POLITECNICO
MILANO 1863

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Student Number: 10648128
Submission Date: 12/11/2019
Assignment #: 6th Week

Question 1

As we know from the presentation the radiation heat transfer formula between to surfaces is reconstructed as following:

$$\dot{Q}_{12,one\ shield} = \frac{E_{b1} - E_{b2}}{\frac{1-\varepsilon_i}{A_1 \times \varepsilon_1} + \frac{1}{A_1 \times F_{12}} + \frac{1-\varepsilon_{3,1}}{A_3 \times \varepsilon_{3,1}} + \frac{1-\varepsilon_{3,2}}{A_3 \times \varepsilon_{3,2}} + \frac{1}{A_3 \times F_{32}} + \frac{1-\varepsilon_i}{A_2 \times \varepsilon_2}}$$

By implementing the facts we know from infinite parallel surfaces:

$$A_1 = A_2 = A_3 = A \quad and \quad F_{1\to 2} = F_{3\to 2}$$

$$\Rightarrow \quad \dot{Q}_{12,one\ shield} = \frac{\sigma \times (T_1^4 - T_2^4)}{(\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1) + (\frac{1}{\varepsilon_{3,1}} + \frac{1}{\varepsilon_{3,2}} - 1)}$$

In case of having multiple shields the formula can be reshaped like this:

$$\dot{Q}_{12,N\ shields} = \frac{\sigma \times (T_1^4 - T_2^4)}{\left(\frac{1}{\varepsilon_1} + \frac{1}{\varepsilon_2} - 1\right) + \left(\frac{1}{\varepsilon_{3,1}} + \frac{1}{\varepsilon_{3,2}} - 1\right) + \cdots + \left(\frac{1}{\varepsilon_{N1}} + \frac{1}{\varepsilon_{N2}} - 1\right)}$$

In the previous assignment, both emissivities were equal to 0.1 as well as the current one for this question. In this case when all epsilons are the same figure, we can use the following formula:

$$\dot{Q}_{12,N\ shields} = \frac{\sigma \times (T_1^4 - T_2^4)}{(N+1) \times \left(\frac{1}{\varepsilon} + \frac{1}{\varepsilon} - 1\right)} = \frac{1}{(N+1)} \dot{Q}_{12,no\ shield}$$

If the heat transfer with N shields is equal to 1% of the heat transfer with no shield then:

$$\dot{Q}_{12,N\ shield} = \frac{1}{100} \dot{Q}_{12,no\ shield} \Rightarrow (N+1) = 100 \Rightarrow \boxed{N = 99}$$

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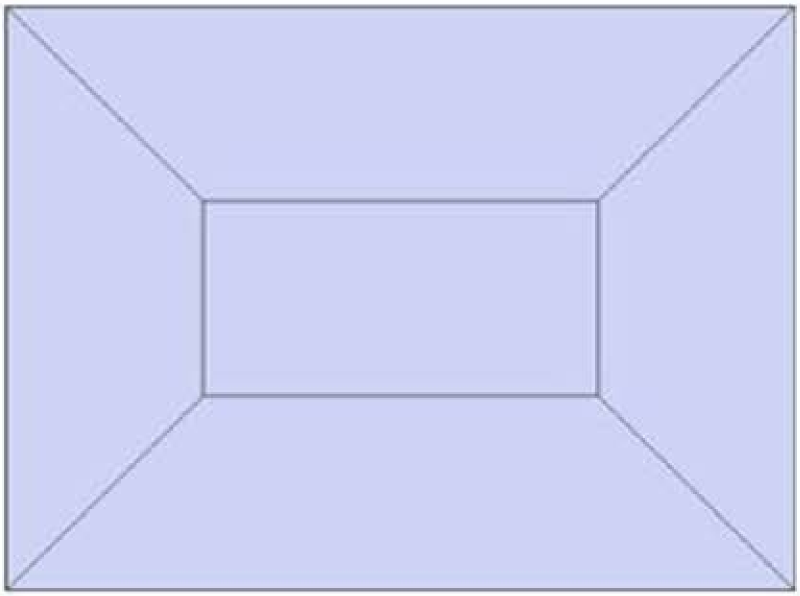
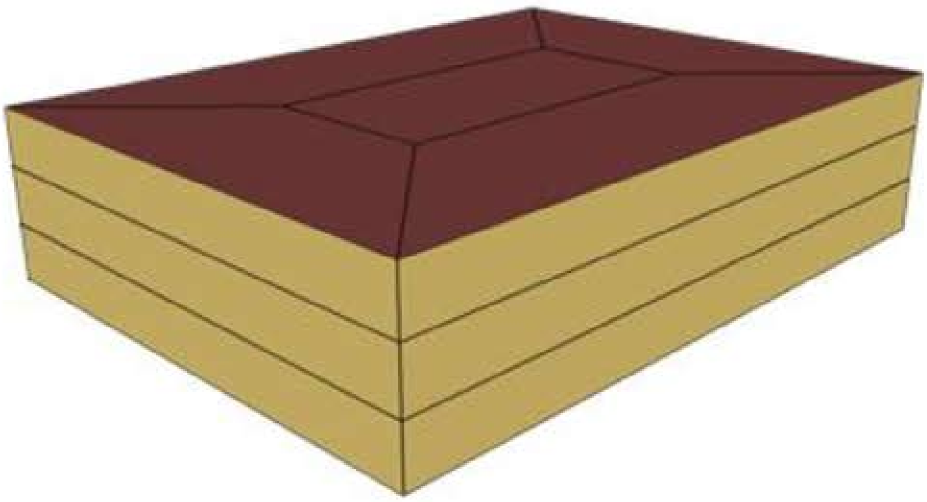
Open Studio Exercise

In the first step we need to draw a 30 × 40 cm rectangle in Sketchup which contains another rectangle inside with offset of 10 cm. Then we connect the corners of outer rectangle to the inner one's. This represents our diagram.



What we do next is to select the diagram and click on **"Create Spaces From Diagram"** icon from open studio extension menu and choose the desired number of floors and their heights.



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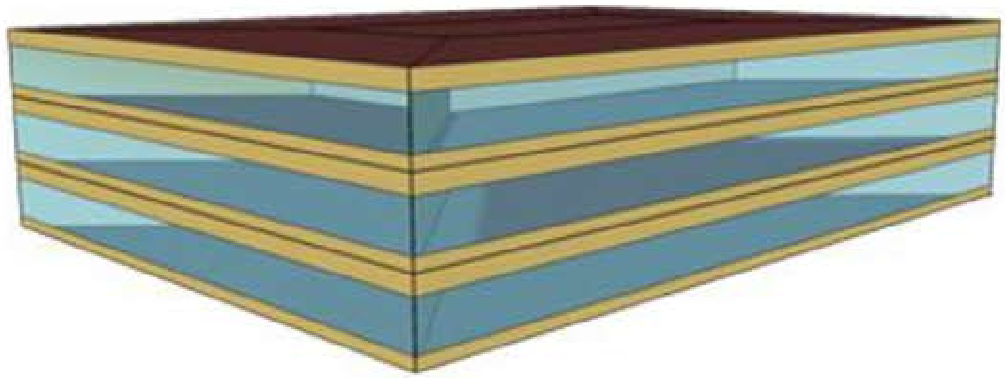
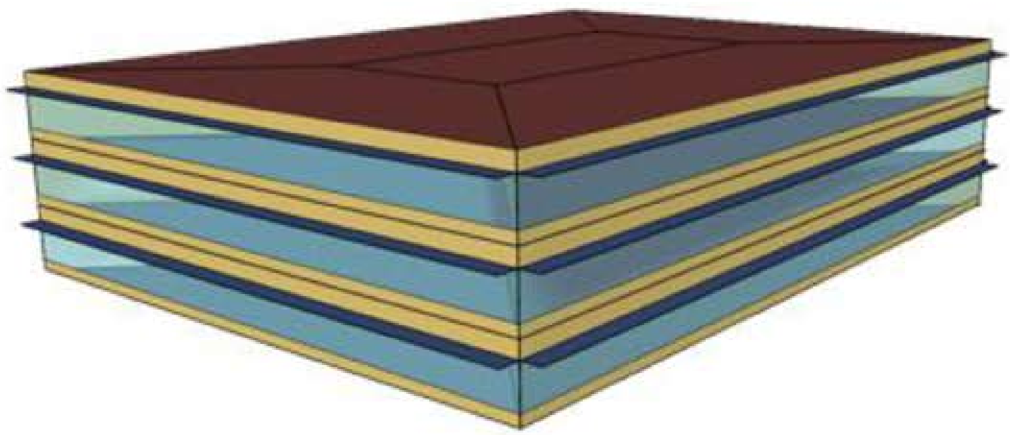
After matching all surfaces **(Extensions ---> OpenStudio ---> Modify Model ---> Surface Matching)** then we can create windows by selecting all surfaces and clicking on **Extensions ---> OpenStudio User Scripts ---> Alter or Add Model Elements ---> Set Window to Wall Ratio** and insert our desired figures.



We can also add overhangs by first selecting the base surfaces (Search Surfaces from the OpenStudio extension menu and then choose the 90-270 degree orientation for surfaces and tick the box for inclusion of horizontal surfaces) and then clicking on **OpenStudio User Scripts ---> Alter or Add Model Elements ---> Add Overhangs by Projection Factor** and insert the desired projection factor and offset.



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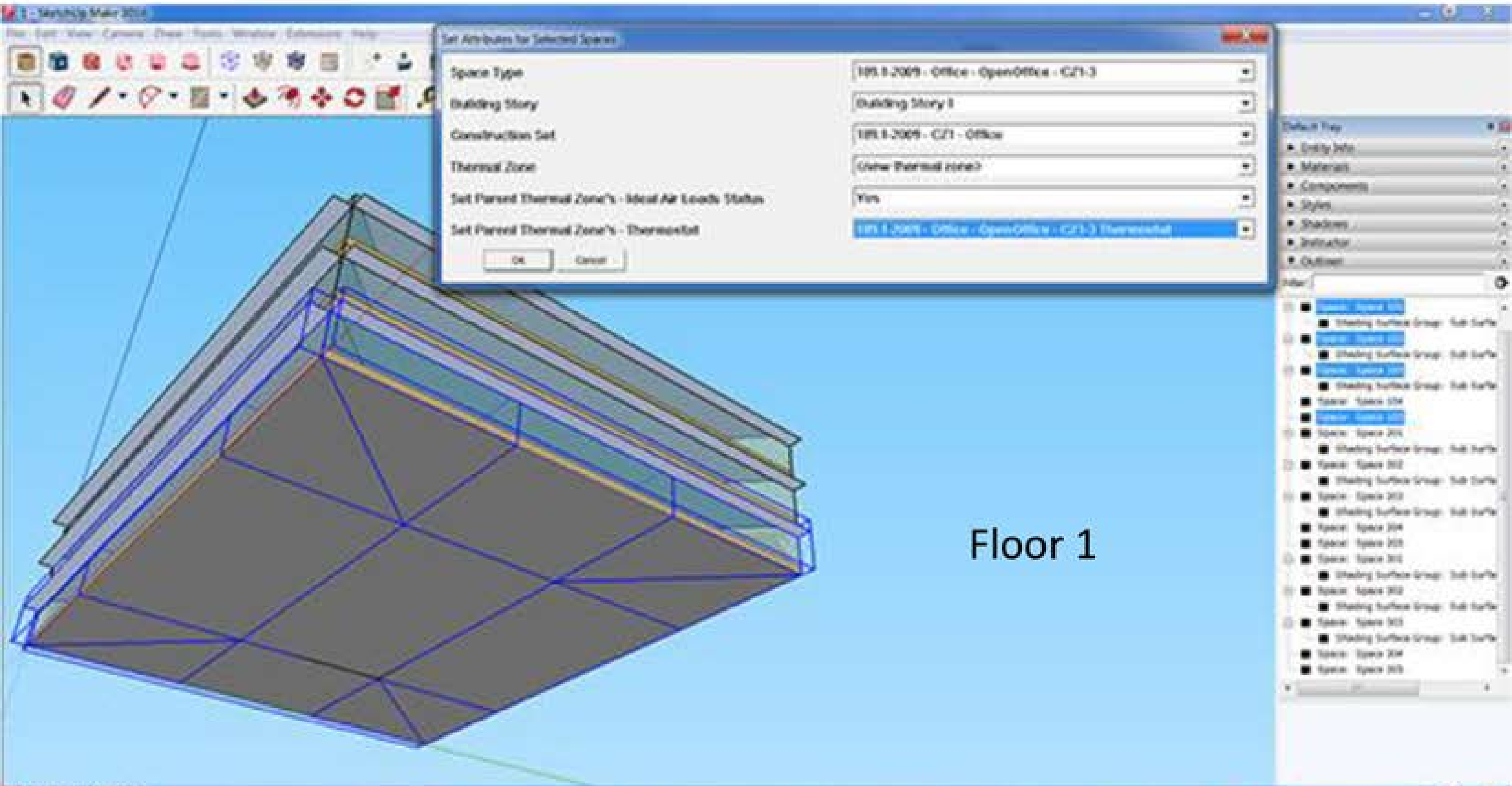
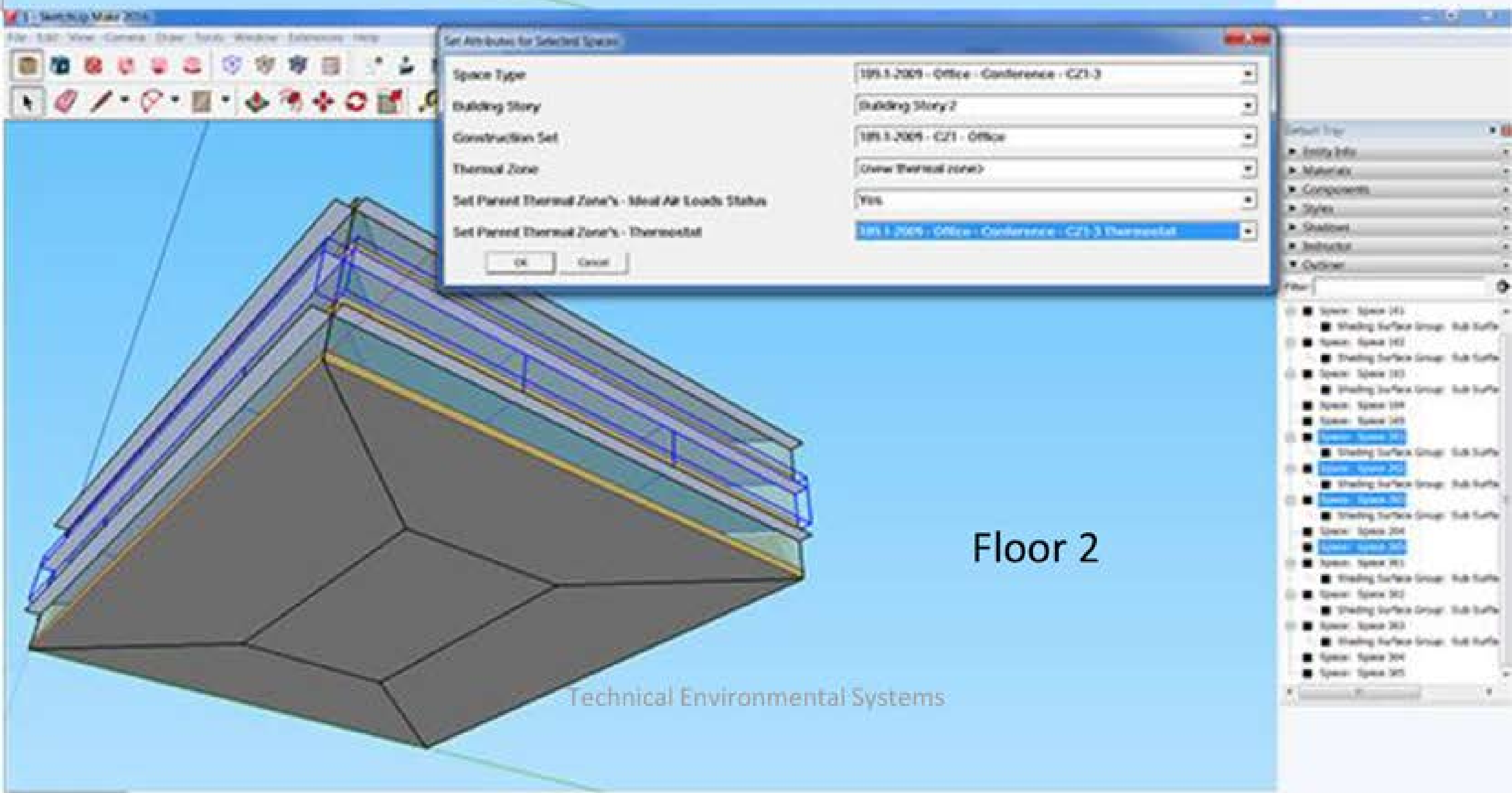
Now we choose the thermal zone for each space within each floor and define some specifications as per our design by selecting our spaces and click on **"Set Attributes for Selected Surfaces"** from the Open Studio extension menu.





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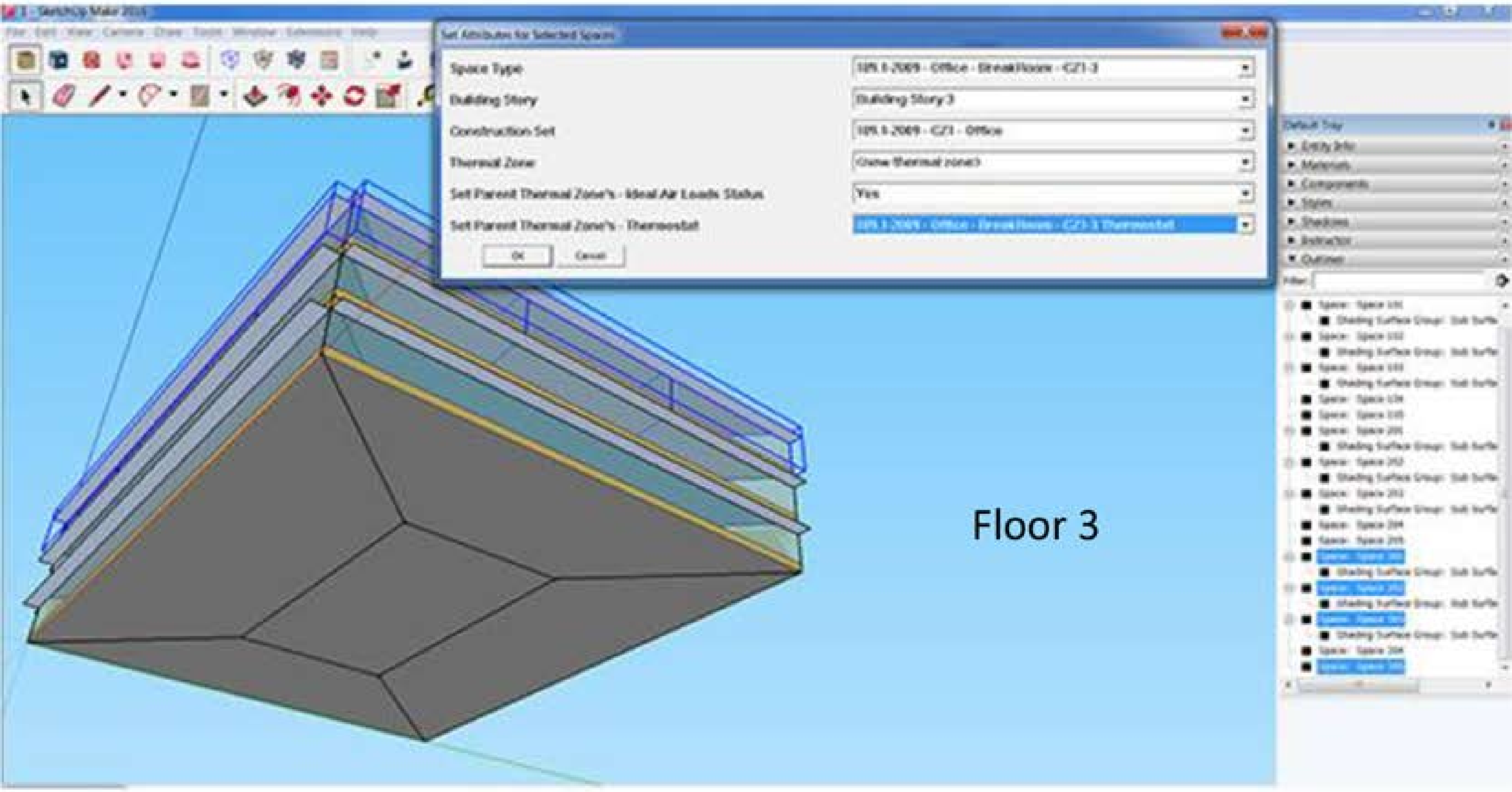
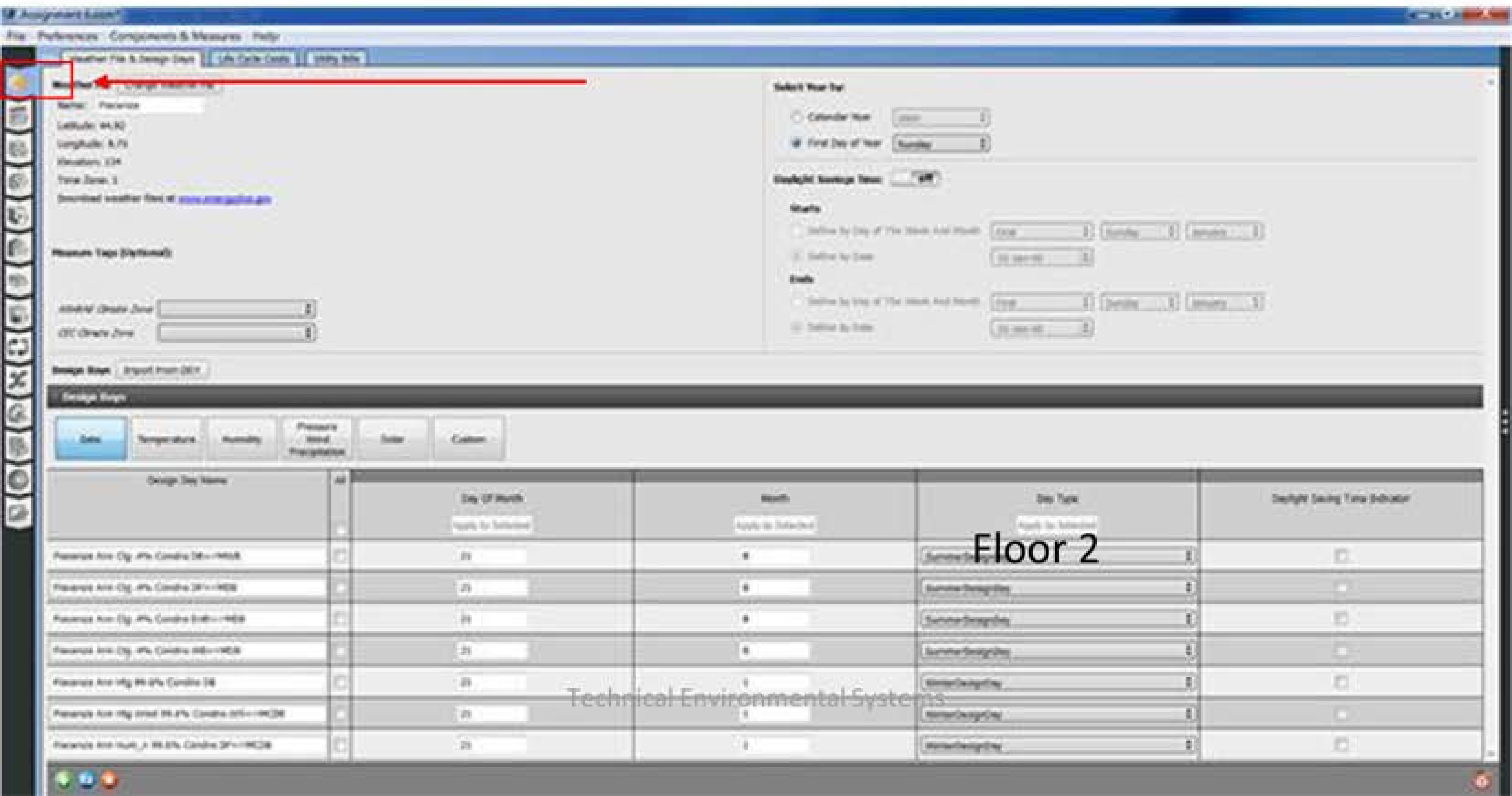


After saving the model as an .osm file by click on save icon from OpenStudio extension menu then we can open it and click on **Site** tab from the menu on the left and load the certain weather data.



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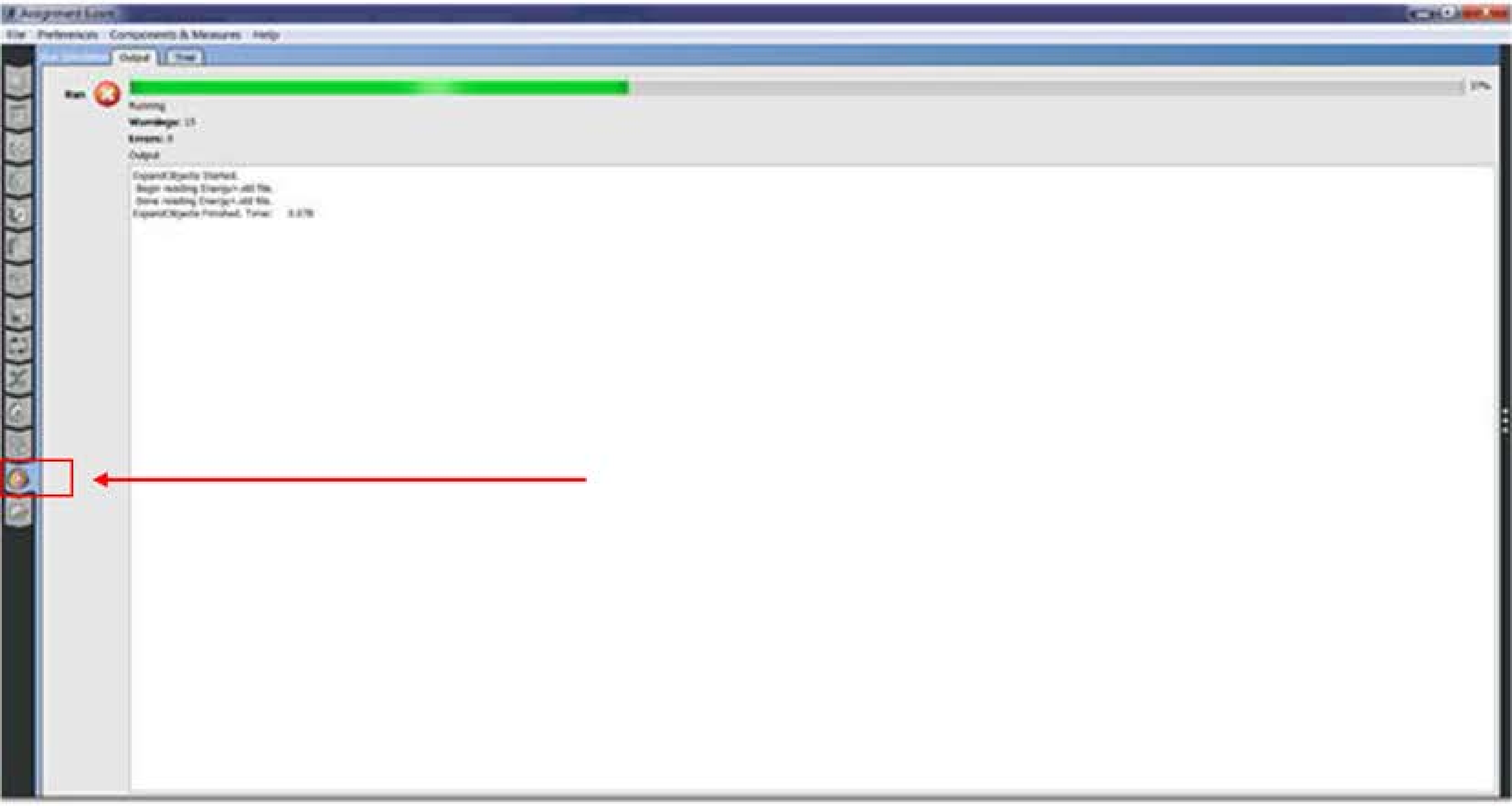
After applying our changes we can click on "**Run**" from the "**Run Simulation menu**" and wait for our results:



Results summary can be seen by click on the last icon down:

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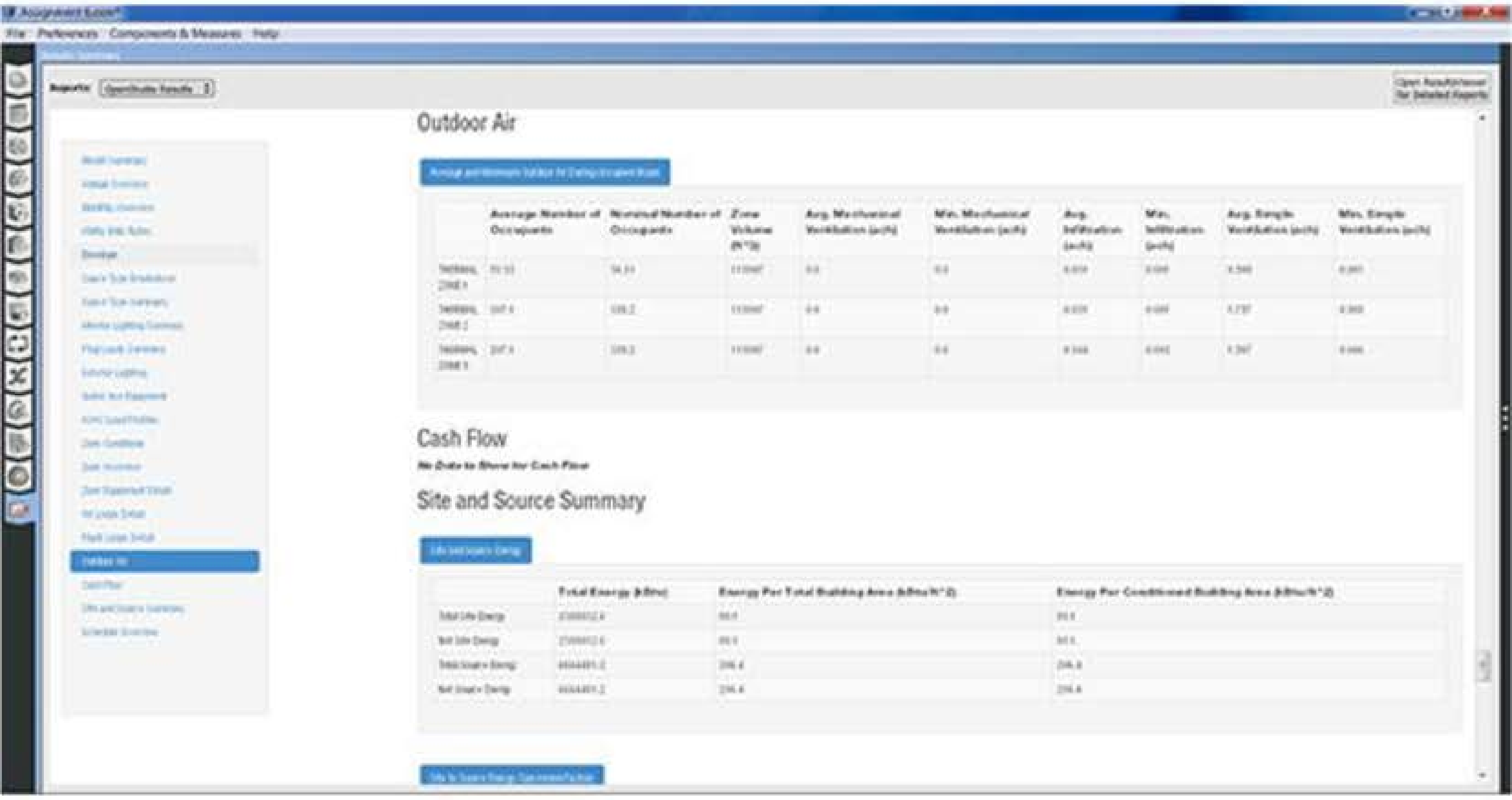
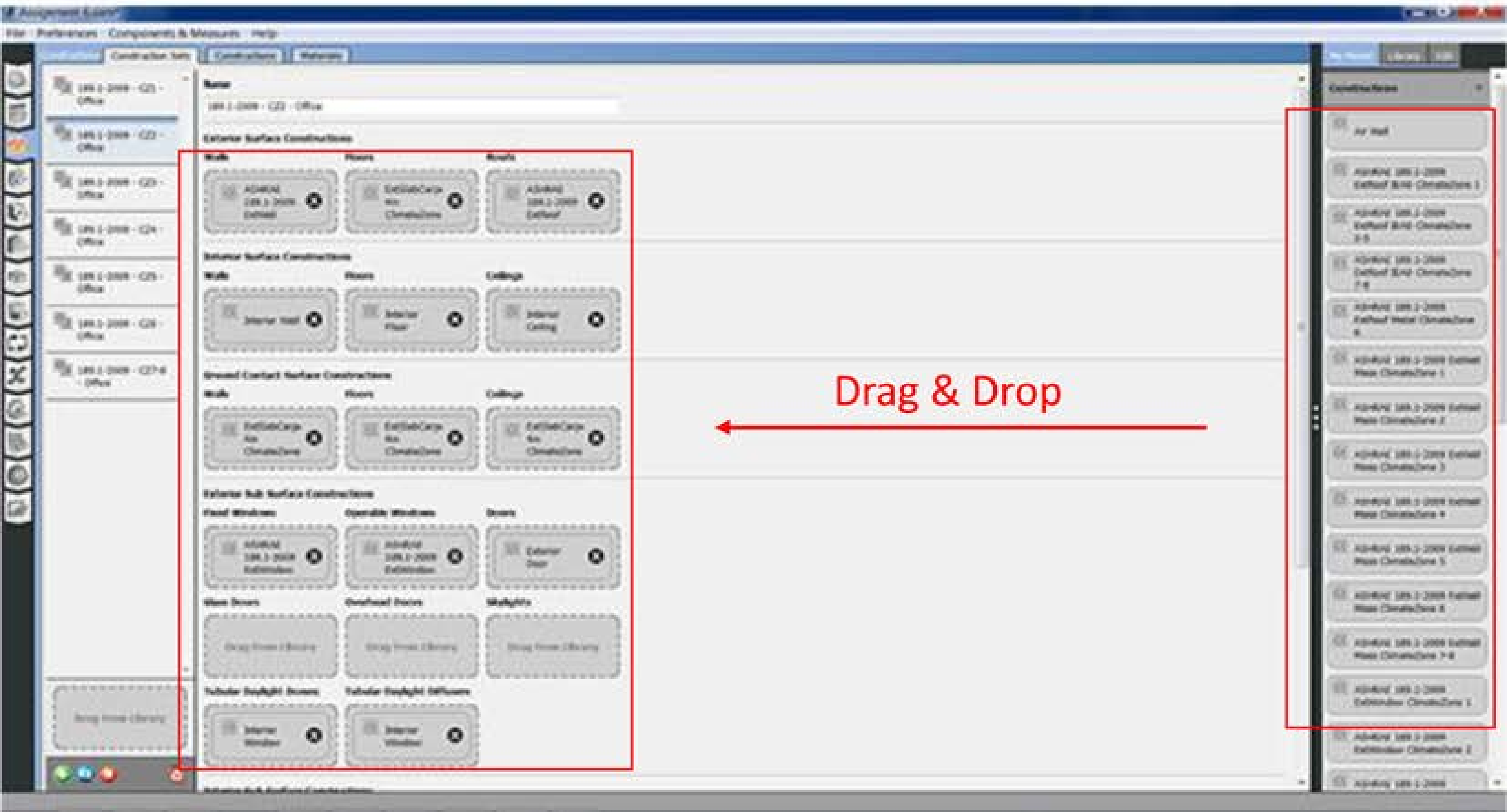


Another ability is OpenStudio is to load and define **Construction Sets** by accessing the **"Constructions"** menu and click on one of the available options.



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In the second tab we can build our building component by defining adjusted layers starting from outside to inside. By accessing the third tab we can edit the specifications of our materials.