SIMULATION OF BUILDING ENERGY PERFORMANCE VIA OPENSTUDIO

TECHNICAL ENVIRONMENTAL SYSTEM

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PART. 1 Introduction and thermal zones

INTRODUCTION

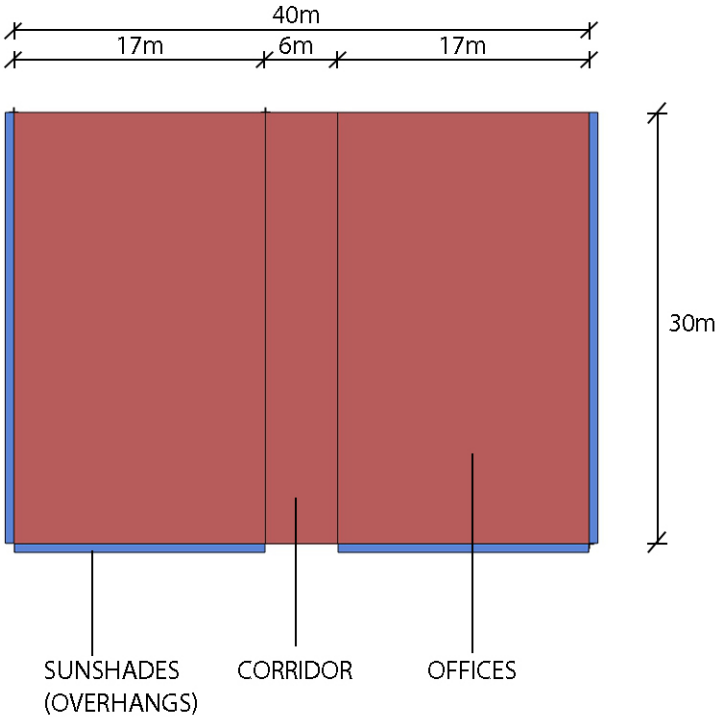
In this report, it has decided to consider the energy consuption of an office building, with at the basement a vending and a lobby part. The area of the building is 1200 ㎡ with 4 floors mainly consisting of open office and a corridor in the central part of the building, with a groud floor of the vending and the lobby. In addition, sunshades have benn added to allthe vertical surfaces, exceptfor the North elevation, in order to increase the sustainability.

It has been decided to locate the building in three different city in this report, Piacenza, Sydney, Hangzhou, in order to have different comparison and results, in terms of energy consuption.

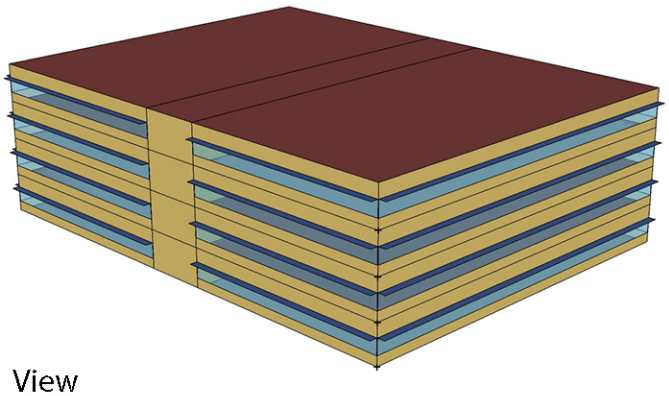
It has been chosen Piacenza as basic city for building details, in terms of default condition. In order to have comparisons, it has been decided to locate the building also in Sydney and Hangzhou, which are at very different latitude, with a verydifferent weather from Piacenza.

In addition, it has been decided to change the construction of external walls, in order to enhance the possibility of sustainability and at the end make a comparison between the three different walls in each different city.

Building type: OFFICE + LOBBY +VENDING
Area: 1200 ㎡
Height: 16m
number of floors: (0 F lobby and vending 1-3F offices
City 1: Piacenza
City 2: Sydney
City 3: Hangzhou



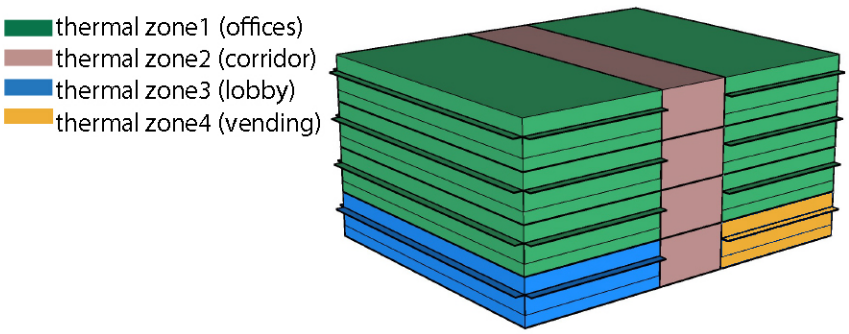
Top view



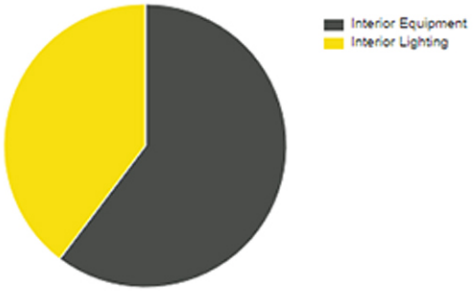
View

THERMAL ZONES

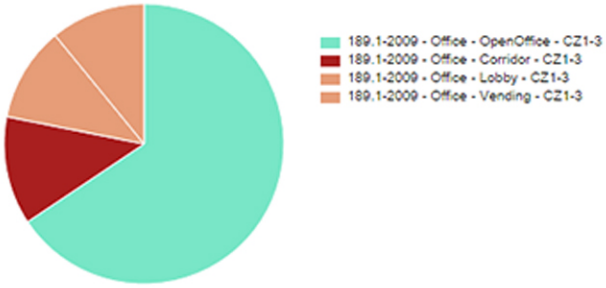
The building has been also divided in different thermal zones, according to the different activities performed inside. so three different thermal zones: first of all the one refered to the office activity (green part), secondly the one refered to the corridor part (brown part) and the one refered to lobby part (blue part) and at the end the one refered to the vending part at the ground floor (orange part)



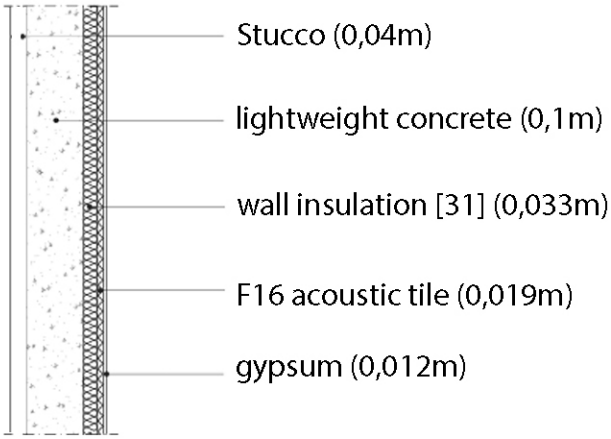
PART. 2 Analysis 1_The same building in the three different cities chosen



EUI - electricity - view table



space type breakdown - view table



DETAIL FOR WALL 1

PART. 2 Analysis 1 Piacenza Wall 1

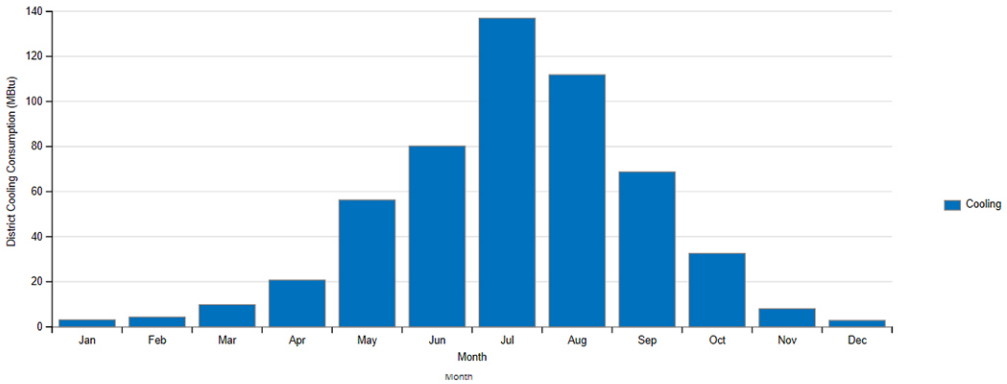
Building Summary

Data	Value
Building Name	Building 1
Total Site Energy	2,220,176 kBtu
Total Building Area	51,667 ft^2
Total Site EUI	42.97 kBtu/ft^2
OpenStudio Standards Building Type	n/a

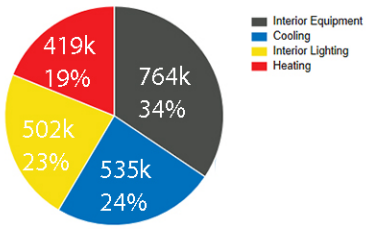
Weather Summary

	Value
Weather File	Piacenza - ITA IGDG WMO#=160840
Latitude	44.92
Longitude	9.73
Elevation	440 (ft)
Time Zone	1.00
North Axis Angle	0.00
ASHRAE Climate Zone	

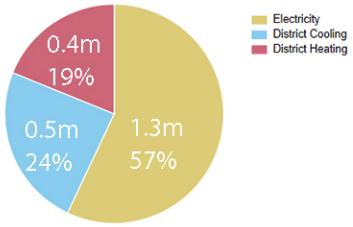
District Cooling Consumption (MBtu) - view table



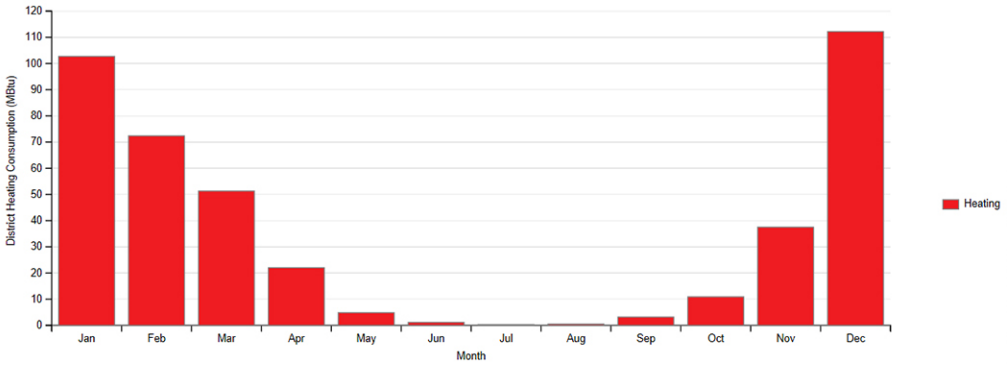
End Use - view table



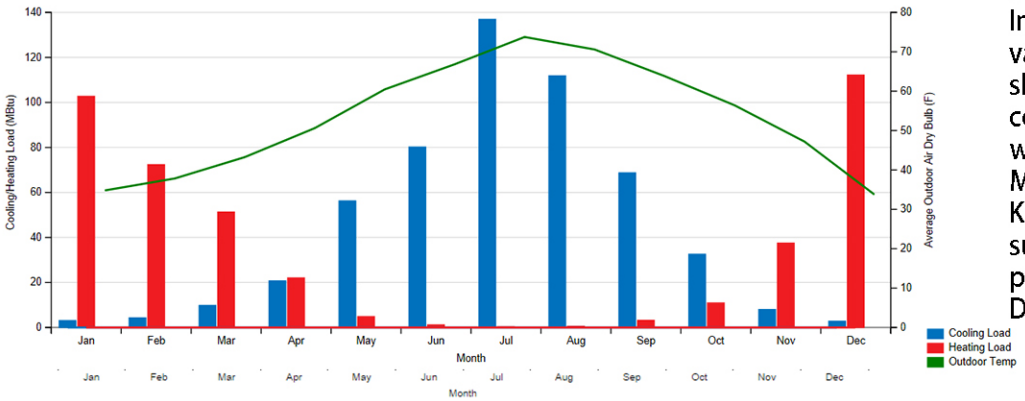
Energy Use - view table



District Heating Consumption (MBtu) - view table



Monthly Load Profiles - view table



In this conditions, in Piacenza, the total site energy of the building, so the annual energy consuption is about 2,220,176 kBtu.
From the energy chart, it can be shown that more of the 57% of the energy is used in the form of electricity, while district cooling is a little bit more than the district heating.
In the other three histograms, the value of energy consuption is shown monthly, in heating and cooling. These values are shown with the unity of measurement of MBtu, corrisponding to 0.29307 Kilowatt-Hour(Kwh). Electricity consumption for cooling reaches its peak in July, while the heating is on December.

PART. 2 Analysis 1_Sydney_Wall 1

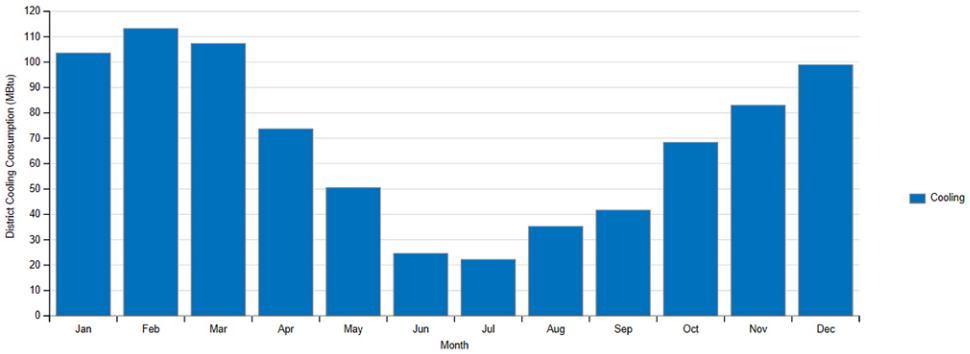
Building Summary

Data	Value
Building Name	Building 1
Total Site Energy	2,140,076 kBtu
Total Building Area	51,667 ft^2
Total Site EUI	41.42 kBtu/ft^2
OpenStudio Standards Building Type	n/a

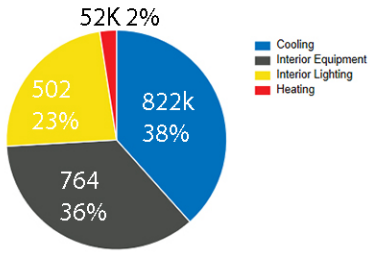
Weather Summary

	Value
Weather File	SYDNEY - AUS IWEC Data WMO#=947670
Latitude	-34.0
Longitude	151.18
Elevation	10 (ft)
Time Zone	10.00
North Axis Angle	0.00
ASHRAE Climate Zone	

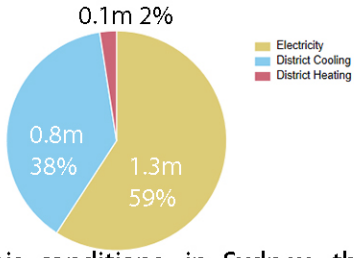
District Cooling Consumption (MBtu) - view table



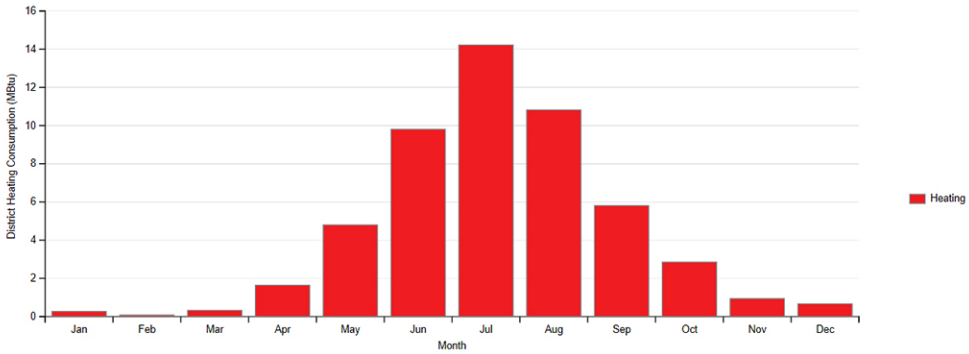
End Use - view table



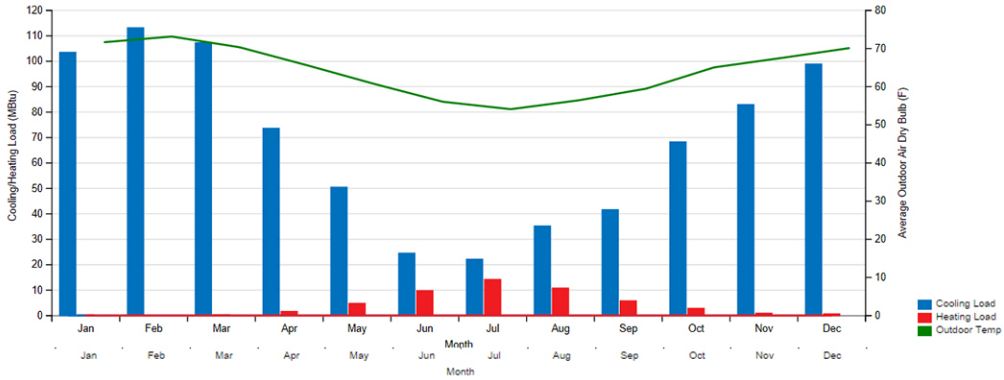
Energy Use - view table



District Heating Consumption (MBtu) - view table



Monthly Load Profiles - view table



In this conditions, in Sydney, the total site energy of the building, so the annual energy consuption is about 2,140,076 kBtu.

From the energy chart, it can be shown that more of the 59.2% of the energy is used in the form of electricity, while district cooling is quite seven times than the district heating.

In the other three histograms, the value of energy consuption is shown monthly, in heating and cooling. These values are shown with the unity of measurement of MBtu, corrisponding to 0.29307 Kilowatt-Hour(Kwh). Electricity consumption for cooling reaches its peak in July, while the heating is on February.

PART. 2 Analysis 1_Hangzhou_Wall 1

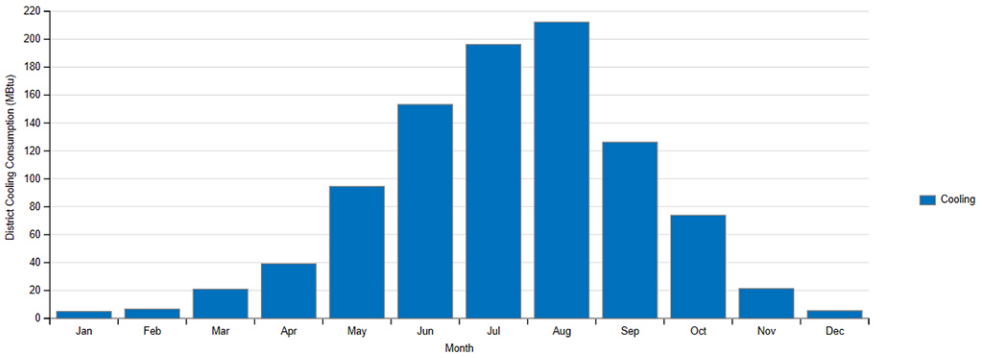
Building Summary

Data	Value
Building Name	Building 1
Total Site Energy	2,432,980 kBtu
Total Building Area	51,667 ft^2
Total Site EUI	47.09 kBtu/ft^2
OpenStudio Standards Building Type	n/a

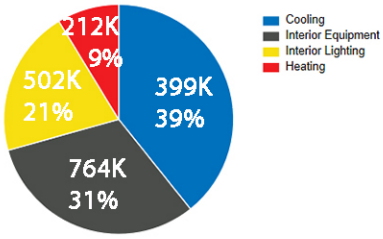
Weather Summary

	Value
Weather File	Hangzhou Zhejiang CHN CSWD WMO#=584570
Latitude	30.23
Longitude	120.17
Elevation	137 (ft)
Time Zone	8.00
North Axis Angle	0.00
ASHRAE Climate Zone	

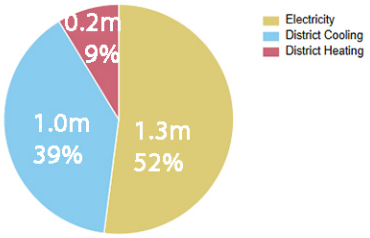
District Cooling Consumption (MBtu) - view table



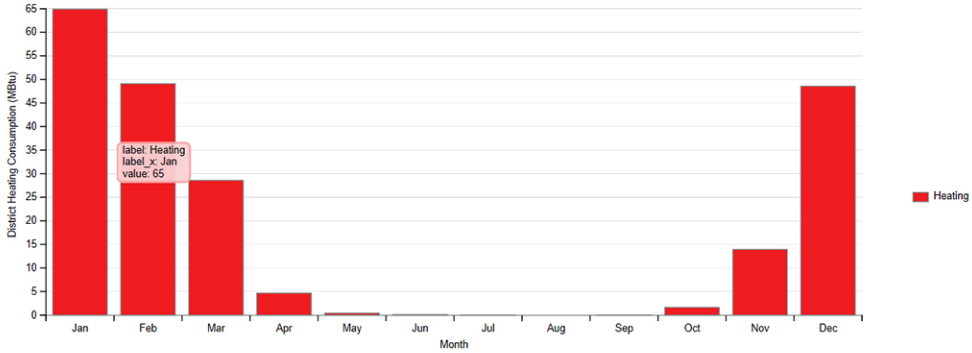
End Use - view table



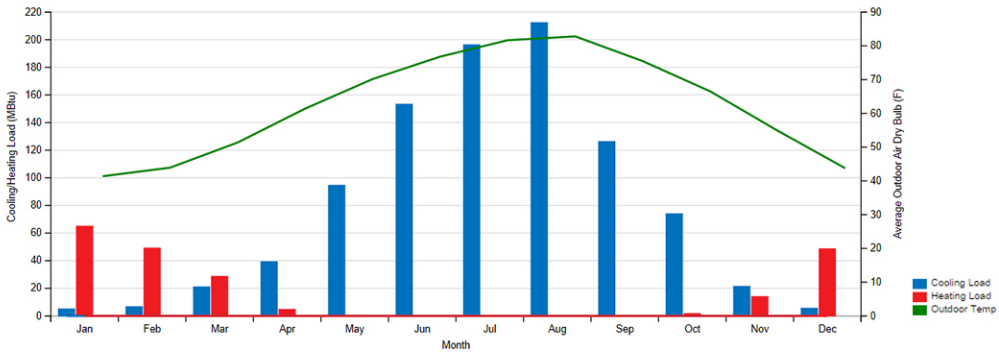
Energy Use - view table



District Heating Consumption (MBtu) - view table



Monthly Load Profiles - view table



In this conditions, in Hangzhou, the total site energy of the building, so the annual energy consuption is about 2,432,980 kBtu.

From the energy chart, it can be shown that more of the 52% of the energy is used in the form of electricity, while district cooling is quite four times than the district heating.

In the other three histograms, the value of energy consuption is shown monthly, in heating and cooling. These values are shown with the unity of measurement of MBtu, corrisponding to 0.29307 Kilowatt-Hour(Kwh). Electricity consumption for cooling reaches its peak in August, while the heating is on January.

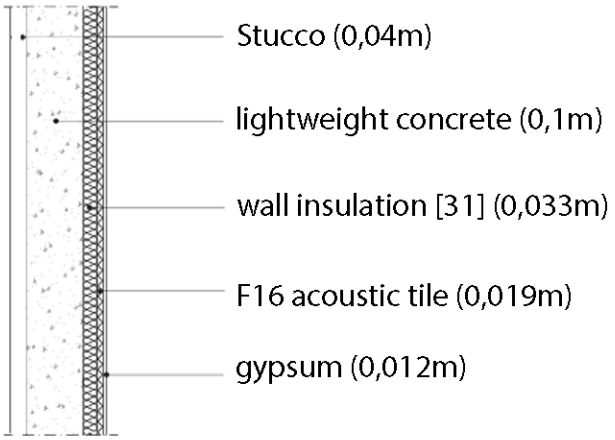
PART. 2 Analysis 1_Conclusion

At the end of this report two different comparisons can be shown, the first one at the end of the analysis 1 and the second one at the end of the analysis 2.
In particular the first comparison is between datas based on the same building but located in different cities at different latidudes and with different weather. Thanks to this comparison it can be shown how the weather conditions influences the results of energy consuption.

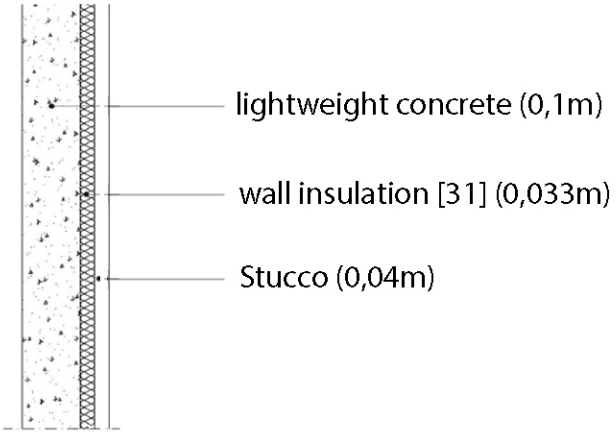
Cities / Energy consuption	Piacenza	Sydney	Hangzhou
Heating	419,020	52,196	211,866
Cooling	535,223	821,956	955,182

In fact, according to these consideration, the results of heating and cooling are so different from one city to each others.
In particular, the values of heating is higher in Piacenza than in the other cities, while the value of cooling in Hangzhou and Sydney is incredible high.
In addition, the value of heating and cooling in Sydney is a huge discrepancy and as well as in Hangzhou. However, the value of cooling in Piacenza is just a little higher than the heating.

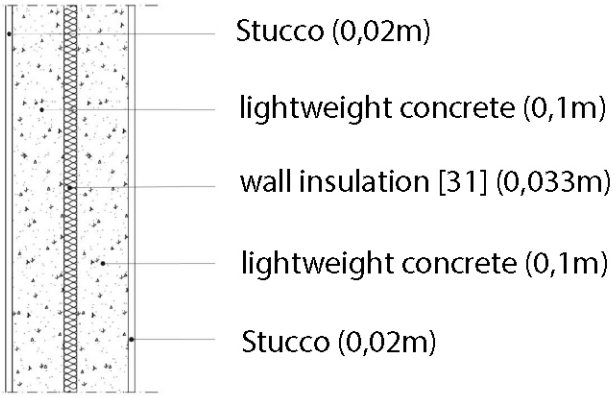
PART. 3 Analysis 2_Different external walls in Piacenza



DETAIL FOR WALL 1



DETAIL FOR WALL 2



DETAIL FOR WALL 3

PART. 3 Analysis 2 Piacenza Wall 1

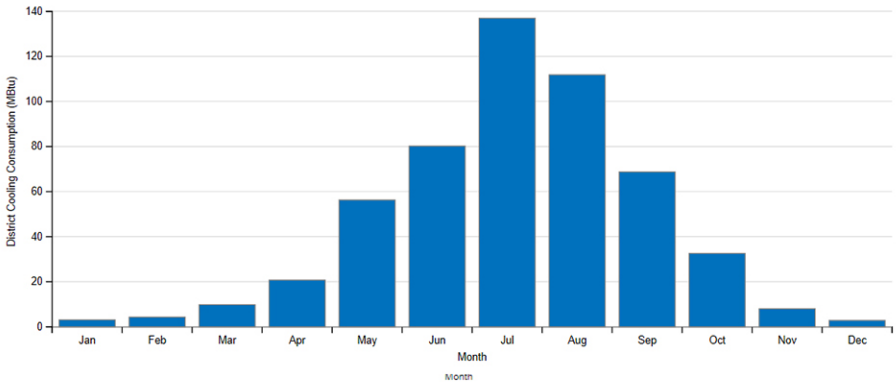
Building Summary

Data	Value
Building Name	Building 1
Total Site Energy	2,220,176 kBtu
Total Building Area	51,667 ft^2
Total Site EUI	42.97 kBtu/ft^2
OpenStudio Standards Building Type	n/a

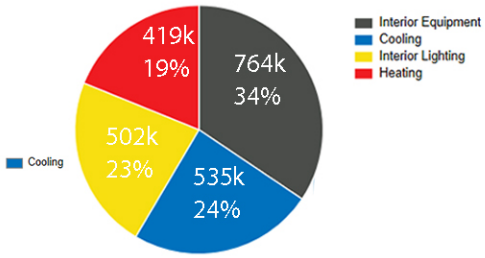
Weather Summary

	Value
Weather File	Piacenza - ITA IGDG WMO#=160840
Latitude	44.92
Longitude	9.73
Elevation	440 (ft)
Time Zone	1.00
North Axis Angle	0.00
ASHRAE Climate Zone	

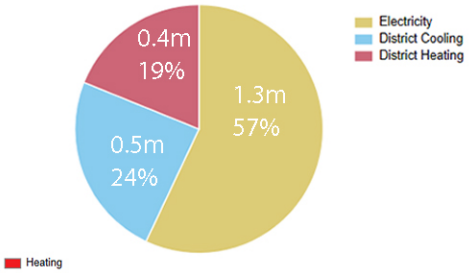
District Cooling Consumption (MBtu) - view table



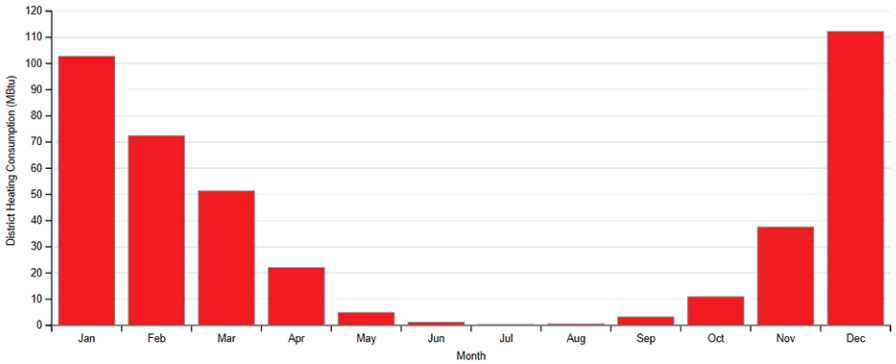
End Use - view table



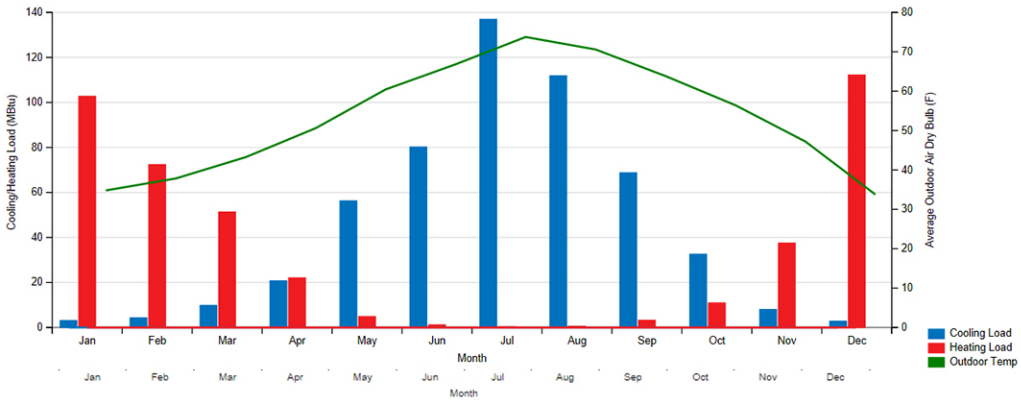
Energy Use - view table



District Heating Consumption (MBtu) - view table



Monthly Load Profiles - view table



PART. 3 Analysis 2_Piacenza_Wall 2

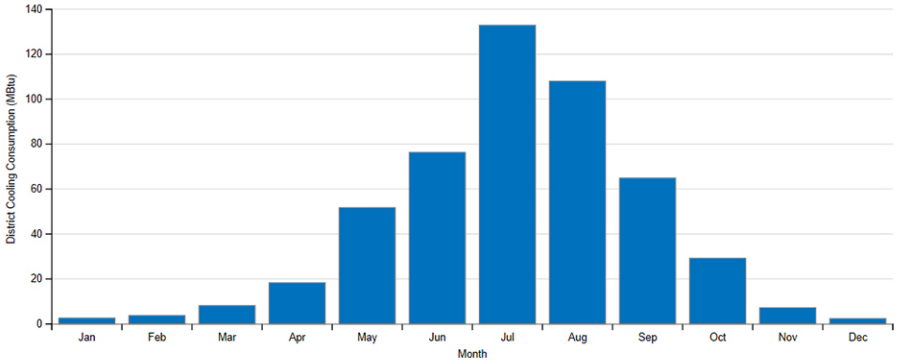
Building Summary

Data	Value
Building Name	Building 1
Total Site Energy	2,222,394 kBtu
Total Building Area	51,667 ft^2
Total Site EUI	43.01 kBtu/ft^2
OpenStudio Standards Building Type	n/a

Weather Summary

	Value
Weather File	Piacenza - ITA IGDG WMO#=160840
Latitude	44.92
Longitude	9.73
Elevation	440 (ft)
Time Zone	1.00
North Axis Angle	0.00
ASHRAE Climate Zone	

District Cooling Consumption (MBtu) - view table



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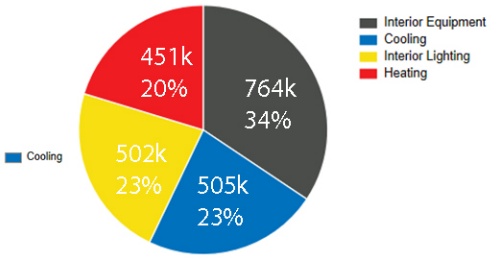
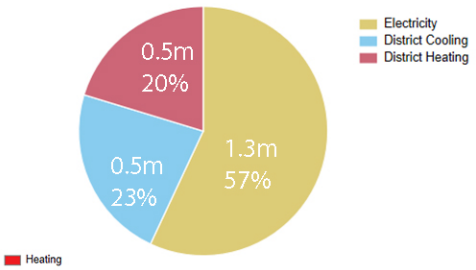
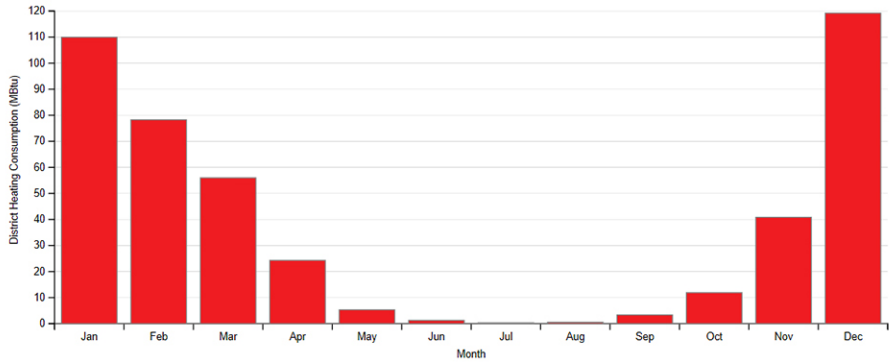


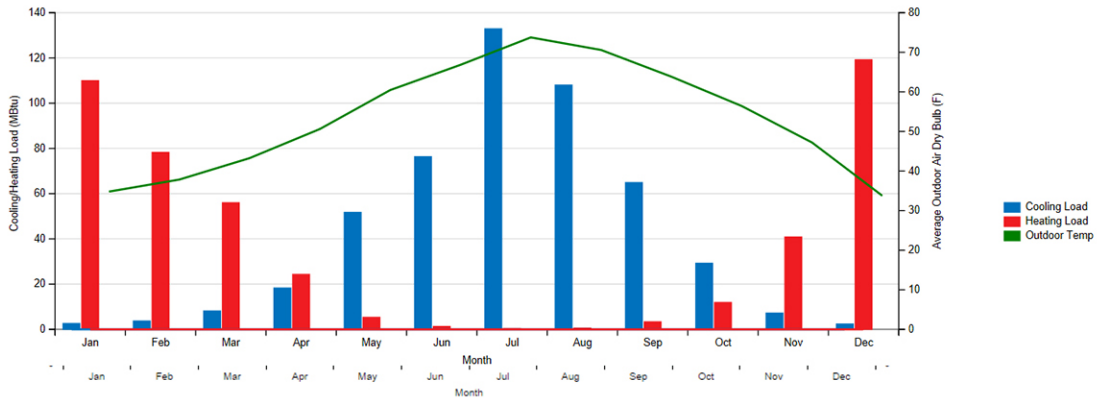
Energy Use - view table



District Heating Consumption (MBtu) - view table



Monthly Load Profiles - view table



PART. 3 Analysis 2_Piacenza_Wall 3

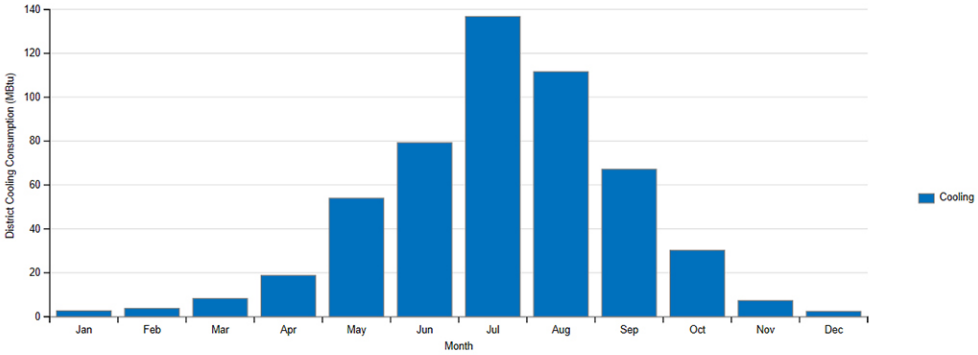
Building Summary

Data	Value
Building Name	Building 1
Total Site Energy	2,208,784 kBtu
Total Building Area	51,667 ft^2
Total Site EUI	42.75 kBtu/ft^2
OpenStudio Standards Building Type	n/a

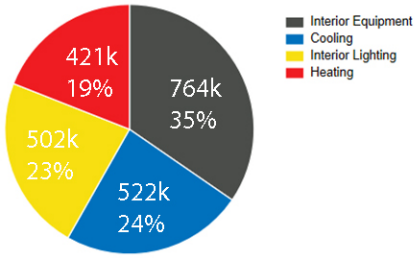
Weather Summary

	Value
Weather File	Piacenza - ITA IGDG WMO#=160840
Latitude	44.92
Longitude	9.73
Elevation	440 (ft)
Time Zone	1.00
North Axis Angle	0.00
ASHRAE Climate Zone	

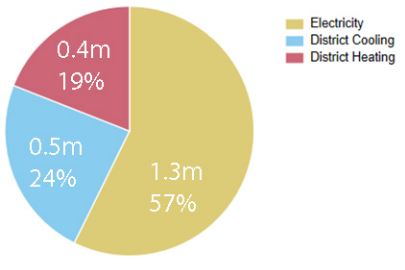
District Cooling Consumption (MBtu) - view table



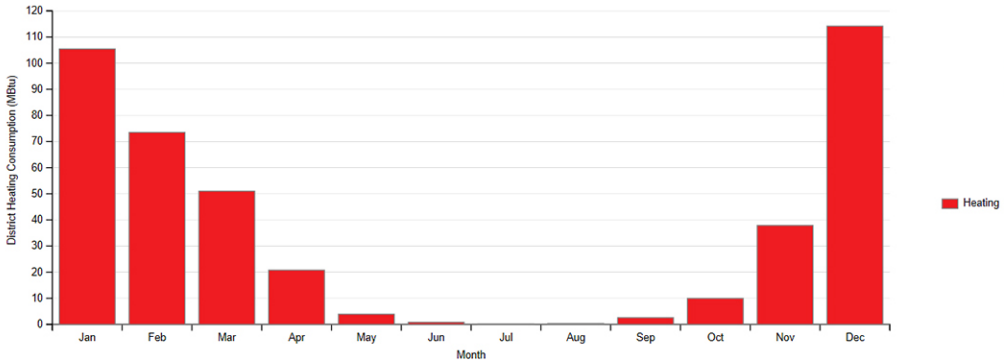
End Use - view table



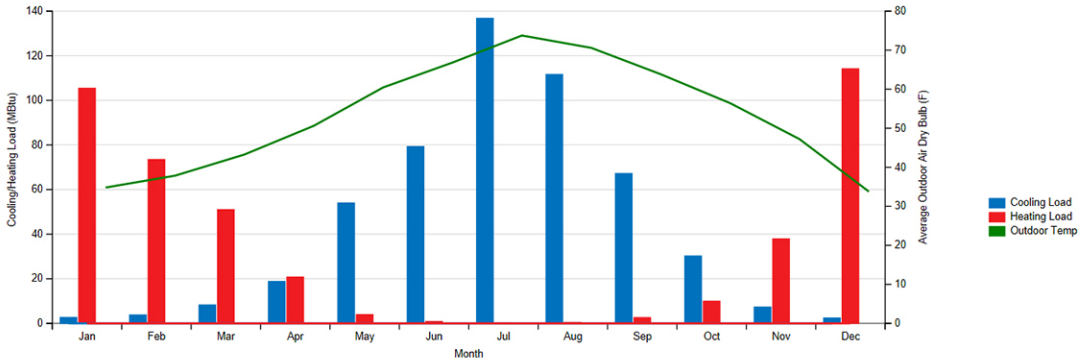
Energy Use - view table



District Heating Consumption (MBtu) - view table



Monthly Load Profiles - view table



PART. 3 Analysis 2_Conclusion

Here below there is the second comparison, mentioned before.
The three different construction for external walls can be used to underline how the building construction affect the value of energy consuption.
In this report the wall 1 and 3 have the lower energy consuption than the wall 2 during the winter, but in summer wall 2 consumed the least energy followed on by wall 1 and wall 3.

Walls Energy consuption	WALL 1	WALL 2	WALL 3
Heating	419,020	451,142	420,556
Cooling	535,223	505,329	522,295

THANK YOU
GRAZIE