

WEEK 6

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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:

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

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

But in the other case, where all the $\epsilon = 0.1$

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:

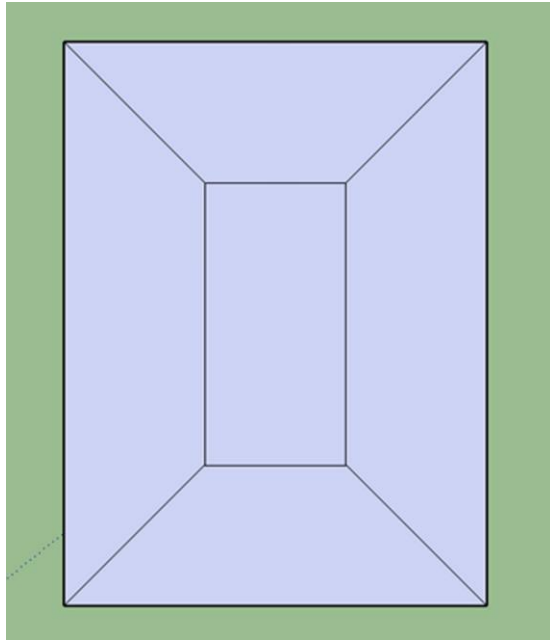
$$\dot{q}_{99 \text{ shields}} = \frac{\delta (T_1^4 - T_2^4)}{(N+1) + \left(\frac{1}{\epsilon} + \frac{1}{\epsilon} - 1\right)}$$

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

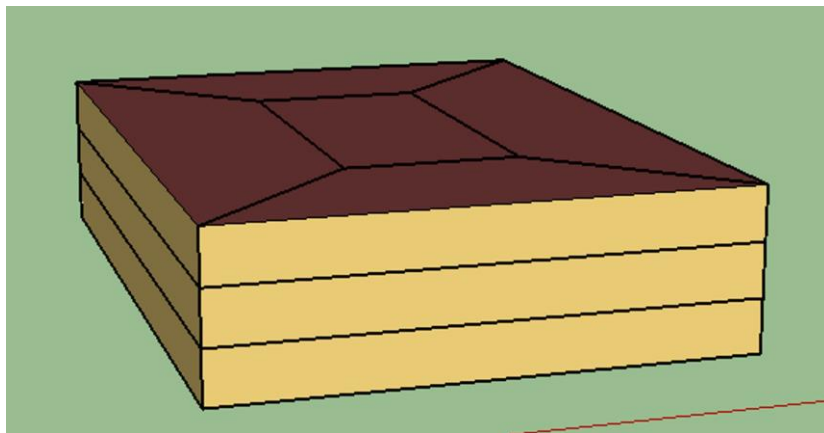
Task 2

You should create a pdf file with screenshots of all of the steps we went through and explain briefly the reason behind the use of each step.

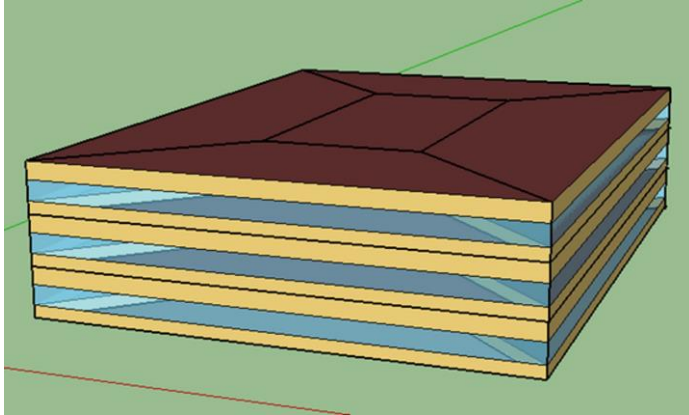
1. Create 2 rectangle (out: 30x40, in: 10x20) connected by lines to create the plan.



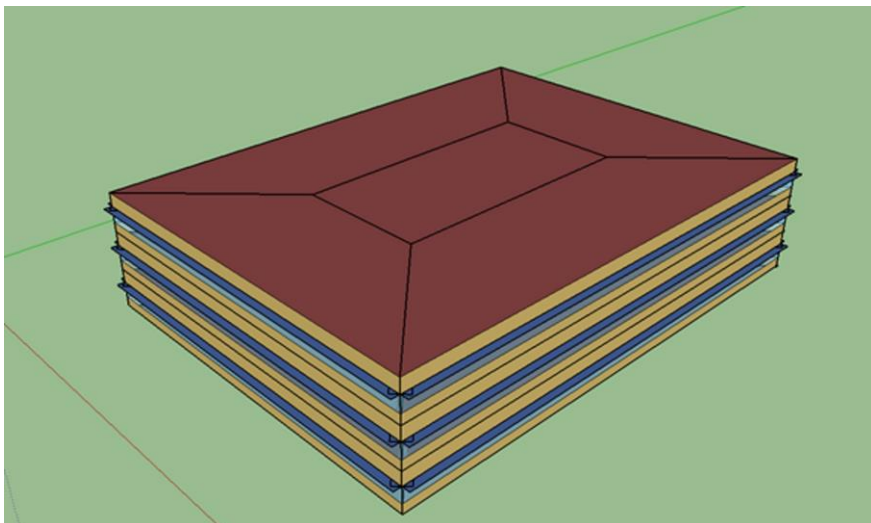
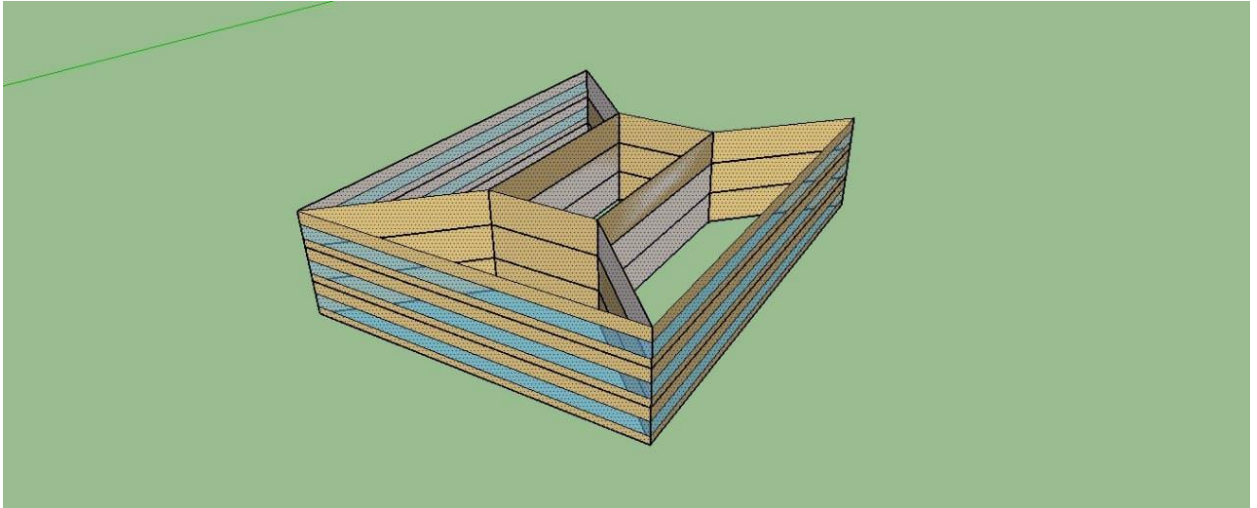
2. Select it and create space from diagram tool and enter 3 floors



3. Use the surface matching tool and then go to extension and apply window to the building.



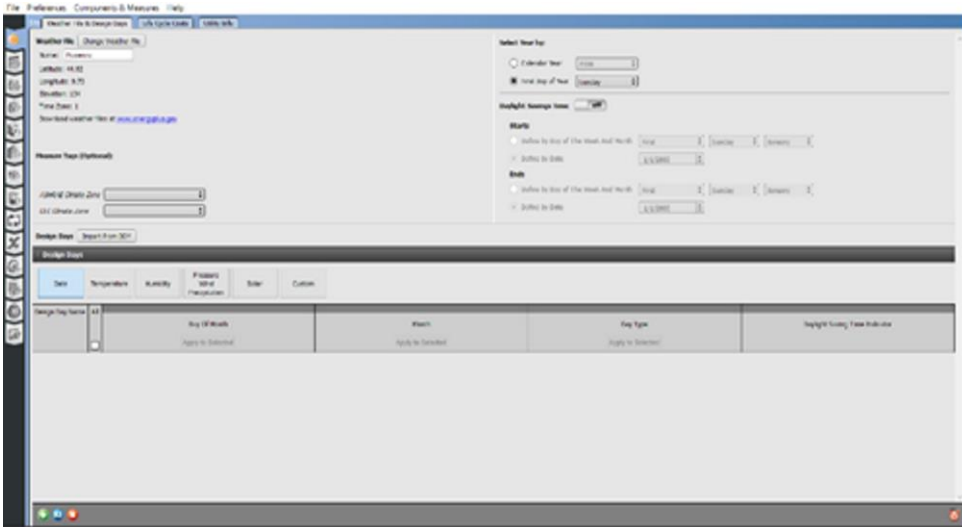
4. Select all of the surfaces except the north and then add overhang by projection factor through the extension, adding overhangs to the external walls.



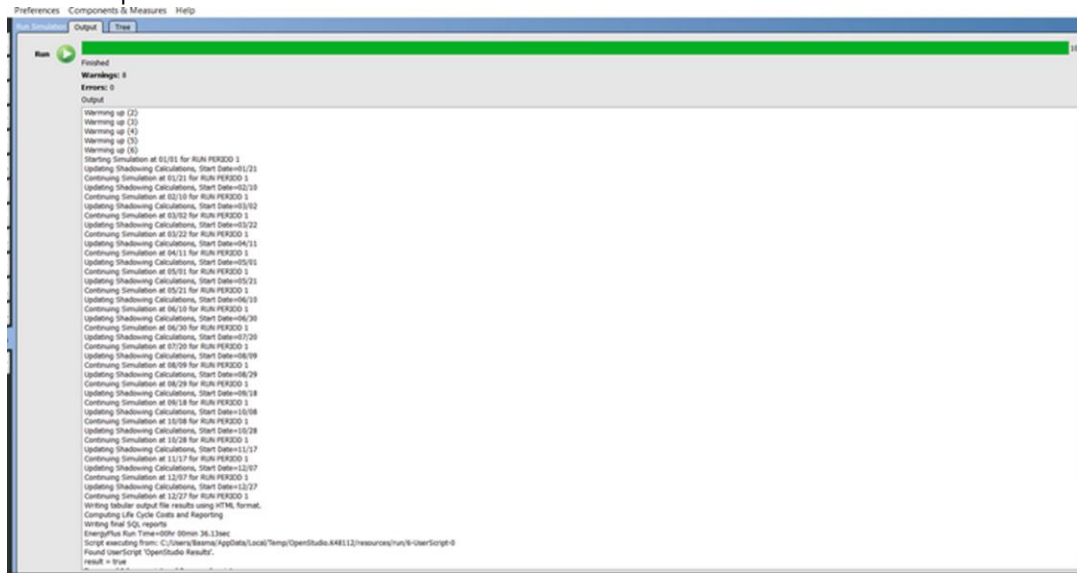
Set Attributes for Selected Spaces

Space Type	189.1-2009 - Office - OpenOffice - CZ1-3
Building Story	Building Story 1
Construction Set	189.1-2009 - CZ1 - Office
Thermal Zone	<new thermal zone>
Set Parent Thermal Zone's - Ideal Air Loads Status	Yes
Set Parent Thermal Zone's - Thermostat	189.1-2009 - Office - OpenOffice - CZ1-3 Thermostat

OK Cancel



7. Run open studio on the model



8. Get the results in the last tab

Open Results/View for Detailed Report

OpenStudio Results

Model Summary

Building Summary

Information	Value	Units
Building Name	Building 1	building_name
Net Site Energy	2,146,853	kBtu
Total Building Area	38,750	ft ²
EUI (Based on Net Site Energy and Total Building Area)	55.40	kBtu/ft ²
OpenStudio Standards Building Type		

Weather Summary

	Value
Weather File	Piacenza - ITA IGGG WMO#160640
Latitude	44.92
Longitude	9.73
Elevation	440 (ft)
Time Zone	1.00
North Axis Angle	0.00
ASHRAE Climate Zone	

