

1 Write summary of the main concepts that went through about solar radiation.

The sun releases electromagnetic energy in the form of radiation in the atmosphere. The energy **density of solar radiation** is approximately 1368 W/m^2 (solar radiation by unit of receiving surface placed out of the atmosphere and perpendicular to the sun-earth ray). At the Earth's surface the energy density is reduced to approximately 1000 W/m^2 due to dispersion and absorption phenomena.

Dispersion occurs due to two macroscopic effects:

- back reflection of part of the incident radiation on the atmosphere forward sidereal space;
- The radiation deflect in all directions known as **diffuse radiation**.

Radiation not intercepted by molecules maintains the incidence direction and it is denoted as **beam radiation**.

$$\text{SOLAR RADIATION} = \text{BEAM RADIATION} + \text{DIFFUSE RADIATION}$$

The solar radiation received on the earth's surface depends on:

- ▶ the **atmosphere clearness**: solar radiation absorption is due to some atmospheric components (such as ozone, water, carbon dioxide) which absorb the incident radiation in specific wavelength bands (called absorption bands). The absorbed solar energy is emitted in longwave in all the direction;
- ▶ the **sun position** in the sky (which changes daily and seasonally) and the **site altitude**: the sun irradiation perpendicular on the plan of the horizon crosses the minimum thickness of the atmosphere instead the sun irradiation with an elevated angle between the solar ray and the plan of the horizon crosses a large thickness of the atmosphere;
- ▶ **sunshine hours**: during the revolution motion the inclination of the terrestrial spin axis is constant but the circle of illumination change its inclination;

Measurement instruments of the solar radiation are:

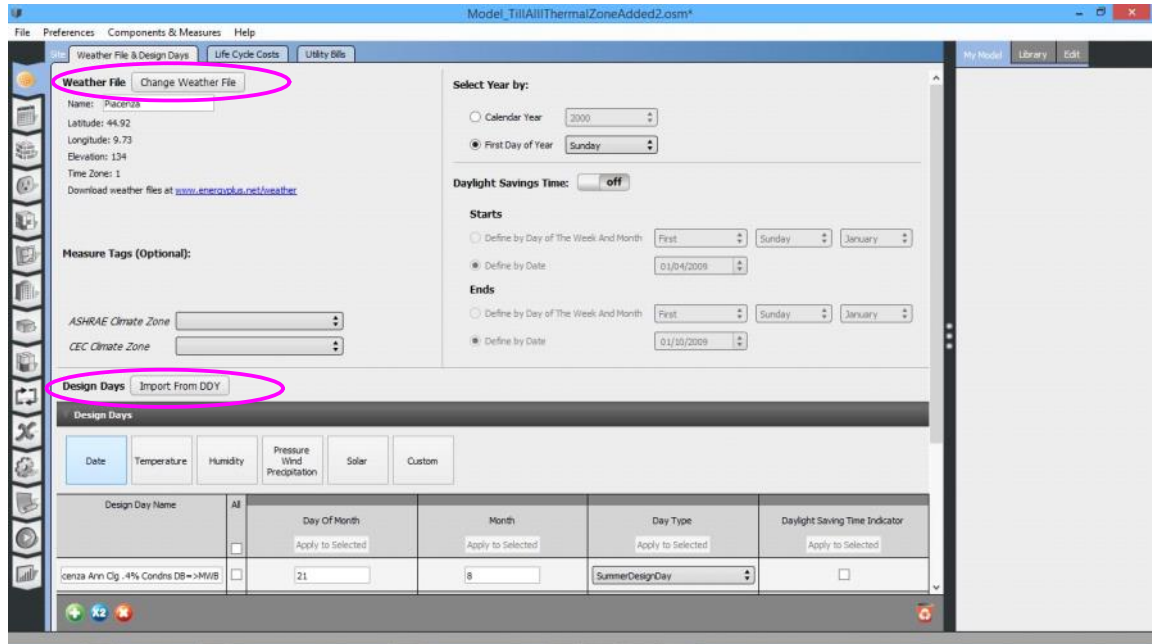
- Pyranometer, to measure the total solar irradiance (beam + diffuse)
- Pyranometer with shadow band, only to measure diffuse one
- Normal Pyrheliometer, to track only the normal direct solar radiation

To sum up on a generic surface arrives:

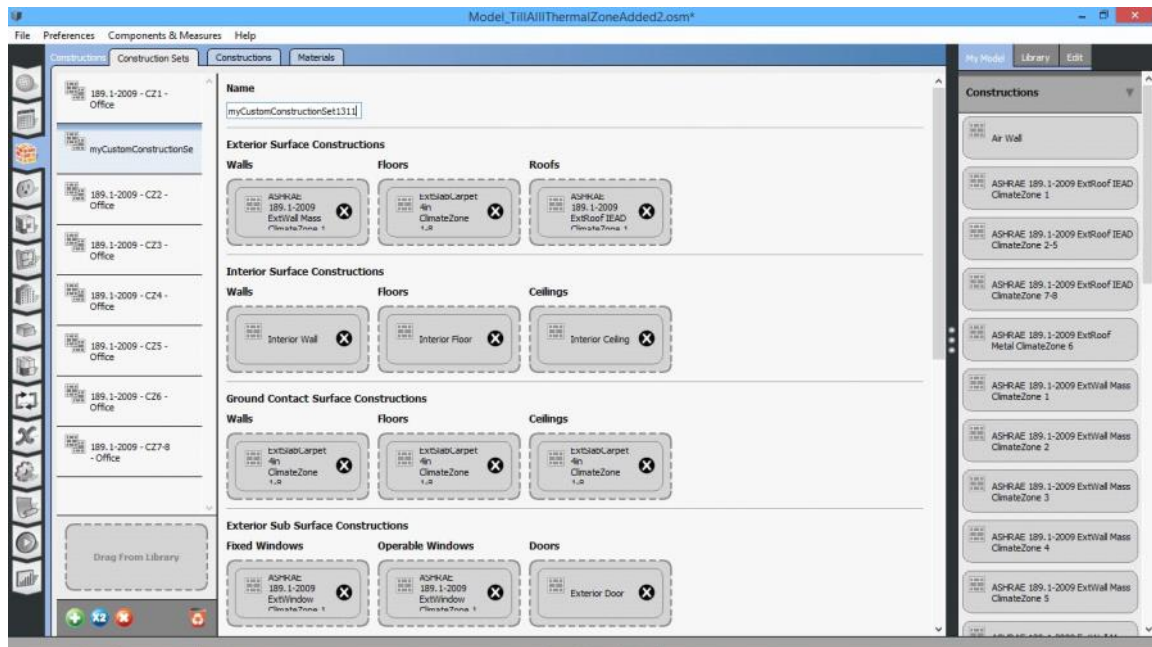
1. normal direct irradiance
2. diffuse irradiance
3. reflected diffuse irradiance

2 Make screenshots of all of the steps we went through during the second class practice on OpenStudio and explain briefly the reason behind the use of each step.

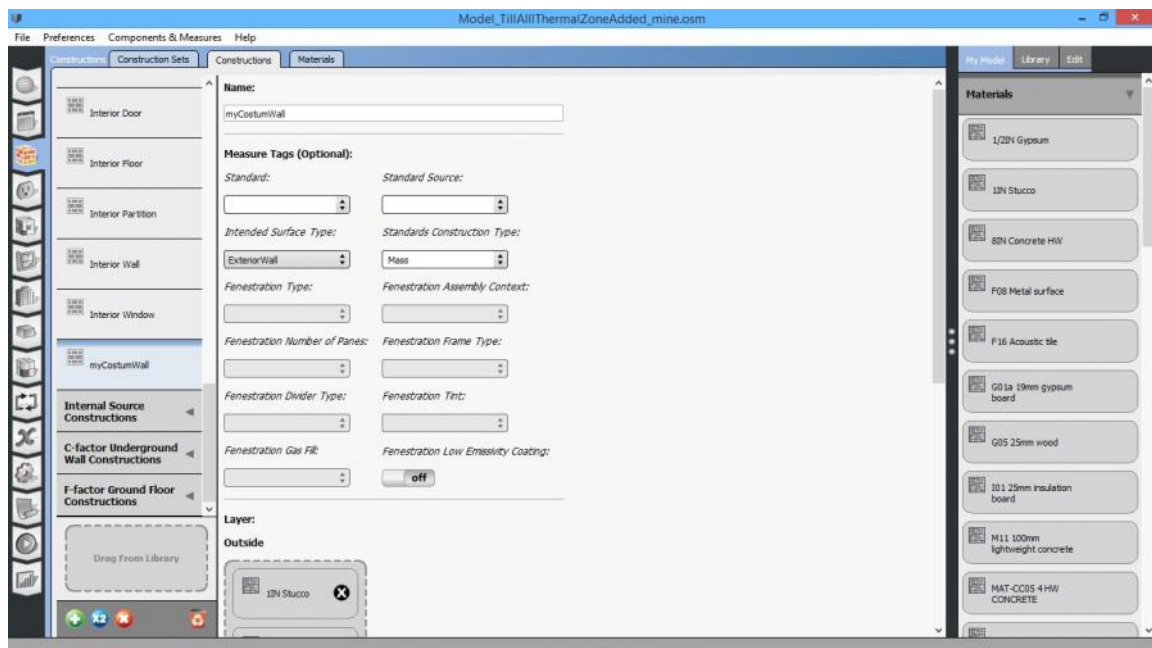
1 The first step is open the default model in Openstudio and put weather data (both .epw and .ddy). We can download weather file for a specific location on the link <https://energyplus.net/weather>.



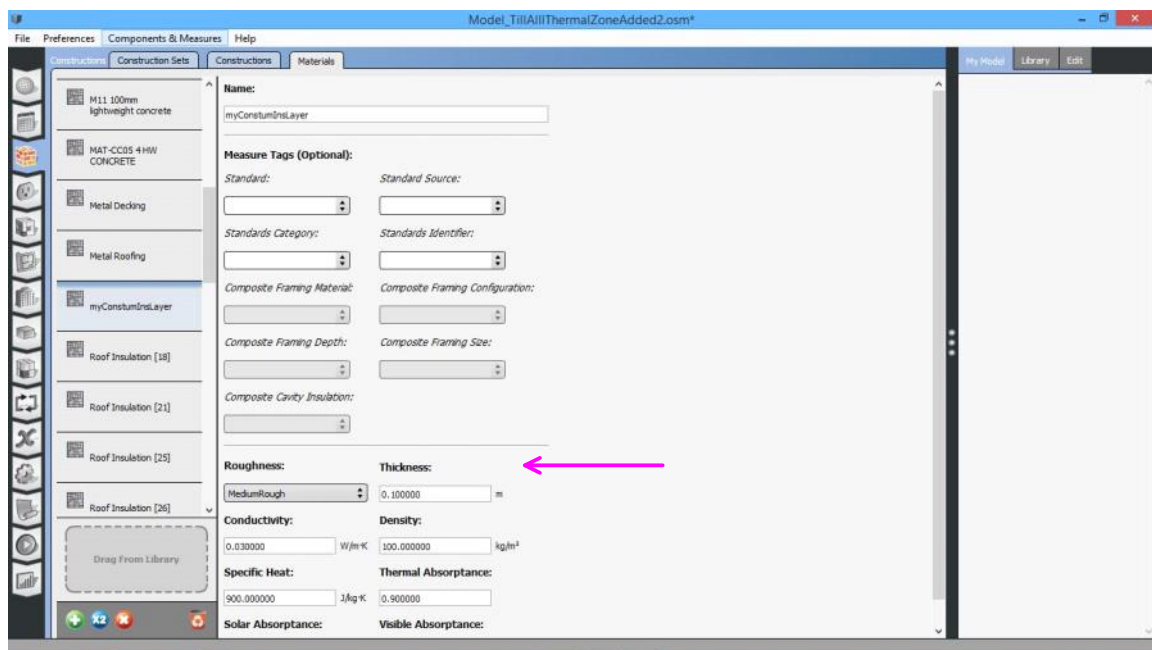
2 When we defined the type of space (for example 'open office' in the previous session) we chose default design features. With this simulation we want to customize our default model. First of all we can change the construction element of our building (walls, floors, roofs, windows, doors, ...). Go on Constructions > Construction Sets, select one default construction set, duplicated it and rename it.



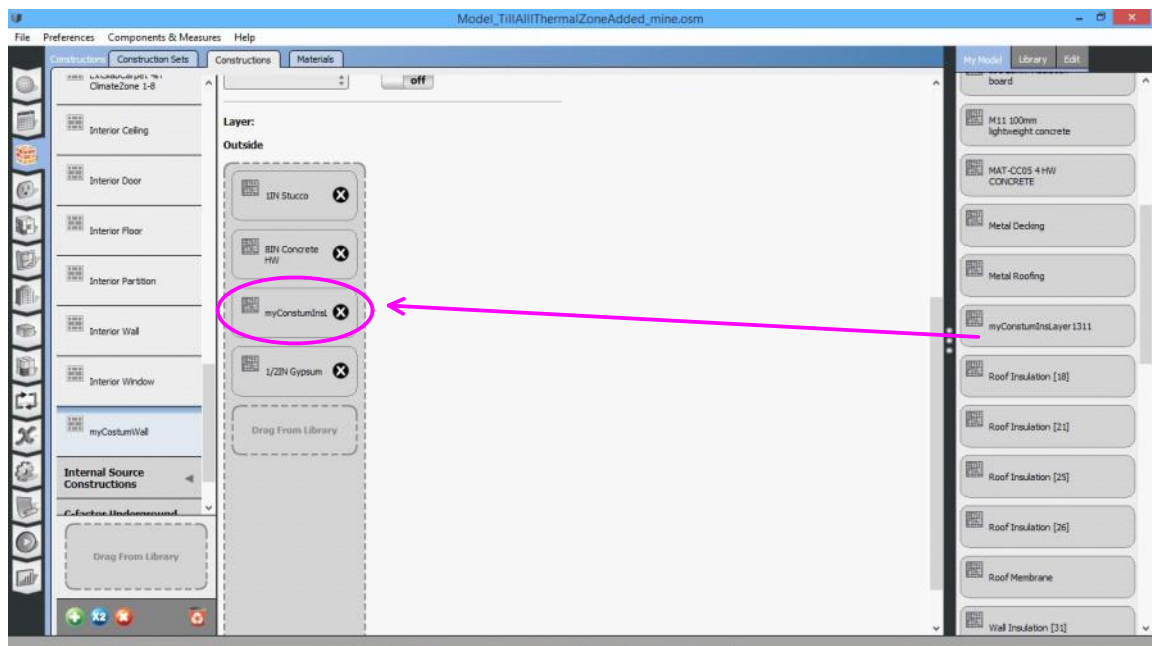
3 Now move to Constructions, select one default element, duplicated it and rename it. In this way we can change for example the layer of the external walls.



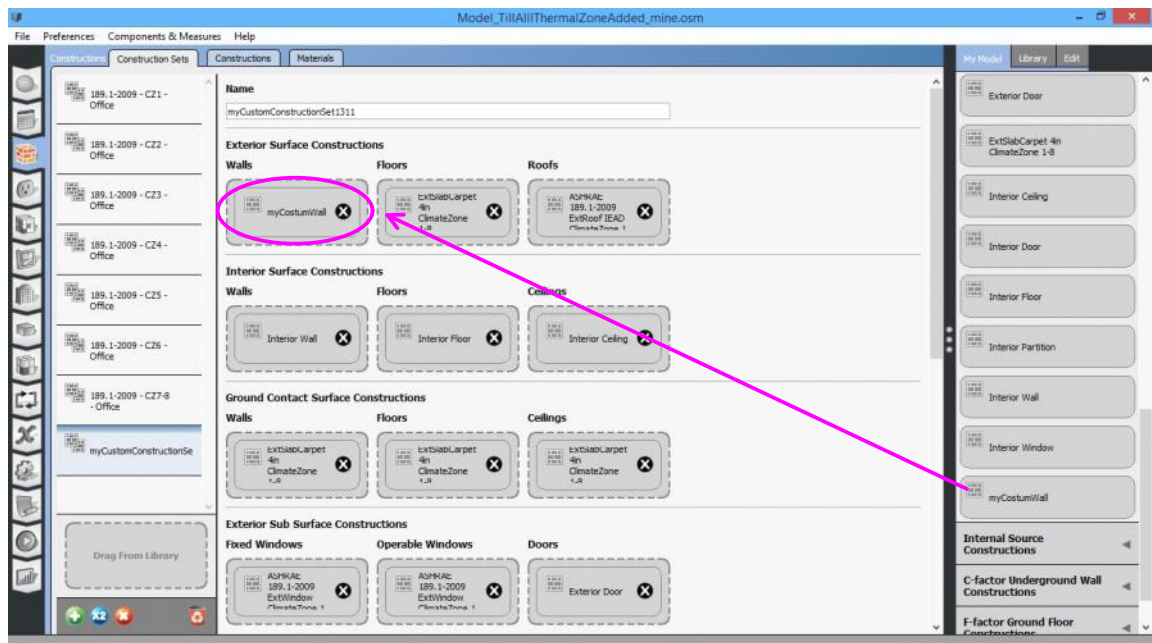
4 After move to Materials to change the features on the material that we want to put in our wall. Duplicate one existing, renamed it and change its property.



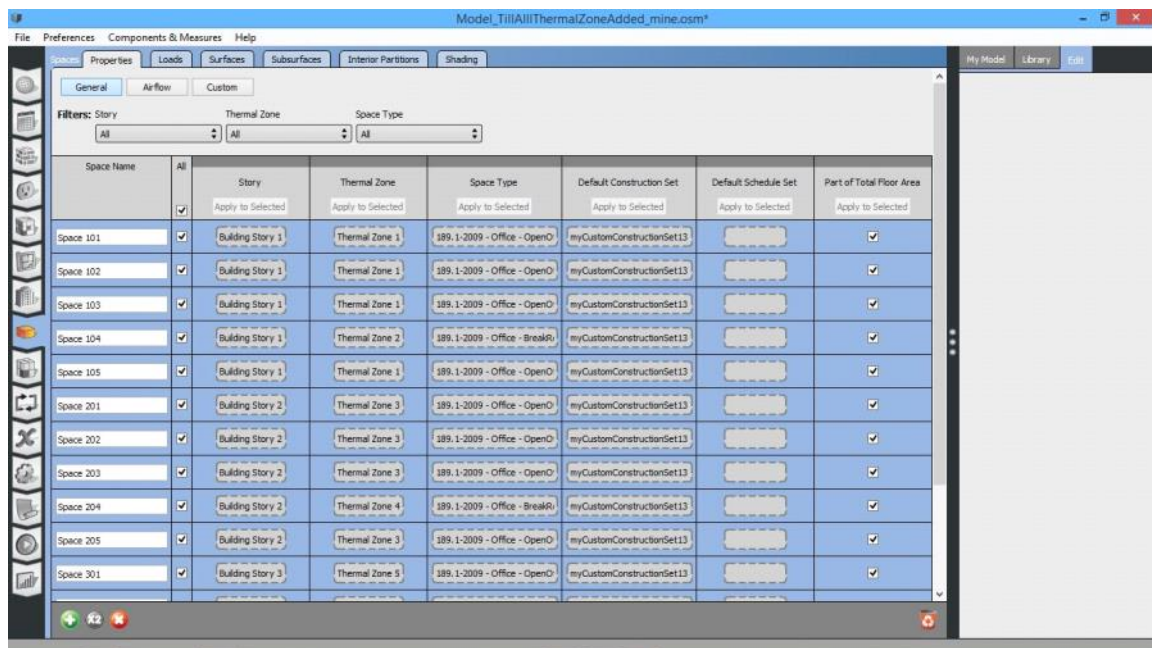
5 Now we can put the material we just created as a layer in the package of our wall dragging it from library.



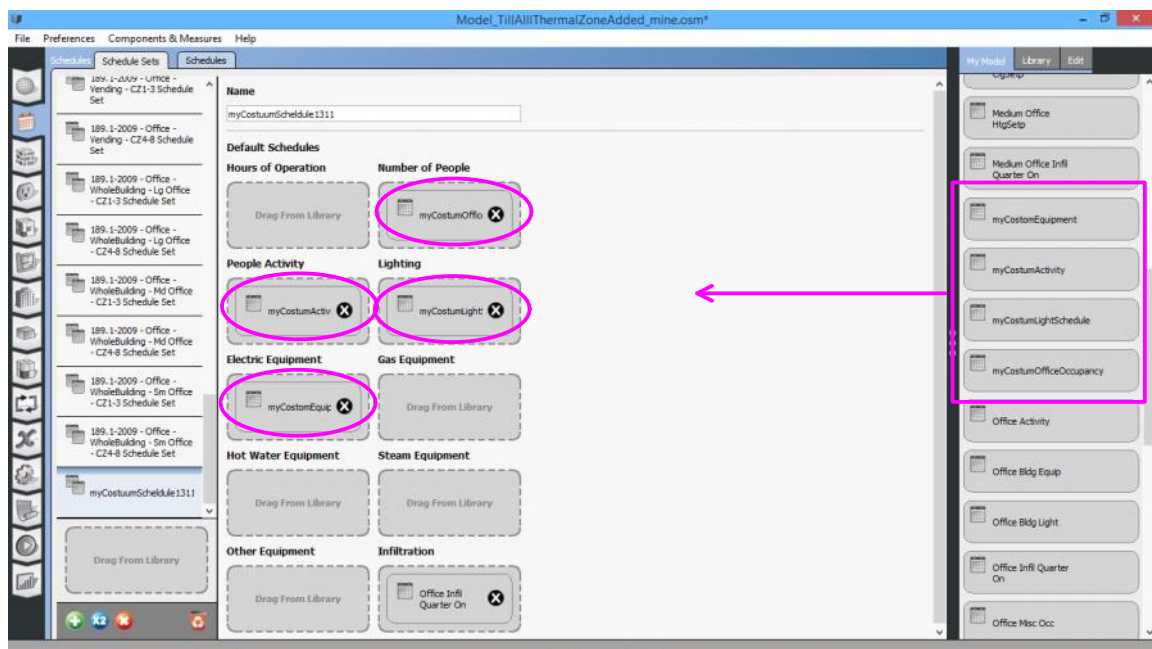
6 Now we can put the new type of wall in our construction dragging it from the library.

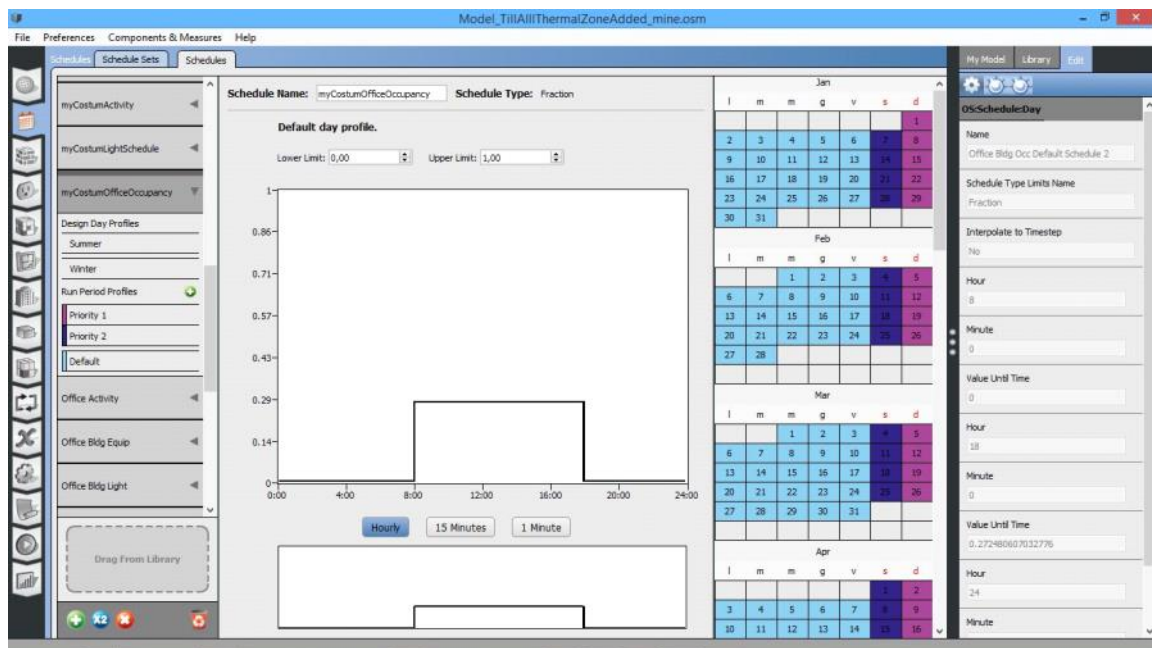


7 If we want all the walls of our building to have these characteristics go to Spaces, put our Construction set, select all the spaces and apply it to all of them.



8 In the same way we can change other features of our model like the schedule going to Schedules > Schedule Sets and create a schedule changing Design Day Profiles (summer and winter) and Run Period Profile (priority 1 and 2). We can define the number of people inside our spaces, the type of activity they do, the time of using light or equipment inside our spaces. In the menu Properties we can select the schedule sets for each space.





Model: T11A111ThermalZoneAdded_mine.osm

File Preferences Components & Measures Help

Spaces Properties Loads Surfaces Subsurfaces Interior Partitions Shading

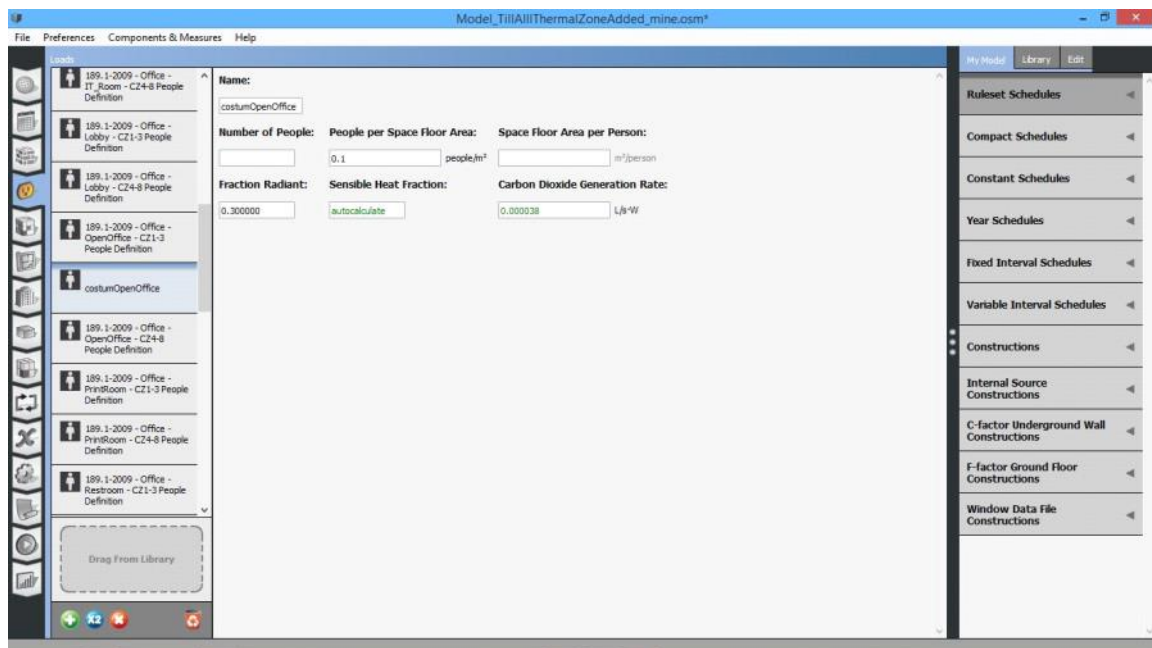
General Airflow Custom

Filters: Story Thermal Zone Space Type
All All All

Space Name	Story	Thermal Zone	Space Type	Default Construction Set	Default Schedule Set	Part of Total Floor Area
Space 101	Building Story 1	Thermal Zone 1	189.1-2009 - Office - OpenO	myCustomConstructionSet13	myCustomSchedule1311	<input checked="" type="checkbox"/>
Space 102	Building Story 1	Thermal Zone 1	189.1-2009 - Office - OpenO	myCustomConstructionSet13		<input checked="" type="checkbox"/>
Space 103	Building Story 1	Thermal Zone 1	189.1-2009 - Office - OpenO	myCustomConstructionSet13		<input checked="" type="checkbox"/>
Space 104	Building Story 1	Thermal Zone 2	189.1-2009 - Office - BreakR	myCustomConstructionSet13		<input checked="" type="checkbox"/>
Space 105	Building Story 1	Thermal Zone 1	189.1-2009 - Office - OpenO	myCustomConstructionSet13		<input checked="" type="checkbox"/>
Space 201	Building Story 2	Thermal Zone 3	189.1-2009 - Office - OpenO	myCustomConstructionSet13		<input checked="" type="checkbox"/>
Space 202	Building Story 2	Thermal Zone 3	189.1-2009 - Office - OpenO	myCustomConstructionSet13		<input checked="" type="checkbox"/>
Space 203	Building Story 2	Thermal Zone 3	189.1-2009 - Office - OpenO	myCustomConstructionSet13		<input checked="" type="checkbox"/>
Space 204	Building Story 2	Thermal Zone 4	189.1-2009 - Office - BreakR	myCustomConstructionSet13		<input checked="" type="checkbox"/>
Space 205	Building Story 2	Thermal Zone 3	189.1-2009 - Office - OpenO	myCustomConstructionSet13		<input checked="" type="checkbox"/>
Space 301	Building Story 3	Thermal Zone 5	189.1-2009 - Office - OpenO	myCustomConstructionSet13		<input checked="" type="checkbox"/>

My Model Library Edit

9 In the same way we can also change people loads, light loads and electric equipment for each space floor.



10 At the end we can check all the features of our building under the menu Space Types.

