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Name: Shivali Sanap

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 ?

Define the radiative heat transfer between two parallel plates shown in the picture.

Case 1 : Without Shields.

$\epsilon_1 = 0.1, \epsilon_2 = 0.1$

$T_1 = 800k$

$T_2 = 500k$

$\sigma = 5.67 * 10^{-8} \frac{W}{m^2 k^4}$

Net Heat transfer without shields,

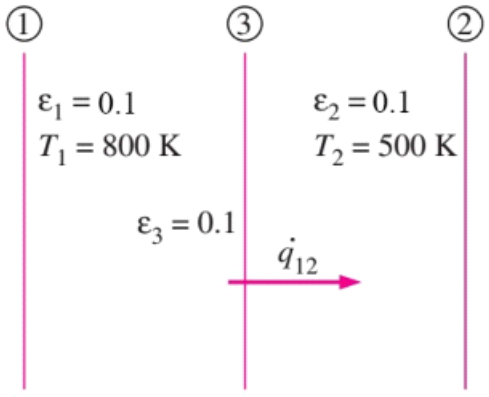
$$\frac{\dot{Q}_{net}}{A} = \frac{\sigma(T_1^4 - T_2^4)}{\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1} = 1 * \frac{5.67 * 10^{-8}(800^4 - 500^4)}{\frac{1}{0.1} + \frac{1}{0.1} - 1}$$

$$= \frac{5.67 * 10^{-8}(4096 * 100^8 - 625 * 100^8)}{19}, \quad = 1035.82 \frac{W}{m^2}$$

Q_{12} = 1035.81 W/m^2

$Q_{12\ N\_shield}$ = 10.3581 W/m^2

Case2 : With shields to reduce the heat transfer by 1%



$\epsilon_1 = 0.1, \epsilon_2 = 0.1$

$T_1 = 800k$

$T_2 = 500k$

$\sigma = 5.67 * 10^{-8} \frac{W}{m^2 k^4}$

$\in_n = 0.1$

Heat transfer with n shields in between 1% of $\frac{\dot{Q}_{net}}{A}$

$Q_{12\ N\_shield} = \frac{1}{N+1} Q_{12}$

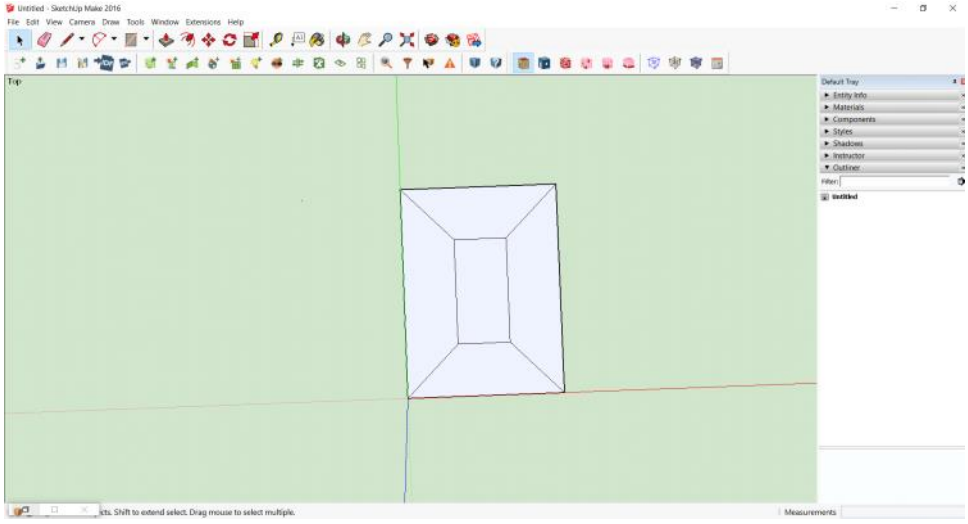
$10.3581 = \frac{1}{N+1} 1035.81$

$\frac{10.3581}{1035.81} = \frac{1}{N+1}$

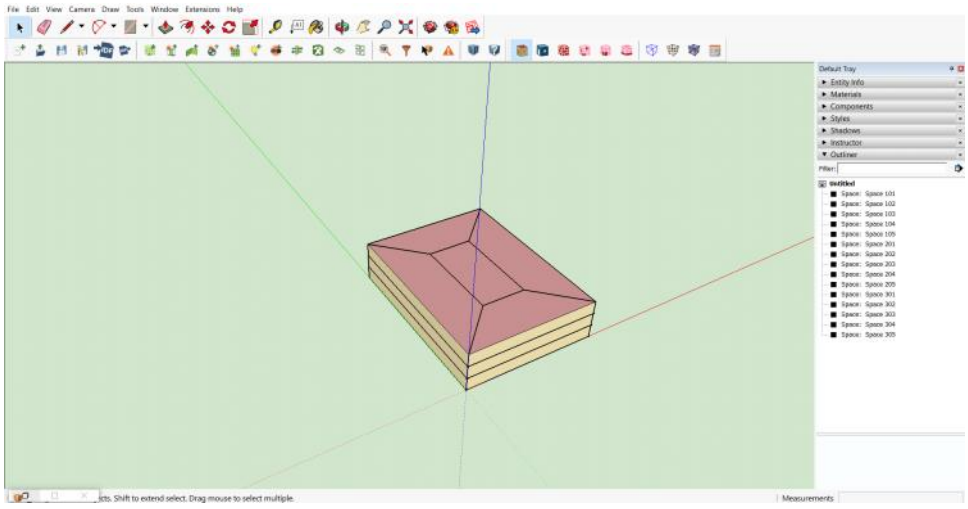
0.01=$\frac{1}{N+1}$, $N + 1 = \frac{1}{0.01}$, $N + 1 = 100$, N=100-1 , N=99

Task 2

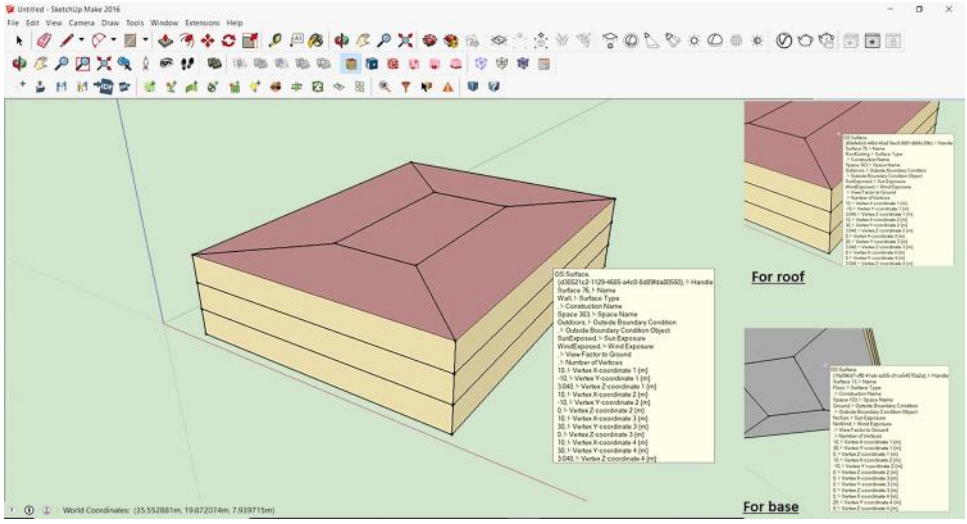
You should create a pdf file with screenshots of all of the steps we went through (clearly from your own file) and explain briefly the reason behind the use of each step.



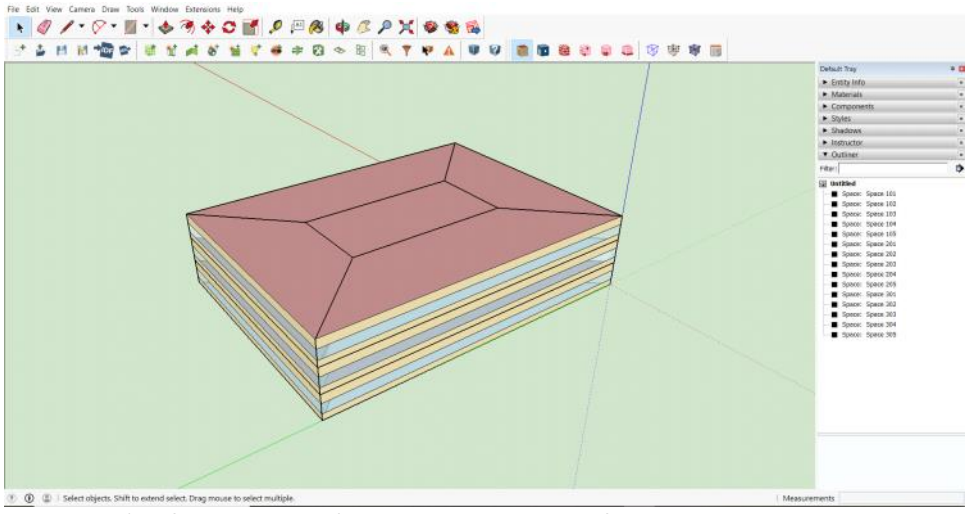
Creating an office plan of 30mx40m.



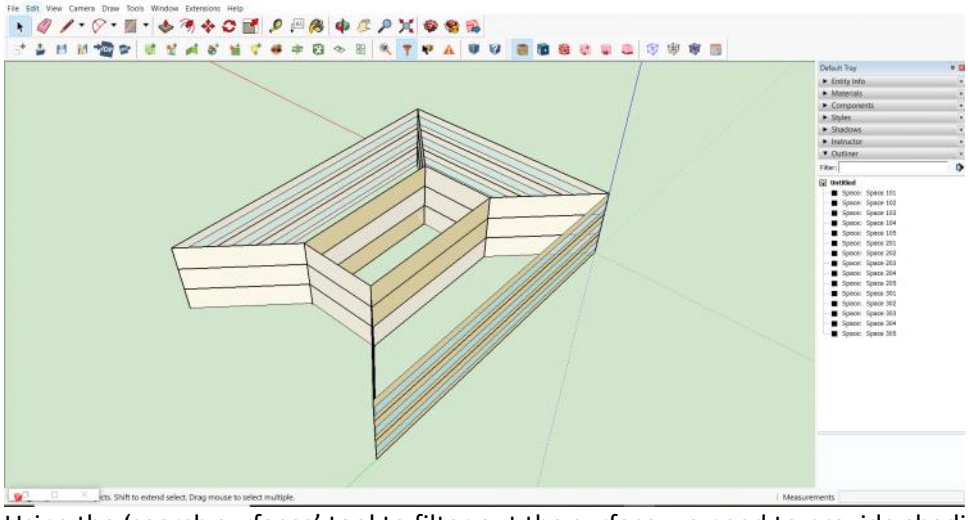
Using the ‘create space from diagram’ tool to give height for each floors and to specify the number of floors.



Using the ‘info’ tool to give us information about the sun, wind, boundary conditions etc. E.g., placing the cursor on the roof will tell us that wind and sun are exposed but if we place the cursor on the base of the building, it will tell us no sun and wind exposed.

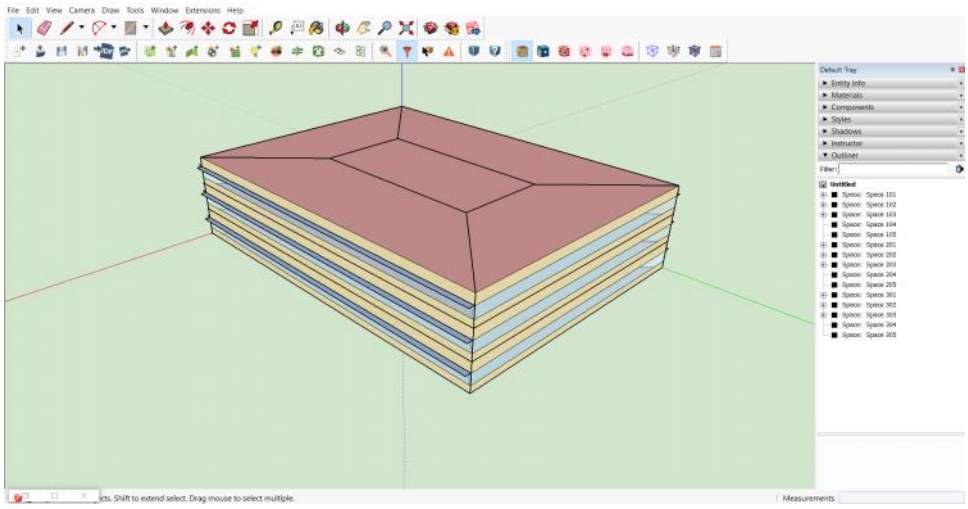


Using the ‘surface matching’ tool to match the surfaces so it is easier to create windows. Creating windows using the ‘set window to wall ratio’ tool by giving the window height and sill height.

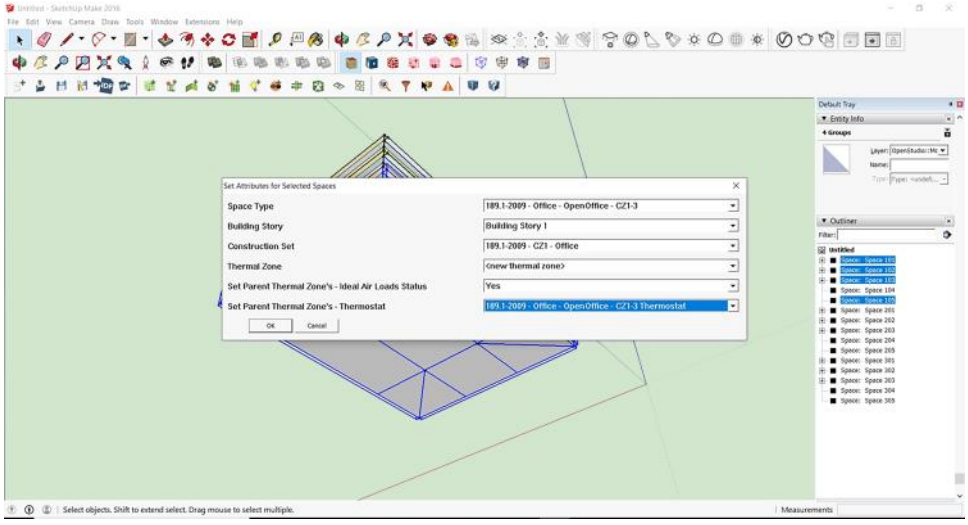


Using the ‘search surfaces’ tool to filter out the surface we need to provide shading (in this exercise). Assuming there is no harsh sun in the North façade, we exclude that by typing 90° to 360° in the

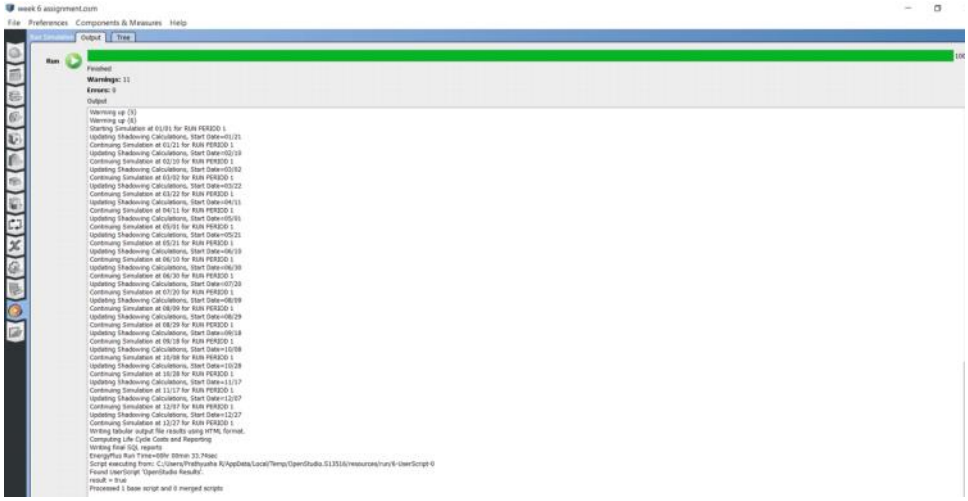
dialog box



Using the ‘add overhangs by projection factor’ tool to provide sun shades for the windows by inputting the width of the projection. Overhangs are not seen in the north face.

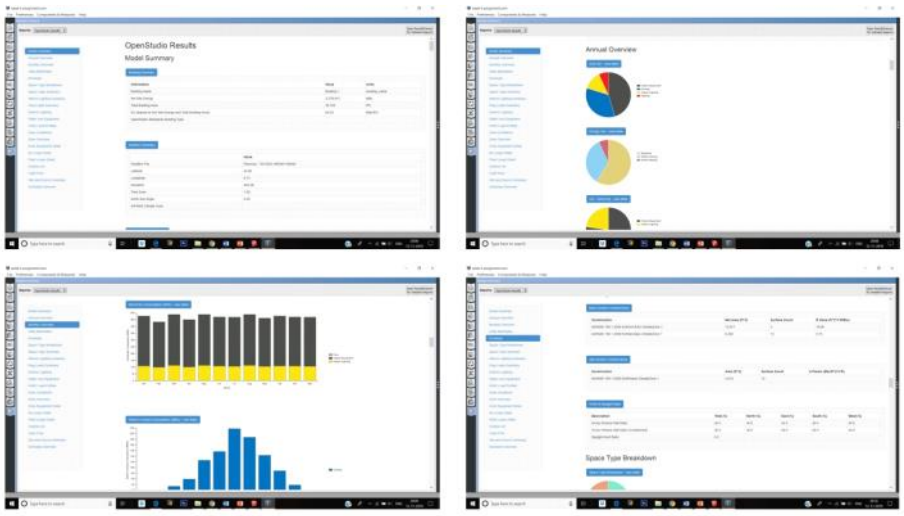


Using the ‘set attributes for the selected spaces’ tool to provide thermal zones for each spaces. In this case open office for the rooms facing outside and break room for the rooms facing inside.



We open the ‘OPEN STUDIO’ software and input in the weather data file i.e. Piacenza weather data (assuming the office is in Piacenza). And then load the sketch file in this software and we run the

model to calculate the energy consumption and other information.



After we run the data, we arrive at the result of the energy consumption like annual overview of the consumption, monthly overview, monthly bills, lighting consumptions, plug point consumption, exterior lighting, equipment consumption(if we have loaded any), water consumption, air loops detail, cash flow etc.