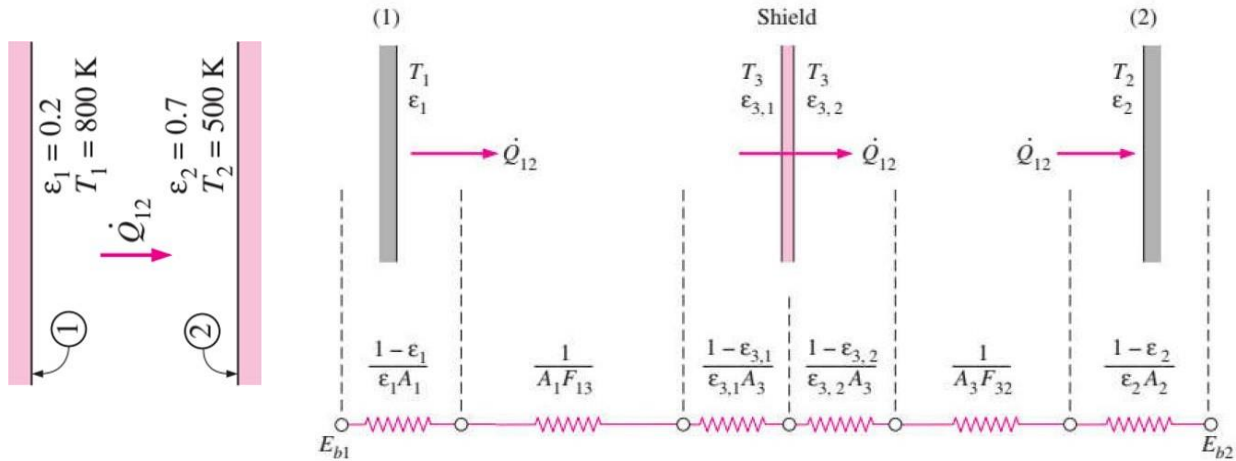


Task 1

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?



ANSWER

Without shield, $\epsilon_1 = 0.2$ and $\epsilon_2 = 0.7$,

$$Q_{12} = \frac{E_{b1} - E_{b2}}{\frac{1 - \epsilon_1}{A\epsilon_1} + \frac{1}{AF_{12}} + \frac{1 - \epsilon_2}{A\epsilon_2}} = \frac{A\sigma(T_1^4 - T_2^4)}{\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1}$$

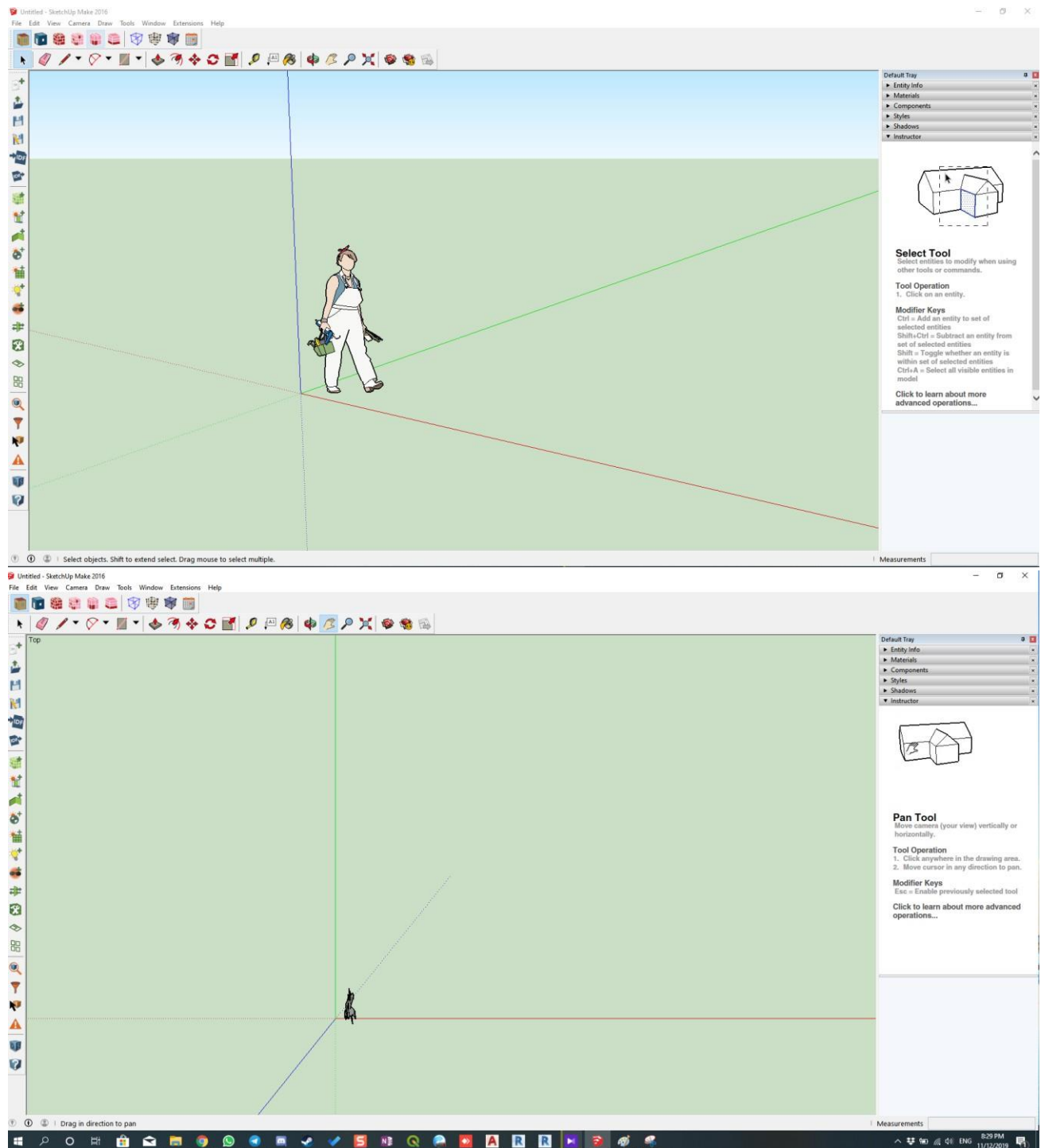
With N shield $\epsilon_3 = 0.1$

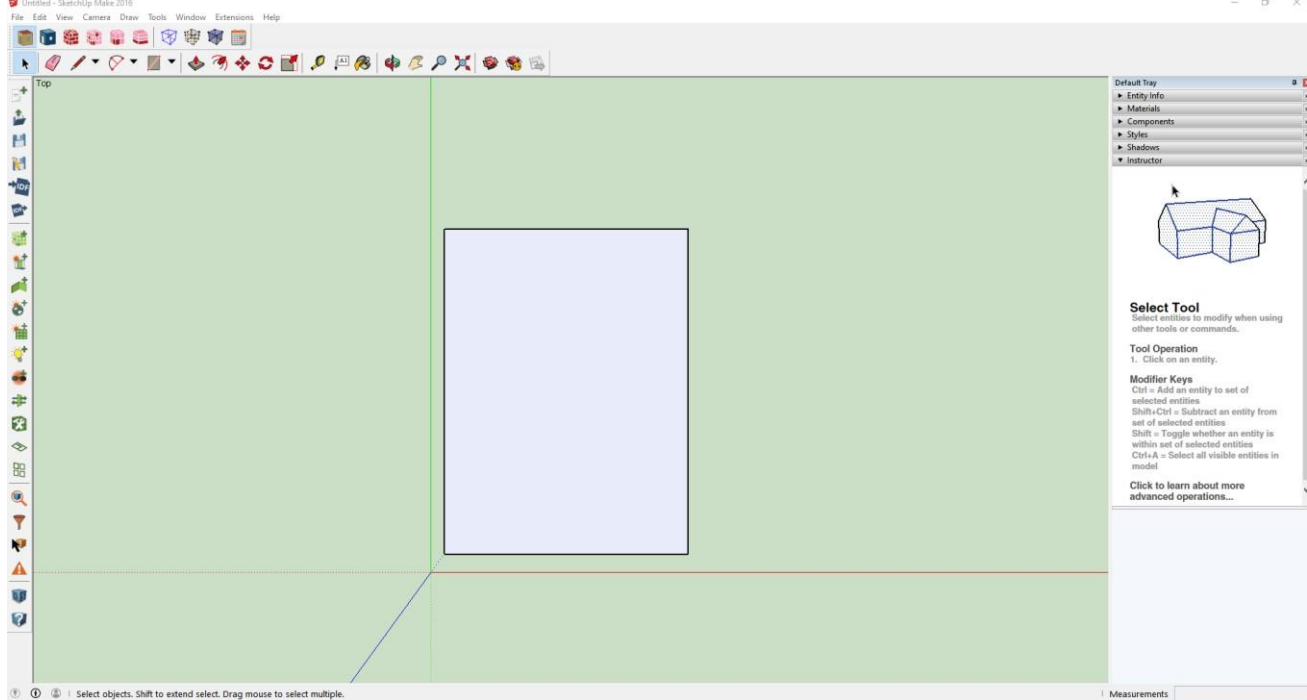
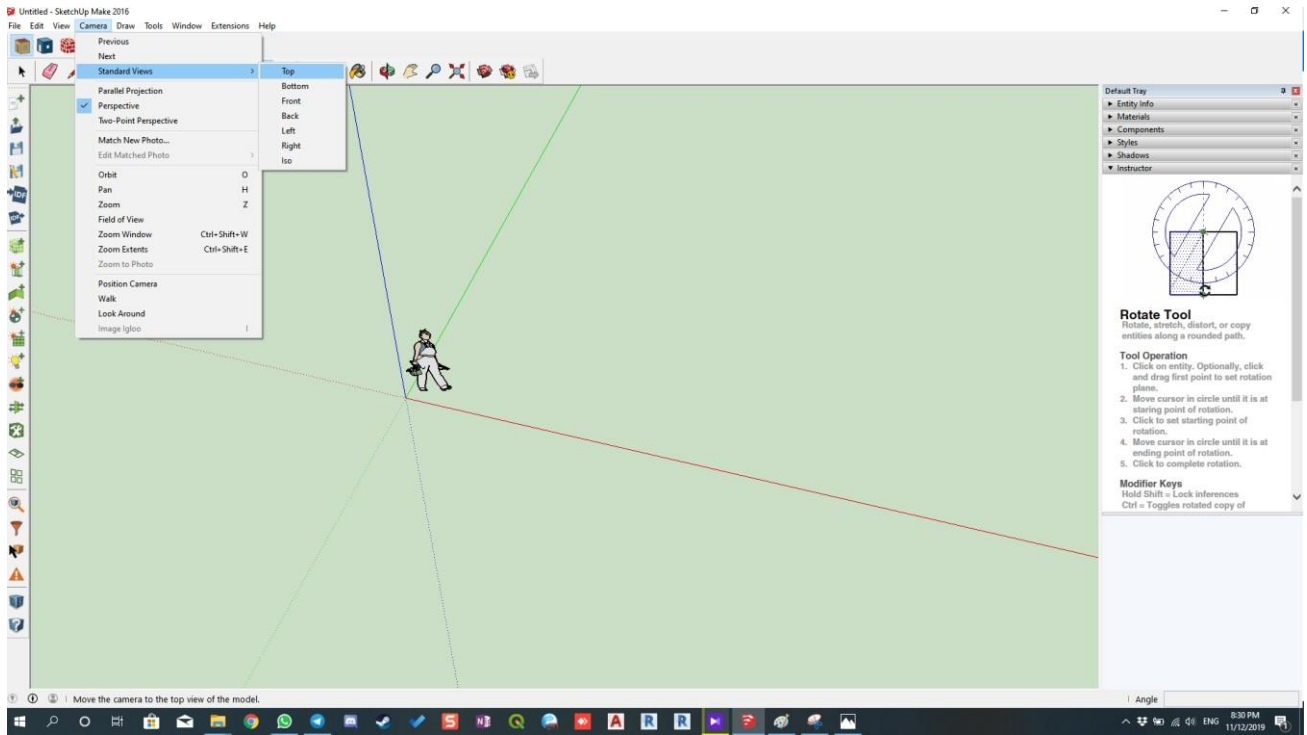
$$\begin{aligned} Q_{12N\text{shields}} &= \frac{E_{b1} - E_{b2}}{\frac{1 - \epsilon_1}{A\epsilon_1} + \frac{1}{AF_{13}} + \frac{1 - \epsilon_3}{A\epsilon_3} + N \times \left(\frac{1 - \epsilon_3}{A\epsilon_3} + \frac{1}{AF_{33}} + \frac{1 - \epsilon_3}{A\epsilon_3} \right) + \frac{1 - \epsilon_3}{A\epsilon_3} + \frac{1}{AF_{32}} + \frac{1 - \epsilon_2}{A\epsilon_2}} \\ &= \frac{A\sigma(T_1^4 - T_2^4)}{\left(\frac{1}{\epsilon_1} + \frac{1}{\epsilon_3} - 1 \right) + N \left(\frac{1}{\epsilon_3} + \frac{1}{\epsilon_3} - 1 \right) + \left(\frac{1}{\epsilon_3} + \frac{1}{\epsilon_2} - 1 \right)} \\ &= \frac{A\sigma(T_1^4 - T_2^4)}{\left(\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1 \right) + (N + 1) \left(\frac{1}{\epsilon_3} + \frac{1}{\epsilon_3} - 1 \right)} \\ \frac{Q_{12N\text{shields}}}{Q_{12}} &= \frac{\left(\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1 \right) + (N + 1) \left(\frac{1}{\epsilon_3} + \frac{1}{\epsilon_3} - 1 \right)}{\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1} = 1 + (N + 1) \frac{\frac{1}{\epsilon_3} + \frac{1}{\epsilon_3} - 1}{\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1} = 100 \end{aligned}$$

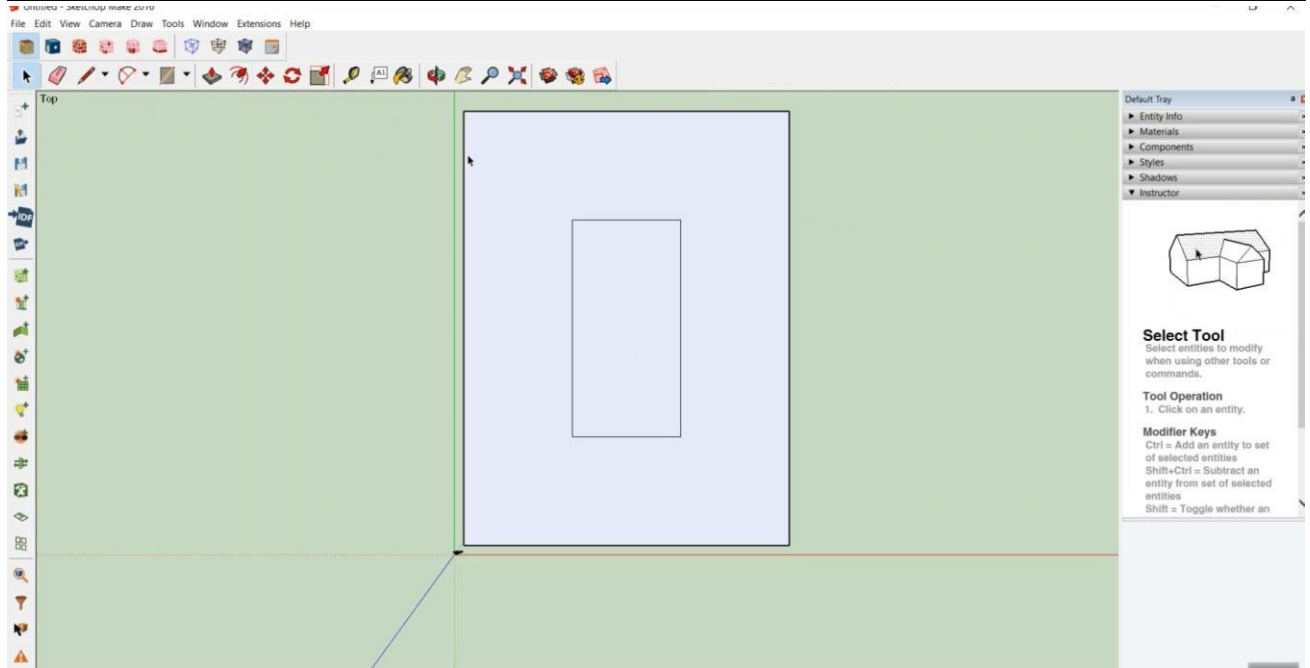
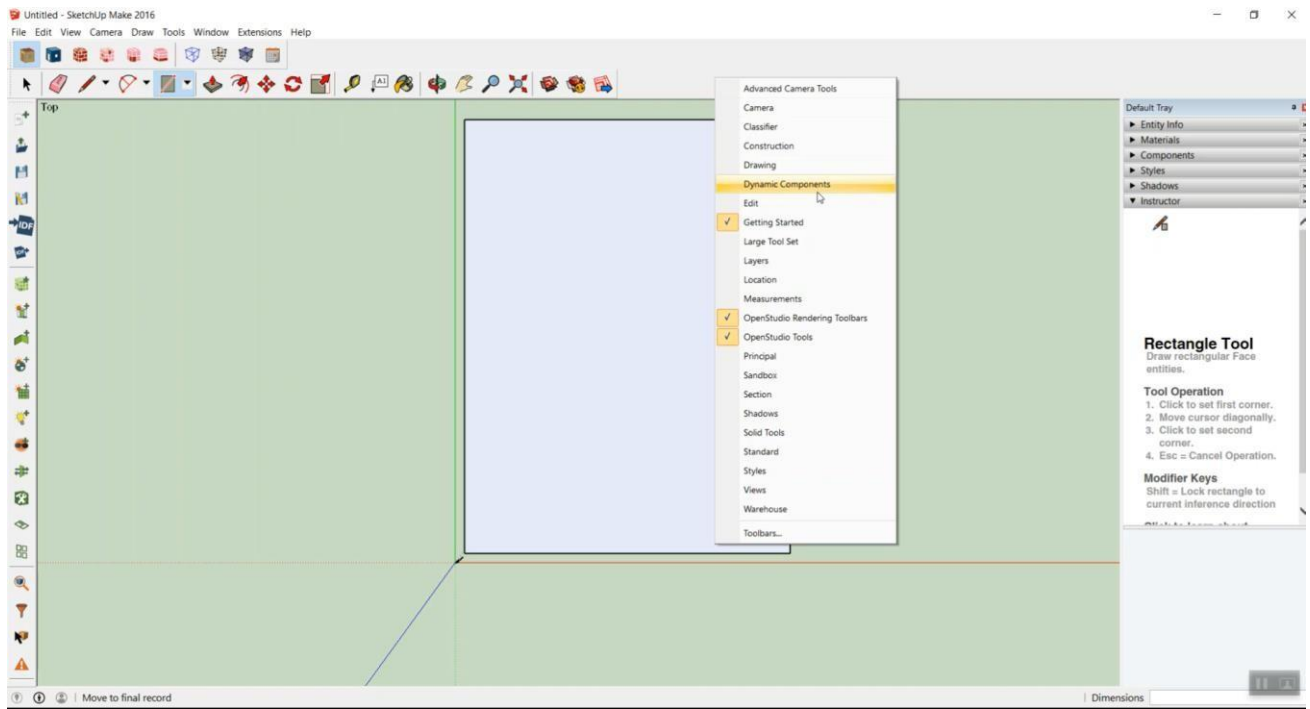
$$\Leftrightarrow N = 99 \times \frac{\frac{1}{\epsilon_1} + \frac{1}{\epsilon_2} - 1}{\frac{1}{\epsilon_3} + \frac{1}{\epsilon_3} - 1} - 1 = 99 \times \frac{\frac{1}{0.2} + \frac{1}{0.7} - 1}{\frac{1}{0.1} + \frac{1}{0.1} - 1} - 1 \approx 27.3$$

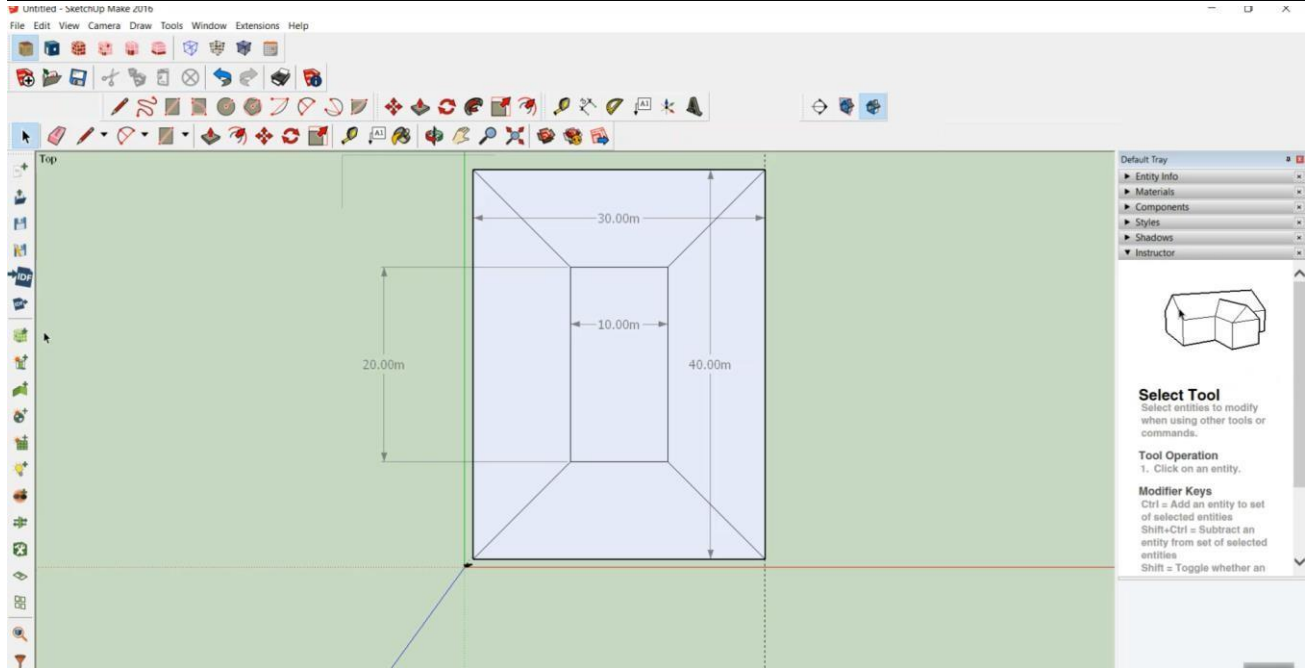
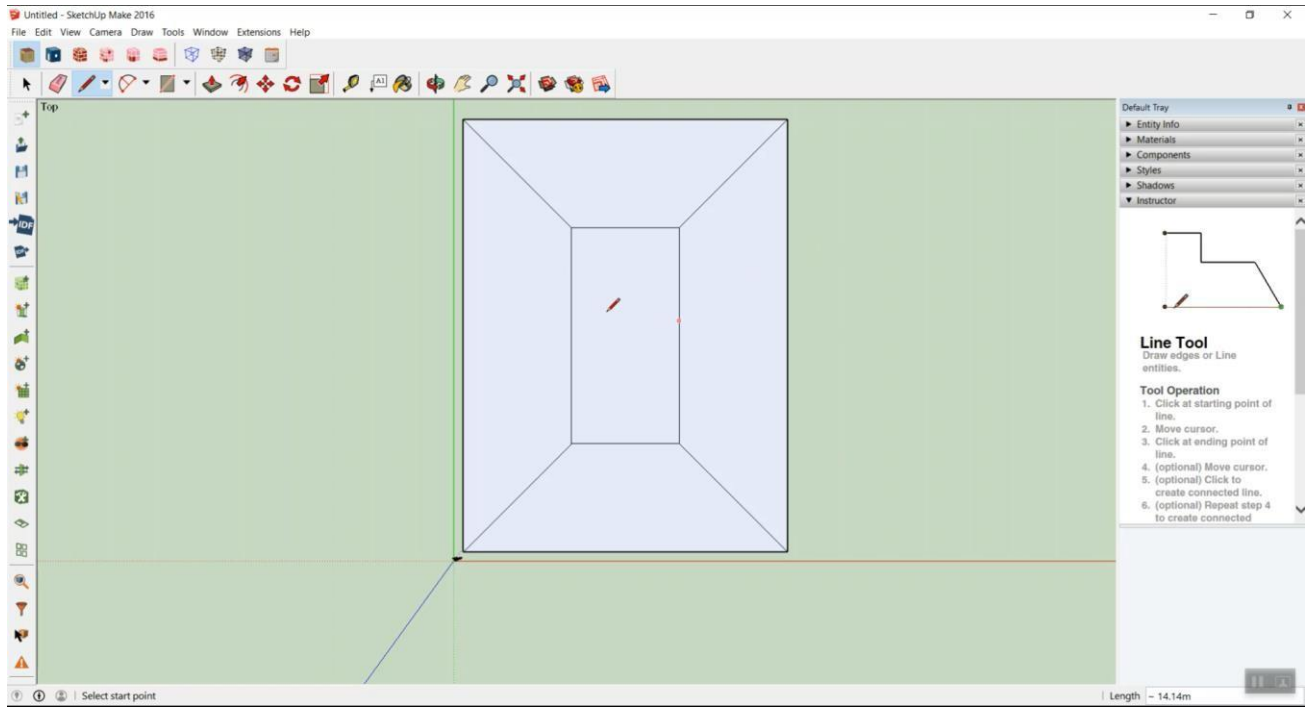
Conclusion: 27 shields can be added.

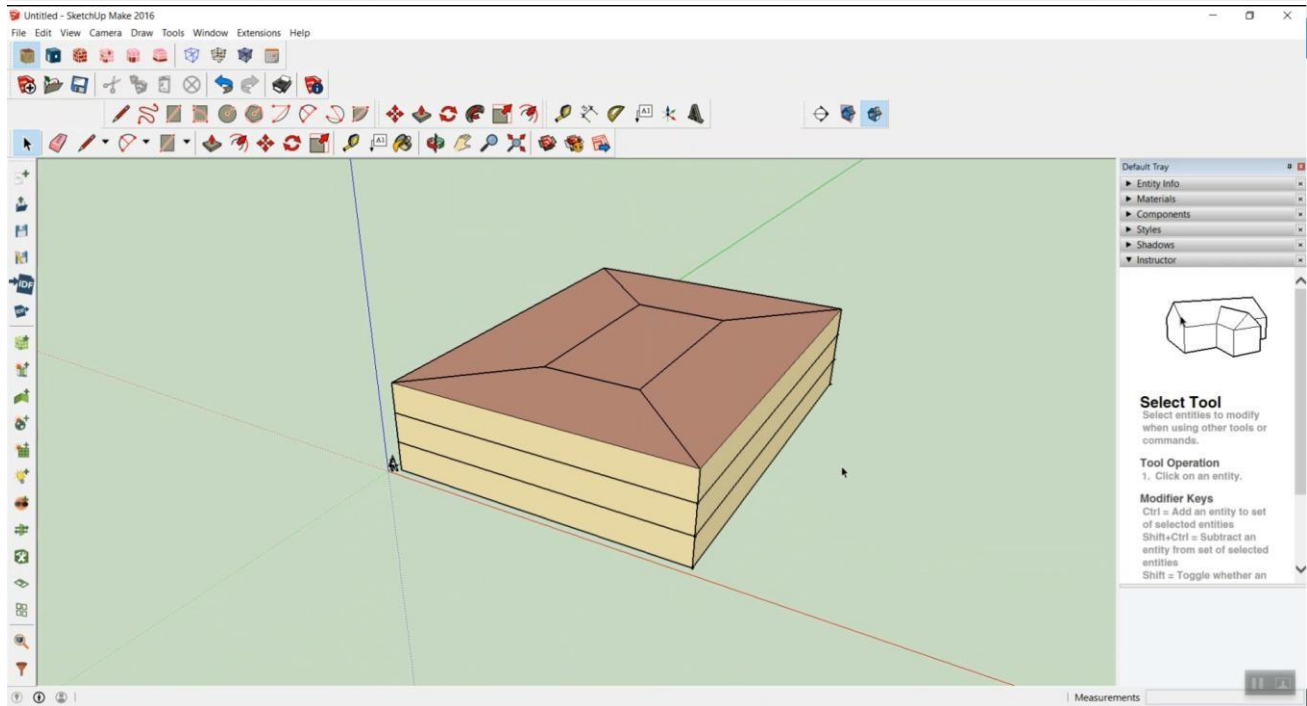
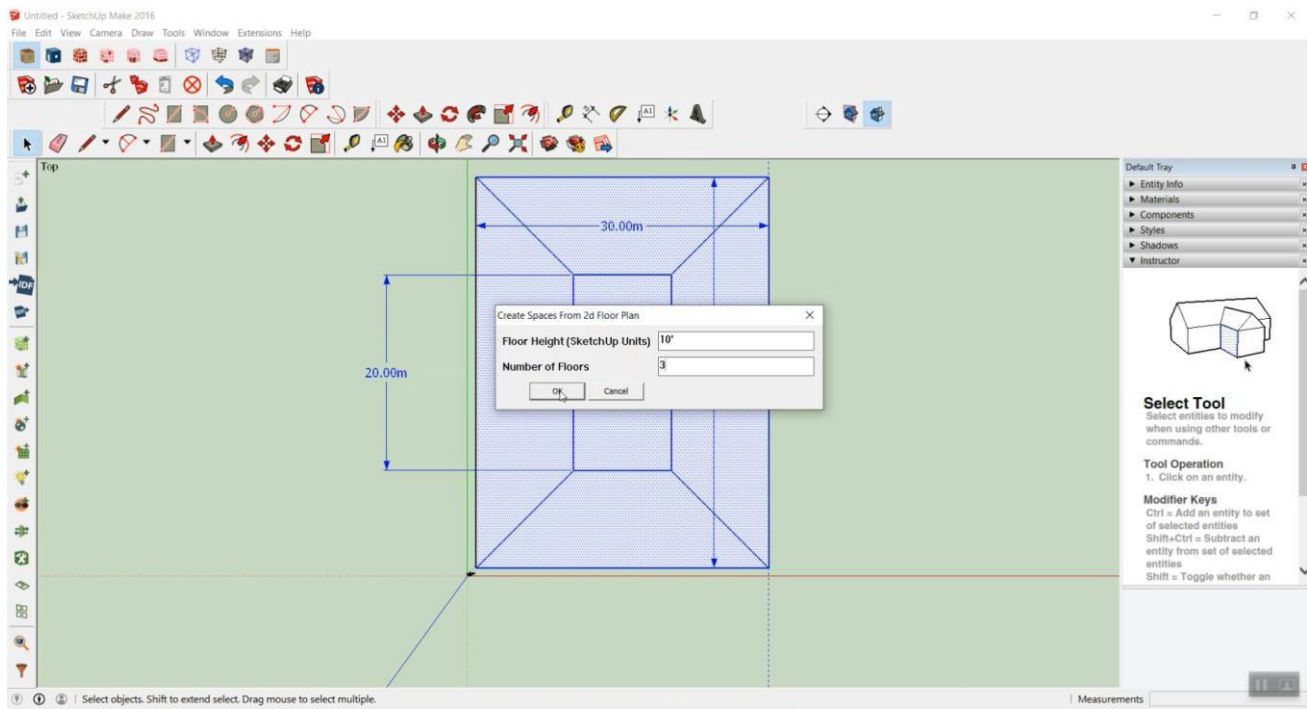
Task 2

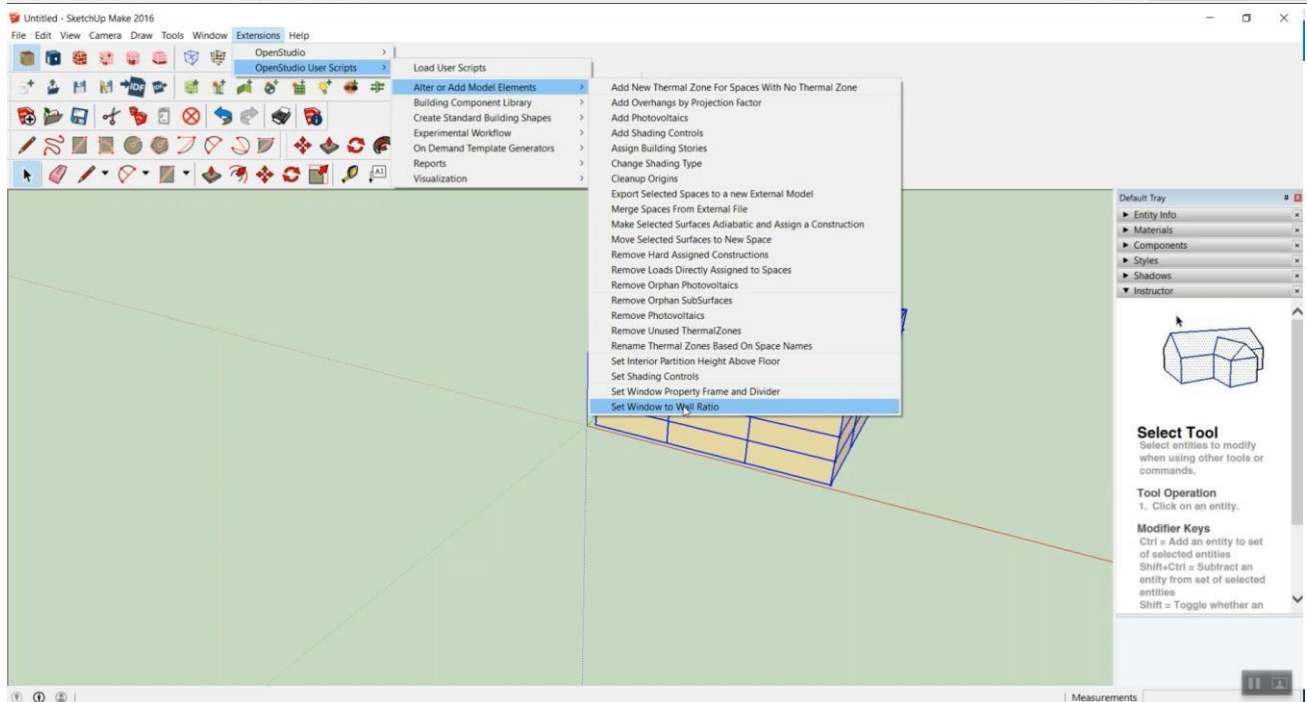
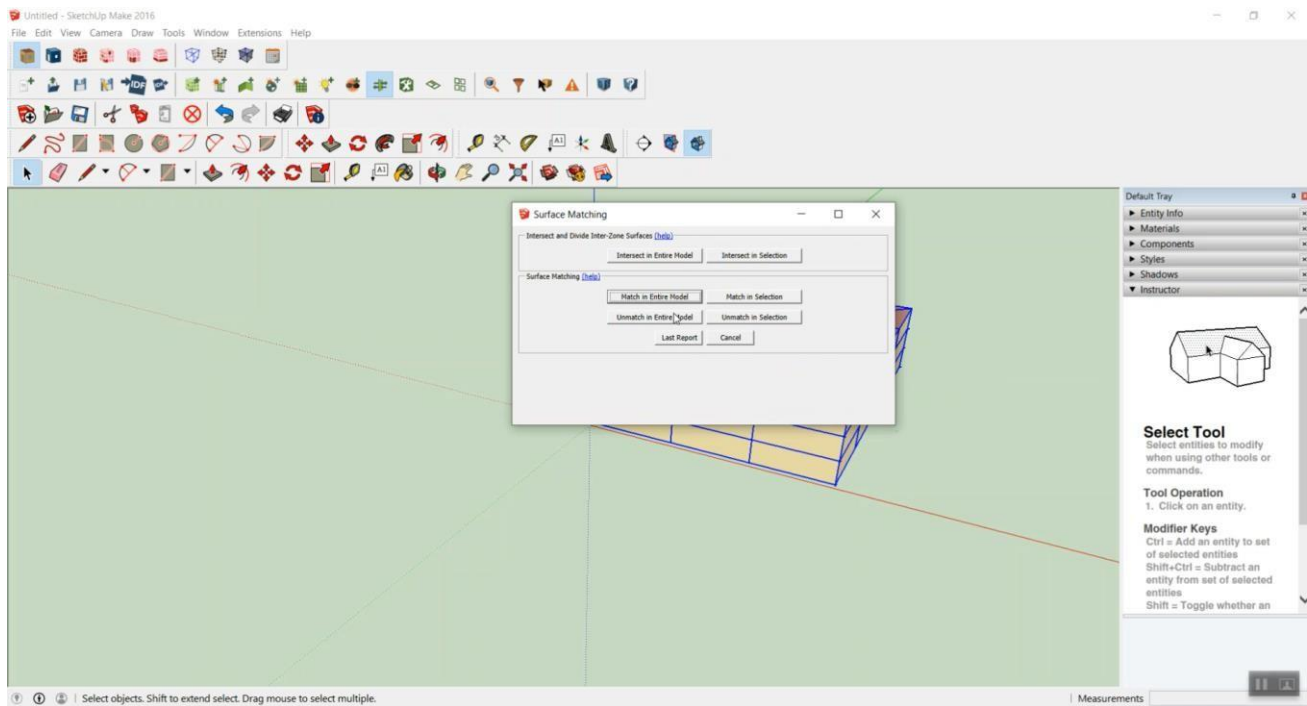


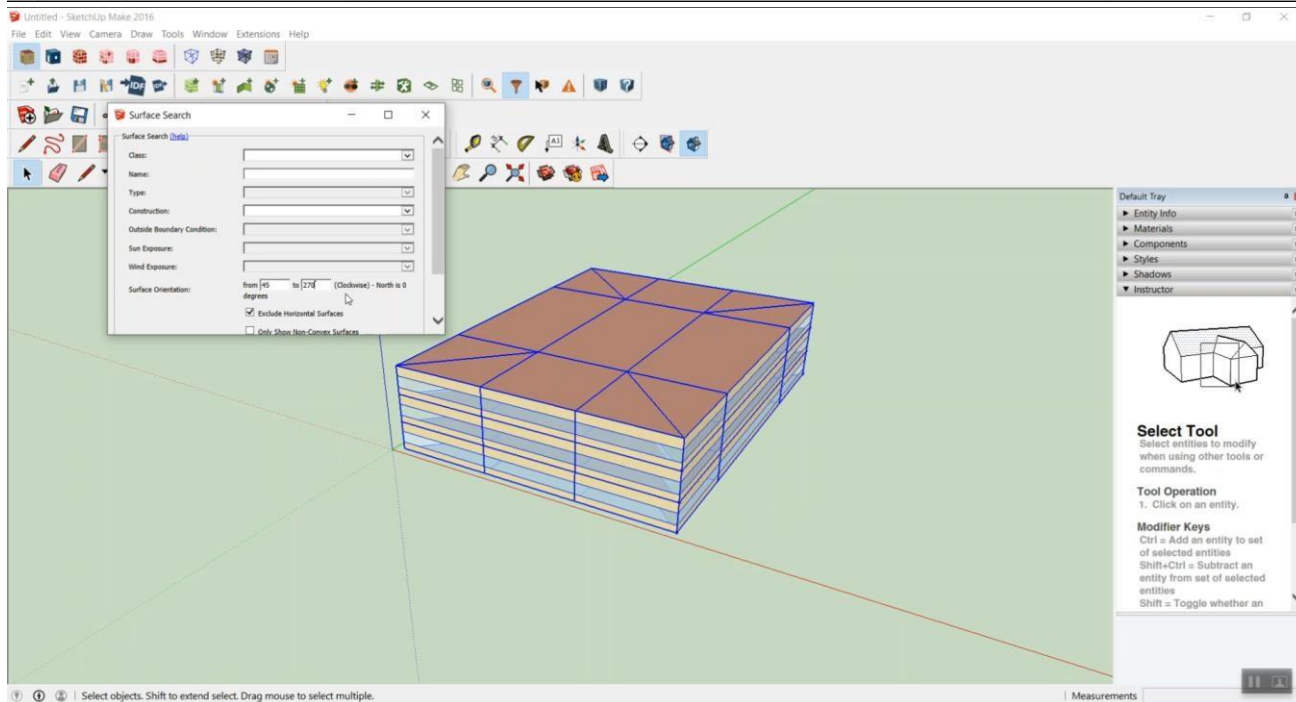
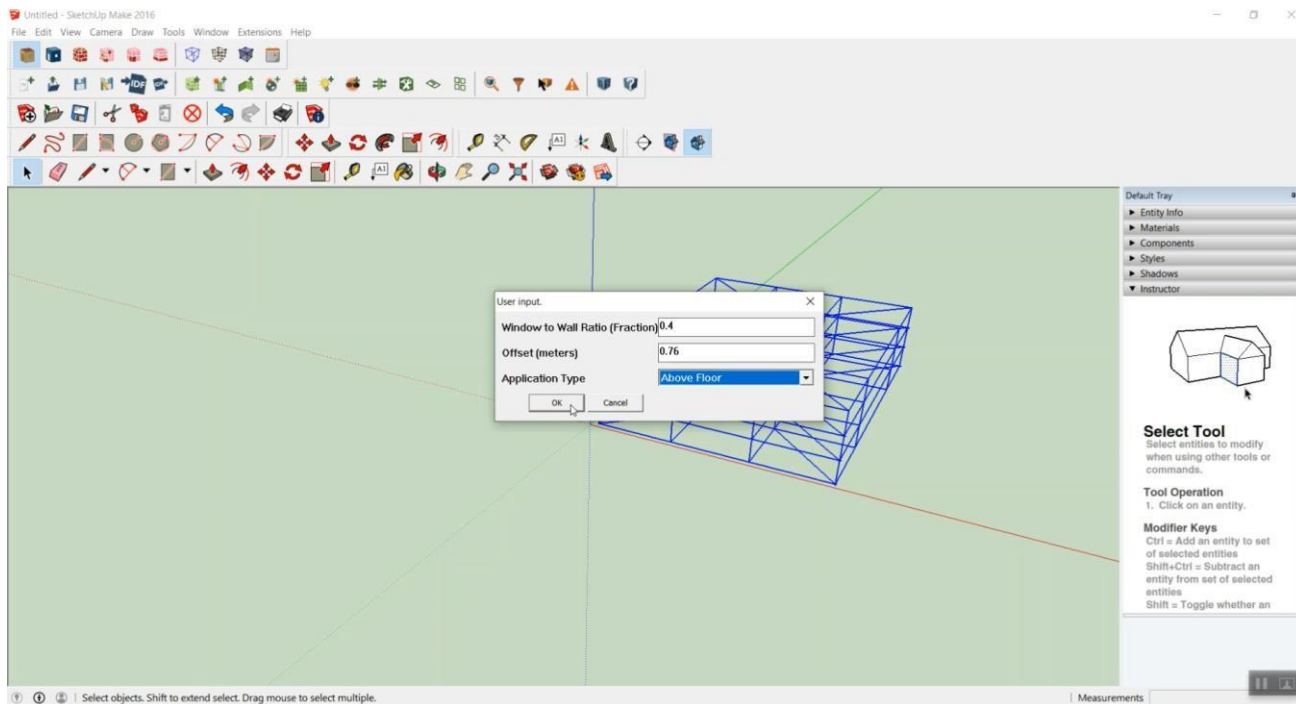


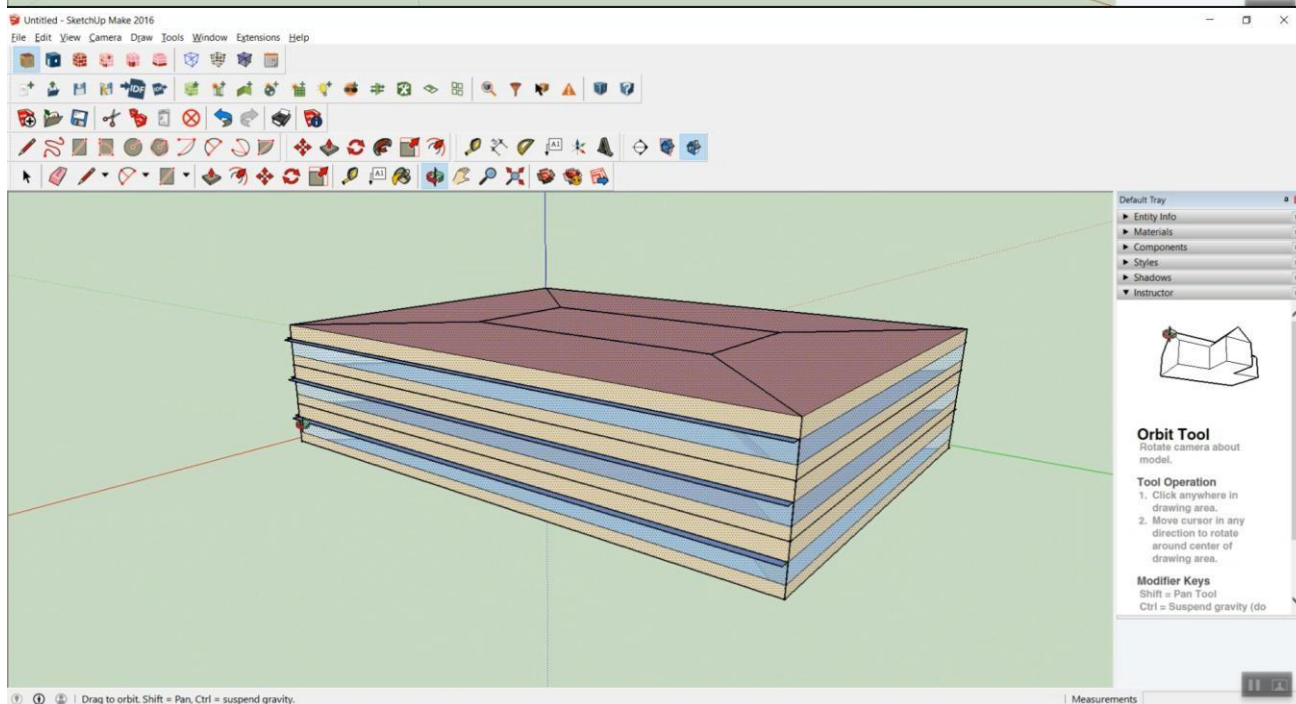
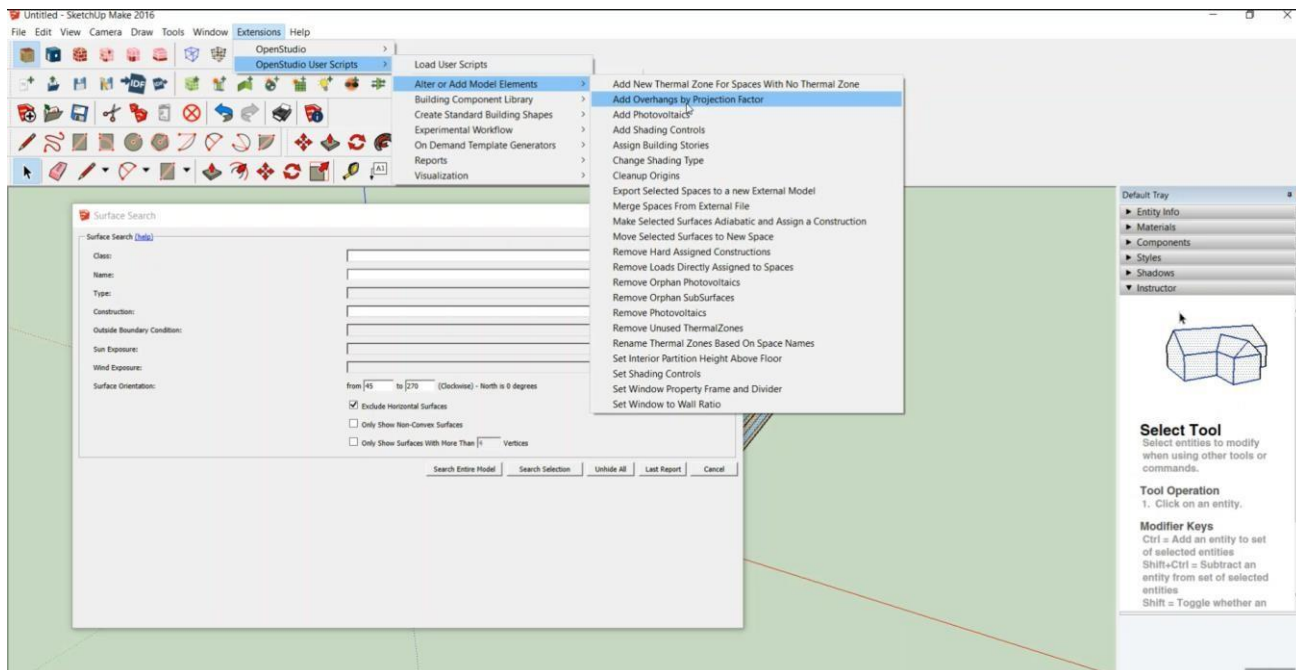


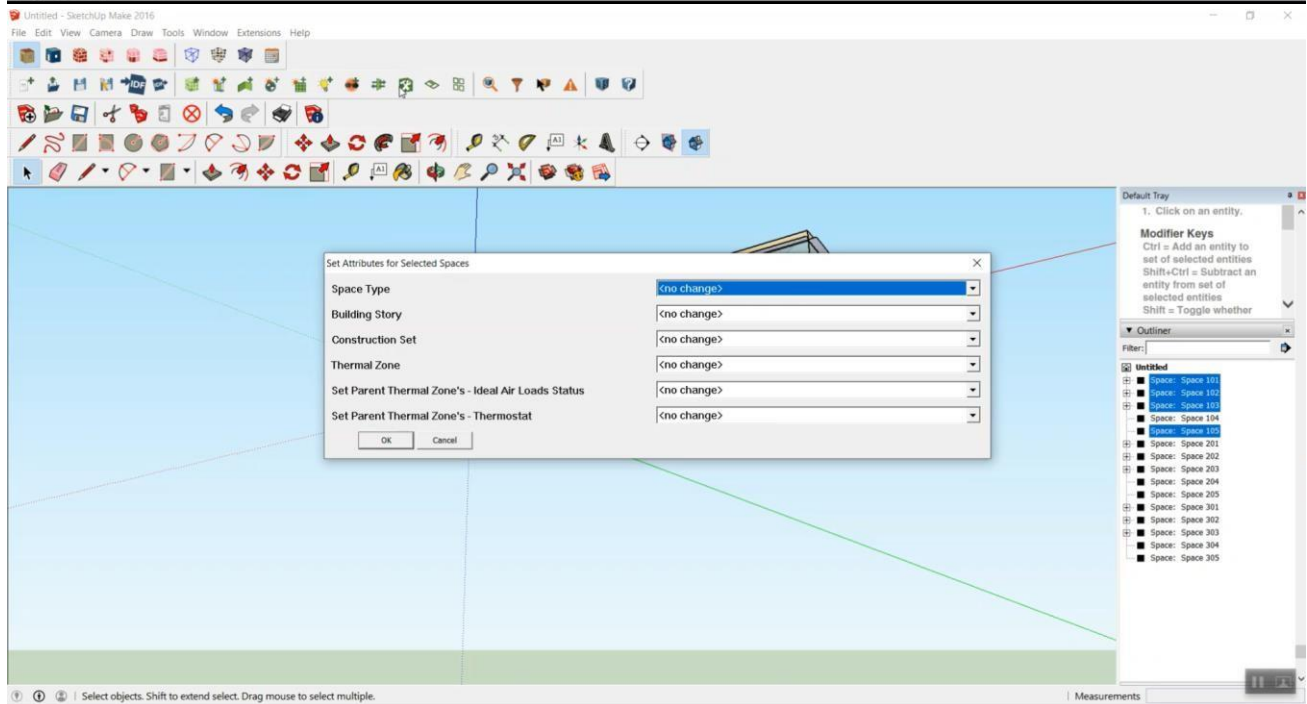
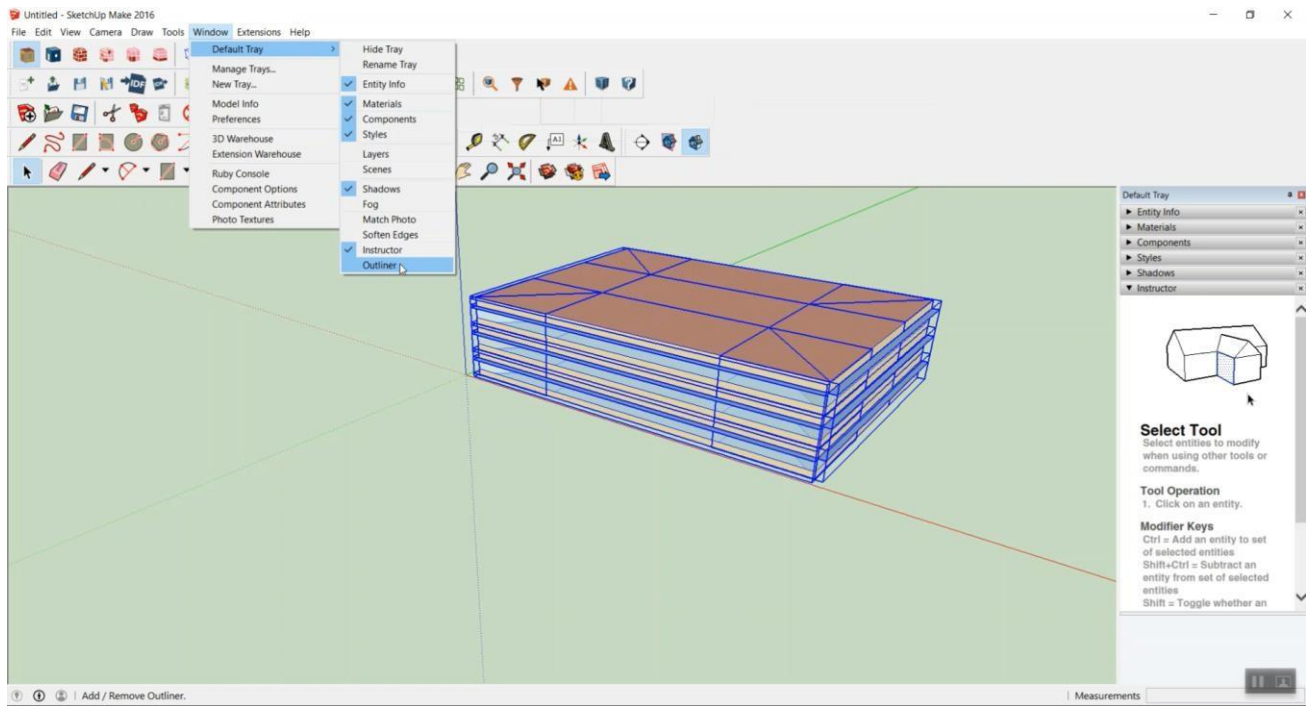


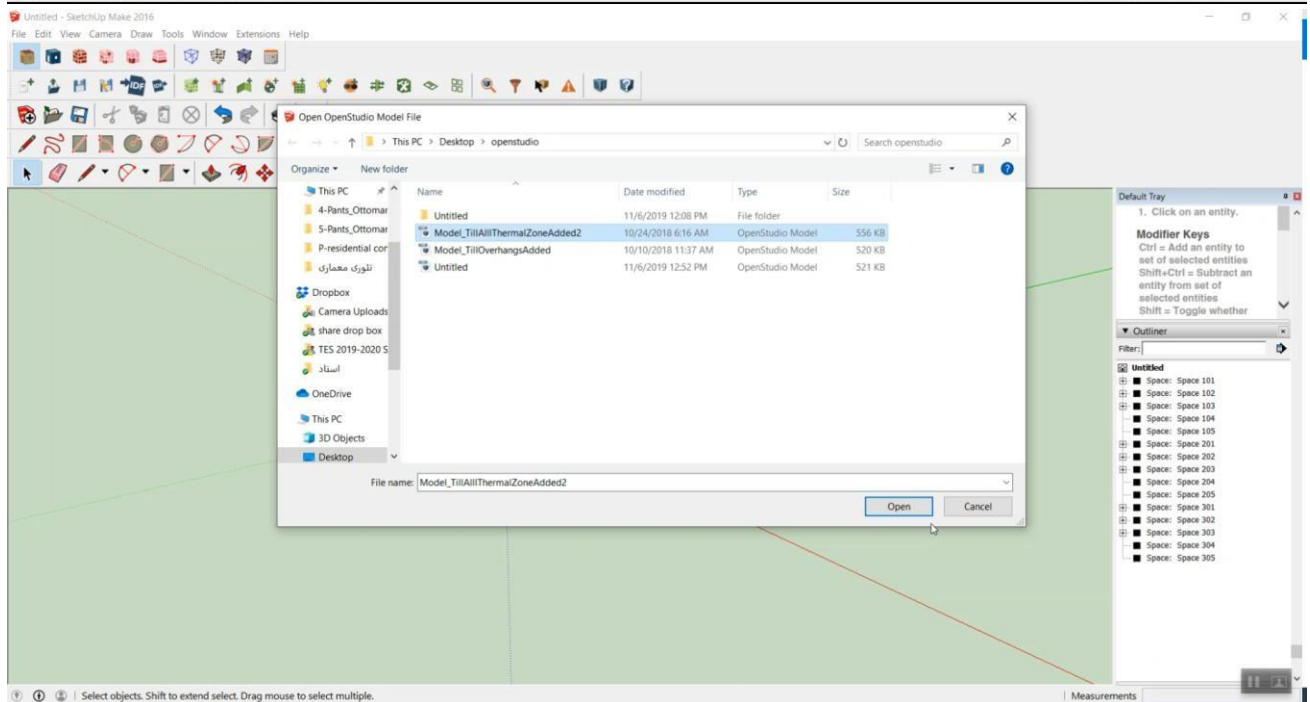
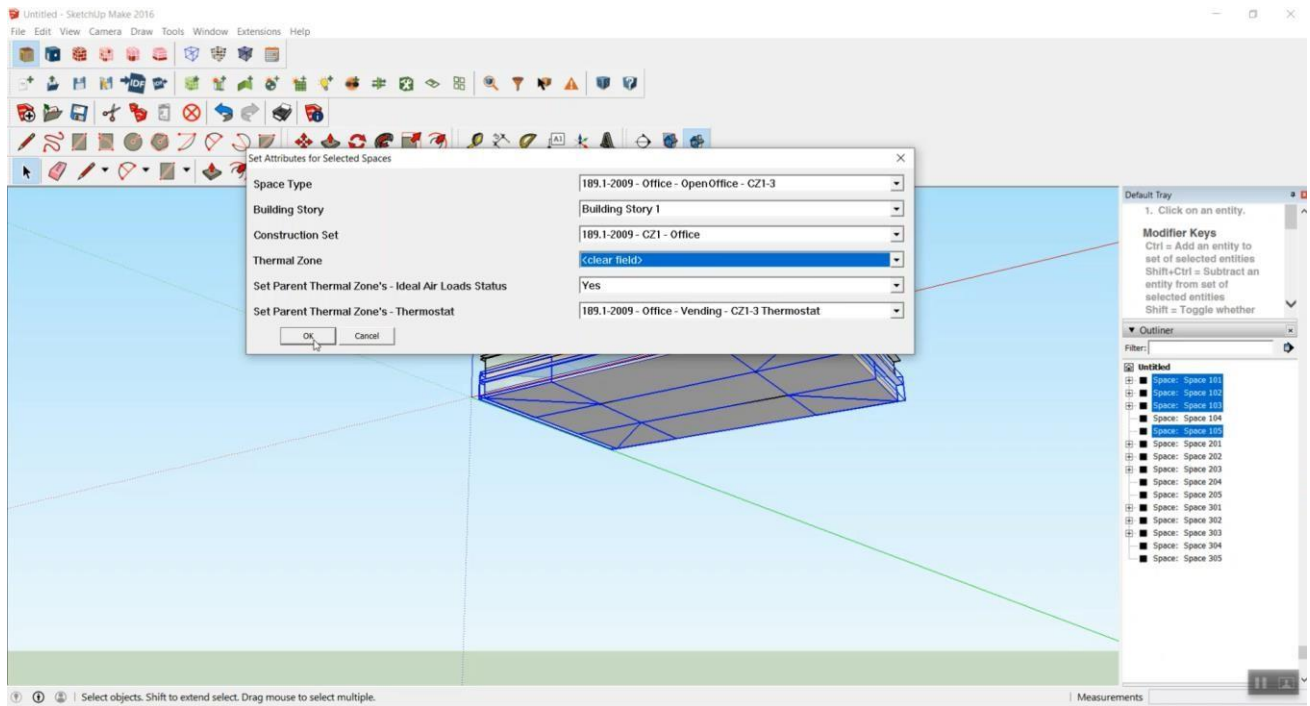


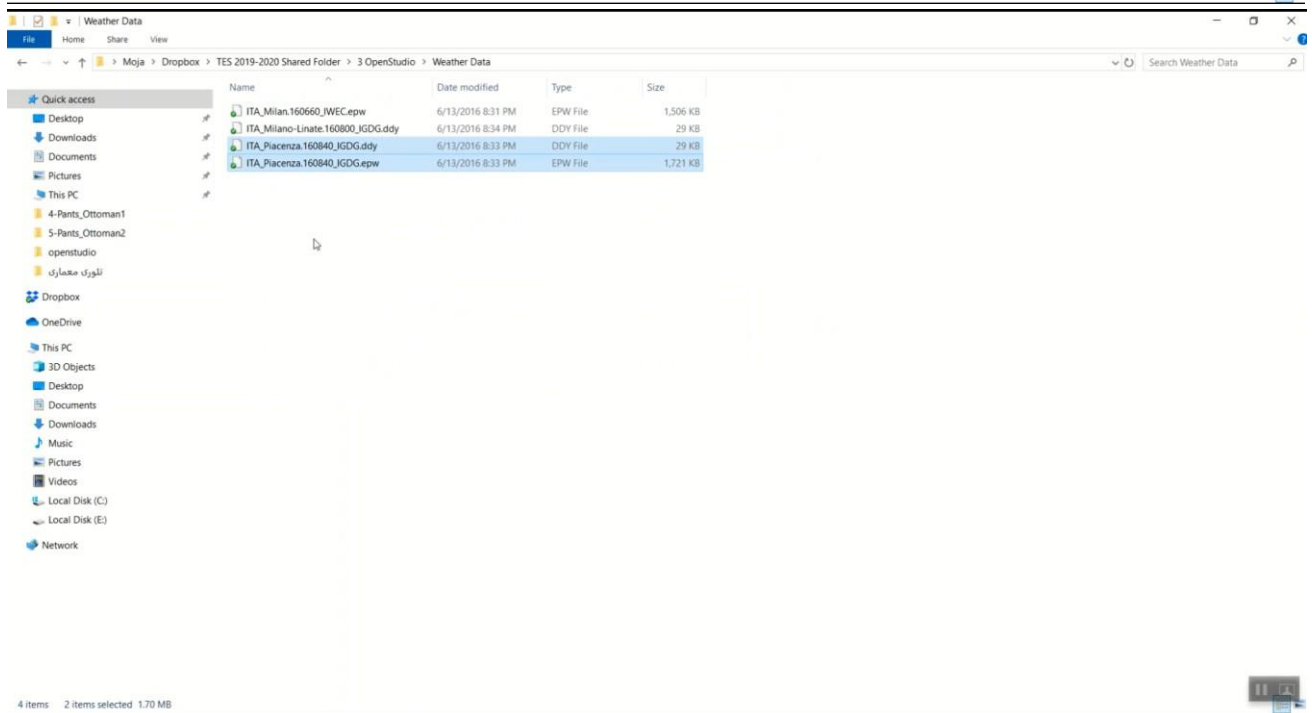
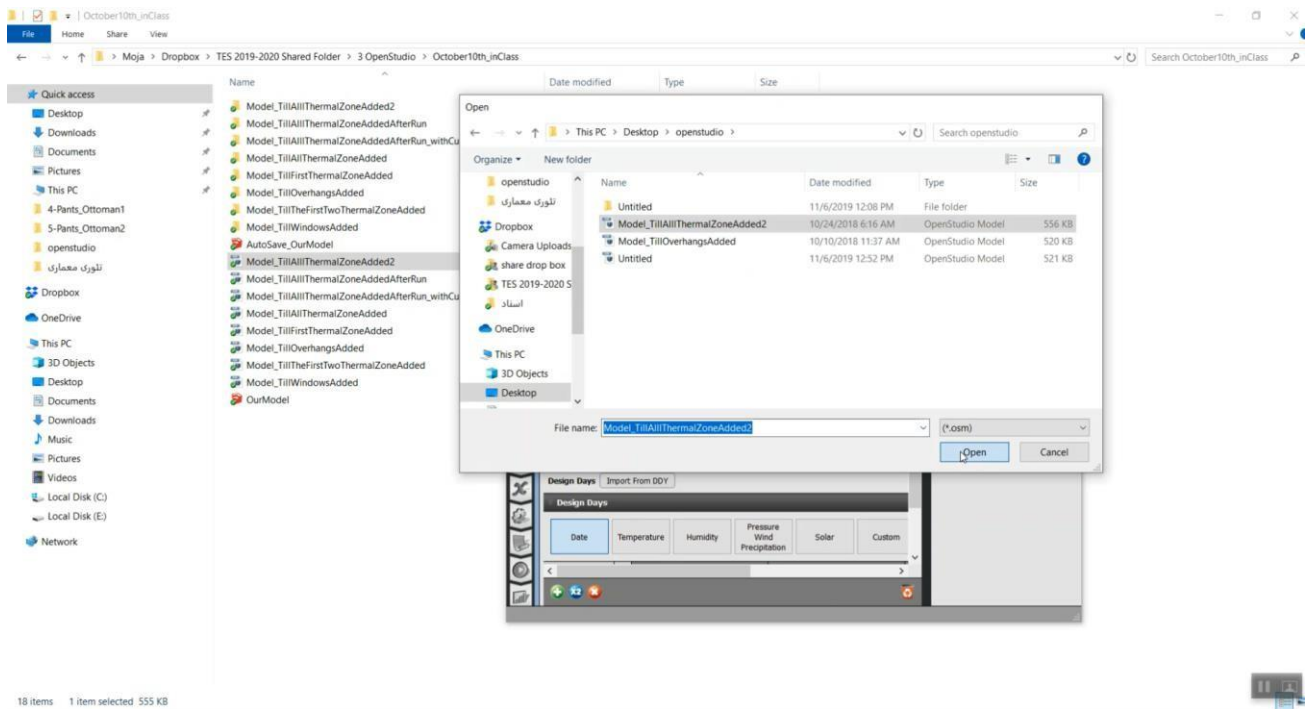












Weather File & Design Days Life Cycle Costs Utility Bills

Weather File Set Weather File

Name:

Latitude:

Longitude:

Elevation:

Time Zone:

Download weather files at www.energypilot.gov

Measure Tags (Optional):

ASHRAE Climate Zone:

CEC Climate Zone:

Design Days Import From DDY

Design Days

Date Temperature Humidity Pressure Wind Precipitation Solar Custom

Design Day Name	All	Day Of Month	Month	Day Type	Daylight Saving Time Indicator
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Weather File & Design Days Life Cycle Costs Utility Bills

Weather File Change Weather File

Name:

Latitude:

Longitude:

Elevation:

Time Zone:

Download weather files at www.energypilot.gov

Measure Tags (Optional):

ASHRAE Climate Zone:

CEC Climate Zone:

Design Days Import From DDY

Design Days

Date Temperature Humidity Pressure Wind Precipitation Solar Custom

Design Day Name	All	Day Of Month	Month	Day Type	Daylight Saving Time Indicator
	<input type="checkbox"/>	Apply to Selected	Apply to Selected	Apply to Selected	
Piacenza Ann Clg .4% Condns DB=>MWB	<input type="checkbox"/>	21	8	SummerDesignDay	<input type="checkbox"/>
Piacenza Ann Clg .4% Condns DP=>MDB	<input type="checkbox"/>	21	8	SummerDesignDay	<input type="checkbox"/>
Piacenza Ann Clg .4% Condns Enth=>MDB	<input type="checkbox"/>	21	8	SummerDesignDay	<input type="checkbox"/>
Piacenza Ann Clg .4% Condns WB=>MDB	<input type="checkbox"/>	21	8	SummerDesignDay	<input type="checkbox"/>
Piacenza Ann Htg 99.6% Condns DB	<input type="checkbox"/>	21	1	WinterDesignDay	<input type="checkbox"/>
Piacenza Ann Htg 99.6% Condns WS=>MCDB	<input type="checkbox"/>	21	1	WinterDesignDay	<input type="checkbox"/>
Piacenza Ann Hum_n 99.6% Condns DP=>MCDB	<input type="checkbox"/>	21	1	WinterDesignDay	<input type="checkbox"/>

