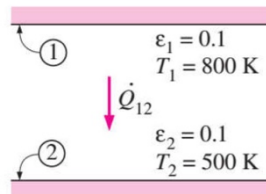


> Considering the same example you solved in the previous assignment (radiative heat transfer between two parallel plates), how many shields with $\varepsilon = 0,1$ should you add in order to have the new heat transfer rate to be 1% of the case without shields?

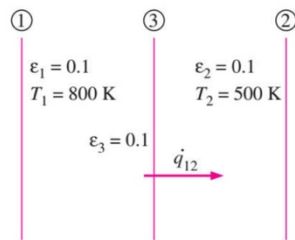
Considering the previous result:



$$\dot{q}_{12} = \frac{5,67 * 10^{-8} * (800^4 - 500^4)}{\frac{1}{0,1} + \frac{1}{0,1} - 1} = \frac{5,67 * 10^{-8} * (4096 * 10^8 - 625 * 10^8)}{19}$$

$$= \frac{19680,57}{19} \approx 1036 \frac{W}{m^2}$$

Assuming $\varepsilon_3 = 0,1$ and the value of \dot{q}_{12} as 1% of 1036, we can find the value of n :



$$10,36 = \frac{5,67 * 10^{-8} * (800^4 - 500^4)}{\left(\frac{1}{0,1} + \frac{1}{0,1} - 1\right) + n * \left(\frac{1}{0,1} + \frac{1}{0,1} - 1\right)}$$

$$10,36 = \frac{19680,57}{19(1 + n)}$$

$$19(1 + n) = \frac{19680,57}{10,36}$$

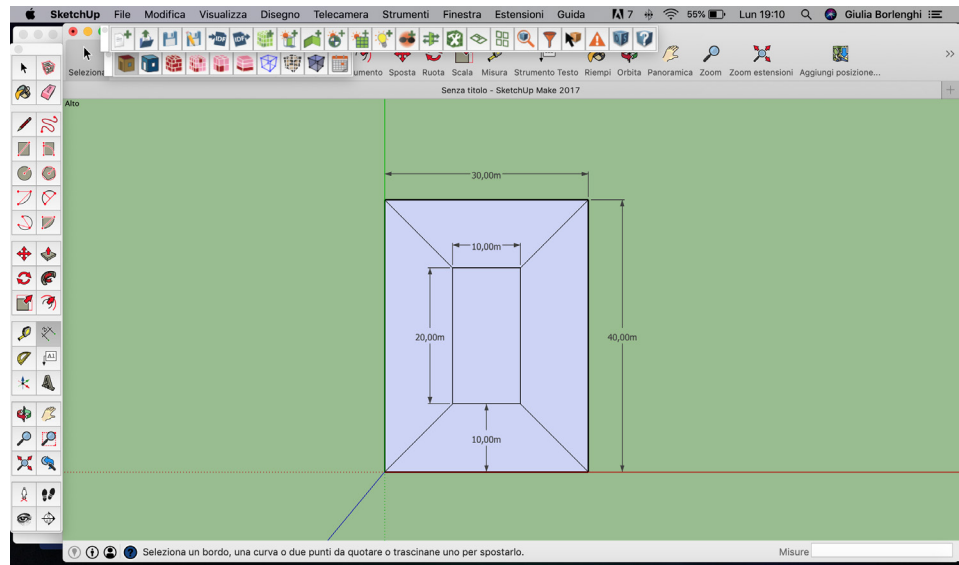
$$n = \frac{1899,67}{19} - 1 = 98,98$$

To have a new heat transfer rate (1% of the heat transfer without shields) we need **99** shields.

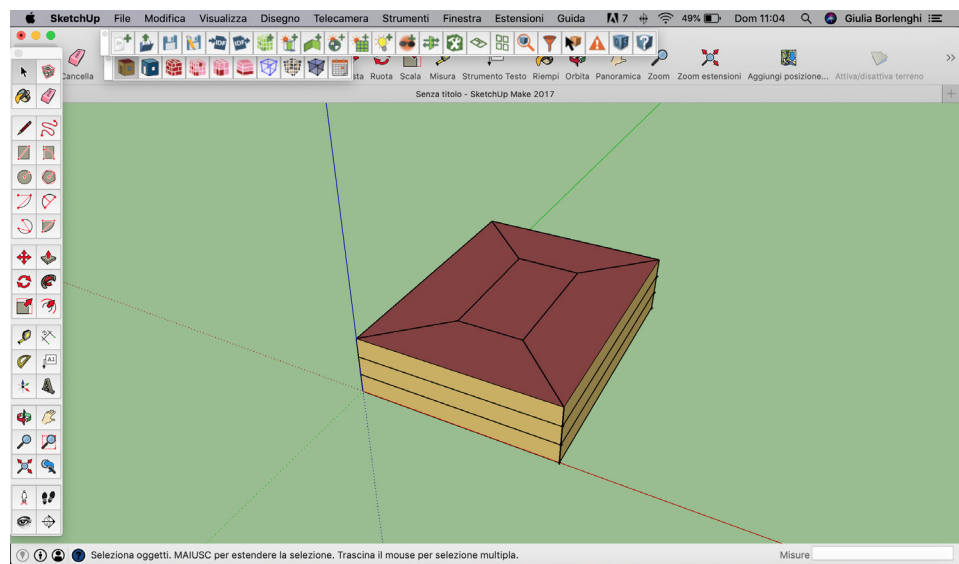
> SketchUp – OpenStudio exercise

1. Create the diagram of the building

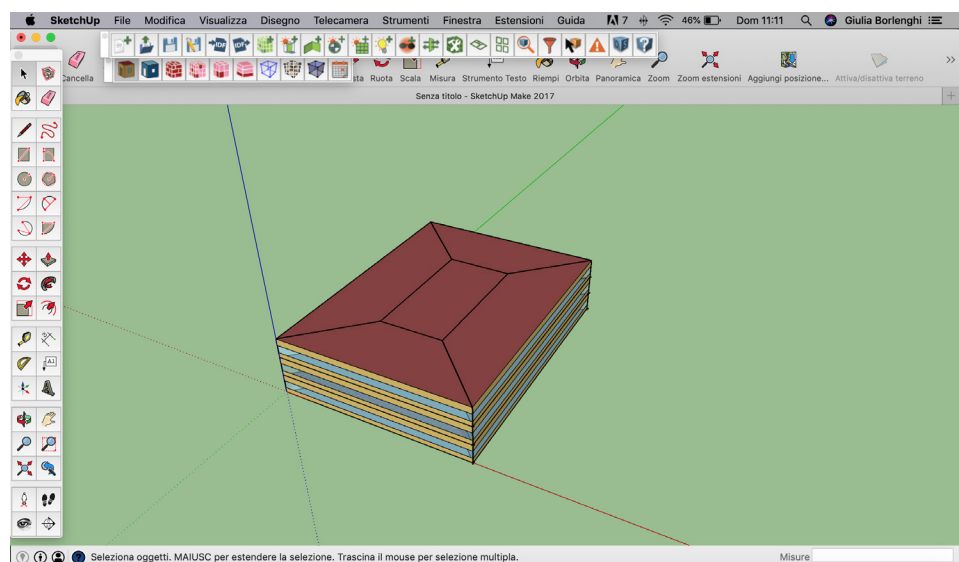
First draw the diagram by creating a 40x30 m rectangle. Then create another rectangle inside it (offset of 10 m) and finally connect the edges with 4 lines.



Then use the command **CREATE SPACES FROM 2D FLOOR** and insert the value of *FLOOR HEIGHT* and *NUMBER OF FLOORS* to obtain a tridimensional diagram.



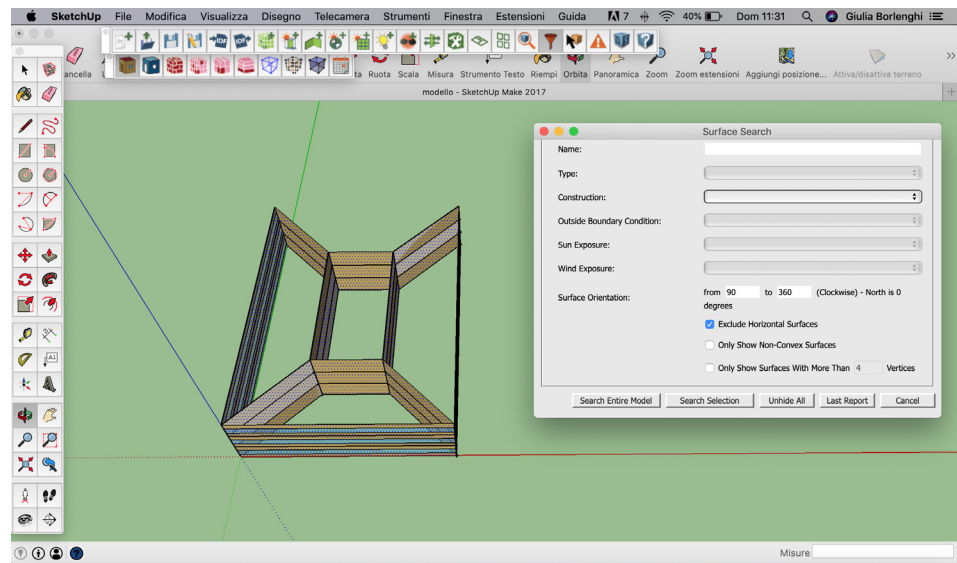
To add windows, is necessary to follow this passages:
Select **SURFACE MATCHING** > **MATCH IN ENTIRE MODEL** because otherwise there would be windows inside of the model.
Then **EXTENSIONS** > **OPENSTUDIO SCRIPTS** > **ALTER ADD MODEL ELEMENTS** > **SET WINDOW TO WALL RATIO** and insert the value of *WINDOW TO WALL RATIO*, *OFFSET (METERS)* and *APPLICATION TYPE*.



2. Add overhang (external shading)

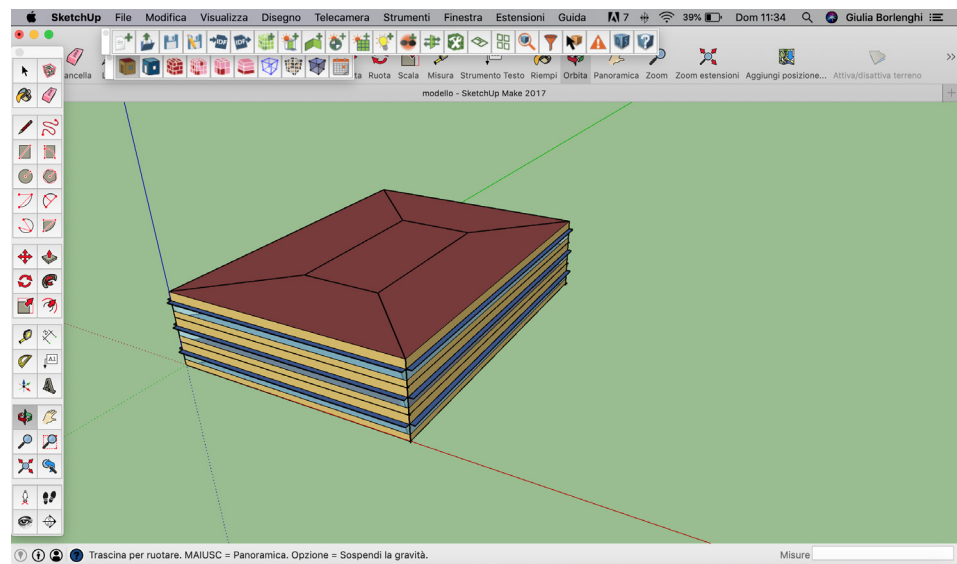
First is necessary to select the surfaces on which add overhang, in this case all the surface except the north.

Use the command **SURFACE SEARCH** to insert the value of **SURFACE ORIENTATION**, in this case from 90 to 360 degrees (because north is 0) and select **EXCLUDE HORIZONTAL SURFACE**.



Since is not necessary to put external shading in the north, by entering these data it is possible to obtain overhang on all surfaces except north.

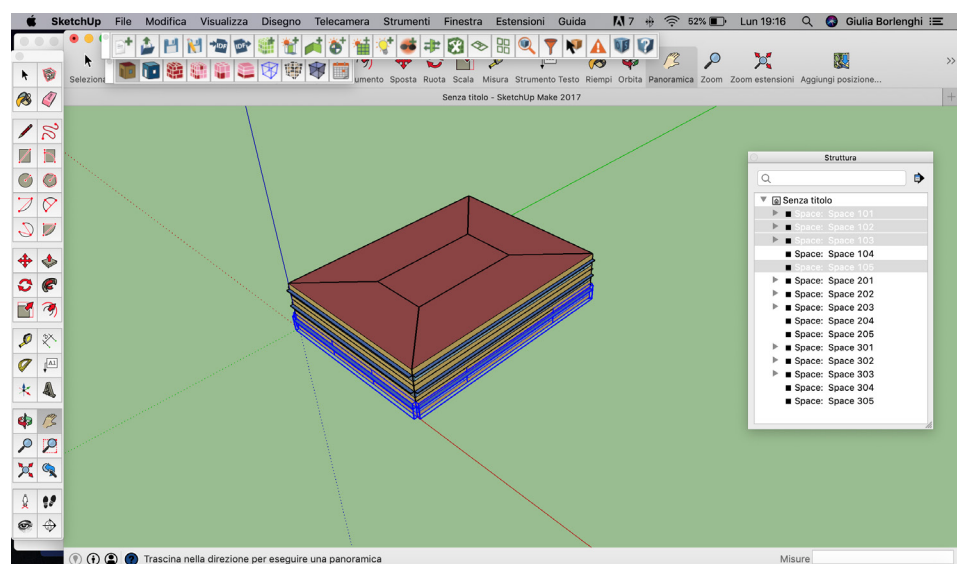
After that is possible to choose 0-360 degrees surfaces and go back to the previous selection.



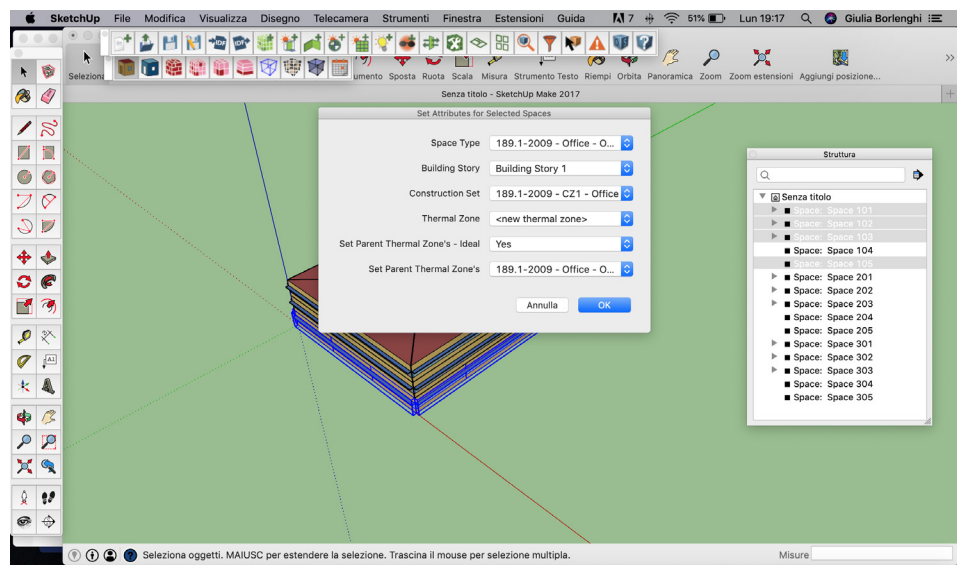
3. Select thermal zone

Now choose the spaces of each thermal zone and add specifications because each part of the building has different technical features.

Using the **OUTLINER** box it's possible to select different *Spaces*.



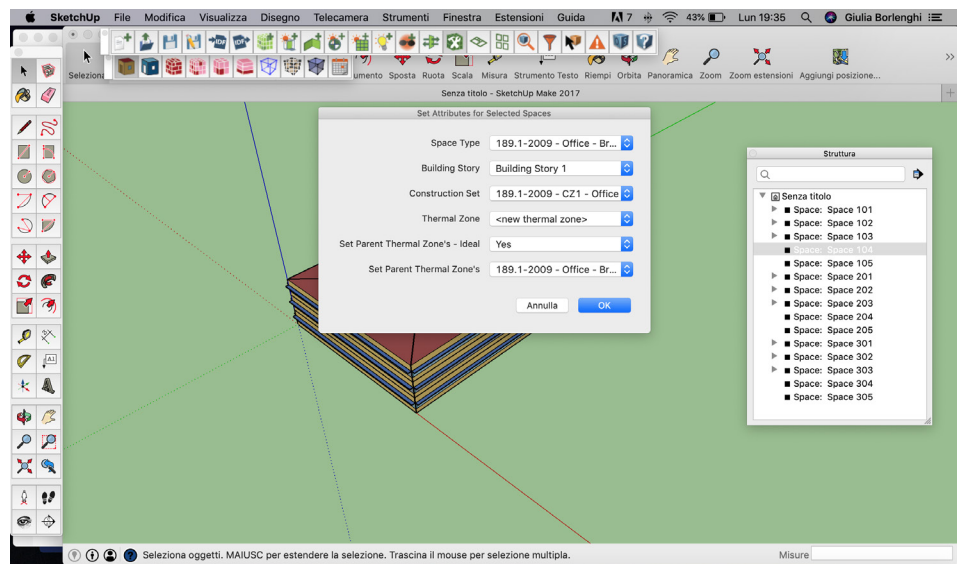
Selecting group of Space with the same features and using the command **SET ATTRIBUTES FOR SELECTED SPACES**, is possible to add some information like: *SPACE TYPE*, *BUILDING STORY*, *CONSTRUCTION SET*, *THERMAL ZONE*, *SET PARENT THERMAL ZONE'S - IDEAL* and *SET PARENT THERMAL ZONE'S*.



In this specific case, for each floor, we select first external surfaces [*SPACE 101*, *SPACE 102*, *SPACE 103*, *SPACE 105*] creating a *BUILDING STORY 1* with *SPACE TYPE* as *OFFICE - OPENOFFICE*.

And after we select *SPACE 104*, that is in the middle of the building with no contact with the outside and so with a different thermal zone. This time we put *SPACE TYPE* as *BREAKROOM*.

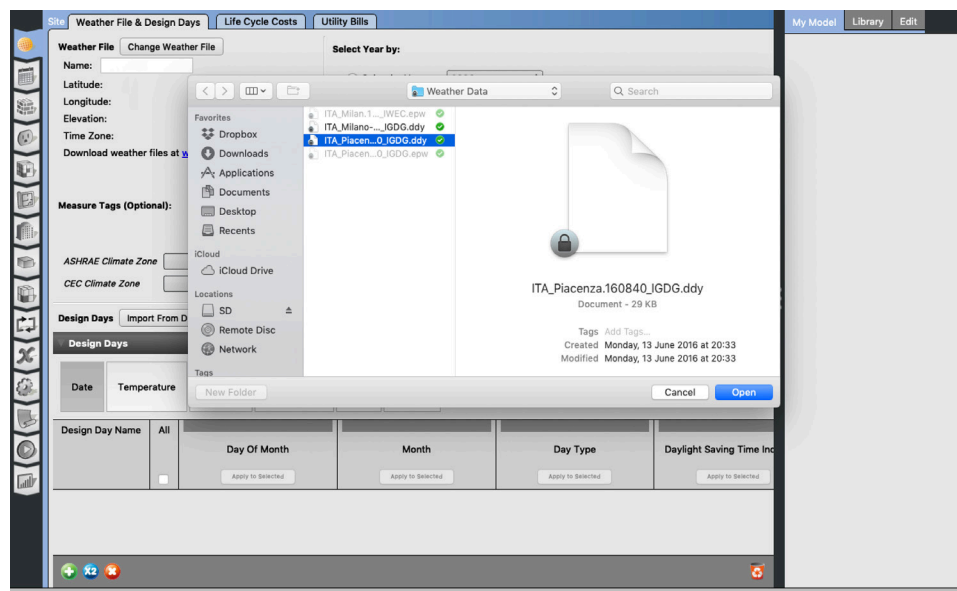
We repeat the same actions for each "floor" obtaining 6 different thermal zones.



4. Launch OpenStudio

To open the OpenStudio program follow the passage: **EXTENSIONS > OPENSTUDIO > LAUNCH OPENSTUDIO**.

Now is necessary to add weather data in the *Site Page* using the command **DESIGN DAYS > IMPORT FROM DDY** and select the file *.ddy*.



In the SPACES PROPERTIES PAGE is possible to have all the information of each SPACE with the data of STORY, THERMAL ZONE, SPACE TYPE and all the other information that were entered before.

Spaces

Properties

Loads

Surfaces

Subsurfaces

Interior Partitions

Shading

General

Airflow

Custom

Filters: Story

Thermal Zone

Space Type

All

All

All

Space Name	All	Story	Thermal Zone	Space Type	Default Construction Set	Default Schedule Set	Part of Total
Space 101	<input type="checkbox"/>	<div>Building Story 1</div> <div>Apply to Selected</div>	<div>Thermal Zone 1</div> <div>Apply to Selected</div>	<div>189.1-2009 - Office - C</div> <div>Apply to Selected</div>	<div>189.1-2009 - CZ1 - Off</div> <div>Apply to Selected</div>	<div></div> <div>Apply to Selected</div>	<input checked="" type="checkbox"/>
Space 102	<input type="checkbox"/>	<div>Building Story 1</div> <div>Apply to Selected</div>	<div>Thermal Zone 1</div> <div>Apply to Selected</div>	<div>189.1-2009 - Office - C</div> <div>Apply to Selected</div>	<div>189.1-2009 - CZ1 - Off</div> <div>Apply to Selected</div>	<div></div> <div>Apply to Selected</div>	<input checked="" type="checkbox"/>
Space 103	<input type="checkbox"/>	<div>Building Story 1</div> <div>Apply to Selected</div>	<div>Thermal Zone 1</div> <div>Apply to Selected</div>	<div>189.1-2009 - Office - C</div> <div>Apply to Selected</div>	<div>189.1-2009 - CZ1 - Off</div> <div>Apply to Selected</div>	<div></div> <div>Apply to Selected</div>	<input checked="" type="checkbox"/>
Space 104	<input type="checkbox"/>	<div>Building Story 1</div> <div>Apply to Selected</div>	<div>Thermal Zone 2</div> <div>Apply to Selected</div>	<div>189.1-2009 - Office - B</div> <div>Apply to Selected</div>	<div>189.1-2009 - CZ1 - Off</div> <div>Apply to Selected</div>	<div></div> <div>Apply to Selected</div>	<input checked="" type="checkbox"/>
Space 105	<input type="checkbox"/>	<div>Building Story 1</div> <div>Apply to Selected</div>	<div>Thermal Zone 1</div> <div>Apply to Selected</div>	<div>189.1-2009 - Office - C</div> <div>Apply to Selected</div>	<div>189.1-2009 - CZ1 - Off</div> <div>Apply to Selected</div>	<div></div> <div>Apply to Selected</div>	<input checked="" type="checkbox"/>
Space 201	<input type="checkbox"/>	<div>Building Story 2</div> <div>Apply to Selected</div>	<div>Thermal Zone 3</div> <div>Apply to Selected</div>	<div>189.1-2009 - Office - C</div> <div>Apply to Selected</div>	<div>189.1-2009 - CZ1 - Off</div> <div>Apply to Selected</div>	<div></div> <div>Apply to Selected</div>	<input checked="" type="checkbox"/>
Space 202	<input type="checkbox"/>	<div>Building Story 2</div> <div>Apply to Selected</div>	<div>Thermal Zone 3</div> <div>Apply to Selected</div>	<div>189.1-2009 - Office - C</div> <div>Apply to Selected</div>	<div>189.1-2009 - CZ1 - Off</div> <div>Apply to Selected</div>	<div></div> <div>Apply to Selected</div>	<input checked="" type="checkbox"/>
Space 203	<input type="checkbox"/>	<div>Building Story 2</div> <div>Apply to Selected</div>	<div>Thermal Zone 3</div> <div>Apply to Selected</div>	<div>189.1-2009 - Office - C</div> <div>Apply to Selected</div>	<div>189.1-2009 - CZ1 - Off</div> <div>Apply to Selected</div>	<div></div> <div>Apply to Selected</div>	<input checked="" type="checkbox"/>
Space 204	<input type="checkbox"/>	<div>Building Story 2</div> <div>Apply to Selected</div>	<div>Thermal Zone 4</div> <div>Apply to Selected</div>	<div>189.1-2009 - Office - B</div> <div>Apply to Selected</div>	<div>189.1-2009 - CZ1 - Off</div> <div>Apply to Selected</div>	<div></div> <div>Apply to Selected</div>	<input checked="" type="checkbox"/>
Space 205	<input type="checkbox"/>	<div>Building Story 2</div> <div>Apply to Selected</div>	<div>Thermal Zone 3</div> <div>Apply to Selected</div>	<div>189.1-2009 - Office - C</div> <div>Apply to Selected</div>	<div>189.1-2009 - CZ1 - Off</div> <div>Apply to Selected</div>	<div></div> <div>Apply to Selected</div>	<input checked="" type="checkbox"/>
Space 301	<input type="checkbox"/>	<div>Building Story 3</div> <div>Apply to Selected</div>	<div>Thermal Zone 5</div> <div>Apply to Selected</div>	<div>189.1-2009 - Office - C</div> <div>Apply to Selected</div>	<div>189.1-2009 - CZ1 - Off</div> <div>Apply to Selected</div>	<div></div> <div>Apply to Selected</div>	<input checked="" type="checkbox"/>
Space 302	<input type="checkbox"/>	<div>Building Story 3</div> <div>Apply to Selected</div>	<div>Thermal Zone 5</div> <div>Apply to Selected</div>	<div>189.1-2009 - Office - C</div> <div>Apply to Selected</div>	<div>189.1-2009 - CZ1 - Off</div> <div>Apply to Selected</div>	<div></div> <div>Apply to Selected</div>	<input checked="" type="checkbox"/>
Space 303	<input type="checkbox"/>	<div>Building Story 3</div> <div>Apply to Selected</div>	<div>Thermal Zone 5</div> <div>Apply to Selected</div>	<div>189.1-2009 - Office - C</div> <div>Apply to Selected</div>	<div>189.1-2009 - CZ1 - Off</div> <div>Apply to Selected</div>	<div></div> <div>Apply to Selected</div>	<input checked="" type="checkbox"/>

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My Model

Library

Edit

Use the command **Run Simulation** to run the model.

Run Simulation		Show Simulation
Run		
Warming up (4)		
Warming up (5)		
Warming up (6)		
Starting Simulation at 08/21 for PIACENZA ANN CLG .4% CONDNS WB==MDB		
Initializing New Environment Parameters		
Warming up (1)		
Warming up (2)		
Warming up (3)		
Warming up (4)		
Warming up (5)		
Warming up (6)		
Starting Simulation at 01/21 for PIACENZA ANN HTG 99.6% CONDNS DB		
Initializing New Environment Parameters		
Warming up (1)		
Warming up (2)		
Warming up (3)		
Warming up (4)		
Warming up (5)		
Warming up (6)		
Starting Simulation at 01/21 for PIACENZA ANN HTG WIND 99.6% CONDNS WS==MCDB		
Initializing New Environment Parameters		
Warming up (1)		
Warming up (2)		
Warming up (3)		
Warming up (4)		
Warming up (5)		
Warming up (6)		
Starting Simulation at 01/21 for PIACENZA ANN HUM,N 99.6% CONDNS DP==MCDB		
Initializing New Environment Parameters		
Warming up (1)		
Warming up (2)		
Warming up (3)		
Warming up (4)		
Warming up (5)		
Warming up (6)		
Starting Simulation at 01/01/2006 for RUN PERIOD 1		
Updating Shadowing Calculations, Start Date=01/21/2006		
Continuing Simulation at 01/21/2006 for RUN PERIOD 1		
Updating Shadowing Calculations, Start Date=02/10/2006		
Continuing Simulation at 02/10/2006 for RUN PERIOD 1		
Updating Shadowing Calculations, Start Date=03/02/2006		
Continuing Simulation at 03/02/2006 for RUN PERIOD 1		
Updating Shadowing Calculations, Start Date=03/22/2006		
Continuing Simulation at 03/22/2006 for RUN PERIOD 1		
Updating Shadowing Calculations, Start Date=04/11/2006		
Continuing Simulation at 04/11/2006 for RUN PERIOD 1		

At the end of the run, in the last page **Result Summary** is possible to review results.

Results Summary		Refresh	Open DView for Detailed Reports
Reports: EnergyPlus Results			
Program Version:EnergyPlus, Version 9.1.0-08d2c308bb, YMD=2019.11.11 19:30		Table of Contents	
Tabular Output Report in Format: HTML			
Building: Building 1			
Environment: RUN PERIOD 1 ** Piacenza - ITA IGDG WMO#160840			
Simulation Timestamp: 2019-11-11 19:30:38			
Report: Annual Building Utility Performance Summary		Table of Contents	
For: Entire Facility			
Timestamp: 2019-11-11 19:30:38			
Values gathered over 8760.00 hours			
Site and Source Energy			
	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	2346.02	651.67	651.67
Net Site Energy	2346.02	651.67	651.67
Total Source Energy	6088.24	1691.18	1691.18
Net Source Energy	6088.24	1691.18	1691.18
Site to Source Energy Conversion Factors			
	Site=>Source Conversion Factor		