International Journal of Innovative Studies in Sociology and Humanities

ISSN 2456-4931 | Open Access | Volume 7, Issue 2, 2022

DOI: https://doi.org/10.20431/2456-4931.0702002

Assessment of the Climate Stress Situation in the Housing -Allotment 309 N°289 Guelma

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Abstarct

With the heavy demand for fossil fuels, a huge amount of greenhouse gases is emitted into the atmosphere, causing significant temperature fluctuations, which leads to the need to regulate the thermal environment conditions. The residential sector is often qualified as energy consuming due to the lifestyle adopted in order to ensure thermal comfort. Hence the need to think of solutions to ensure thermal comfort.

The aim of this study is to demonstrate that the inhabitants suffer from climatic stress during the overheating season, which leads to excessive energy consumption resulting from the use of cooling equipment, which is also relative to the anthropic factor, hence the importance of adopting bioclimatic strategies in order to re-establish the balance between man, environment and building, on a sample of a housing located in the semi-arid climate of the landlocked city of Guelma, which benefits from a large bioclimatic potential. The correlation between the study of Givoni, as well as an approach by measurement in-situ inside the house, and an investigation with the inhabitants.

The results of this research show that the indoor thermal conditions are out of the comfort range, which is why it is necessary to produce a positive energy building by exploiting the bioclimatic potential of the site to improve both thermal comfort and energy efficiency, while adopting a participatory approach in order to adopt a resiliant lifestyle, since the anthropic factor determines the energy consumption.

Keywords: positive energy buildings; energy efficiency; inhabitant; thermal comfort, adaptive comfort.

INTRODUCTION

The purpose of all architecture is to ensure the human being comfort , in order to satisfy its thermal needs inhabitants use technologies such as air conditioning to regulate the thermal conditions. The role of a housing is to ensure protection against the vagaries of the climate to ensure thermal comfort, Hensen (1991) points out that thermal comfort is a state in which there are no impulses that lead to correct the environment of the occupant by his behavior. The purpose of construction is to modify the climate in order to meet the needs of the inhabitants.

In order to ensure thermal comfort, the inhabitant has recourse to energy-consuming behaviors to regulate his thermal environment, by drawing on the fossil energies at his disposal, but any energy consumption generates an ecological bill, according to footprintnetwork site An average inhabitant of the Earth would only need five soccer pitches to live, the lifestyle adopted by the human being causes irreversible repercussions on the environment due to the greenhouse gases that increase the temperature of the globe, which increases the discomfort situation.

THERMAL COMFORT

Thermal comfort is a concept that has a vast definition which depends on objective and subjective factors, it is a state of satisfaction felt by the human being regarding his thermal environment. According to Milon, thermal comfort is defined as follows: "we are in a state of thermal comfort when we perceive neither cold nor hot sensation". (Marité Milon, 2004) [1]. Indeed, thermal comfort is defined as a state of balance and general satisfaction expressed regarding the thermal environment of the surrounding environment.

to feel comfortable, three conditions must be met: The body must maintain a stable internal temperature, The production of sweat must not be too abundant and the average temperature of the skin must be comfortable, No part of the body must be too hot or too cold (local discomfort). (Commission de la Santé et de la Sécurité du Travail du Québec, 2002)[2], the notion of comfort is therefore the correlation between three well-defined parameters: a stable internal temperature, little or not too much sweating, and the absence of local discomfort.

Thermal comfort can only be achieved when the temperature, humidity and air movement are within the limits of the so-called "comfort zone" (C.C.H.S.T. - Canadian Centre for Occupational Health and Safety, 2002). [3]

Thermal comfort defines ranges of temperatures, air flow velocities and humidity levels in which the inhabitants do not feel the need for heating or cooling, and therefore feel the thermal comfort that depends on the heat exchange between the human body and its environment. According to Givoni this "balance" is only possible thanks to the constant action of regulation mechanisms. (Givoni, 1978), Givoni in 1978 established a psychrometric diagram or it determines a comfort zone characterized by a temperature between 20 ° C and 27 ° C, and a relative humidity between 20% and 28% during which the index of dissatisfaction is relatively zero, outside the comfort zone Givoni proposes architectural devices to improve indoor comfort in each case. Fig. 1

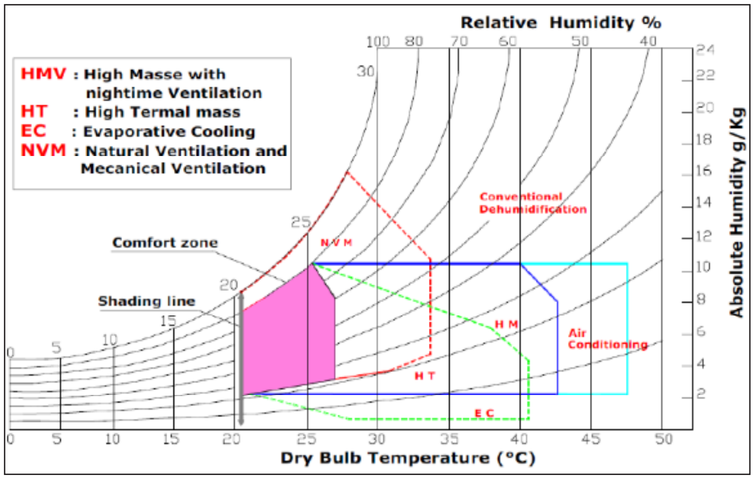


Figure 1. diagramme of givoni

THE ANTHROPIC FACTOR AND THE CONCEPT OF ADAPTIVE COMFORT

The sensation of thermal comfort is provided by the evacuation of body heat. The movement of air increases heat loss by convection and facilitates the evaporation of humidity from the surface of the skin. [4] therefore thermal comfort is related to thermal exchanges between the human body and its environment .In a moderate environment, a person loses heat in five ways: metabolism, clothing, ambient air temperature, relative air humidity (RH), and air flow velocity, which should not exceed 0.2 m/s.

The concept of thermal comfort depends not just on objective physical factors (temperature, relative humidity, air flow velocity), but also on subjective factors related to the psychology of the inhabitants according to customs, culture, and metabolism, in fact there are no typical conditions for a typical man. Unlike physiological responses which can be measured objectively, the determination of subjective responses of the senses depends on the person's own evaluation of a given environment. This evaluation is not unique, but varies with the individuals, and also for the same individual according to different periods. [5] , the concept of adaptive comfort demonstrates that the ranges of comfort depend on objective and subjective quantitative and qualitative factors according to the customs and the individual needs of the individuals, the notions of adaptive comfort put forward the variations of the individual place and time, led by personal strategies which could be physiological, psychological, social, cultural and behavioral. Unlike physiological responses that can be measured objectively, the determination of subjective sensory responses depends on the individual's own evaluation of a given environment. This evaluation is not unique, but varies with the individuals, and also for the same individual according to different periods. Between objective and subjective determination of the concept of thermal comfort and the purpose of the work is to improve the method of evaluation of thermal comfort by analyzing the various parameters involved quantitatively and qualitatively. [6]

THE PASSIVE BUILDING AND ENERGY EFFICIENCY

The passive building establishes a relatively resilient way of life because it reduces energy consumption by using thermal inertia and the suitability of building materials, as well as the orientation and shape of the dwelling, in addition to a range of passive processes . Used for centuries in some parts of the planet Passive strategies provide answers both economically and adapted to the environment where the construction must have the day They take into account the temperature orientation and wind It is also possible to take advantage of the local orography to ensure the thermal regulation of the interiors or make use of materials offering a high thermal mass or high quality insulation. [7].

A passive house is a building with a pleasant indoor climate in winter as well as in summer without conventional heating or cooling systems"[8] . This is achieved by drastically reducing the heating energy requirements, mainly through architectural and constructional measures.

The passive building meets technical requirements

-Reinforced thermal insulation, high quality windows

-The elimination of thermal bridges

-Excellent air tightness

-Double flow ventilation (with heat recovery)

-The optimal but passive capture of solar energy and calories from the ground

-The limitation of the consumption of the household appliances

The passive building does not save on the level of comfort but on the contrary increases it while decreasing energy consumption, by its efficient envelope, according to the standard 90.1-2016 The new requirements of technical envelope include:

Mandatory requirements for envelope verification, with a focus on reduced air infiltration and increased requirements air leakage to overhead roll-up doors.

-More stringent prescriptive requirements for metal construction, roofs and walls, fenestration and opaque doors.

-Improved clarity of exterior wall definitions, building orientation, and clarity around R-value.

-New requirements based on the addition of climate zone 0.[9]

It is also important to note that the passive building is adapted to its environment, the materials used, the orientation, the exploitation of renewable energy, to ensure a comfortable thermal environment.

The passive building alone can not ensure the energy efficiency In the field of housing, we talk about its insulation or we can compare the energy consumption between different buildings, based on a unit of (kW / m^2 / year). Note that a building that does not consume much energy is a well insulated building [10] . According to hocine tabbouch et al many buildings have not been conceived, designed and constructed taking into account the specific nature and context of the environment where they are located [11]. The inadequacy of the construction to its environment leads to increased energy consumption, so it is essential to ensure energy efficiency. It is the ratio between the useful energy produced by a system and the total energy consumed to make it work well. This definition can have a broadening as it becomes the set of technologies and practices to decrease the energy consumption until the setting of an equivalent level of performance whose objective is to do better with less.

This concept is often interpreted in a broader sense to refer to technologies and practices that allow to reduce energy consumption while maintaining an equivalent level of final performance[12] . According to the International Energy Agency (IEA), energy efficiency is considered as a means to control and reduce energy consumption.

Energy efficiency is the use of processes and technologies to satisfy needs while saving as much energy as possible, in fact it is about doing better with less energy. In this way we ensure comfortable living spaces, and we reduce energy consumption and therefore reduce the ecological footprint. It is about providing the same services while consuming less energy or even doing better with less.

If we want to improve the energy efficiency it will be necessary to adopt the bioclimatic approach which re-establishes resiliant relation between architecture and its environment without breaking the dynamism between man and his environment , it is a matter of assuring the balance between the construction and its environment by putting man in the center of this loop. It is also necessary to work on the external envelope of the buildings which is the thread of the energy consumption because by decreasing the depredative surface we decrease the energy consumption .

This is why the improvement of energy efficiency in the building sector is a priority axis to develop in order to preserve the environment, to fulfill needs, and to guarantee the capacity of future generations to answer theirs. To do so, it is imperative to consider the two components, energy and technology, as a phenomenon of interaction between the two.

Energy technologies and occupant behavior have been treated as separate actors in the comfort, energy engineering and social domains; recent efforts attempt to link them, considering energy consumption as a result of human activity in a context of interrelations between users, technologies, skills, social contexts[10]

if we do not sensitize the inhabitants to adopt a resilient lifestyle and daily practices, by choosing appliances of category A and B on the ecological label, and to use them rationally without falling into excess.

RESEARCH METHODOLOGY

The correlation between the study of Givoni which determines large areas of underheating and overheating, and the approach by measurement in situ inside the house: temperature, relative humidity, air velocity, reveal indoor temperatures beyond the ranges of comfort which causes stress situations to the inhabitants.

Criteria for Choosing the City Guelma

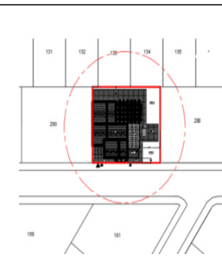
Guelma is located in north-east of Algeria characterized by the climate of the mountainous back-coast (Zone B), a semi-humid climate. Determined by colder and longer winters and hotter and less humid summers than those of the coast, benefiting from a great sustainable potential by its forest and agricultural coverage, as well as by the solar bombardment which covers 243.3 hectare per year also by its hydraulic potential with 264.96 million m^3 of mobilizable water with multiple source of hot water, it is also an enclave city surrounded by four mountains which defines the living conditions and the microclimate of the city.

In spite of all this potential, the inhabitants suffer from stressful situations, as demonstrated by the study of Givoni according to medejelakh.D there is a very cold under-heating zone for the months of January and February (T° between 4.5 and 5°C) as well as a cold under-heating season from December to February, and from March (T° between 5 and 15°C).

Figure 2. geographical situation of the city of Guelma

Choosing Criteria for the Case of Study

Table 1: Technical sheet case study

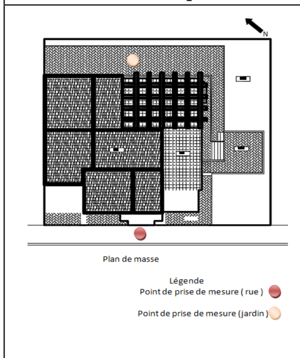
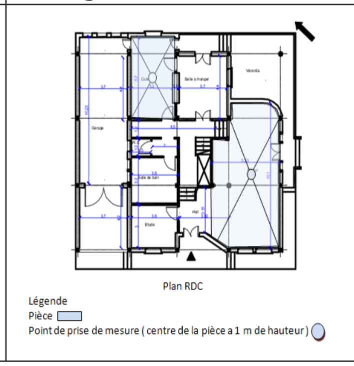
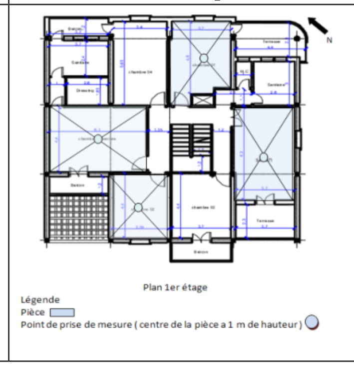
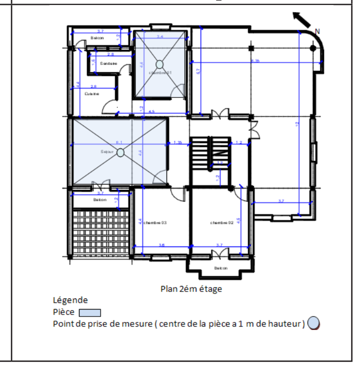
Villa Mokhnache	Villa R+2	
total Surface	480 m^2	
Built surface	224 m^2	
Coefficient of occupation on the ground	0.46	

The villa 309 is chosen to evaluate the thermal comfort of the inhabitants according to different rooms, orientation, and function, the accessibility to the house guarantees the conduct of the measurement campaign without worries.

The measurement campaign took place over 03 successive days during the heat wave, the rooms subject to investigation were chosen according to the floor, orientation and occupation.

The plans of the villa in the following tables.

Table 2: plans of villa 289

Mesurment points	ground floor Plan	1 st floor plan	2 nd floor plan
			

Equipment Used

The temperature and humidity readings are made by a portable waterproof thermo-hygrometer HANNA 9564. Fig. 3

The air speed was measured by a BA16 Trotec propeller anemometer. Fig.4

Figure 3. Thermo-Hygrometer HANNA 9564

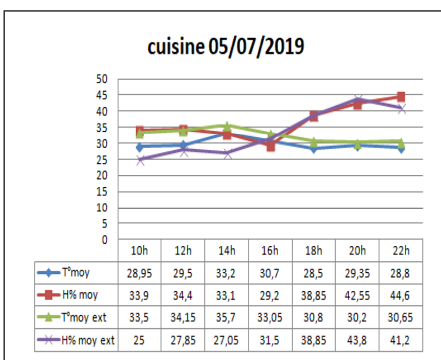
Figure 4. Anemometer BA16 trotec

RESULTS

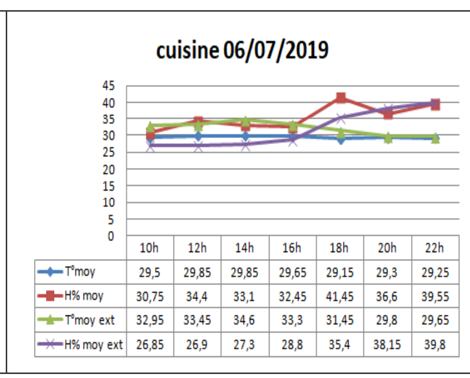
The results of the measurement campaign are shown in the following graphs.

The air flow velocity during the whole duration of the measurement campaign remained constant below 0.76 m/s.

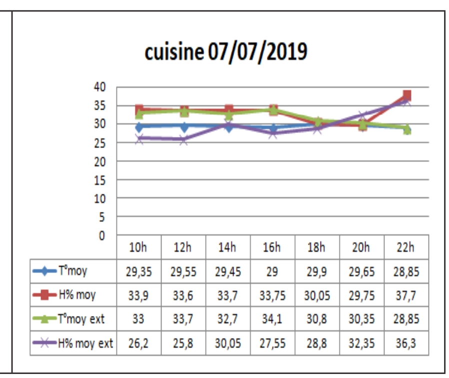
Table 3: kitchen measurement campaign



	10h	12h	14h	16h	18h	20h	22h
T°moy	28,95	29,5	33,2	30,7	28,5	29,35	28,8
H% moy	33,9	34,4	33,1	29,2	38,85	42,55	44,6
T°moy ext	33,5	34,15	35,7	33,05	30,8	30,2	30,65
H% moy ext	25	27,85	27,05	31,5	38,85	43,8	41,2

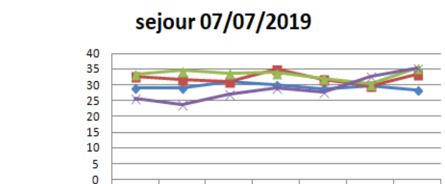


	10h	12h	14h	16h	18h	20h	22h
T°moy	29,5	29,85	29,85	29,65	29,15	29,3	29,25
H% moy	30,75	34,4	33,1	32,45	41,45	36,6	39,55
T°moy ext	32,95	33,45	34,6	33,3	31,45	29,8	29,65
H% moy ext	26,85	26,9	27,3	28,8	35,4	38,15	39,8

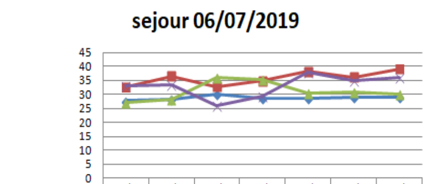


	10h	12h	14h	16h	18h	20h	22h
T°moy	29,35	29,55	29,45	29	29,9	29,65	28,85
H% moy	33,9	33,6	33,7	33,75	30,05	29,75	37,7
T°moy ext	33	33,7	32,7	34,1	30,8	30,35	28,85
H% moy ext	26,2	25,8	30,05	27,55	28,8	32,35	36,3

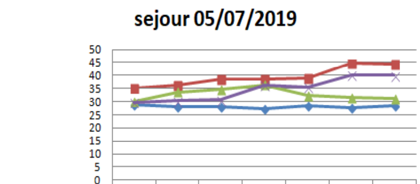
Table 4: Siting room measurement campaign



	10h	12h	14h	16h	18h	20h	22h
T°moy	29	28,9	31,1	29,9	28,8	29,75	28,4
H% moy	32,7	31,75	30,95	34,8	31,75	29,65	33,3
T°moy ext	33,25	34,45	33,55	33,8	31,95	30,2	35,15
H% moy ext	25,8	23,65	26,95	29	27,85	32,5	35,15

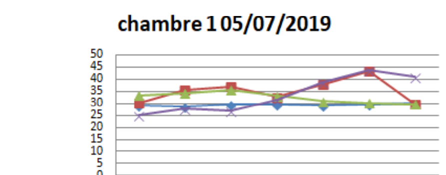


	10h	12h	14h	16h	18h	20h	22h
T° moy	27,65	28,35	29,95	28,7	28,65	28,95	28,9
H% moy	32,55	36,5	32,75	34,75	38,25	36,1	39
T° moy ext	27,1	28,25	35,8	35,3	30,55	30,9	29,95
H% moy	32,95	33,25	25,9	29,35	37,7	34,9	36,1

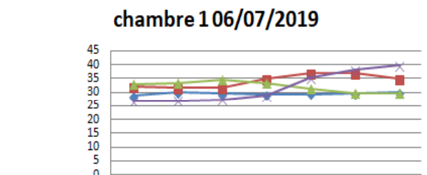


	10h	12h	14h	16h	18h	20h	22h
T°moy	28,75	28,05	28,2	27,35	28,5	27,7	28,4
H% moy	35,2	36,05	38,65	38,75	38,85	44,6	44,5
T°moy ext	30,1	33,7	34,55	36,4	32,5	31,4	31,15
H% moy ext	29,75	30,35	30,75	36,4	35,6	40,15	39,95

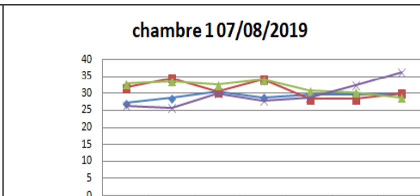
Table 5: Room 1 measurement campaign



	10h	12h	14h	16h	18h	20h	22h
T°moy	29,25	28,6	29,4	29,65	28,95	29,65	29,95
H% moy	30,05	35,65	37,15	32,65	37,75	43,4	29,85
T°moy ext	33,5	34,15	35,7	33,15	30,8	30,2	29,85
H% moy ext	25	27,85	27,05	31,5	38,85	43,8	41,2

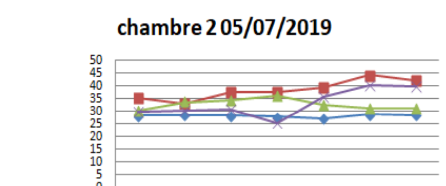


	10h	12h	14h	16h	18h	20h	22h
T°moy	28,85	29,9	29,45	29,15	29,4	29,55	30
H% moy	32	31,75	31,7	34,85	36,9	36,85	34,8
T°moy ext	32,95	33,45	34,6	33,3	31,45	29,8	29,65
H% moy ext	26,85	26,9	27,3	28,8	35,4	38,15	39,8

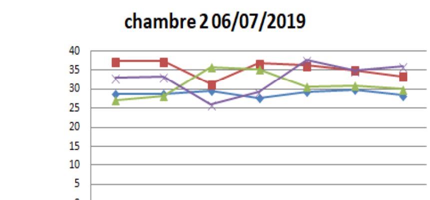


	10h	12h	14h	16h	18h	20h	22h
T°moy	27,15	28,65	30,4	28,8	29,7	29,5	30
H% moy	31,65	34,55	30,45	34,15	28,3	28,35	30
T°moy ext	33	33,7	32,7	34,1	30,8	30,35	28,85
H% moy ext	26,2	25,8	30,05	27,75	28,81	32,35	36,3

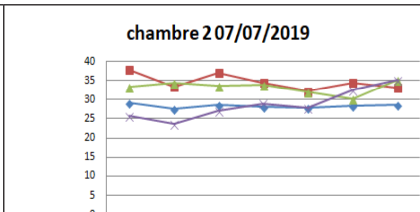
Table 6: Room 2 measurement campaign



	10h	12h	14h	16h	18h	20h	22h
T°moy	28,3	28,6	28,5	28	27,25	29,05	28,6
H% moy	35,3	33,25	37,45	37,65	39,5	44,2	42,05
T°moy ext	30,1	33,7	34,55	36,4	32,5	31,4	31,15
H% moy ext	29,75	30,35	30,75	25,4	35,6	40,15	39,95

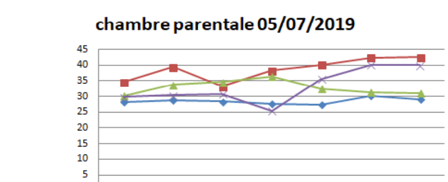


	10h	12h	14h	16h	18h	20h	22h
T°moy	28,8	28,8	29,5	27,65	29,25	29,9	28,4
H% moy	37,35	37,35	31,45	36,85	36,3	35,1	33,45
T°moy ext	27,1	28,25	35,8	35,3	30,55	30,9	29,95
H% moy ext	32,95	33,25	25,9	29,35	37,7	34,9	36,1

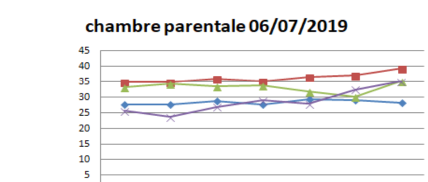


	10h	12h	14h	16h	18h	20h	22h
T°moy	29,15	27,65	28,7	28,05	27,85	28,3	28,65
H% moy	37,85	33,4	37	34,4	32,2	34,4	33,2
T°moy ext	33,25	34,45	33,55	33,8	31,95	30,2	35,15
H% moy ext	25,8	23,65	26,95	29	27,85	32,5	35,15

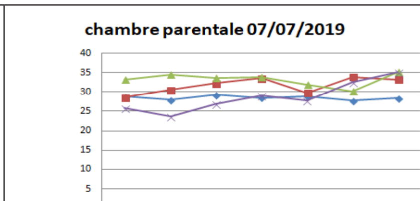
Table 7: Parental room measurment compaign



	10h	12h	14h	16h	18h	20h	22h
T°moy	28,1	28,8	28,35	27,65	27,45	30,2	29,05
H% moy	34,7	39,4	33,2	38,3	40,1	42,4	42,5
T°moy ext	30,1	33,7	34,55	36,4	32,5	31,4	31,15
H% moy ext	29,75	30,35	30,75	25,4	35,6	40,15	39,95

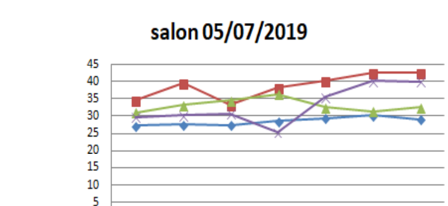


	10h	12h	14h	16h	18h	20h	22h
T°moy	27,7	27,7	28,8	27,7	29,35	28,95	28,35
H% moy	34,8	34,8	35,95	35,1	36,45	37,15	39,25
T°moy ext	33,25	34,45	33,55	33,8	31,95	30,2	35,15
H% moy ext	25,8	23,65	26,95	29	27,85	32,5	35,15

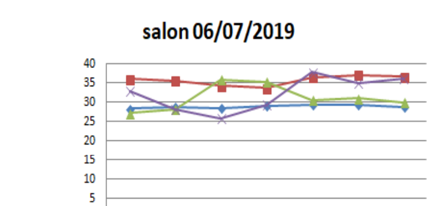


	10h	12h	14h	16h	18h	20h	22h
T°moy	28,8	28	29,25	28,55	28,8	27,75	28,35
H% moy	28,6	30,55	32,3	33,55	29,8	33,95	33,2
T°moy ext	33,25	34,45	33,55	33,8	31,95	30,2	35,15
H% moy ext	25,8	23,65	26,95	29	27,85	32,5	35,15

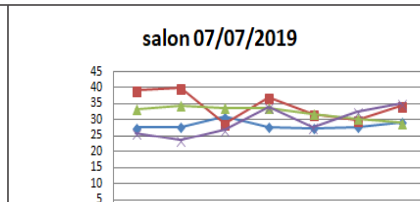
Table 8 siting room measurment compaign



	10h	12h	14h	16h	18h	20h	22h
T°moy	27,32	27,5	27,42	28,65	29,45	30,2	29,05
H% moy	34,7	39,4	33,2	38,3	40,1	42,4	42,5
T°moy ext	31,1	33,2	34,55	36,4	32,5	31,4	32,55
H% moy ext	29,75	30,35	30,75	25,4	35,6	40,15	39,95



	10h	12h	14h	16h	18h	20h	22h
T°moy	28,3	28,7	28,55	29	29,4	29,3	28,8
H% moy	35,9	35,55	34,2	33,6	36,45	37	36,5
T°moy ext	27,1	28,25	35,8	35,3	30,55	30,9	29,95
H% moy ext	32,95	28,25	25,9	29,35	37,7	34,9	36,1



	10h	12h	14h	16h	18h	20h	22h
T°moy	27,7	27,9	30,9	27,8	27,55	27,75	29,3
H% moy	39,3	39,95	28,7	37,15	31,9	29,95	34,25
T°moy ext	33,25	34,45	33,55	33,8	31,95	30,2	29,05
H% moy ext	25,8	23,65	26,95	34	27,85	32,5	35,15

Table 9: Room 1 2nd floor measurment compaign

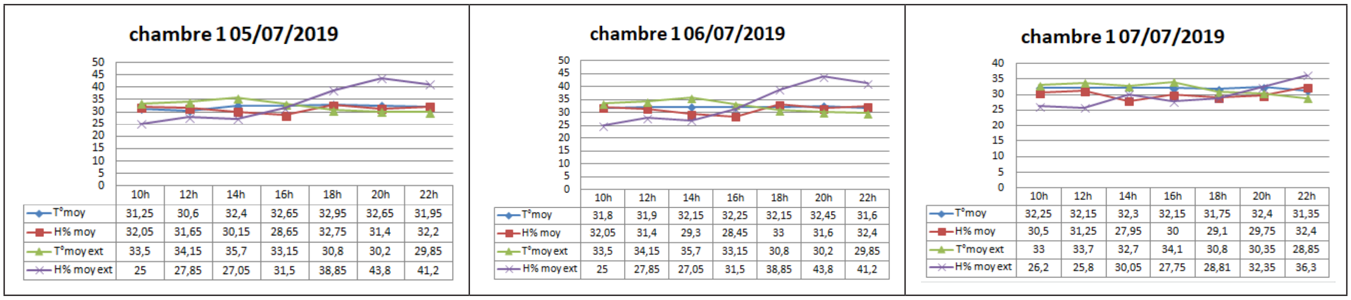
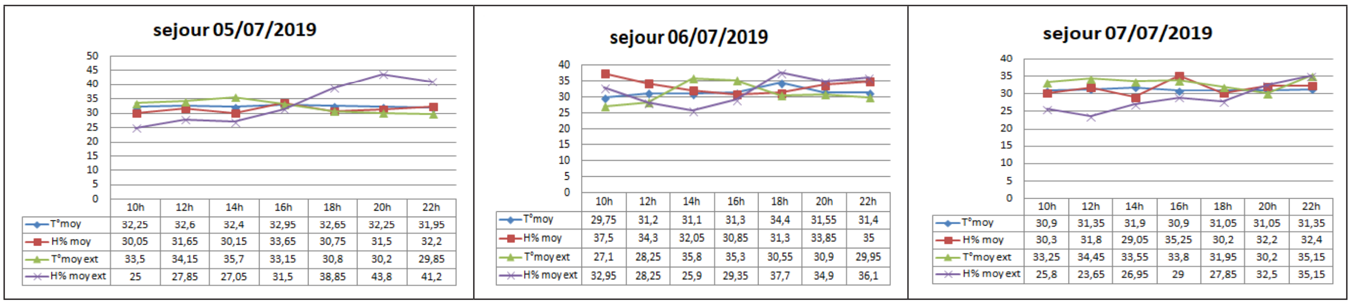


Table 10: Siting room 2nd floor measurment compaign



DISCUSSION

The results of the measurement campaign reveal that the air flow velocity is less than 0.76 m/s and included in the comfort zone 0.2m/s, the indoor humidity rates are included within the limits of the comfort zone defined by Givoni 1986, (T° 20°C/27°C°) (H 20M%-80%) the minimum rate is 23. 65% at 12:00 on 07/07/2019 in the master bedroom, and the maximum rate is 44.6% at 22:00 on 05/07/2019 in the kitchen, when the temperature is always beyond the comfort zone temperature with a minimum of 27.10°C at 10:00 in the living room DRC on 06/07/2019, while the maximum is 34.4°C at 18:00 on 07/07/2019 in the living room 2nd floor.

Generally the coolest temperatures are noted on the ground floor first of all because the under ground takes part in the cooling of the air, but also because the hot air is heavier than the fresh air, this is why the ground floor is the freshest floor, and the highest temperatures are noted on the 2nd floor, then in the room 1 on the 1st floor because of the orientation full west but also because of the ceiling exposed to the solar radiation because above it is an accessible terrace.

To improve the thermal conditions the inhabitants resort to air conditioners whose use varies according to the anthropic activity. Table 11

Table 11: Use of air conditioner to cool down the temperature

FLOOR	ROOM	TIME USAGE	REMARKS
Ground floor	Kitchen	/	The rate of dissatisfaction is 100%, because all the inhabitants attest a situation of discomfort and estimate that it is impossible to use the living spaces without the air conditioners to regulate the temperature 25°C in the living room, 24°C in room 1, and 22°C in room 2.
	Staying room	16h-19h rare	
1ER ETAGE	Room 1/2	00h-12h 15h-17h daily	
	Parents room	23h-07h Quotidien	
	Staying room	13h-19h 22h-10h	
2EM ETAGE	Staying room	22h-09h rare	
	Room 1	/	

RECOMMENDATION

The solution to ensure energy efficiency is the passive building.

According to the 1978 Givoni psychrometric diagram, the following corrections should be made

-high thermal mass with night ventilation

-high thermal mass

-natural and mechanical ventilation

combined with other passive cooling strategies, the use of air conditioners can be reduced or even dispensed with by adopting the following strategies

-use of materials with high thermal inertia to ensure the phase shift of temperatures.

-an efficient envelope

a good thermal insulation

airtightness: reducing air infiltration can save 5-40% of cooling needs.

optimum exposure to the sun

-obstruction of the glazing

-use of double glazing instead of single glazing

-fixed and movable solar protection

-clear cladding for exterior walls and roof

-decrease the form coefficient K to reduce the depredative surface of the envelope.

-Bioclimatic strategy of the cold.

Avoid: efficient envelope

Protect: solar protection

Cooling: water point, vegetation

Minimize the internal contributions

Dissipate: natural ventilation

CONCLUSION

The situation of climatic stress felt by the inhabitants is due to the defect of construction, the bad choice of the materials of construction, the orientation, the thermal bridge, as well as with the lack of ecological gesture on behalf of the inhabitants as well in the choice of the household appliances, the device for lighting and air-conditioning without caring about the ecological label, that when in their jobs, this is why before thinking has to bring corrections of technical order it is primordial to act on the anthropic factor.

The dissatisfaction of the inhabitants vis a vis their thermal environment is translated by an important energy consumption which requires to be reasoned, One can ensure the energy efficiency by the ticket of the passive building and its powerful envelope because it is the part exposed to the hazards of nature, it plays the role of regulator determining the interior environment of the dwelling indeed it creates a microclimate with its own parameters of temperature, moisture, ventilation, lighting, sunning. ... ect that it determines by its shape, its components, and its orientation, so it is thanks to the passive building adapted to the semi-arid climate of the city of Guelma that we can ensure energy efficiency.

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Citation: *Mokhnache nardjesse, Alkama djamel. Assessment of the Climate Stress Situation in the Housing -Allotment 309 N°289 Guelma. Int J Innov Stud Sociol Humanities. 2022; 7(2): 01-09. DOI: https://doi.org/10.20431/2456-4931.0702002.*