International Journal of Engineering Science Invention (IJESI)
ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726
www.ijesi.org ||Volume 8 Issue 01 Ver. I || Jan 2019 || PP 01-07

Climatic potential: Starting point for the design of Residential housing

Dr. Carlos Alberto Fuentes-Pérez[1], Dra. Yolanda Guadalupe Aranda-Jiménez[2]

[1](*National researcher CONCYT-FADU/ Autonomous University of Tamaulipas, Mexico)*

[2](*National researcher CONCYT-FADU / Autonomous University of Tamaulipas, Mexico)*

Corresponding Author: Dr. Carlos Alberto Fuentes-Pérez

Abstract: *The investigation evaluates the fluctuations of temperature and relative humidity of the housing study of the residential suburban-rural case during 2018; therefore, the objective of the present investigation is to determine the interaction of the interior climate comfort with the vegetal environment. It is an applied experimental research, which is supported by several types of studies such as descriptive, bibliographic and field studies. But where the main importance is the result of the work, the main thing of the study is to determine that the climatic tendencies, derived from the primary architectural decisions of the initial design phase, adapt and predispose the final energy performance of the existing residential housing. On this basis, the alternative reconditioning proposal called the architectural energy modification strategy focuses on the genetic energy code of these basic architectural features.*

Keywords-*climate change prevention, energy efficiency of the project (EEP), human thermal comfort condition (HTCC), parametric approach to passive housing.*

Date of Submission: 21-12-2018 Date of acceptance: 05-01-2019

I. Introduction

In relation to the way of measuring the energy performance of the architectural project to its environment, the following is taken up by [1], the design process of a residential environmental home is considered thermally balanced by means of its openings. The first step towards the condition of thermal comfort of the user of residential housing [2], is the analysis of the climatic environment of the place chosen for its location, where it should be noted that each element produces a different impact and presents a varied situation; the second tool to be evaluated for [3], are the incidences of climate in physiological terms, and the third information to be established [4], is the technical solution adopted in the construction of residential housing to adapt to climate change with thermal impact on the inside.

The study for the design of residential housing brings together the principles of architecture, giving express meaning [5], to those interactions of the basic elements of the user of the housing with their environment and explaining the what makes each situation different, where these elements can be found, based on concepts of the laws of thermodynamics that come to be the dynamics of heat, and which comments [6], is one of the branches of physics that studies the effects of changes in thermal magnitudes.

For [7], the climatic potential within residential housing is understood as the degree of hygrothermal adaptability, which is "the realization of any normal activity in the home and where the thermoregulatory mechanisms of the user do not intervene".

With the understanding that overheating in residential housing for [8], it is expected to increase due to anthropogenic climate change and the modification of the local urban climate that leads to an increase in the urban heat island effect. Characteristics of residential housing for [9], such as geometry, orientation, appearance, and glass, and envelope characteristics such as thermal mass and strength can influence the risk of overheating.

From the environmental factors to be monitored indoors, for [10], the temperature (T) is the basic parameter for the thermal evaluation of the house as an element of the climate; it is the parameter that determines the transmission of heat from one body to another in comparative form by means of a scale in °C.

Similarly, relative humidity (RH) is usually the appropriate factor without apparent influences with values between 40.00% and 60.00% inside the home. When personal and environmental factors are moderate, [11] they consider the interval between 30.00% and 70.00% relative humidity satisfactory.

For the analysis and interpretation of the adaptive thermal design of residential housing, there are different ways of analyzing environmental factors and their interrelationships; to say that [12], among the

best known are the hour-grade with temperature and relative humidity measurements every hour inside and outside of the house.

Under these proposals the zone of local thermal comfort is determined and from these thermal values, [13], any average temperature that is above the upper limit has excessive cooling requirements, subtracting the degrees that exceed the limit.

While any monthly average temperature, which is below the lower limit of the local thermal comfort zone, has heating requirements for loss, determined by the number of days-grade of the month analyzed [14].

For which [15], we move on to the environmental adaptability graphs to determine them as the tools to obtain the information in the climatic potential data of the monitored space in degree hours and determine their classification of the residential housing.

II. Research method

2.1 Residential housing case study

The residential housing in total contemplates 1000.00 m^2 of construction in a suburban-rural land of 24 hectares.

Figure 1. Inside of the Residence

Figure 2. Outside of the Residence

2.2 Suburban-architectural features of the housing case study

In its metropolitan area, at coordinates 25º 3' North latitude and 100º05' west longitude at 403 meters above sea level. It is bordered on the north by Pesquería, on the south by Santiago, on the east by Cadereyta Jiménez and on the west by Guadalupe.

Its territorial extension is 247.00 square kilometers. The land on which the municipality is located is mountainous, but its elevations are unimportant. This municipality has 70% between flat and semi-flat areas and 30% of hill areas. The river the chair joins in Santa Catarina is a place called Las Adjuntas, crossing its municipality to later join San Juan in Cadereyta Jiménez. The climate is dry and warm; its average temperature is 22.00ºC and its annual media of 400 mm. The prevailing winds are from the North.

2.3 Interview with the users of the housing case study

Each of the elements of the residential housing case study is reviewed in detail, from there an interview is conducted with the users, to explain the research project and request authorization for the installation of the instruments for measuring temperature and relative humidity and to be able to lower the thermal data of every season change during 2018 for the study; thermal measurement instruments will be placed in various parts of the exterior and interior of the housing case study.

It should be clarified that if you have the availability of users to place the measuring instruments that will be done indoors in unheated spaces to analyze the changes in temperature and relative humidity of normal activity and make constant revisions, especially every change of season of the year for its proper functioning, as well as backing the information obtained in a certain time.

2.4 Applied experimental research

Through the research carried out so far based on the need for congruence between the natural environment and architecture; the theoretical and methodological foundations; the background and historical climate analysis and the development of the case study housing are determined as follows:

Because the present work is an applied experimental research, it is established to typify in the document, the thermal values of the passive residential housing case study considering the activities and functions that are usually carried out so as not to interfere in the timely monitoring of temperature and relative humidity, it is determined that it will be evaluated at their respective seasons and its critical winter months in January; and summer in August, to determine the strategies of adaptability and thermal classification.

2.5 Graphics temperature and monthly relative humidity with constant comfort zone

The hygrothermal graphs of T of the air and HR of the residential housing case study and their respective spaces are based on the daily average values provided by the hobo's UX100-003 for the interior and for the exterior the house has the Hobo's Prov2 U23-001, its values are considered as priorities, considering the critical months of low and high annual temperature, and elaborated in a zone of constant comfort.

With this type of graph we determine the Tn-upper and lower limits-days of comfort, excess and thermal loss of T-thermal expansion, minimum and maximum T-HRc-upper and lower limits-days of comfort, excess and thermal loss of HR-minimum and maximum thermal expansion of monthly HR.

1.6 Indoor / outdoor thermal measurement instruments

2.6.1 Measuring instruments inside

The measurements are made with the data loggers, also called hobo's UX100-003. The team counts the measurements at the beginning of each investigation. The hobo is an electronic instrument capable of measuring air temperature and relative humidity inside the residential housing case study, figure 3.

The thermal measurements are for a period of one year in the residence case study, with monitoring intervals every hour, 24 hours a day.

Figure 3. Hobo UX100-003

Figure 4. Hobo Pr0 V2 U23-001

2.6.2 Placement of the exterior Hobo's Pro v2 U23-001

The Hobo's Prov2 U23-001 was also used for the temperature and relative humidity of some external parts of the residence case study, placed at a considerable height at least 4.00 m high, considering one to the cardinal point East and other to the West, where they are oriented, with the exception that they are protected by some hole in the residence so as not to leave them in direct contact with the rain and alter the measurements.

The thermal measurements abroad are for a year in the residence case study, with monitoring intervals every hour, 24 hours a day.

The T / HR sensor allows a fast response and superior durability in wet conditions with the use of external sensors of reduced diameter for installation in small spaces or ducts of the residence see Figure 4.

2.6.3 Optical Base Station U-4

A Base U-4 Optical Base Station with coupler is required to operate the Hobo Pro v2 U23-001.
The Hobo Waterproof Shuttle transports the field data and can also be used as a Base Station, shown in Figure 5.

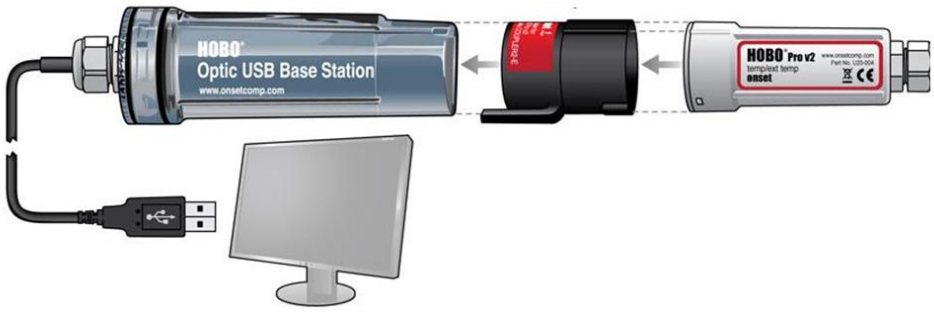

Figure 5. Optical Base Station U-4

III. Result and Discussion

3.1 Hygrothermal graphs of housing case study

The results are presented based on the scientific experiment, which emanates from the monitoring of the values of temperature and relative humidity inside and outside the residential dwelling, to determine the thermal amplitude in the graphs of hygrothermal behavior in 2018 of the Municipality of Juárez, Nuevo León. Mexico.

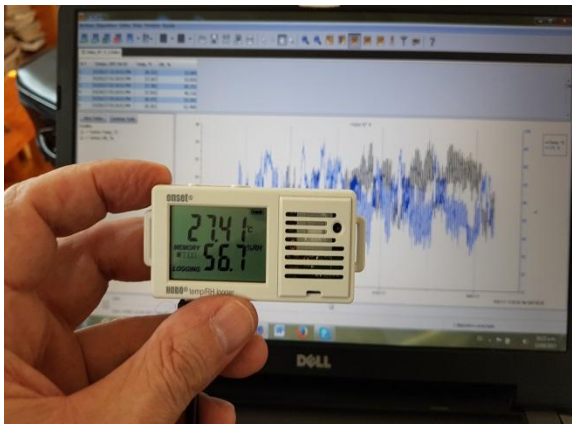

Figure 6. Obtaining data from Hobo UX100-003

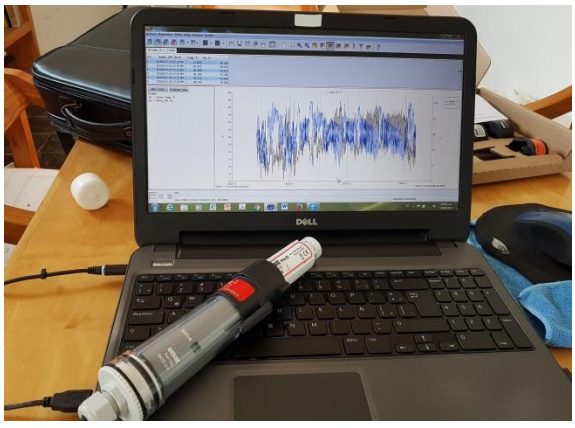

Figure 7. Obtaining data from Hobo Pr0 V2 U23-001

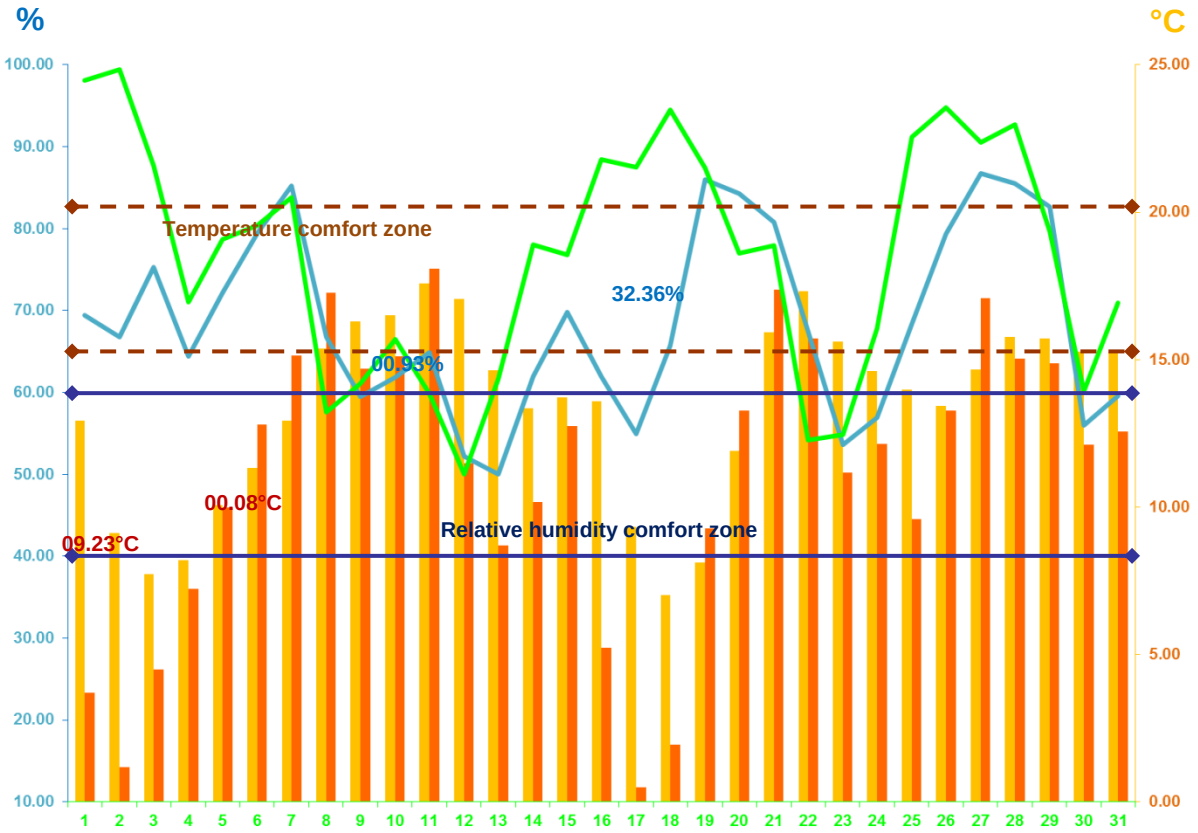

Figure 8. Areas of constant comfort of temperature and relative humidity in January

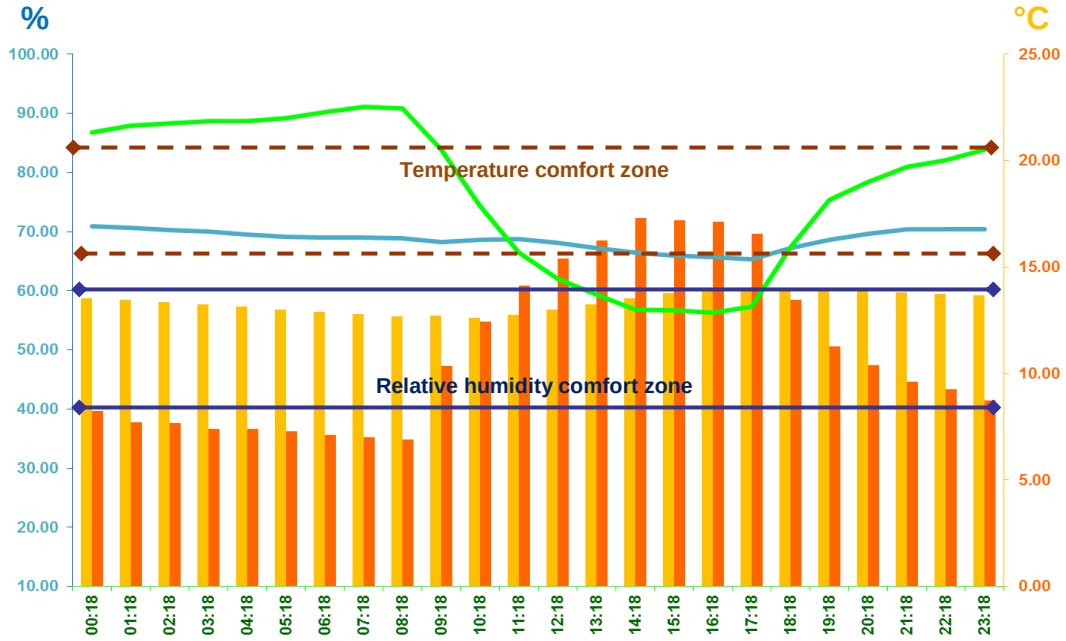

Figure 9. Areas of constant comfort of temperature and relative humidity
Typical day of residential housing in January

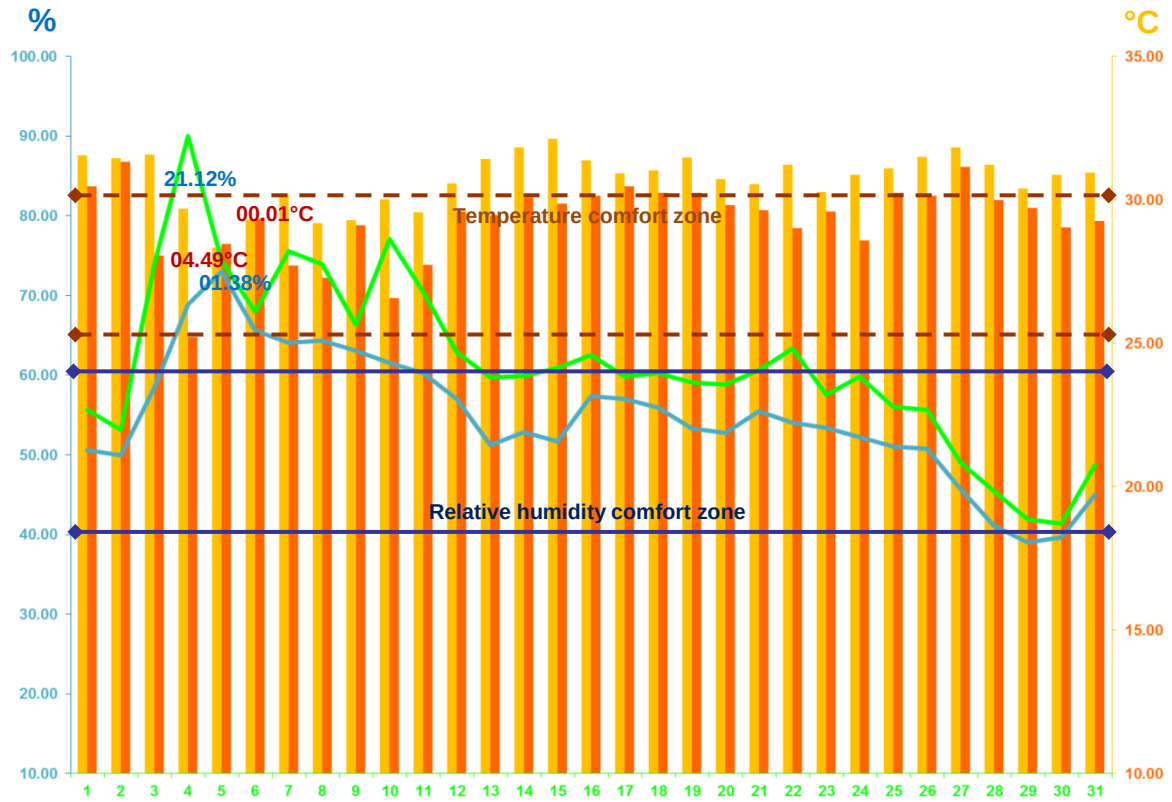

Figure 10. Areas of constant comfort of temperature and relative humidity in August

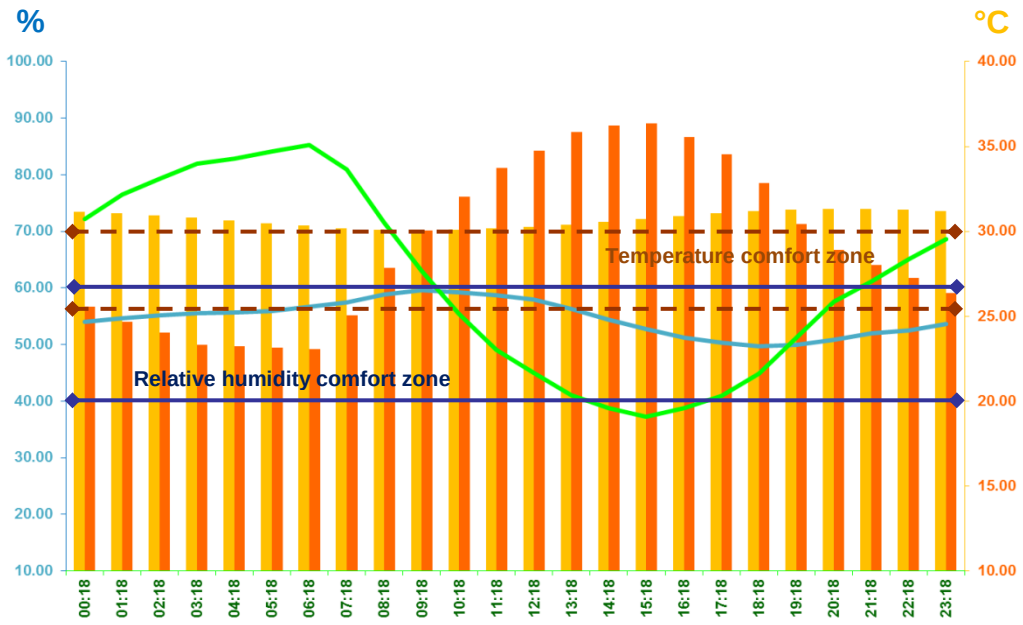

Figure 11. Areas of constant comfort of temperature and relative humidity
Typical day of residential housing inAugust

IV. Conclusion

Interactions of residential housing with the suburban-rural microclimate through exchanges of thermal energy. It offers a passive option architecture, which requires good cross ventilation. The average annual climatic classification of the residence is of a warm and humid space.

The residence experiences an excess of discomfort due to thermal energy and can be harmful to human health (the user). This matches with the forecasts of many warm regions around the world, which will become very hot due to global climate change.

The typology of residential housing can play a crucial role in the contemporary environmental and architectural framework, due to the numerous attempts developed in recent years to adopt a model of passive housing and climatic criteria in Mexico.

According to a climate sensitive approach, the interactive and adaptive relationship between construction, site and climate is considered a basic rule to reduce environmental impact and improve energy efficiency in residential homes [16].

From the results obtained from the Hobo´s data, it can be deduced that its main negative aspect is that the residence reveals a high accumulation of relative humidity, which avoids its dehumidification. Therefore, it affirms that its interior spaces are warm and that they produce suffocating heat, but at a higher relative humidity inside the interior is perceived.

In the last ten years, this concept has extended to the preservation of the thermal identity of the location and its vegetation. The high level of adaptive, sustainable and functional performance of residential homes can be deduced, as evidenced by the case of the Municipality of Juárez, Nuevo León.

Acknowledgments

In a formal way, I thank the deference for the support granted and the authorization of the Framework Agreement for Academic Cooperation of the Program for Professional Development, for the higher type that is subscribed to the General Direction of Higher Education University with the Autonomous University of Tamaulipas (UAT) for the accomplishment of the short stay for the investigation that at the moment was made in the Municipality of Juárez, Nuevo Leon. (Official N°. 511-6 / 18-6972).

References

[1]. M. Missoum, A. Hamidat, K. Imessad, S. Bensalem and Khoudja, A., Impact of a grid-connected PV system application in a bioclimatic house toward the zero energy status in the north of Algeria, Energy and Buildings, 128(2), 2016, 370-383.
[2]. J. L. Perez Galaso, I. L. de Guevara Lopez, J. Boned Purkiss, The influence of microclimate on architectural projects: a bioclimatic analysis of the single-family detached house in Spain's Mediterranean climate, Energy Efficiency, 9(3), 2016, 621-645.
[3]. I. Cinar, Assessing the Correlation between Land Cover Conversion and Temporal Climate Change-A Pilot Study in Coastal Mediterranean City, Fethiye, and Turkey, Atmosphere, 6(8), 2015, 1102-111.
[4]. C. Rubio Bellido, J. A. Pulido Arcas and J. M. Cabeza Lainez. Adaptation Strategies and Resilience to Climate Change of Historic Dwellings, Sustainability, 7(4), 2015, 3695-3713.
[5]. R. D. Oliveira, R. V. Goncalves de Souza, A. J. Maia Mairink, Rizzi, T. Gomes and R. M. da Silva, Concrete walls thermal performance analysis by Brazilian Standards, 6th International Building Physics Conference, 78(4), 2015,213-218.
[6]. P. N. de Freitas and M. Correia Guedes, The use of windows as environmental control in "Baixa Pombalina's" heritage buildings, Renewable Energy, 73(1), 2015, 92-98.
[7]. H. Sulaiman and F. Olsina, Comfort reliability evaluation of building designs by stochastic hygrothermal simulation, Renewable & Sustainable Energy Reviews, 40(3), 2014, 171-184.
[8]. O. Kinnane, T. Grey and M. Dyer, Adaptable housing design for climate change adaptation, Proceedings of the Institution of Civil Engineers-Engineering Sustainability, 170(5), 2017,249-267.
[9]. Z. Lazovic, M. Grbic & V. Djokic, The dissociation from the Giddens paradox in housing architecture in Serbia, Energy and Clean Technologies Conference Proceedings, II(4),2016, 615-622.
[10]. R. Barbosa, R. Vicente and Rui. Santos, Climate change and thermal comfort in Southern Europe housing: A case study from Lisbon, Building and Environment, 92(6), 2017, 440-451.
[11]. M. Vellei, M. Herrera, D. Fosas, Sukumar. Natarajan, The influence of relative humidity on adaptive thermal comfort, Building and Environment, 124(8), 2017,171-185.
[12]. H. Salkini, Laura. Greco and R. Lucente, Towards adaptive residential buildings traditional and contemporary scenarios in bioclimatic design (the case of Aleppo), International High-Performance Built Environment Conference - a Sustainable, 180(4), 2017, 1083-1092.
[13]. N. Fezzioui, M. Benyamine, B. Draoui and C.-A. Roulet, The traditional house with horizontal opening: a trend towards zero-energy house in the hot, dry climates, Energy Procedia, 96(4), 2016, 934-944.
[14]. C. Croitoru, I. Nastase, M. Sandu and C. Lungu, Multi-criteria design and impact on energy consumption of a residential house- a parametric study, Energy Procedia, 85(6), 2016,141-148.
[15]. L. Yang, F. Qian, and Zhao, D.D., Analysis of the modern residential district planning and design. Alexandria Engineering Journal, 55(2), 2016, 1447-1454.
[16]. J. Victoria, S. A. Mahayuddin, W. A. Z. W Zaharuddin, S. N. Harun & B. Ismail, Bioclimatic design approach in Dayak traditional longhouse. International High-Performance Built Environment Conference - A Sustainable 2016 Series, 180(6), 2017. 562-570.

Dr. Carlos Alberto Fuentes-Pérez "Climatic potential: Starting point for the design of Residential housing" International Journal of Engineering Science Invention (IJESI), vol. 08, no. 1, 2019, pp01-07