

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 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?

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 $\epsilon_1 = 0.2$
 $T_1 = 800\text{K}$
 $\epsilon_2 = 0.7$
 $T_2 = 500\text{K}$
 $\dot{q} = 1035.81 \frac{\text{W}}{\text{m}^2}$ (without shields)

$$\frac{3625.37}{100} = \frac{\sigma(T_1^4 - T_2^4)}{\left(\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1\right) + \left(\frac{1}{\epsilon_3} + \frac{1}{\epsilon_3} - 1\right) (\text{number of shields})}$$

$$\left(\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1\right) + \left(\frac{1}{\epsilon_3} + \frac{1}{\epsilon_3} - 1\right) (N) = \frac{\sigma(T_1^4 - T_2^4)}{36.25}$$

$$N = \frac{\sigma(T_1^4 - T_2^4)}{36.25} - \left(\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1\right)$$

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

$$\Rightarrow \dot{q} = \frac{\sigma(T_1^4 - T_2^4)}{\left(\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1\right) + \left(\frac{1}{\epsilon_3} + \frac{1}{\epsilon_3} - 1\right) (\text{number of shields})}$$

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

given: $\epsilon_1 = 0.1, T_1 = 800\text{K}, \epsilon_2 = 0.1, T_2 = 500\text{K}, \dot{q} = 1035.81 \frac{\text{W}}{\text{m}^2}$ (without shields)

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

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

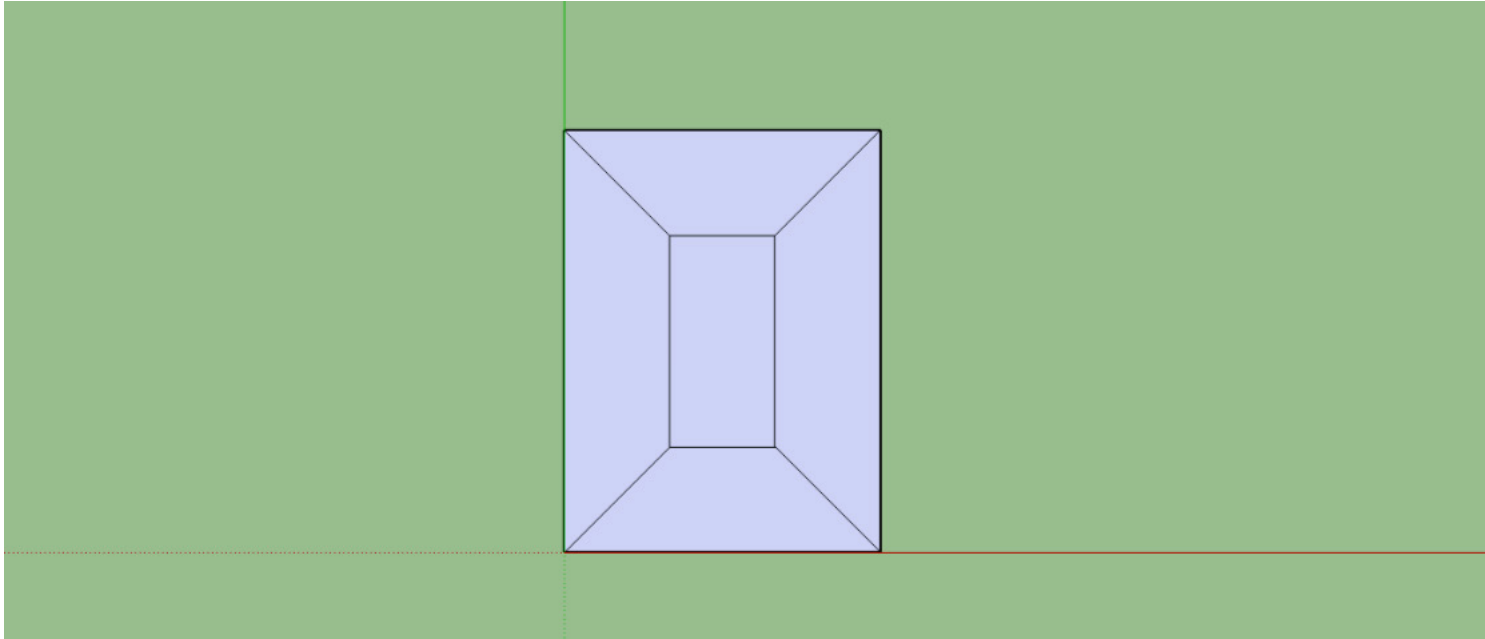
$$(1\%)(N+1) = 100\%$$

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

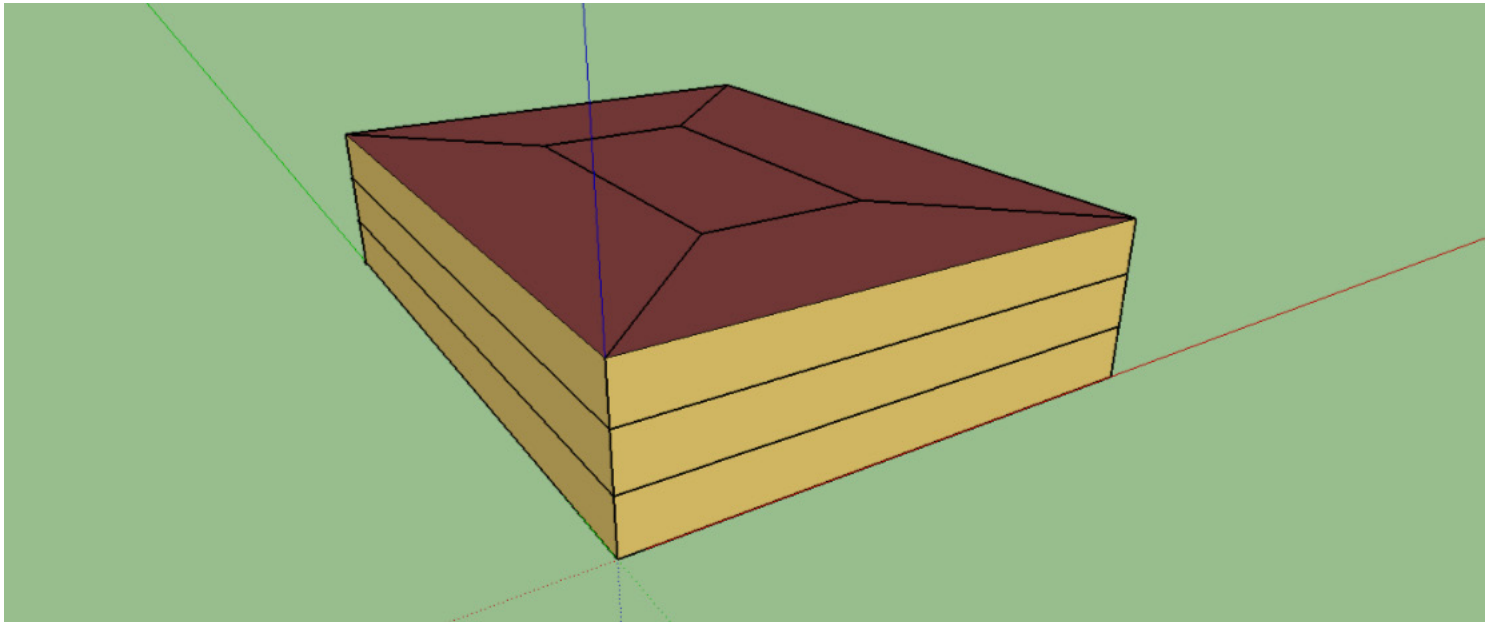
$$\Rightarrow \dot{q}_{99 \text{ shields}} = \frac{\sigma(T_1^4 - T_2^4)}{(N+1) + \left(\frac{1}{\epsilon} + \frac{1}{\epsilon} - 1\right)}$$

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

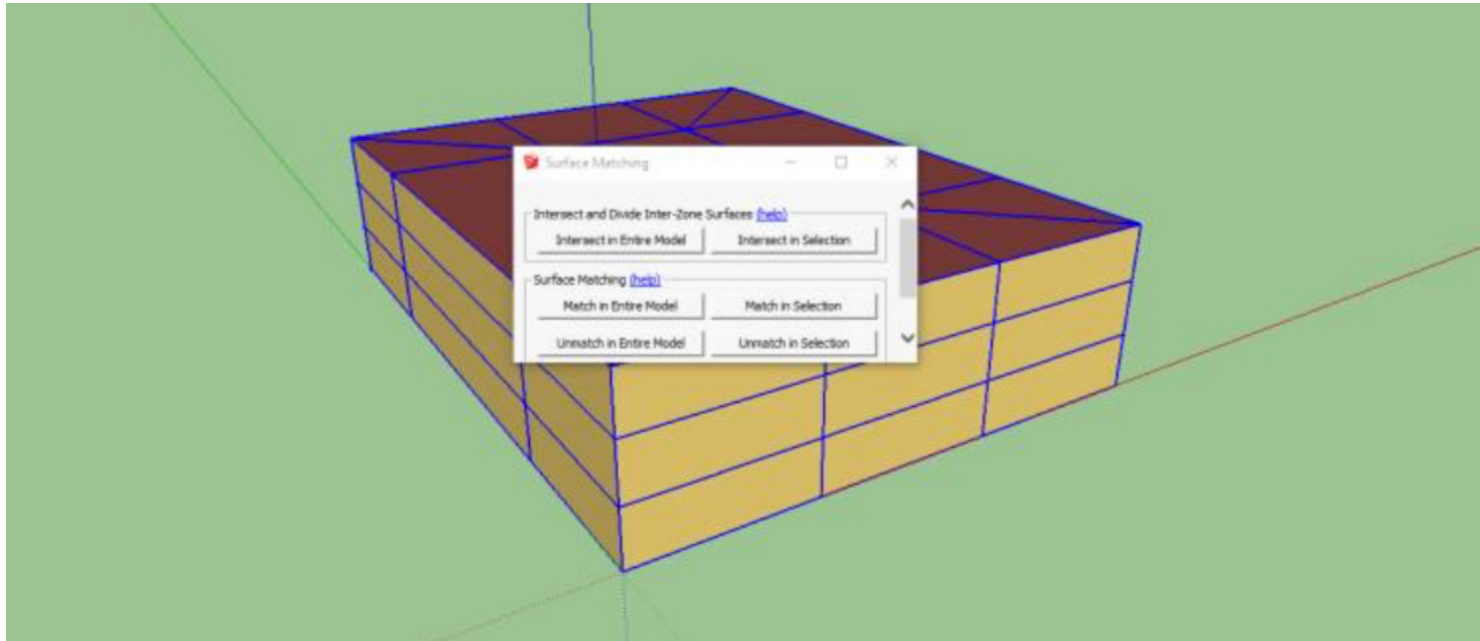
1. draw a 30x40 diagram of the spaces



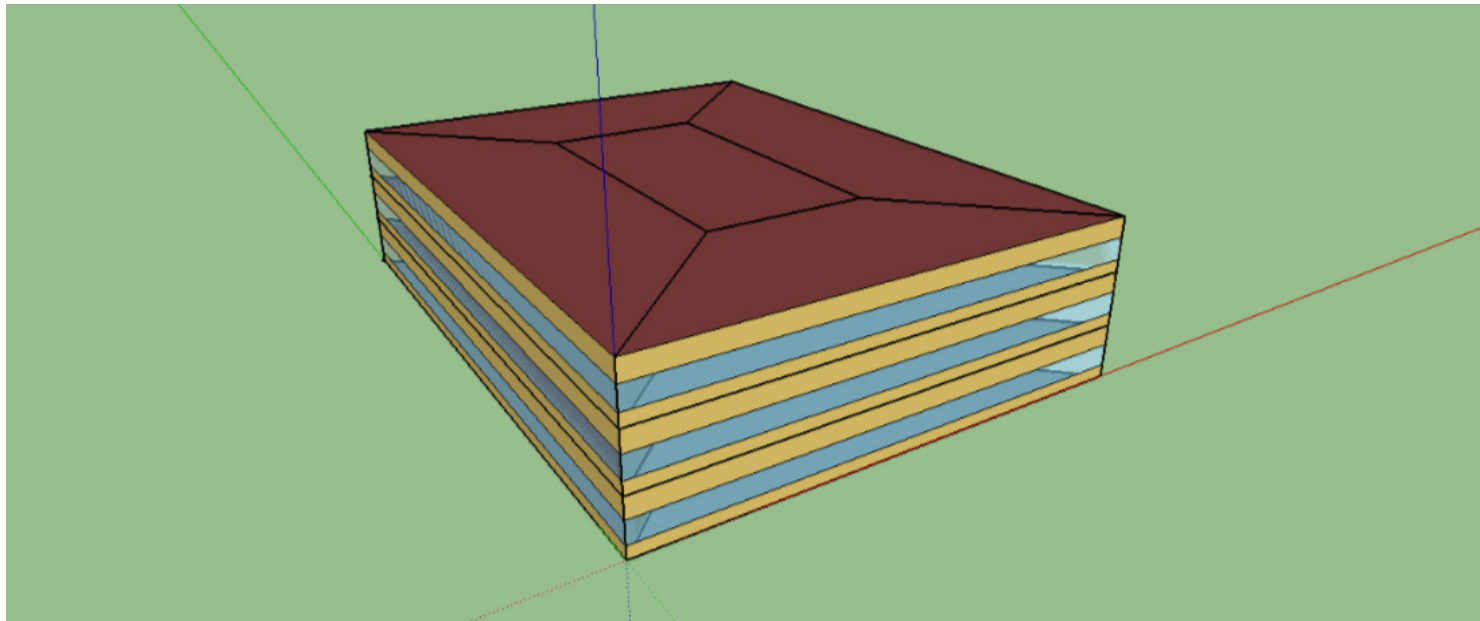
2. select the whole diagram and create a building of three floors



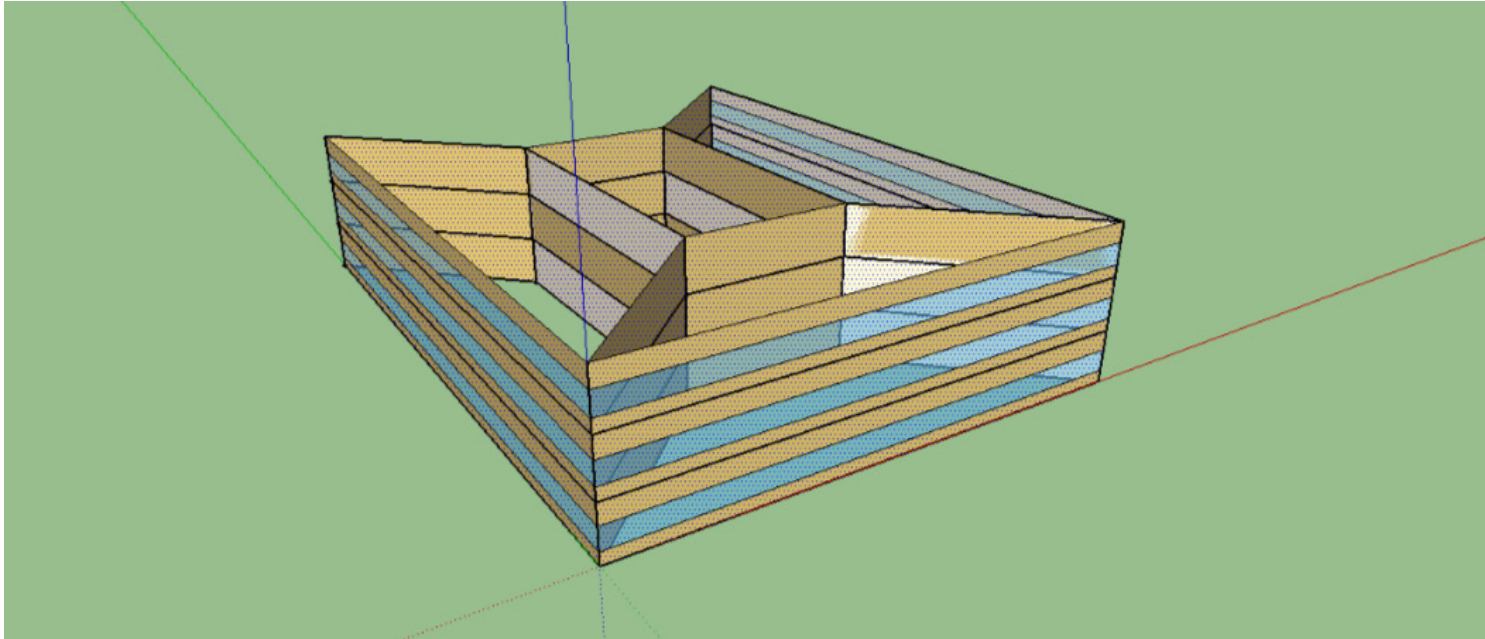
3. separate the interior walls from the external ones through *surface matching* tool



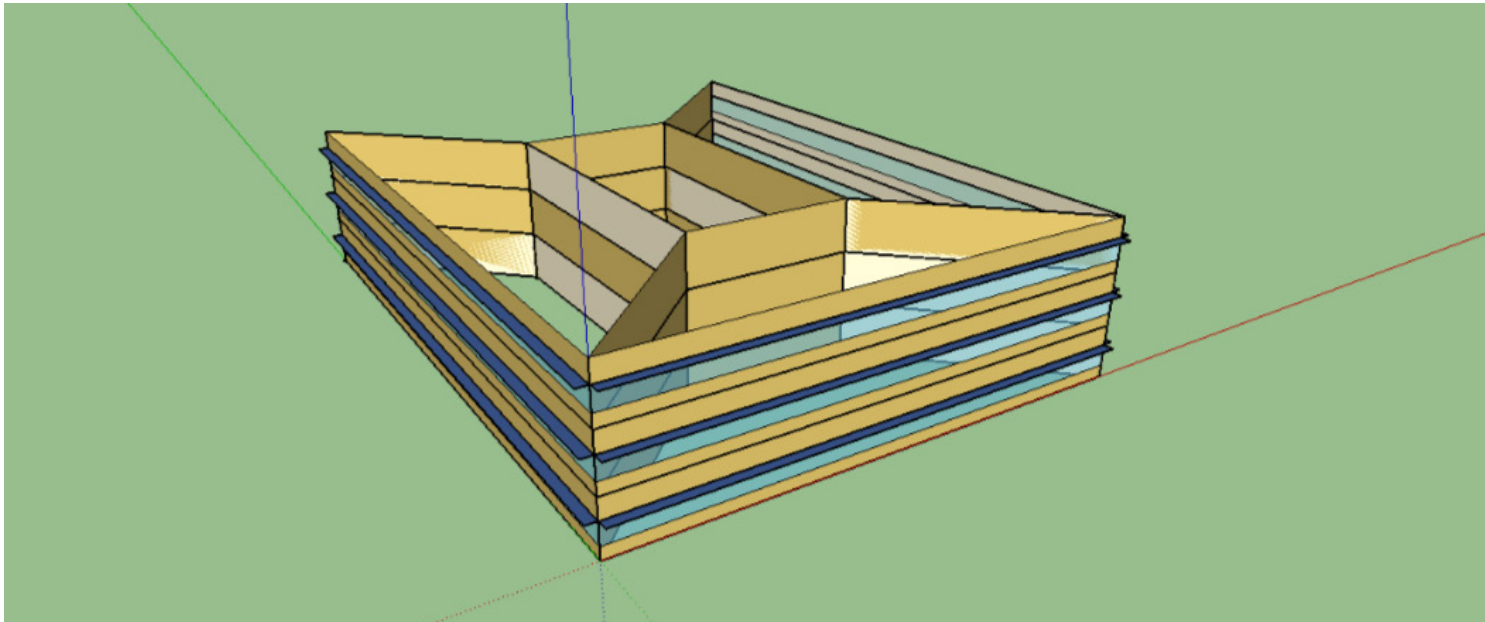
4. add windows through *alter / add model elements* tool



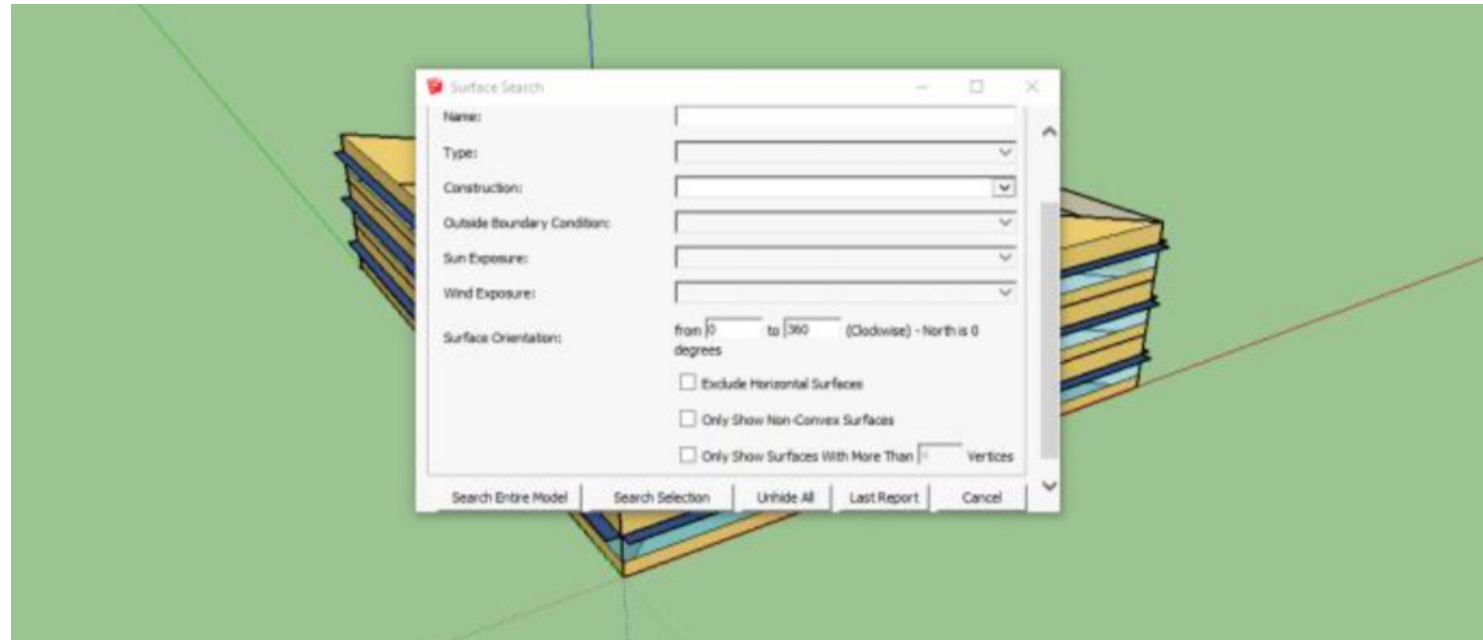
5. select all the facades surfaces (except the north facade) through *surface search* tool



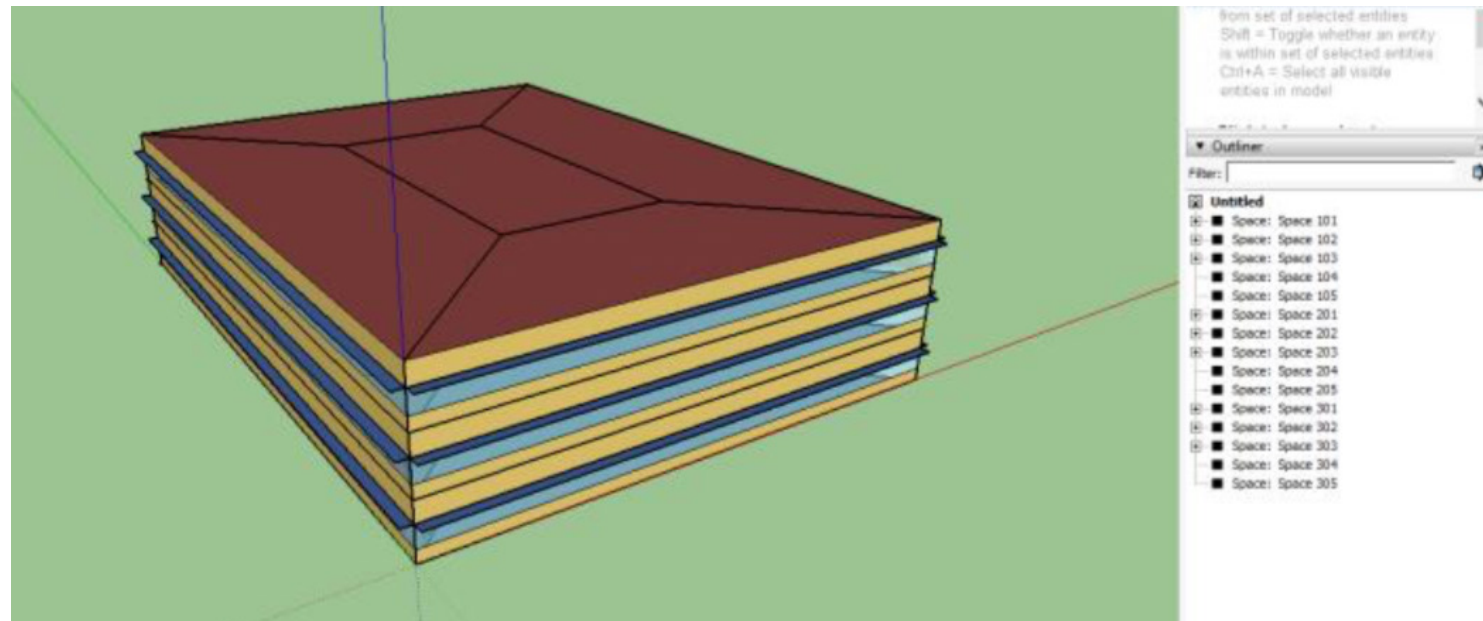
6. add overhang (external shading) through *alter / add model element* tool



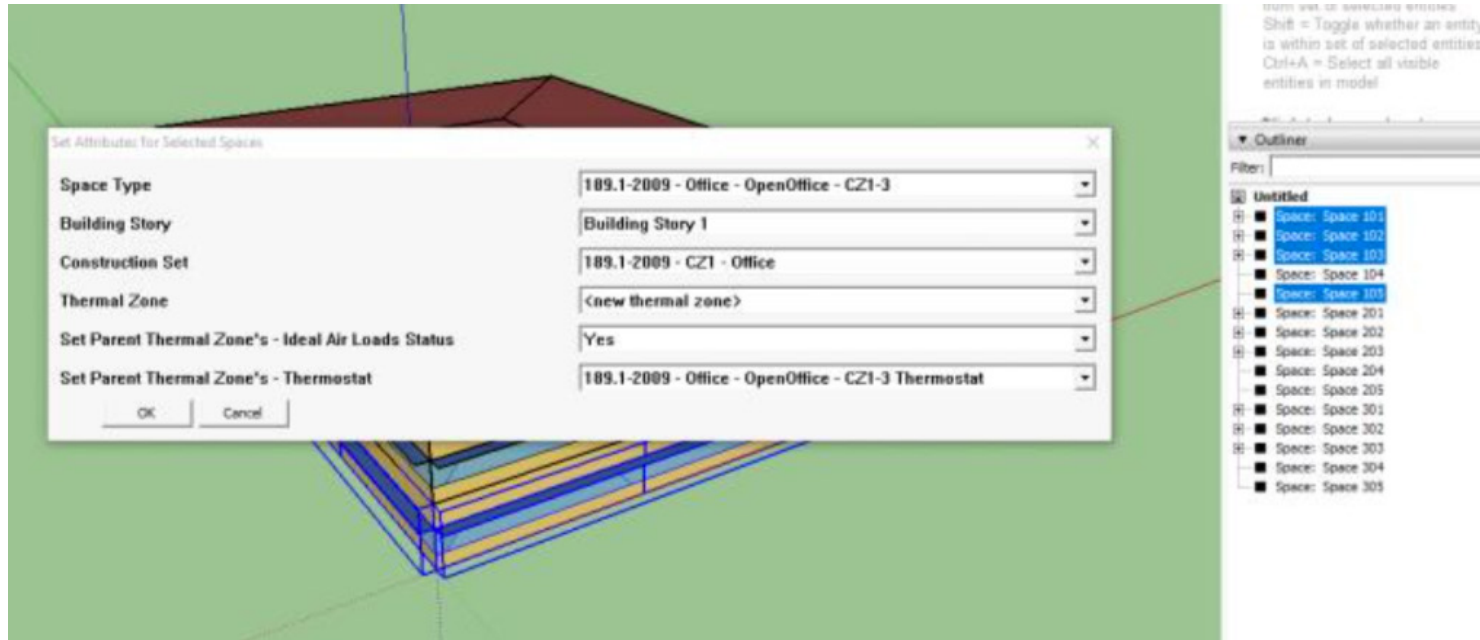
7. select all the surfaces through *surface search* tool



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

The screenshot shows the 'Weather File & Design Days' dialog box in OpenStudio. The 'Weather File' tab is active, showing fields for Name (Piacenza), Latitude (44.92), Longitude (9.73), Elevation (134), and Time Zone (1). A link to download weather files is provided. The 'Measure Tags (Optional)' section has dropdowns for ASHRAE and CEC Climate Zones. The 'Design Days' section has a button to 'Import From DDY'. The 'Select Year by:' section has radio buttons for 'Calendar Year' (2000) and 'First Day of Year' (Sunday). The 'Daylight Savings Time' section has a toggle for 'off'. The 'Starts' and 'Ends' sections have radio buttons for 'Define by Day of The Week And Month' and 'Define by Date' (1/1/2000). The 'Design Days' table is visible at the bottom.

Design Day Name	All	Day Of Month	Month	Day Type	Daylight Saving Time Indicator
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12. run the model

The screenshot shows the 'Run' dialog box in OpenStudio. The 'Finished' status is indicated. The 'Warnings' section shows 10 warnings and 0 errors. The 'Output' section shows the simulation progress, including updating shading calculations and continuing simulation for RUN PERIOD 1. The 'EnergyPlus Run Time' is 00hr 00min 26.86sec. The script is executing from C:\Users\carav\AppData\Local\Temp\OpenStudio.S10216\resources\run\6-userScript-0.

```
Finished
Warnings: 10
Errors: 0
Output
Continuing Simulation at 03/02 for RUN PERIOD 1
Updating Shading Calculations, Start Date=03/02
Continuing Simulation at 03/22 for RUN PERIOD 1
Updating Shading Calculations, Start Date=04/11
Continuing Simulation at 04/11 for RUN PERIOD 1
Updating Shading Calculations, Start Date=05/01
Continuing Simulation at 05/01 for RUN PERIOD 1
Updating Shading Calculations, Start Date=05/21
Continuing Simulation at 05/21 for RUN PERIOD 1
Updating Shading Calculations, Start Date=06/10
Continuing Simulation at 06/10 for RUN PERIOD 1
Updating Shading Calculations, Start Date=06/30
Continuing Simulation at 06/30 for RUN PERIOD 1
Updating Shading Calculations, Start Date=07/20
Continuing Simulation at 07/20 for RUN PERIOD 1
Updating Shading Calculations, Start Date=08/09
Continuing Simulation at 08/09 for RUN PERIOD 1
Updating Shading Calculations, Start Date=08/29
Continuing Simulation at 08/29 for RUN PERIOD 1
Updating Shading Calculations, Start Date=09/18
Continuing Simulation at 09/18 for RUN PERIOD 1
Updating Shading Calculations, Start Date=10/08
Continuing Simulation at 10/08 for RUN PERIOD 1
Updating Shading Calculations, Start Date=10/28
Continuing Simulation at 10/28 for RUN PERIOD 1
Updating Shading Calculations, Start Date=11/17
Continuing Simulation at 11/17 for RUN PERIOD 1
Updating Shading Calculations, Start Date=12/07
Continuing Simulation at 12/07 for RUN PERIOD 1
Updating Shading Calculations, Start Date=12/27
Continuing Simulation at 12/27 for RUN PERIOD 1
Writing tabular output file results using HTML format.
Computing Life Cycle Costs and Reporting
Writing final SQL reports
EnergyPlus Run Time=00hr 00min 26.86sec
Script executing from: C:\Users\carav\AppData\Local\Temp\OpenStudio.S10216\resources\run\6-userScript-0
Run and simulation finished. Please see the Run Log.
```


13. review the results

Reports: **EnergyPlus Results** Open ResultsViewer for Detailed Reports

Program Version: **EnergyPlus, Version 8.5.0-c87e61b44b, YMD=2019.11.10 22:22** [Table of Contents](#)

Tabular Output Report in Format: **HTML**

Building: **Building 1**

Environment: **RUN PERIOD 1 ** Piacenza - ITA IGDG WMO#=160840**

Simulation Timestamp: **2019-11-10 22:22:06**

Report: **Annual Building Utility Performance Summary** [Table of Contents](#)

For: **Entire Facility**

Timestamp: **2019-11-10 22:22:06**

Values gathered over **8760.00 hours**

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	2372.70	659.08	659.08