

1. SUMMARY OF SOLAR RADIATION

The solar radiations are the electromagnetic waves (infrared, ultraviolet and visible ones) exhaled by the Sun.

The amount of this energy outside the atmosphere is defined by the solar constant. A solar constant is defined as the amount of energy that is captured in the space outside the atmosphere from a surface of one square meter, in a second, at the average distance of the Earth from the Sun ($C = 1.367 \text{ W / m}^2$).

The intensity of solar radiation is measured by two physical quantities:

- Insolation: Average daily energy ($\text{kWh / m}^2 \text{ day}$)
- Radiation: Instantaneous power on horizontal surface (kW / m^2)

It is possible to divide the solar radiation into different components:

- global radiation
- diffuse radiation
- direct radiation
- reflected radiation
- net radiation

Global radiation is defined as the sum of the radiation measured on the ground on a horizontal plane coming directly from the Sun and that spread by the sky (atmosphere). The relationships between the two components are related to weather conditions. The spectrum of wavelengths involved is between 0.3 and 3 mm. Most of the instruments used to measure solar radiation measure this parameter. The global radiation must always be lower than the maximum theoretical radiation calculated outside the atmosphere but can be, at the limit, equal to the maximum theoretical values calculated taking into account the atmosphere.

The diffuse radiation is the component, measured on a horizontal plane, of the solar radiation that reaches the earth not directly from the Sun but due to the atmosphere (gas, clouds, etc.); the spectrum of wavelengths involved is between 0.3 and 3 mm. The instrument used for the measurement is a solarimeter with a device that keeps the sensitive element in “shadow” with respect to the light coming directly from the Sun.

The direct radiation is the radiation coming only directly from the Sun between 0.3 and 3 mm. The instrument (the "pyrheliometer") measures only what comes from the disk of the Sun.

The reflected radiation is the solar radiation reflected from a surface within the band 0.3 - 3 mm. The ratio between the reflected radiation and the global radiation gives the albedo. The measuring instrument is placed horizontally but facing downwards.

The net radiation is the difference between the radiation coming from the sky and that coming from the surface under examination in the 0.3 - 60 mm band. The instrument for measurement consists of two radiometers: one facing upwards and one pointing downwards.

1. OPENSTUDIO

Climate data of the city.

Site Weather File & Design Days Life Cycle Costs Utility Bills

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 01/04/09

Ends

☐ Define by Day of The Week And Month First Sunday January
☒ Define by Date 01/10/09

Design Days Import From DDY

Design Days

Date	Temperature	Humidity	Pressure Wind Precipitation	Solar	Custom
Design Day Name	All	Day Of Month	Month	Day Type	Daylight Saving Time Indicator
		Apply to Selected	Apply to Selected	Apply to Selected	Apply to Selected

Customize the building

Constructions Construction Sets Constructions Materials

My Model Library Edit

Constructions

189.1-2009 - CZ1 - Office
myconstructionSet1311
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
myconstructionSet1311

Exterior Surface Constructions

Walls **Floors** **Roofs**

ASHRAE 189.1-2009 ExtWall 4in ClimateZone 1
ASHRAE 189.1-2009 4in ClimateZone 1
ASHRAE 189.1-2009 ExtRoof 4in ClimateZone 1

Interior Surface Constructions

Walls **Floors** **Ceilings**

Interior Wall
Interior Floor
Interior Ceiling

Ground Contact Surface Constructions

Walls **Floors** **Ceilings**

ASHRAE 189.1-2009 4in ClimateZone 1
ASHRAE 189.1-2009 4in ClimateZone 1
ASHRAE 189.1-2009 4in ClimateZone 1

Exterior Sub Surface Constructions

Fixed Windows **Operable Windows** **Doors**

ASHRAE 189.1-2009 ExtWindow ClimateZone 1
ASHRAE 189.1-2009 ExtWindow ClimateZone 1
Exterior Door

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

Customize the wall package

Measure Tags (Optional):

Standard: Standard Source:

Intended Surface Type: Standards Construction Type:

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 X

8IN Concrete HW X

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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

Insert the project layer applying to the building

Spaces Properties Loads Surfaces Subsurfaces Interior Partitions Shading

My Model Library Edit

General Airflow Custom

Filters: Story Thermal Zone Space Type

All All All

Space Name	All	Story	Thermal Zone	Space Type	Default Construction Set	Default Schedule Set	Part of Total
Space 101	<input checked="" type="checkbox"/>	Building Story 1	Thermal Zone 1	189.1-2009 - Office - C	myconstructionSet1311		<input checked="" type="checkbox"/>
Space 102	<input checked="" type="checkbox"/>	Building Story 1	Thermal Zone 1	189.1-2009 - Office - C	myconstructionSet1311		<input checked="" type="checkbox"/>
Space 103	<input checked="" type="checkbox"/>	Building Story 1	Thermal Zone 1	189.1-2009 - Office - C	myconstructionSet1311		<input checked="" type="checkbox"/>
Space 104	<input checked="" type="checkbox"/>	Building Story 1	Thermal Zone 2	189.1-2009 - Office - E	myconstructionSet1311		<input checked="" type="checkbox"/>
Space 105	<input checked="" type="checkbox"/>	Building Story 1	Thermal Zone 1	189.1-2009 - Office - C	myconstructionSet1311		<input checked="" type="checkbox"/>
Space 201	<input checked="" type="checkbox"/>	Building Story 2	Thermal Zone 3	189.1-2009 - Office - C	myconstructionSet1311		<input checked="" type="checkbox"/>
Space 202	<input checked="" type="checkbox"/>	Building Story 2	Thermal Zone 3	189.1-2009 - Office - C	myconstructionSet1311		<input checked="" type="checkbox"/>
Space 203	<input checked="" type="checkbox"/>	Building Story 2	Thermal Zone 3	189.1-2009 - Office - C	myconstructionSet1311		<input checked="" type="checkbox"/>
Space 204	<input checked="" type="checkbox"/>	Building Story 2	Thermal Zone 4	189.1-2009 - Office - E	myconstructionSet1311		<input checked="" type="checkbox"/>
Space 205	<input checked="" type="checkbox"/>	Building Story 2	Thermal Zone 3	189.1-2009 - Office - C	myconstructionSet1311		<input checked="" type="checkbox"/>
Space 301	<input checked="" type="checkbox"/>	Building Story 3	Thermal Zone 5	189.1-2009 - Office - C	myconstructionSet1311		<input checked="" type="checkbox"/>

Change other specifications

MODEL_1 (R001) 11/01/2019 10:00:00 (2.0000000000000000)

Loads

109.1-2008 - Office - WholeBuilding - Md Office - CZ1-3 Electric Equipment Definition

109.1-2008 - Office - WholeBuilding - Md Office - CZ4-8 Electric Equipment

109.1-2008 - Office - WholeBuilding - Sm Office - CZ1-3 Electric Equipment Definition

109.1-2008 - Office - WholeBuilding - Sm Office - CZ4-8 Electric Equipment

1mycostumElectricEqu

Gas Equipment Definitions

Steam Equipment Definitions

Other Equipment Definitions

Drag From Library

Name: 1mycostumElectricEquipment

Design Level: Watts Per Space Floor Area: Watts Per Person:

W 10.000000 W/m² W/person

Fraction Latent: 0.000000 Fraction Radiant: 0.000000

Fraction Lost: 0.000000

My Model Library Edit

Ruleset Schedules

Compact Schedules

Constant Schedules

Year Schedules

Fixed Interval Schedules

Variable Interval Schedules

Constructions

Internal Source Constructions

C-factor Underground Wall Constructions

F-factor Ground Floor Constructions

Window Data File Constructions