Assessment of Heating and Cooling Energy Needs in Residential Buildings in SETTAT - Morocco

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Keywords: Thermal evaluation of buildings, Heating needs, Trnsys building, Energy Efficiency, Thermal transfer.

Abstract: The building design with low energy consumption is a major issue in the energy transition in order to reduce emissions of greenhouse gases and high energy consumption. Indeed, the residential sector is a major consumer of energy worldwide, especially in Morocco, and also represents a strong potential for improving energy efficiency, it is in this perspective that this work fits. Our study is based on the evaluation of heating and cooling needs, with TRNsys software, of an apartment located in the city of Settat and which contains no measure of energy efficiency.

1 INTRODUCTION

Energy has become indispensable for the human and economic development of society. After the first oil shock, fossil energy deposits are becoming scarce and the cost of energy is increasing. However, climate and environmental upheavals are the main factors leading to an awareness of the rational use of energy.

The building is in the heart of the energy issue, which represents about half of the total energy consumption of Morocco. All the parts of a building is subject to heat transfer and good control of the latter leads to good management of energy consumption.

It is in this case that our work is inscribed, to evaluate the energy needs in heating and cooling of a residential building type apartment locatedin the Settat city in the chaouia region in Morocco.

In order to carry out this evaluation our work will follow this plan:

- In the first part, we model our building subject of the study
- the second part will be reserved for the results and the discussion.

2 MODELING THE BUILDING

2.1 Building

The residential building chosen for our study is an apartment with a living area of 110 m2 with an overall floor-to-ceiling ratio of 17.5%.

$$TGBV = \frac{\sum \text{Surfaces of windows of external walls}}{\sum \text{Gross surfaces of exterior walls}} \quad (1)$$

2.2 Meteorological Data

It is necessary to introduce weather data collected from the Meteonorm software in order to carry out the dynamic thermal simulations with the TRNsys software.

Thus, the Kingdom of Morocco is divided into 6 climatic zones according to the criteria of temperature, humidity and direct and diffuse horizontal radiation.

Boussafi, A. and Ouaaline, N.
Assessment of Heating and Cooling Energy Needs in Residential Buildings in SETTAT - Morocco.
DOI: 10.5220/0009771503260329
In *Proceedings of the 1st International Conference of Computer Science and Renewable Energies (ICCSRE 2018)*, pages 326-329
ISBN: 978-989-758-431-2

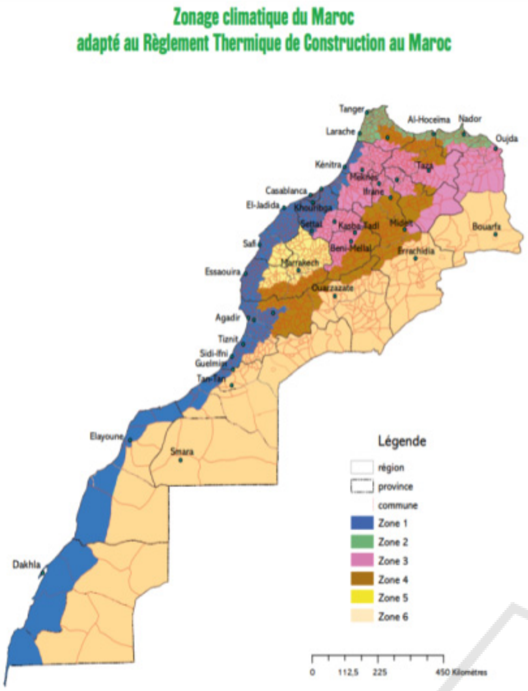

Figure 1: Morocco's climate zonation

In our study, we took Settat as much as a representative city for zone 1, where our building is located. The following table presents these geographic coordinates.

Table 1: Geographic coordinates of Settat

Area	City	Altitude	longitude	latitude
Area 1	Settat	365 m	-7,6160	33,0010

2.3 Hypothesis of Dynamic Thermal Simulation

A. Contributions Due to Occupants

The human body is assimilated as much as a thermal system whose power depends on the activity exerted. In our study, the apartment studied is occupied by a young couple and the following table describes the occupancy benefit of this building.

Table 2: Building occupancy benefit

Time	Occupation
Week (17 :00-08 :00)	2
Weekend	2

The TRNsys software represents a set of several types of occupant gains based on the 7730 standard. For our case wehave:

- **Kitchen:** 185W/Personne
- **Living room:** 170W/Personne
- **Other rooms:** 100W/Personne

B. The Contributions Due to Lighting and Electrical Appliances

The electric powers of lighting and electrical appliances are as follows:

- **Computers:** 230W/PC
- **Lighting:** 10W/m^2
- **Appliances:** 4500W

C. The Air Change Rate

The air renewal rate or the brewing rate is fixed according to the Moroccan standard 13789/2010 at 0.6 vol / h.

$$ACH = \frac{\text{Blown air flow } (m^3.h)}{\text{Volume of the room}(m^3)} \qquad (2)$$

D. Internal Shading

The value of the internal shading is fixed throughout the year, at a fixed value of 25% of the surface of the exterior windows.

E. Heating and Air Conditioning

The installed air conditioning system allows stabilizing the temperature on 25 °, as well as the heating the maintenance in 20 °.

So we divided our building into 3 zones based on temperature, direction and profiles of occupants.

Figure 2: Thermal zoning of the habitat

3 RESULTS AND DISCUSSION

A multitude of simulation has been carried out on the studied building following baseline scenarios that involves considering the building constructed without any measure of energy efficiency.
The following figure describes our simulation model with the TRNsys software environment.

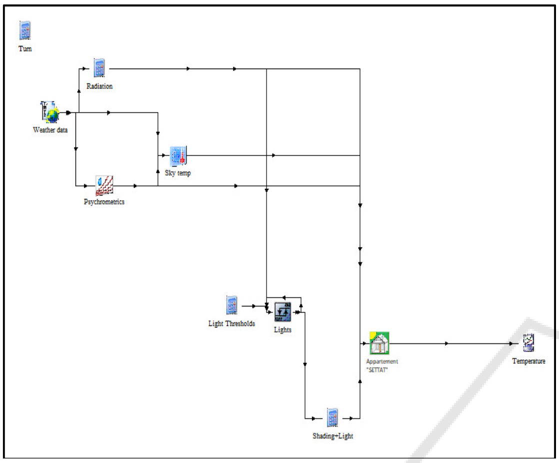

Figure 3 :Project withTRNsys

The following two figures describe the thermal behavior of the building, the first describes the thermal behavior of the building without a heating or cooling system, and the second figure shows the thermal behavior of the house while introducing a heating and cooling system.

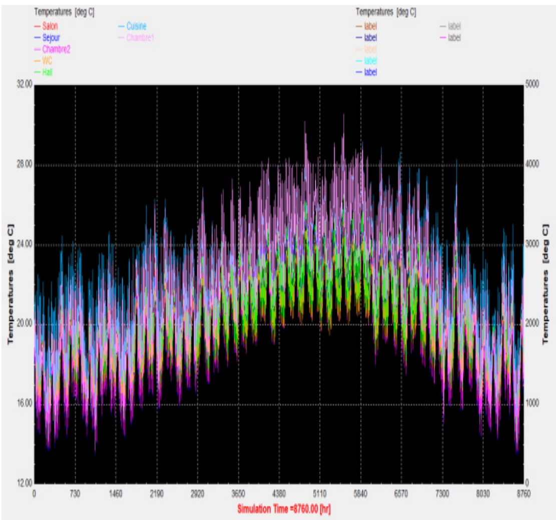

Figure 4: Thermal behavior of the building without heating or cooling system

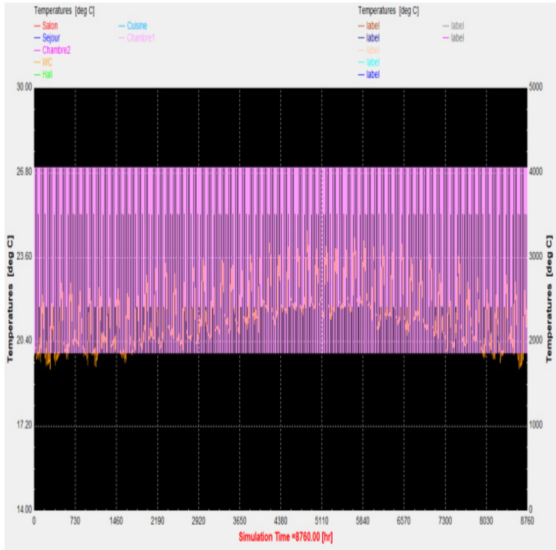

Figure 5: Thermal behavior of the building with a heating and cooling system

The graph below shows the electrical energy consumption in the case of the building with a heating and cooling system (the blue graph) and without them (the black graph).

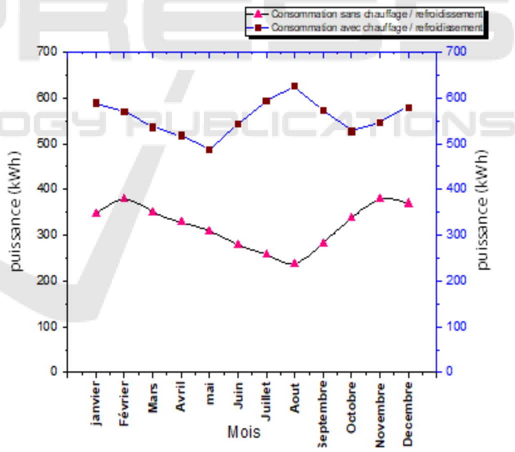

Figure 6: Annual consumption of the building with and without the heating / cooling system

4 CONCLUSION

According to the results obtained, the electricity consumption has increased twice and this due to the adaptation of the heating and cooling system and which exceeds the thresholds set by the Moroccan Building Thermal Regulation.

These lead us to a thorough study on the optimization of natural lighting and design an energy losses and improve airtightness and ensure high thermal inertia.

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