

# TECHNICAL ENVIRONMENT SYSTEMS REPORT

2018-2019

POLITECNICO DI MILANO

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# INTRODUCTION

The report is to research the internal energy of building with different exterior walls in different cities. We made one building and put it into three cities-PIACENZA,PARIS,OSLO to test its energy performances . In the first three cases, we analyzed three exterior walls in PIACENZA, one is the basic wall, the others are new walls . The last two cases are in the other cities with one of the new wall. At last, we summarized the results and compared the energy performances of the building with different exterior walls in one city and it with the same exterior wall in different cities

BUILDING

PIACENZA

PARIS

OSLO

ENERGY PERFORMANCE ?

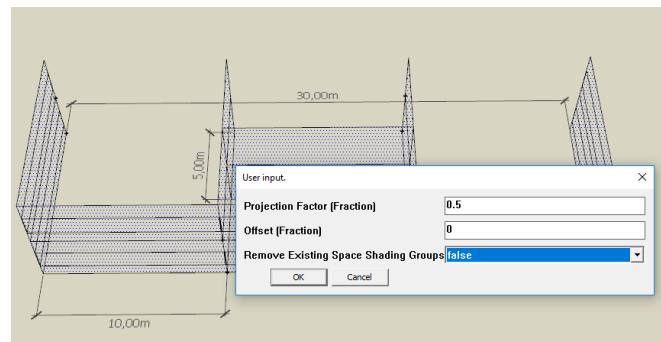
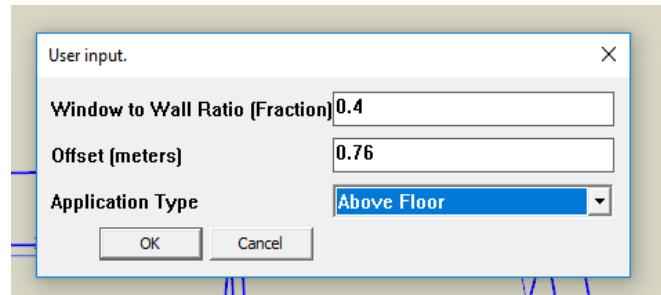
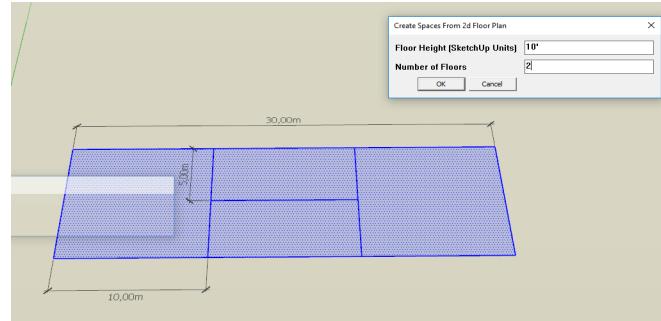
BASIC WALL

WALL 1

WALL 2

# BUILDING

We made an office building in this case which is 30 meters long, 10 meters wide and 10 meters high. The total building area has 600 square meters . This building has two floors and has some simple structure . It is surrounded by walls and glasses.



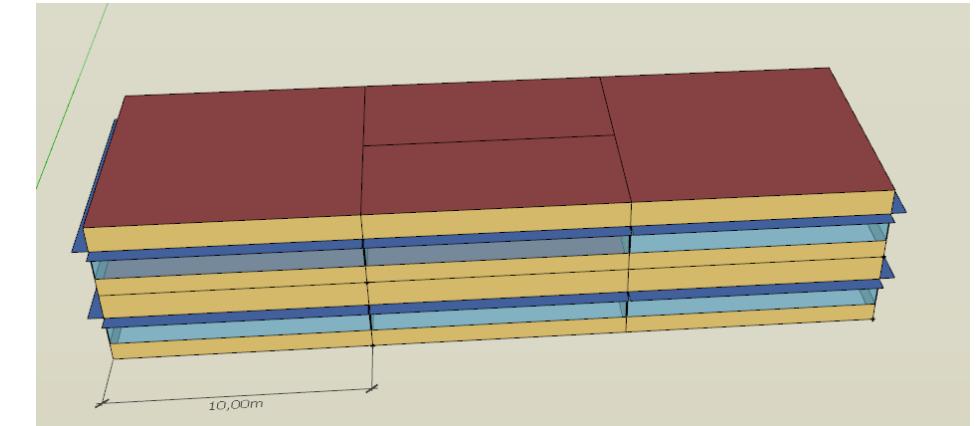
## Building Area

	Area [m <sup>2</sup> ]
Total Building Area	600.00
Net Conditioned Building Area	600.00
Unconditioned Building Area	0.00

## ENVELOPE

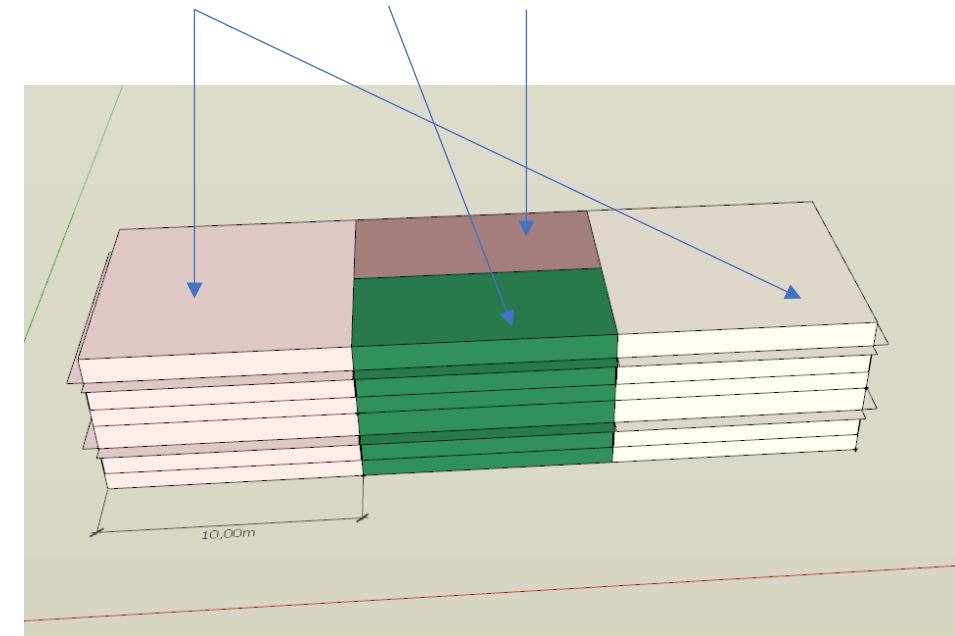
### Window-Wall Ratio

	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 <sup>2</sup> ]	487.68	182.88	60.96	182.88	60.96
Above Ground Wall Area [m <sup>2</sup> ]	487.68	182.88	60.96	182.88	60.96
Window Opening Area [m <sup>2</sup> ]	195.07	73.15	24.38	73.15	24.38
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



## Thermal zones

Open offices / Break Room / Stairs



# PIACENZA-BASIC WALL

**BASIC WALL : Stucco (2,5cm) / Concrete (20cm) / Insulation (3cm) / Gypsum (1.3cm)**

Program Version:EnergyPlus, Version 8.9.0-eba93e8e1b, YMD=2018.12.19 10:17

Tabular Output Report in Format: **HTML**

Building: **Building 1**

Environment: **RUN PERIOD 1 \*\* Piacenza - ITA IGDG WMO#=160840**

Simulation Timestamp: **2018-12-19 10:17:25**

Report: **Annual Building Utility Performance Summary**

For: **Entire Facility**

Timestamp: **2018-12-19 10:17:25**

Values gathered over **8760.00 hours**

The screenshot shows the JIANI MODEL BASIC WALL\_PIACE software interface. On the left is a vertical toolbar with various icons. The main window has tabs for 'Constructions', 'Construction Sets', 'Constructions', and 'Materials'. Under 'Constructions', there are sections for 'Exterior Surface Constructions' (Walls, Floors, Roofs), 'Interior Surface Constructions' (Walls, Floors, Ceilings), 'Ground Contact Surface Constructions' (Walls, Floors, Ceilings), and 'Exterior Sub Surface Constructions' (Fixed Windows, Operable Windows, Doors). Each section contains a list of available components with small preview icons and 'X' buttons. A 'Drag From Library' button is at the bottom. The 'Materials' tab on the right lists items like '189.1-200 - CZ1 - Office' through '189.1-200 - CZ7-8 - Office'. A 'Drag From Library' button is also present here.

This screenshot shows the material properties for 'G05 25mm wood'. The 'Materials' tab is selected. The 'Measure Tags (Optional)' section includes fields for 'Standard', 'Standard Source', 'Standards Category', 'Standards Identifier', 'Composite Framing Material', 'Composite Framing Depth', 'Composite Cavity Insulation', 'Roughness', 'Thickness', 'Conductivity', 'Specific Heat', 'Solar Absorptance', 'Density', 'Thermal Absorptance', and 'Visible Absorptance'. Below these are dropdown menus for 'Composite Framing Configuration', 'Composite Framing Depth', 'Composite Cavity Insulation', 'Roughness', 'Thickness', 'Conductivity', 'Specific Heat', 'Solar Absorptance', 'Density', 'Thermal Absorptance', and 'Visible Absorptance'. At the bottom are buttons for 'Drag From Library' and 'Save'.

This screenshot shows the configuration for an 'Exterior Wall' assembly. It includes fields for 'Name' (ASHRAE 189.1-2009 ExtWall Mass ClimateZone 1), 'Measure Tags (Optional)', 'Intended Surface Type' (ExteriorWall), 'Standard' (ASHRAE 189.1-2009), 'Standard Source', 'Fenestration Type' (Mass), 'Fenestration Assembly Context', 'Fenestration Number of Panes', 'Fenestration Frame Type', 'Fenestration Divider Type', 'Fenestration Tint' (off), 'Fenestration Gas Fill', 'Fenestration Low Emissivity Coating', and a 'Layer' section for 'Outside' containing '1IN Stucco', '8IN Concrete HW', 'Wall Insulation [31]', and '1/2IN Gypsum'.

# PIACENZA-BASIC WALL

BASIC WALL : Stucco (2,5cm) / Concrete (20cm) / Insulation (3cm) / Gypsum (1.3cm)

## Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	442.49	737.49	737.49
Net Site Energy	442.49	737.49	737.49
Total Source Energy	1284.32	2140.53	2140.53
Net Source Energy	1284.32	2140.53	2140.53

## 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	151.34	0.00
Cooling	0.00	0.00	0.00	87.43	0.00	0.00
Interior Lighting	69.74	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	133.99	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00

## 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

## End Uses By Subcategory

	Subcategory	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	General	0.00	0.00	0.00	0.00	151.34	0.00
Cooling	General	0.00	0.00	0.00	87.43	0.00	0.00
Interior Lighting	General	69.74	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	General	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	General	133.99	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	General	0.00	0.00	0.00	0.00	0.00	0.00

# PIACENZA-WALL 1

## NEW WALL 1 : Stucco (2,5cm) / Concrete (30cm) / Insulation (3cm) / Gypsum (1.3cm)

Program Version:EnergyPlus, Version 8.9.0-eba93e8e1b, YMD=2018.12.19 10:35

Tabular Output Report in Format: **HTML**

Building: **Building 1**

Environment: **RUN PERIOD 1 \*\* Piacenza - ITA IGDG WMO#=160840**

Simulation Timestamp: **2018-12-19 10:35:12**

Report: **Annual Building Utility Performance Summary**

For: **Entire Facility**

Timestamp: **2018-12-19 10:35:12**

**Values gathered over 8760.00 hours**

Materials

Name: BIN Concrete HW

Measure Tags (Optional):

Standard: ASHRAE 189.1-2009  
Standard Source: ASHRAE 189.1-2009

Standards Category: Composite Framing Material: Composite Framing Configuration:

Composite Framing Depth: Composite Framing Size:

Composite Cavity Insulation:

Roughness: Thickness: MediumRough 0.203300 m

Conductivity: Density: 1.729600 W/m-K 2243.000000 kg/m³

Specific Heat: Thermal Absorptance: 837.000000 J/kg-K 0.900000

Solar Absorptance: Visible Absorptance: 0.650000 0.650000

Drag From Library

Constructions

Name: 189.1-2009 - CZ1 - Office

Exterior Surface Constructions

Walls: NEW WALL 1 (X)

Floors: EXTERIOR 4in ClimateZoi (X)

Roofs: KNRK 189.1-200 ExtRoof (X)

Interior Surface Constructions

Walls: Interior Wall (X)

Floors: Interior Floor (X)

Ceilings: Interior Ceiling (X)

Ground Contact Surface Constructions

Walls: EXTERIOR 4in ClimateZoi (X)

Floors: EXTERIOR 4in ClimateZoi (X)

Ceilings: EXTERIOR 4in ClimateZoi (X)

Exterior Sub Surface Constructions

Fixed Windows: KNRK 189.1-200 ExtWindow (X)

Operable Windows: KNRK 189.1-200 ExtWindow (X)

Doors: Exterior Door (X)

Glass Doors: Overhead Doors: Skylights:

Drag From Library

Name: NEW WALL 1

Measure Tags (Optional):

Standard: ASHRAE 189.1-2009  
Standard Source: ASHRAE 189.1-2009

Intended Surface Type: ExteriorWall  
Standards Construction Type: WoodFramed

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 30cm (X)

Wall Insulation [3] (X)

1/2IN Gypsum (X)

# PIACENZA-WALL 1

NEW WALL 1 : Stucco (2,5cm) / Concrete (30cm) / Insulation (3cm) / Gypsum (1.3cm)

## Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	442.12	736.86	736.86
Net Site Energy	442.12	736.86	736.86
Total Source Energy	1283.73	2139.54	2139.54
Net Source Energy	1283.73	2139.54	2139.54

## 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	151.26	0.00
Cooling	0.00	0.00	0.00	87.14	0.00	0.00
Interior Lighting	69.74	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	133.99	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00

## End Uses By Subcategory

	Subcategory	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	General	0.00	0.00	0.00	0.00	151.26	0.00
Cooling	General	0.00	0.00	0.00	87.14	0.00	0.00
Interior Lighting	General	69.74	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	General	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	General	133.99	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	General	0.00	0.00	0.00	0.00	0.00	0.00

## 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

# PIACENZA-WALL 2

**NEW WALL 2: Stucco (2,5cm) / Concrete (20cm) / Insulation (10cm) / Gypsum (1.3cm)**

Program Version:EnergyPlus, Version 8.9.0-eba93e8e1b, YMD=2018.12.19 10:36

Tabular Output Report in Format: **HTML**

Building: **Building 1**

Environment: **RUN PERIOD 1 \*\* Piacenza - ITA IGDG WMO#=160840**

Simulation Timestamp: **2018-12-19 10:36:58**

Report: **Annual Building Utility Performance Summary**

For: **Entire Facility**

Timestamp: **2018-12-19 10:36:58**

Values gathered over **8760.00 hours**

**Materials**

**Name:** 1IN Stucco

**Measure Tags (Optional):**

- Standard: ASHRAE 189.1-2009
- Standard Source: ASHRAE 189.1-2009
- Standards Category: WoodFramed
- Standards Identifier: 189.1-2009 - CZ1 - Office

**Composite Framing Material:** 1IN Stucco

**Composite Framing Configuration:** 1IN Stucco

**Composite Framing Depth:** 1IN Stucco

**Composite Framing Size:** 1IN Stucco

**Composite Cavity Insulation:** 1IN Stucco

**Roughness:** MediumRough

**Thickness:** 0.203300 m

**Conductivity:** 1.729600 W/m-K

**Density:** 2243.000000 kg/m<sup>3</sup>

**Specific Heat:** 837.000000 J/kg-K

**Thermal Absorptance:** 0.900000

**Solar Absorptance:** 0.650000

**Visible Absorptance:** 0.650000

**Drag From Library**

**Constructions**

**Name:** 189.1-2009 - CZ1 - Office

**Exterior Surface Constructions**

- Walls: NEW WALL 2
- Floors: 4in ClimateZoi
- Roofs: 189.1-2009 ExtRoof

**Interior Surface Constructions**

- Walls: Interior Wall
- Floors: Interior Floor
- Ceilings: Interior Ceiling

**Ground Contact Surface Constructions**

- Walls: 4in ClimateZoi
- Floors: 4in ClimateZoi
- Ceilings: 4in ClimateZoi

**Exterior Sub Surface Constructions**

- Fixed Windows: 189.1-2009 ExtWindow
- Operable Windows: 189.1-2009 ExtWindow
- Doors: Exterior Door

**Glass Doors**

**Overhead Doors**

**Skylights**

**Drag From Library**

**Name:** NEW WALL 2

**Measure Tags (Optional):**

- Standard: ASHRAE 189.1-2009
- Standard Source: ASHRAE 189.1-2009
- Intended Surface Type: ExteriorWall
- Standards Construction Type: WoodFramed

**Fenestration Type:**

**Fenestration Number of Panes:**

**Fenestration Frame Type:**

**Fenestration Divider Type:**

**Fenestration Tint:**

**Fenestration Gas Fill:**

**Fenestration Low Emissivity Coating:** off

**Layer:**

**Outside**

- 1IN Stucco
- 8IN Concrete HW
- Wall Insulation [31] 10 cm
- 1/2IN Gypsum

# PIACENZA-WALL 2

NEW WALL 2: Stucco (2,5cm) / Concrete (20cm) / Insulation (10cm) / Gypsum (1.3cm)

## Site and Source Energy

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	427.92	713.20	713.20
Net Site Energy	427.92	713.20	713.20
Total Source Energy	1237.16	2061.94	2061.94
Net Source Energy	1237.16	2061.94	2061.94

## 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	138.91	0.00
Cooling	0.00	0.00	0.00	85.28	0.00	0.00
Interior Lighting	69.74	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	133.99	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00

## End Uses By Subcategory

	Subcategory	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	General	0.00	0.00	0.00	0.00	138.91	0.00
Cooling	General	0.00	0.00	0.00	85.28	0.00	0.00
Interior Lighting	General	69.74	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	General	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	General	133.99	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	General	0.00	0.00	0.00	0.00	0.00	0.00

**PARIS-WALL 2****Stucco (2,5cm) / Concrete (20cm) / Insulation (10cm) / Gypsum (1.3cm)**

Program Version:EnergyPlus, Version 8.9.0-eba93e8e1b, YMD=2018.12.19 10:35

Report: Annual Building Utility Performance Summary

Tabular Output Report in Format: **HTML**For: **Entire Facility**Building: **Building 1**Timestamp: **2018-12-19 10:39:25**Environment: **RUN PERIOD 1 \*\* Piacenza - ITA IGDG WMO#=160840****Values gathered over 8760.00 hours****Site and Source Energy**

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	442.12	736.86	736.86
Net Site Energy	442.12	736.86	736.86
Total Source Energy	1283.73	2139.54	2139.54
Net Source Energy	1283.73	2139.54	2139.54

**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	148.66	0.00
Cooling	0.00	0.00	0.00	52.40	0.00	0.00
Interior Lighting	69.74	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	133.99	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00

**End Uses By Subcategory**

	Subcategory	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	General	0.00	0.00	0.00	0.00	148.66	0.00
Cooling	General	0.00	0.00	0.00	52.40	0.00	0.00
Interior Lighting	General	69.74	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	General	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	General	133.99	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	General	0.00	0.00	0.00	0.00	0.00	0.00

**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

# OSLO-WALL 2 Stucco (2,5cm) / Concrete (20cm) / Insulation (10cm) / Gypsum (1.3cm)

Program Version:EnergyPlus, Version 8.9.0-eba93e8e1b, YMD=2018.12.19 10:40

Tabular Output Report in Format: HTML

Building: Building 1

Environment: RUN PERIOD 1 \*\* OSLO/FORNEBU - NOR IWEC Data WMO#=014880

Simulation Timestamp: 2018-12-19 10:40:42

**Site and Source Energy**

	Total Energy [GJ]	Energy Per Total Building Area [MJ/m2]	Energy Per Conditioned Building Area [MJ/m2]
Total Site Energy	487.55	812.58	812.58
Net Site Energy	487.55	812.58	812.58
Total Source Energy	1593.67	2656.11	2656.11
Net Source Energy	1593.67	2656.11	2656.11

**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	253.69	0.00
Cooling	0.00	0.00	0.00	30.13	0.00	0.00
Interior Lighting	69.74	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	133.99	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	0.00	0.00	0.00	0.00	0.00	0.00

**End Uses By Subcategory**

	Subcategory	Electricity [GJ]	Natural Gas [GJ]	Additional Fuel [GJ]	District Cooling [GJ]	District Heating [GJ]	Water [m3]
Heating	General	0.00	0.00	0.00	0.00	253.69	0.00
Cooling	General	0.00	0.00	0.00	30.13	0.00	0.00
Interior Lighting	General	69.74	0.00	0.00	0.00	0.00	0.00
Exterior Lighting	General	0.00	0.00	0.00	0.00	0.00	0.00
Interior Equipment	General	133.99	0.00	0.00	0.00	0.00	0.00
Exterior Equipment	General	0.00	0.00	0.00	0.00	0.00	0.00

Report: Annual Building Utility Performance Summary

For: Entire Facility

Timestamp: 2018-12-19 10:40:42

Values gathered over 8760.00 hours

**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

# SUMMARY

## TEST IN PIACENZA WITH THE 3 DIFFERENT WALLS

ENERGY USE	Total use (GJ)	Cooling (GJ)	Heating (GJ)
BASIC WALL	442.49	87.43	151.34
NEW WALL 1	442.12	87.14	151.26
NEW WALL 2	427.92	85.28	138.91

## TEST WITH WALL 2 IN 3 DIFFERENT CITIES

ENERGY USE	Total use (GJ)	Cooling (GJ)	Heating (GJ)
OSLO	487.55	30.13	253.69
PARIS	404.79	52.40	148.66
PIACENZA	427.92	85.28	138.91