ANDREA FOPPIANI // WEEK 7 ASSIGNMENT

TASK 1

Provide a summary of the main concepts that we went through about solar radiation (formulas are not needed)

1. MEAN RADIANT TEMPERATURE:

Mean radiant temperature of a given surface is the **temperature** that would have the equivalent black enclosure with which the given surface would exchange the same radiative flux that it exchanges with all the other surfaces.

2. OPERATIVE TEMPERATURE:

Operative temperature of a given surface is the **temperature of a virtual place** in which the sum of the radiative and convective thermal flow that is exchanged, is the same as the one which is exchanged with the air and all other surfaces.

3. SOLAR RADIATION DENSITY:

The solar constant G_{SC} is a flux density, measuring mean solar electromagnetic radiation (solar irradiance) per unit area. The solar constant is not a physical constant, but an **average** obtained from a varying value. This average is 1367 W/m^2.

4. SOLAR RADIATION CHARACTERISTICS:

Solar radiation is **attenuated** both in the spectral distribution and in the total radiation. This is due to the dispersion and absorption phenomena.

5. ATMOSPHERIC ABSORPTION:

The absorption of solar radiation is due to the atmospheric components: mostly **ozone**, water and carbon dioxide, which absorb the incident radiation in specific absorption bands, consequently modifying its energy spectrum. The stratospheric ozone absorbs almost all the ultraviolet component of solar radiation.

6. SOLAR ENERGY – AVAILABILTY:

The solar radiation depends on many factors like: the sun **position** in the sky (altitude and azimuth angles), which changes daily and seasonally; the **weather** conditions; the site **altitude** over the sea level; **sunshine** hours.

TASK 2

Create a pdf file with screenshots of all of the steps we went through in the second lesson on OpenStudio and explain briefly the reason behind the use of each step.

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model1_tutorial.osm

File Preferences Components & Measures Help

Site | Weather File & Design Days | Life Cycle Costs | Utility Bills

My Model | Library | Edit

Weather File Change Weather File

Name: Piacenza

Latitude: 44.92

Longitude: 9.73

Elevation: 134

Time Zone: 1

Download weather files at www.energyplus.net/weather

Measure Tags (Optional):

ASHRAE Climate Zone

CEC Climate Zone

Select Year by:

Calendar Year 2000

First Day of Year Sunday

Daylight Savings Time: off

Starts

Define by Day of The Week And Month First Sunday January

Define by Date 01/04/2009

Ends

Define by Day of The Week And Month First Sunday January

Define by Date 01/10/2009

Design Days Import From DDY

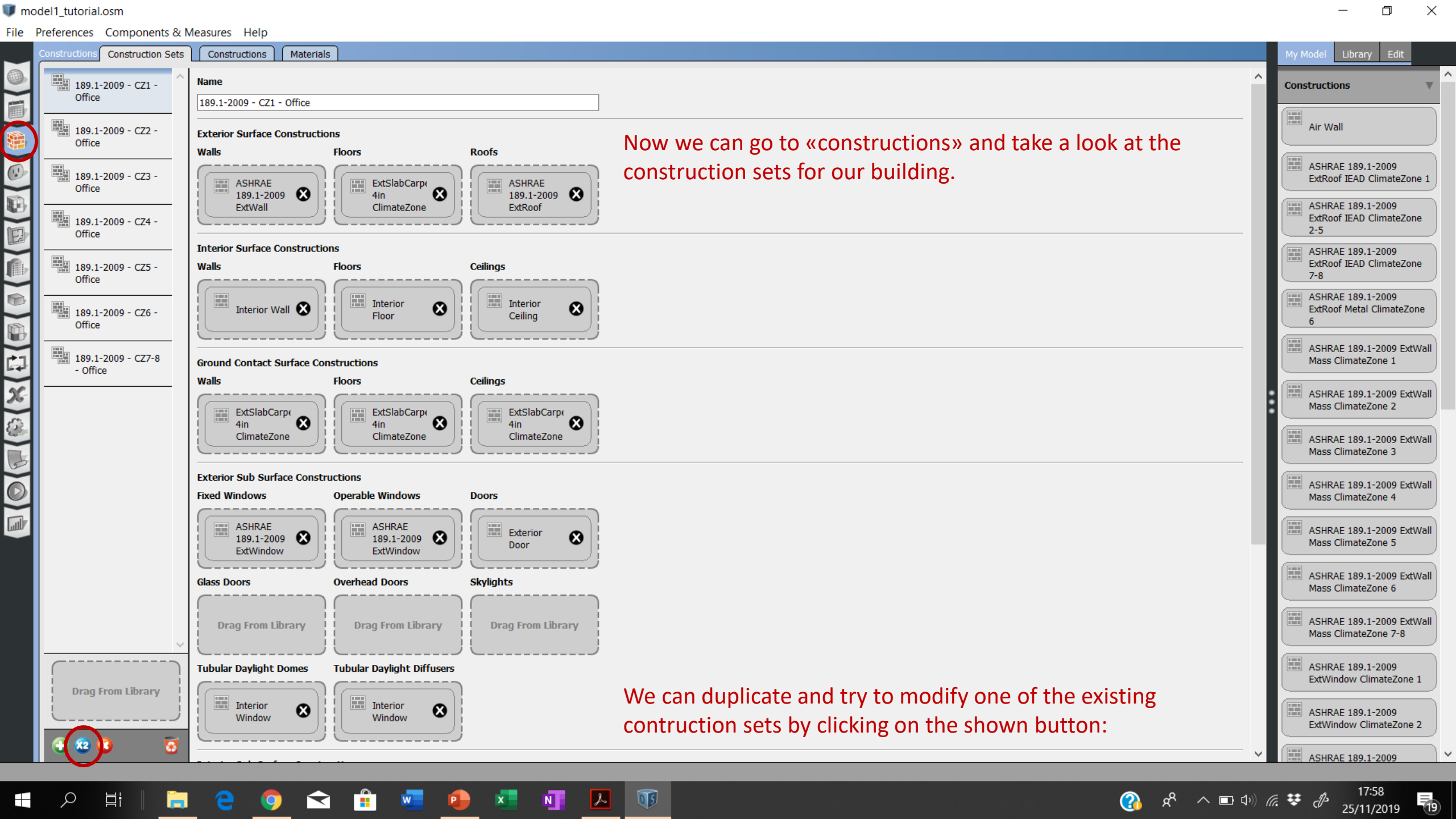
Design Days

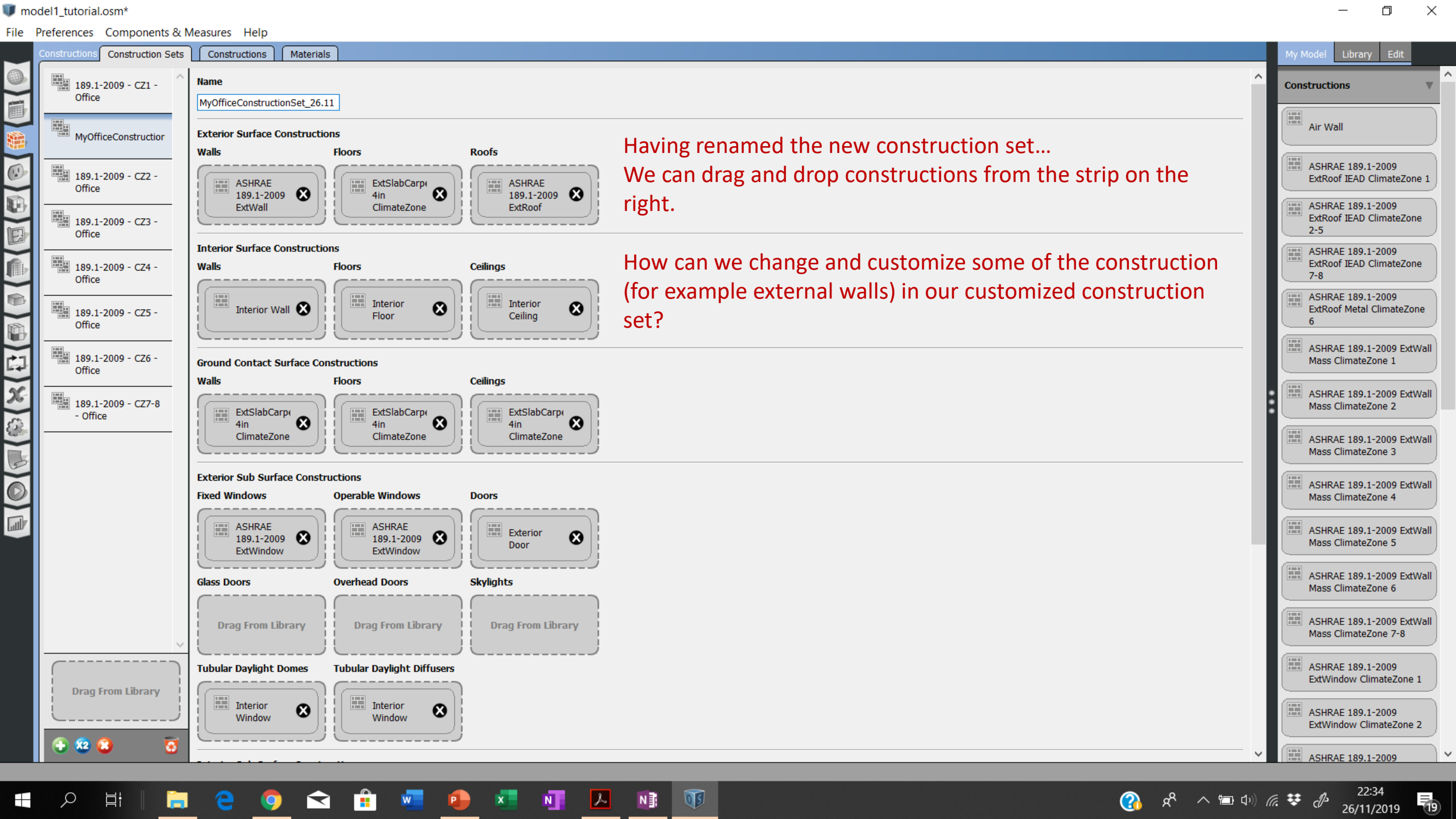
Date | Temperature | Humidity | Pressure Wind Precipitation | Solar | Custom

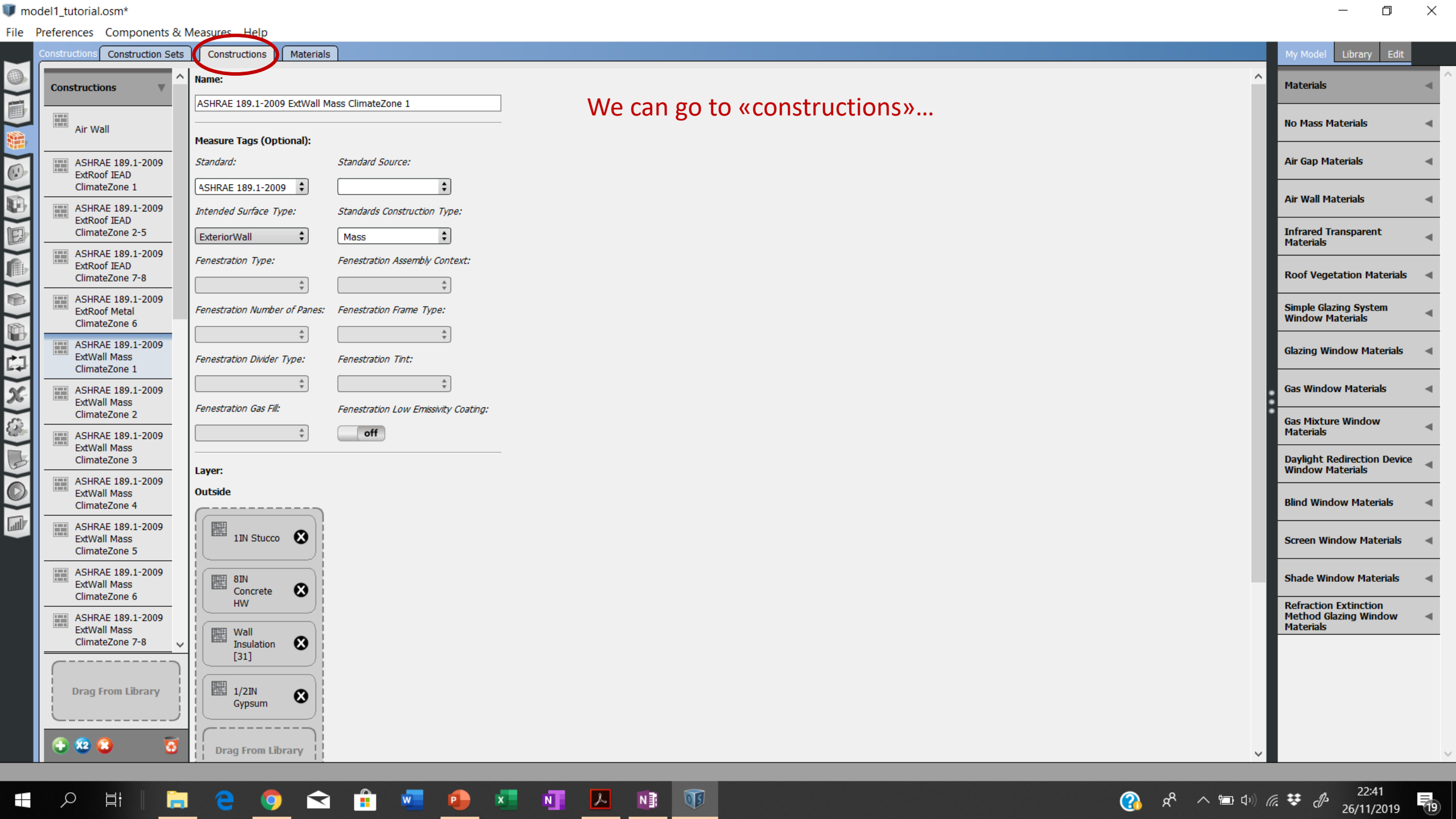
We already added the climatic data about Piacenza...

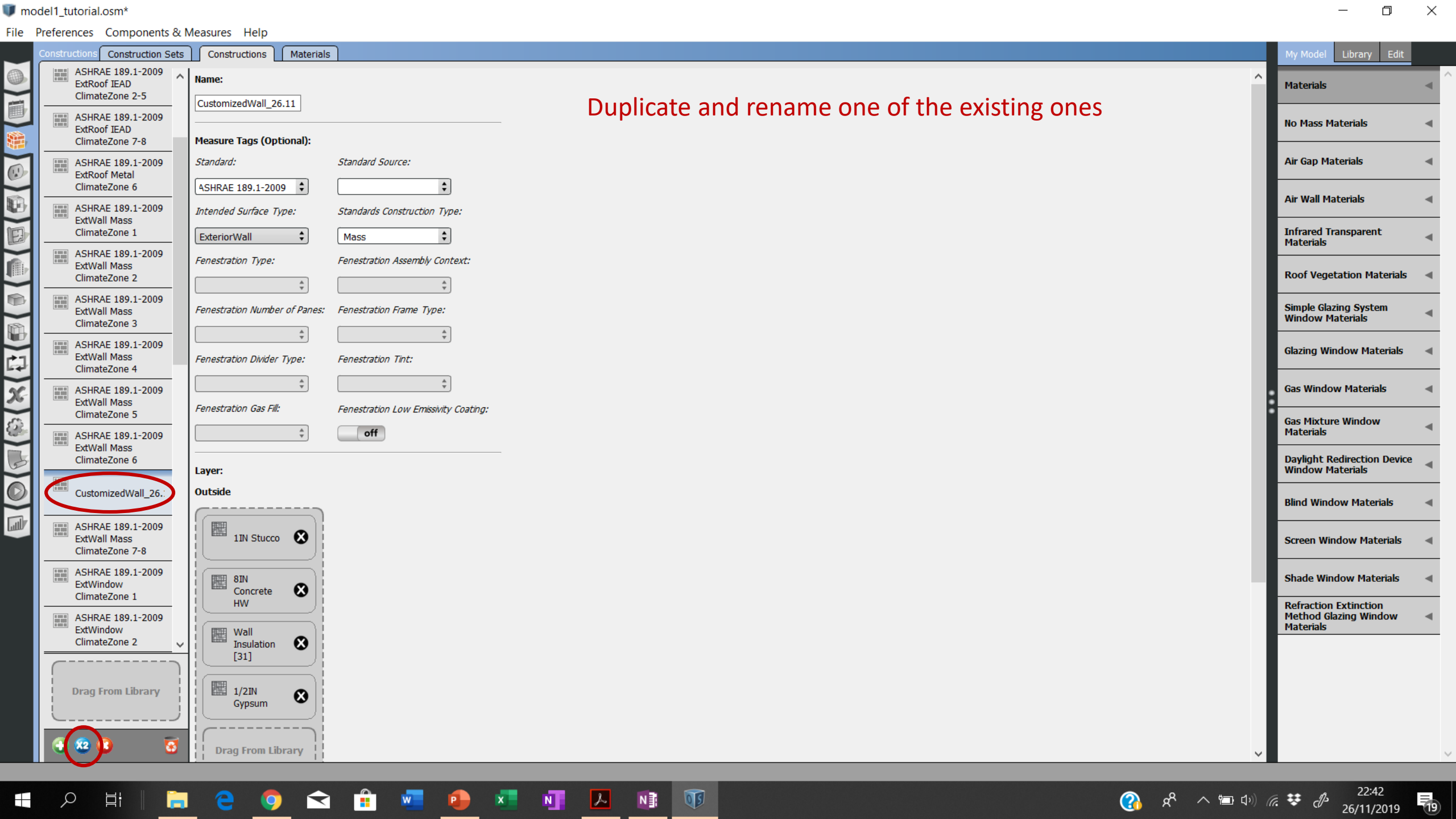
Design Day Name	All	Day Of Month (Apply to Selected)	Month (Apply to Selected)	Day Type (Apply to Selected)	Daylight Saving Time Indicator (Apply to Selected)
Piacenza Ann Clg .4% Condns DB=>MWB		21	8	SummerDesignDay	
Piacenza Ann Clg .4% Condns DP=>MDB		21	8	SummerDesignDay	
Piacenza Ann Clg .4% Condns Enth=>MDB		21	8	SummerDesignDay	
Piacenza Ann Clg .4% Condns WB=>MDB		21	8	SummerDesignDay	
Piacenza Ann Htg 99.6% Condns DB		21	1	WinterDesignDay	
Piacenza Ann Htg Wind 99.6% Condns WS=>MCDB		21	1	WinterDesignDay	
Piacenza Ann Hum .n 99.6% Condns DP=>MCDB		21	1	WinterDesignDay	

17:54
25/11/2019


model1_tutorial.osm
File
Preferences
Components & Measures
Help
Constructions
Construction Sets
Constructions
Materials
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 - CZ7-8 - Office
Drag From Library
Name
189.1-2009 - CZ1 - Office
Exterior Surface Constructions
Walls
ASHRAE 189.1-2009 ExtWall
Floors
ExtSlabCarpet 4in ClimateZone
Roofs
ASHRAE 189.1-2009 ExtRoof
Interior Surface Constructions
Walls
Interior Wall
Floors
Interior Floor
Ceilings
Interior Ceiling
Ground Contact Surface Constructions
Walls
ExtSlabCarpet 4in ClimateZone
Floors
ExtSlabCarpet 4in ClimateZone
Ceilings
ExtSlabCarpet 4in ClimateZone
Exterior Sub Surface Constructions
Fixed Windows
ASHRAE 189.1-2009 ExtWindow
Operable Windows
ASHRAE 189.1-2009 ExtWindow
Doors
Exterior Door
Glass Doors
Drag From Library
Overhead Doors
Drag From Library
Skylights
Drag From Library
Tubular Daylight Domes
Interior Window
Tubular Daylight Diffusers
Interior Window
Now we can go to «constructions» and take a look at the construction sets for our building.
We can duplicate and try to modify one of the existing contruction sets by clicking on the shown button:
Constructions
Air Wall
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 1
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 2-5
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 7-8
ASHRAE 189.1-2009 ExtRoof Metal ClimateZone 6
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 1
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 2
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 3
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 4
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 5
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 6
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 7-8
ASHRAE 189.1-2009 ExtWindow ClimateZone 1
ASHRAE 189.1-2009 ExtWindow ClimateZone 2
ASHRAE 189.1-2009
17:58
25/11/2019


model1_tutorial.osm*
File
Preferences
Components & Measures
Help
Constructions
Construction Sets
Constructions
Materials
My Model
Library
Edit
189.1-2009 - CZ1 - Office
MyOfficeConstructior
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 - CZ7-8 - Office
Drag From Library
Name
MyOfficeConstructionSet_26.11
Exterior Surface Constructions
Walls
ASHRAE 189.1-2009 ExtWall
Floors
ExtSlabCarpe 4in ClimateZone
Roofs
ASHRAE 189.1-2009 ExtRoof
Having renamed the new construction set…
We can drag and drop constructions from the strip on the right.
Interior Surface Constructions
Walls
Interior Wall
Floors
Interior Floor
Ceilings
Interior Ceiling
How can we change and customize some of the construction (for example external walls) in our customized construction set?
Ground Contact Surface Constructions
Walls
ExtSlabCarpe 4in ClimateZone
Floors
ExtSlabCarpe 4in ClimateZone
Ceilings
ExtSlabCarpe 4in ClimateZone
Exterior Sub Surface Constructions
Fixed Windows
ASHRAE 189.1-2009 ExtWindow
Operable Windows
ASHRAE 189.1-2009 ExtWindow
Doors
Exterior Door
Glass Doors
Drag From Library
Overhead Doors
Drag From Library
Skylights
Drag From Library
Tubular Daylight Domes
Interior Window
Tubular Daylight Diffusers
Interior Window
Constructions
Air Wall
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 1
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 2-5
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 7-8
ASHRAE 189.1-2009 ExtRoof Metal ClimateZone 6
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 1
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 2
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 3
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 4
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 5
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 6
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 7-8
ASHRAE 189.1-2009 ExtWindow ClimateZone 1
ASHRAE 189.1-2009 ExtWindow ClimateZone 2
ASHRAE 189.1-2009
22:34
26/11/2019


model1_tutorial.osm*
File
Preferences
Components & Measures
Help
Constructions
Construction Sets
Constructions
Materials
My Model
Library
Edit
Constructions
Air Wall
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 1
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 2-5
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 7-8
ASHRAE 189.1-2009 ExtRoof Metal ClimateZone 6
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 1
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 2
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 3
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 4
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 5
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 6
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 7-8
Drag From Library
Name:
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 1
Measure Tags (Optional):
Standard:
ASHRAE 189.1-2009
Standard Source:
Intended Surface Type:
ExteriorWall
Standards Construction Type:
Mass
Fenestration Type:
Fenestration Assembly Context:
Fenestration Number of Panes:
Fenestration Frame Type:
Fenestration Divider Type:
Fenestration Tint:
Fenestration Gas Fill:
Fenestration Low Emissivity Coating:
off
Layer:
Outside
1IN Stucco
8IN Concrete HW
Wall Insulation [31]
1/2IN Gypsum
Drag From Library
We can go to «constructions»…
Materials
No Mass Materials
Air Gap Materials
Air Wall Materials
Infrared Transparent Materials
Roof Vegetation Materials
Simple Glazing System Window Materials
Glazing Window Materials
Gas Window Materials
Gas Mixture Window Materials
Daylight Redirection Device Window Materials
Blind Window Materials
Screen Window Materials
Shade Window Materials
Refraction Extinction Method Glazing Window Materials
22:41
26/11/2019


model1_tutorial.osm*
File
Preferences
Components & Measures
Help
Constructions
Construction Sets
Constructions
Materials
My Model
Library
Edit
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 2-5
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 7-8
ASHRAE 189.1-2009 ExtRoof Metal ClimateZone 6
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 1
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 2
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 3
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 4
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 5
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 6
CustomizedWall_26.
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 7-8
ASHRAE 189.1-2009 ExtWindow ClimateZone 1
ASHRAE 189.1-2009 ExtWindow ClimateZone 2
Drag From Library
X2
Name:
CustomizedWall_26.11
Measure Tags (Optional):
Standard:
ASHRAE 189.1-2009
Standard Source:
Intended Surface Type:
ExteriorWall
Standards Construction Type:
Mass
Fenestration Type:
Fenestration Assembly Context:
Fenestration Number of Panes:
Fenestration Frame Type:
Fenestration Divider Type:
Fenestration Tint:
Fenestration Gas Fill:
Fenestration Low Emissivity Coating:
off
Layer:
Outside
1IN Stucco
8IN Concrete HW
Wall Insulation [31]
1/2IN Gypsum
Drag From Library
Duplicate and rename one of the existing ones
Materials
No Mass Materials
Air Gap Materials
Air Wall Materials
Infrared Transparent Materials
Roof Vegetation Materials
Simple Glazing System Window Materials
Glazing Window Materials
Gas Window Materials
Gas Mixture Window Materials
Daylight Redirection Device Window Materials
Blind Window Materials
Screen Window Materials
Shade Window Materials
Refraction Extinction Method Glazing Window Materials
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26/11/2019

model1_tutorial.osm*

File Preferences Components & Measures Help

Constructions | Construction Sets | Constructions | Materials

My Model | Library | Edit

ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 2-5
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 7-8
ASHRAE 189.1-2009 ExtRoof Metal ClimateZone 6
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 1
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 2
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 3
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 4
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 5
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 6
CustomizedWall_26.
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 7-8
ASHRAE 189.1-2009 ExtWindow ClimateZone 1
ASHRAE 189.1-2009 ExtWindow ClimateZone 2

Drag From Library

Name: CustomizedWall_26.11

Measure Tags (Optional):

Standard: ASHRAE 189.1-2009
Standard Source:
Intended Surface Type: ExteriorWall
Standards Construction Type: Mass
Fenestration Type:
Fenestration Assembly Context:
Fenestration Number of Panes:
Fenestration Frame Type:
Fenestration Divider Type:
Fenestration Tint:
Fenestration Gas Fill:
Fenestration Low Emissivity Coating: off

Layer:

Outside

Drag From Library

Delete all the layers

Materials
No Mass Materials
Air Gap Materials
Air Wall Materials
Infrared Transparent Materials
Roof Vegetation Materials
Simple Glazing System Window Materials
Glazing Window Materials
Gas Window Materials
Gas Mixture Window Materials
Daylight Redirection Device Window Materials
Blind Window Materials
Screen Window Materials
Shade Window Materials
Refraction Extinction Method Glazing Window Materials

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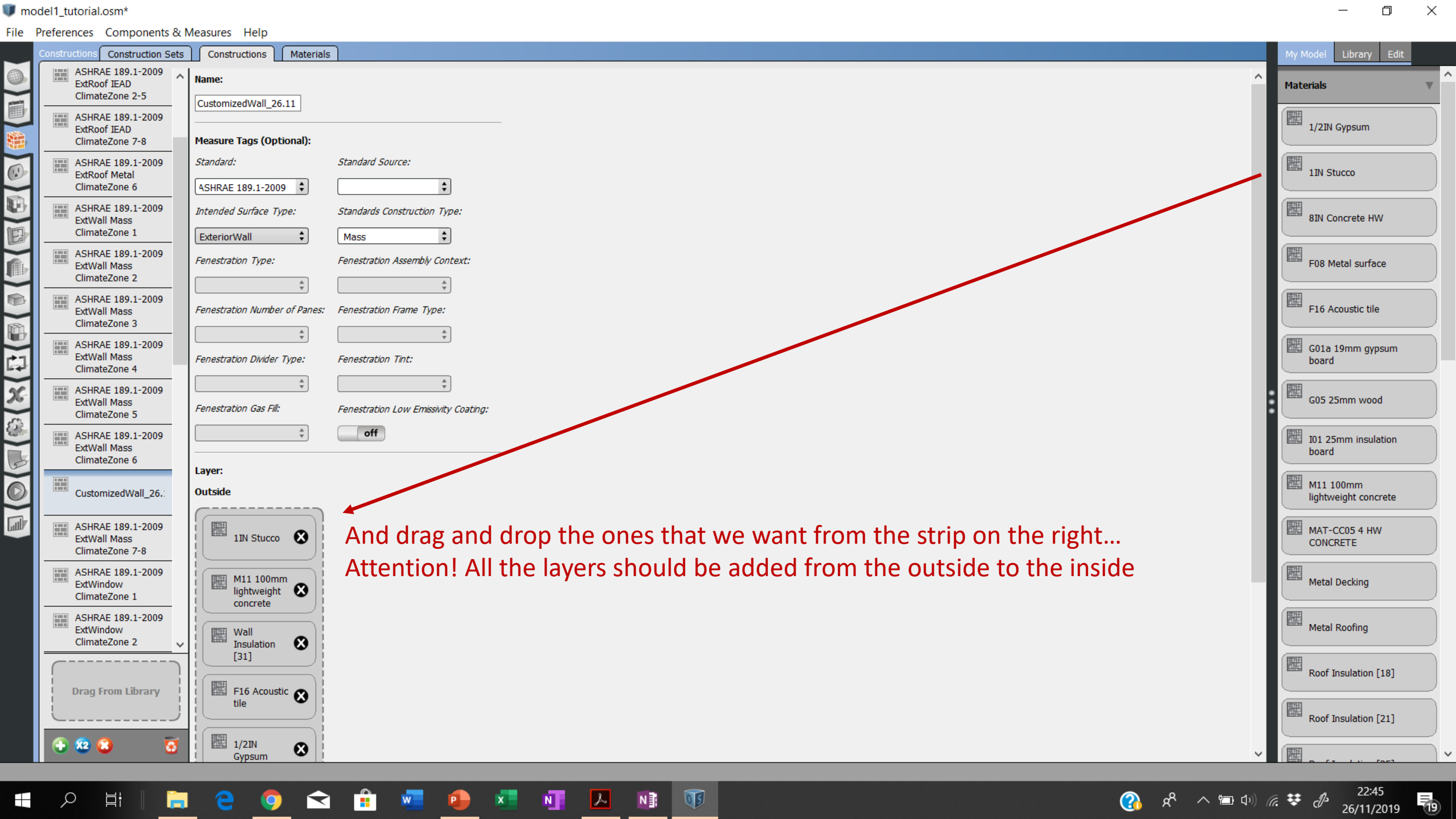
model1_tutorial.osm*
File
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Help
Constructions
Construction Sets
Constructions
Materials
My Model
Library
Edit
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 2-5
ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone 7-8
ASHRAE 189.1-2009 ExtRoof Metal ClimateZone 6
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 1
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 2
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 3
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 4
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 5
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 6
CustomizedWall_26.
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 7-8
ASHRAE 189.1-2009 ExtWindow ClimateZone 1
ASHRAE 189.1-2009 ExtWindow ClimateZone 2
Drag From Library
Name:
CustomizedWall_26.11
Measure Tags (Optional):
Standard:
ASHRAE 189.1-2009
Standard Source:
Intended Surface Type:
ExteriorWall
Standards Construction Type:
Mass
Fenestration Type:
Fenestration Assembly Context:
Fenestration Number of Panes:
Fenestration Frame Type:
Fenestration Divider Type:
Fenestration Tint:
Fenestration Gas Fill:
Fenestration Low Emissivity Coating:
off
Layer:
Outside
1IN Stucco
M11 100mm lightweight concrete
Wall Insulation [31]
F16 Acoustic tile
1/2IN Gypsum
Materials
1/2IN Gypsum
1IN Stucco
8IN Concrete HW
F08 Metal surface
F16 Acoustic tile
G01a 19mm gypsum board
G05 25mm wood
I01 25mm insulation board
M11 100mm lightweight concrete
MAT-CC05 4 HW CONCRETE
Metal Decking
Metal Roofing
Roof Insulation [18]
Roof Insulation [21]
And drag and drop the ones that we want from the strip on the right…
Attention! All the layers should be added from the outside to the inside
22:45
26/11/2019

model1_tutorial.osm*

File Preferences Components & Measures Help

Constructions | Construction Sets | Constructions | Materials

My Model | Library | Edit

Materials

- No Mass Materials
- Air Gap Materials
- Simple Glazing System Window Materials
- Glazing Window Materials
- Gas Window Materials
- Gas Mixture Window Materials
- Blind Window Materials
- Daylight Redirection Device Window Materials
- Screen Window Materials
- Shade Window Materials
- Air Wall Materials
- Infrared Transparent Materials
- Roof Vegetation Materials
- Refraction Extinction Method Glazing Window Materials

Drag From Library

Name: 1/2IN Gypsum

Measure Tags (Optional):

Standard: *Standard Source:*

Standards Category: *Standards Identifier:*

Composite Framing Material: *Composite Framing Configuration:*

Composite Framing Depth: *Composite Framing Size:*

Composite Cavity Insulation:

Roughness: Smooth	**Thickness:** 0.012700 m
Conductivity: 0.160000 W/m·K	**Density:** 784.900000 kg/m³
Specific Heat: 830.000000 J/kg·K	**Thermal Absorptance:** 0.900000
Solar Absorptance: 0.400000	**Visible Absorptance:** 0.400000

Let's take a look at the properties of the «materials» for the constructions…

Can we create a new material and customize it?

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model1_tutorial.osm*

File Preferences Components & Measures Help

Constructions | Construction Sets | Constructions | Materials

My Model | Library | Edit

Materials

- 1/2IN Gypsum
- NewMaterial_26.11
- 1IN Stucco
- 8IN Concrete HW
- F08 Metal surface
- F16 Acoustic tile
- G01a 19mm gypsum board
- G05 25mm wood
- I01 25mm insulation board
- M11 100mm lightweight concrete
- MAT-CC05 4 HW CONCRETE
- Metal Decking

Drag From Library

Name: NewMaterial_26.11

Measure Tags (Optional):

Standard: *Standard Source:*

Standards Category: *Standards Identifier:*

Composite Framing Material: *Composite Framing Configuration:*

Composite Framing Depth: *Composite Framing Size:*

Composite Cavity Insulation:

Roughness: Smooth

Thickness: 0.012700 m

Conductivity: 0.160000 W/m·K

Density: 784.900000 kg/m³

Specific Heat: 830.000000 J/kg·K

Thermal Absorptance: 0.900000

Solar Absorptance: 0.400000

Visible Absorptance: 0.400000

To create a new material, again duplicate and rename one of the existing ones from the column on the left…

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model1_tutorial.osm*

File Preferences Components & Measures Help

Constructions | Construction Sets | Constructions | Materials

My Model | Library | Edit

Materials

- 1/2IN Gypsum
- NewMaterial_26.11
- 1IN Stucco
- 8IN Concrete HW
- F08 Metal surface
- F16 Acoustic tile
- G01a 19mm gypsum board
- G05 25mm wood
- I01 25mm insulation board
- M11 100mm lightweight concrete
- MAT-CC05 4 HW CONCRETE
- Metal Decking

Drag From Library

Name: NewMaterial_26.11

Measure Tags (Optional):

Standard: *Standard Source:*

Standards Category: *Standards Identifier:*

Composite Framing Material: *Composite Framing Configuration:*

Composite Framing Depth: *Composite Framing Size:*

Composite Cavity Insulation:

Roughness: Smooth

Thickness: 0.04 m

Conductivity: 0.691800 W/m·K

Density: 858.000000 kg/m^3

Specific Heat: 837.000000 J/kg·K

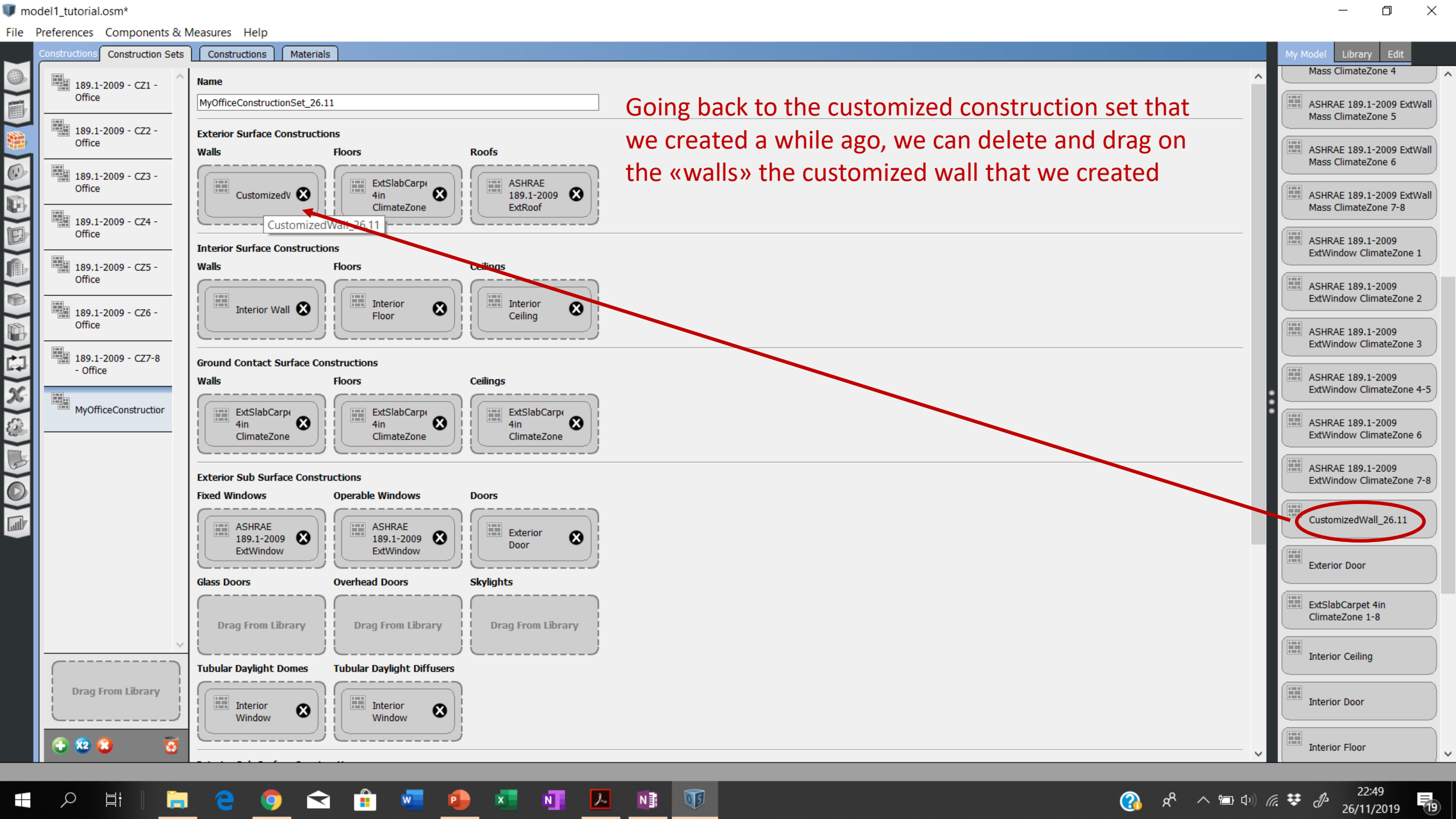
Thermal Absorptance: 0.900000

Solar Absorptance: 0.920000

Visible Absorptance: 0.920000

Now we can change its thickness and properties…

22:48
26/11/2019


model1_tutorial.osm*
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Constructions
Materials
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 - CZ7-8 - Office
MyOfficeConstructior
Drag From Library
Name
MyOfficeConstructionSet_26.11
Exterior Surface Constructions
Walls
Floors
Roofs
CustomizedV
ExtSlabCarpe 4in ClimateZone
ASHRAE 189.1-2009 ExtRoof
CustomizedWall_26.11
Interior Surface Constructions
Walls
Floors
Ceilings
Interior Wall
Interior Floor
Interior Ceiling
Ground Contact Surface Constructions
Walls
Floors
Ceilings
ExtSlabCarpe 4in ClimateZone
ExtSlabCarpe 4in ClimateZone
ExtSlabCarpe 4in ClimateZone
Exterior Sub Surface Constructions
Fixed Windows
Operable Windows
Doors
ASHRAE 189.1-2009 ExtWindow
ASHRAE 189.1-2009 ExtWindow
Exterior Door
Glass Doors
Overhead Doors
Skylights
Drag From Library
Drag From Library
Drag From Library
Tubular Daylight Domes
Tubular Daylight Diffusers
Interior Window
Interior Window
Going back to the customized construction set that we created a while ago, we can delete and drag on the «walls» the customized wall that we created
Mass ClimateZone 4
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 5
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 6
ASHRAE 189.1-2009 ExtWall Mass ClimateZone 7-8
ASHRAE 189.1-2009 ExtWindow ClimateZone 1
ASHRAE 189.1-2009 ExtWindow ClimateZone 2
ASHRAE 189.1-2009 ExtWindow ClimateZone 3
ASHRAE 189.1-2009 ExtWindow ClimateZone 4-5
ASHRAE 189.1-2009 ExtWindow ClimateZone 6
ASHRAE 189.1-2009 ExtWindow ClimateZone 7-8
CustomizedWall_26.11
Exterior Door
ExtSlabCarpet 4in ClimateZone 1-8
Interior Ceiling
Interior Door
Interior Floor
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