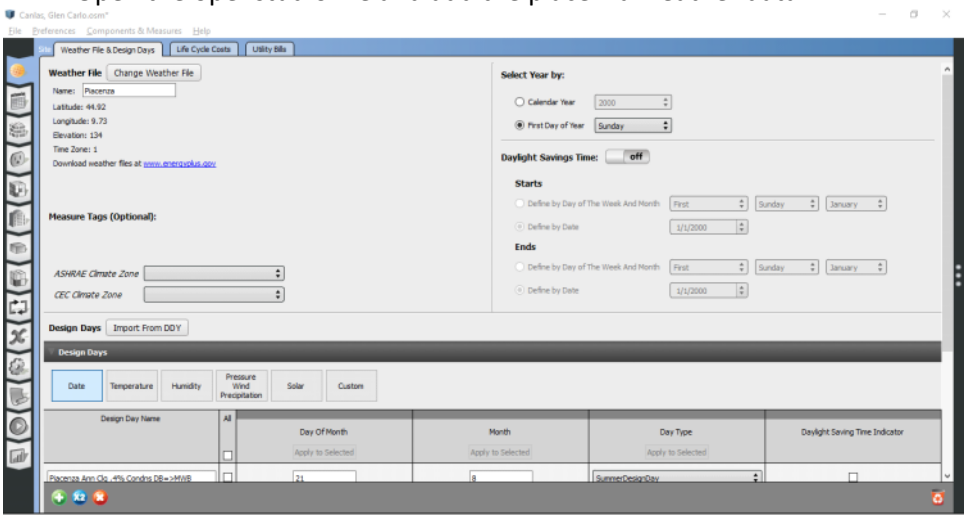
9. Choose the outer spaces of the 1st floor and add the specifications



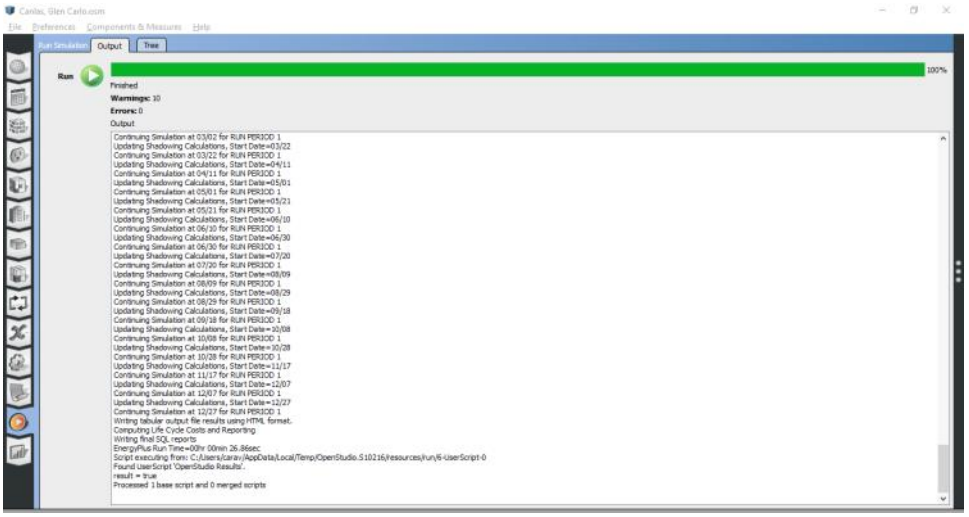
10. Choose the inner space of the 1st floor and add the specifications
11. Repeat steps 9 and 10 to the 2nd and 3rd floors



12. Open the openstudio file and add the piacenza weather data



13. Run the model



14. Review the results