



---

## Measurement of the apparent temperature index to determine human comfort - Al-Janaina Primary School as a model

**Assistant Instructor :Hind Fadel Ibrahim** - Ministry of Education  
**Instructor :Firas S.Rahem** :University of Baghdad- Education College  
**Prof :Ali A. Alwaeli** : University of Baghdad- Education College  
**Prof :Osameh. K.Alsharifi** : University of Baghdad- Education College  
aannalhabe@yahoo.com

### Abstract

The study of different criteria for climatic comfort and its application to school have (21 rooms and two rooms as management rooms, one room to the rest to the teachers, so we find a library and kitchen and large area and Garden with accept Bulled ) as a virtual temperature provides a scientific material useful in understanding the reality and different levels of comfort, it helps in determining the monthly patterns of the physiological climate, and in the appointment of the best times and places and most suitable for the comfort of the human body ( specially the student ) for the exploitation and development for tourism purposes .

### Introduction

This climate study falls within the so-called Bioclimatology, which appeared to express interest in the impact of the environment on living organisms, especially humans, where this aspect of the applied climate is concerned with pollution, human health and comfort, and an understanding of the direct and indirect impact of climate on the physiological functions of man And its impact on his feeling of comfort within different climates of the topics that were dealt with greatly, but the problem that such studies suffer from is the difficulty of defining an accurate and specific concept of comfort that can be measured and expressed in a quantitative and objective way as well as the method to achieve this, due to the many The number of variables that affect the sense of comfort and the difficulty of measuring some of them, in addition to that some of these variables are physiological and psychological, and some of them follow the civilized environment of the person and is

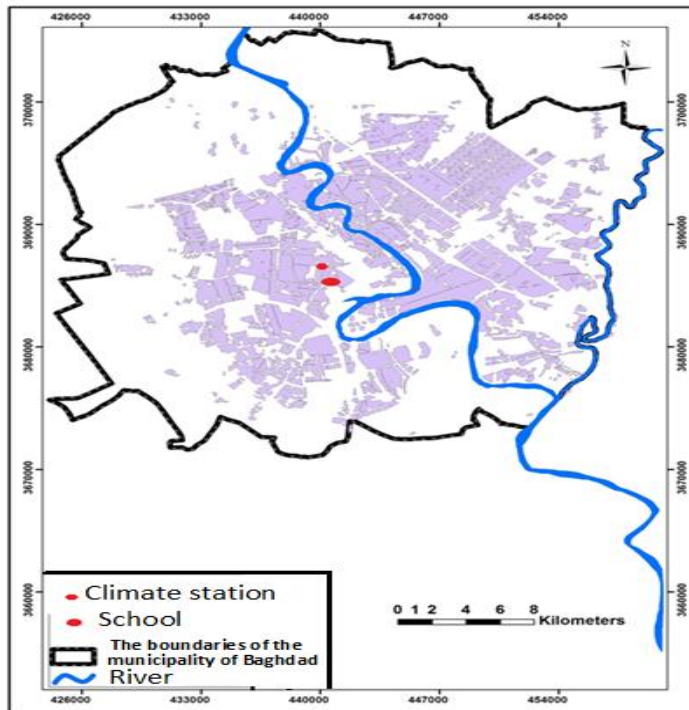
affected by the extent of its compatibility with the environment in which it lives.

**2. Research problem:** Can a person's comfort in an elementary school be determined by means of the apparent temperature presumption? And how?

**3. Research hypothesis:** Human comfort is determined by various mathematical methods, including the apparent temperature presumption, through the use of its equation and comparison of results with its scale.

**4. Research limits:** It was determined in the temporal dimensions, which is represented by a climatic year (starting from September and ending in August) represented by the climatic data of the mobile climatic station that was installed on the roof of one of the houses near the school to measure the climate elements, see map (1), see pictures (1) (2), (3), (4), (5) and (6), and the spatial dimension represented by the boundaries of the school in which the measurement was made.

**Map (1) the location of the school from Baghdad and the location of the mobile climate station.**



Source: Researcher work based on Arc Gis 10.3, Baghdad Municipality, Design Department, GIS Division, Data (unpublished), for 2019.

Picture(1) In the Summer 1



Picture(2) In the Summer 2



Picture (3) In the Winter 1



Picture (4) In the Winter 2



Picture(5) In the Summer 3



Picture(6) In the Winter 3



## 5. Application:s

The apparent temperature presumption results from the effects that the relative humidity of the atmosphere has limited at the actual temperature, and it can be extracted from Table (1): - When speaking about the subject of human comfort, the following must be mentioned <sup>(1)</sup> - :

A- At low temperatures ( $<3^{\circ}\text{C}$ ) the effect of relative humidity is not important.

B- At high temperatures and high relative humidity the predominant condition is discomfort.

A- When the temperature exceeds "38 degrees Celsius", most people feel the heat regardless of the relative humidity.

D - In case the relative humidity exceeds 30% at a temperature of "38 ° C," the weather becomes difficult to tolerate.

E - If the relative humidity is greater than 70% and the temperature is "28 ° C", the weather becomes difficult to tolerate.

F- When the relative humidity is low then the feeling of temperature is less than the actual temperature .

This is why when the actual temperature in the shade is 32 degrees Celsius and the relative humidity (70%), the apparent temperature is very annoying if it reaches "41 degrees Celsius", while if the temperatures drop to less than "3 degrees Celsius" the effect of relative humidity It does not matter, while if the temperature exceeds "38 degrees Celsius", people feel the heat regardless of the humidity, and the atmosphere becomes unlikely in the case of the relative humidity exceeding (70%) and the temperature (28 ° C) <sup>(2)</sup>, And through Figure (1), humidity can be determined by how people feel the heat through the apparent temperature curve.

It is clear from Table (2) that when the apparent temperature reaches between (27-32 ° C) it causes negative and serious harm to the individual's health condition causing heat stroke or heat stroke especially that the study area (school) has a large square in which students can be present, Whereas if the temperature reaches between (32 - 41 ° C), the effect of the danger on the student's health condition increases, causing muscle spasm, and the negative effect of the return on his health condition increases if the temperature rises to more than (54 ° C) when the student is exposed to fatigue because the

degree of heat stress varies with different Growth, human safety from disease, structure, and other physical characteristics<sup>(3)</sup> .

When applying the general apparent temperature presumption to the study area station, it becomes evident that there is a difference in the rates from month to month according to the difference in the monthly rates of the normal temperature and relative humidity, and through Table (3) and its comparison with the scale in Table (2), It is clear that the general apparent temperature data during the winter months (December - January - February) ranges between (21 and 22), and it turns out that these months fall outside the danger of thermal stress, and the same applies to the spring months (March, April and May) where they are outside The risk of thermal stress ranges from (20) to (28), so it is alarming in the month of May without the other spring months, and when examining the same schedule and table (4) it becomes evident that the summer months (June, July, August) are very alarming and the danger is to rest. By (33, 35, 34) and it was the highest in the month of July. As for the fall semester, most stations of the study area are alarming during Hour in (September), and either two months (October-November) It Be outside the risk of heat stress in the study area station .

Table (4) also shows that the school is "very dangerous" and ranges from "a warning to a danger and a severe warning to danger", so a "warning of danger" will be in the month of May, but (severe warning of danger) will be in the months (June, July, August), While the moderate is in the months (October, November, December, January, February, March, April).

It is clear from Table (5) that the presumption of daytime apparent temperature during comparison with the ladder through Table (2). When applying the equation using the maximum air temperature rates with the lowest relative humidity rates, it is clear that all stations of the study area during the winter months (December - January) - February) It is ideal for rest through low temperatures and high humidity, and the values of that context are between (19-21) for the winter months, while the spring months (March and May) are comfortable and out of danger while the month of April is uncomfortable and can be hit by a sunstroke As for the summer months (June - July) - August) The presumption of the daytime apparent temperature is between

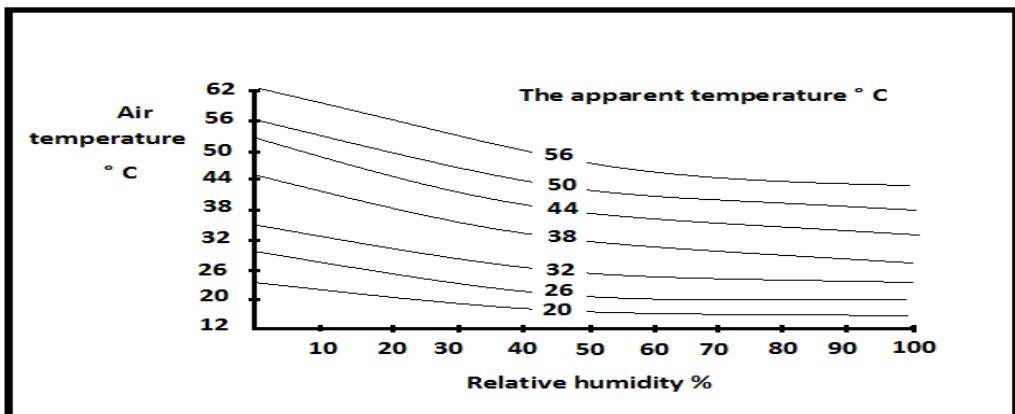
severe and dangerous warning) in all these months by (38, 41 and 41), respectively, while the month of (November) is (comfortable .

Table (1) apparent temperature and its relation to relative humidity (RH).

The actual air temperature °C	The apparent temperature is °C																			
	٦٠	٥٢																		
٥٧	٤٩	٥٣																		
٥٤	٤٧	٥٠	٥٥																	
٥٢	٤٤	٤٧	٥١	٥٥	٦١															
٤٩	٤٢	٤٤	٤٧	٥١	٥٤	٥٩	٦٤													
٤٦	٣٩	٤٢	٤٤	٤٦	٤٩	٥٣	٥٧	٦٢	٦٦											
٤٣	٣٧	٣٩	٤١	٤٢	٤٤	٤٧	٥١	٥٤	٥٨	٦٦	٦٢									
٤١	٣٥	٣٦	٣٨	٣٩	٤١	٤٣	٤٥	٤٨	٥١	٥٤	٥٧	٦١	٦٥							
٣٨	٣٣	٣٤	٣٥	٣٦	٣٧	٣٨	٤٠	٤٢	٤٣	٤٦	٤٩	٥٢	٥٦	٥٩	٦٢					
٣٥	٣١	٣١	٣٢	٣٣	٣٤	٣٦	٣٧	٣٨	٤٠	٤٢	٤٣	٤٦	٤٨	٥١	٥٤	٥٨				
٣٢	٥٠	٢٩	٢٩	٣٠	٣١	٣١	٣٢	٣٣	٣٤	٣٥	٣٦	٣٧	٣٨	٣٩	٤١	٤٣	٤٥	٤٧	٥٠	
٢٩	٢٦	٢٦	٢٧	٢٧	٢٨	٢٨	٢٩	٢٩	٣٠	٣١	٣١	٣٢	٣٢	٣٣	٣٤	٣٥	٣٦	٣٧	٣٩	٤١
٢٧	٢٣	٢٣	٢٤	٢٤	٢٥	٢٥	٢٦	٢٦	٢٦	٢٧	٢٧	٢٧	٢٨	٢٨	٢٩	٣٠	٣١	٣١	٣٢	٣٢
٢٤	٢١	٢١	٢٢	٢٢	٢٢	٢٣	٢٣	٢٣	٢٣	٢٤	٢٤	٢٤	٢٤	٢٥	٢٥	٢٦	٢٦	٢٦	٢٦	٢٧
٢١	١٨	١٨	١٨	١٨	١٩	١٩	١٩	١٩	٢٠	٢٠	٢١	٢١	٢١	٢١	٢١	٢٢	٢٢	٢٢	٢٢	٢٢
Relative % humidity	١٠٠	٩٥	٩٠	٨٥	٨٠	٧٥	٧٠	٦٥	٦٠	٥٥	٥٠	٤٥	٤٠	٣٥	٣٠	٢٥	٢٠	١٥	١٠	٥

Source: Ali Abdul-Zahra al-Waeli, Significant climatic phenomena, previous source, p. 198.

Figure (1) apparent temperature



Source: Depending on: Ali Hassan Musa, The Biosphere, Ed. 1, Nineveh for Studies, Publishing and Distribution, Syria, Damascus, 2002, p. 48.

Table (2) The scale of apparent temperatures according to the apparent temperature

Apparent temperature ° C	Degree of danger, degree of thermal stress	Symptoms of heat
27 – 32	Warning of danger	Heat stroke or sunstroke
32 – 41	Very dangerous alarm	Sun stroke, muscle spasms and cramps
41 – 52	Danger	Sunstroke, muscle spasms, colic and heat stress
Greater than 54	very dangerous	Fatigue in case of prolonged exposure

Source: - Ali Hassan Musa, The Vital Climate, (1st edition) Nineveh Publishing and Distribution, Syria, Damascus, 2002, p. 49.

Upon observing Table (6), it becomes clear that the months (May, June, September, October) have a very dangerous climate, while (alarm of danger) is represented in the month of April, while the climate (danger) is represented during the months (July, August), The very dangerous climate was not represented in the school.

The indication of the apparent nocturnal temperature is shown from Table (7), and by applying the equation using the lowest temperature rates with maximum relative humidity<sup>(1)</sup>. When comparing the ladder in Table (2), all months in the study station during the months (winter, spring, and autumn) will be at (20-21). -22) As these months are comfortable or convenient for rest, while the apparent night temperature during the summer months (June - July - August) is in June acceptable and comfortable at night, while during the two months (July and August) the presumption of the apparent night temperature is not comfortable .

It appears from Table (8), which indicates the summary of Table (7), that the months in which the rest is (threatening) in the months (July, August) and the moderate and acceptable in the months (January, February, March, April, May, June, September , October, November, December), and we notice from the same schedule that the stations in the study area are free from the "high risk alarm" ladder ("danger") and "very dangerous" during the apparent night temperature index.

Table (3) General apparent temperature presumption and result of application with scale and analysis of the study area station for the year 2018-2019 .

Station	The Season	The autumn			Winter The			the spring			the summer			
		September	October	November	December	January	February	March	April	May	June	July	August	
School	The month	31	22	21	21	21	20	22	24	28	33	35	34	
	Result of the application	Severe warning of danger	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Warning danger	Severe warning of danger	Severe warning of danger	Severe warning of danger	
	With Rank	sunstroke	Acceptable heat	Acceptable heat	Acceptable heat	Acceptable heat	Acceptable heat	Acceptable heat	Acceptable heat	Acceptable heat	sunstroke	Muscle spasm	Muscle spasm	Muscle spasm
	The analysis													

Source: The researcher relying on: 1- Appendix (1) monthly averages for the normal temperature 2- Appendix (4) monthly averages for relative humidity 3- equation of apparent temperature and its correlation with relative humidity (RH).

Table (4) General apparent temperature index

Moderate	very dangerous	Danger	Alarm severe danger	Warning of danger	The station
October, November, December, January, February, March, April	-	September	June , July , August	May	The School

Source: Depending on Table (3)

**Table (5) the daytime virtual temperature index and the result of application with the scale and analysis of the study area a station for the year 2018-2019.**

Station	The Season	The autumn			Winter The			the spring			the summer		
	The month	September	October	November	December	January	February	March	April	May	June	July	August
School	Result of the application	37	33	22	21	20	19	22	26	23	38	41	41
	With Rank of danger	Severe warning of danger	Severe warning of danger	Moderate	Moderate	Moderate	Moderate	Moderate	Warning danger	Moderate	Severe warning of danger	danger	danger
	The analysis	sunstroke	sunstroke	Acceptable heat	Acceptable heat	Acceptable heat	Acceptable heat	Acceptable heat	sunstroke	Acceptable heat	Muscle spasm	sunstroke	sunstroke

Table based on: 1. Appendix (2) monthly averages for maximum temperature. 2. Appendix (6) the monthly minimum relative humidity rates 3. The apparent temperature equation and its relation to the relative humidity (RH).

Table (6) the daytime virtual temperature index

Station	warning of danger	Severe warning of danger	danger	Very danger
School	April	,September ,October, May June	,July August	-

Source: Depending on: Table (5).

**Table (7) the apparent overnight temperature presumption and the result of application with the scale and analysis of the study area station for the year 2018 – 2019**

Station	The Season	The autumn			Winter The			the spring			the summer		
	The month	September	October	November	December	January	February	March	April	May	June	July	August
School	Result of the application	21	21	22	22	22	22	21	21	24	24	27	27
	With Rank	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Warning danger	Warning danger
	The analysis	Acceptable heat	Acceptable heat	Acceptable heat	Acceptable heat	Acceptable heat	Acceptable heat	Acceptable heat	Acceptable heat	Acceptable heat	Acceptable heat	sunstroke	sunstroke

Source: From the work of the researcher by relying on: 1- Appendix (3), monthly minimum temperature levels. Appendix (5) monthly average high relative humidity. 3. The apparent temperature equation and its relation to relative humidity (RH).

**Table (8) overnight temperature indication**

Station	warning of danger	Severe warning of danger	danger	Very danger	
School	July August	-	-	-	,September ,October ,November ,December , January ,February, March April,May, June

Source: drawing on table (7).



## 6. Conclusions

- 1- By applying the apparent temperature index, the feeling of malaise increases during the day compared to the night, and the opposite occurs in the winter.
- 2- When applying the general apparent temperature presumption, it is clear that the study station (the selected school) and during the winter months "December - January - February" ranges between (21 and 22) and it is clear that these months fall outside the danger of thermal stress, and the same applies to The months of spring are "March and April", where they are outside the danger of thermal stress, ranging from (20) to (26).
- 3- When applying the apparent daytime temperature presumption, it is clear that the school climate during the winter months (December, January, February) is ideal for rest through low temperatures and high humidity, and the values of that presumption are between (20, 21) for the winter months. As for the months of spring (March and April), they are comfortable and out of danger, while the month of (May) is alarming.
- 4- When applying the indication of the apparent night temperature, it becomes clear that the study area during the winter, spring and autumn months (20, 21, 22) is comfortable or suitable for rest. As for the apparent night temperature during the summer months (June - July - August), it is comfortable. During the month of June.



---

### Data Availability

The data used to support the findings of this study are included in the article.

### Conflicts of Interest

The authors declare that they have no conflicts of interest.

### Sources:

1. Ahmed H Jasim, Ali A K Al-Waeli, Kadhem A N Al-Asadi, The impact of Waste from oil exploration on air pollution in Al-Roumila North oil field- Governorate of Basra – Iraq, Journal of Scientific and Engineering Research, Volume 5, Issue 2, 2018.
2. Ali A Al-Waeli<sup>1</sup>, Kadhem A N Al-Asadi<sup>2</sup>, Khaleel I Abass, The Performance Assessment of Solar & Wind Hybrid System in Iraqi Climatic Conditions, International Research Journal of Advanced Engineering and Science, Volume 4, Issue 3, 2019.
3. Ali Abdul-Zahra al-Waeli, Significant climatic phenomena (Book), previous source, Baghdad, publisher Ahmed al-Dabbagh, 2014.
4. Ali Hassan Musa, The Biosphere, Ed. 1, Nineveh for Studies(Book), Publishing and Distribution, Syria, Damascus, 2002.
5. Ali Hassan Musa, The Vital Climate, (1st edition) Nineveh Publishing and Distribution, Syria, Damascus, 2002.
6. Aida M J Mahdi<sup>1</sup>, Khalid S. Reza<sup>2</sup>, Jafaar A. Kadhem<sup>2</sup>, Ali A K. Al-Waeli<sup>3</sup>, Kadhem A. H. Al-Asadi<sup>4</sup>, The Effect of Iraqi Climate Variables on the Performance of Photovoltaic Modules, International Journal of Scientific Engineering and Science, Volume 1, Issue 1, 2017.
7. Khaleel I Abass, Ali A K Al-Waeli and Kadhem A N Al-Asadi, Solar Panel's Current-Voltage Characteristics, International Journal of Trend in Research and Development, Volume 6(3), May – June 2019.

## The appendices

Appendix (1) monthly and yearly rates (for the normal temperature (° C) for the study area station for 2018-2019

Station	The Season	The autumn			Winter The			the spring			the summer		
School	The month	September	October	November	December	January	February	March	April	May	June	July	August
		30.9	24.8	16.5	11.5	9.7	12.5	16.8	22.7	29.4	33	35.7	34.7

Source: Depending on: - Measurement of the mobile climate station installed by the researcher at Al-Janaina Primary School.

Appendix (2) monthly and yearly averages (for maximum temperature in M) for the study area station for 2018-2019

Station	The Season	The autumn			Winter The			the spring			the summer		
School	The month	September	October	November	December	January	February	March	April	May	June	July	August
		40.5	33.7	23.7	17.5	16	18.9	23.7	30.1	36.7	41.8	44.4	43.6

Source: Depending on: - Measurement of the mobile climate station installed by the researcher at Al-Janaina Primary School.

Appendix (3) monthly and yearly averages (for minimum temperature in ° C) for the study area station for 2018-2019

Station	The Season	The autumn			Winter The			the spring			the summer		
School	The month	September	October	November	December	January	February	March	April	May	June	July	August
		21.4	16.7	9.6	5.5	4.4	6	10.4	15.8	21.6	24.7	25.4	25.3

Source: Depending on: - Measurement of the mobile climate station installed by the researcher at Al-Janaina Primary School.

Appendix (4) monthly and annual rates (relative humidity%) for the study area station for the year 2018-2019

Station	The Season	The autumn			Winter The			the spring			the summer		
School	The month	September	October	November	December	January	February	March	April	May	June	July	August
		32.9	25.5	58.9	70.4	73.8	59.4	51.6	44.7	33.9	26.4	25.8	26.8

Source: Depending on: - Measurement of the mobile climate station installed by the researcher at Al-Janaina Primary School.

Appendix (5) monthly and annual rates (maximum relative humidity%) for the study area station for the year 2018-2019

Station	The Season	The autumn			Winter The			the spring			the summer		
School	The month	September	October	November	December	January	February	March	April	May	June	July	August
		55.7	65	81.6	87.7	89.1	83.3	74.7	65.8	52.2	45.8	43.5	46.9



Source: Depending on: - Measurement of the mobile climate station installed by the researcher at Al-Janaina Primary School.

Appendix (6) monthly and yearly rates (minimum relative humidity%) for the study area station for the year 2018-2019

Station	The Season	The autumn			Winter The		the spring			the summer			
School	The month	September	October	November	December	January	February	March	April	May	June	July	August
		15.5	22.8	35.6	43.6	47.2	34.3	26.8	23.5	16.4	12.3	12.4	12.3

Source: Depending on: - Measurement of the mobile climate station installed by the researcher at Al-Janaina Primary School.

## Margins

(<sup>1</sup>) Khaleel I Abass, Ali A K Al-Waeli and Kadhem A N Al-Asadi, Solar Panel's Current-Voltage Characteristics, International Journal of Trend in Research and Development, Volume 6(3), May – June 2019, p.6.

(2) Ahmed H Jasim, Ali A K Al-Waeli, Kadhem A N Al-Asadi, The impact of Waste from oil exploration on air pollution in Al-Roumilla North oil field-Governorate of Basra – Iraq, Journal of Scientific and Engineering Research, Volume 5, Issue 2, 2018.p. 412.

(3) Ali A Al-Waeli1, Kadhem A N Al-Asadi2, Khaleel I Abass, The Performance Assessment of Solar & Wind Hybrid System in Iraqi Climatic Conditions, International Research Journal of Advanced Engineering and Science, Volume 4, Issue 3, 2019.p. 66.

(<sup>4</sup>) Aida M J Mahdi1, Khalid S. Reza2, Jafaar A. Kadhem2, Ali A K. Al-Waeli3, Kadhem A. H. Al-Asadi4, The Effect of Iraqi Climate Variables on the Performance of Photovoltaic Modules, International Journal of Scientific Engineering and Science, Volume 1, Issue 1, 2017. p. 8.