

Assignment Report

TECHNICAL ENVIRONMENTAL SYSTEM

2018-2019

Professor:

Renzo Marchesi

Behzad najafi

Team member:

Fan zixuan

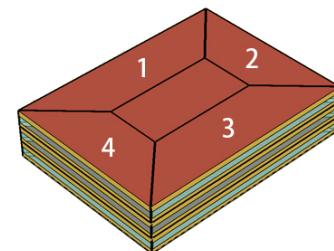
Ni ting

Yan yijia

Wang xinyi

0. Overall introduction

- In this project, based on the usage of 2 software tools (OpenStudio, EnergyPlus) to build modeling and simulate energy consumption, we chose the layout of a conference building, whose total building area is 3600m².
- To test the impact of Building introduction: The conference building is used as the experimental basement. It has three floors, and each floor is three-meter high. This official space is totally open and surrounded by glass.
- To test the different factors on the energy consumption of the building, we changed two groups of input which are the material of the external wall (wood, metal and concrete) and the site. We chose Messina, Milan, Bergen 3 cities from average temperature high to low, which are located on extreme south of Europe, on the southern Europe, and on the Northern Europe respectively.
- So in the following report, we will analysis 9 situations that 3 different walls build in 3 different cities.



Building Area

	Area [m ²]
Total Building Area	3600.00
Net Conditioned Building Area	3600.00
Unconditioned Building Area	0.00

ENVELOPE

Window-Wall Ratio

	Total	North (315 to 45 deg)	East (45 to 135 deg)	South (135 to 225 deg)	West (225 to 315 deg)
Gross Wall Area [m ²]	1280.16	274.32	365.76	274.32	365.76
Above Ground Wall Area [m ²]	1280.16	274.32	365.76	274.32	365.76
Window Opening Area [m ²]	512.06	109.73	146.30	109.73	146.30
Gross Window-Wall Ratio [%]	40.00	40.00	40.00	40.00	40.00
Above Ground Window-Wall Ratio [%]	40.00	40.00	40.00	40.00	40.00

Assignment Report of Technical Environmental System

1 Wood Setting

Constructions

- Roof Membrane
- Wall Insulation [2]
- Wall Insulation [31]
- Wall Insulation [35]
- Wall Insulation [36]
- Wall Insulation [37]
- Wall Insulation [40]
- Wall Insulation [42]
- Wall Insulation [44]
- Wood Siding
BCL
- No Mass Materials
- Air Gap Materials
- Simple Glazing System
- Window Materials

Constructions

Name: Wood Siding

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: Thickness:

MediumSmooth 0.010000 m

Conductivity: Density:

0.110000 W/m-K 544.620000 kg/m³

Specific Heat: Thermal Absorptance:

1210.000000 J/kg·K 0.900000

Solar Absorptance: Visible Absorptance:

0.780000 0.780000

Constructions

- 90.1-1999 Nonres B2 Ext Wall Wood-Framed and Other
- 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

Constructions

Name: 90.1-1999 Nonres B2 Ext Wall

Measure Tags (Optional):

Standard:

Intended Surface Type:

Fenestration Type:

Fenestration Number of Panes:

Fenestration Divider Type:

Fenestration Gas Fill:

Layer: Outside

Wood Siding
BCL

Wall Insulation [2]
BCL

1/2IN Gypsum 1
BCL

Constructions

Name: 189.1-2009 - CZ1 - Office

Exterior Surface Constructors

Walls	Floors	Roofs
<input checked="" type="checkbox"/> 90.1-1999 Nonres B2 Ext Wall BCL	<input checked="" type="checkbox"/> Calculated 4in ClimateZone	<input checked="" type="checkbox"/> ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone

Interior Surface Constructors

Walls	Floors	Ceilings
<input checked="" type="checkbox"/> Interior Wall	<input checked="" type="checkbox"/> Interior Floor	<input checked="" type="checkbox"/> Interior Ceiling

Ground Contact Surface Constructors

Walls	Floors	Ceilings
<input checked="" type="checkbox"/> Calculated 4in ClimateZone	<input checked="" type="checkbox"/> Calculated 4in ClimateZone	<input checked="" type="checkbox"/> Calculated 4in ClimateZone

Exterior Sub Surface Constructors

Fixed Windows	Operable Windows	Doors
<input checked="" type="checkbox"/> Permanent 189.1-2009 ExtWindow ClimateZone	<input checked="" type="checkbox"/> Permanent 189.1-2009 ExtWindow ClimateZone	<input checked="" type="checkbox"/> Exterior Door

Glass Doors

Overhead Doors

Skylights

Tubular Daylight Domes

Tubular Daylight Diffusers

Constructions

Name: 189.1-2009 - CZ1 - Office

Exterior Surface Constructors

Walls	Floors	Roofs
<input checked="" type="checkbox"/> 90.1-1999 Nonres B2 Ext Wall BCL	<input checked="" type="checkbox"/> Calculated 4in ClimateZone	<input checked="" type="checkbox"/> ASHRAE 189.1-2009 ExtRoof IEAD ClimateZone

Interior Surface Constructors

Walls	Floors	Ceilings
<input checked="" type="checkbox"/> Interior Wall	<input checked="" type="checkbox"/> Interior Floor	<input checked="" type="checkbox"/> Interior Ceiling

Ground Contact Surface Constructors

Walls	Floors	Ceilings
<input checked="" type="checkbox"/> Calculated 4in ClimateZone	<input checked="" type="checkbox"/> Calculated 4in ClimateZone	<input checked="" type="checkbox"/> Calculated 4in ClimateZone

Exterior Sub Surface Constructors

Fixed Windows	Operable Windows	Doors
<input checked="" type="checkbox"/> Permanent 189.1-2009 ExtWindow ClimateZone	<input checked="" type="checkbox"/> Permanent 189.1-2009 ExtWindow ClimateZone	<input checked="" type="checkbox"/> Exterior Door

Glass Doors

Overhead Doors

Skylights

Tubular Daylight Domes

Tubular Daylight Diffusers

Assignment Report of Technical Environmental System

1.1 Milan

- The tables below show the situation of energy consumption, the red parts present the consumption (GJ) and power(W) of heating and cooling.
- Report: Annual Building Utility Performance Summary

For: Entire Facility

Timestamp:2018-12-18 16:20:00

Site to Source Energy Conversion Factors

	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613
Steam	0.300
Gasoline	1.050
Diesel	1.050
Coal	1.050
Fuel Oil #1	1.050
Fuel Oil #2	1.050
Propane	1.050
Other Fuel 1	1.000
Other Fuel 2	1.000

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	1585.48	440.41	440.41
Net Site Energy	1585.48	440.41	440.41
Total Source Energy	4383.86	1217.74	1217.74
Net Source Energy	4383.86	1217.74	1217.74

End Uses

	Electricity [W]	Natural Gas [W]	Propane [W]	District Cooling [W]	District Heating [W]	Water [m3/s]
Time of Peak	02-JAN-08:09	-	-	29-JUN-15:00	30-JAN-06:10	-
Heating	0.00	0.00	0.00	0.00	273628.68	0.00
Cooling	0.00	0.00	0.00	137042.81	0.00	0.00
Interior Lighting	34526.32	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	24761.30	0.00	0.00	0.00	0.00	0.00

End Uses

	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	0.00	0.00	0.00	0.00	304.65	0.00
Cooling	0.00	0.00	0.00	366.28	0.00	0.00
Interior Lighting	445.42	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	469.14	0.00	0.00	0.00	0.00	0.00

Assignment Report of Technical Environmental System

1.2 Bergen

- The tables below show the situation of energy consumption, the red parts present the consumption (GJ) and power(W) of heating and cooling.
- Report: Annual Building Utility Performance Summary

For: Entire Facility

Timestamp:2018-12-18 20:08:36

Site to Source Energy Conversion Factors

	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613
Steam	0.300
Gasoline	1.050
Diesel	1.050
Coal	1.050
Fuel Oil #1	1.050
Fuel Oil #2	1.050
Propane	1.050
Other Fuel 1	1.000
Other Fuel 2	1.000

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	1469.90	408.31	408.31
Net Site Energy	1469.90	408.31	408.31
Total Source Energy	4765.22	1323.67	1323.67
Net Source Energy	4765.22	1323.67	1323.67

End Uses

	Electricity [W]	Natural Gas [W]	Propane [W]	District Cooling [W]	District Heating [W]	Water [m3/s]
Time of Peak	02-JAN-08:09	-	-	03-AUG-15:00	02-JAN-06:10	-
Heating	0.00	0.00	0.00	0.00	259688.43	0.00
Cooling	0.00	0.00	0.00	82865.39	0.00	0.00
Interior Lighting	34526.32	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	24761.30	0.00	0.00	0.00	0.00	0.00

End Uses

	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	0.00	0.00	0.00	0.00	501.46	0.00
Cooling	0.00	0.00	0.00	53.89	0.00	0.00
Interior Lighting	445.42	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	469.14	0.00	0.00	0.00	0.00	0.00

Assignment Report of Technical Environmental System

1.3 Messina

- The tables below show the situation of energy consumption, the red parts present the consumption (GJ) and power(W) of heating and cooling.
- Report: Annual Building Utility Performance Summary

For: Entire Facility

Timestamp: 2018-12-18 20:24:56

Site to Source Energy Conversion Factors

	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613
Steam	0.300
Gasoline	1.050
Diesel	1.050
Coal	1.050
Fuel Oil #1	1.050
Fuel Oil #2	1.050
Propane	1.050
Other Fuel 1	1.000
Other Fuel 2	1.000

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	1481.81	411.61	411.61
Net Site Energy	1481.81	411.61	411.61
Total Source Energy	3610.22	1002.84	1002.84
Net Source Energy	3610.22	1002.84	1002.84

End Uses

	Electricity [W]	Natural Gas [W]	Propane [W]	District Cooling [W]	District Heating [W]	Water [m3/s]
Time of Peak	02-JAN-08:09	-	-	10-JUL-16:00	02-JAN-06:10	-
Heating	0.00	0.00	0.00	0.00	227136.12	0.00
Cooling	0.00	0.00	0.00	151031.40	0.00	0.00
Interior Lighting	34526.32	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	24761.30	0.00	0.00	0.00	0.00	0.00

End Uses

	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	0.00	0.00	0.00	0.00	44.96	0.00
Cooling	0.00	0.00	0.00	522.30	0.00	0.00
Interior Lighting	445.42	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	469.14	0.00	0.00	0.00	0.00	0.00

Assignment Report of Technical Environmental System

2 Metal setting

The image displays three separate windows of a software application, likely a building information modeling (BIM) or technical documentation tool, used for creating construction details.

Left Window: This window shows the creation of a "Constructions" entry. The "Name" field is set to "189.1-2009 Nonres 1A Ext Wall Metal Building". Under "Measure Tags (Optional)", fields like "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", and "Fenestration Low Emissivity Coating" are populated. A "Layer" section indicates "Outside" with components like "Metal Siding" and "Wall Insulation [32]". A "Drag From Library" button is present at the bottom.

Middle Window: This window shows the creation of a "Materials" entry. The "Name" field is set to "Metal Siding". Under "Measure Tags (Optional)", fields like "Standard", "Standard Source", "Standards Category", "Standards Identifier", "Composite Framing Material", "Composite Framing Configuration", "Composite Framing Depth", "Composite Framing Size", "Composite Cavity Insulation", "Roughness", "Thickness", "Conductivity", "Density", "Specific Heat", "Thermal Absorptance", "Solar Absorptance", and "Visible Absorptance" are populated. A "Drag From Library" button is present at the bottom.

Bottom Window: This window shows the creation of a "Construction Sets" entry for "189.1-2009 - C21 - Office". It lists various construction elements categorized by location: "Exterior Surface Constructors" (Walls, Floors, Roofs), "Interior Surface Constructors" (Walls, Floors, Ceilings), "Ground Contact Surface Constructors" (Walls, Floors, Ceilings), "Exterior Sub Surface Constructors" (Fixed Windows, Operable Windows, Doors), "Glass Doors", "Overhead Doors", "Skylights", "Tubular Daylight Domes", and "Tubular Daylight Diffusers". A "Drag From Library" button is present at the bottom.

Assignment Report of Technical Environmental System

2.1 Milan

- The tables below show the situation of energy consumption, the red parts present the consumption (GJ) and power(W) of heating and cooling
- Report: Annual Building Utility Performance Summary
For: Entire Facility

Timestamp: 2018-12-19 00:13:24

Site to Source Energy Conversion Factors

	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613
Steam	0.300
Gasoline	1.050
Diesel	1.050
Coal	1.050
Fuel Oil #1	1.050
Fuel Oil #2	1.050
Propane	1.050
Other Fuel 1	1.000
Other Fuel 2	1.000

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	1563.97	434.44	434.44
Net Site Energy	1563.97	434.44	434.44
Total Source Energy	4363.03	1211.95	1211.95
Net Source Energy	4363.03	1211.95	1211.95

End Uses

	Electricity [W]	Natural Gas [W]	Propane [W]	District Cooling [W]	District Heating [W]	Water [m3/s]
Time of Peak	02-JAN-08:09	-	-	29-JUN-15:00	30-JAN-06:10	-
Heating	0.00	0.00	0.00	0.00	272472.57	0.00
Cooling	0.00	0.00	0.00	132565.46	0.00	0.00
Interior Lighting	34526.32	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	24761.30	0.00	0.00	0.00	0.00	0.00

End Uses

	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	0.00	0.00	0.00	0.00	305.38	0.00
Cooling	0.00	0.00	0.00	344.04	0.00	0.00
Interior Lighting	445.42	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	469.14	0.00	0.00	0.00	0.00	0.00

Assignment Report of Technical Environmental System

2.2 Bergen

- The tables below show the situation of energy consumption, the red parts present the consumption (GJ) and power(W) of heating and cooling.
- Report: Annual Building Utility Performance Summary

For: Entire Facility

Timestamp:2018-12-19 00:16:32

Site to Source Energy Conversion Factors

	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613
Steam	0.300
Gasoline	1.050
Diesel	1.050
Coal	1.050
Fuel Oil #1	1.050
Fuel Oil #2	1.050
Propane	1.050
Other Fuel 1	1.000
Other Fuel 2	1.000

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	1462.10	406.14	406.14
Net Site Energy	1462.10	406.14	406.14
Total Source Energy	4752.09	1320.02	1320.02
Net Source Energy	4752.09	1320.02	1320.02

End Uses

	Electricity [W]	Natural Gas [W]	Propane [W]	District Cooling [W]	District Heating [W]	Water [m3/s]
Time of Peak	02-JAN-08:09	-	-	03-AUG-15:30	10-FEB-06:10	-
Heating	0.00	0.00	0.00	0.00	259251.11	0.00
Cooling	0.00	0.00	0.00	79470.83	0.00	0.00
Interior Lighting	34526.32	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	24761.30	0.00	0.00	0.00	0.00	0.00

End Uses

	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	0.00	0.00	0.00	0.00	499.54	0.00
Cooling	0.00	0.00	0.00	48.00	0.00	0.00
Interior Lighting	445.42	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	469.14	0.00	0.00	0.00	0.00	0.00

2.3 Messina

- The tables below show the situation of energy consumption, the red parts present the consumption (GJ) and power(W) of heating and cooling
- Report: Annual Building Utility Performance Summary
For: Entire Facility

Timestamp:2018-12-19 00:09:29

Site to Source Energy Conversion Factors

	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613
Steam	0.300
Gasoline	1.050
Diesel	1.050
Coal	1.050
Fuel Oil #1	1.050
Fuel Oil #2	1.050
Propane	1.050
Other Fuel 1	1.000
Other Fuel 2	1.000

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	1459.04	405.29	405.29
Net Site Energy	1459.04	405.29	405.29
Total Source Energy	3586.38	996.22	996.22
Net Source Energy	3586.38	996.22	996.22

End Uses

	Electricity [W]	Natural Gas [W]	Propane [W]	District Cooling [W]	District Heating [W]	Water [m3/s]
Time of Peak	02-JAN-08:09	-	-	10-JUL-16:00	02-JAN-06:10	-
Heating	0.00	0.00	0.00	0.00	227095.43	0.00
Cooling	0.00	0.00	0.00	149007.52	0.00	0.00
Interior Lighting	34526.32	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	24761.30	0.00	0.00	0.00	0.00	0.00

End Uses

	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	0.00	0.00	0.00	0.00	45.04	0.00
Cooling	0.00	0.00	0.00	499.45	0.00	0.00
Interior Lighting	445.42	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	469.14	0.00	0.00	0.00	0.00	0.00

3 Concrete setting

The image consists of three separate screenshots of a software application's interface, likely for building energy modeling or construction documentation.

Screenshot 1 (Top Left): Construction Properties

- Constructions:** MAT-CC05 4 HW CONCRETE
- Measure Tags (Optional):**
 - Standard: [dropdown]
 - Standard Source: [dropdown]
 - Standards Category: [dropdown]
 - Standards Identifier: [dropdown]
- Composite Framing Material:** Composite Framing Configuration: [dropdown]
- Composite Framing Depth:** Composite Framing Size: [dropdown]
- Composite Cavity Insulation:** [dropdown]
- Roughness:** Thickness: [dropdown] 0.101600 m
- Conductivity:** Density: 1.311000 W/m-K 2240.000000 kg/m³
- Specific Heat:** Thermal Absorptance: 836.800000 J/kg-K 0.900000
- Solar Absorptance:** Visible Absorptance: 0.850000 0.850000

Screenshot 2 (Top Right): Construction Set Details

- Constructions:**
 - 109.1-2011 Nonres / Ext Wall Mass 8in Solid Concrete with Steel Frame
 - 90.1-1999 Nonres B2 Ex Wall Wood- Framed and Other
 - 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 ExtWall 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
- Layer:** Outside
- Inside:** A list of materials including Normalweight concrete, G0113mm gypsum board, and MAT-CC05 4 HW CONCRETE.

Screenshot 3 (Bottom): Construction Set Components

- Construction Set:** 189.1-2009 - CZ1 - Office
- Exterior Surface Constructors:**
 - Walls: 109.1-2011 Nonres 7 Ext Wall
 - Floors: 189.1-2009 ExtRoof IEAD
 - Roofs: 189.1-2009 ExtRoof IEAD
- Interior Surface Constructors:**
 - Walls: Interior Wall
 - Floors: Interior Floor
 - Ceilings: Interior Ceiling
- Ground Contact Surface Constructors:**
 - Walls: 189.1-2009 4in ClimateZone
 - Floors: 189.1-2009 4in ClimateZone
 - Ceilings: 189.1-2009 4in ClimateZone
- Exterior Sub Surface Constructors:**
 - Fixed Windows: 189.1-2009 ExtWindow
 - Operable Windows: 189.1-2009 ExtWindow
 - Doors: Exterior Door
- Glass Doors:** Drag From Library
- Overhead Doors:** Drag From Library
- Skylights:** Drag From Library
- Tubular Daylight Domes:** Drag From Library
- Tubular Daylight Diffusers:** Drag From Library

3.1 Milan

- The tables below show the situation of energy consumption, the red parts present the consumption (GJ) and power(W) of heating and cooling.
- Report: Annual Building Utility Performance Summary

For: Entire Facility

Timestamp: 2018-12-18 21:00:49

Site to Source Energy Conversion Factors

	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613
Steam	0.300
Gasoline	1.050
Diesel	1.050
Coal	1.050
Fuel Oil #1	1.050
Fuel Oil #2	1.050
Propane	1.050
Other Fuel 1	1.000
Other Fuel 2	1.000

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	1678.16	466.16	466.16
Net Site Energy	1678.16	466.16	466.16
Total Source Energy	4765.95	1323.87	1323.87
Net Source Energy	4765.95	1323.87	1323.87

End Uses

	Electricity [W]	Natural Gas [W]	Propane [W]	District Cooling [W]	District Heating [W]	Water [m3/s]
Time of Peak	02-JAN-08:09	-	-	25-JUL-06:10	30-JAN-06:10	-
Heating	0.00	0.00	0.00	0.00	286178.21	0.00
Cooling	0.00	0.00	0.00	183905.41	0.00	0.00
Interior Lighting	34526.32	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	24761.30	0.00	0.00	0.00	0.00	0.00

End Uses

	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	0.00	0.00	0.00	0.00	415.78	0.00
Cooling	0.00	0.00	0.00	347.82	0.00	0.00
Interior Lighting	445.42	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	469.14	0.00	0.00	0.00	0.00	0.00

3.2 Bergen

- The tables below show the situation of energy consumption, the red parts present the consumption (GJ) and power(W) of heating and cooling.
- Report: Annual Building Utility Performance Summary
For: Entire Facility

Timestamp: 2018-12-18 21:06:34

Site to Source Energy Conversion Factors

	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613
Steam	0.300
Gasoline	1.050
Diesel	1.050
Coal	1.050
Fuel Oil #1	1.050
Fuel Oil #2	1.050
Propane	1.050
Other Fuel 1	1.000
Other Fuel 2	1.000

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	1698.18	471.72	471.72
Net Site Energy	1698.18	471.72	471.72
Total Source Energy	5633.76	1564.93	1564.93
Net Source Energy	5633.76	1564.93	1564.93

End Uses

	Electricity [W]	Natural Gas [W]	Propane [W]	District Cooling [W]	District Heating [W]	Water [m3/s]
Time of Peak	02-JAN-08:09	-	-	03-AUG-16:10	02-JAN-06:10	-
Heating	0.00	0.00	0.00	0.00	281362.66	0.00
Cooling	0.00	0.00	0.00	81685.52	0.00	0.00
Interior Lighting	34526.32	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	24761.30	0.00	0.00	0.00	0.00	0.00

End Uses

	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	0.00	0.00	0.00	0.00	746.82	0.00
Cooling	0.00	0.00	0.00	36.81	0.00	0.00
Interior Lighting	445.42	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	469.14	0.00	0.00	0.00	0.00	0.00

3.3 Messina

- The tables below show the situation of energy consumption, the red parts present the consumption (GJ) and power(W) of heating and cooling.
- Report: Annual Building Utility Performance Summary

For: Entire Facility

Timestamp:2018-12-18 21:11:24

Site to Source Energy Conversion Factors

	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613
Steam	0.300
Gasoline	1.050
Diesel	1.050
Coal	1.050
Fuel Oil #1	1.050
Fuel Oil #2	1.050
Propane	1.050
Other Fuel 1	1.000
Other Fuel 2	1.000

Site and Source Energy

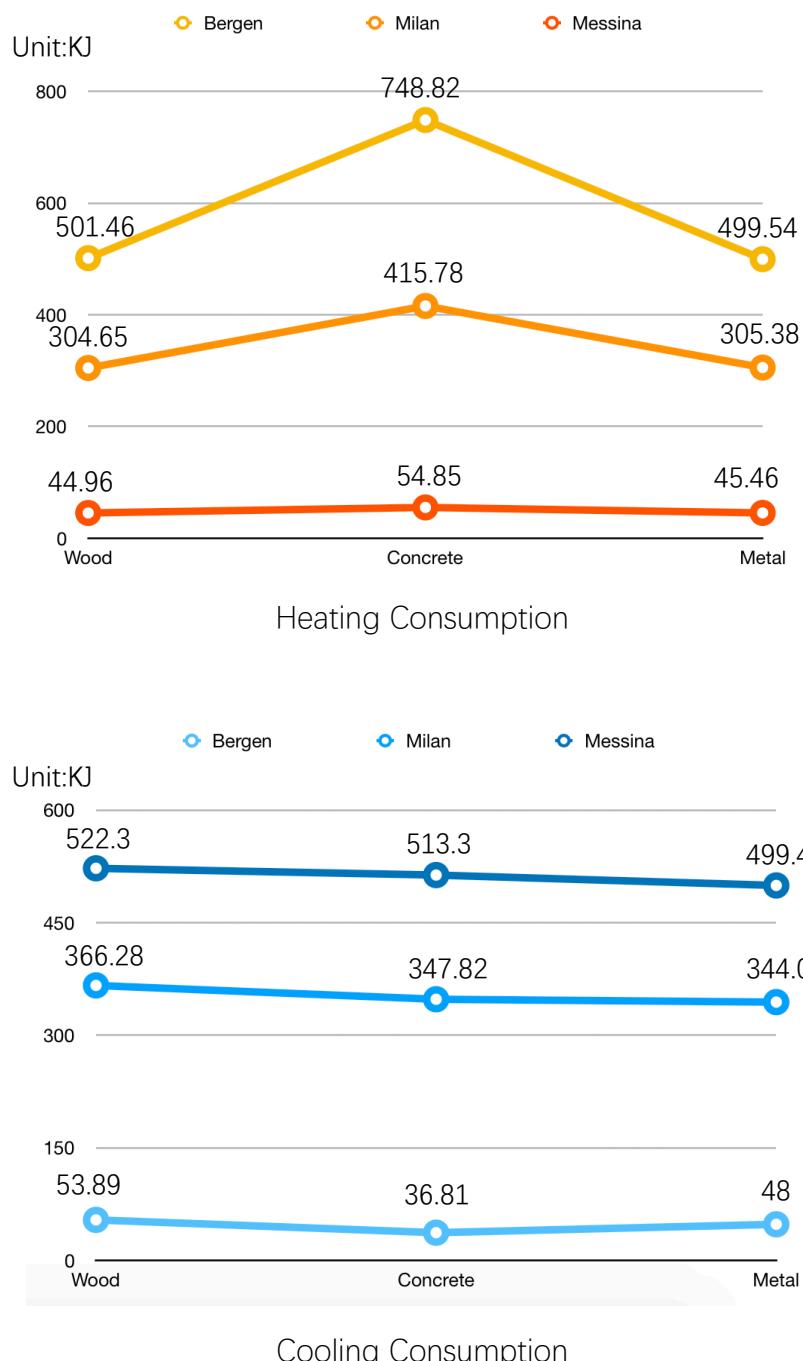
	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	1482.70	411.86	411.86
Net Site Energy	1482.70	411.86	411.86
Total Source Energy	3636.45	1010.13	1010.13
Net Source Energy	3636.45	1010.13	1010.13

End Uses

	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	0.00	0.00	0.00	0.00	54.85	0.00
Cooling	0.00	0.00	0.00	513.30	0.00	0.00
Interior Lighting	445.42	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	469.14	0.00	0.00	0.00	0.00	0.00

	Electricity [W]	Natural Gas [W]	Propane [W]	District Cooling [W]	District Heating [W]	Water [m3/s]
Time of Peak	02-JAN-08:09	-	-	13-JUL-06:10	02-JAN-06:10	-
Heating	0.00	0.00	0.00	0.00	229950.04	0.00
Cooling	0.00	0.00	0.00	223102.72	0.00	0.00
Interior Lighting	34526.32	0.00	0.00	0.00	0.00	0.00

4 Summary



After all the analysis, we can have two kinds of comparers.

- The first one is to analysis the same wall but different positions. It shows how the weather condition influences the value of energy consumption. In this case, Messina has the least energy consumption.
- The second one is to analysis the different materials in the same position which shows how the building construction affect the energy consumption. In this case, the wall 3 which has the metal has the least energy consumption.