POLITECNICO
MILANO 1863

Renewables and Environmental Sustainability – RES

ENERGY AND ENVIRONMENTAL TECHNOLOGIES FOR BUILDING SYSTEMS

2017-2018 POLIMI, PIACENZA

Office Building Project - Open Studio

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Introduction and scheme of the building

Regarding to the “Energy and environmental technologies for building systems” project, the following building has been considered. There are 3 floors and each floor has 5 parts. This building is assumed to build in Tehran as a Base case, but we considered it as a same building for other cities in different countries.

Closed office, Corridor, Print Room, Rest Room, and Stair have been considered for this building in each floor.

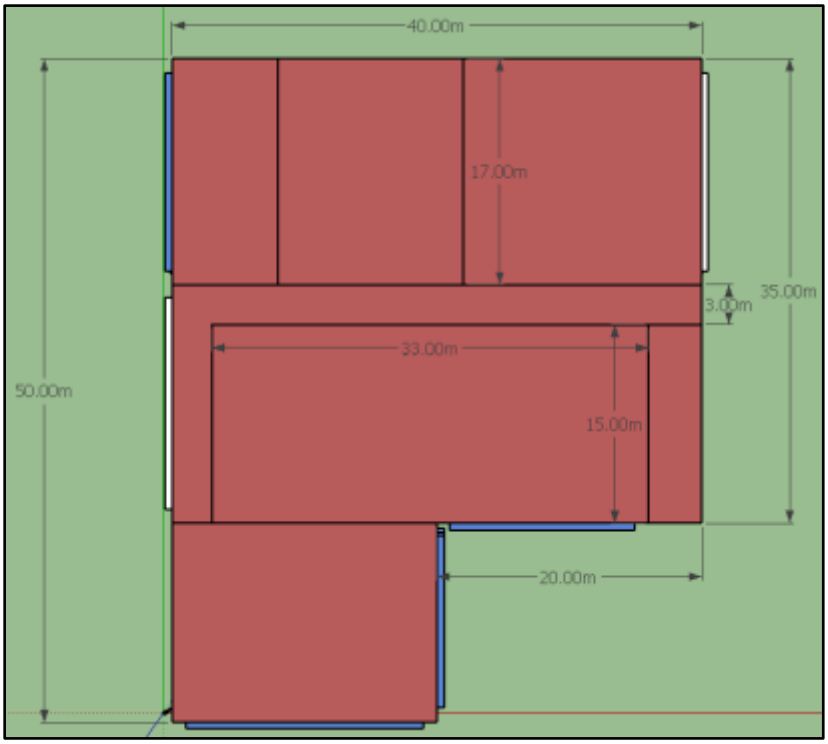

Fig A. schematic representation of general Official Building

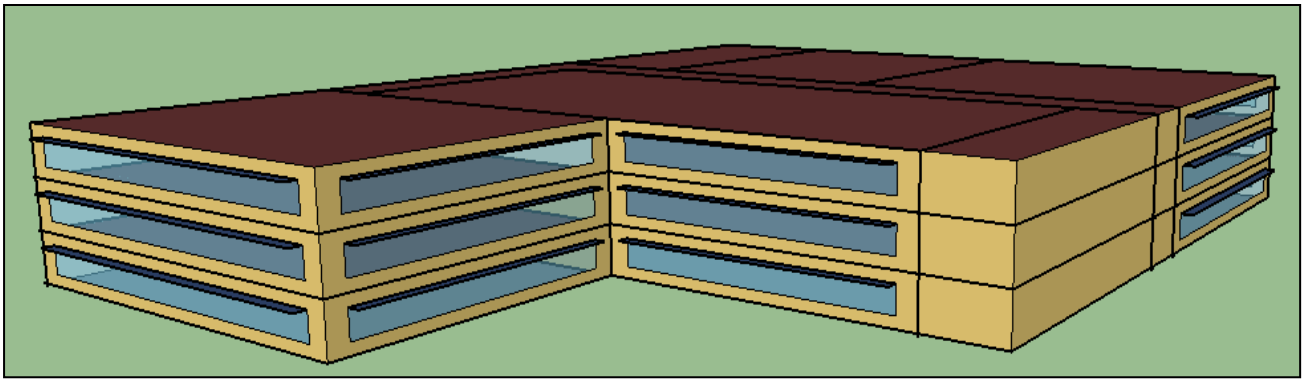

Fig B. schematic representation of general Official Building in 3D view

- According to the Fig. A and B, it has been considered window for all directions except for the print room and considered shading for all directions except for the north;
- Height of each floor is 2.2 m;
- Windows in south are 1.34*18 and 1.34*14. For west are 1.34*15 and 1.34*16. For the north are 12*1.34 and for east are 1.34*15 m^2;
- Each part of the building has the following measurement:

Thermal zones	Room	Area(m2)	Volume(m3)	Gross wall	Window area
Floor 1					
1	Stair	60	132	41.8	0
4	Corridor	165	363	46.2	19.2
7	Closed office	1033	2272.6	176	68.4
10	Rest room	306	673.2	77	37.2
13	Print room	136	299.2	55	18
Floor 2					
2	Stair	60	132	41.8	0
5	Corridor	165	363	46.2	19.2
8	Closed office	1033	2272.6	176	68.4
11	Rest room	306	673.2	77	37.2
14	Print room	136	299.2	55	18
Floor 3					
3	Stair	60	132	41.8	0
6	Corridor	165	363	46.2	19.2
9	Closed office	1033	2272.6	176	68.4
12	Rest room	306	673.2	77	37.2
15	Print room	136	299.2	55	18

Table 1. Measurement for each part of the building

In this project Tehran city has been considered as a base case and the following table shows the temperature properties which have been taken from the https://energyplus.net/weather.

	Maximum Dry Bulb [C]	Daily Temperature Range [deltaC]	Humidity Value	Humidity Type	Wind Speed [m/s]	Wind Direction
TEHRAN MEHRABAD ANN CLG .4% CONDNS DB=>MWB	38.50	10.60	19.00	Wetbulb [C]	3.60	120.00
TEHRAN MEHRABAD ANN CLG .4% CONDNS DP=>MDB	31.00	10.60	18.90	Dewpoint [C]	3.60	120.00
TEHRAN MEHRABAD ANN CLG .4% CONDNS ENTH=>MDB	32.70	10.60	72900.00	Enthalpy [J/kg]	3.60	120.00
TEHRAN MEHRABAD ANN CLG .4% CONDNS WB=>MDB	33.00	10.60	22.50	Wetbulb [C]	3.60	120.00
TEHRAN MEHRABAD ANN HTG 99.6% CONDNS DB	-2.80	0.00	-2.80	Wetbulb [C]	1.90	270.00
TEHRAN MEHRABAD ANN HTG WIND 99.6% CONDNS WS=>MCDB	9.50	0.00	9.50	Wetbulb [C]	11.50	270.00
TEHRAN MEHRABAD ANN HUM_N 99.6% CONDNS DP=>MCDB	6.20	0.00	-13.00	Dewpoint [C]	1.90	270.00

Table 2. The temperature datas for the base case

Heating and cooling loads by location

According to the table 3 there are four base exterior wall materials for the base case in different cities in different countries.

1 Inch Stucco	8 Inches concrete	Wall insulation	½ Inches gypsum

Table 3. Exterior wall materials for the base case

The cities chosen are: Tehran, Stuttgart and Vancouver

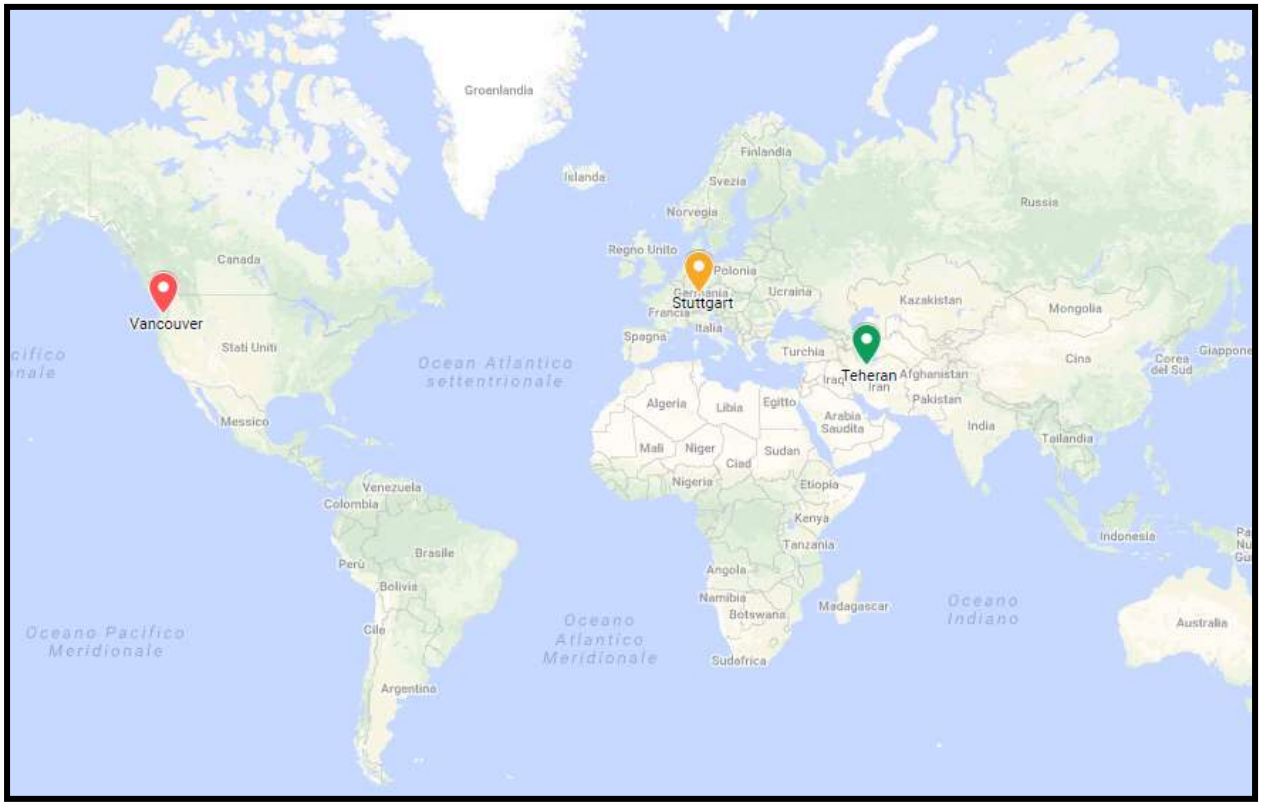

Fig C. Cities considered

The simulation has been run, and we have obtained the following results from the “results viewer” for each cooling and heating load (GJ).

Cities	Cooling [GJ]	Heating [GJ]
Tehran	1015,33	927,05
Stuttgart	252,8	2146,07
Vancouver	211,09	1942

Table 4. Results for cooling for heating load for different cities

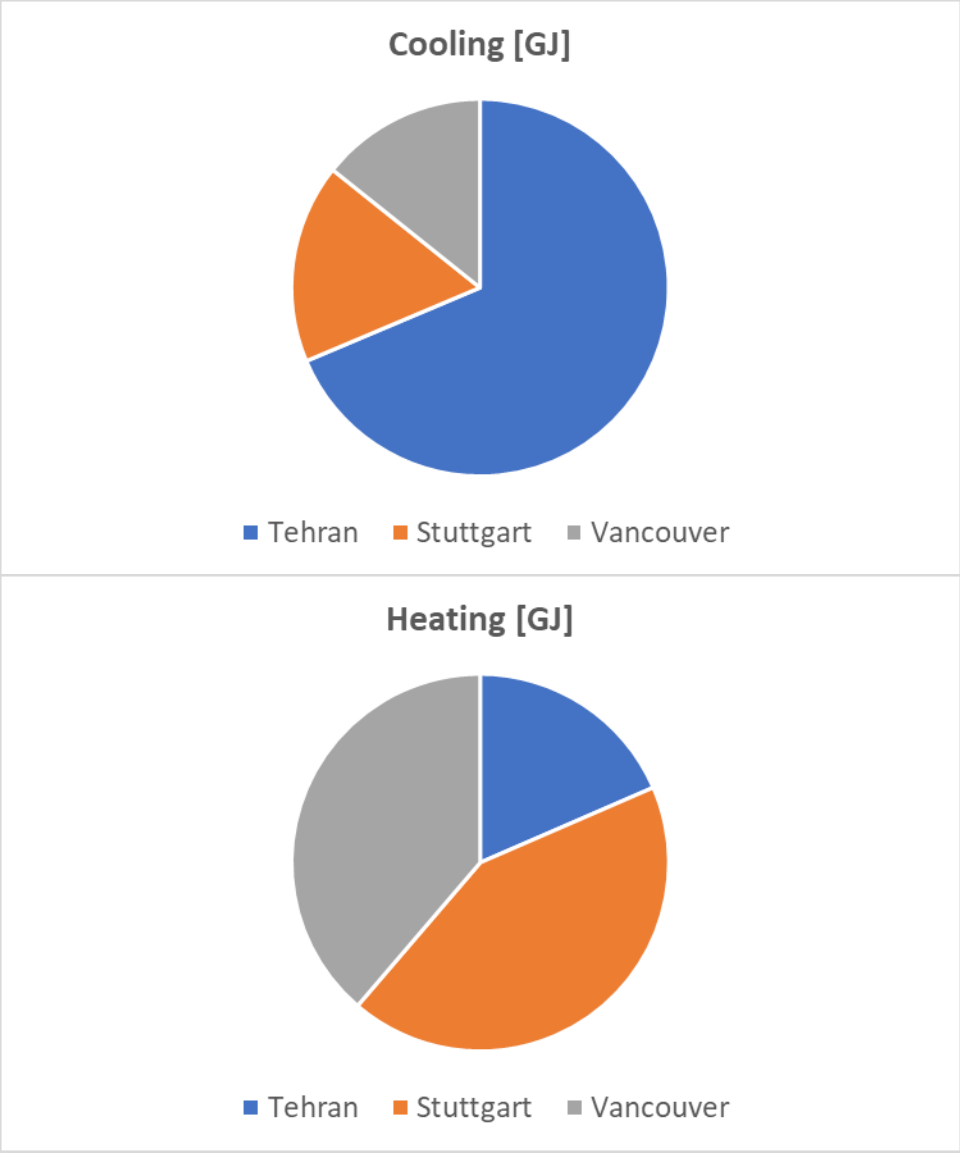

Fig D. Pie charts for comparing the loads in the cities

Heating and cooling loads by wall characteristics

After analyzing the dependency of the building loads from the location, we considered two other types of wall for the building located in Tehran (our base case).

First we substituted the insulation material with an air gap and then we considered a wall made by wood without insulation.

We obtained the following results:

Tehran	Heating [GJ]	Cooling [GJ]
base case	927,05	1015,33
wall 1	947,19	1084,64
wall 2	968,76	1147,05

Table 5. Results for cooling for heating load for different walls

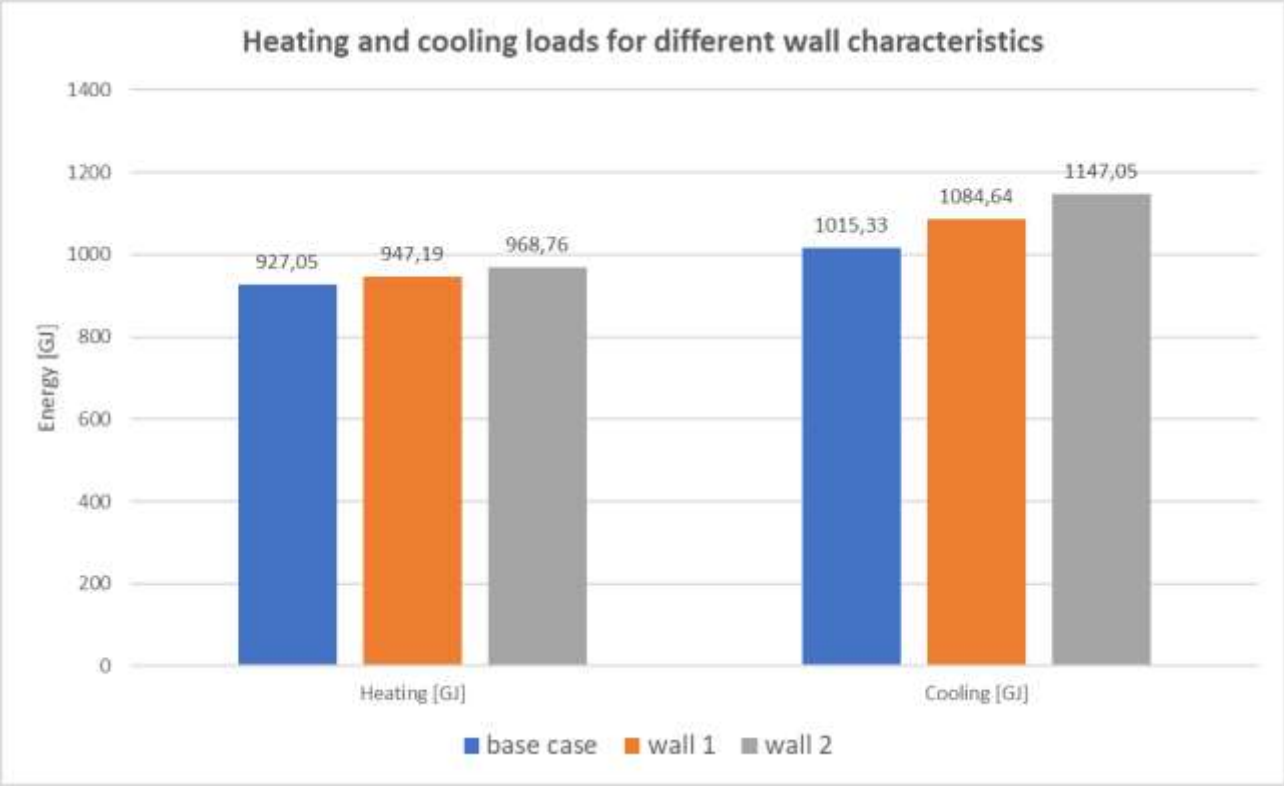

Fig E. Results comparison for the different walls

Conclusion

Considering the same building with the same external walls, the place where is built plays an important role for the heating and cooling loads. Our base case, Tehran, needs high cooling load and, on the other hand, colder places like Stuttgart or Vancouver needs more heating. These are quite obvious results.

Keeping the building in the same place, changes in loads are caused by different wall characteristics. We can see that passing from an insulation material layer to an air gap, the heating load sligthly increases cause the resistance decreases. Of course we have the same results if we don’t have the insulation at all.