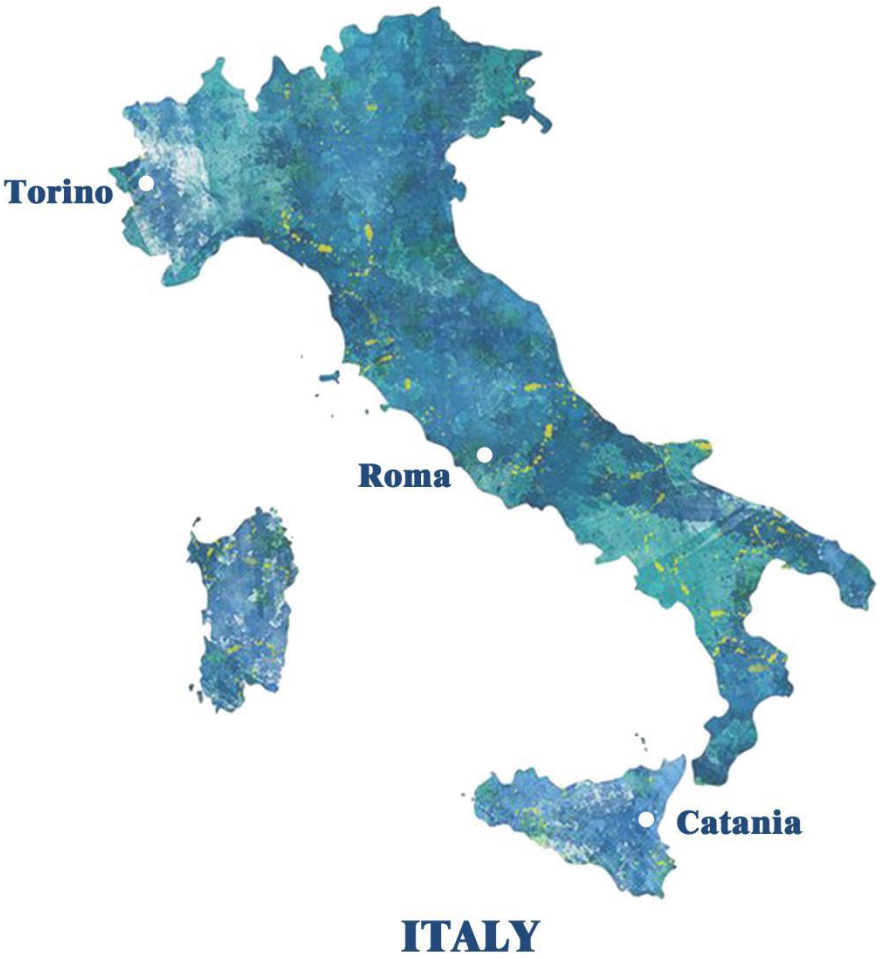


Assignment Report

TECHNICAL ENVIRONMENTAL SYSTEM

2019-2020

Professor:

Behzad najafi

Team member:

Xu Jiatong

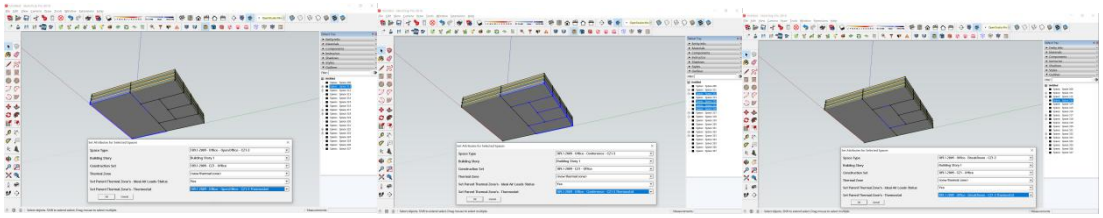
Wang yijin

Ji nan

Shi yanghongyi

0. Overall introduction

- In our project, based on the usage of software tools (OpenStudio, EnergyPlus) to build modeling and simulate energy consumption, we chose the layout of a conference building, whose total building area is 14400m² . There are 2 floors inside and each floor has 6 rooms.

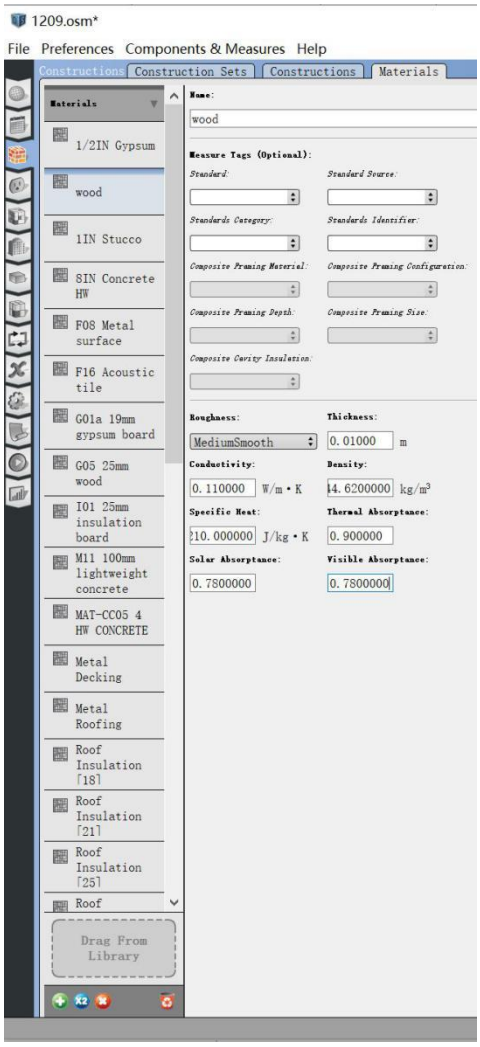


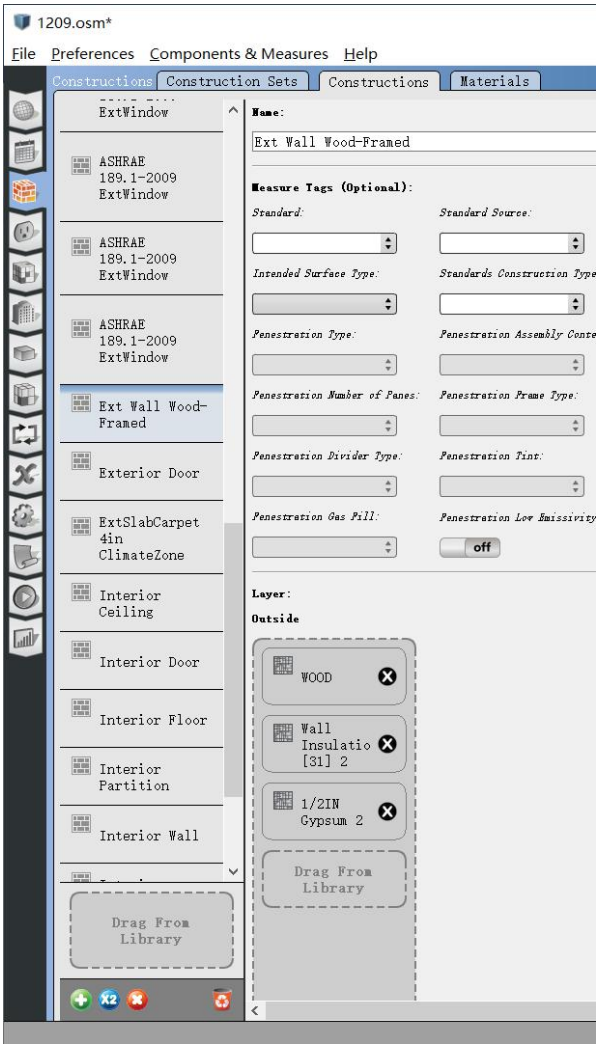
- To test the impact of Building introduction: It has two floors, and each floor is four-meter high. This commercial space is totally open and surrounded by glass and concrete.
- To test the different factors on the energy consumption of the building, we changed two groups of input which are the material of the external wall (wood, metal and concrete) and the site. We chose Turin, Roma, Catania three cities from average temperature low to high. These three cities are located in central and southern northern Italy.
- So in the following report, we will analysis 9 situations that 3 different walls build in 3 different cities.

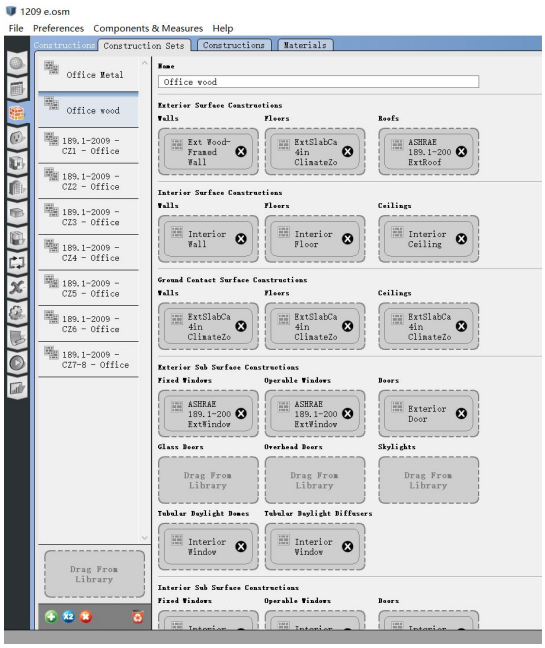
Building Area

	Area [m2]
Total Building Area	14400.00
Net Conditioned Building Area	14400.00
Unconditioned Building Area	0.00

1 Wood Setting







1.1 Turin

- 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: 2019-12-10 04:46:04

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	8458.77	587.41	587.41
Net Site Energy	8458.77	587.41	587.41
Total Source Energy	21946.50	1524.06	1524.06
Net Source Energy	21946.50	1524.06	1524.06

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

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	1330.07	0.00
Cooling	0.00	0.00	0.00	2574.71	0.00	0.00
Interior Lighting	1925.64	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	2628.34	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00	0.00	0.00
Total End Uses	4553.99	0.00	0.00	2574.71	1330.07	0.00

Note: District heat appears to be the principal heating source based on energy usage.

1.2 Roma

- 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: 2019-12-10 04:46:14

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	8425.78	585.12	585.12
Net Site Energy	8425.78	585.12	585.12
Total Source Energy	20116.33	1396.97	1396.97
Net Source Energy	20116.33	1396.97	1396.97

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

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	628.12	0.00
Cooling	0.00	0.00	0.00	3243.68	0.00	0.00
Interior Lighting	1925.64	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	2628.34	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00	0.00	0.00
Total End Uses	4553.99	0.00	0.00	3243.68	628.12	0.00

Note: District heat appears to be the principal heating source based on energy usage.

1.3 Catania

- 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: 2019-12-10 04:47:21

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	8755.69	608.03	608.03
Net Site Energy	8755.69	608.03	608.03
Total Source Energy	19707.51	1368.58	1368.58
Net Source Energy	19707.51	1368.58	1368.58

Site to Source Energy Conversion Factors

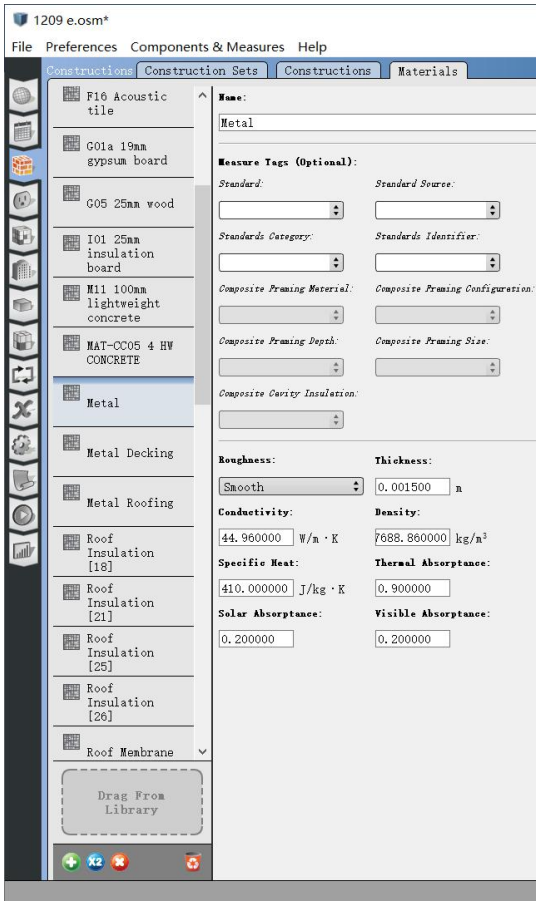
	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613
Steam	0.300
Gasoline	1.050
Diesel	1.050
Coal	1.050
Fuel Oil #1	1.050
Fuel Oil #2	1.050
Propane	1.050
Other Fuel 1	1.000
Other Fuel 2	1.000

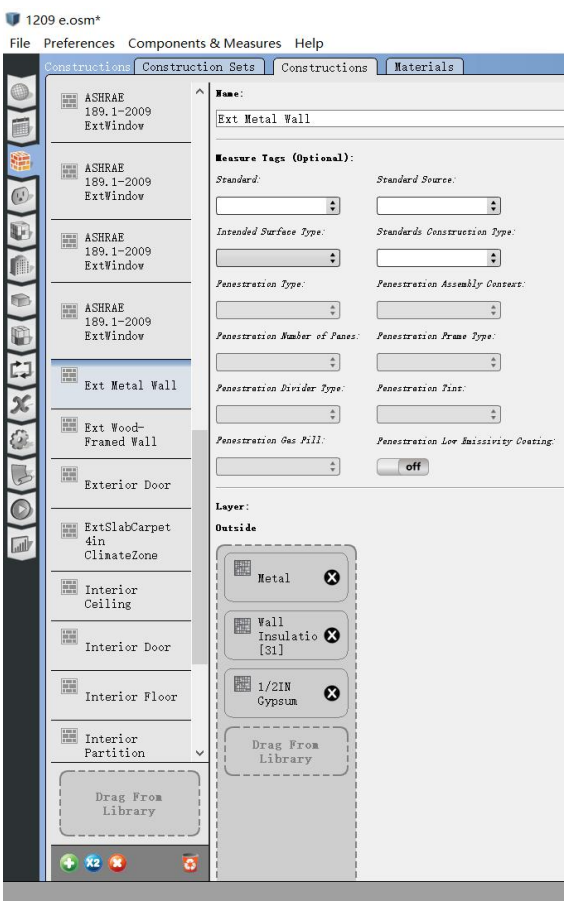
End Uses

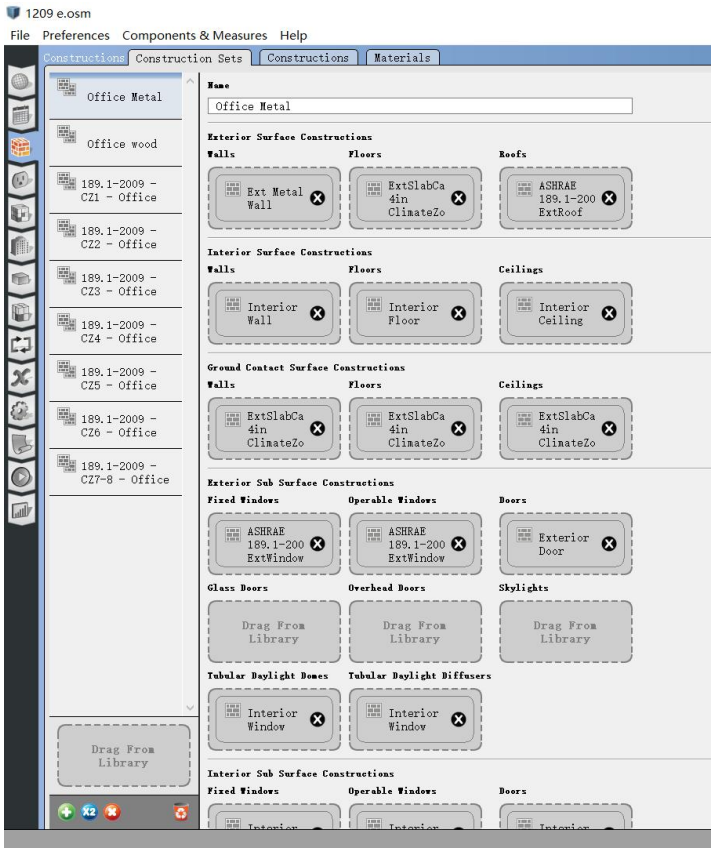
	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	0.00	0.00	0.00	0.00	332.11	0.00
Cooling	0.00	0.00	0.00	3869.59	0.00	0.00
Interior Lighting	1925.64	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	2628.34	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00	0.00	0.00
Total End Uses	4553.99	0.00	0.00	3869.59	332.11	0.00

Note: District heat appears to be the principal heating source based on energy usage.

2 Metal Setting







2.1 Turin

- 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: 2019-12-10 04:52:35

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	8416.17	584.46	584.46
Net Site Energy	8416.17	584.46	584.46
Total Source Energy	22010.35	1528.50	1528.50
Net Source Energy	22010.35	1528.50	1528.50

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

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	1372.62	0.00
Cooling	0.00	0.00	0.00	2489.56	0.00	0.00
Interior Lighting	1925.64	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	2628.34	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00	0.00	0.00
Total End Uses	4553.99	0.00	0.00	2489.56	1372.62	0.00

Note: District heat appears to be the principal heating source based on energy usage.

2.2 Roma

- 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: 2019-12-10 05:12:53

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	8368.45	581.14	581.14
Net Site Energy	8368.45	581.14	581.14
Total Source Energy	20109.60	1396.50	1396.50
Net Source Energy	20109.60	1396.50	1396.50

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

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	649.15	0.00
Cooling	0.00	0.00	0.00	3165.31	0.00	0.00
Interior Lighting	1925.64	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	2628.34	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00	0.00	0.00
Total End Uses	4553.99	0.00	0.00	3165.31	649.15	0.00

Note: District heat appears to be the principal heating source based on energy usage.

2.3 Catania

- 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: 2019-12-10 05:15:45

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	8680.76	602.83	602.83
Net Site Energy	8680.76	602.83	602.83
Total Source Energy	19663.18	1365.50	1365.50
Net Source Energy	19663.18	1365.50	1365.50

Site to Source Energy Conversion Factors

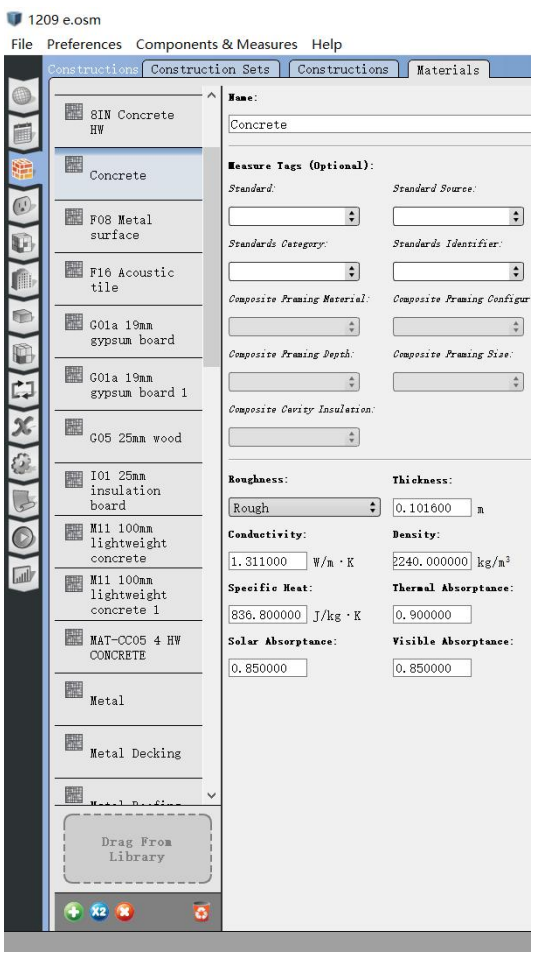
	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613
Steam	0.300
Gasoline	1.050
Diesel	1.050
Coal	1.050
Fuel Oil #1	1.050
Fuel Oil #2	1.050
Propane	1.050
Other Fuel 1	1.000
Other Fuel 2	1.000

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	345.71	0.00
Cooling	0.00	0.00	0.00	3781.06	0.00	0.00
Interior Lighting	1925.64	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	2628.34	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00	0.00	0.00
Total End Uses	4553.99	0.00	0.00	3781.06	345.71	0.00

Note: District heat appears to be the principal heating source based on energy usage.

3 Concrete Setting


1209 e.osm
File Preferences Components & Measures Help
Constructions Construction Sets Constructions Materials
8IN Concrete HW
Concrete
F08 Metal surface
F16 Acoustic tile
G01a 19mm gypsum board
G01a 19mm gypsum board 1
G05 25mm wood
I01 25mm insulation board
M11 100mm lightweight concrete
M11 100mm lightweight concrete 1
MAT-CC05 4 HW CONCRETE
Metal
Metal Decking
Drag From Library
Name:
Concrete
Measure Tags (Optional):
Standard:
Standard Source:
Standards Category:
Standards Identifier:
Composite Framing Material:
Composite Framing Configur
Composite Framing Depth:
Composite Framing Size:
Composite Cavity Insulation:
Roughness:
Rough
Thickness:
0.101600 m
Conductivity:
1.311000 W/m · K
Density:
2240.000000 kg/m³
Specific Heat:
836.800000 J/kg · K
Thermal Absorptance:
0.900000
Solar Absorptance:
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Visible Absorptance:
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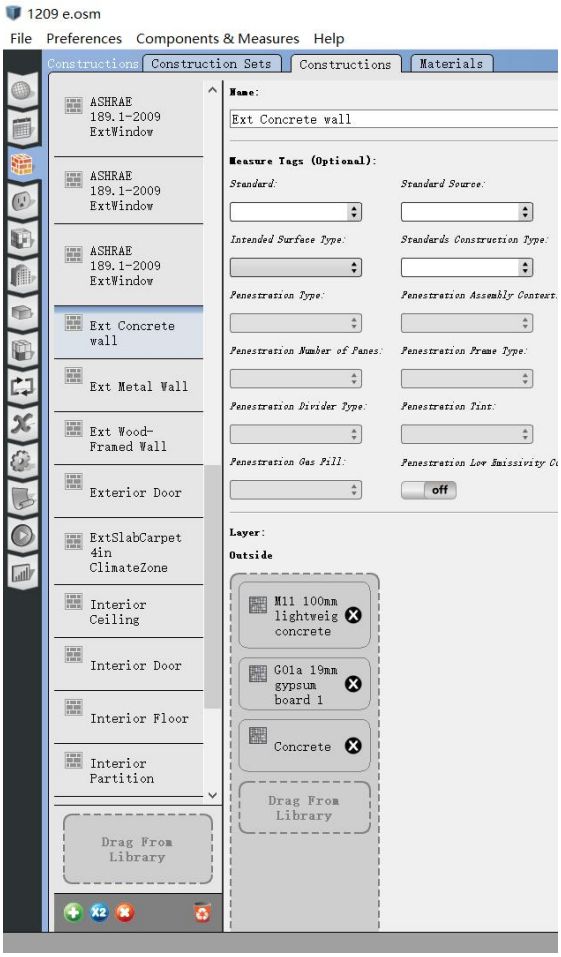
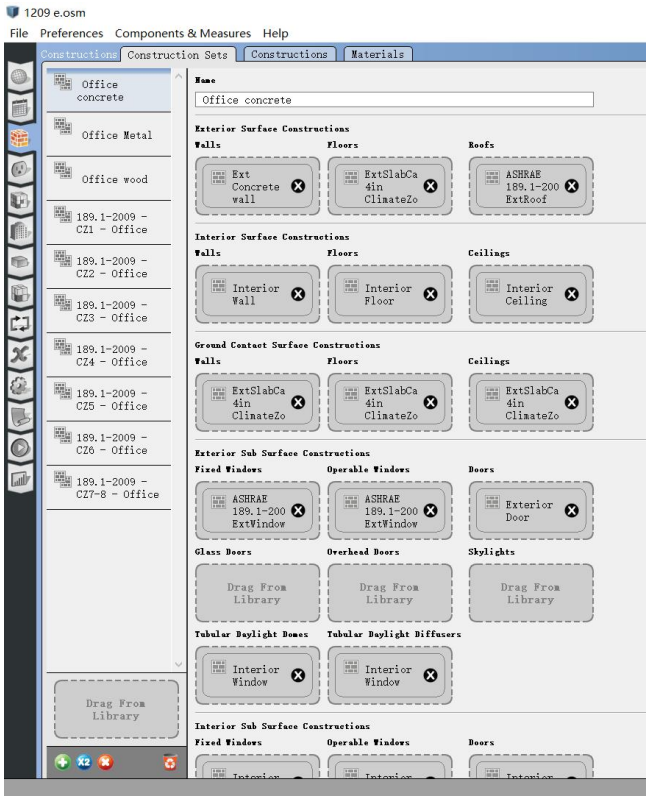

1209 e.osm
File Preferences Components & Measures Help
Constructions Construction Sets Constructions Materials
ASHRAE 189.1-2009 ExtWindow
ASHRAE 189.1-2009 ExtWindow
ASHRAE 189.1-2009 ExtWindow
Ext Concrete wall
Ext Metal Wall
Ext Wood-Framed Wall
Exterior Door
ExtSlabCarpet 4in ClimateZone
Interior Ceiling
Interior Door
Interior Floor
Interior Partition
Drag From Library
Name:
Ext Concrete wall
Measure Tags (Optional):
Standard:
Standard Source:
Intended Surface Type:
Standards Construction Type:
Penestration Type:
Penestration Assembly Content
Penestration Number of Panes:
Penestration Frame Type:
Penestration Divider Type:
Penestration Tint:
Penestration Gas Fill:
Penestration Low Emissivity C
off
Layer:
Outside
M11 100mm lightweig concrete
G01a 19mm gypsum board 1
Concrete
Drag From Library


1209 e.osm
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Constructions Construction Sets Constructions Materials
Office concrete
Office Metal
Office wood
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
Office concrete
Exterior Surface Constructions
Walls
Floors
Roofs
Ext Concrete wall
ExtSlabCa 4in ClimateZo
ASHRAE 189.1-200 ExtRoof
Interior Surface Constructions
Walls
Floors
Ceilings
Interior Wall
Interior Floor
Interior Ceiling
Ground Contact Surface Constructions
Walls
Floors
Ceilings
ExtSlabCa 4in ClimateZo
Exterior Sub Surface Constructions
Fixed Windows
Operable Windows
Doors
ASHRAE 189.1-200 ExtWindow
Exterior Door
Glass Doors
Overhead Doors
Skylights
Drag From Library
Tubular Daylight Domes
Tubular Daylight Diffusers
Interior Window
Interior Sub Surface Constructions
Fixed Windows
Operable Windows
Doors

3.1 Turin

- 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: 2019-12-10 05:27:25

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	8501.94	590.41	590.41
Net Site Energy	8501.94	590.41	590.41
Total Source Energy	22326.52	1550.45	1550.45
Net Source Energy	22326.52	1550.45	1550.45

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

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	1460.83	0.00
Cooling	0.00	0.00	0.00	2487.12	0.00	0.00
Interior Lighting	1925.64	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	2628.34	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00	0.00	0.00
Total End Uses	4553.99	0.00	0.00	2487.12	1460.83	0.00

3.2 Roma

- 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: 2019-12-10 05:29:49

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	8388.65	582.55	582.55
Net Site Energy	8388.65	582.55	582.55
Total Source Energy	20238.94	1405.48	1405.48
Net Source Energy	20238.94	1405.48	1405.48

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

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	691.39	0.00
Cooling	0.00	0.00	0.00	3143.28	0.00	0.00
Interior Lighting	1925.64	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	2628.34	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00	0.00	0.00
Total End Uses	4553.99	0.00	0.00	3143.28	691.39	0.00

Note: District heat appears to be the principal heating source based on energy usage.

3.3 Catania

- 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: 2019-12-10 05:32:25

Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	8668.88	602.01	602.01
Net Site Energy	8668.88	602.01	602.01
Total Source Energy	19680.35	1366.69	1366.69
Net Source Energy	19680.35	1366.69	1366.69

Site to Source Energy Conversion Factors

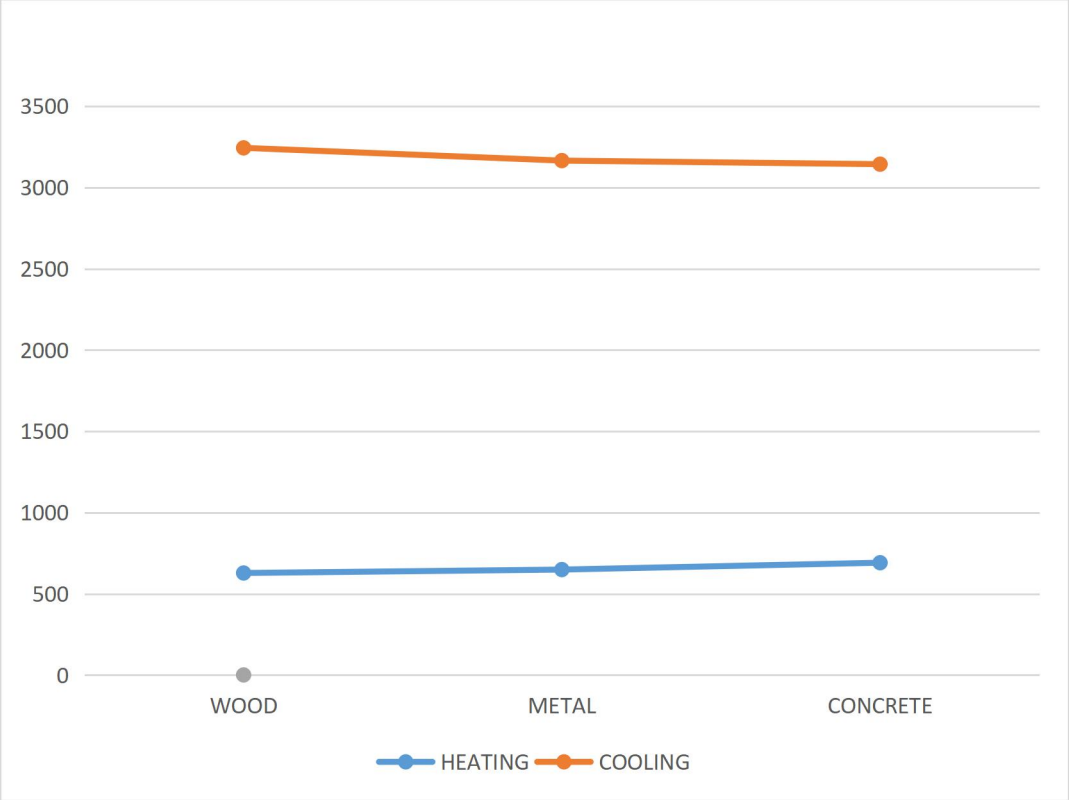
	Site=>Source Conversion Factor
Electricity	3.167
Natural Gas	1.084
District Cooling	1.056
District Heating	3.613
Steam	0.300
Gasoline	1.050
Diesel	1.050
Coal	1.050
Fuel Oil #1	1.050
Fuel Oil #2	1.050
Propane	1.050
Other Fuel 1	1.000
Other Fuel 2	1.000

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	357.33	0.00
Cooling	0.00	0.00	0.00	3757.56	0.00	0.00
Interior Lighting	1925.64	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	2628.34	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00
Fans	0.00	0.00	0.00	0.00	0.00	0.00
Pumps	0.00	0.00	0.00	0.00	0.00	0.00
Heat Rejection	0.00	0.00	0.00	0.00	0.00	0.00
Humidification	0.00	0.00	0.00	0.00	0.00	0.00
Heat Recovery	0.00	0.00	0.00	0.00	0.00	0.00
Water Systems	0.00	0.00	0.00	0.00	0.00	0.00
Refrigeration	0.00	0.00	0.00	0.00	0.00	0.00
Generators	0.00	0.00	0.00	0.00	0.00	0.00
Total End Uses	4553.99	0.00	0.00	3757.56	357.33	0.00

4. Sensitivity analysis on the walls for Roma

	WOOD	METAL	CONCRETE
HEATING[GJ]	628.12	649.15	691.39
COOLING[GJ]	3243.68	3165.31	3143.28

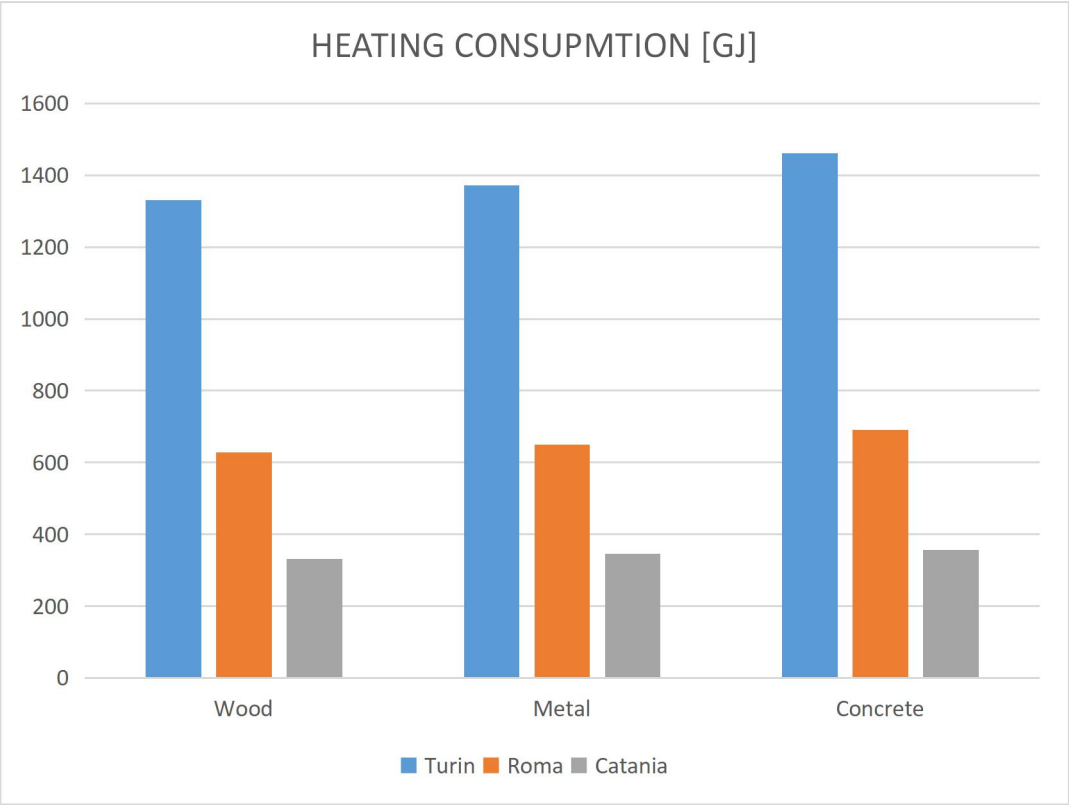


- From the comparison of the above table, it can be seen that the energy consumption of the wall is different for different materials in the same place.
- From the HEATING column, the walls made of wood have the minimum value of district heating and the walls made of concrete have the maximum value of district heating.
- From the COOLING column, the walls made of concrete have the minimum value of district cooling and the walls made of wood have the maximum value of district cooling.

5. Summary

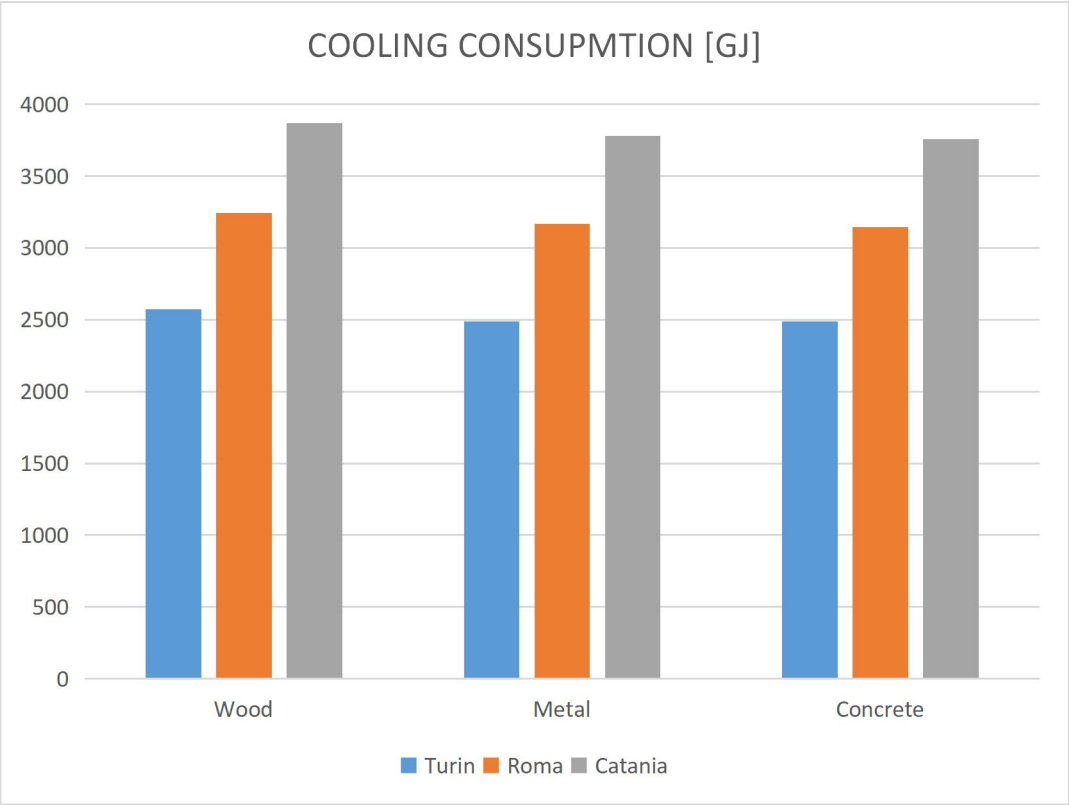
- HEATING CONSUMPTION [GJ]

	Turin	Roma	Catania
wood	1330.07	628.12	332.11
metal	1372.62	649.15	345.71
concrete	1460.83	691.39	357.33



- COOLING CONSUMPTION [GJ]

	Turin	Roma	Catania
wood	2574.71	3243.68	3869.59
metal	2489.56	3165.31	3781.06
concrete	2487.12	3143.28	3757.56



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, Catania 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 made of concrete has the least energy consumption.