

Energy and Environmental Technologies for Building Systems

Final Project

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Characteristics

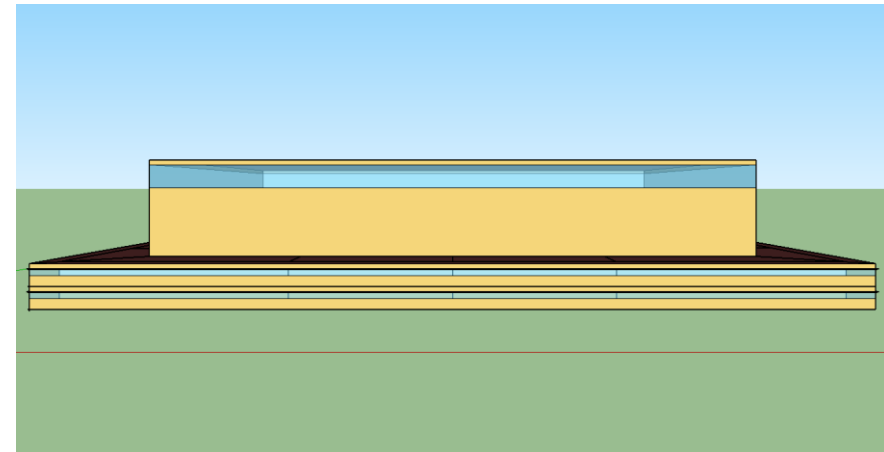
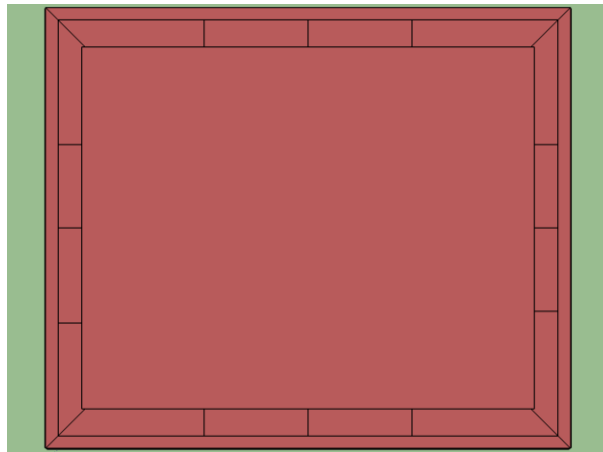
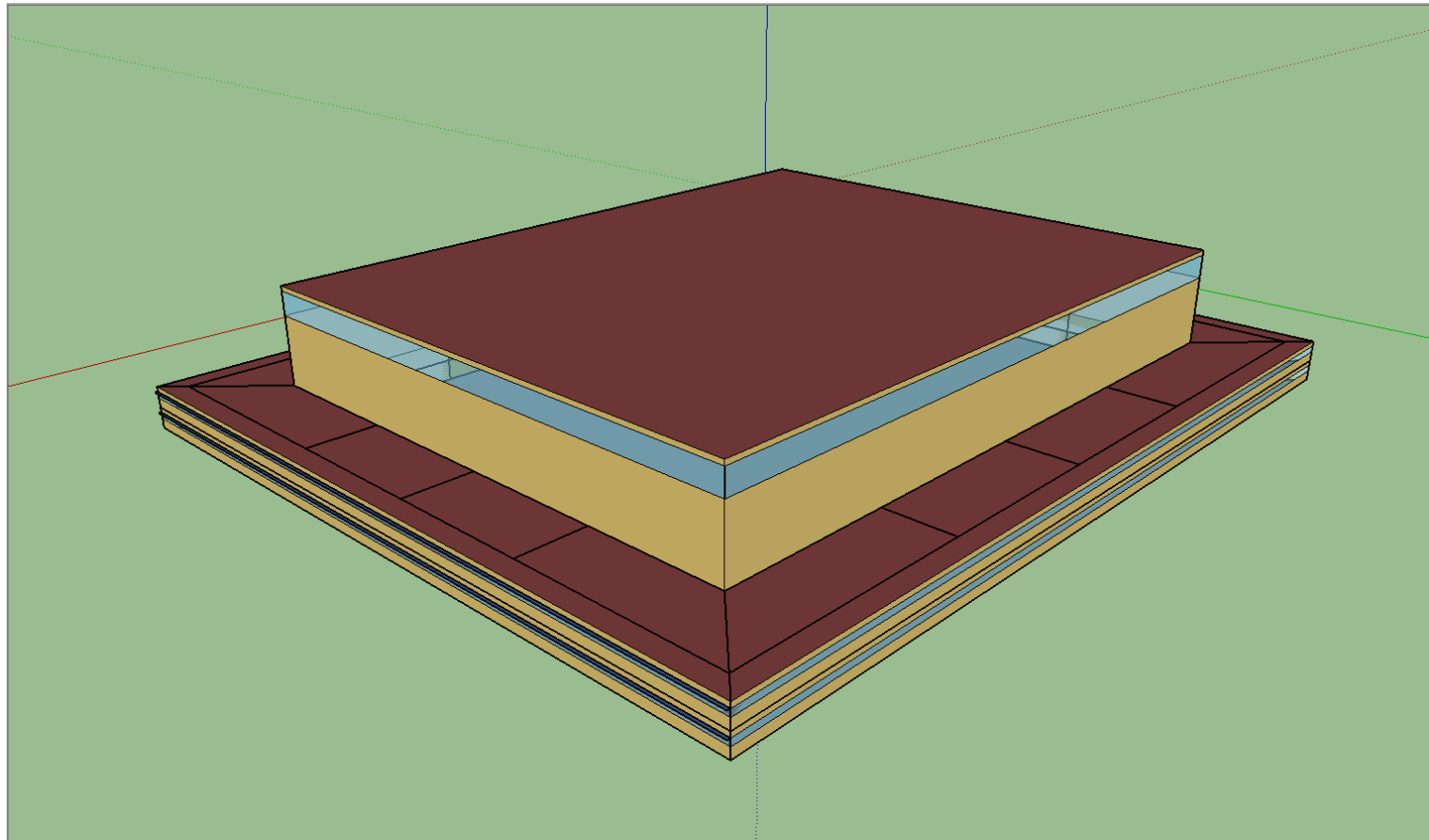
- Building Dimensions = 126m x 106m (13356m²)
- Stadium Dimensions = 100m x 80m
- Peripheral building height = 6m (2x 3m floors)
- Total building Height = 20m

1st FLOOR

- Stadium (22 000 occupants)
- External Corridor (3m width)
- Shops (10m width)
- Stadium's Changing room (10m width, north side of the building)

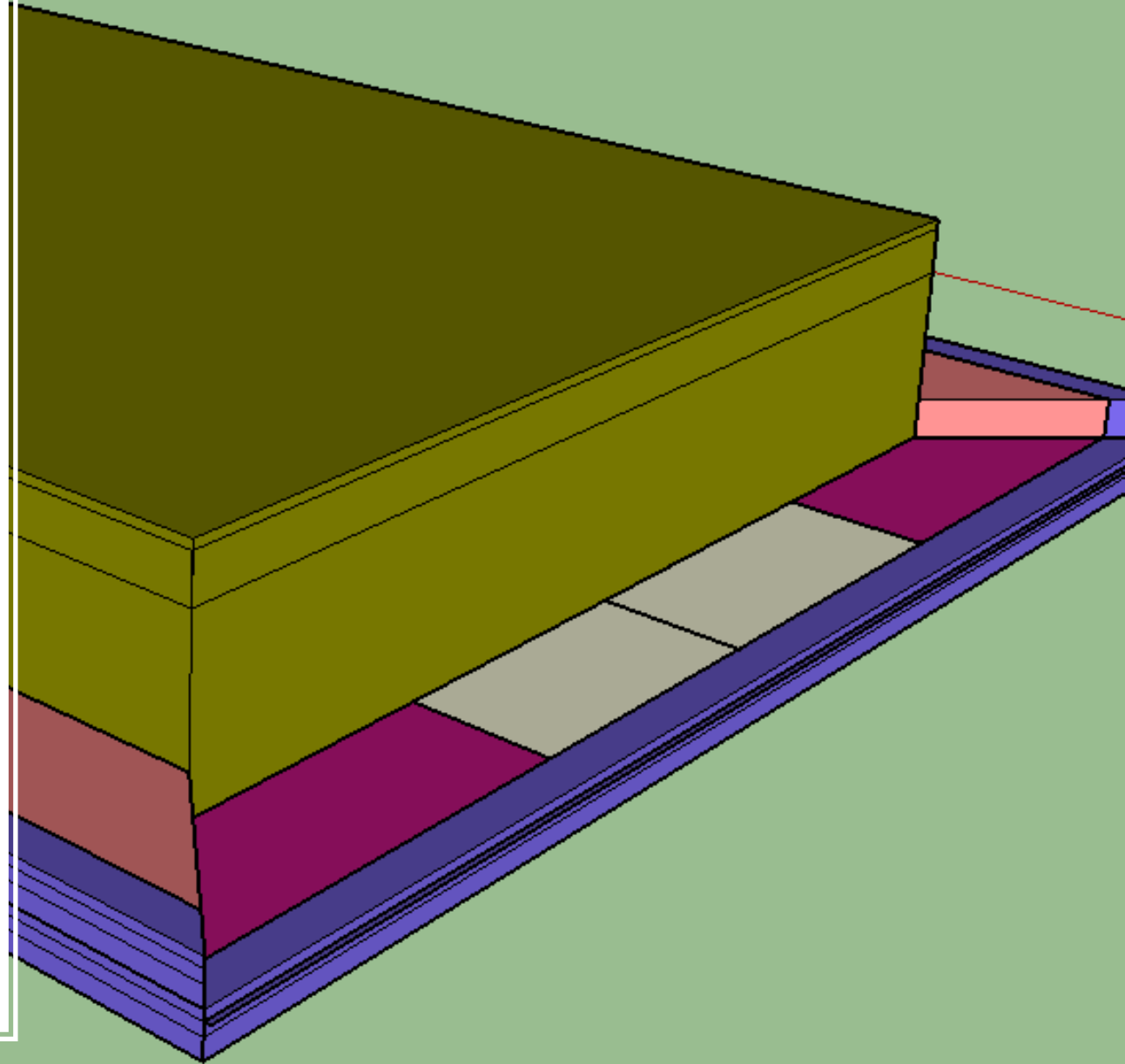
2nd FLOOR

- External Corridor (3m width)
- Offices (10m width)



Thermal Zones

- Thermal zone 1 – Corridors (violet)
- Thermal zone 2 – Offices (pink)
- Thermal zone 3 – Shops (purple)
- Thermal zone 4 – Changing Rooms (grey)
- Thermal zone 5 – Stadium (green)



Walls

- The external walls of the peripheral building have been set with the default construction properties.
- The external walls of the stadium (base case) have been customized based on real data taken from a stadium located in Bergamo.
- Best case and worst case have been set by modifying the base case adding or removing insulation layers

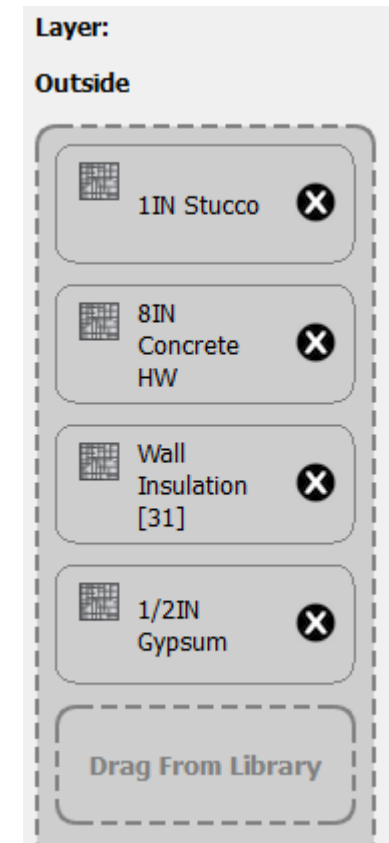
- Base Case



- Best Case



- Worst Case



Windows

Windows constitute:

- 20% of stadium walls
- 30% of peripheral building's walls

External shadings are located above the windows of the peripheral building except for the surfaces facing northward.

Windows' construction sets has been defined as follows:

Base Case

Measure Tags (Optional):

| | |
|-------------------------------|--------------------------------------|
| Standard: | Standard Source: |
| <input type="text"/> | <input type="text"/> |
| Intended Surface Type: | Standards Construction Type: |
| <input type="text"/> | <input type="text"/> |
| Fenestration Type: | Fenestration Assembly Context: |
| <input type="text"/> | <input type="text"/> |
| Fenestration Number of Panes: | Fenestration Frame Type: |
| <input type="text"/> | <input type="text"/> |
| Fenestration Divider Type: | Fenestration Tint: |
| <input type="text"/> | <input type="text"/> |
| Fenestration Gas Fill: | Fenestration Low Emissivity Coating: |
| <input type="text"/> | <input type="checkbox"/> |

Layer:

Outside

Clear 3mm 1

Best Case

Measure Tags (Optional):

| | |
|-------------------------------|--------------------------------------|
| Standard: | Standard Source: |
| <input type="text"/> | <input type="text"/> |
| Intended Surface Type: | Standards Construction Type: |
| <input type="text"/> | <input type="text"/> |
| Fenestration Type: | Fenestration Assembly Context: |
| <input type="text"/> | <input type="text"/> |
| Fenestration Number of Panes: | Fenestration Frame Type: |
| <input type="text"/> | <input type="text"/> |
| Fenestration Divider Type: | Fenestration Tint: |
| <input type="text"/> | <input type="text"/> |
| Fenestration Gas Fill: | Fenestration Low Emissivity Coating: |
| <input type="text"/> | <input checked="" type="checkbox"/> |

Layer:

Outside

Theoretical Glass [221]

Worst Case

Measure Tags (Optional):

| | |
|-------------------------------|--------------------------------------|
| Standard: | Standard Source: |
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| Intended Surface Type: | Standards Construction Type: |
| <input type="text"/> | <input type="text"/> |
| Fenestration Type: | Fenestration Assembly Context: |
| <input type="text"/> | <input type="text"/> |
| Fenestration Number of Panes: | Fenestration Frame Type: |
| <input type="text"/> | <input type="text"/> |
| Fenestration Divider Type: | Fenestration Tint: |
| <input type="text"/> | <input type="text"/> |
| Fenestration Gas Fill: | Fenestration Low Emissivity Coating: |
| <input type="text"/> | <input type="checkbox"/> |

Layer:

Outside

Theoretical Glass [167]

$$U_{th(221)} < U_{clear} < U_{th(119)}$$

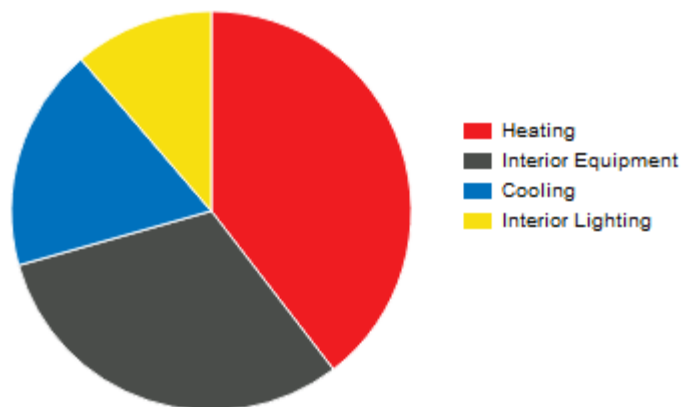
Main location: Bergamo

- Base case

Total energy consumption = 9785 GJ

Annual Overview

End Use - view table

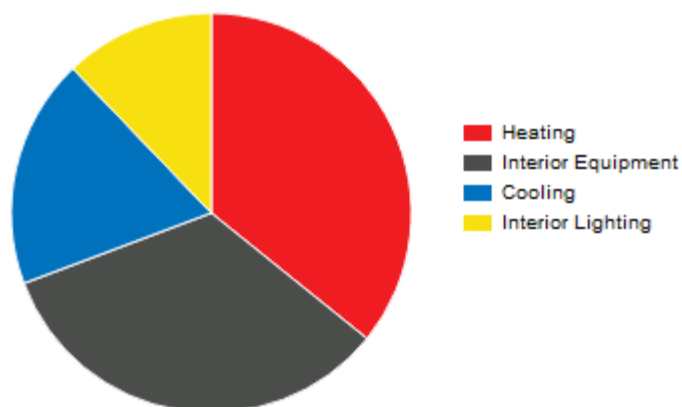


- Best case

Total energy consumption = 9082 GJ

Annual Overview

End Use - view table

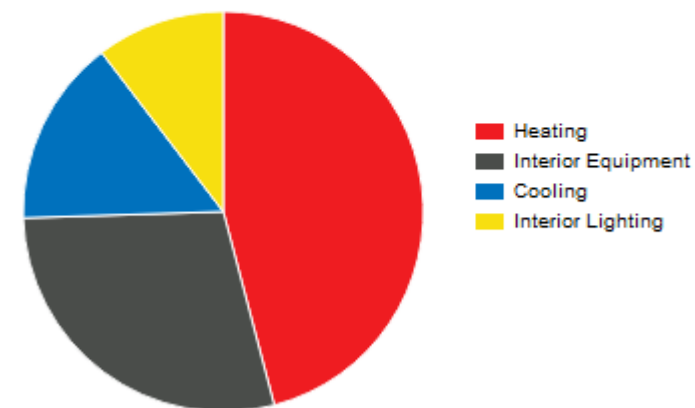


- Worst case

Total energy consumption = 10628 GJ

Annual Overview

End Use - view table



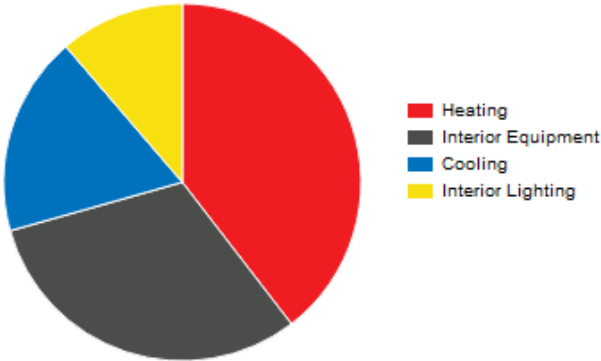
Bergamo - Italy

| | Value |
|------------------|-----------------------------|
| Weather File | Bergamo-Orio al Serio - ITA |
| Latitude | 45.67 |
| Longitude | 9.70 |
| Elevation | 781 (ft) |
| Time Zone | 1.00 |
| North Axis Angle | 0.00 |

Total energy
consumption = 9785 GJ

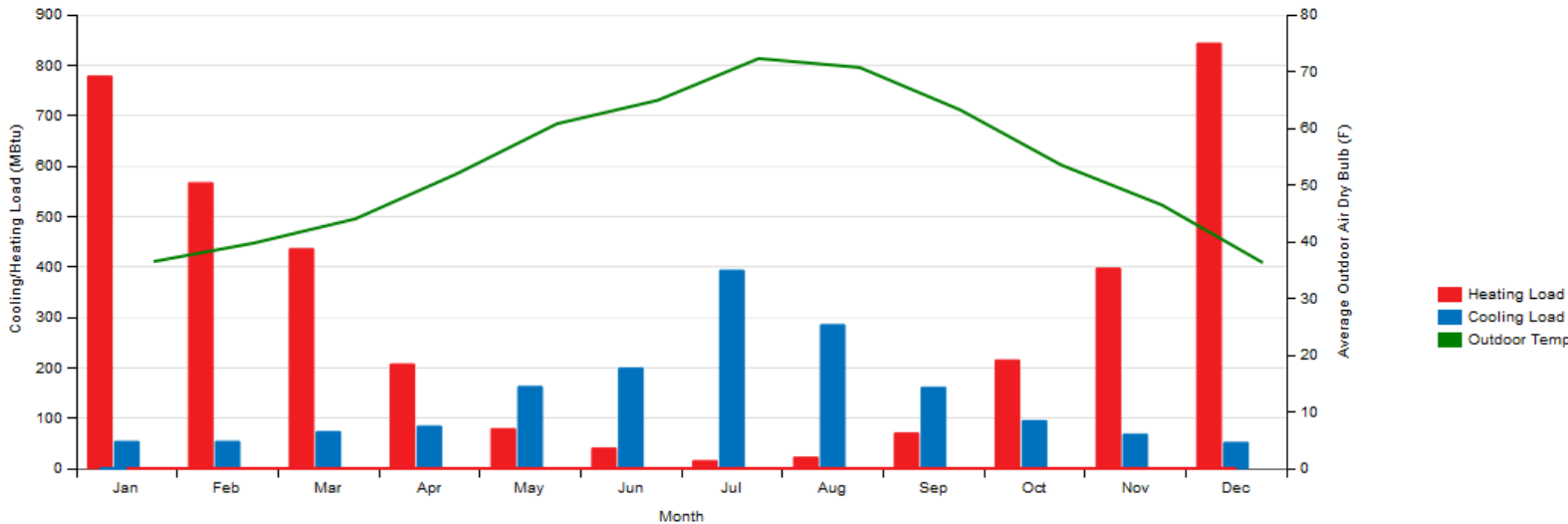
Annual Overview

End Use - view table



HVAC Load Profiles

Monthly Load Profiles - view table



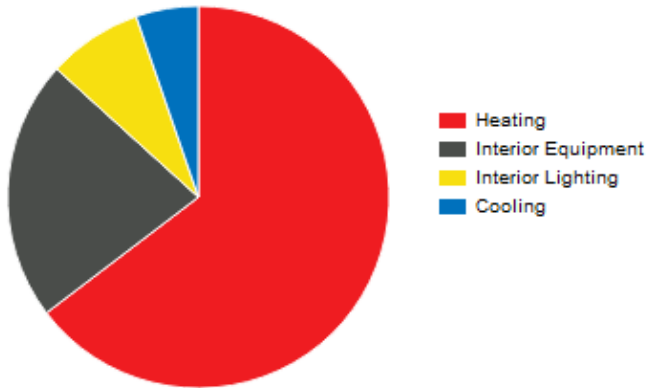
Cold bay - Alaska

| | Value |
|------------------|-----------------|
| Weather File | COLD_BAY AK USA |
| Latitude | 55.20 |
| Longitude | -162.7 |
| Elevation | 95 (ft) |
| Time Zone | -9.0 |
| North Axis Angle | 0.00 |

Total energy
consumption = 13780 GJ

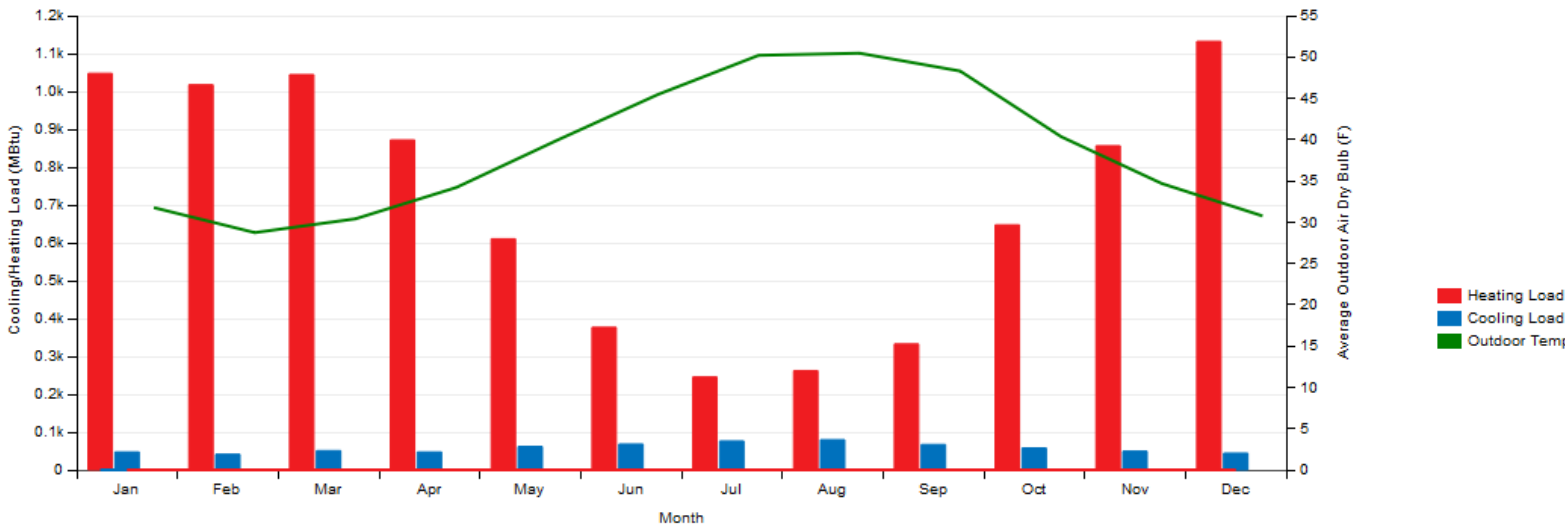
Annual Overview

End Use - view table



HVAC Load Profiles

Monthly Load Profiles - view table



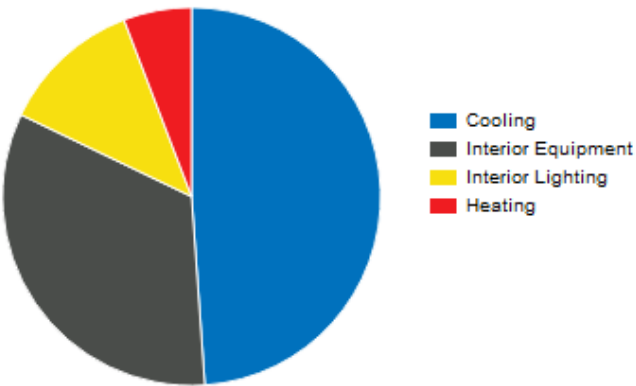
Cairo - Egypt

| | Value |
|------------------|-------------|
| Weather File | CAIRO - EGY |
| Latitude | 30.13 |
| Longitude | 31.40 |
| Elevation | 243 (ft) |
| Time Zone | 2.00 |
| North Axis Angle | 0.00 |

Total energy
consumption = 9146 GJ

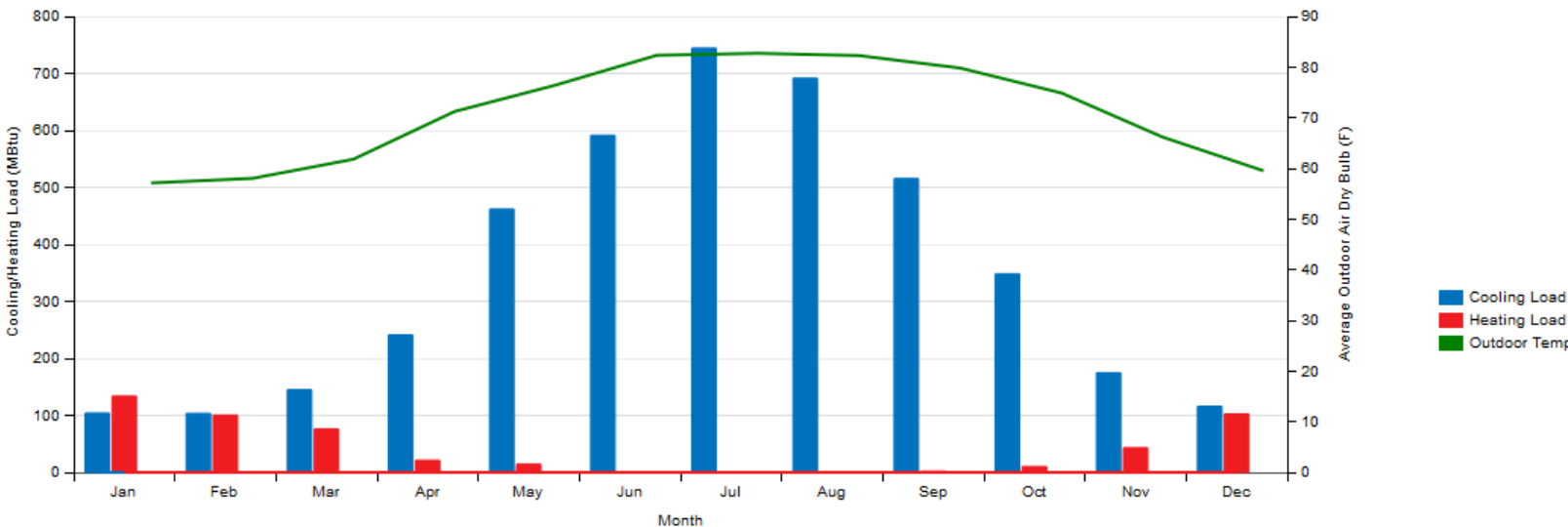
Annual Overview

End Use - view table



HVAC Load Profiles

Monthly Load Profiles - view table



References

- “Norme CONI per l’impiantistica sportiva”: general dimensions of stadium and rest rooms
- “Progetto esecutivo manutenzione palazzetto dello sport Villa D’Ogna – Bergamo” : construction set (layers, materials and thicknesses) for stadium’s walls