

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 $\epsilon = 0.1$ should you add in order to have the new heat transfer rate to be 1% of the case without shields?

Given: $\epsilon_1 = 0.2$, $T_1 = 800$ K, $\epsilon_2 = 0.7$, $T_2 = 500$ K, $\dot{q} = 3625.37 \frac{W}{m^2}$ (without shields)

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

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

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

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

Checking:

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

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

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

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

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

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

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

Checking:

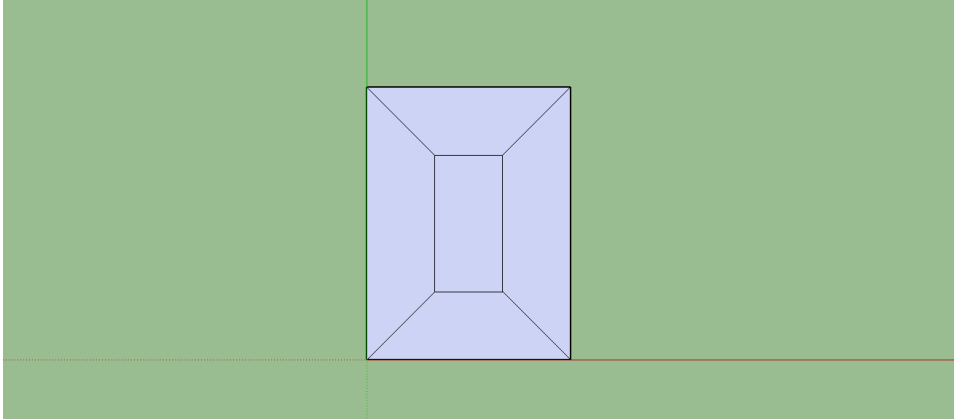
$$\dot{q}_{99 \text{ shields}} = \frac{\delta (T_1^4 - T_2^4)}{(N+1) + \left(\frac{1}{\epsilon} + \frac{1}{\epsilon} - 1\right)}$$

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

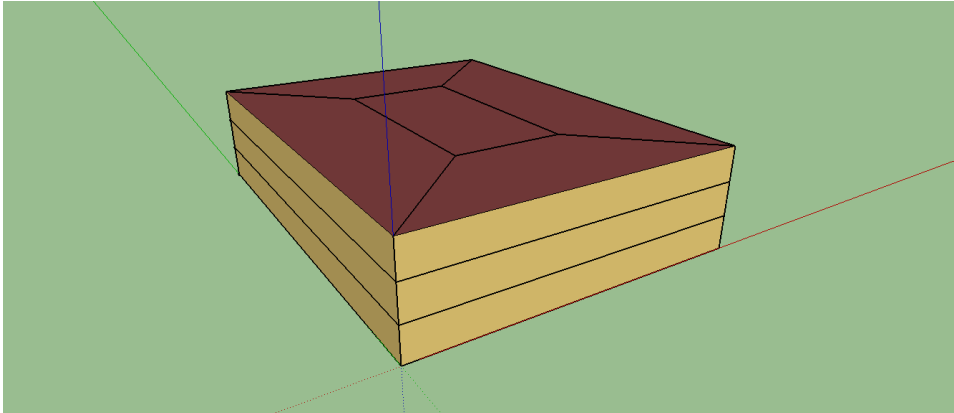
Task 2

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!)

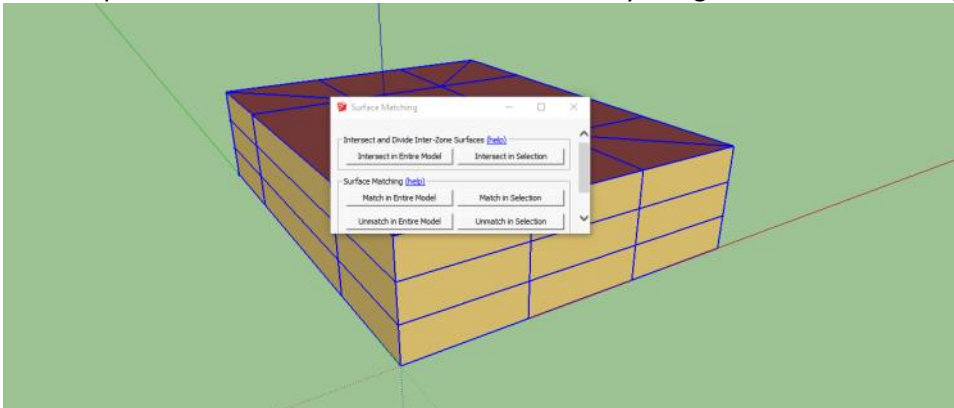
1. Draw a 30 X 40 diagram of the spaces



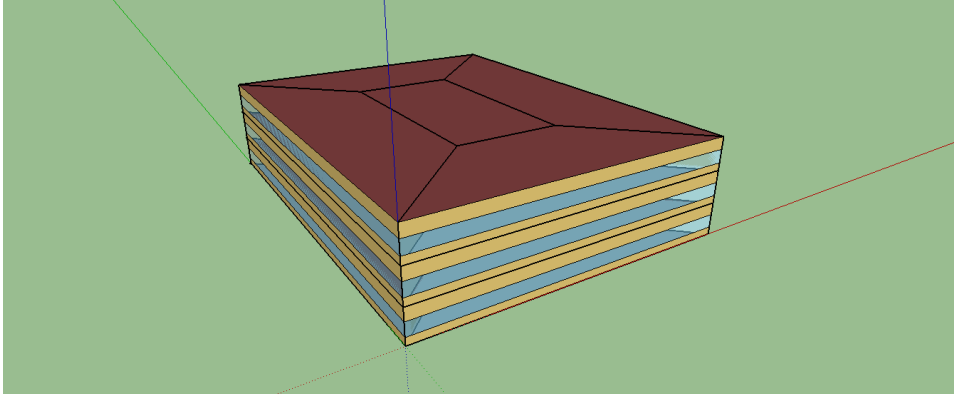
2. Select the whole diagram and create the building with 3 floors



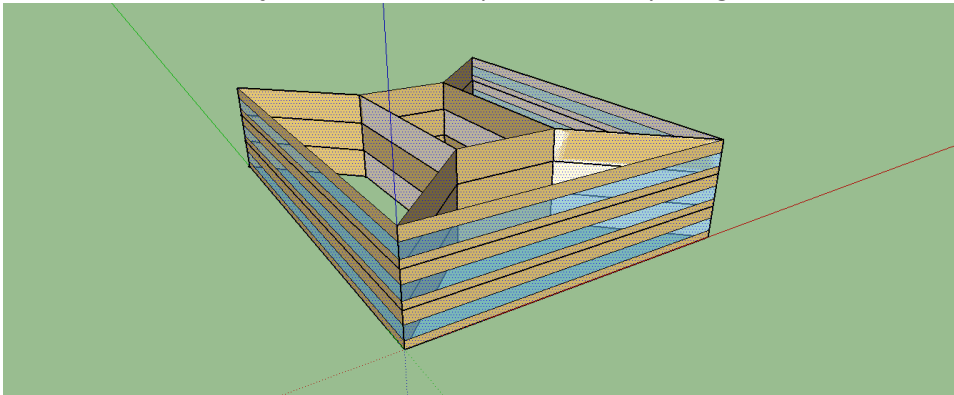
3. Separate the interior walls from the exterior by using the surface matching tool



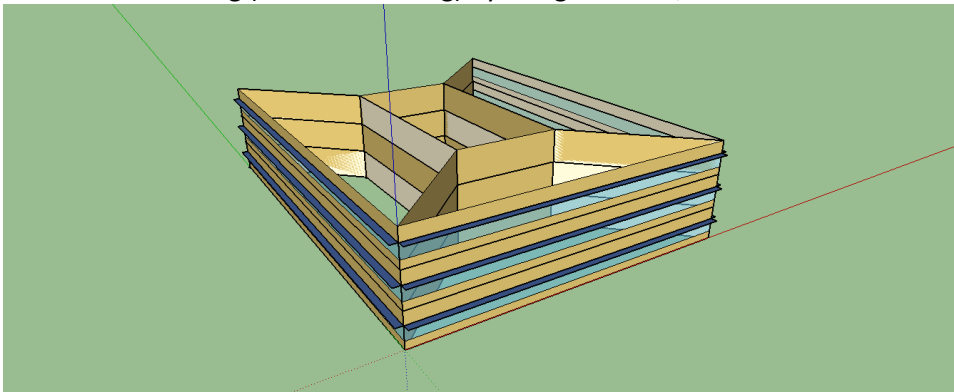
4. Add windows by using the alter/add model elements tool



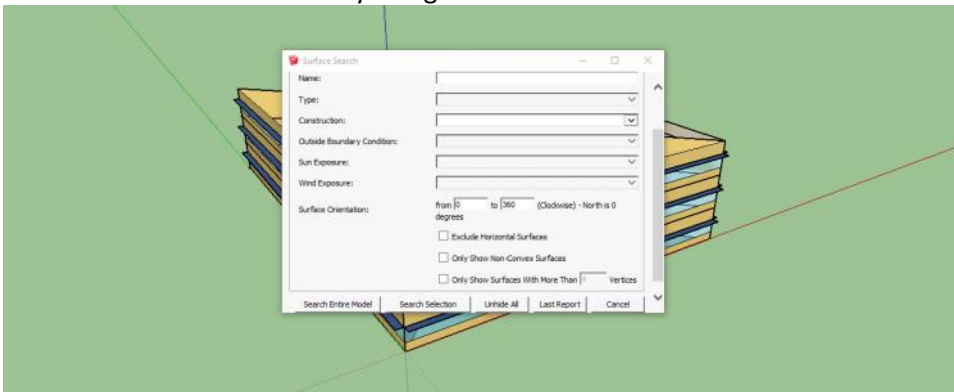
5. Select all the façade surfaces except the north by using the surface search tool



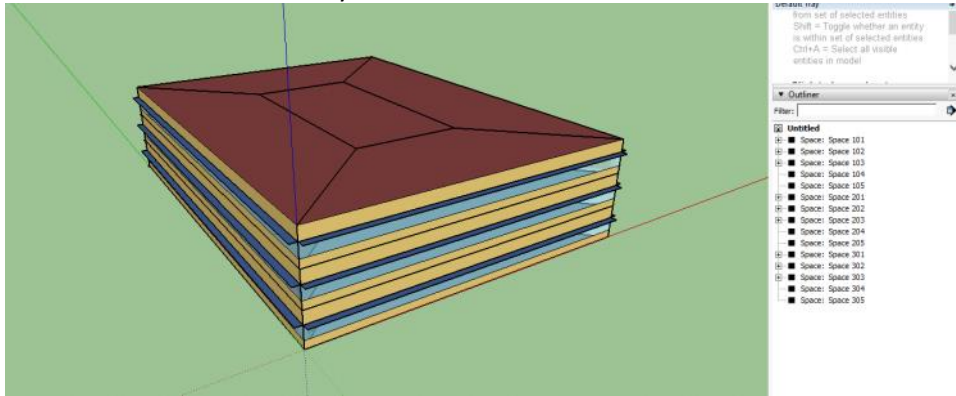
6. Add overhang (external shading) by using the alter/add model element tool



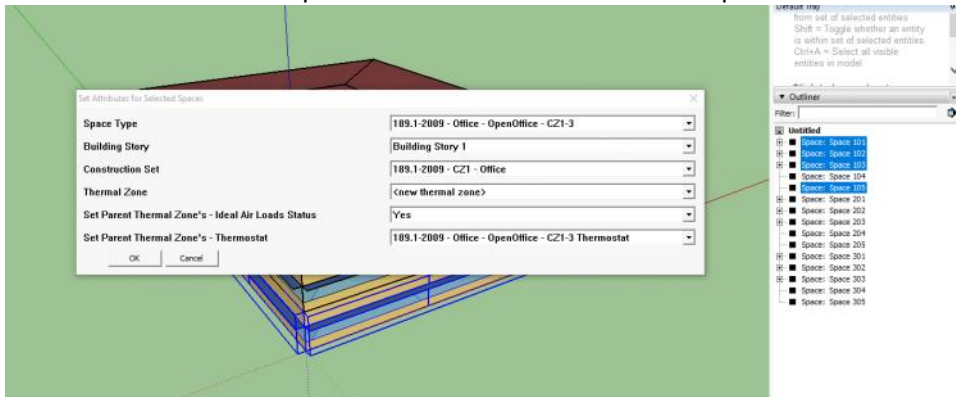
7. Select all the surfaces by using the surface search tool



8. Select the outlier tray in the window menu

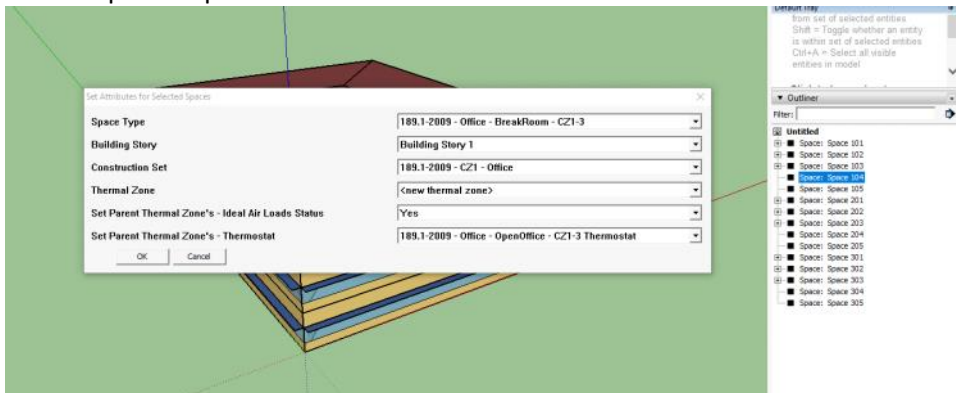


9. Choose the outer spaces of the 1st floor and add the specifications



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



CarSim, User Cells.com

File Preferences Components & Measures Help

Run Simulation Output Time

Run

Finished

Warnings: 10

Errors: 0

Output:

Continuing Simulation at 03/02 for RUN PERIOD 1
 Updating Shadowing Calculations, Start Date=03/02
 Continuing Simulation at 03/02 for RUN PERIOD 1
 Updating Shadowing Calculations, Start Date=04/11
 Continuing Simulation at 04/11 for RUN PERIOD 1
 Updating Shadowing Calculations, Start Date=05/01
 Continuing Simulation at 05/01 for RUN PERIOD 1
 Updating Shadowing Calculations, Start Date=05/21
 Continuing Simulation at 05/21 for RUN PERIOD 1
 Updating Shadowing Calculations, Start Date=06/08
 Continuing Simulation at 06/08 for RUN PERIOD 1
 Updating Shadowing Calculations, Start Date=06/20
 Continuing Simulation at 06/20 for RUN PERIOD 1
 Updating Shadowing Calculations, Start Date=06/28
 Continuing Simulation at 06/28 for RUN PERIOD 1
 Updating Shadowing Calculations, Start Date=07/06
 Continuing Simulation at 07/06 for RUN PERIOD 1
 Updating Shadowing Calculations, Start Date=08/09
 Continuing Simulation at 08/09 for RUN PERIOD 1
 Updating Shadowing Calculations, Start Date=08/29
 Continuing Simulation at 08/29 for RUN PERIOD 1
 Updating Shadowing Calculations, Start Date=09/18
 Continuing Simulation at 09/18 for RUN PERIOD 1
 Updating Shadowing Calculations, Start Date=10/08
 Continuing Simulation at 10/08 for RUN PERIOD 1
 Updating Shadowing Calculations, Start Date=10/28
 Continuing Simulation at 10/28 for RUN PERIOD 1
 Updating Shadowing Calculations, Start Date=11/17
 Continuing Simulation at 11/17 for RUN PERIOD 1
 Updating Shadowing Calculations, Start Date=12/07
 Continuing Simulation at 12/07 for RUN PERIOD 1
 Updating Shadowing 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 the SQL reports
 EnergyPlus Run Time=00m 40m 26.86sec
 Script executing from: C:\Users\user\AppData\Local\Temp\OpenStudio.5.10216\resources\run\RunUserScript.0
 result = true
 Found UserScript 'OpenStudio Results'.
 Processed 1 base script and 0 merged scripts

File Preferences Components & Measures Help

Results Summary

Reports: EnergyPlus Results Open Results/Viewer for Detailed Reports

Program Version: EnergyPlus, Version 8.5.0-c87e61b44b, YMD=2019.11.10 22:22

Tabular Output Report in Format: HTML Table of Contents

Building: Building 1

Environment: RUN PERIOD 1 ** Piacenza - ITA IGDG WMO#=160540

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
Net Site Energy	2372.70	659.08	659.08
Total Source Energy	6126.52	1701.81	1701.81