

solar radiation

Solar radiation is radiant energy emitted by the sun from a nuclear fusion reaction that creates electromagnetic energy. The spectrum of solar radiation is close to that of a black body with a temperature of about 5800 K. About half of the radiation is in the visible short-wave part of the electromagnetic spectrum. The other half is mostly in the near-infrared part, with some in the ultraviolet part of the spectrum. The solar radiation we receive on the Earth is attenuated both in spectral distribution and in total irradiance because of dispersion and absorption phenomena.

diffuse and direct beam solar radiation

The solar radiation reaching the Earth's surface can be divided into two types of solar radiation: Direct beam solar radiation and diffuse solar radiation.

As sunlight passes through the atmosphere, some of it enters the surface of the Earth direct and undisturbed - the so-called beam solar radiation. Beam solar radiation throws sharp shadows and can be focused. Another component of sunlight is the diffuse solar radiation, on its way through the atmosphere it is absorbed, scattered, or reflected by dust, water vapor, clouds, pollutants, etc. Diffuse solar radiation does not throw sharp shadows and cannot be focused.

The sum of the diffuse and direct beam solar radiation is called global solar radiation.

absorption of solar radiation

Solar radiation absorption is due to some atmospheric components, especially ozone, water and carbon dioxide. Stratospheric ozone absorbs almost all the ultraviolet component of the solar radiation for wavelength less than 0.29 μm , water vapor has important absorption bands in the infrared field, centered at 1.0, 1.4, and 1.8 μm . Over 2.5 μm the atmosphere becomes practically opaque to solar radiation for the strong absorption due to water and carbon dioxide.

air mass

The sun to the zenith crosses the minimum thickness of the atmosphere, the sun with an elevated zenith angle crosses a large thickness of the atmosphere.

the solar radiation density

The maximum yearly average solar radiation density is the solar constant, which is the solar irradiance, its value is 1367 W/m^2 .

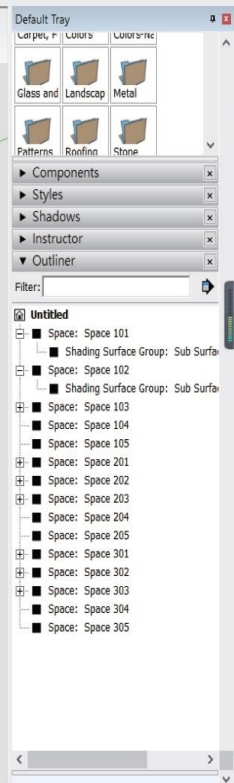
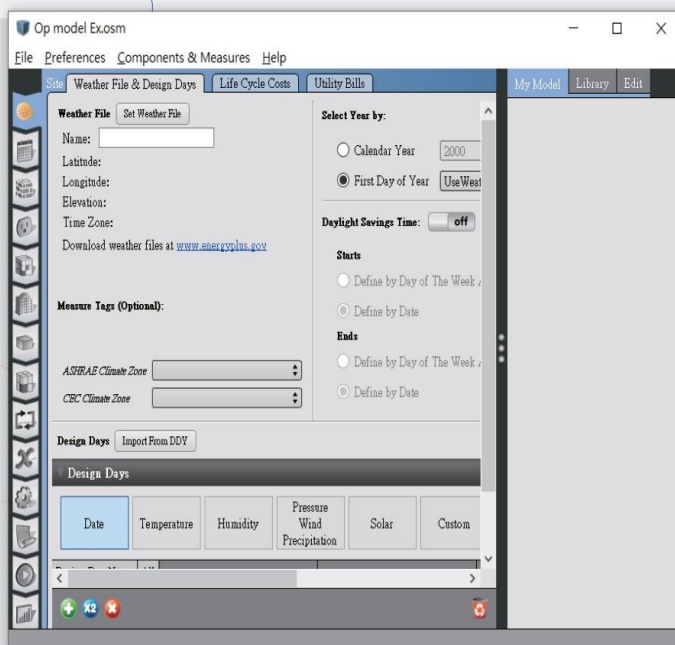
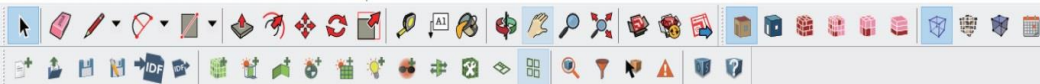
solar energy: availability

The solar radiation, available on the Earth's surface for conversion in other energy forms, depends on the sun position, the weather condition, the site altitude over the sea level, and the daylight hours.

adding weather data

Untitled - SketchUp Make 2016

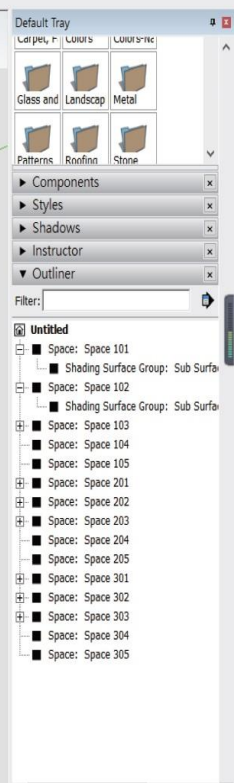
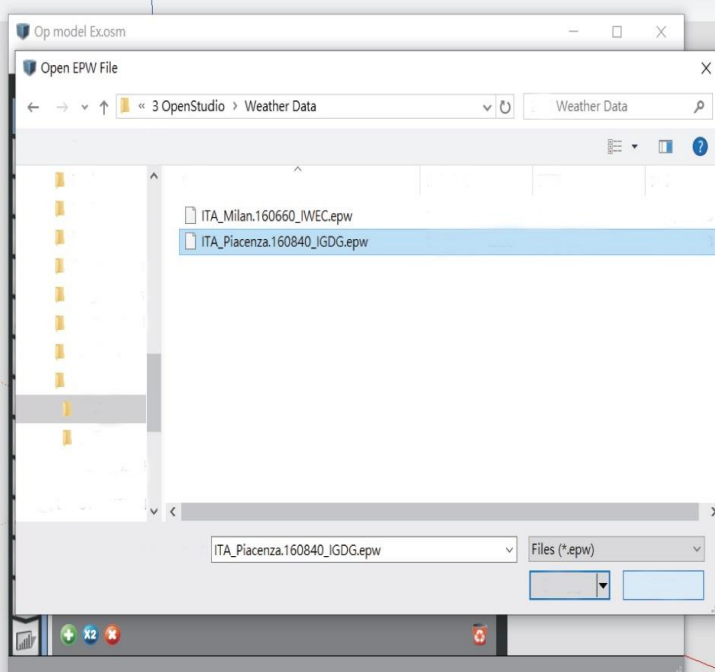
File Edit View Camera Draw Tools Window Extensions Help



Pan the camera view vertically or horizontally.

Untitled - SketchUp Make 2016

File Edit View Camera Draw Tools Window Extensions Help



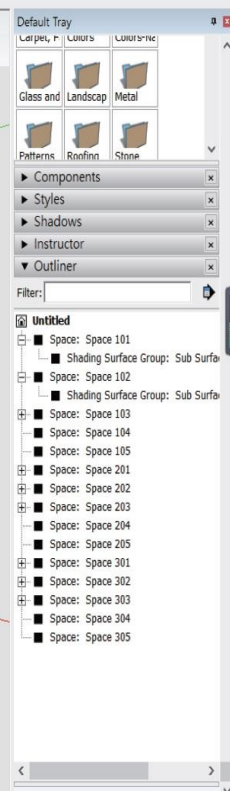
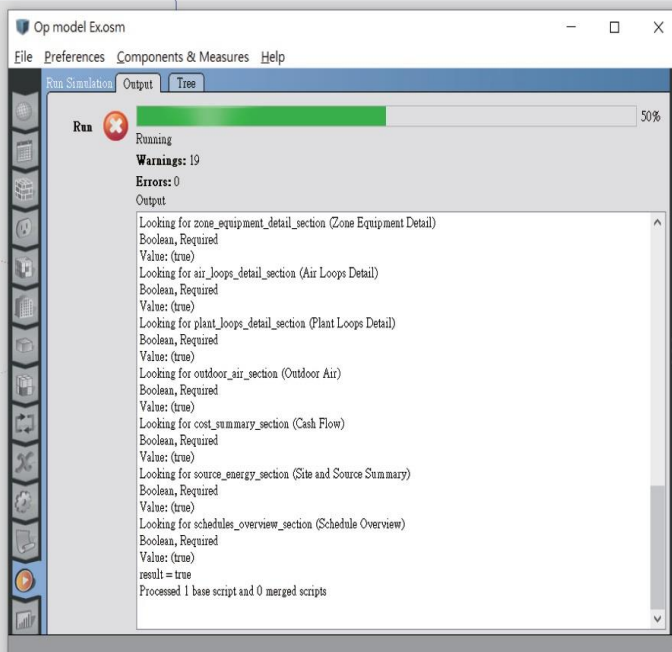
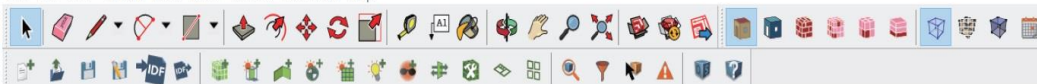
Select objects. Shift to extend select. Drag mouse to select multiple.

Measurements

run the analysis

Untitled - SketchUp Make 2016

File Edit View Camera Draw Tools Window Extensions Help



Select objects. Shift to extend select. Drag mouse to select multiple.

Measurements

shown analysis

Op model Exosm

File Preferences Components & Measures Help

Results Summary

Reports: OpenStudio Results

Model Summary

Annual Overview

Monthly Overview

Utility Bills/Rates

Envelope

Space Type Breakdown

Space Type Summary

Interior Lighting Summary

Plug Loads Summary

Exterior Lighting

Water Use Equipment

HVAC Load Profiles

Zone Conditions

Zone Overview

Zone Equipment Detail

Air Loops Detail

Plant Loops Detail

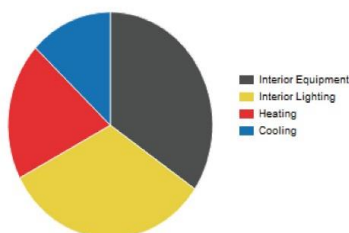
Outdoor Air

Cash Flow

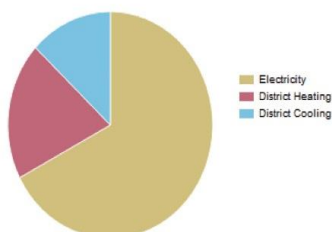
Site and Source Summary

Schedule Overview

End Use - view table



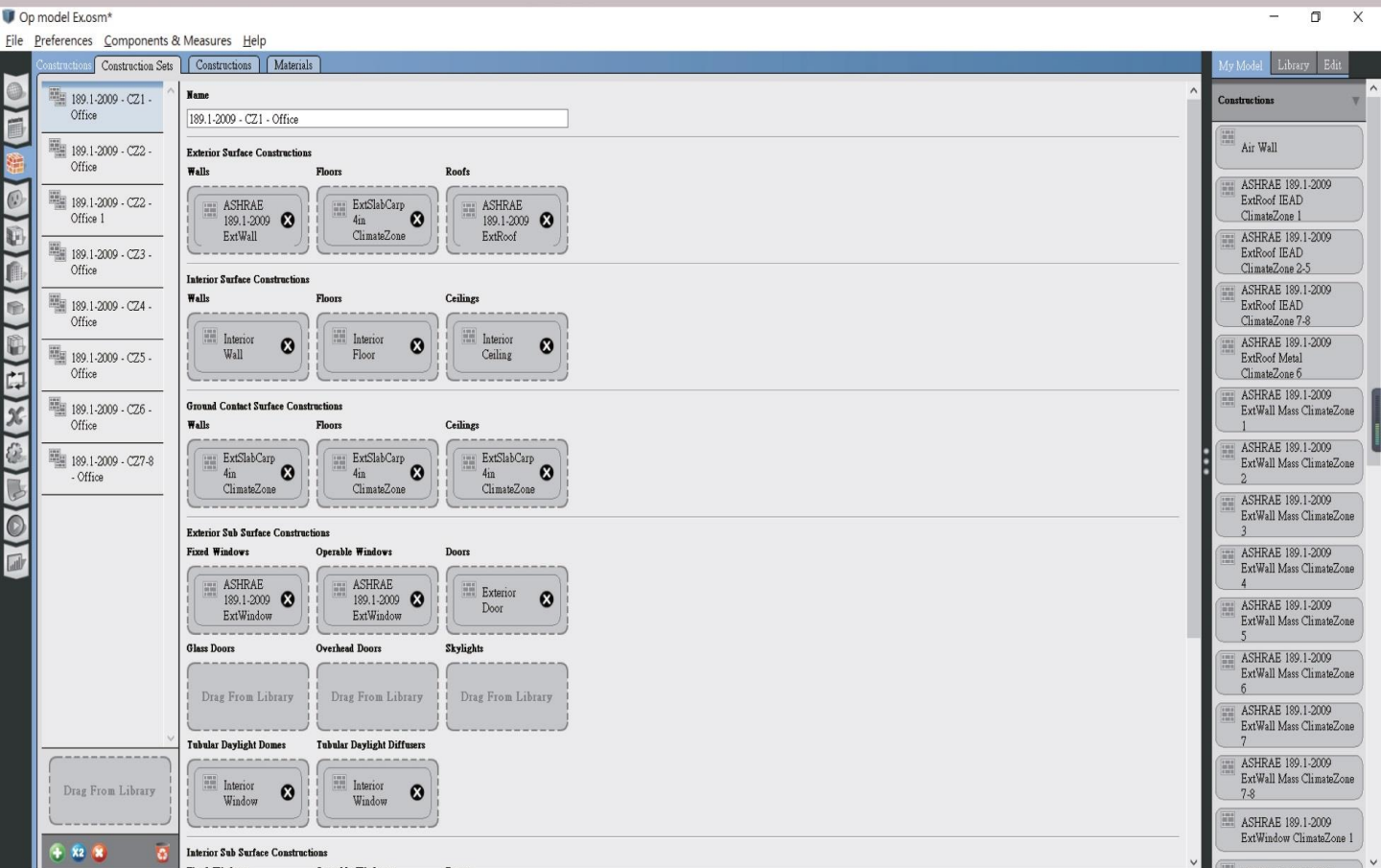
Energy Use - view table



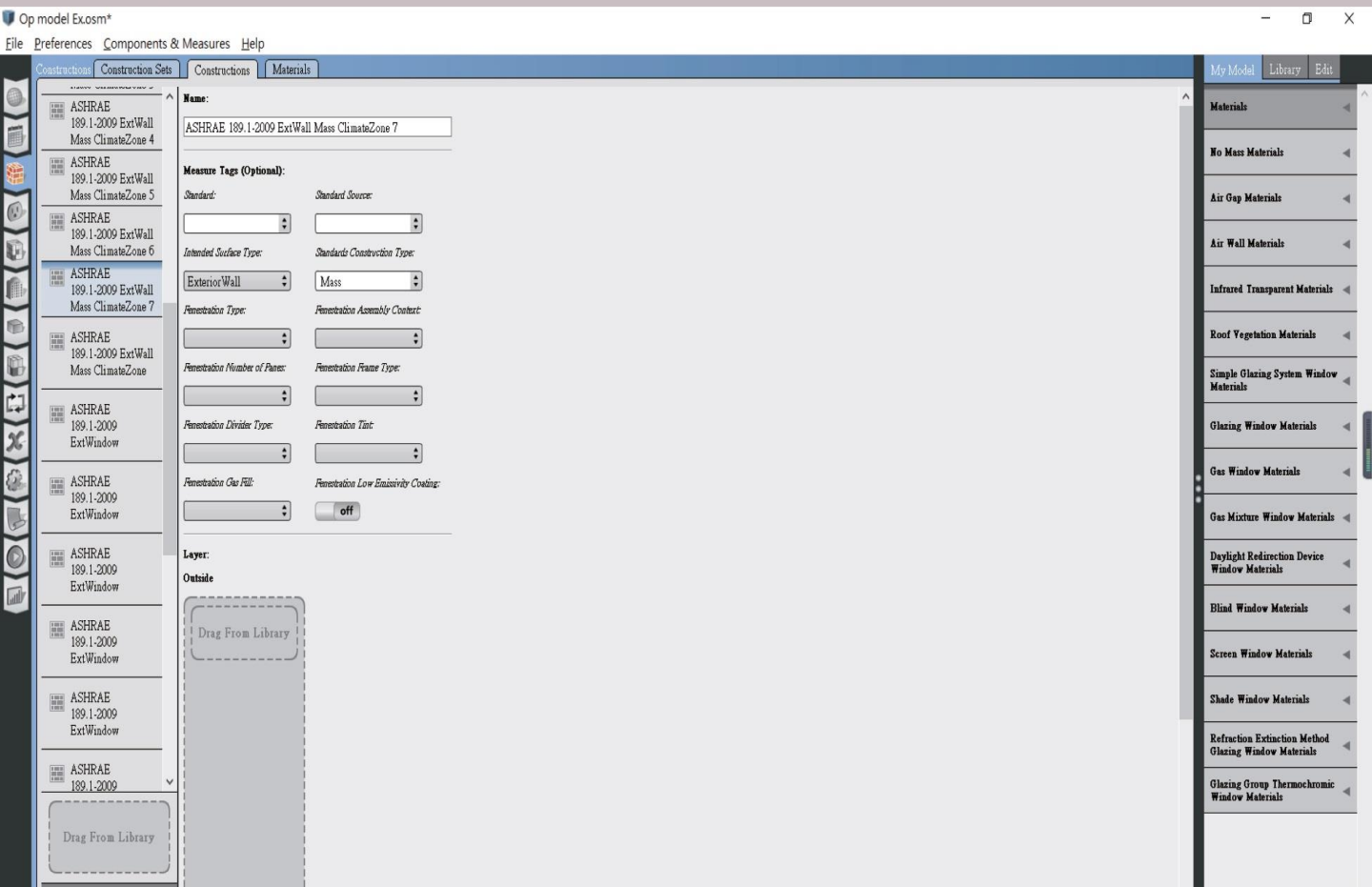
EUI - Electricity - view table

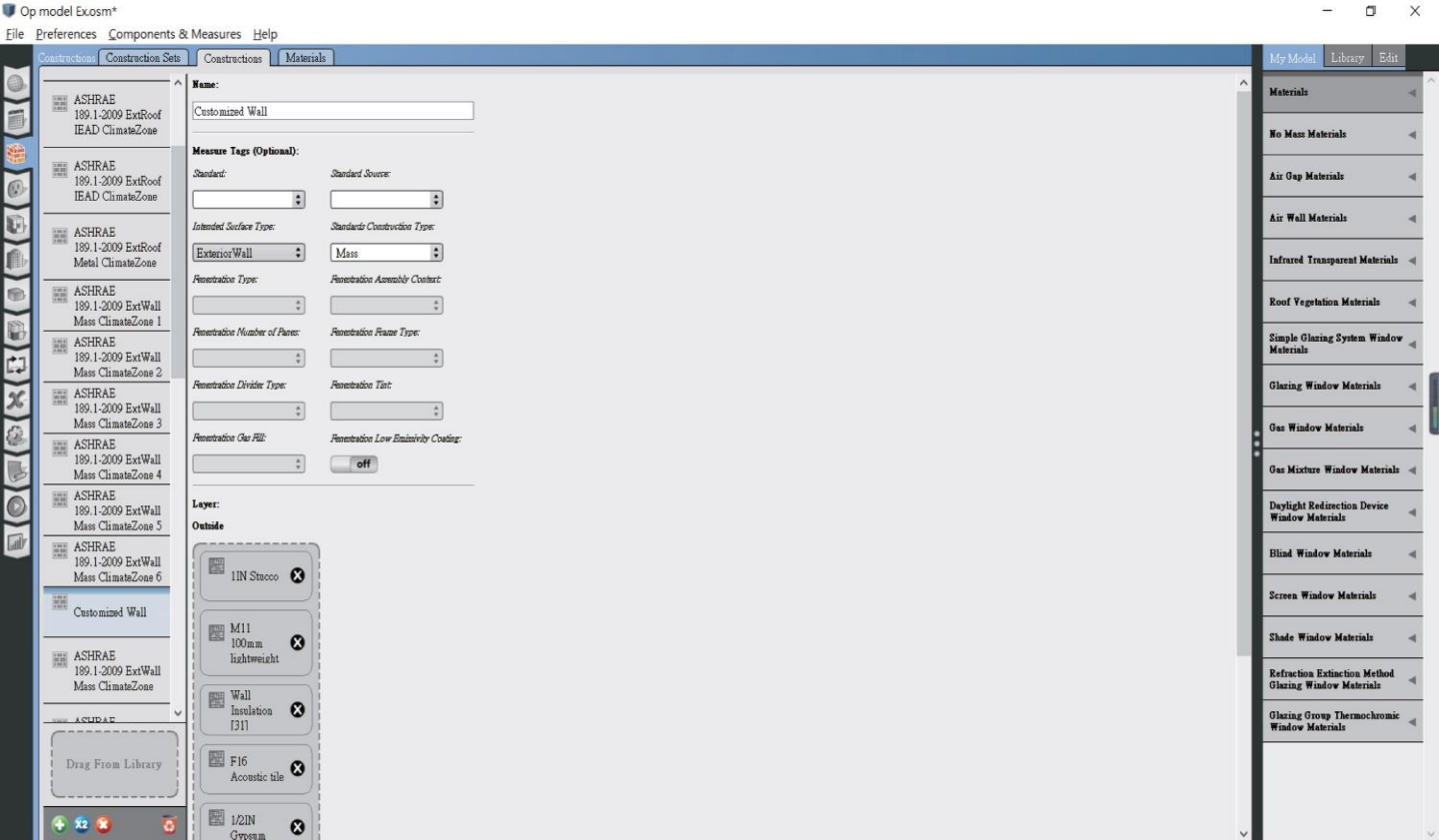


the construction sets

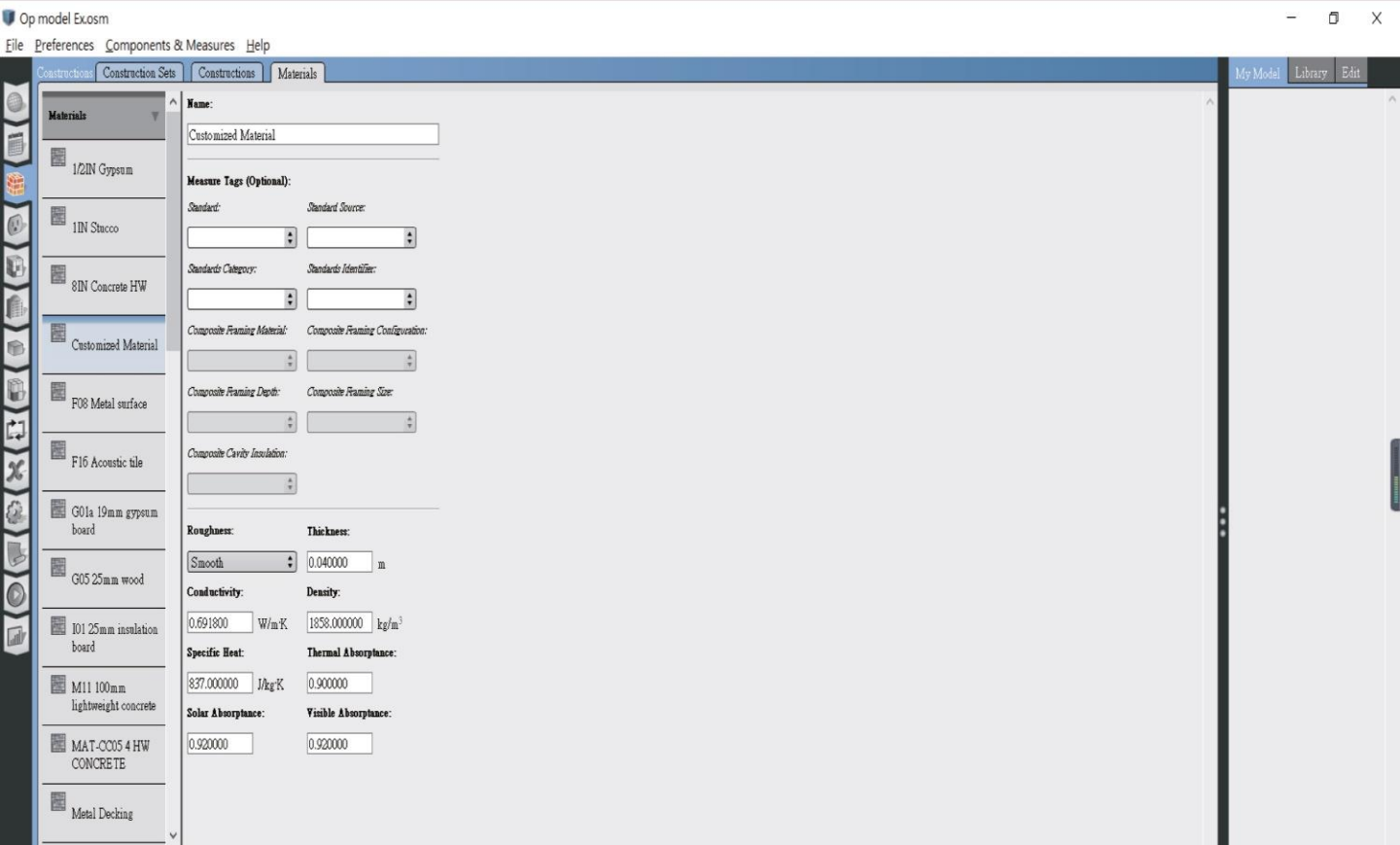


customizing walls





customizing materials



applying the customized walls to construction

Op model Exosm*

File Preferences Components & Measures Help

189.1-2009 - CZ1 - Office

189.1-2009 - CZ2 - Office

189.1-2009 - CZ2 - Office 1

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

189.1-2009 - CZ1 - Office

Exterior Surface Constructions

Walls

Customized Wall

Floors

ExtSlabCarp 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

ExtSlabCarp 4in ClimateZone

Floors

ExtSlabCarp 4in ClimateZone

Ceilings

ExtSlabCarp 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

Tabular Daylight Domes

Interior Window

Tabular Daylight Diffusers

Interior Window

My Model

Library

Edit

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

Customized Wall

Exterior Door

ExtSlabCarp 4in ClimateZone 1-8

Interior Ceiling

Interior Door

Interior Floor