

SOLAR RADIATION

The solar radiation is the electromagnetic energy emitted by the sun. Calculating its rate means taking in account many factors such as the incidence which depends on the latitude, the season, the thickness of the atmosphere, effects due to atmosphere such as scattering, attenuation and back dispersion.

The maximum yearly average solar radiation density out of the Earth's atmosphere is the solar constant G_{sc} ($G_{sc} = 1367 \text{ W/m}^2$), which is the extraterrestrial solar irradiance (the solar radiation by the unit of receiving surface placed out of the atmosphere and perpendicular to the Sun-Earth ray).

The maximum yearly average solar radiation density on the Earth's surface is 1000 W/m^2

The characteristics of the Solar Radiation are that:

- The Solar radiation, which crosses the atmosphere to reach the Earth's surface, is modified (attenuation), both in the spectral distribution and in the total irradiance. That is caused by the dispersion (molecular and particle scattering) and the absorption phenomena: the scattering/microscopic effect is composed of the back reflection and the diffuse solar radiation (or diffuse irradiance), G_d .
- The Solar radiation that isn't intercepted by molecules and maintains the incidence direction is the direct solar radiation or beam radiation or direct irradiance, G_b .

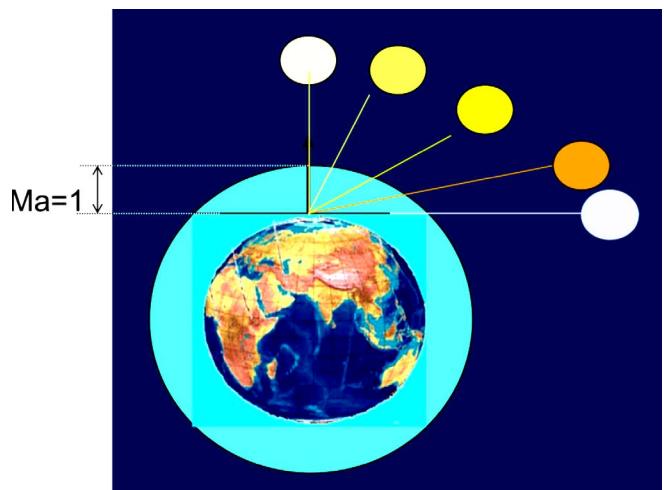
the elements in the atmosphere that absorb the incident radiation (modifying the energetic spectrum) are especially ozone, water and carbon dioxide (absorption bands). The absorbed solar energy is finally converted into internal energy, which is then reemitted in the far-infrared in all the directions.

The solar radiation depends on:

- the position of the Sun (in day and season)
- the weather condition (continental and microclimatic)
- the site altitude over the sea level
- the sunshine hours

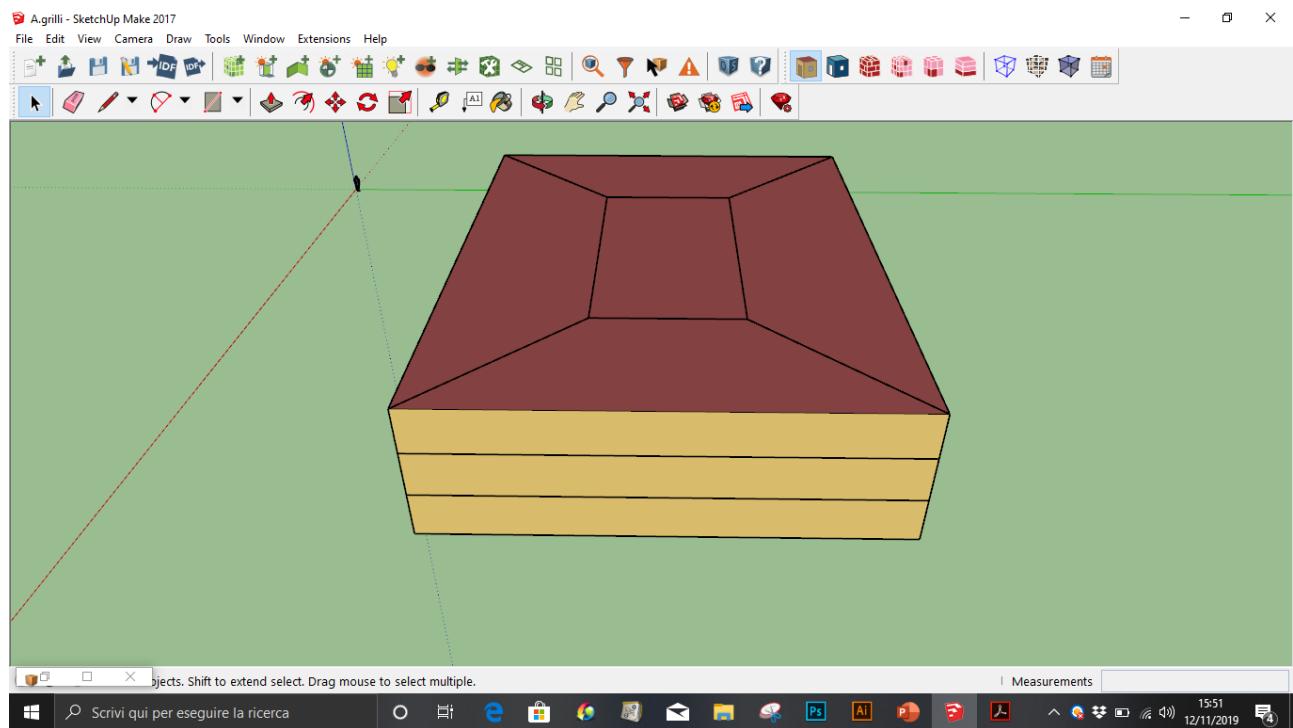
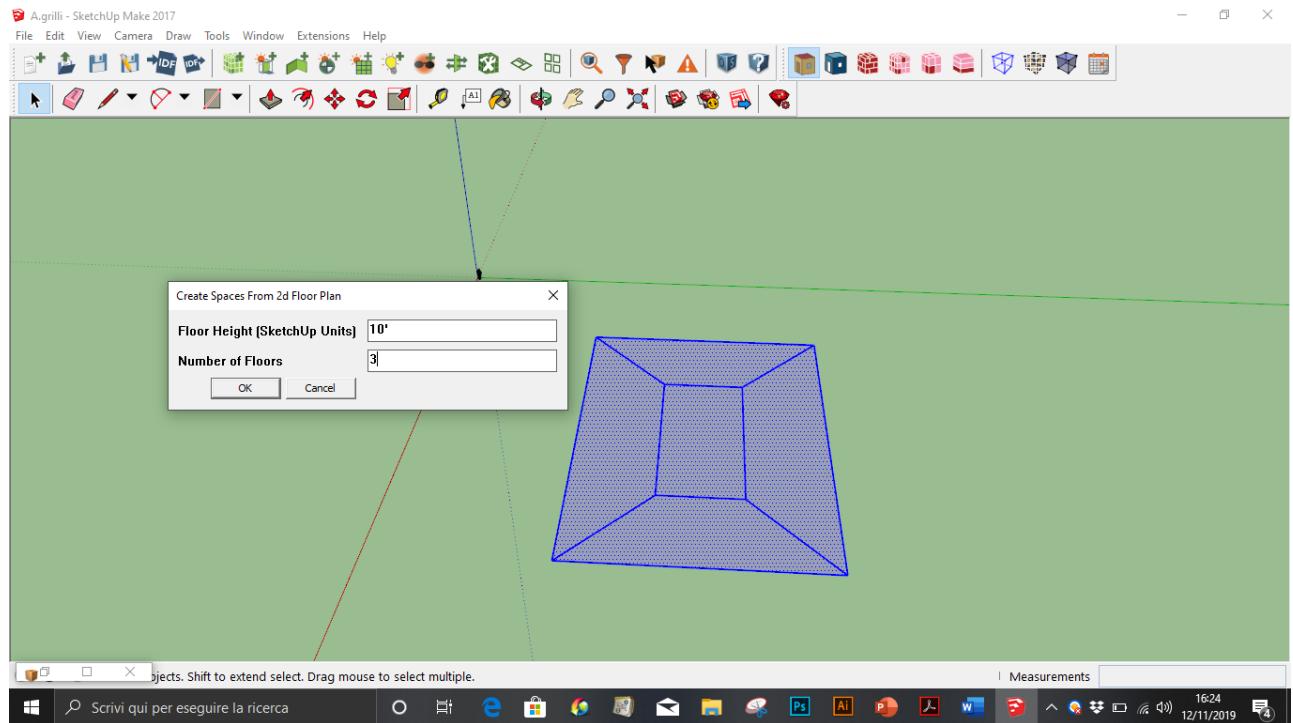
The instrument used to measure solar radiation are:

- Pyranometer: to measure the total solar irradiance (diffuse + direct)
- Pyranometer with shadow band: to measure only the diffuse irradiance
- Normal pyranometer: to measure only the normal direct solar radiation

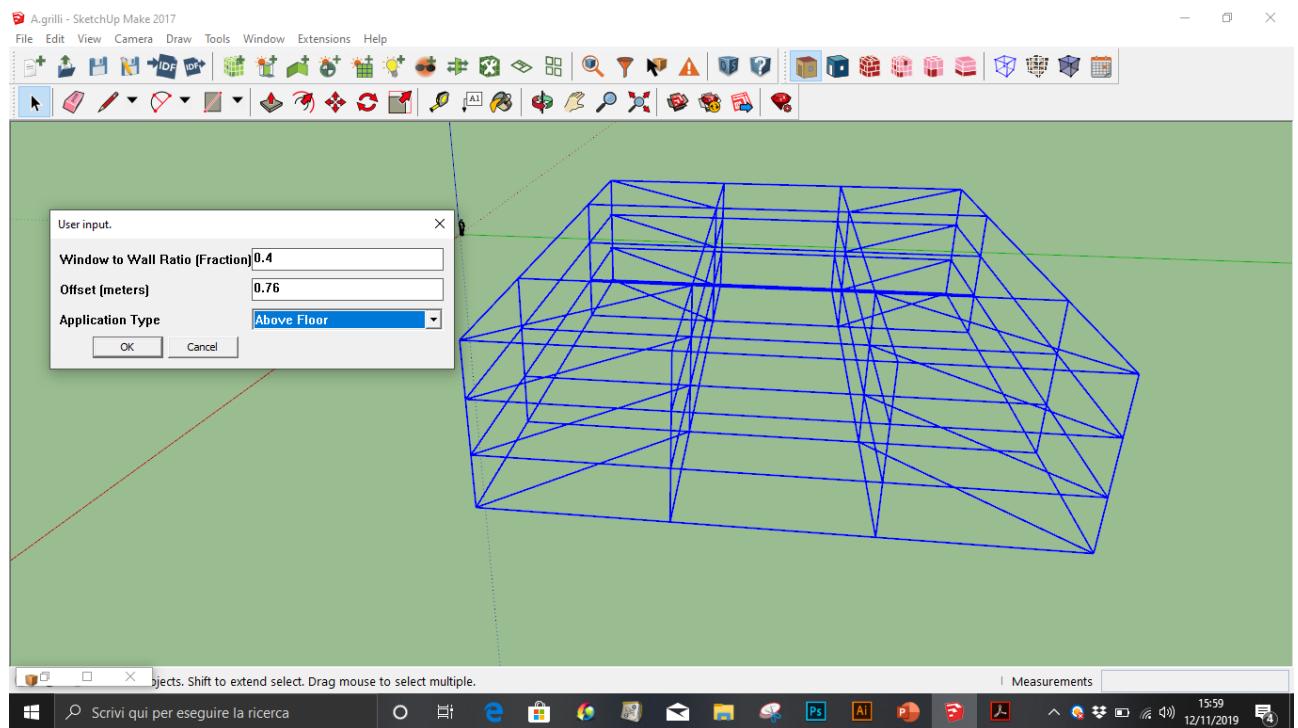
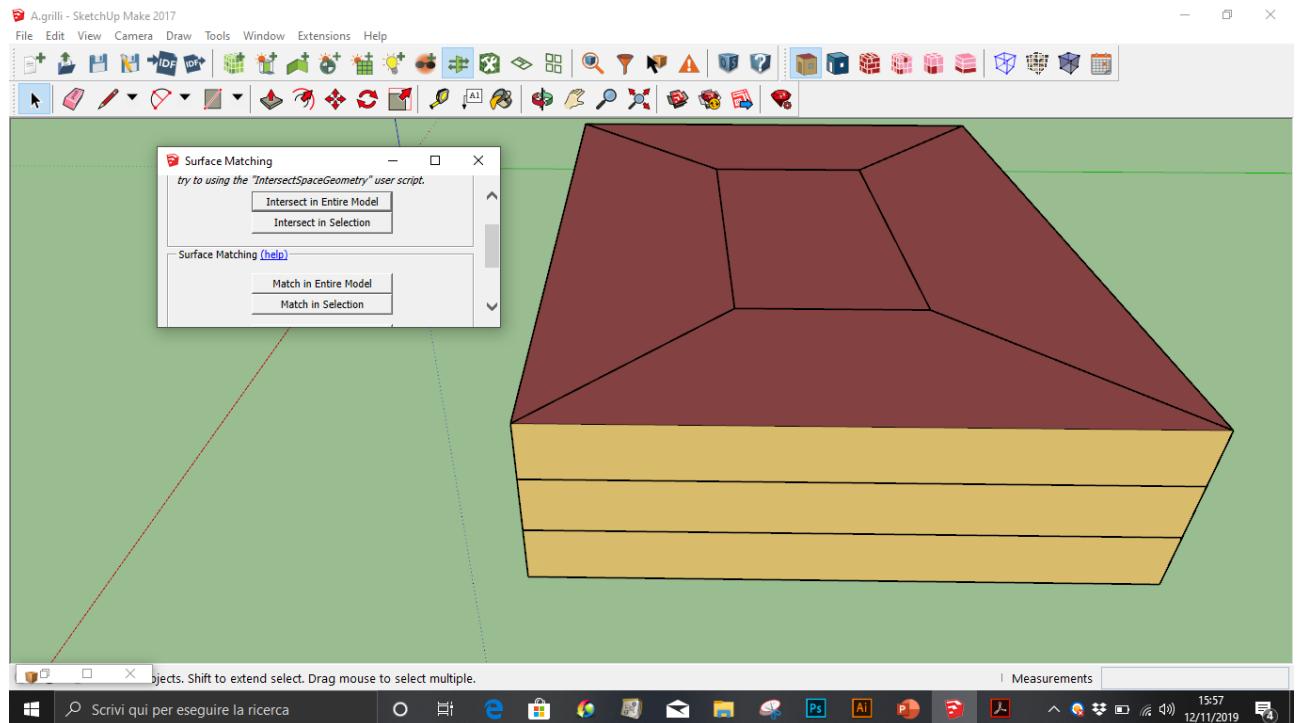


Open Studio exercise

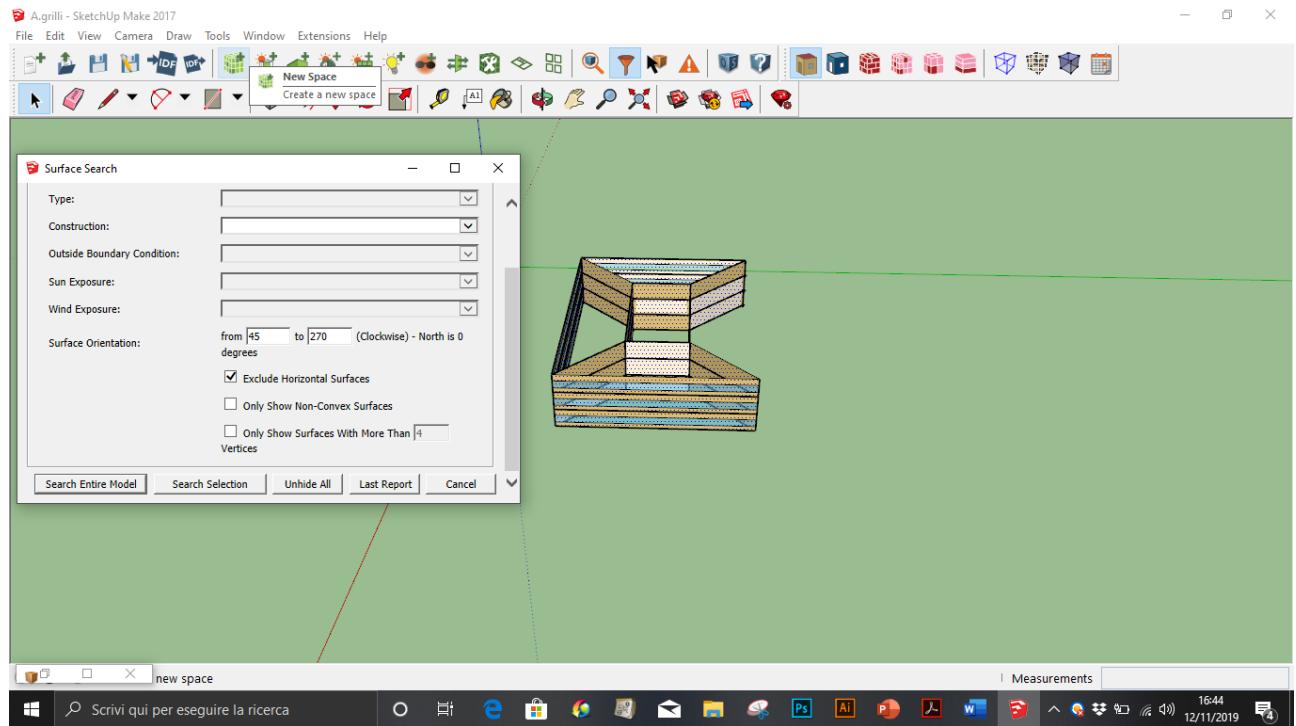
After the diagram is ready, let's make it a building by adding a number of floor of the same height



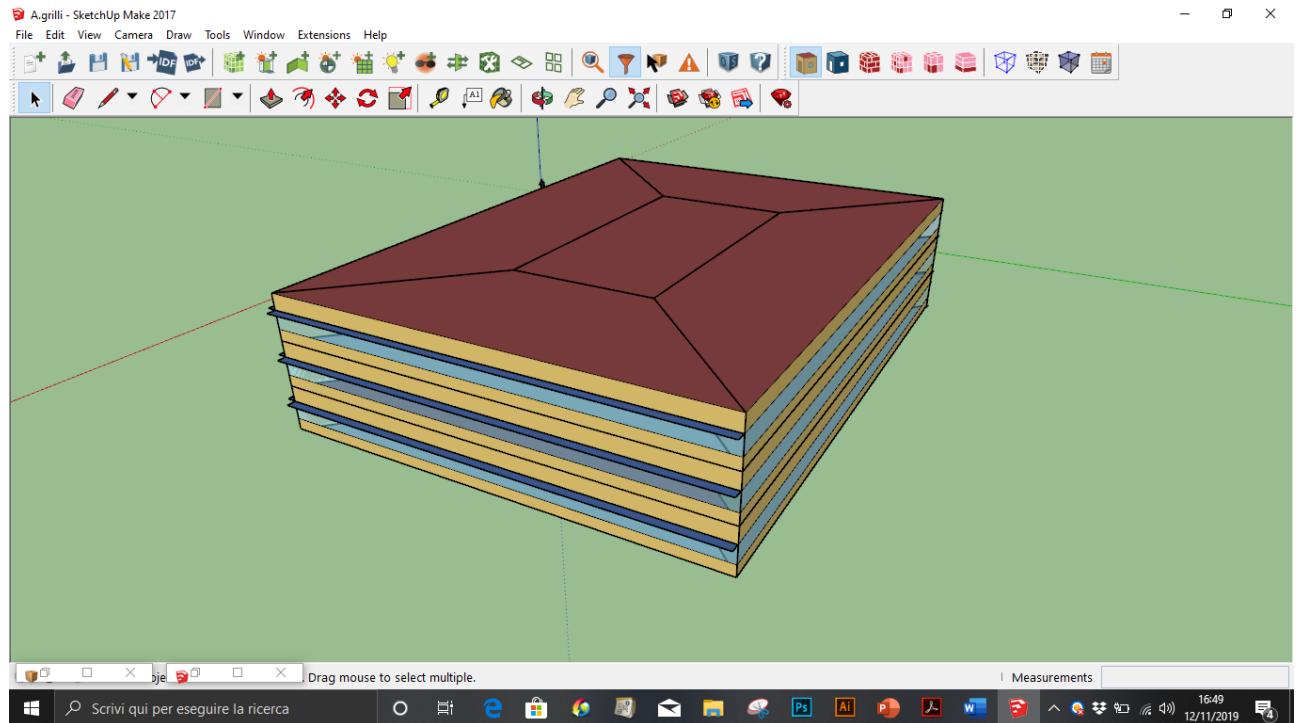
2) Before creating windows, we have to match the surfaces in order to have separate units with only the windows in the outside surfaces



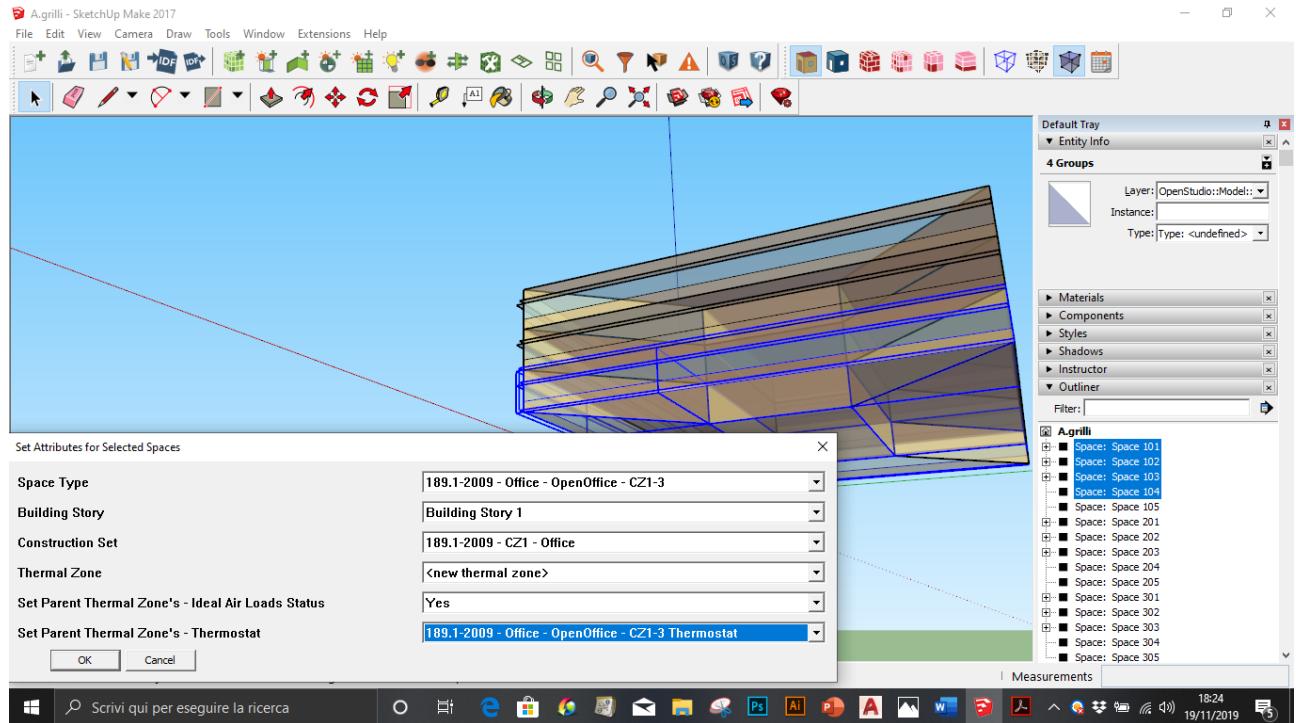
3) For adding the overhangs, we need to select all the surfaces except the one facing North (between 45 and 270 degrees)



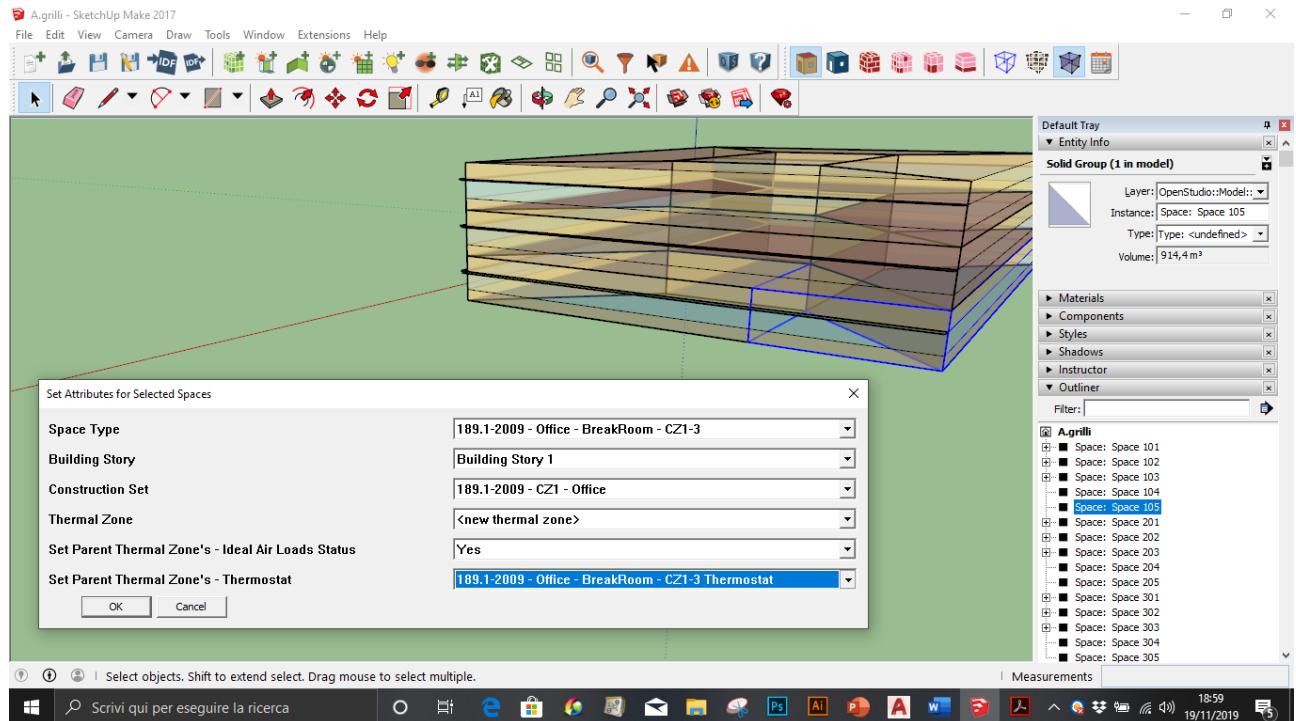
Then adding overhands on the remaining surfaces and reselect all the surfaces again to see the entire model



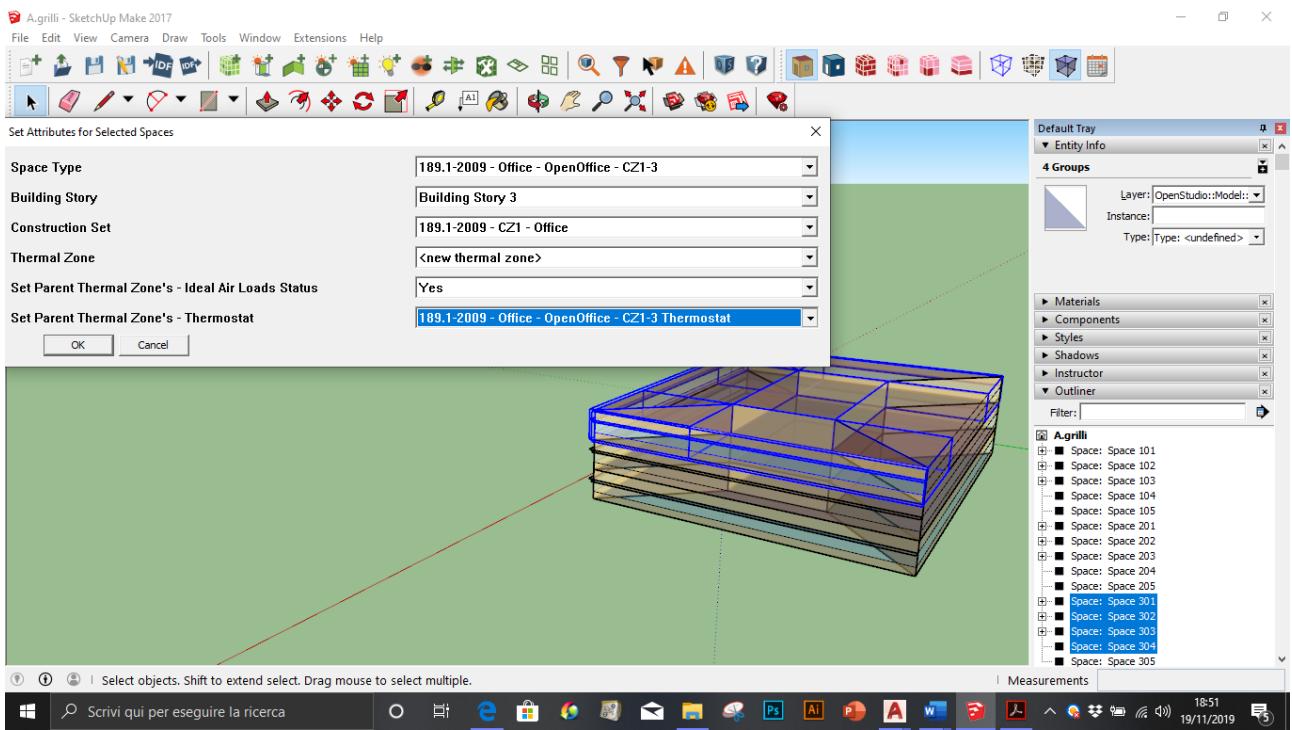
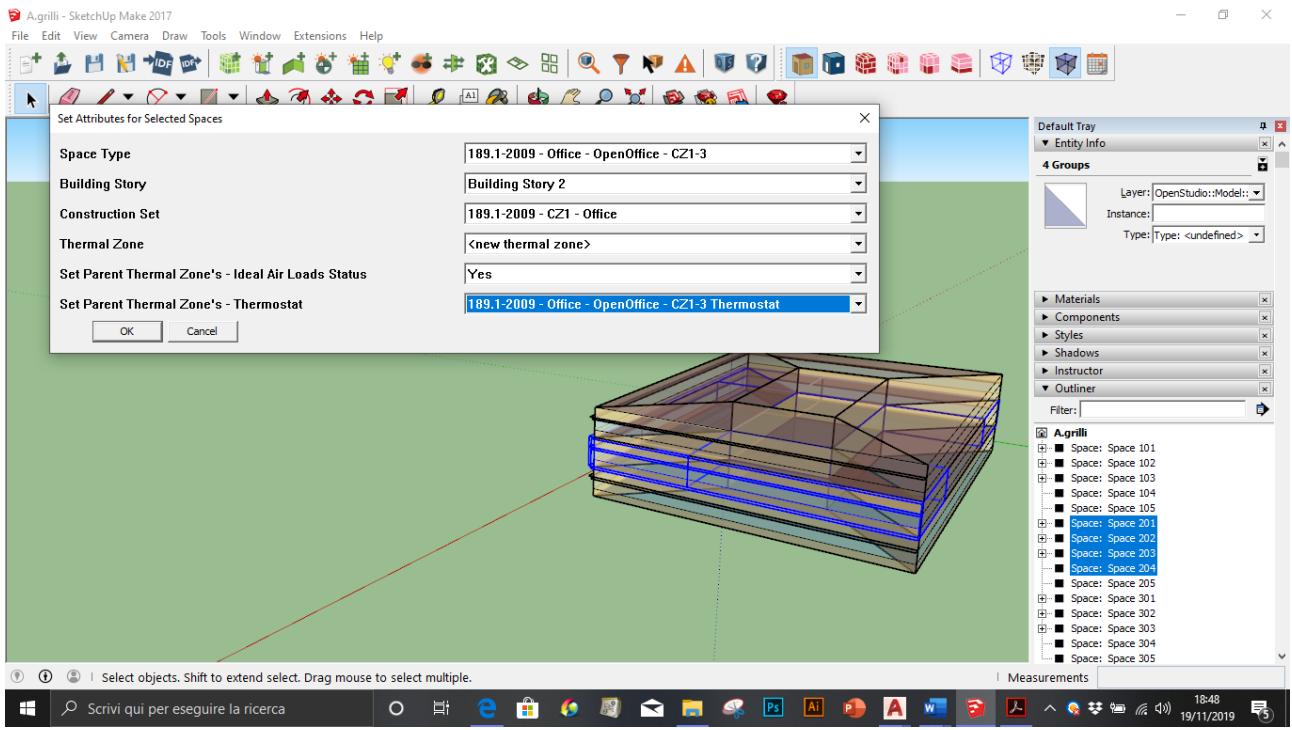
4) Next we choose the spaces of each thermal zone and we add specifications: we choose 4 spaces to be offices...

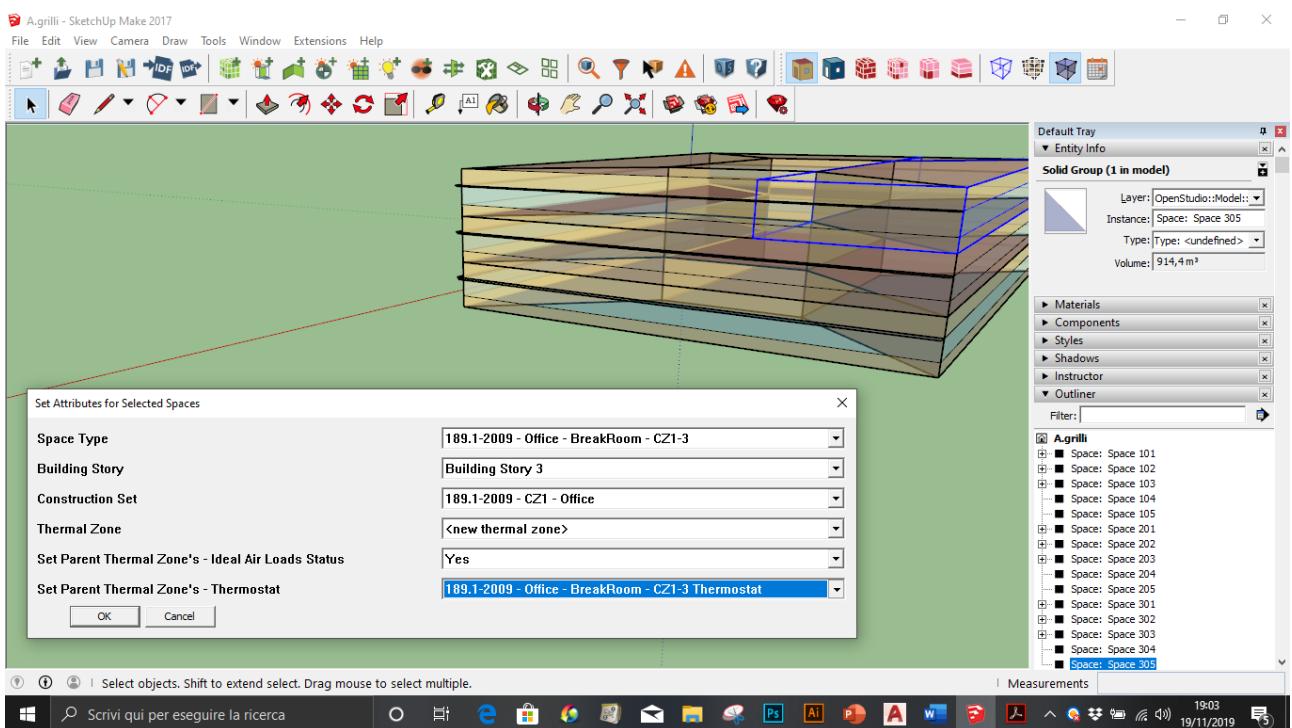
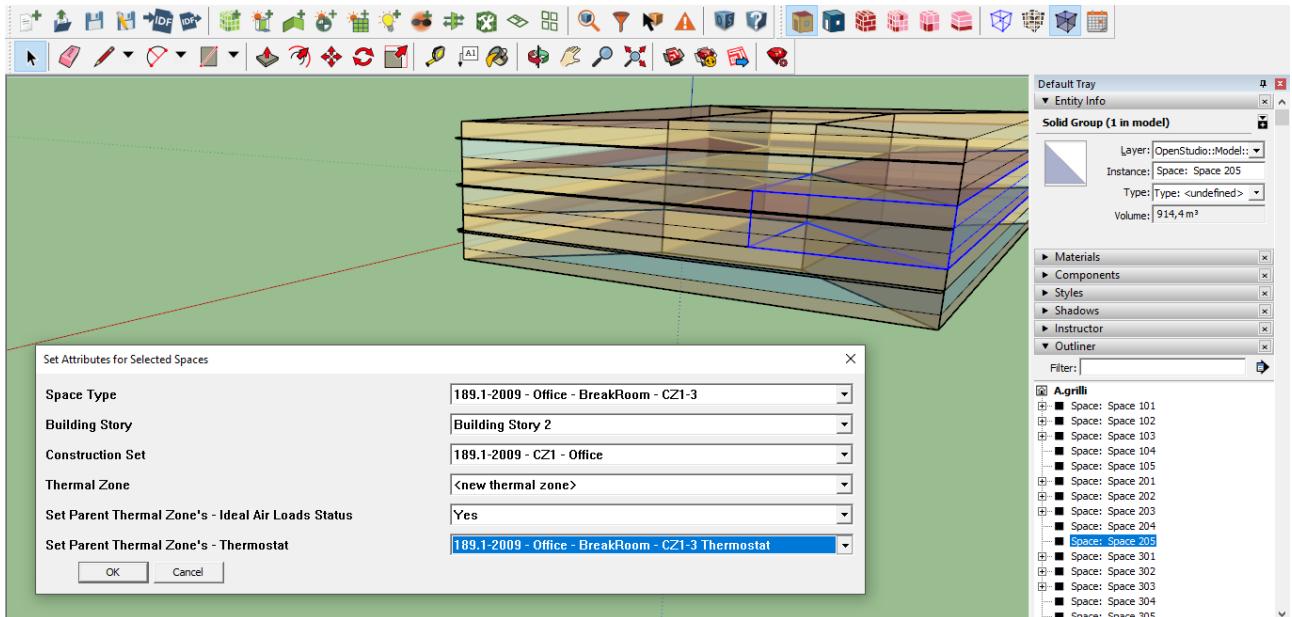


And one to be the breakroom.

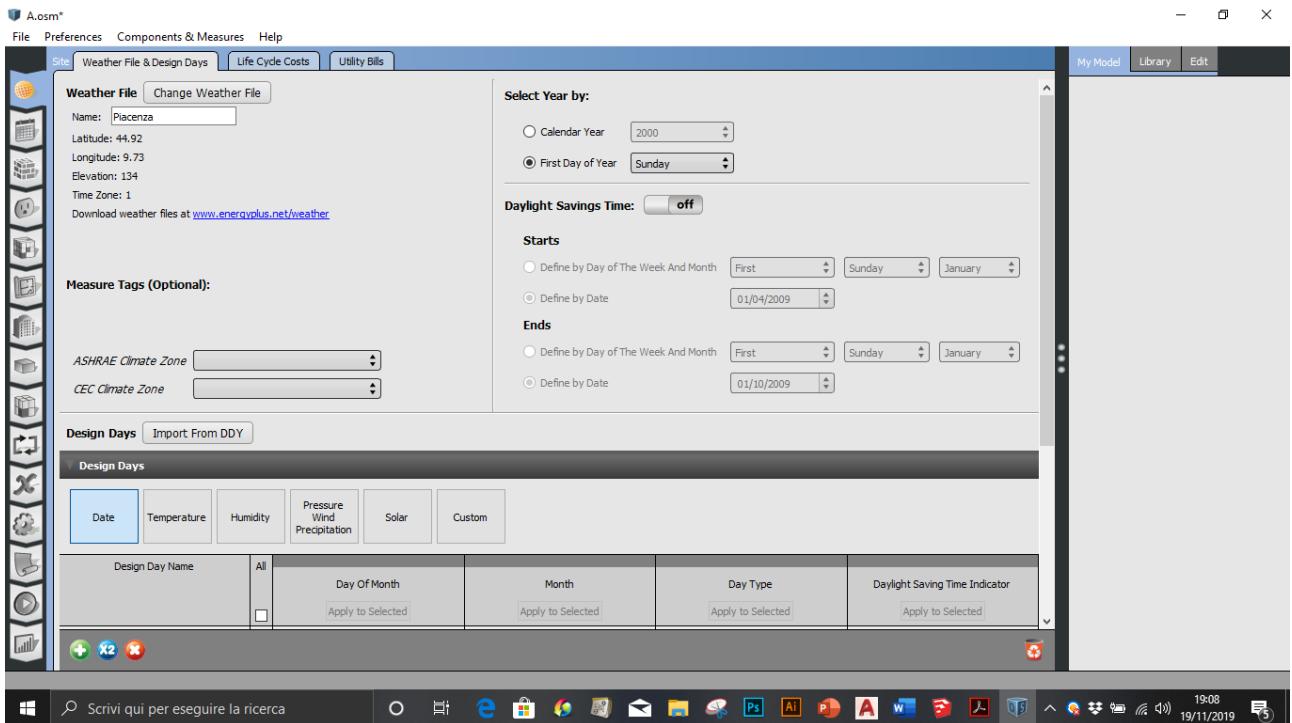


And repeat the passage for all the floors

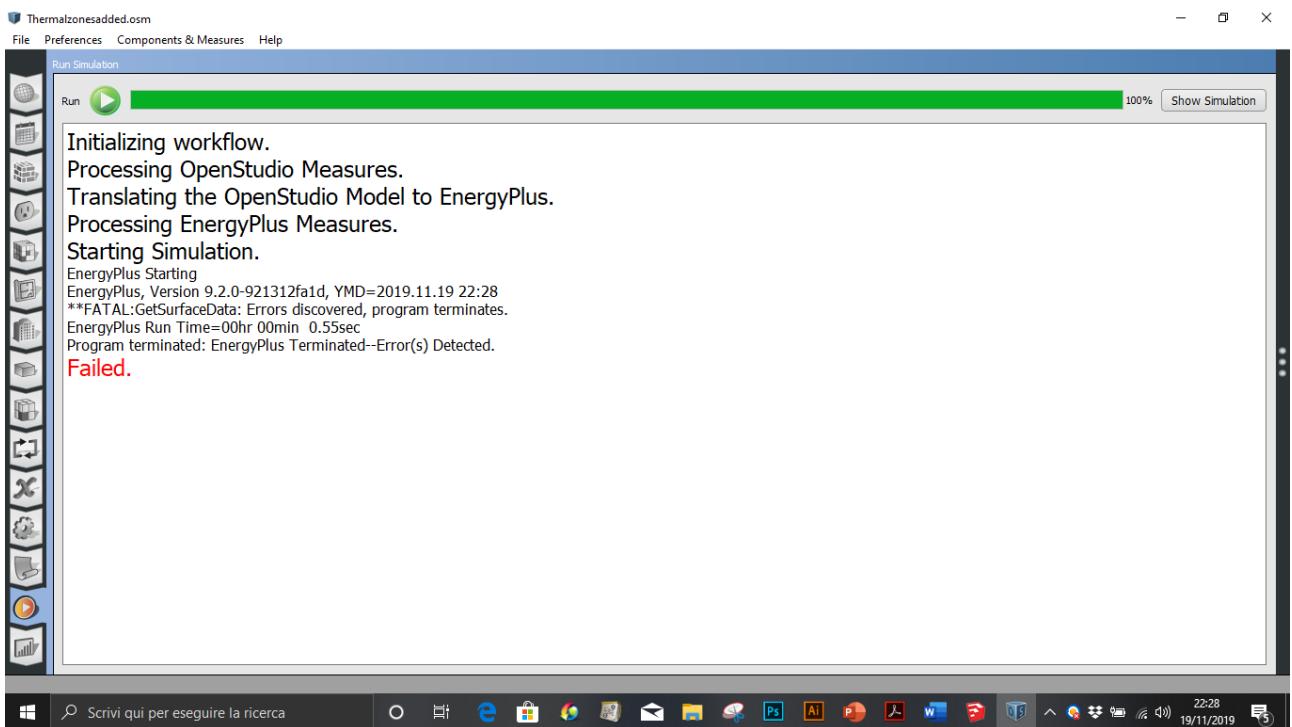




5) Adding the weather Data of Piacenza: I import the file created in SketchUp and insert the Weather File and the Design Days.



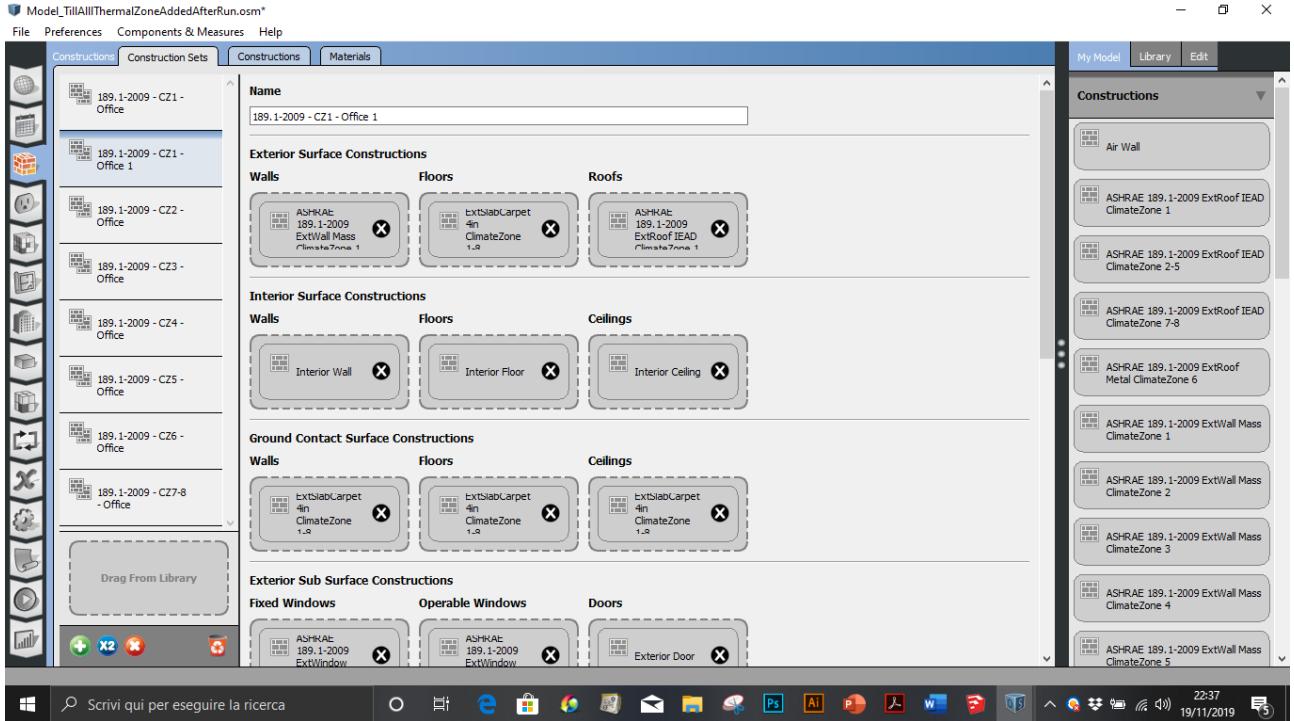
6) Then I run the simulation



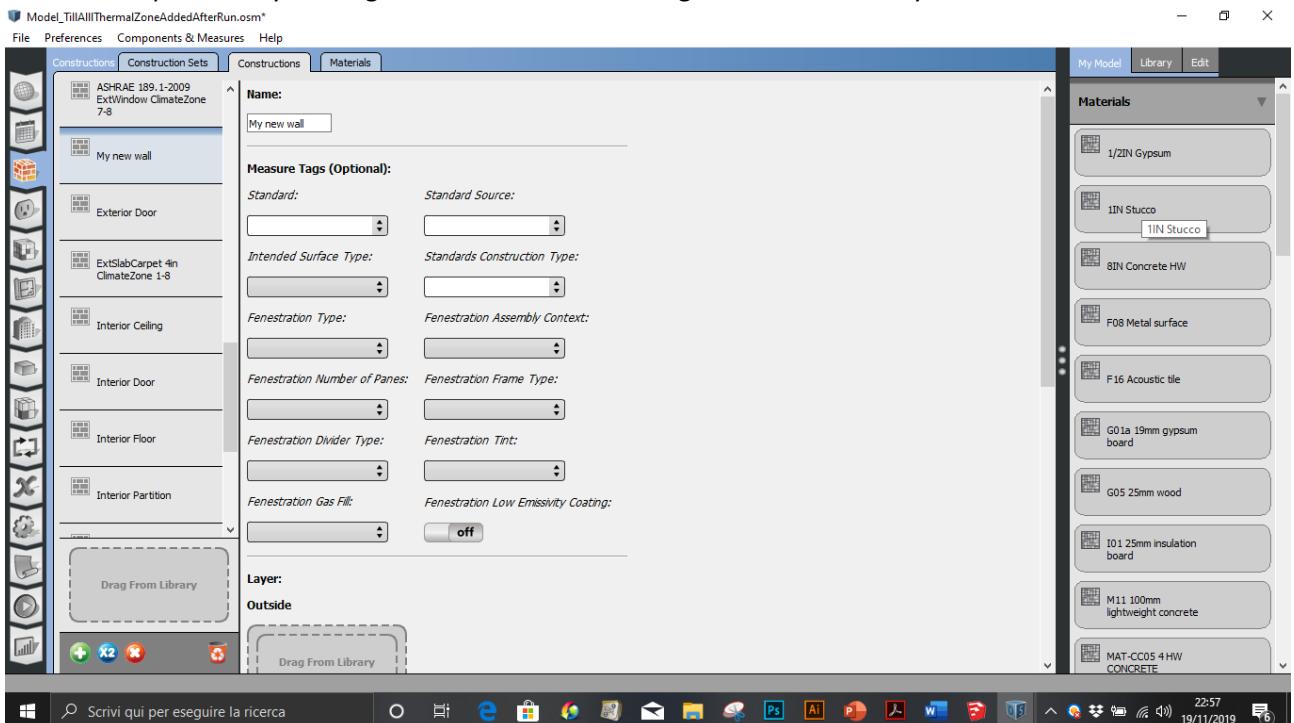
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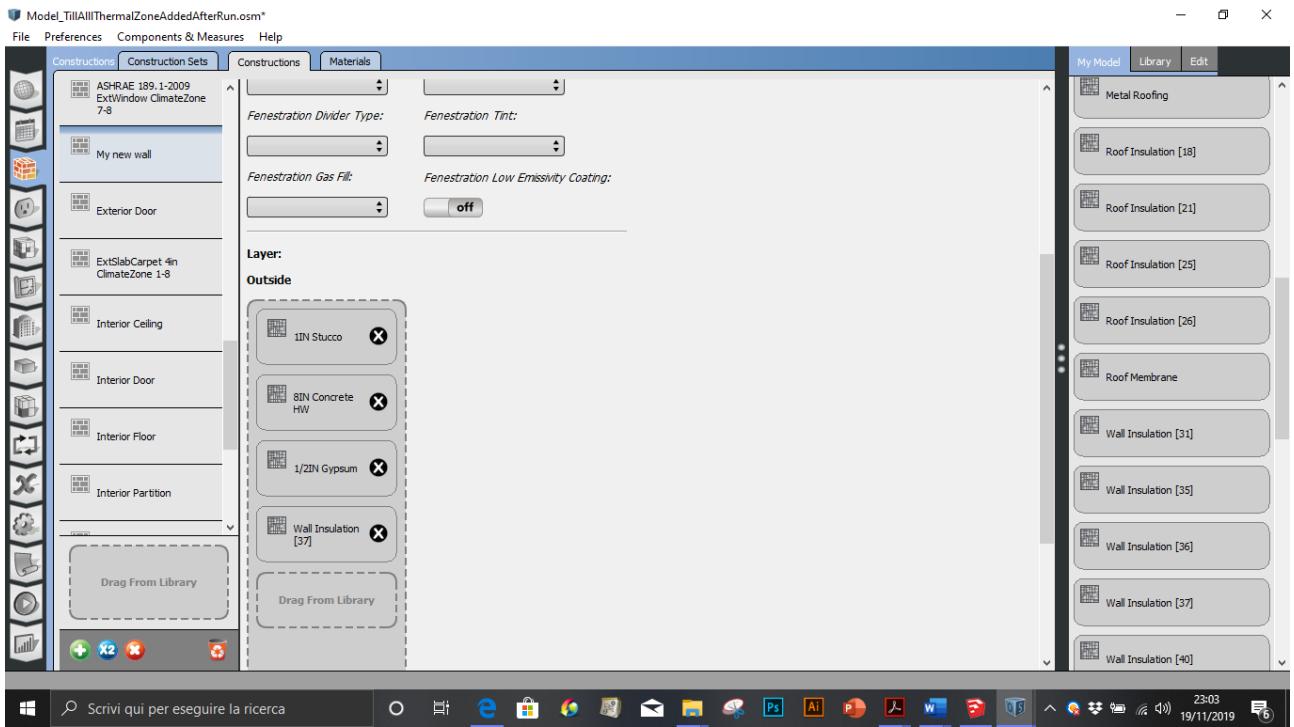
Second Part

- I duplicate the first construction set in the third row (Constructions)

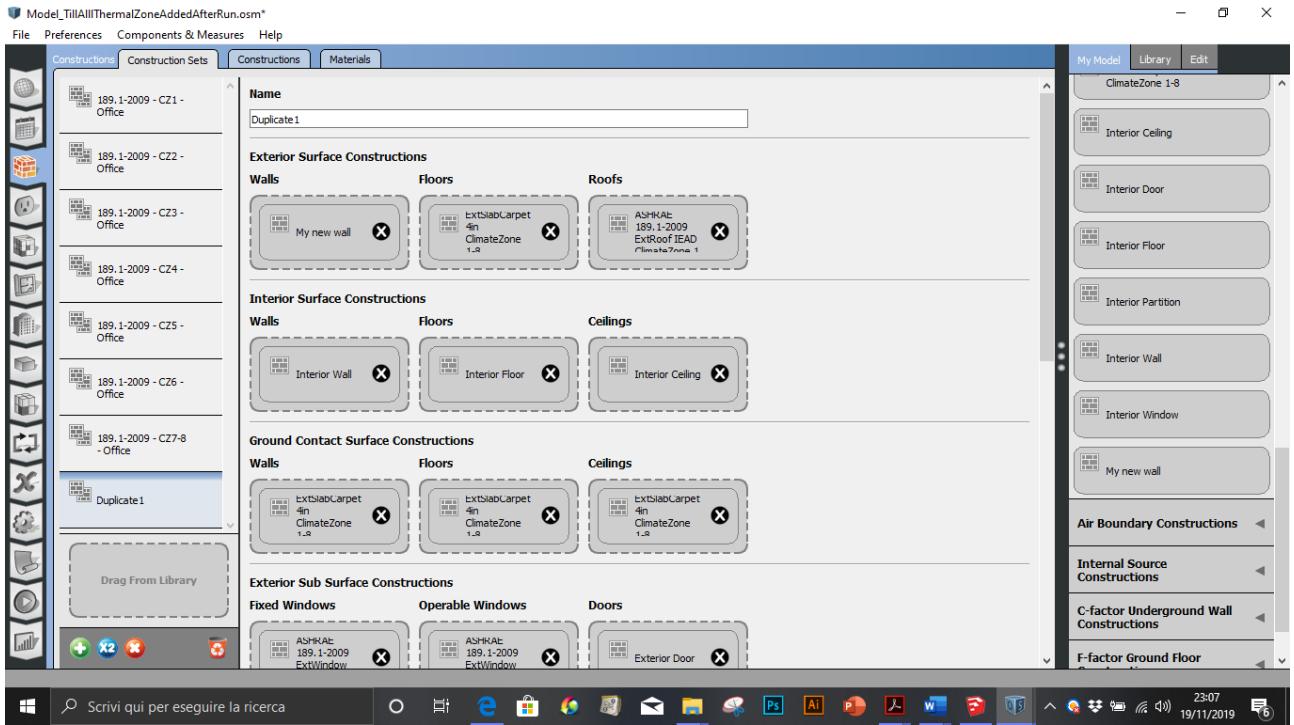


- In the “Construction” voice, I create a new element that I want to be my new wall: I decide its composition by moving the materials from the right section in the layer's area.





3) Back to Construction Set I replace the walls with my new wall with the layers I have chosen before.



4) I go to the “sapces” voice and I select in the table all the spaces in which I want to apply the new material just created

Model_TillAllThermalZoneAddedAfterRun.osm*

File Preferences Components & Measures Help

Spaces Properties Loads Surfaces Subsurfaces Interior Partitions Shading

General Airflow Custom

Filters: Story Thermal Zone Space Type

Space Name	All	Story	Thermal Zone	Space Type	Default Construction Set	Default Schedule Set	Part of Total Floor Area
Space 101	<input checked="" type="checkbox"/>	Building Story 1	Thermal Zone 1	189.1-2009 - Office - OpenO	Duplicate1		<input checked="" type="checkbox"/>
Space 102	<input checked="" type="checkbox"/>	Building Story 1	Thermal Zone 1	189.1-2009 - Office - OpenO	Duplicate1		<input checked="" type="checkbox"/>
Space 103	<input checked="" type="checkbox"/>	Building Story 1	Thermal Zone 1	189.1-2009 - Office - OpenO	Duplicate1		<input checked="" type="checkbox"/>
Space 104	<input checked="" type="checkbox"/>	Building Story 1	Thermal Zone 2	189.1-2009 - Office - BreakR	Duplicate1		<input checked="" type="checkbox"/>
Space 105	<input checked="" type="checkbox"/>	Building Story 1	Thermal Zone 1	189.1-2009 - Office - OpenO	Duplicate1		<input checked="" type="checkbox"/>
Space 201	<input checked="" type="checkbox"/>	Building Story 2	Thermal Zone 3	189.1-2009 - Office - OpenO	Duplicate1		<input checked="" type="checkbox"/>
Space 202	<input checked="" type="checkbox"/>	Building Story 2	Thermal Zone 3	189.1-2009 - Office - OpenO	Duplicate1		<input checked="" type="checkbox"/>
Space 203	<input checked="" type="checkbox"/>	Building Story 2	Thermal Zone 3	189.1-2009 - Office - OpenO	Duplicate1		<input checked="" type="checkbox"/>
Space 204	<input checked="" type="checkbox"/>	Building Story 2	Thermal Zone 4	189.1-2009 - Office - BreakR	Duplicate1		<input checked="" type="checkbox"/>
Space 205	<input checked="" type="checkbox"/>	Building Story 2	Thermal Zone 3	189.1-2009 - Office - OpenO	Duplicate1		<input checked="" type="checkbox"/>

My Model Library Edit

OsDefaultConstructionSet

- Name Duplicate1
- Default Exterior Surface Constructions Name
- Default Surface Constructions 1
- Default Interior Surface Constructions Name
- Default Surface Constructions 2
- Default Ground Contact Surface Construction
- Default Surface Constructions 3
- Default Exterior SubSurface Constructions Name
- Default Sub Surface Constructions 1
- Default Interior SubSurface Constructions Name
- Default Sub Surface Constructions 2
- Interior Partition Construction Name
- Interior Partition
- Space Shading Construction Name
- Building Shading Construction Name
- Site Shading Construction Name

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I select the material from the column, then press "apply to all"

Model_TillAllThermalZoneAddedAfterRun.osm*

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Space 103	<input checked="" type="checkbox"/>	Building Story 1	Thermal Zone 1	189.1-2009 - Office - OpenO	Duplicate1		<input checked="" type="checkbox"/>
Space 104	<input checked="" type="checkbox"/>	Building Story 1	Thermal Zone 2	189.1-2009 - Office - BreakR	Duplicate1		<input checked="" type="checkbox"/>
Space 105	<input checked="" type="checkbox"/>	Building Story 1	Thermal Zone 1	189.1-2009 - Office - OpenO	Duplicate1		<input checked="" type="checkbox"/>
Space 201	<input checked="" type="checkbox"/>	Building Story 2	Thermal Zone 3	189.1-2009 - Office - OpenO	Duplicate1		<input checked="" type="checkbox"/>
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Space 204	<input checked="" type="checkbox"/>	Building Story 2	Thermal Zone 4	189.1-2009 - Office - BreakR	Duplicate1		<input checked="" type="checkbox"/>
Space 205	<input checked="" type="checkbox"/>	Building Story 2	Thermal Zone 3	189.1-2009 - Office - OpenO	Duplicate1		<input checked="" type="checkbox"/>

My Model Library Edit

- 189.1-2009 - CZ1 - Office
- 189.1-2009 - CZ2 - Office
- 189.1-2009 - CZ3 - Office
- 189.1-2009 - CZ4 - Office
- 189.1-2009 - CZ5 - Office
- 189.1-2009 - CZ6 - Office
- 189.1-2009 - CZ7-B - Office
- Duplicate1

Schedule Sets

Design Specification Outdoor Air

People Definitions

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- 5) In this section, I can see the Schedule Sets of my building, and in the Schedules part, I can change the amount of loads during the week and the whole year and in all the different functions.

