TECHNIUM
SOCIAL SCIENCES JOURNAL

Technium.

39/2023

2023
A new decade for social changes

Technium Social Sciences

Powered by PLUS COMMUNICATION
International Communication & PR

Technium Social Sciences Journal
Vol. 39, 700-715, January, 2023
ISSN: 2668-7798
www.techniumscience.com

Study on the Outdoor Comfort Threshold from Physical Loads: A Case Study in Biskra, Algeria

Rami Qaoud[1], Alkama Djamal[2]

[1]Department of Architecture,Lacomofa Laboratory, Biskra University, Biskra 07000, Algeria, [2]Department of Architecture, Faculty Of Sciences And Technology, Guelma University, Guelma 024, Algeria

rami.qaoud@univ-biskra.dz, abdelkrim@univ-guelma.dz, ramiqaoud@hotmail.com

Abstract. This study explores the values threshold of physical loads (air temperature, illumination, and sound level) applied in the urban space that represents the limits of human comfort, as well as the effect of the urban environment in terms of the density of buildings on those loads and help to provide ultimate comfort. The methodology of this study was founded on field experiments to obtain the physical load's data for three consecutive days during the summer season's peak. Then, this data is to be studied and analyzed through a comprehensive approach of the physical loads and according to the comfort levels of each load. The results proved the failure of the urban environment of the measurement stations to keep all the physical loads below the comfort threshold, except for the wind and sound loads that were below the comfort threshold. The air temperature and illumination were far from the comfort threshold, especially at midday and peak time. There were also differences in the values of the recorded loads between the measurement samples that reached a degree and a half for the air temperature, 8000 lux for illumination, and 7 dB for sound level. This remarkable difference explained the role of building density in the physical loads found in the open urban space, and the reduction of those loads to be within the required range of the physical comfort threshold.

Keywords. Physical Comfort; Physical Loads; Building Density; Outdoor Comfort Threshold

1. Introduction

The concept of comfort in outdoor spaces has grained the attention of many researchers belonging to the scientific domain of architecture and buildings studies. The study of physical comfort within the space occupied by humans is the ultimate goal of the architectural designers who strive to design an architectural space and succeed to control its environmental physical loads [1] The comfort in urban public spaces has become increasingly important for improving environmental quality and encouraging people spend more time in outdoor activities[2], such as the air temperature, illuminance level, the amount of noise and the wind speed. This comprehensive approach to the physical loads is indispensable to the study of the effectiveness of the architectural and urban space in achieving comfort of the physical loads in the indoor environments, which is called physical comfort [3]. This approach depends on linking loads of the natural environment to each other and studying them according to their comfort limits.

Technium Social Sciences Journal
Vol. 39, 700-715, January, 2023
ISSN: 2668-7798
www.techniumscience.com

The study of the concept of physical comfort is undeniably important as it represents a crucial point of view of the comfort definition. An example that illustrates this idea is that looking from the ground to the sky is very different from looking from the sky to the ground. Although the vision path is the same, the viewing direction is different, which produces a different vision. Similarly, human comfort within the urban space cannot be viewed from the point of thermal and optical comfort only, but there must be a comprehensive view of physical comfort that includes all the other influencing loads. The present research study provides a comprehensive analysis of the concept of physical comfort and identifies its main dimensions. It also defines the values at which the human comfort threshold is in the direction of the environmental physical loads, which allows the definition of the loads applied towards the outdoor physical comfort threshold. Thus, we will be able to determine the position of the architectural space towards those loads, that is to say, when these loads are below the comfort threshold, they reflect a good architectural performance; yet, when they are above that threshold, they would eventually threaten the human wellbeing, and negatively affect his health condition[4].

2.Physical comfort

The concept of physical comfort takes part of a more comprehensive concept that includes psychological comfort that involves color, place, and music; and physical comfort that embraces natural physical loads and comfort applied in the urban construction [1-5]. These loads are divided into four main categories, 1- air convection 2- illumination 3- wind load 4- acoustic load [4-6].. While extreme loads threaten human wellbeing, moderate loads are human-friendly. This latter is called 'physical comfort' [6]., meaning that there is a state of complete convenience with the different natural physical loads. Nevertheless, the fifth type, called 'olfactory load' cannot be measured by numerical values as it depends on the human mind map, in which tastes differ from one person to another according to their cultural background, unlike other loads that represent a physical truth that affects the human body physically and has nothing to do with human culture, gender, or belief [4-7].

3.The environmental physical loads

3.1. Air convection

Air temperature is produced from the interaction of several common factors of the natural and the urban environment [8]. Air temperature is the most perceptible element by humans and through which the extent of a person's thermal comfort in relation to the urban space is measured, even though the air temperature is a result of thermal interaction between the natural and urban environmental components constructed from humidity and wind movement and the temperature of the surfaces ... etc. [9]. In this regard, the level of human thermal comfort is primarily determined by the air temperature in contact with his body. Air particles play an intermediate role in the transfer and the loss of thermal energy between the physical surfaces of the urban environment by conduction, where the warm air layer rises until the air temperature is inconvenient with the surface environment [10]. The air temperature is also affected by wind speed and humidity rate, so that the air movement speeds up the heat exchange process between the human body and its environment, and helps relative humidity found in air particles increase the rates of reflection of thermal rays towards the sky[3]. The air temperature is measured by a thermometer.

Technium Social Sciences Journal
Vol. 39, 700-715, January, 2023
ISSN: 2668-7798
www.techniumscience.com

3.2. Light load

Light rays belong to the general solar rays beam, which constitutes 46% of its total [11] is responsible for human vision within the free urban space during daytime. These rays also carry light energy - similar to thermal rays- responsible for the light levels produced in the space. In this regard, light rays adopt the same technique as solar radiation, as the direct rays are accompanied by large light energy coming from the center of the sun while the indirect and dispersed rays are generated from the sky, clouds, buildings, asphalt ... etc. [12]. The light rays are closely related to the geographical location, the state of clouds, and the height above the sea level so that all these factors directly affect the strength of the light radiation in contact with the ground. [9-13].

3.3. Wind load

One of the most important characteristics of the wind is its direction, speed, strength, and rotation of static. The wind or air movement has a great influence on the heat equation that creates comfort, as it can determine the rates of heat exchange of the human body and the natural climate, as well as the rate of sweat evaporation on human skin [9-14]. In this regard, air movement is regarded as an essential element for the occurrence of the thermal equilibrium process between the air and the surfaces forming the constructed physical environment, so that it can affect the speed of heat loss from the built surfaces with the air through conduction [15].

3.4.Acoustic load

Sound is a natural physical phenomenon that is formed according to the three basic principles of the source, the medium, the receiver. The sound moves from the source through 'sound waves' that have different lengths. The length of the sound wave is the distance between two successive centers and it is also related to the frequency of the sound wave identified by the number of vibrations per second with which air particles vibrate as a result of the vibrations of an object [16]. Accordingly, high-frequency sounds have a short wavelength while low-frequency sounds have a long wavelength. Hence, the sound is controlled by technical characteristics that can directly affect the acoustic environment of the urban environment, which is always taken into account when studying the concept of the sound [17].

4.The physical comfort range

4.1. Comfort Range for Convection

The effect of urban overheating on human health is well-documented [18]. The American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), defines the range of thermal comfort as the period in which a person and all his senses feel completely satisfied with his surrounding environment [9-18]. It plays a most important role to encourage people for using outdoor spaces [19]. Researchers conducted several field experiments in different regions of the world to determine an area or a range of human thermal. Yet, they couldn't limit the number of the discovered areas or the uniform range of human thermal comfort, due to several reasons, including the differences in location, geography, age...etc. [20]. In light of the above, we can briefly review some of the experiments' results related to the requirements of thermal and human comfort in some countries mentioned in the previous table:

Table 1. Comfort range for convection

Country	Comfort range	References
British	°20 – 17	(1967 ،vanstraaten)
Canada	°19	(1967 ،vanstraaten)
far East	° 23 – 22	(1967 ،vanstraaten)
Iran	°25	(1967 ،vanstraaten)
South Africa	° 22 – 19	(1967 ،vanstraaten)
United State	°23 – 20	(1967 ،vanstraaten)
Tropical regions	°27 -22	1973) ،(koenigsberger et al.
Singapore	°27 – 25	1973) ،(koenigsberger et al.
Australia	° 27 -19	1973) ،(koenigsberger et al.
Nigeria	°26.5 – 23	1973) ،(koenigsberger et al.

4.2.Comfort range for illuminance load

Several studies on lighting conditions in indoor environments showed that specific illuminance conditions may encourage human performance [21], it's the same think for outdoor spaces. The field of visual comfort is physically determined according to the levels of light rays, which help to determine the luminous environment and produce human visual perception. In this regard, scientists agree that the range of light rays required in achieving comfortable visual perception and visual comfort is between 200 to 1000 lux [22]. This field can reach up to 2000 lux in the open urban space, including the shaded and sunny spaces, as the values of the light ray levels facilitate the performance of tasks and visual functions within the urban fabric [23]. This field may decrease at dawn or at sunset or in spaces with high urban density; thus, illumination levels become insufficient to perform visual functions within the urban space. On the contrary, this field may increase in low-density urban spaces where there is a high illumination level as well as a high level of reflection of those rays on the roofs, building facades, and floors, which may produce a better glow condition [24].

4.3. Comfort range for wind load

Wind comfort inside the urban open space mainly consists of avoiding the wind's high speed, especially when it is loaded with sand [25]. Hence, the protection of the urban space from the wind's force implies redirecting the wind away from the open space by reducing its speed as much as possible while maintaining its movement within the required range that does not exceed 13 m / s, due to the importance of wind movement in the thermal equilibrium responsible for thermal comfort [26]. Winds are classified according to their speed as follows:

- Breeze at speed of less than 5 m / s;
- Gusts at speed from 13.8 to 24.5 m / s;
- Whirlwind winds gusting from 24.5 to 32.7 m / s;
- The hurricane with a speed of more than 32.7 m / s.

4.4. Comfort range for acoustic load

Acoustic comfort implies the protection from disturbances, noise, high sound levels in the external [27-28] and internal sphere, and quality in the internal acoustic vitality [29]. The scientific and technical standards for acoustic well-being in the urban environment aim to

Technium Social Sciences Journal
Vol. 39, 700-715, January, 2023
ISSN: 2668-7798
www.techniumscience.com

determine the optimal field for human acoustic well-being and to ensure a sound and noise-free acoustic environment, in order to protect humans from any kind of health problems [16-30]. The standard values proposed by the World Health Organization (WHO) should be respected by all countries when planning their acoustic environments. Through these reference values, WHO aims to protect human health in a comprehensive manner. At the international level, the organization collected scientifically proven materials and analyzed all interview and questionnaire indicators to set the best level of human vocal well-being. Accordingly, scholars define the concept of health as not merely the absence of disease or disability by also a state of complete physical, mental and social safety [17]. Noises harm the human body and mind and hinder him from performing his duties properly. The previous table shows the approved values of the World Health Organization.

Table 2. Comfort range for acoustic load

Place	**timing**	
	AM / PM	night time
External area of a residential neighborhood	(A) 16 = 50 dB hours	40 dB(A) (8h)
		55 dB(A) (8h)
External area of schools and playgrounds	55 dB(A)	
	playing time	
External area of the industrial zone	70 dB(A) (16h)	70 dB(A) (8h)
	110 dB(A)	110 dB(A)

5. Determining the physical comfort threshold

Our research study is based on the idea that humans are always surrounded by different physical loads in their daily life, such as air, light rays, and sound waves. That is why the human body must feel completely comfortable when getting exposed to these loads. Through our research paper, we tried to develop a graphic visualization that collects all the physical loads and studies them on the basis of the common values representing the threshold of human comfort. Combining the different comfort loads and connecting them can be considered a real threshold for physical comfort. This technique provides those interested in the urban space with an accurate assessment of the extent of the reached human physical comfort. It can also help to perform the urban tasks in a better way, thus, according to the criteria related to the comfort range for each load, the physical comfort range can be precisely defined by compiling the comfort values of all physical loads. The following diagram shows the threshold that includes the different load values that represent the limits of physical comfort. This latter can range from 17 min. to 27 ° C as a maximum air temperature [31], 200 lux to 2000 lux for illumination level [32], from 0 to 55dB for sound level [22], and from 0 to 5 m / s for wind speed [26]. As shown in the following image, the line at the top of the indicator defines the maximum limits of the physical load comfort i.e. The limits of the comfort threshold, while the line at the bottom

Technium Social Sciences Journal
Vol. 39, 700-715, January, 2023
ISSN: 2668-7798
www.techniumscience.com

represents the minimum limits for the previous values. Thus, we can determine the position of the physical loads applied within the space. If the physical loads are in a low position below the line, they are not regarded as a burden for human wellbeing, but if they are in a high position above the line, they turn out to be a real threat to humans.

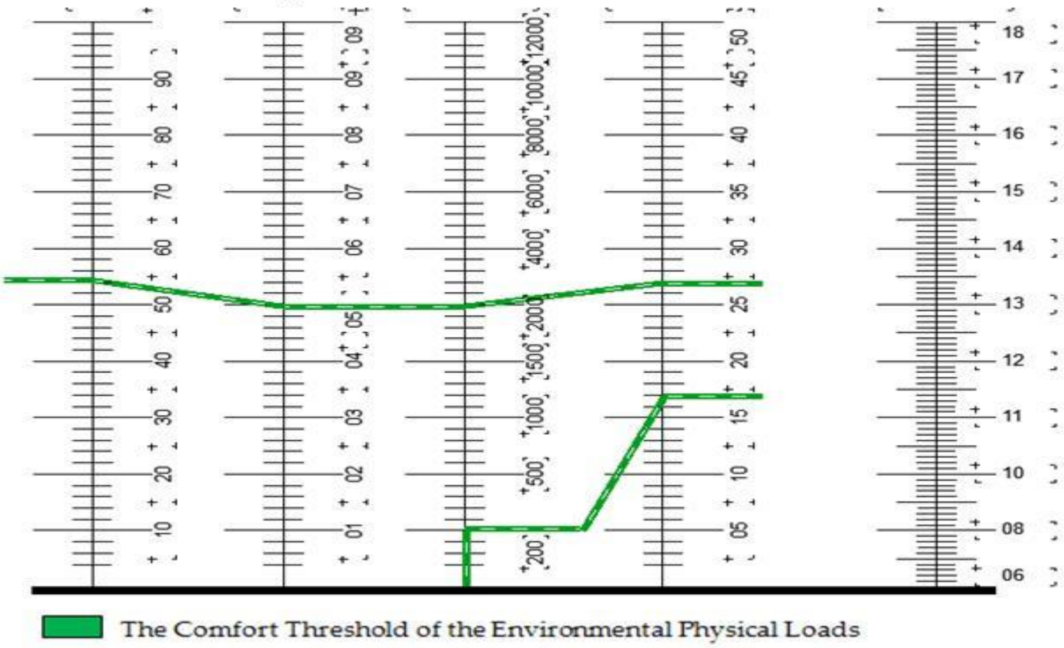

Figure 1. The physical comfort threshold.

6. Materials and Methods

6.1. The physical environment of the research sample

The urban environment under study is the city of Biskra, which is located southeast of the city of Algiers, at a distance of 430 km, and geographically located in the east of the Greenwich line between longitude 5 ° and north-east between 34 ° and 35 ° N.

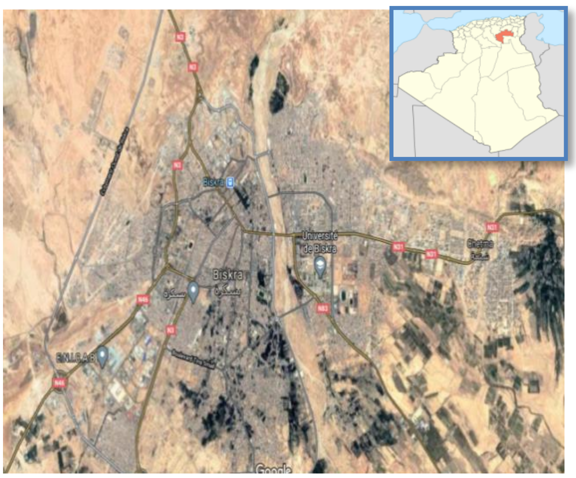

Figure 2. The city of Biskra.

Technium Social Sciences Journal
Vol. 39, 700-715, January, 2023
ISSN: 2668-7798
www.techniumscience.com

6.2.Measurement stations and site description

The two measurement stations are located on Palestine Street in a downtown neighborhood located in the city center which enjoys constant movements throughout the daytime due to its location and diverse services. The neighborhood also includes several types of medium and high building density.

Figure 3. The site of measurement stations.

6.3.Technical card

Table 3. Technical card for measurement stations

	S 01	S 02
Building density	2	4
the number of floors	2	4
The ratio between the facade height and the street width	1.1	2.25
Sky openness coefficient (SVF)	0.39	0.22

6.4. Description of measurement stations

The two measurement stations are represented in two types of street. The first type is the equal street type (L = W) with an openness coefficient of (S.V.F = 0.39) while the second type is the deep street type (L≥ 2W) with an openness coefficient of (S.V.F = 0.22)

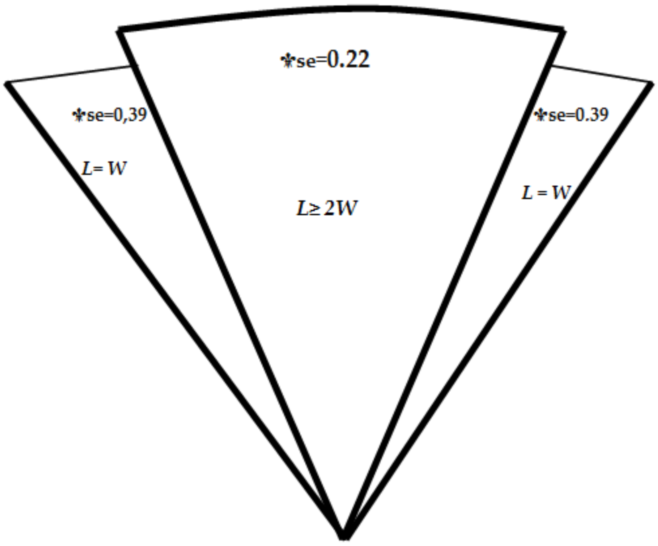

Figure 4. Description of measurement stations.

6.5.Describing measuring stations by images.

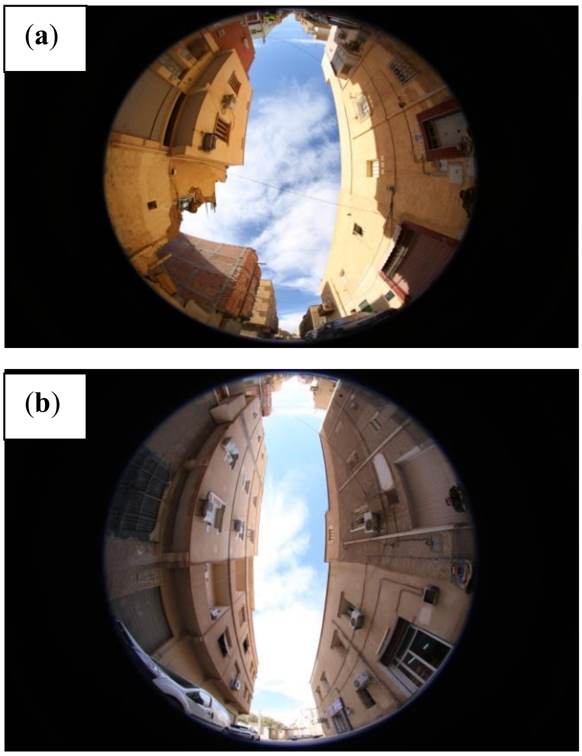

Figure 5. (**a**) measurement station n° 01 ; (**b**) measurement station n° 02.
tech the fish's eye.

Figure 6. (**a**) measurement station n° 01 ; (**b**) measurement station n° 02.

6.6.The registered values (study the sample)

The following table shows the registered average values of the physical loads from the measurement stations during three consecutive days at 6 AM, 12 PM, and 4 PM.3.

Table 4. The registered values form measurement stations.

STETION 02	**STETION 01**		**TIME**
30.4	30.7	C°	**6.00 AM**
1400	1890	LUX	
0.4	1	M/S	
40.8	47.9	dB	
38,6	39,4	C°	**12.00 PM**
7895	8167	LUX	
0,9	1,3	M/S	
52	53,36	dB	
39,5	41,0	C°	**16.00 PM**
4660	12833	LUX	
0,9	1,3	M/S	
46,1	48,9	dB	

Technium Social Sciences Journal
Vol. 39, 700-715, January, 2023
ISSN: 2668-7798
www.techniumscience.com

7.Results

7.1. At the timing of the measurement 6.00

Figure 7. The physical loads at the timing of the measurement 6.00 AM.

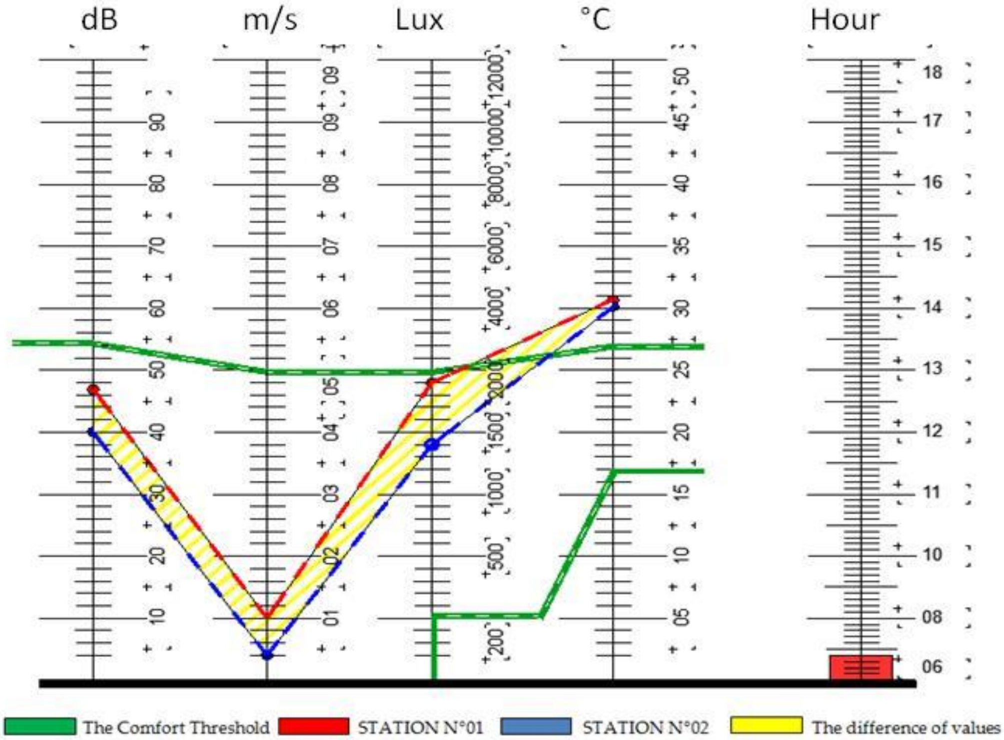

Figure 7. The physical loads at the timing of the measurement 6.00 AM.

This indicator shows that all the values of the physical loads at the measurement stations are below the comfort threshold line or close to it, which means that the values recorded at this time are low and do not harm the human being; therefore, they fall within the range of the human physical comfort. Yet, a difference in the values of the light load between the two stations was registered. The first station registered 1890 lux while the second one registered 1400 lux. As for the air convection, the second station registered a slight increase above the comfort limits, as the first station registered 30.7 degrees while the second one registered 30.4 degrees. The acoustic load was in the ultimate comfort range, as the first station registered 47.9 dB while the second one registered 40.8 dB. The wind movement was completely static in the two stations.

7.2. At the timing of the measurement 12.00

At this measurement timing, we noticed that air convection and the illuminance load in the two stations exceeded the comfort threshold, whereas the wind and the sound loads remain below the line and in the human comfort range. Air temperature registered in the first station was at 38.66 degrees and 38.63 degrees in the second station. The illumination level recorded in the first station was at 8167 lux and 7895 lux in the second station.

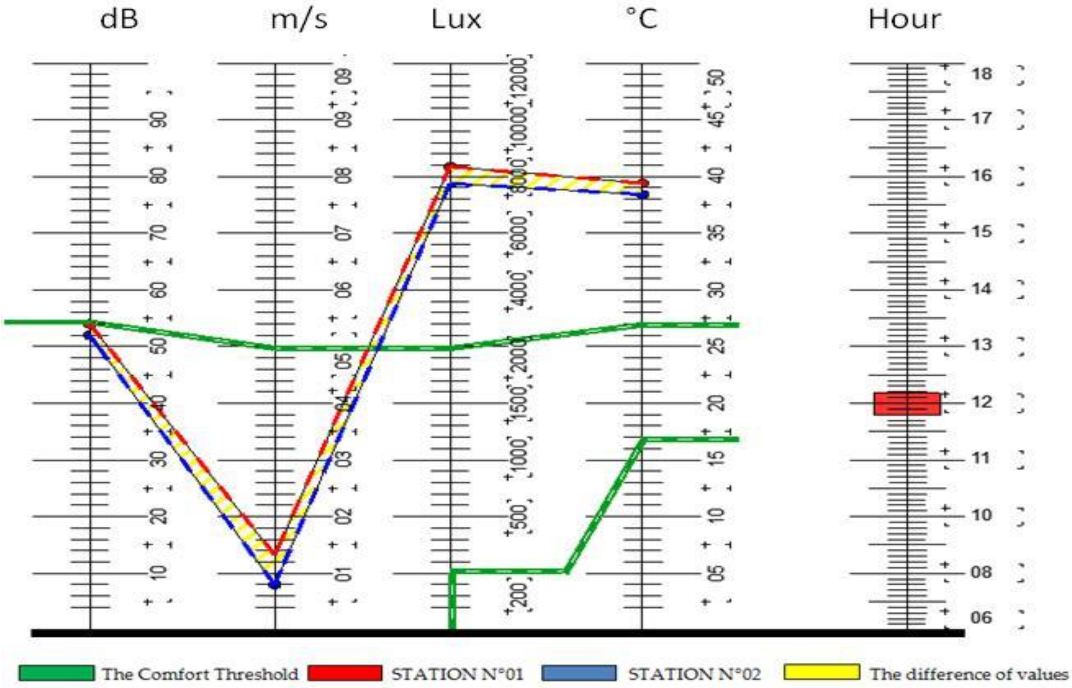

Figure 8. The physical loads at the timing of the measurement 12.00 PM.

7.3. At the timing of the measurement 16.00

Exactly at the human comfort range, the wind values recorded at the two stations were relatively close to 1 m / s. The acoustic load was 53.36 db. at the first station and 52 dB in the second station. We can notice that the sound values are in contact with the comfort limit line, meaning that they represent the maximum values for acoustic comfort. Therefore, this result clearly indicates the presence of an imbalance in physical comfort, which means that the urban space does not provide physical comfort at this period due to the rise in the values of air convection and illuminance load.

This timing is considered as the end of the peak time as the solar angle begins to refract. In this measurement, the values of air and illuminance loads are still very high and would eventually reach their peak, but with a clear discrepancy between the two stations, as the first station registered an air temperature of 41.06, while the second registered an air temperature of 39.5. The illuminance load registered in the first station was at 12833 lux, while it registered4660 lux in the second station. The thermal and optical load values represent a clear risk to human wellbeing. Yet, the acoustic load was within the acceptable limits of the comfort threshold, as the first station registered 48.9 dB and the second station registered 46.1 dB, with a static air movement recorded at the two stations, estimated at 1 m / s. Thus, these results clearly indicate an imbalance in physical comfort, which means that the urban space at this time does not provide human physical comfort due to a rise in the values of the air convection and the illuminance load and the registered difference between the two stations.

Technium Social Sciences Journal
Vol. 39, 700-715, January, 2023
ISSN: 2668-7798
www.techniumscience.com

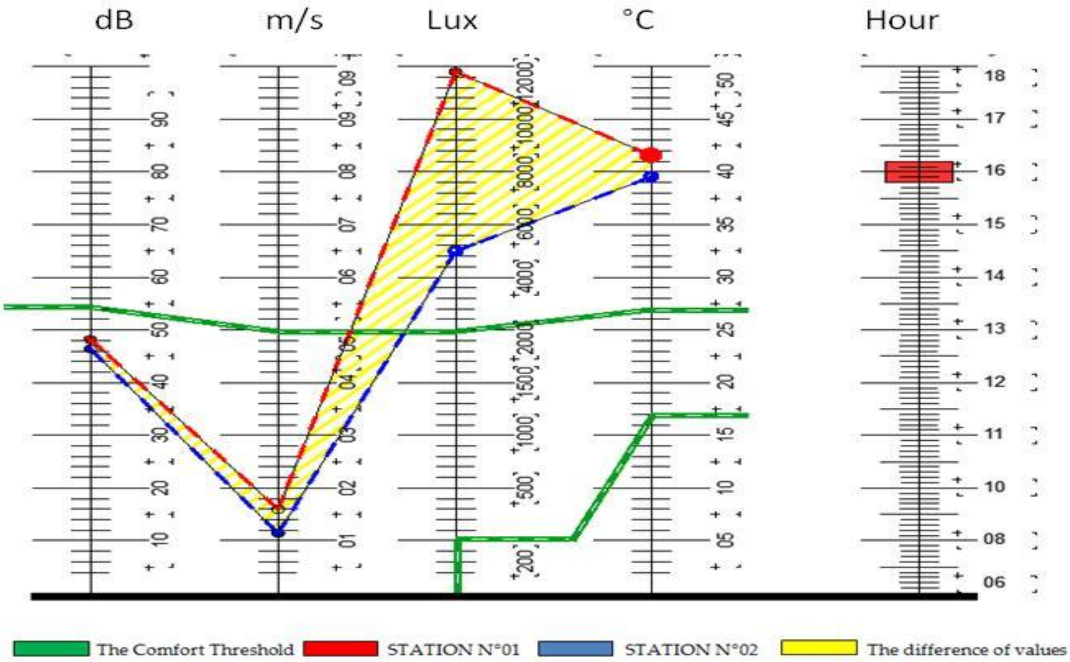

Figure 9. The physical loads at the timing of the measurement 16.00 PM.

After analyzing the given data, we conclude that there was a physical comfort within the urban space during the first hours of the day due to the decrease of the values of all physical loads applied in the urban space, which was showed by the graphical indicator. All the values were below the comfort threshold line on the indicator, except for a slight increase in the heat load.

Consequently, the physical loads present in the urban space were all comfortable and didn't present any kind of human risk. Yet, during daylight hours, there was an increase in loads due to the rise of the sun disk in the sky. These informations were deduced from the analysis of the values at the timing of the measurement in the middle of the day as the indicator showed the inability of the urban fabric to maintain all the load values according to the physical comfort threshold, because there was a significant increase in the values of the air convection and the illuminance level that push them outside the comfort limits. Therefore, the user of this urban space will feel uncomfortable at this period of time towards the air temperature and the level of the natural elevated light, with a registered difference in all values between the two measurement stations.

We also conclude that there was a difference in the values of all physical loads between the two stations during the peak time. The heat and illuminance level were also outside the comfort limits with a discrepancy between the two stations, as the first station (lower building density) registered the largest values for the thermal and illuminance loads compared to the second station (greater structural density) that registered closer values to the limits of physical comfort. We also conclude that the wind and sound load were below the comfort threshold line during the three measurement times as their values were low and did not constitute any human risk. In this regard, we can say that the urban fabric provided comfort towards all physical loads only during the first hours of the day. However, when the physical loads intensified at midday and peak time, the wind and sound loads remained below the comfort threshold, but the air temperature and illuminance loads were far from the comfort threshold with remarkable differences between them. Thus, we can say that the urban fabric did not succeed in maintaining all loads below the comfort threshold during the day in the two measuring stations, especially for the light load and air temperature, with registered differences between the values in the two stations, as the obtained results showed a difference in the values of the physical loads between the two stations, represented in 1.5 degrees for air temperature, 8000 lux for illuminance and 7 dB for sound level.

8. Discussion

We should discuss the reason behind the failure of the urban fabric of the two measuring stations in maintaining the comfort threshold of the physical loads, especially the heat and illuminance load, is the occurrence of direct insolation as a result of the rise of the solar angle, which was close to perpendicular to 83 degrees. At this angle, the urban fabric could provide shade in the open urban space and has become completely exposed to short-term solar radiation that carries large energy of heat and daylight, which led to the deviation of the values of heat and daylight convection completely beyond the threshold of physical comfort. During the daytime, the gradual refraction of the solar angle at 4 pm led to the emergence of sunny and shaded environments. This condition indicates that the building's height was not sufficient to cover the solar angle at this time of the day in the first environment and thus the open urban space was sunny. In the second environment, the building height was sufficient to cover the solar angle and provide alternating shade for the open urban space. Thus, a clear decrease in the thermal and illuminance values was recorded as a result of exposure to scattered solar radiation with weak thermal and light energy. The sound level was kept below the comfort threshold in the two environments because of the height of the buildings, which provided an adequate acoustic screen to repel the sound waves coming from the source and disperse a large part of them outside the open urban space. In addition to the difference in the structural density, there was a difference in the heights of the buildings surrounding the open space and also a difference in the amount of openness towards the sky, which resulted in a clear variation in the amount of thermal, illuminance, sound and wind energy getting into the urban space. The transformed energy into numerical values reflect its real amount and power. This interpretation depends mainly on the tangible results recorded on the field experiment related to the study of the building density variable while fixing all the other variables such as street direction, building materials, and their thermal, optical, and acoustic properties, flooring type ... etc. The only variable under study was the building density of the buildings. Therefore, the difference in the obtained data from the field was solely due to the difference in the building density of the urban fabric. The obtained results have also proven that the urban environment of the second measuring station with the highest density and the lowest openness factor towards the sky was the closest to the comfort threshold from physical loads compared to the recorded values to the urban environment of the primary measurement station. Hence, the urban environment of the second station provided a greater alternating shadow during the day from thermal and light rays. It also provided shade from sound waves and wind movement, meaning that the building density of buildings can form a shadow of all physical loads.

9. Conclusions

The physical comfort threshold is regarded as an important tool that helps to develop a definition of physical loads in relation to human comfort, as the threshold constitutes the limits of the comfort range of those loads. Therefore, these loads can be either in the comfortable range, that is, they are below the comfort threshold and do not threaten human health, or outside the comfort threshold which constitutes real human wellbeing and may cause serious health complications, meaning that the comfort threshold represents the line that separates the comfortable and uncomfortable values of all physical loads.

The obtained results showed that the dense urban construction environment could provide a better level of physical loads within the comfort threshold than the less dense environment. Through our field experiment, we found out that despite the timing of the experiment, which was at the peak of the summer season, the luminous and thermal load values closest to the comfort threshold were the densest. The values of acoustic and wind loads were lower than those recorded in the least dense environment. Thus, the building density of buildings greatly affects the level of physical loads as to be within or close to the comfort threshold, meaning that the greater the building density is the less the physical loads are and within the limits of the comfort threshold.

10. The scientific contribution of this research study

This research study provided a good definition of the concept of physical comfort for the urban and architectural space, as it identifies a clearly defined range of this type of comfort. The study represents a new scientific building block for those interested in studying the physical loads within the architectural and urban space and paves the way for future studies related to the effects of physical loads on architectural and urban functions.

References

[1] Allain, R.Morphologie Urbaine. Geographi Amenagement Et Architecture: Paris. Armand Colin, 2006.

[2] Assessing Comfort in Urban Public Spaces: A Structural Equation Model Involving Environmental Attitude and Perception, You Peng and all . **February 2021 ,** https://doi.org/10.3390/ijerph18031287.

[3] Abd al-Qadir Riziq al-Makhadami, 2006, "Environmental Pollution," University Press, Algeria

[4] Balkhal Ezz El-Din, Lecture, Biskra University, on thermal well-being - second year bachelor degree.

[5] Allen, K . Translation. Ahmed, K. The Standards of the Design Warm Areas: Mketbh Anglo-Egyptian, 2011.

[6] Qaoud, R. Djamal, A. The Role Of The Urban Fabric in Reducing of the physical loads for the environment applied Within The Free Space - Street- , For Saharan Cities, Case Study Of The City Of Biskra -Algerie. Energy procedia, Vol 157.P 02–09, 2019

[7] Boukhabla, M. Djamal, A. The Effect Of Urban Morphology On Urban Heat Island In The City Of Biskra In Algeria: International Journal Of Ambient Energy, Vol 34:2.P 100–110, 2013.

[8] Al-Khouli, Muhammad Badr al-Din, 1975, Climate Effects and Arab Architecture, Beirut, Beirut Arab University.

[9] Saeed Abdul Rahim Saeed Bin Auf, 1994, Climatic Elements and Architectural Design, Scientific Publishing and Press, King Saud University

[10] Saeed, Saeed Abdul-Rahim, 1991, "Requirements for shading and fixing the angles of shadows and choosing the optimal orientation for buildings and arrivals in the city of Riyadh," UAE University.
[11] Saeed Al-Yahani - light - Umm Al-Qura University - College of Applied Sciences - Department of Physics.
[12] Cote, M. La Ville Et Le Désert: Paris. Karthala,2005.
[13] Lozano, E.E. 1974. Visual needs in the urban environment, Town PlanningReview, Vol 45, No.4.
[14] La Cambre. villes et architecteurs, karthala paris,1991.
[15] MILLS G , M,. the urban canopy layer heat island . IAUC teaching resources, 2005.
[16] ElakHmi, M. 1982. the sound and architecture. Damascus: The new printing press-Damascus University.P4
[17] Bruxelles Environnement (IBGE). Leefmilieu Brussel (BIM). Observatoire des Données de l'Environnement. Observatorium voor Milieugegevens. 2010. 37. Les valeurs acoustiques et vibratoires utilisées en Région bruxelloise. Accessed NOVEMBRE 1, 2010 .
[18] Matthaios Santamourisand all, **7 December** 2020, Increasing Green Infrastructure in Cities: Impact on Ambient Temperature, Air Quality and Heat-Related Mortality and Morbidity, https://doi.org/10.3390/buildings10120233.
[19] Mohamed H. Elnabawi.and Neveen Hamza, 11 December 2020, Outdoor Thermal Comfort: Coupling Microclimatic Parameters with Subjective Thermal Assessment to Design Urban Performative Spaces, https://doi.org/10.3390/buildings10120238.
[20] Izard And Guyot ,. archi bio , parenthése edition,1979.
[21] WJM van Bommel , and GJ van den Beld, December 1, 2004, Lighting for work: a review of visual and biological effects, https://doi.org/10.1191/1365782804li122oa.
[22] Nikolopoulou, M. Concevoir Des Espaces Extérieursen Environnement Urbain: Une Approche Bioclimatique. Centre For Renewable Energy Sources (C.R.E.S.) (http://alpha.cres.gr/ruros/) visit in 15/12/2015, 2004.
[23] Jean, D. Edmond, b. les milieux désertiques. Paris : armand colin ,2001.
[24] Qaoud, R. Djamal, A. The Impact Of Constructivism Density Of The Urban Fabric In Improving The Urban Ambience- Thermal, Visual - Of The Street. For Saharian Cities. Casa Study Of The City Of Biskra: procedings plea 2017, Vol 01. P 820–826, 2017.
[25] Sultan Al-Rifai, 2009, Environmental Pollution, Usama Publishing House, First Edition.
[26] Attiyat Hamdi, 1965, Geography of Urbanism, an applied objective study, Dar Al Maaref.
[27] Tallal Abdel Karim Bouzir and all, 2018, Assessment and analysis of noise pollution in Biskra public gardens (Algeria), https://aip.scitation.org/doi/abs/10.1063/1.5039256.
[28] Tallal Abdel Karim Bouzir and all, 2017, Assessment of Noise Pollution in the City of Biskra, Algeria.
[29] Qaoud, R. Djamal, A. The Impact Of Constructivism Density Of The Urban Fabric In Improving The Physical Urban Ambience Of The Free Space - The Street- For Saharian Cities. The Study Of The Case City Of Biskra: Energy procedia, Vol 119.P 201–2013, 2017.
[30] Hanafi Awad, 1997, City Residents, Between Time and Place, Zagazig University, Computer Scientific Bureau for Publishing and Distribution, Alexandria.

[31] Khaled, O. Contribute To The Project In The Island Of Thermal Analysis Indicators: Memo Master. University Of Nantes, 2008.
[32] Mazor Al-Saeed, University of Umm El-Bouaghi, a lecture on welfare, post-graduation students.
[33] Qaoud, R. Djamal, A. The role of L/W in the sola r radiation for Saharian cities JOURNAL E3S Web of Conferences,Vol 91.P 05006, 2019.
[34] Roberts Darren. urban morphology and indicators of radiation availability . solar energy , vol.80, 2006.
[35] Pelletier Jean,Delfante Charles. villes et urbanisme dans le monde , armand colin editeur , paris, 2000.
[36] Panerai, P. Jean, C. Jean-C, D. Formes Urbaines De L'ilot A La Barre: Marseille. Editions Parenthéses,2009.
[37] OKE T.R. boundary layer climates , sec edition , methuen, london and new york ,1987.
[38] La Cambre. villes et architecteurs, karthala paris,1991.
[39] Lynch k, 1999. L'image de la cite, Dunod Paris.
[40] Koenigsberger, O, Ingersoll, T, Alan, May-hew and Szokolay.