Week 6_ Assignment_ Francesca Aiuti

13/11/19

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

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.

① $\varepsilon_1 = 0.2$
$T_1 = 800K$
$\varepsilon_2 = 0.7$
$T_2 = 500K$
$\dot{q} = 1035.81 \frac{W}{m^2}$ (without shields)

$$\frac{3625.37}{100} = \frac{\delta(T_{14} - T_{24})}{\left(\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1\right) + \left(\frac{1}{\varepsilon_3} + \frac{1}{\varepsilon_3} - 1\right)(\text{number of shields})}$$

$$\left(\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1\right) + \left(\frac{1}{\varepsilon_3} + \frac{1}{\varepsilon_3} - 1\right)(N) = \frac{\delta(T_{14} - T_{24})}{36.25}$$

$$N = \frac{\frac{\delta(T_{14} - T_{24})}{36.25} - \left(\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1\right)}{\left(\frac{1}{\varepsilon_3} + \frac{1}{\varepsilon_3} - 1\right)}$$

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

$$\Rightarrow \dot{q} = \frac{\delta(T_{14} - T_{24})}{\left(\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1\right) + \left(\frac{1}{\varepsilon_3} + \frac{1}{\varepsilon_3} - 1\right)(\text{number of shields})}$$

$$\dot{q} = \frac{5.67 \times 10^{-8}(800^4 - 500^4)}{\left(\frac{1}{0.2} + \frac{1}{0.7} - 1\right) + \left(\frac{1}{0.1} + \frac{1}{0.1} - 1\right)(28)} = 10.36 \frac{W}{m^2} \left(1\% \text{ of } 1035.81 \frac{W}{m^2}\right)$$

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

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

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

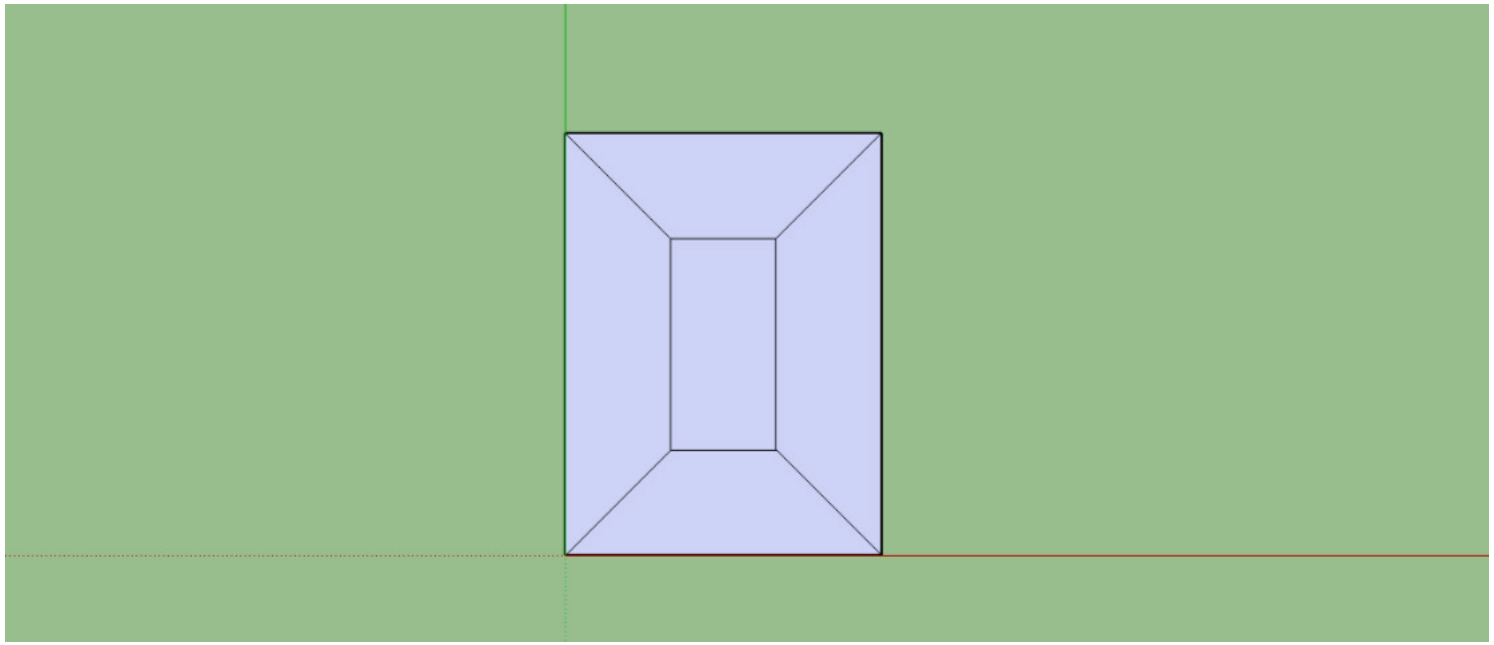
$$(1\%)(N+1) = 100\%$$

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

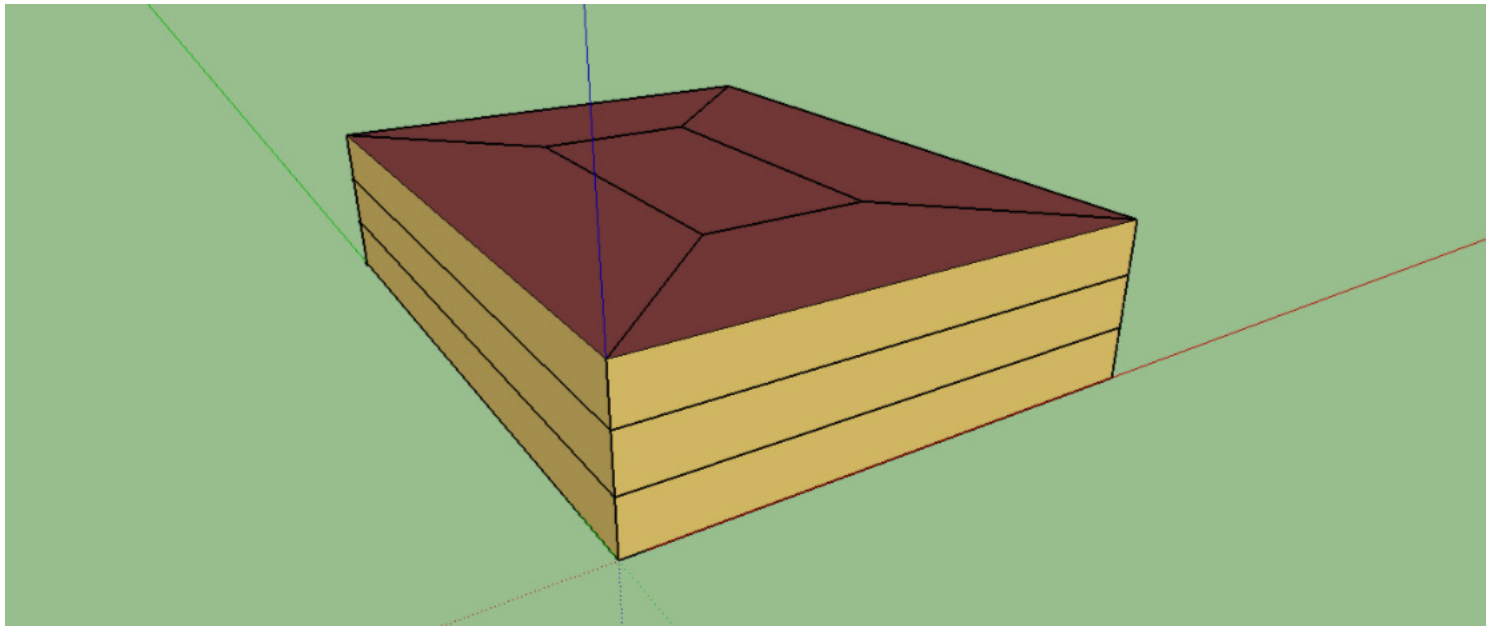
$$\Rightarrow \dot{q}_{99\,\text{shields}} = \frac{\delta(T_{14} - T_{24})}{(N+1) + \left(\frac{1}{\varepsilon} + \frac{1}{\varepsilon} - 1\right)}$$

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

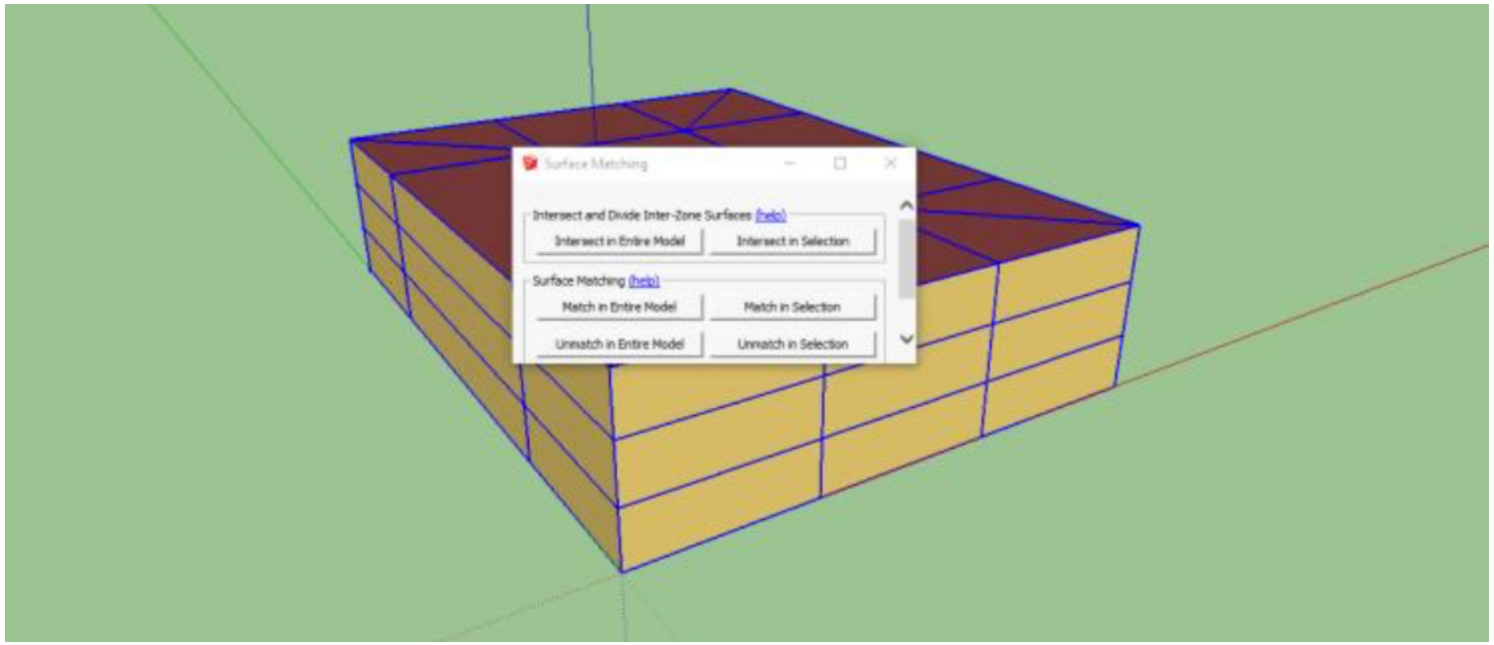
1. draw a 30x40 diagram of the spaces



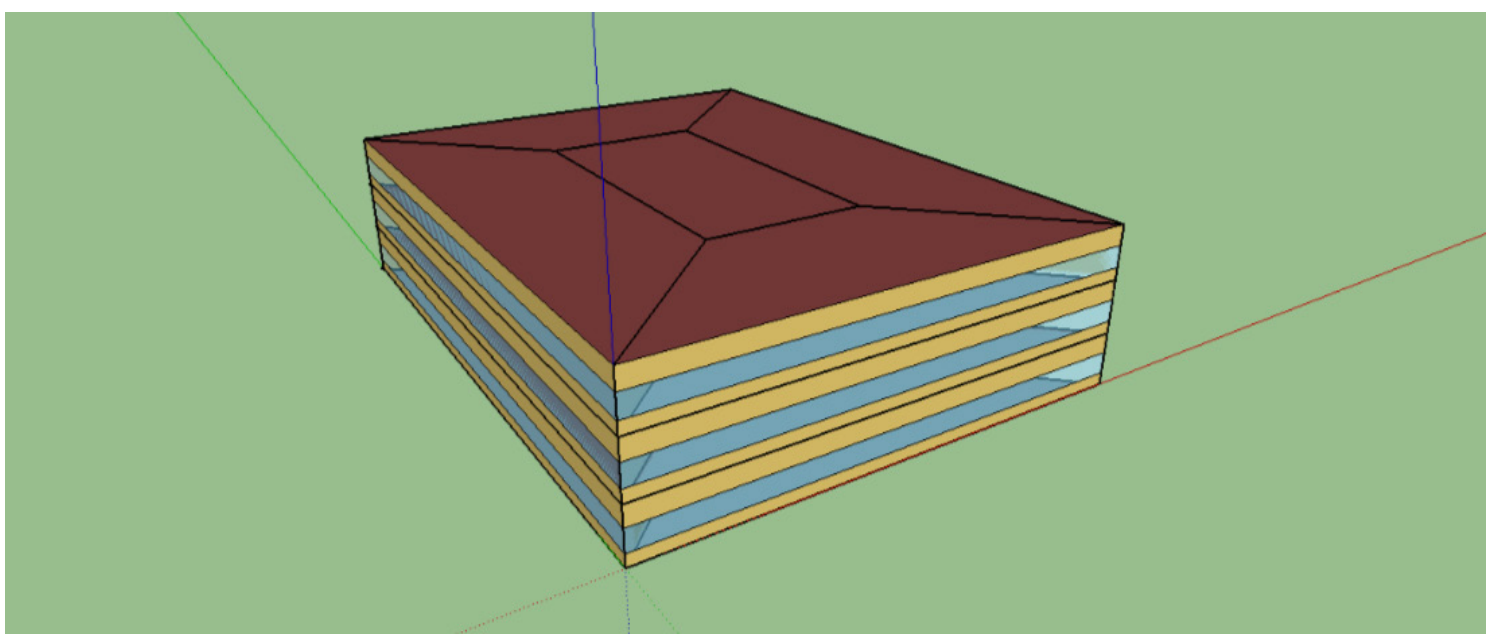
2. select the whole diagram and create a building of three floors



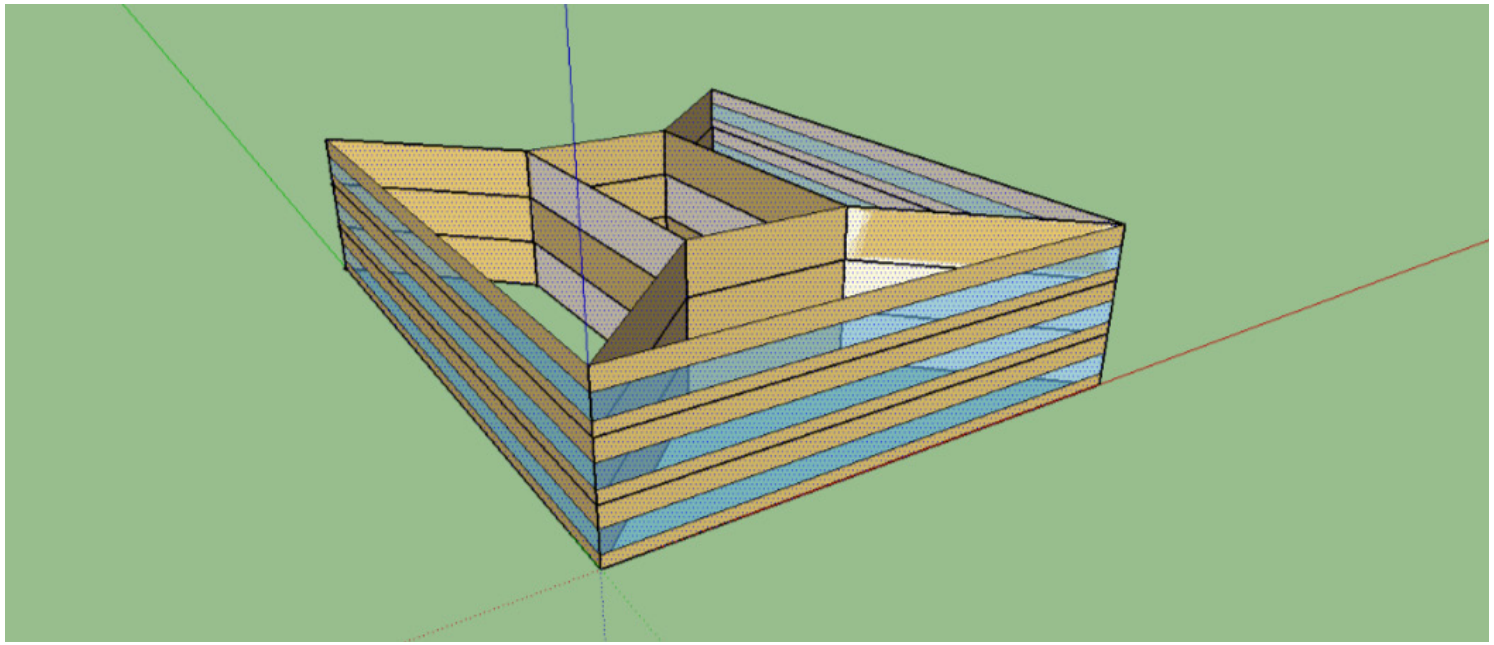
3. separate the interior walls from the external ones through *surface matching* tool



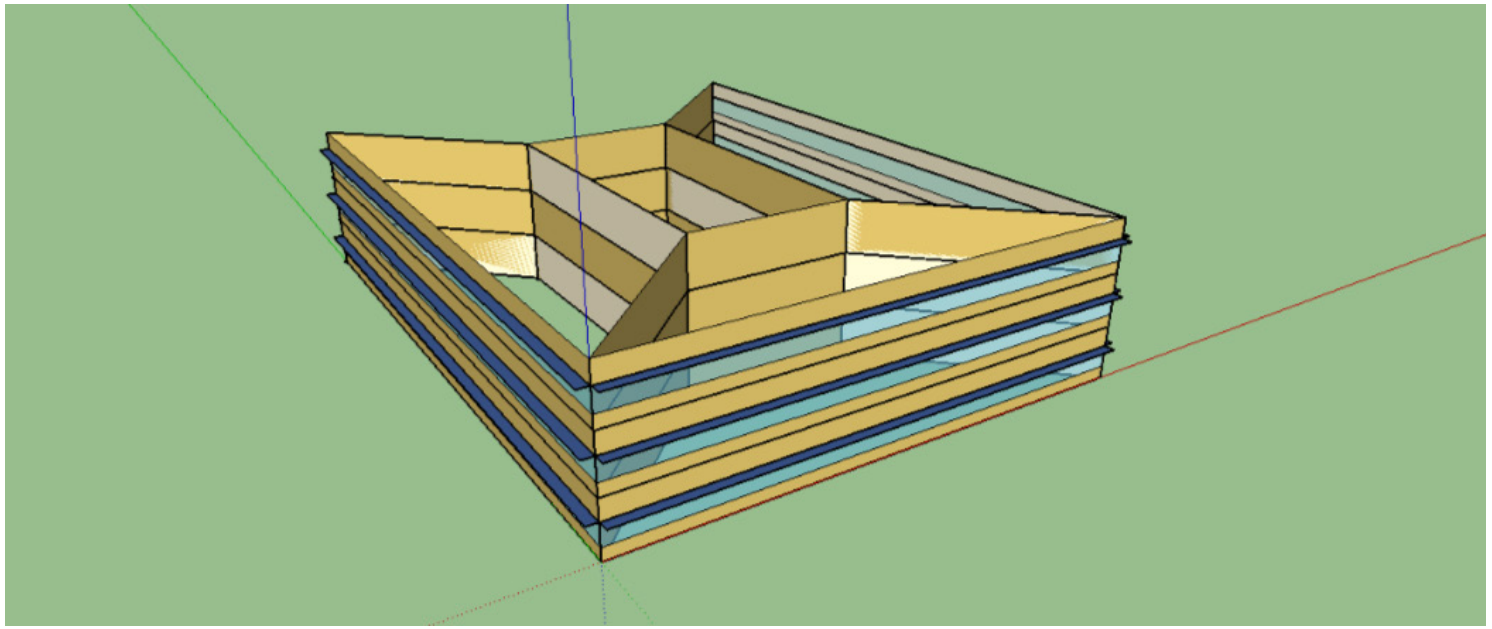
4. add windows through *alter* / *add model elements* tool



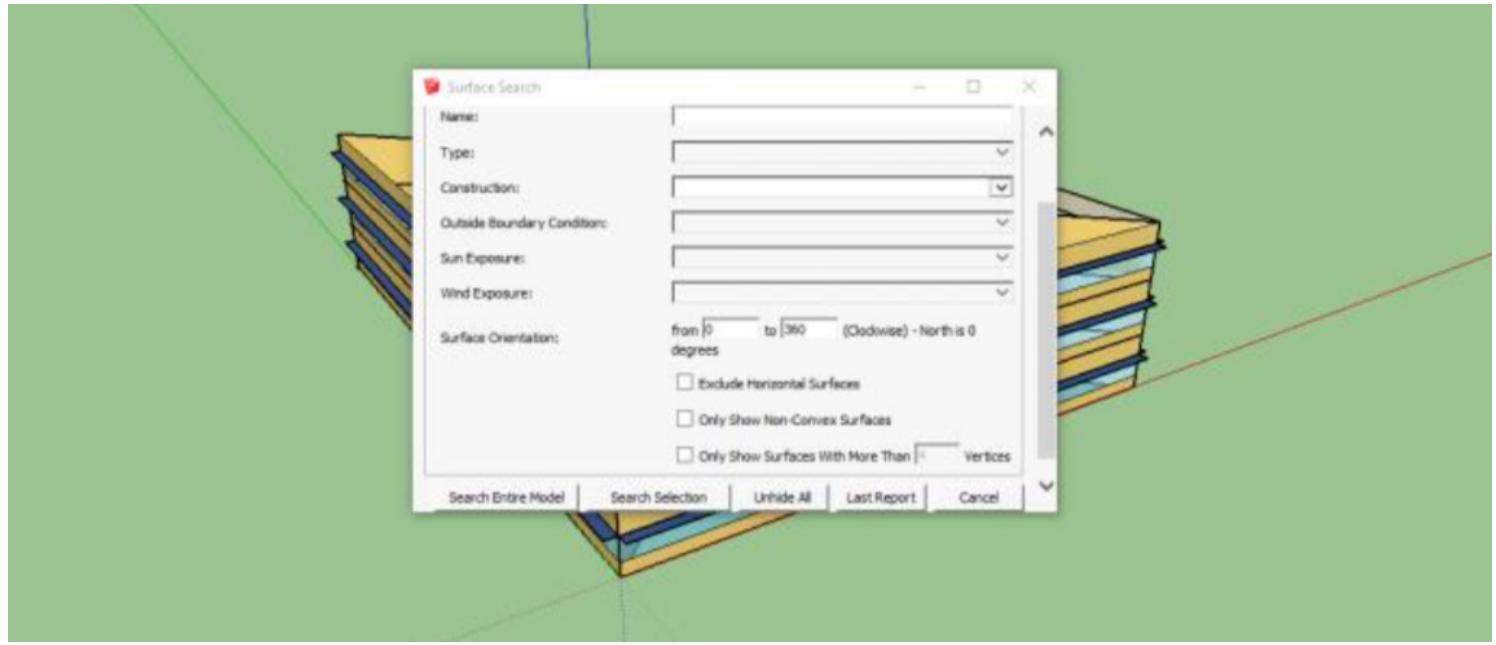
5. select all the facades surfaces (except the north facade) through *surface search* tool



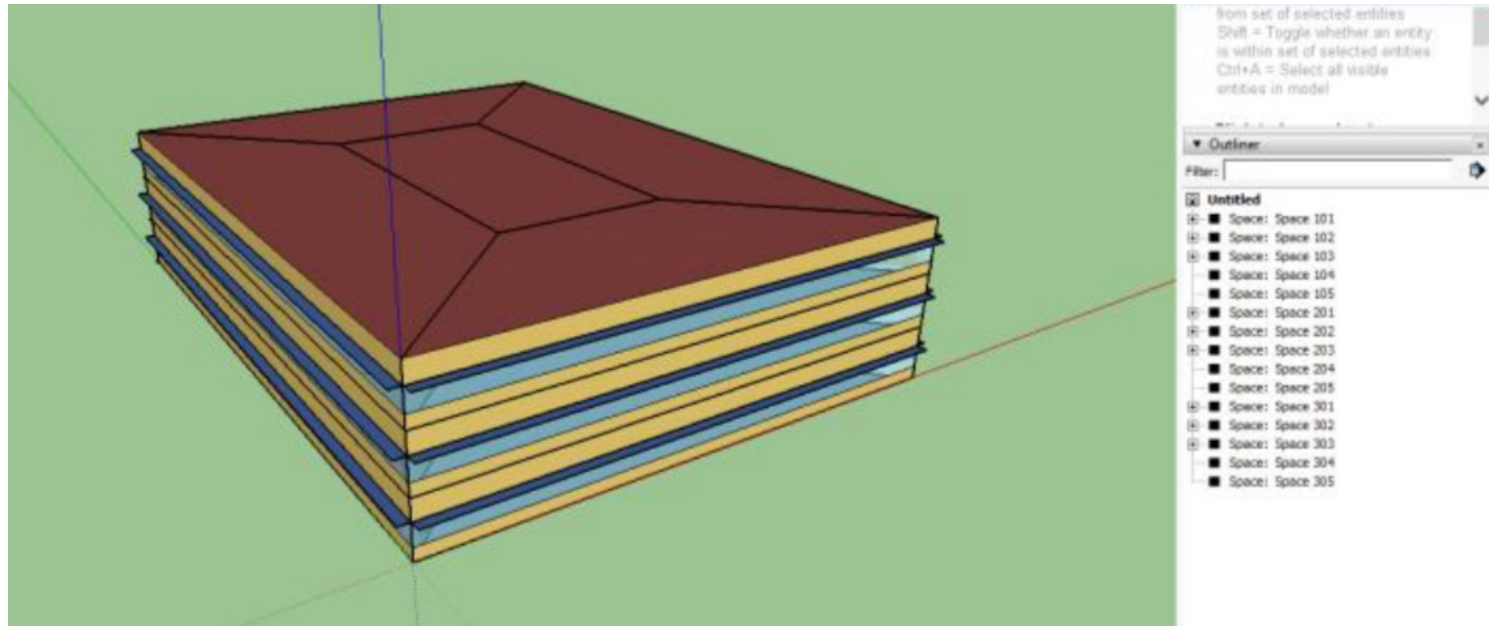
6. add overhang (external shading) through *alter* / *add model element* tool



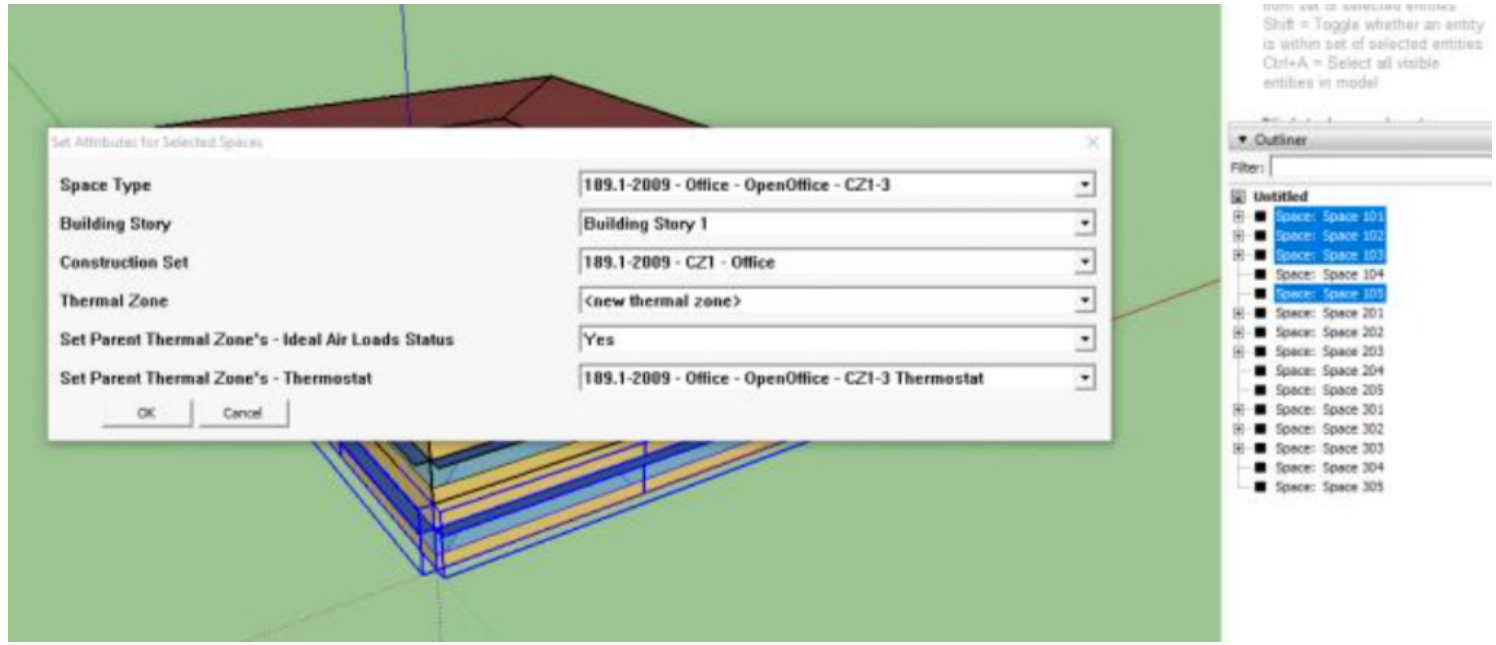
7. select all the surfaces through *surface search* tool



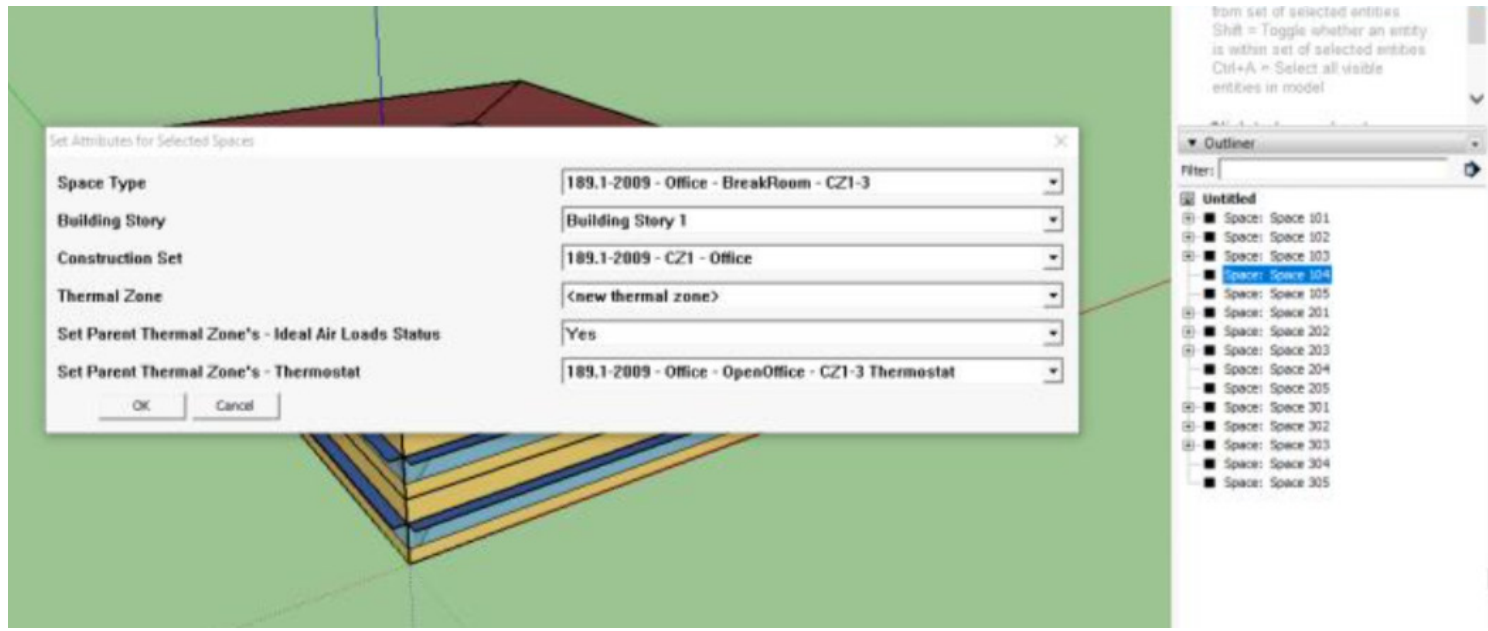
8. select the outliner tray in the window menu



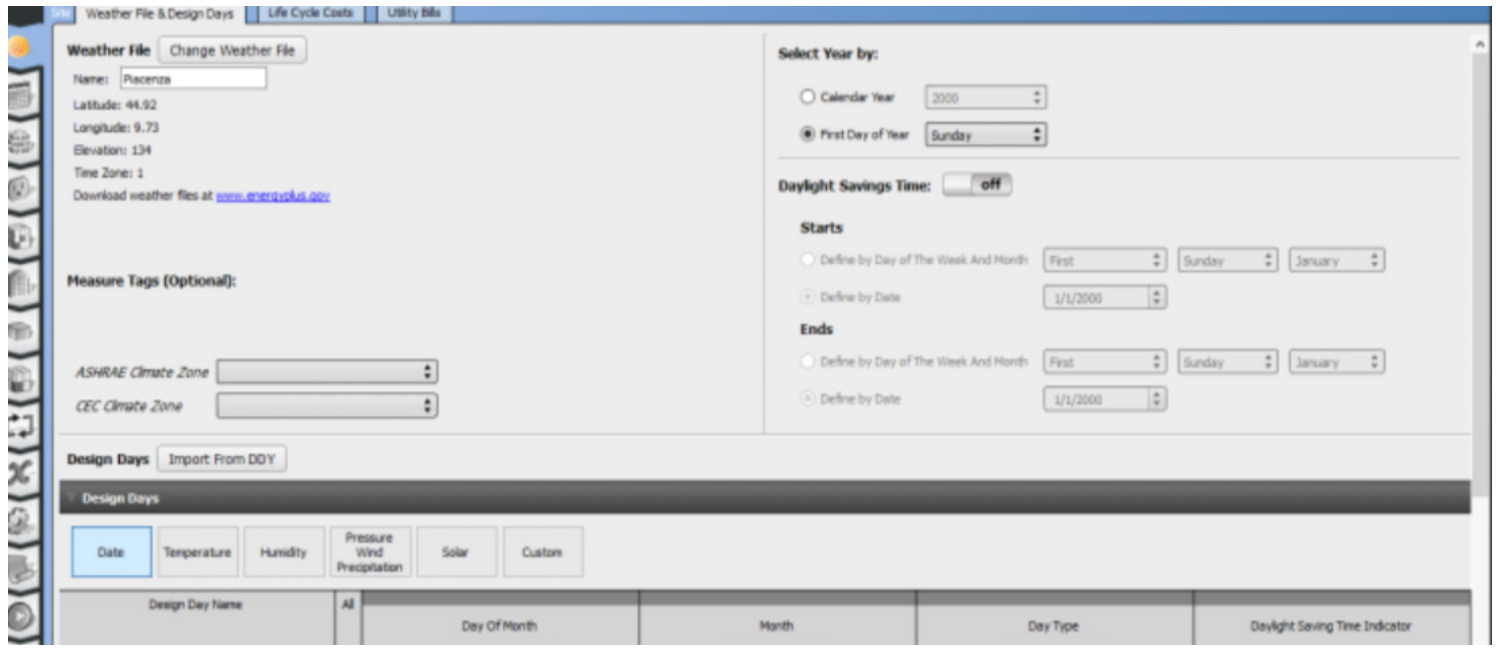
9. choose the outer spaces of the 1st floor and add the specifications



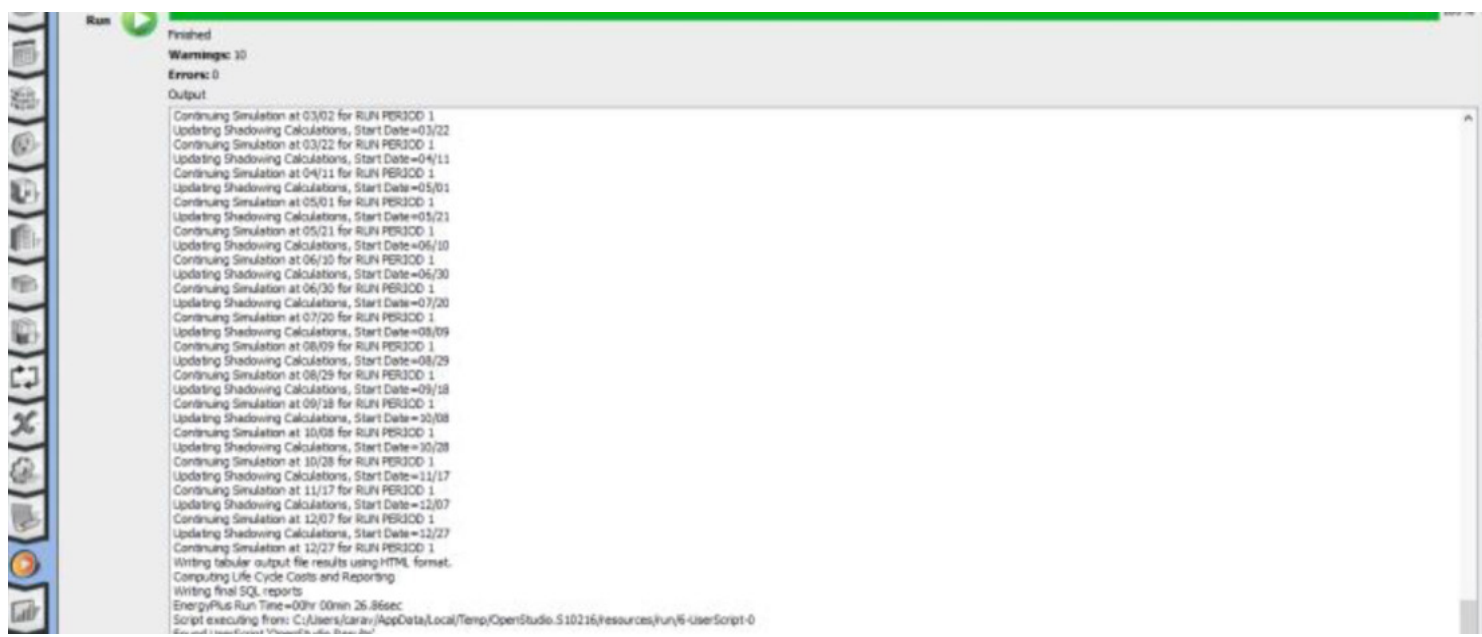
10. choose the inner spaces of the 1st floor and add the specifications (repeat step 9 and 10 for 2nd and 3rd floor)



11. open the openstudio file and add Piacenza's weather data



12. run the model



13. review the results