

# Week6 assignment

12 Kasım 2019 14:40

#Week 6

\*\* 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 (in your own words!)

**PREVIOUS PROBLEM :** Find the net heat transfer between two surface  $A_1 = 1.5 \text{ m}^2$ ,

$$\varepsilon_1 = \varepsilon_2 = 0.1, T_1 = 800 \text{ K}, T_2 = 500 \text{ K} \quad \sigma = 5.67 * 10^{-8} \frac{W}{m^2 K^4}$$

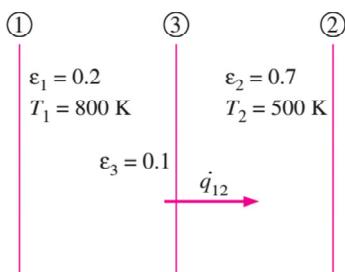
- All  $\varepsilon$  values are equal !!

**SOLUTION:**

$$\begin{aligned} Q_{net\ 12} &= A\sigma \frac{T_1^4 - T_2^4}{\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1} \\ &= 1.5 \times (5.67 \times 10^{-8}) \times (800^4 - 500^4) / \frac{1}{0.1} + \frac{1}{0.1} - 1 \\ &= 1035.81 \text{ W} \end{aligned}$$

**TASK 1 :** 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 ?

Net heat transfer without shield:



- All  $\varepsilon$  values are not equal in terms of previous example!

$$\begin{aligned} \dot{Q}_{\square} &= A\sigma \frac{T_1^4 - T_2^4}{\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1} \\ &= 1.5 \times (5.67 \times 10^{-8}) \times (800^4 - 500^4) / \frac{1}{0.2} + \frac{1}{0.7} - 1 \\ &= 3625.4 \text{ W} \end{aligned}$$

$$3625.4 \times \frac{1}{100} = 36.25$$

$$\begin{aligned} \frac{Q}{A} &= \frac{\sigma(T_1^4 - T_2^4)}{\left(\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1\right) \left(\frac{1}{\varepsilon_{31}} + \frac{1}{\varepsilon_{31}} - 1\right) \dots \dots + \left(\frac{1}{\varepsilon_{n1}} + \frac{1}{\varepsilon_{n1}} - 1\right)} \\ &= 1.5 \times 10^{-8} \times \frac{(800^4 - 500^4)}{\left(\frac{1}{0.2} + \frac{1}{0.7} - 1\right) n \times \frac{1}{0.1} + \frac{1}{0.1} - 1} = 36.25 \\ &= 1.5 \times (5.67 \times 10^{-8}) \times (800^4 - 500^4) / 5.42 + 19n = 36.25 \end{aligned}$$

$$19n = 537.49$$

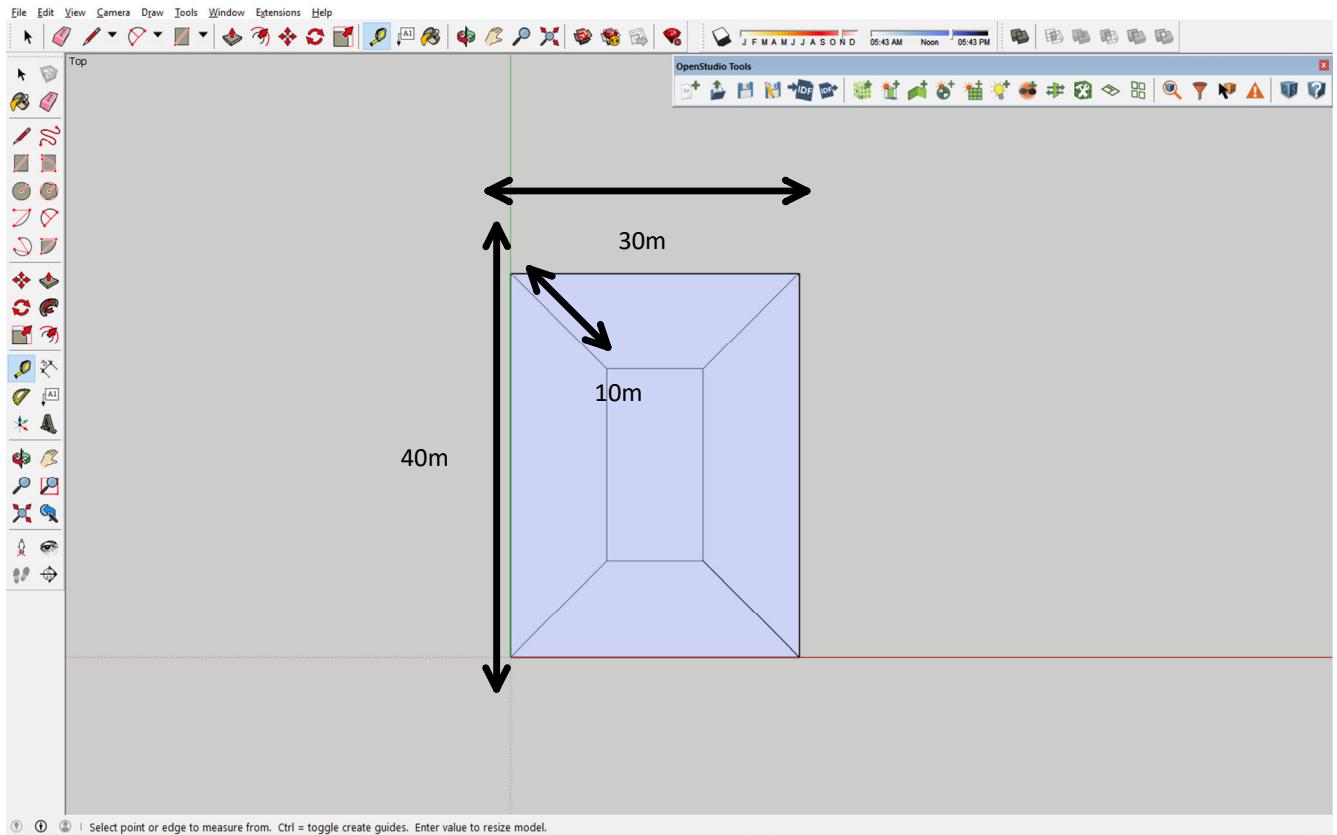
$$n = 28.1$$

28 shields were needed to new heat transfer rate to be 1% of the case without shields.

## TASK 2

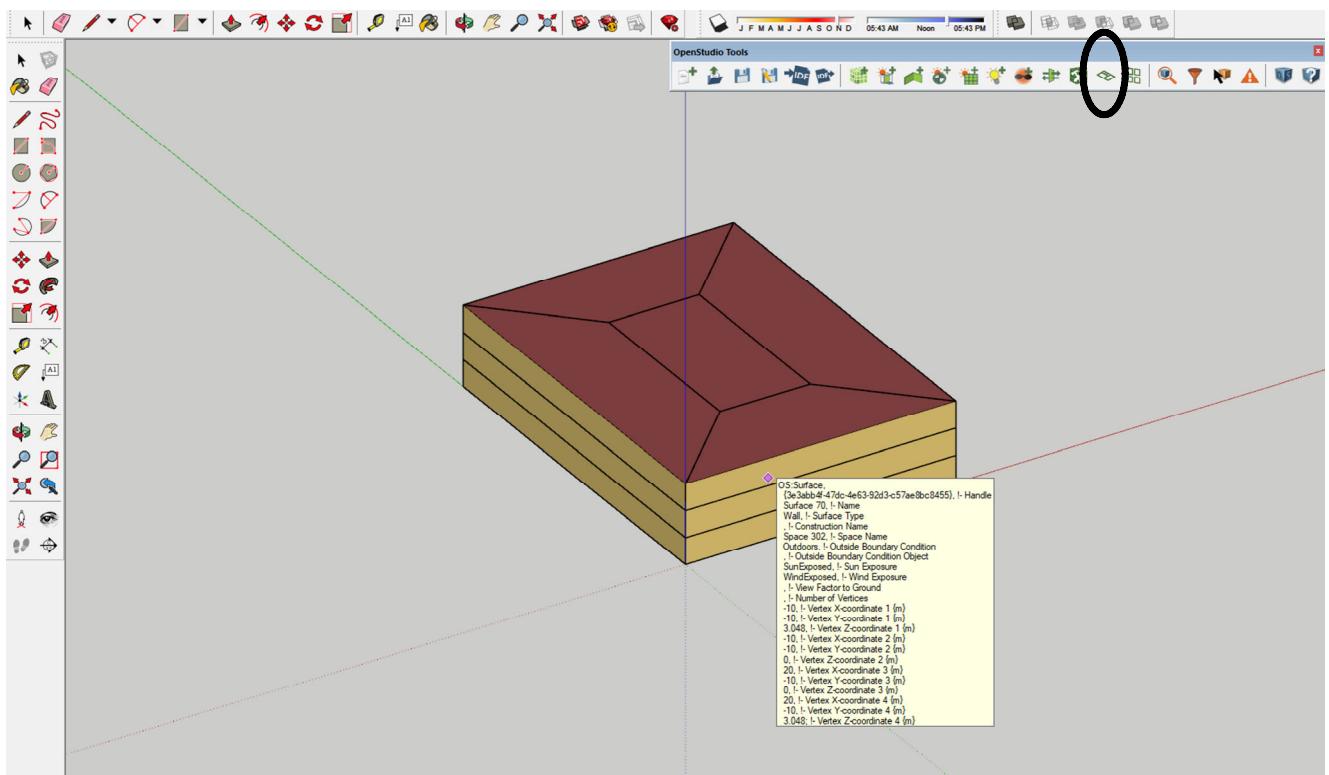
### STEP-1

A planar rectangle was drawn with 40x30m measurement and 10 m offset through inside to create smaller rectangle.



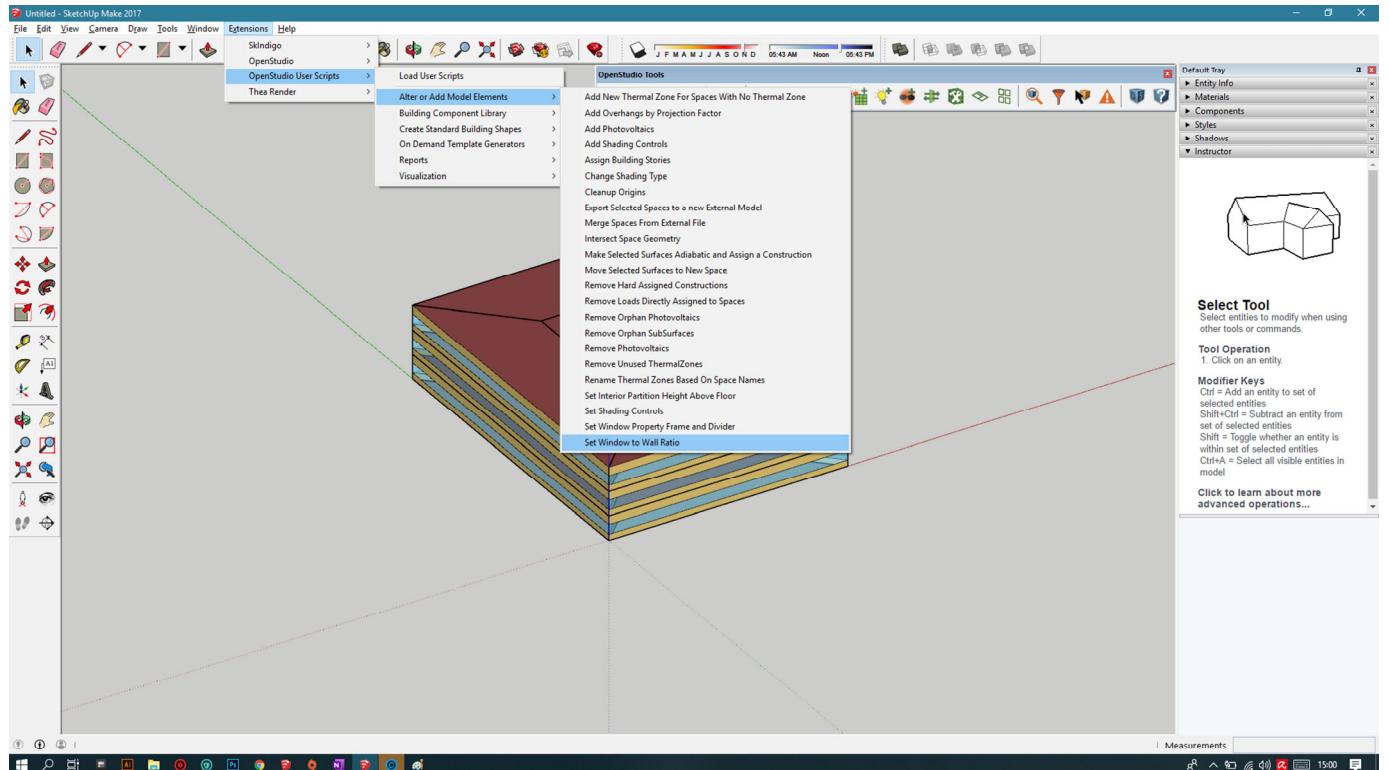
### STEP-2

Create spaces from diagram button was selected and 3 floor were created equally.



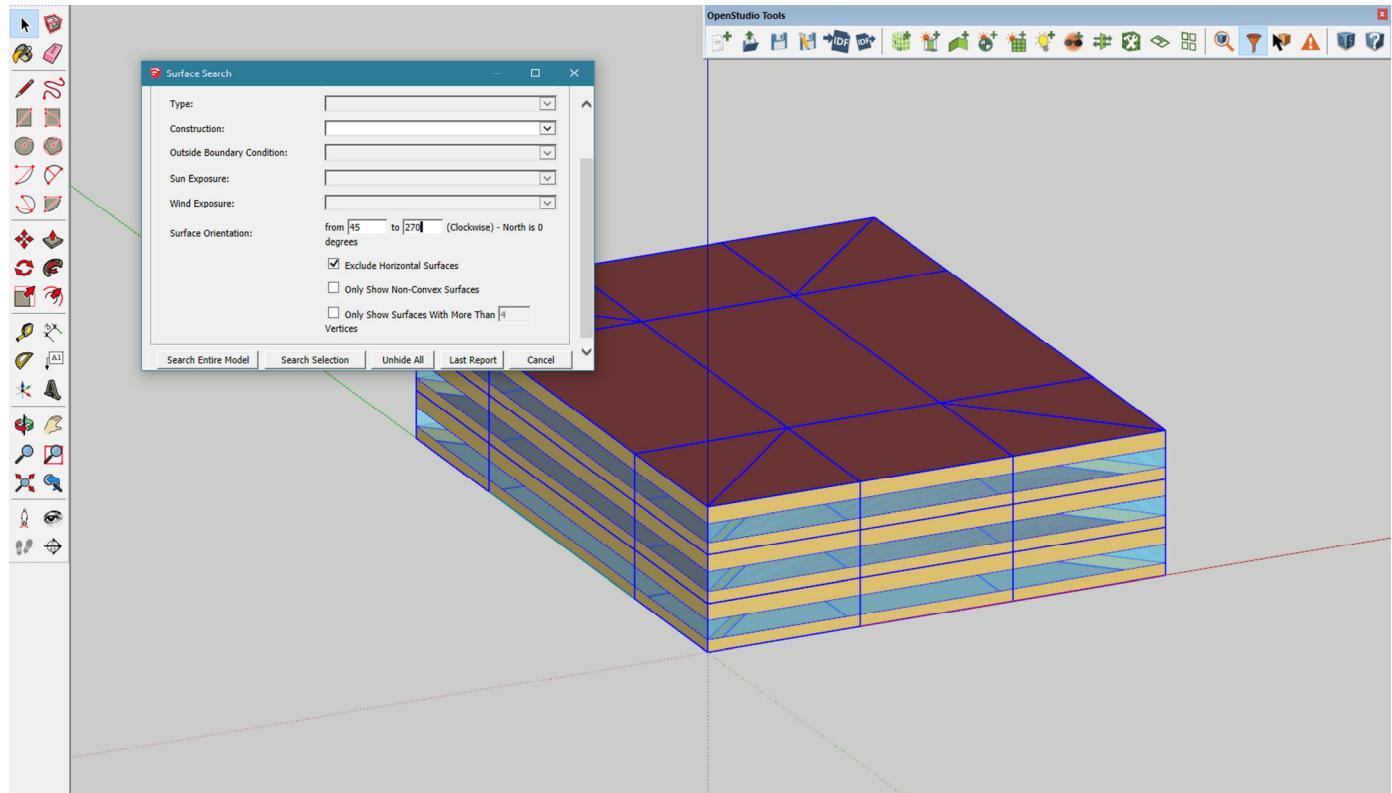
### STEP-3

Set window to wall ratio button created windows surrounding the building in every floor, this will help to sun lights get in the building to provide heating.



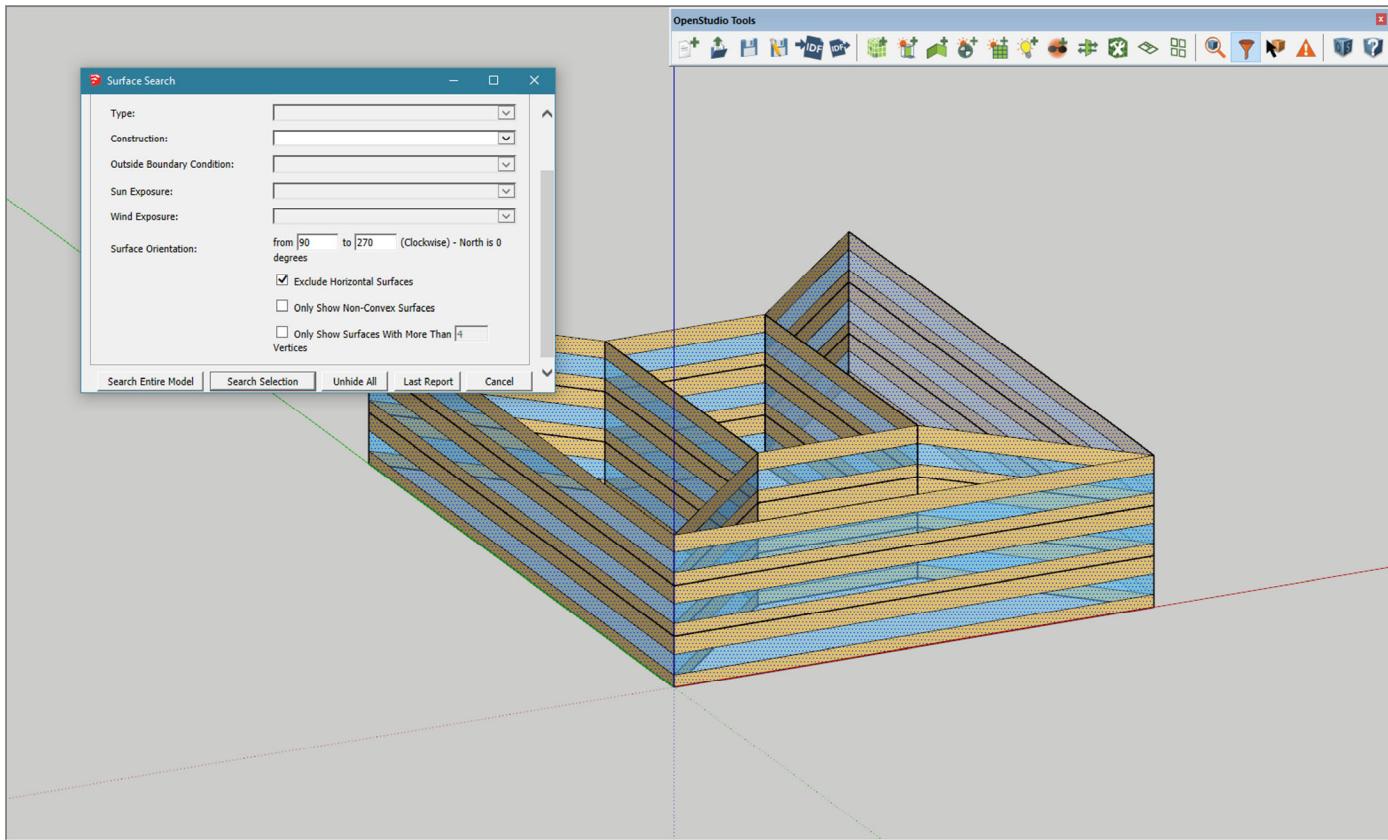
### STEP-4

Surfaces were selected except north side ( because north façade doesn't need sun shading so it doesn't receive enough daylight already! )



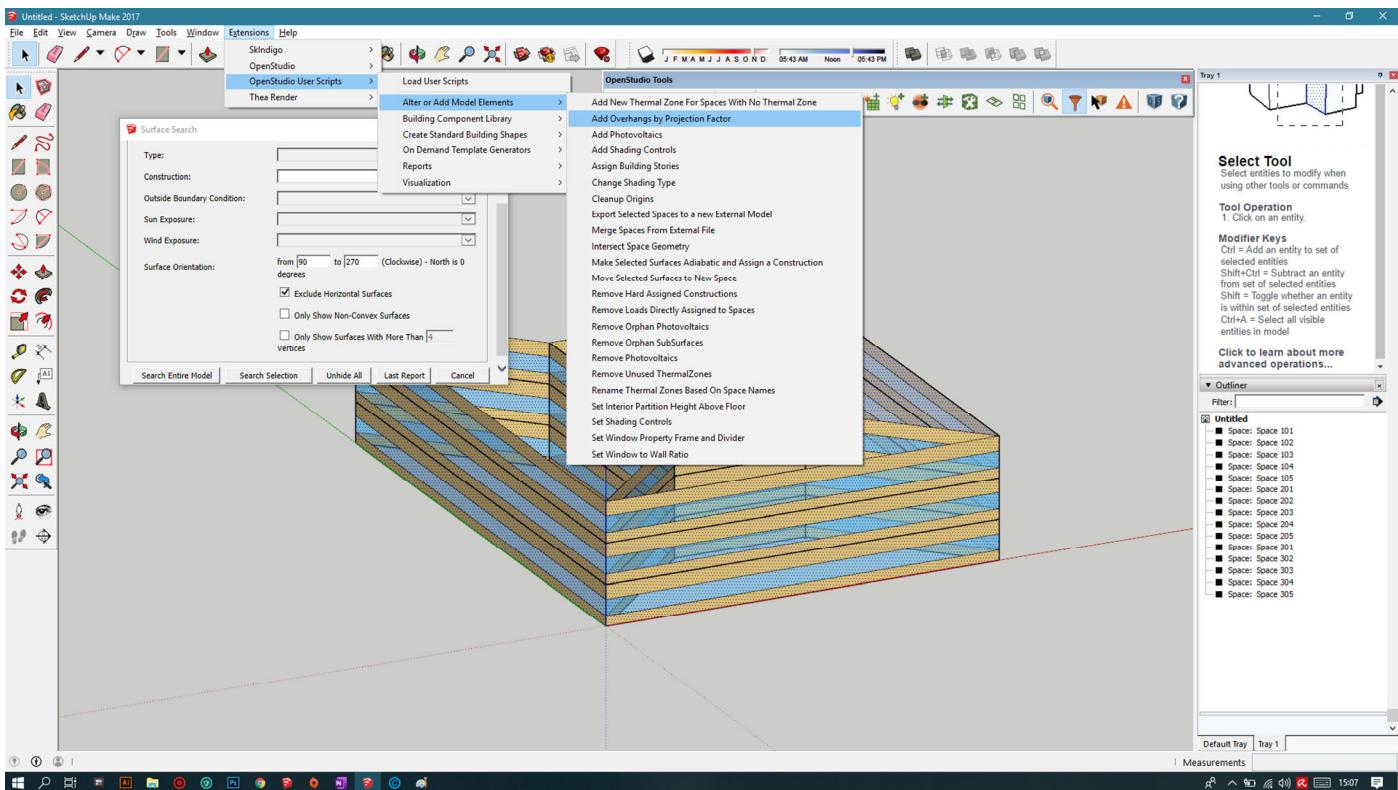
## STEP-5

Angle was setted from 90 to 270 degree as work space to neglect the northern façade.



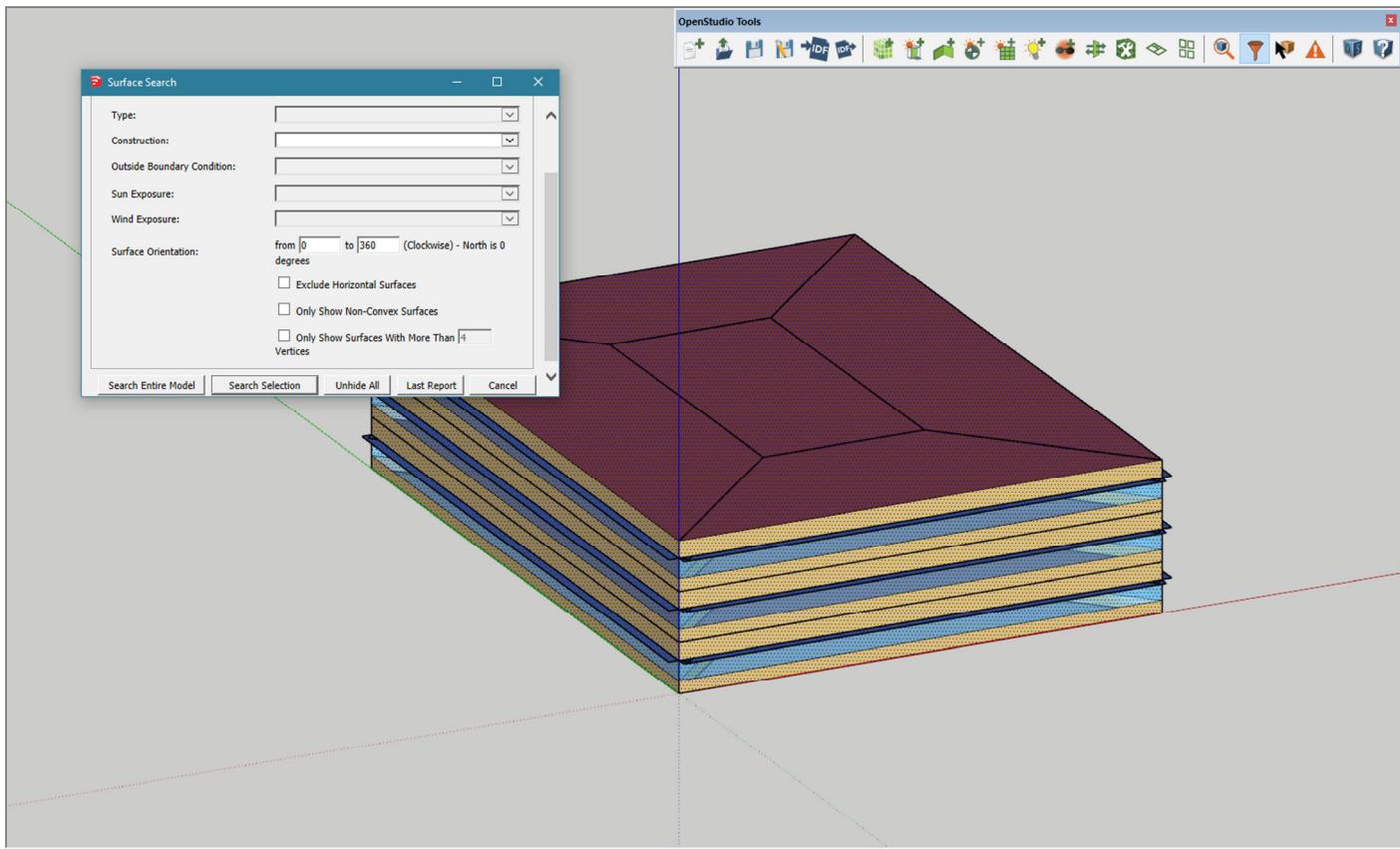
## STEP-6

For creating sun shading element; Add overhang by projection factor button was selected. Sun shading elements will provide blocking the sun light which is coming directly inside the building so it can solve the problem of overheating in summer .



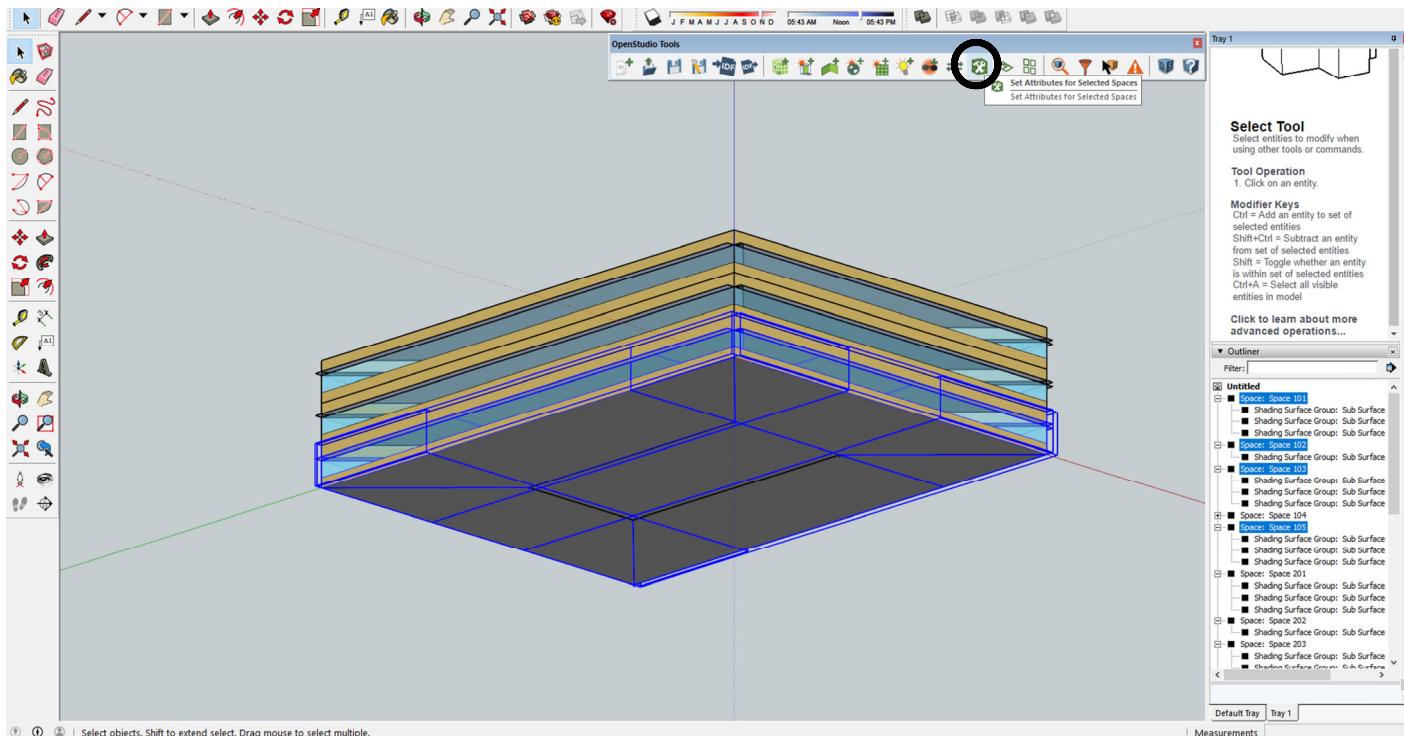
## STEP-7

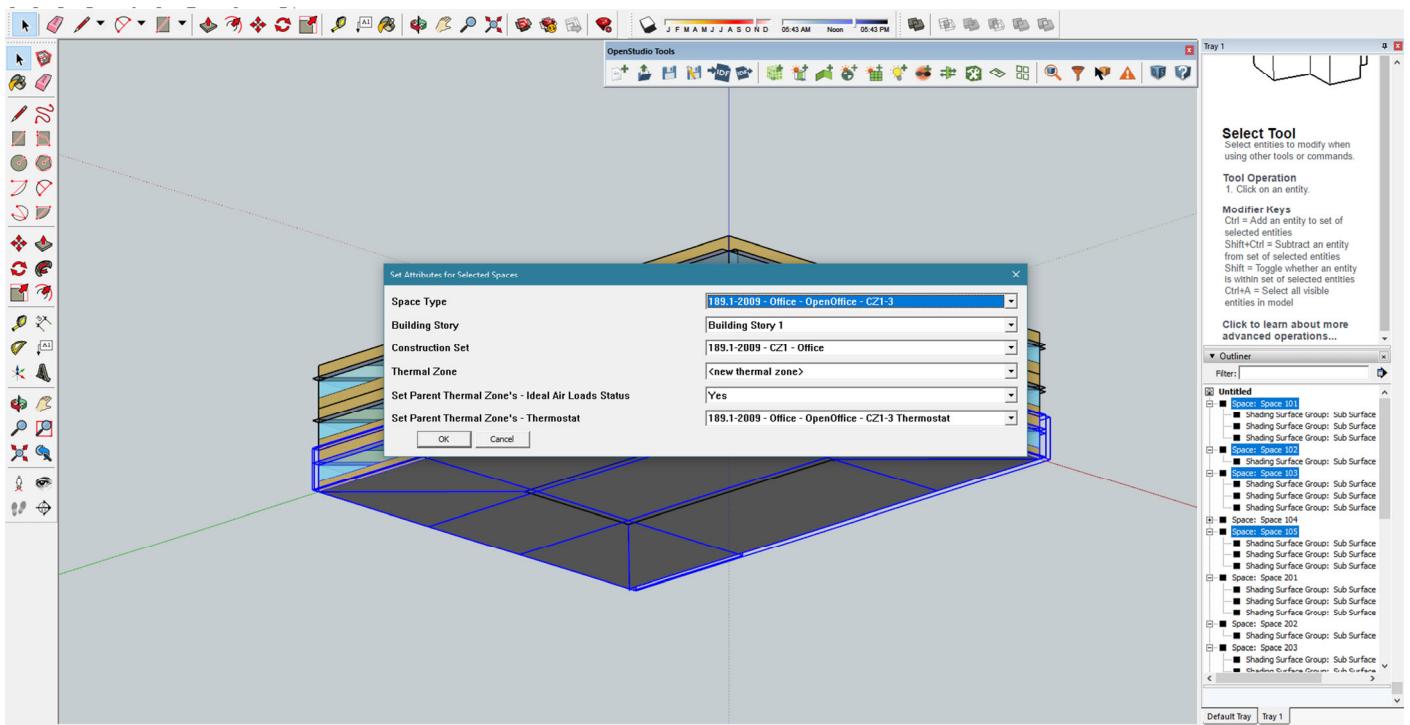
Surface selection settings were returned to normal.



## STEP-8

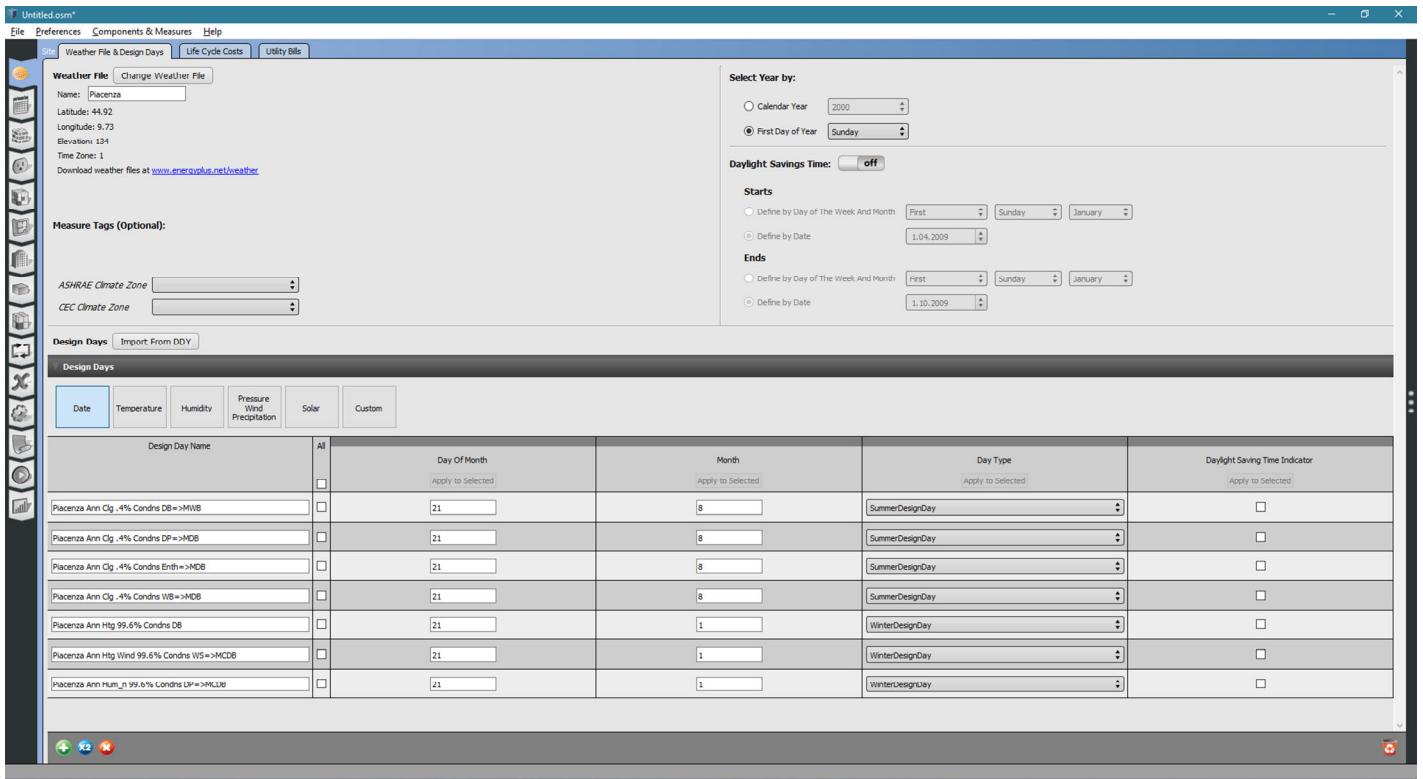
Relevant floor spaces were selected from outliner and set attributes for selected spaces button was pushed and the following settings have been applied to the structure





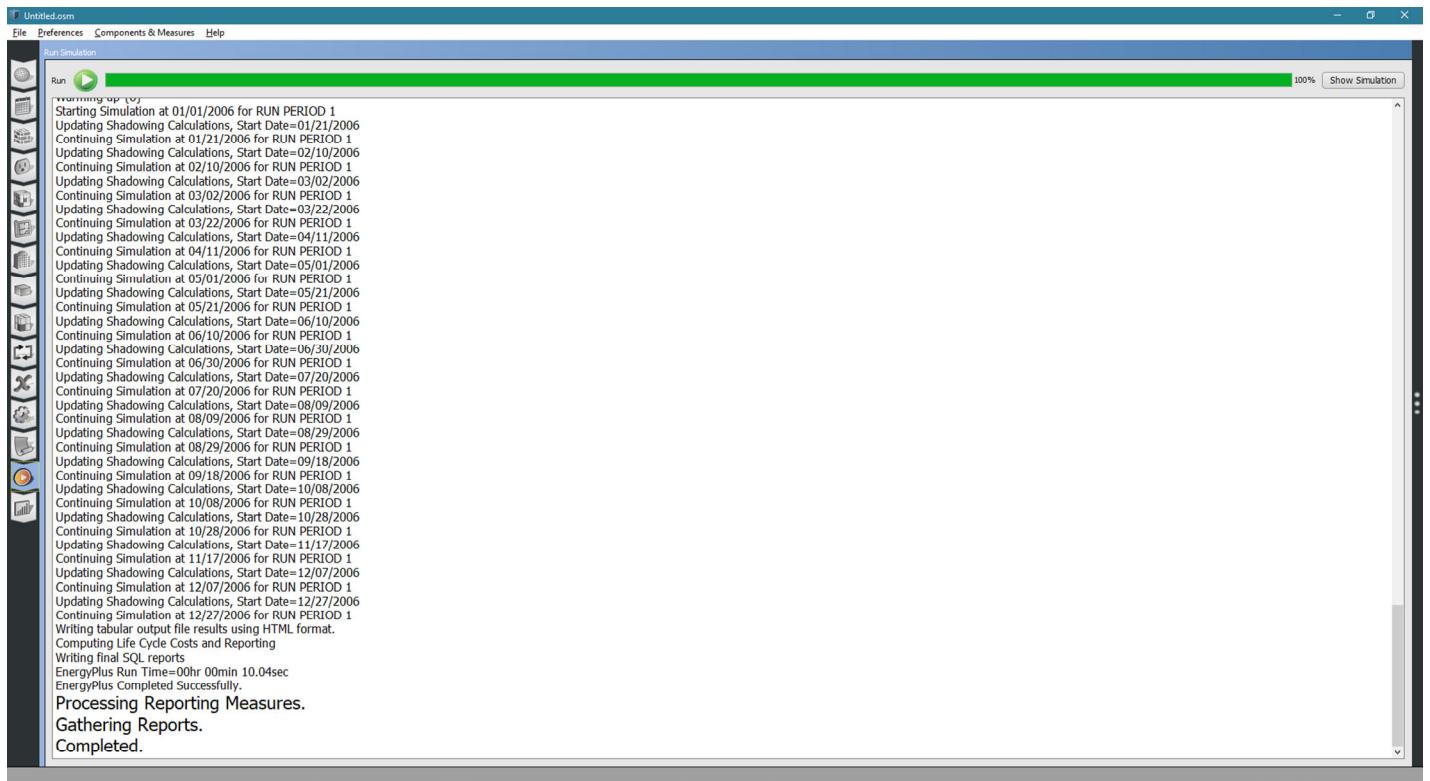
## STEP-9

.Epw and .ddy file imported to the program to reach Piacenza's real weather informations so the report will provide us the real calculations.



## STEP-10

Clicked to the run button tho start to calculation



## STEP-11

Finally reached to the annual building utility performance report

The screenshot shows the EnergyPlus Results Summary report interface. The title bar says "Untitled.osm" and "Results Summary". The menu bar includes "File", "Reports", "Components & Measures", and "Help". The toolbar on the left has icons for Reports, Components & Measures, and Help. The main content area displays the following information:

Program Version EnergyPlus, Version 9.2.0-921312fa1d, YMD=2019.11.12 15:22  
Tabular Output Report in Format: HTML  
Building: Building 1  
Environment: RUN PERIOD 1 \*\* Piacenza - ITA IGDG WMO#=160840  
Simulation Timestamp: 2019-11-12 15:22:20

Report: Annual Building Utility Performance Summary  
For: Entire Facility  
Timestamp: 2019-11-12 15:22:20  
Values gathered over \$760.00 hours

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m <sup>2</sup> ]	Energy Per Conditioned Building Area [MJ/m <sup>2</sup> ]
Total Site Energy	638.19	638.19	638.19
Net Site Energy	638.19	638.19	638.19
Total Source Energy	2010.49	2010.49	2010.49
Net Source Energy	2010.49	2010.49	2010.49

Site to Source Energy Conversion Factors

	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613
Steam	0.300
Gasoline	1.050
Diesel	1.050
Coal	1.050

Untitled.com

File Preferences Components & Measures Help

Results Summary

Reports: EnergyPlus Results

Fuel Oil #2 1.050  
Propane 1.050  
Other Fuel 1 1.000  
Other Fuel 2 1.000

**Building Area**

	Area [m <sup>2</sup> ]
Total Building Area	1000.00
Net Conditioned Building Area	1000.00
Unconditioned Building Area	0.00

**End Uses**

	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m <sup>3</sup> ]
Heating	0.00	0.00	0.00	0.00	312.94	0.00
Cooling	0.00	0.00	0.00	71.20	0.00	0.00
Interior Lighting	123.73	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.06	0.00	0.00
Interior Equipment	130.32	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.06	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.06	0.00	0.00
Total End Uses	254.04	0.00	0.00	71.20	312.94	0.00

Note: District heat appears to be the principal heating source based on energy usage.

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File Preferences Components & Measures Help

Results Summary

Reports: EnergyPlus Results

Report: Input Verification and Results Summary

For: Entire Facility

Timestamp: 2019-11-12 15:22:20

**General**

	Value
Program Version and Build	EnergyPlus, Version 9.2.0-921312fa1d, YMD=2019.11.12 15:22
RunPeriod	RUN PERIOD 1
Weather File	Piacenza - ITA IGDG WMO#=160840
Latitude [deg]	44.92
Longitude [deg]	9.73
Elevation [m]	134.00
Time Zone	1.00
North Axis Angle [deg]	0.00
Rotation for Appendix G [deg]	0.00
Hours Simulated [hrs]	8760.00

**ENVELOPE**

**Window-Wall Ratio**

	Total	North (315 to 45 deg)	East (45 to 135 deg)	South (135 to 225 deg)	West (225 to 315 deg)
Gross Wall Area [m <sup>2</sup> ]	954.44	208.13	269.09	208.13	269.09
Above Ground Wall Area [m <sup>2</sup> ]	954.44	208.13	269.09	208.13	269.09
Window Opening Area [m <sup>2</sup> ]	381.78	83.25	107.64	83.25	107.64
Gross Window-Wall Ratio [%]	40.00	40.00	40.00	40.00	40.00
Above Ground Window-Wall Ratio [%]	40.00	40.00	40.00	40.00	40.00

**Conditioned Window-Wall Ratio**

	Total	North (315 to 45 deg)	East (45 to 135 deg)	South (135 to 225 deg)	West (225 to 315 deg)
Gross Wall Area [m <sup>2</sup> ]	954.44	208.13	269.09	208.13	269.09