WEEK 7_BALAGANESAN NAVANEETHA

SOLAR RADIATION

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 units of measure are Watts per square meter.

DIFFUSE AND DIRECT BEAM SOLAR RADIATION

Solar radiation striking a collector has two components, direct beam radiation and diffuse radiation. Additionally, radiation reflected by the surface in front of a collector contributes to the solar radiation received. But unless the collector is tilted at a steep angle from the horizontal and the ground is highly reflective (e.g: snow), this contribution is small.

Direct beam radiation comes in a direct line from the sun. For sunny days with clear skies, most of the solar radiation is direct beam radiation. On overcast days, the sun is obscured by the clouds and the direct beam radiation is zero.

Diffuse radiation is scattered out of the direct beam by molecules, aerosols, and clouds. Because it comes from all regions of the sky, it is also referred to as sky radiation. The portion of total solar radiation that is diffuse is about 10% to 20% for clear skies and up to 100% for cloudy skies.

ABSORPTION OF SOLAR RADIATION

About 23 percent of incoming solar energy is absorbed in the atmosphere by water vapor, dust, and ozone, and 48 percent passes through the atmosphere and is absorbed by the surface. Thus, about 71 percent of the total incoming solar energy is absorbed by the Earth system.
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

For a path length **L** through the atmosphere, and solar radiation incident at angle z relative to the normal to the Earth's surface, the air mass coefficient is

$$\mathrm{AM} = \frac{\mathrm{L}}{\mathrm{L0}}$$

where L_0 is the path length at zenith (i.e., normal to the Earth's surface) at sea level.

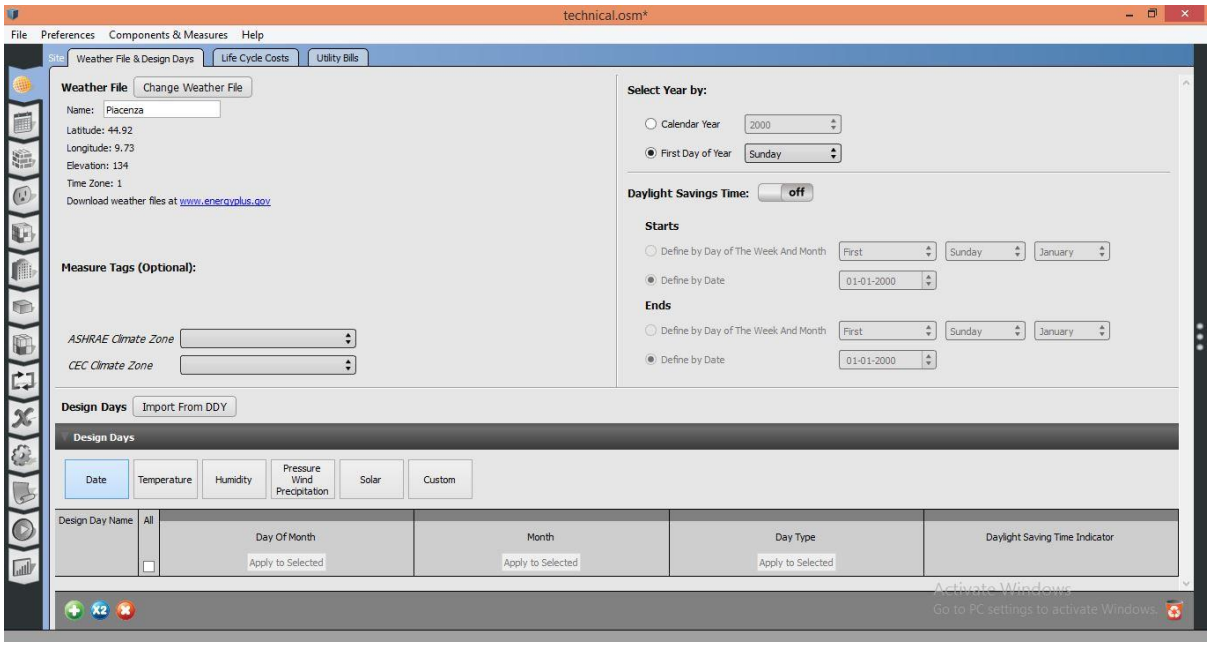
The air mass number is thus dependent on the Sun's elevation path through the sky and therefore varies with time of day and with the passing seasons of the year, and with the latitude of the observer.

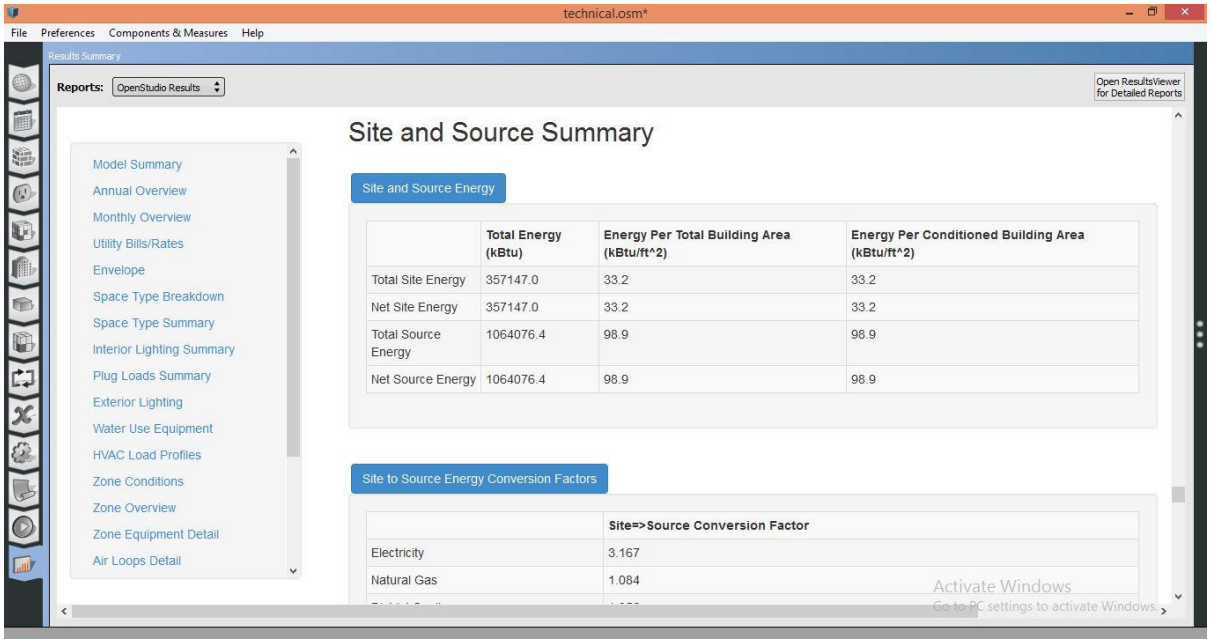
SOLAR RADIATION DENSITY

The maximum yearly average solar radiation density is the solar constant, which is the solar irradiance, its value is 1367 W/m2.

SOLAR RADIATION: AVAILABILITY

Solar energy is spread out and is available in all places around the world. Its intensity varies significantly according the place on the earth's surface and for the same place according to the time of the day, the time of the year and the existing meteorological conditions. It is very spread out, in dilute concentration. As a very important renewable energy source solar radiation parameters and solar-earth angles are of importance for the estimation of the energy reaching the earth's surface.

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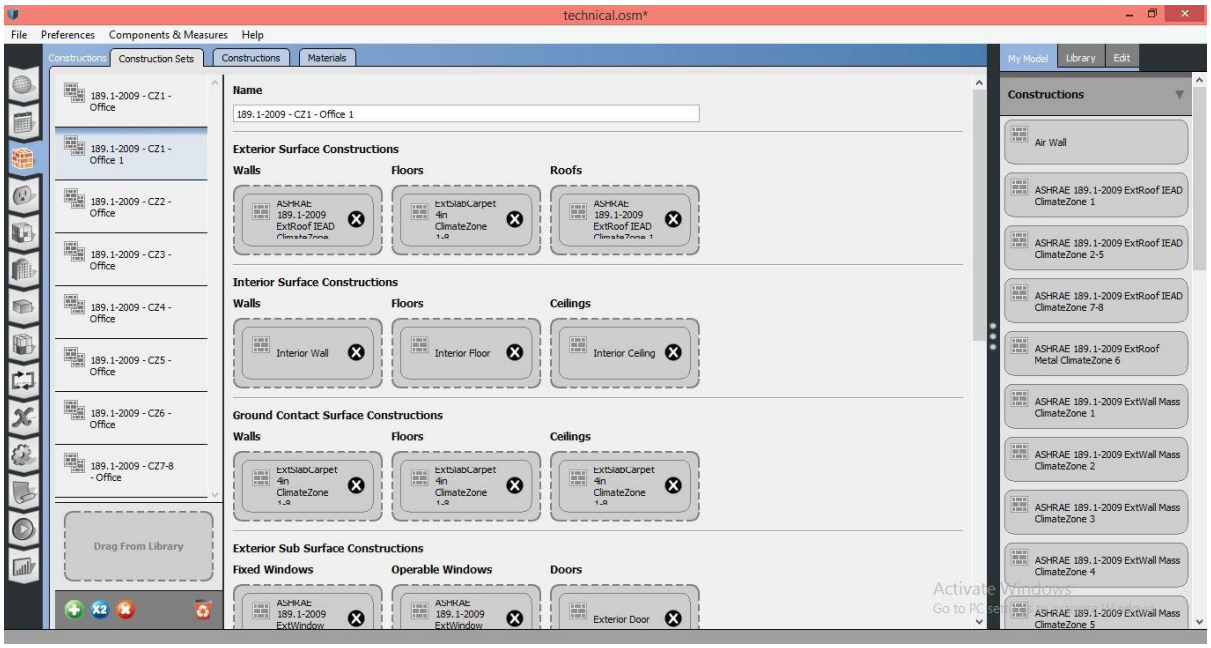
File
Preferences
Components & Measures
Help
Results Summary
Reports:
OpenStudio Results
Open ResultsViewer for Detailed Reports
Model Summary
Annual Overview
Monthly Overview
Utility Bills/Rates
Envelope
Space Type Breakdown
Space Type Summary
Interior Lighting Summary
Plug Loads Summary
Exterior Lighting
Water Use Equipment
HVAC Load Profiles
Zone Conditions
Zone Overview
Zone Equipment Detail
Air Loops Detail
Site and Source Summary
Site and Source Energy
Total Energy (kBtu)
Energy Per Total Building Area (kBtu/ft^2)
Energy Per Conditioned Building Area (kBtu/ft^2)
Total Site Energy 357147.0 33.2 33.2
Net Site Energy 357147.0 33.2 33.2
Total Source Energy 1064076.4 98.9 98.9
Net Source Energy 1064076.4 98.9 98.9
Site to Source Energy Conversion Factors
Site=>Source Conversion Factor
Electricity 3.167
Natural Gas 1.084
Activate Windows
Go to PC settings to activate Windows.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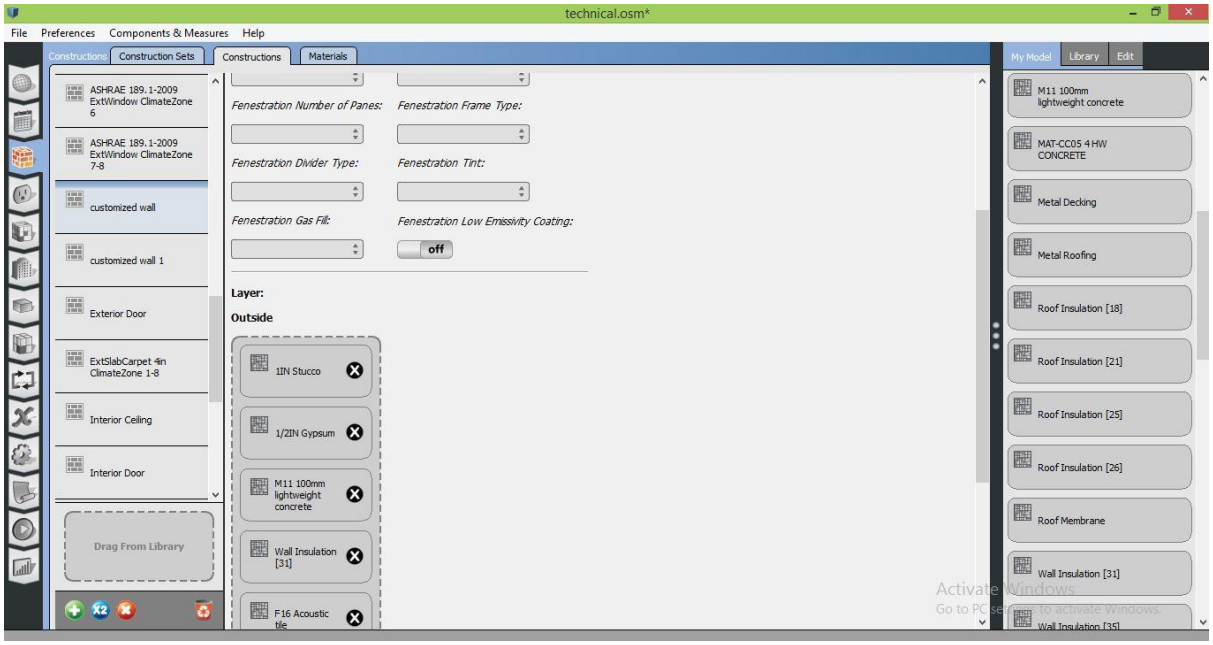
Components & Measures
Help
Constructions
Construction Sets
Constructions
Materials
189.1-2009 - CZ1 - Office
189.1-2009 - CZ1 - Office 1
189.1-2009 - CZ2 - Office
189.1-2009 - CZ3 - Office
189.1-2009 - CZ4 - Office
189.1-2009 - CZ5 - Office
189.1-2009 - CZ6 - Office
189.1-2009 - CZ7-8 - Office
Drag From Library
Name
189.1-2009 - CZ1 - Office 1
Exterior Surface Constructions
Walls
Floors
Roofs
Interior Surface Constructions
Walls
Floors
Ceilings
Interior Wall
Interior Floor
Interior Ceiling
Ground Contact Surface Constructions
Walls
Floors
Ceilings
Exterior Sub Surface Constructions
Fixed Windows
Operable Windows
Doors
Exterior Door
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
Activate Windows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File
Preferences
Components & Measures
Help
Constructions
Construction Sets
Constructions
Materials
My Model
Library
Edit
ASHRAE 189.1-2009 ExtWindow ClimateZone 6
ASHRAE 189.1-2009 ExtWindow ClimateZone 7-8
customized wall
customized wall 1
Exterior Door
ExtSlabCarpet 4in ClimateZone 1-8
Interior Ceiling
Interior Door
Drag From Library
Fenestration Number of Panes:
Fenestration Frame Type:
Fenestration Divider Type:
Fenestration Tint:
Fenestration Gas Fill:
Fenestration Low Emissivity Coating:
off
Layer:
Outside
1IN Stucco
1/2IN Gypsum
M11 100mm lightweight concrete
Wall Insulation [31]
F16 Acoustic tile
M11 100mm lightweight concrete
MAT-CC05 4 HW CONCRETE
Metal Decking
Metal Roofing
Roof Insulation [18]
Roof Insulation [21]
Roof Insulation [25]
Roof Insulation [26]
Roof Membrane
Wall Insulation [31]
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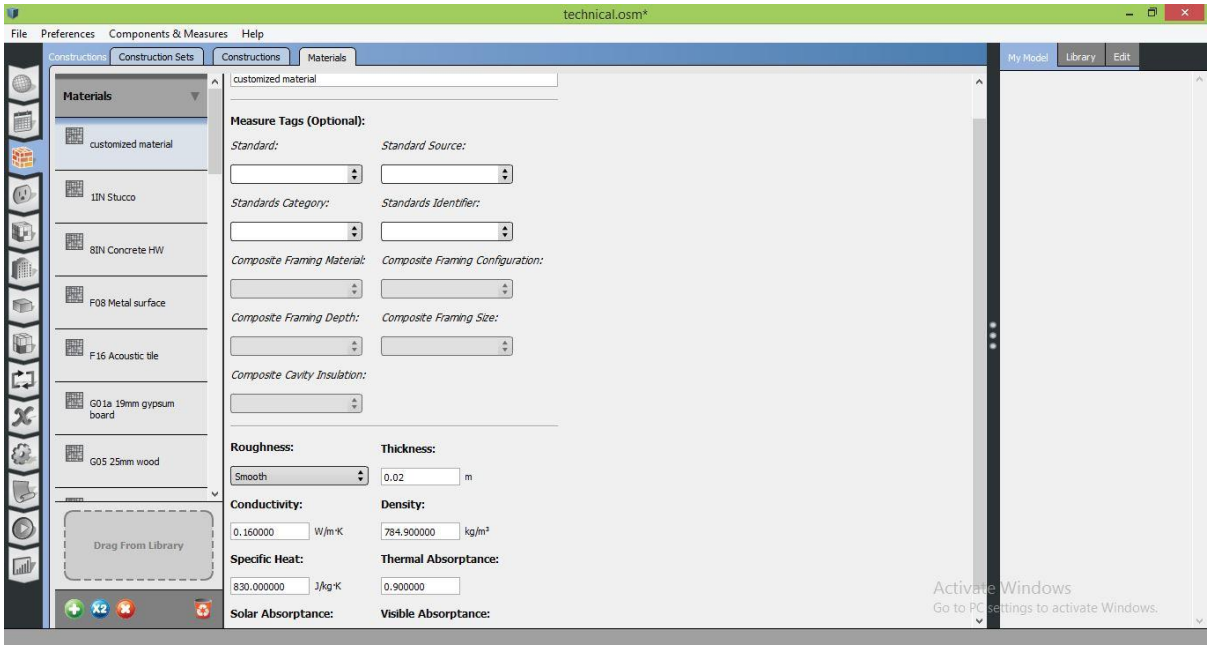
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File
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Constructions
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Constructions
Materials
My Model
Library
Edit
Materials
customized material
1IN Stucco
8IN Concrete HW
F08 Metal surface
F16 Acoustic tile
G01a 19mm gypsum board
G05 25mm wood
Drag From Library
customized material
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:
0.02
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:
Visible Absorptance:
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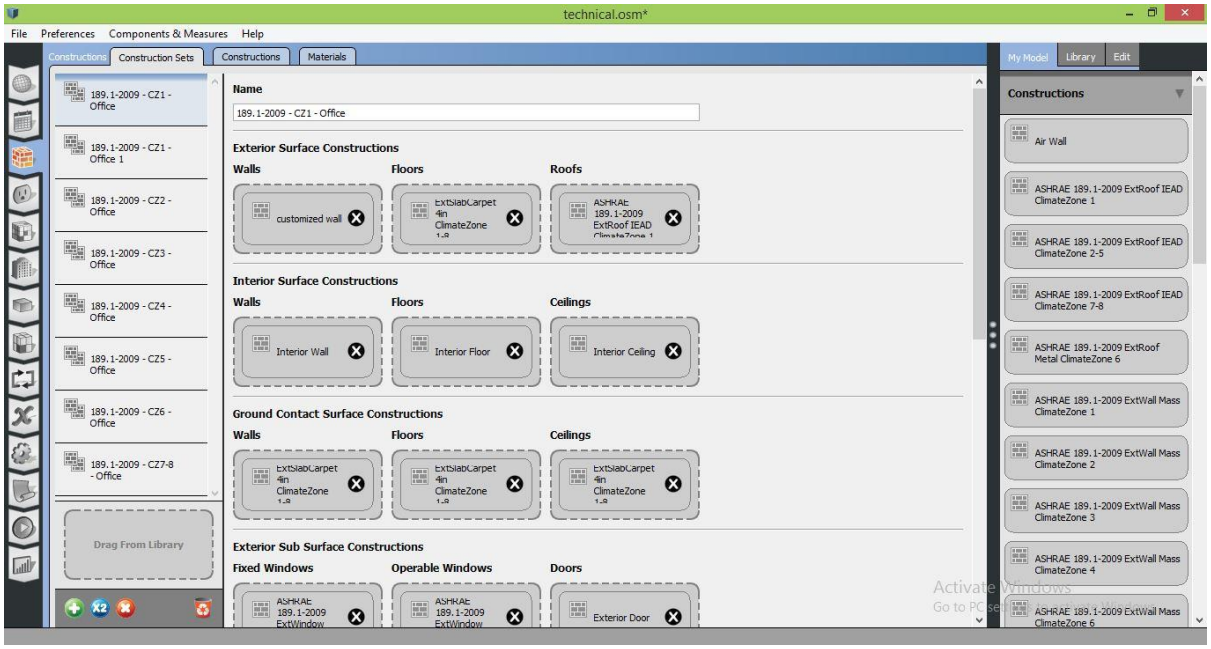
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