

## The effect of green areas in improving the local climate of Najaf city according to the criterion of thermal comfort

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### **Abstract**

The green areas in the city are of great importance in improving the internal environment of their residents. The increase in the number of people living in urban centers of large cities and the expansion of housing horizontally and vertically contributed directly to the increase in the various means of transportation and polluting economic activities and for this the urgent need to expand into the existing green areas Within the cities, the city of Najaf lacks sufficient areas to meet The actual needs of its population of (791217) people, where green area uses occupy an area not exceeding (613122) m<sup>2</sup> at a rate of (1.7%) of the total area of the city, i.e. (10.1%) of the total public area for recreational services . Green areas are generally defined as the areas in which the largest part is covered by various plants. The importance of green spaces is evident through its capabilities to control climate elements, foremost of which is direct and reflected solar radiation and increased shading, as well as its role in controlling winds by reserving, changing its path, or filtering to the air as well. Its control increases relative humidity and temperature, and is thus one of Major strategies for climate solutions to outer space for cities. Green spaces can be counted as the element that works to balance the environmental systems within the city, it reduces the average temperature and helps to get rid of air pollutants in the atmosphere, and this, therefore, determining the thermal comfort criterion for any area requires determining climatic elements that are directly related to human comfort such as temperature, solar radiation and air humidity The wind speed and the effect of each of these elements on the thermal balance of the human body, which is what this study examined.

**Keywords:** *Green areas, , local climate, thermal requirements, criterion , thermal comfort.*

### **.Research question : First**

1-What is the effect of green areas in improving the local climate of the city of Najaf ?

2-What is the value of significant of green areas in providing thermal comfort for the city's population ?

### **Research Hypothesis : Second**

1-There is a great importance of green areas in improving the local climate of the city of Najaf spatially the

Temperature .

2- Green areas contribute thermal comfort of Najaf residents.

Research Aim: Third

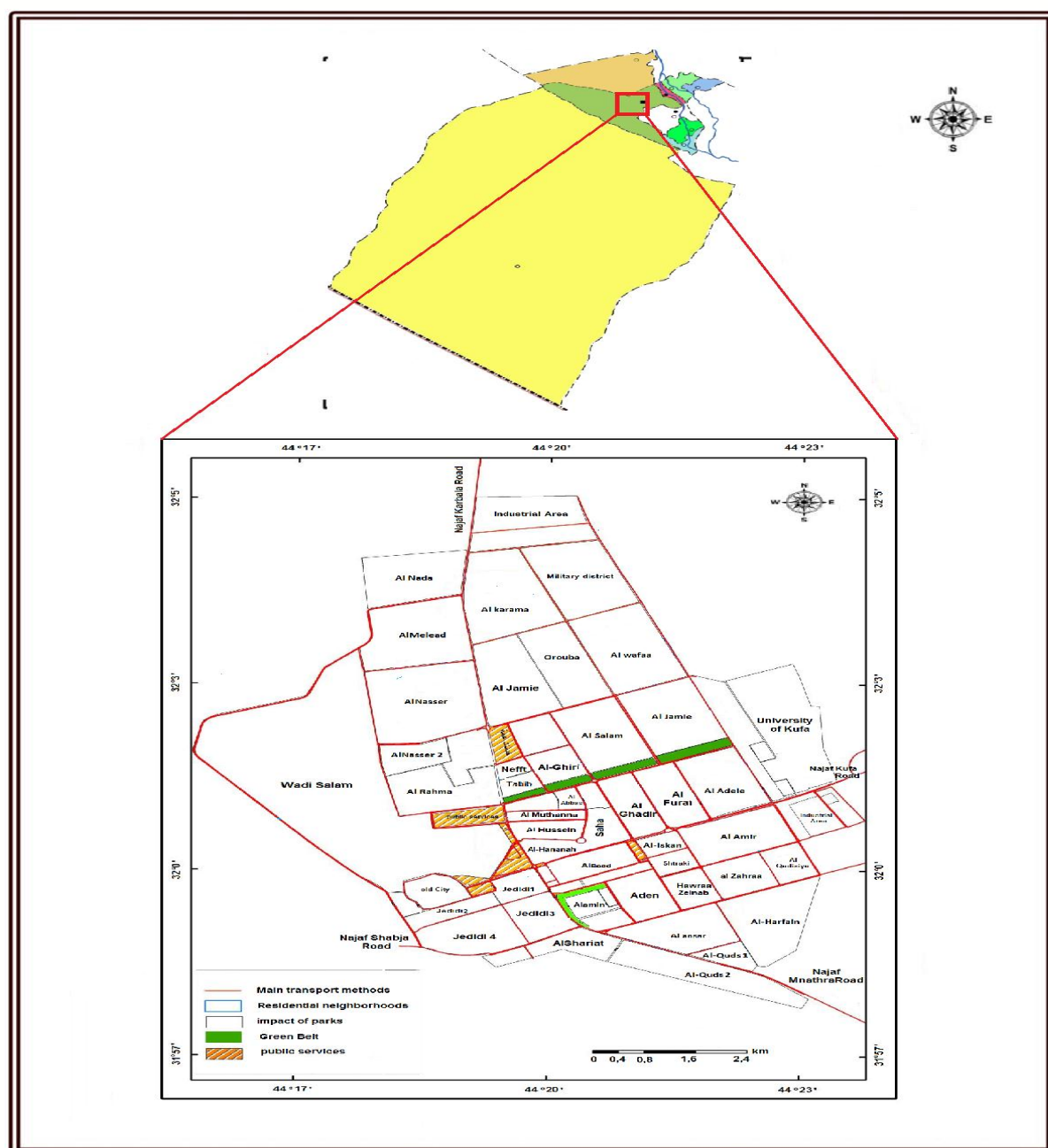
The aim of the research is to highlight the role of green areas within the city in increasing the efficiency of the local climate and achieve thermal comfort. To achieve this goal, the study includes of the concept of thermal comfort and elements which identified the role of green spaces in improving the local climate the efficiency and the extent of their impact .

#### **Research Methodology: Fourth**

The Research has been based on the analytical approach through data analysis and also field study and also the official references .

#### **Fifth : Research structure**

The first topic included the theoretical framework for the research , The second topic focuses on the geographical distribution of green areas in Najaf city, while the third section concludes the requirements of thermal comfort and the effect of green areas. The spatial dimension is the administrative boundary of the Najaf Governorate, which lies geographically in the southwestern part of the Republic of Iraq and extends between the latitudes (31.57 - 32.23) north and between the longitudes (44.17 - 44.23) east See map (1).



Map (1)-Location of the city of Najaf of Najaf governorate

Source: General Organization for Survey, Iraq Administrative Map, Baghdad. 2015

first topic

Green areas for cities and environmental criterion .

First – green areas

The green areas as defined by several definitions . they are those areas that occupy large areas of green space that are large than the open spaces and cultivation of a number of large and high trees which give natural beauty to the residential neighborhoods <sup>(i)</sup> the green areas usually penetrate a number of corridors that benefit the population either to travel exercise or to spend leisure time and it is the most

important recreation facilities since ancient times it the oldest the easier and the least expensive and it is also the closest to the accommodation <sup>(ii)</sup> .

Parks within the green areas fall into the use of land designated for recreational function these areas that are opened to the general public and private park which are exclusively used by a special group of members of the community <sup>(iii)</sup>

Second -the importance of Green areas.

The importance of open areas and green spaces in their impact on the physical and psychological side of the human feeling of psychological comfort away from all the pollutants of the city in a place characterized by some environmental and natural components, the effects on human mental capacity are reflected in the exercise of all vital activities , such as exercise , reading painting , etc. Green spaces also have an economic impact by providing job opportunities to a large number of people directly or indirect through economic activities related to those areas and green spaces , except for the income of the city and state which is used as part of entertainment projects. Highlighting the importance and effects on the environmental side, reducing pollution in all its from and temperate temperatures , <sup>(iv)</sup> the distribution of Green areas amidst buildings and cement roads helps to make on major climate change . through the operation of air currents and allow the sun to access the neigh boring building in addition to the consequence of the process of photosynthesis and transpiration of oxygen and water vapor for plants and trees.

A: Environmental importance

Plants play an important role in reducing the percentage of toxic gases in the air , where (O<sub>3</sub>,NO<sub>2</sub>,SO<sub>2</sub>) gases are dangerous contaminants that cause serious damage to humans animals and plants . they cause poor vision ,hard breathing and brain function disorders . It is also a component of smog that obscures the vision in addition to the health damage already mentioned . Environmental studies have shown that plants can remove these gases and other gaseous pollutants between (30-60%) of their presence in the air <sup>(v)</sup>. Laboratory experiments have shown that the greater the efficiency of the leaves in absorbing these gases.

The environmental characteristic of the presence of plants in cities are :

- 1-plants work to purify the air from pollution within city centers.
- 2-plants work to provide environmental balance within the city.
- 3-plants reduce temperatures in the summer while finding appropriate amount shadows in surrounding areas.

B: Climate importance:

vegetation effects the city's local climate as these plants account for (48%) of the total area in open squares and fields <sup>(vi)</sup>. It is known that the tree cover causes a kind of mechanical disability of the movement of the air to change the currents of air in terms of strength and direction and speed in addition to the introduction of water vapor and tempering the temperature.

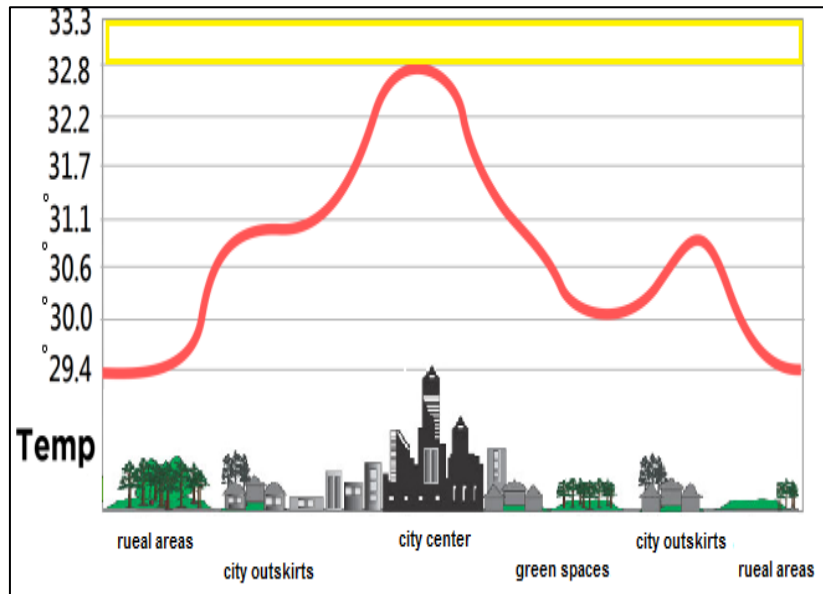


Figure (1) Thermal distribution for cities

source: Macron Lud, Thermal Island, Munich, 2016,p76

C: entertainments importance :

the planning objectives for organizing and distributing green areas, gardens , parks and sport stadiums with in the city in order to satisfy or satisfy the desire for entertainment and recreation for the population Green areas are an essential element within the urban style of diverse recreational venues.

: Third -Classification of green areas and its levels :

Green areas are among the most important components of city .as they have significant impact on their environment and their impact on human life . the united nations has put forward a proposal for green spaces .with avery capita urban area of  $6m^2$  L person. IT table (1) shows these criteria and the figure (2) and (3) showing areas within the residential areas and the access distances.

Table (1)-United Nations standards for green spaces in the cities

	Kind of Green space	After the green space for the dwelling	Area	Average Area $M^2$ /Person
1-	Green space at the level of a small residential area (neighborhood unit)	0,3	1	$4m^2$ /Person
2-	Green space at the level of residential area residential district)(	0,8	10-6	$8m^2$ / Person
3-	Green space at the level of a large residential area (sector)	1,6	60-30	$6m^2$ /Person
4-	Green space at the city level	3,2	400-200	$32m^2$ / Person
5-	Green space at the suburban level	6,5	4000-3000	-
6-	Green space at the level of great cities (complexes)	15,0	30000-10000	-

source of table (1): Abud Allah Mohamed Ahmed and others , the History of cities planning . Egyeption Anjelo library ,Cairo, 1993,p85



Most standards of classification focus on the neighborhood unit as it is the first unit or cell for classification the city , by integration these cells or units ,the city quarters and suburbs would be formed and formed the whole city <sup>(vii)</sup>

The health condition are related to neighboring planning and neighborhood with a number of factors , most important are population density , density of construction area , building mode ,green spaces ,provide the necessary facilities for urban fabric of the city...etc. There are indicators (numbers and percentages) for each of these factors.

1-the first indicator: Population density =  $\frac{\text{Population}}{\text{number} / \text{Hectare Space}}$

2-the second indicator: Density of construction area =  $\frac{\text{total area of building area}}{\text{x100\%}}$

#### Neighborhood unit space

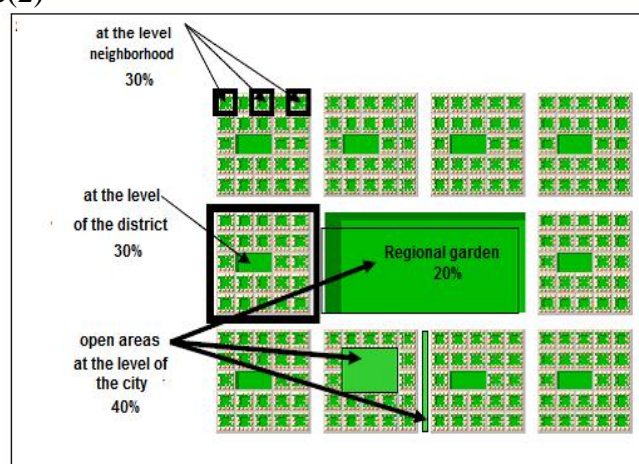
The criteria used in land for residential proximity are mostly focus on the following elements (Population,

space , Education ,Trade ,Service, and Health Building ,Green Areas, Transport.

Therefore these standards lack integrated elements to the proportions of open green areas, which are striped areas or water with a recreational or cultural or natural linking the open contain the intensity of greening and contribute to perception of the visual image of the city.

The national coordinating body for urbanization classified zones as following: <sup>(viii)</sup>

1- Green Areas at the city level : The green and open areas of the city must be provided so that the per capita population of the city shall not be less than the minimum stipulated in the rates determined by the competent ministries these semi-public areas which are limited to specific categories such as (Clubs, school playgrounds and youth centers ) can be counted within the open spaces to be provided . If it is within half of the total area ,and does not count within the open spaces in the city any semi-public more than the area of open areas free and semi-free . Gardens and privet open areas do not count within the open area .the public gardens outside the urban block can also be provided in an area that is used as a zoo, provided that it is far from the non –integrated uses such residential ,industrial and health services the determinates of human and animal protection must be take into account the design of this diversity of gardens look figure(2)



Figure( 2)-Schematic classification of green areas and their levels

Source: National Coordinating Authority, "Principles and Criteria for Civilizational Coordination of Open Areas and Green Areas", Handbook. 6 Ministry of Culture, Cairo, p. 56

2-Green areas at the residential level : they are gardens which serve the neighborhood and provide external and internal services to the population . each garden of this type serve variety of residential communities this type of gardens includes both tranquil recreation such as picnic , sitting etc., recreation accompanied by sport for both children and adults. At least ( $1m^2$ pe person) and may be included in the youth centers in the neighborhood .the area of buildings in the youth centers, which is more than (1%) of the total area Figure( 3).

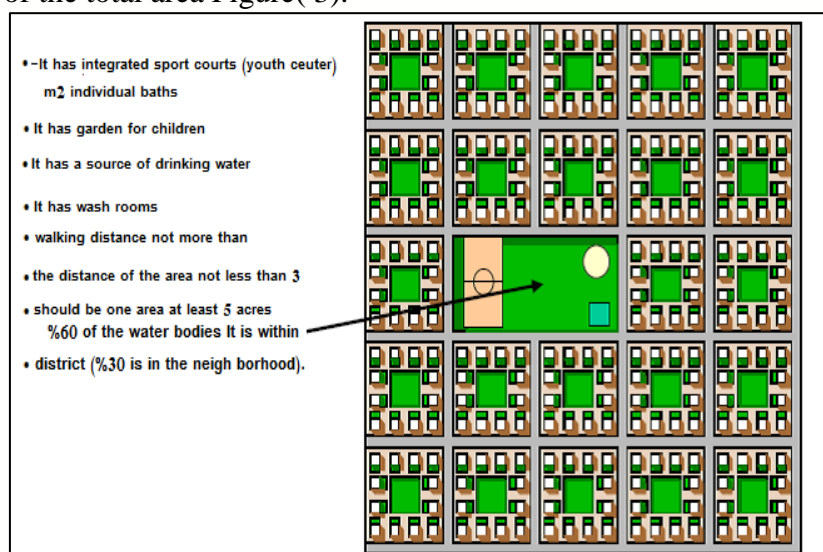


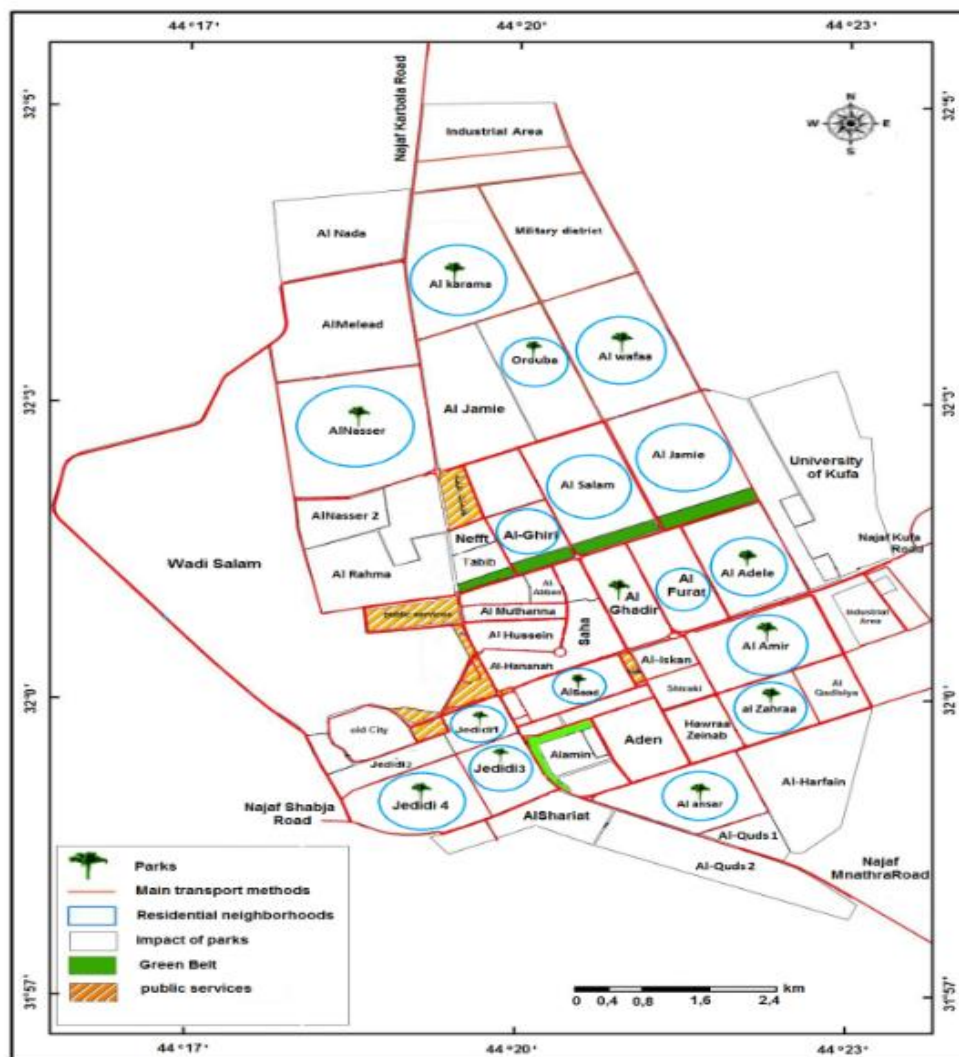
Figure (3)- Green areas at the level of the neighborhood

Source: National Coordinating Authority, "Principles and Criteria for Civilizational Coordination of Open Areas and Green Areas", Handbook. I 6 Ministry of Culture, Cairo, p. 57

3-Green areas at the neighborhood level : access to it on foot is easy for all neighborhood occupants ,and should proportionate.to the density of the population they serve ,where there are plenty of green areas with seasonal leers to provide light and sun in winter with the selection of plants that do not need continuous ear.

Fourth: Zone of environmental impact of green area and water bodies :

Gardens parks and water eighties are an outlet for the resident of the city and in achieving the psychological comfort of the human being ,so its presence and accessibility to the inhabitants of the city and the region it serves are necessary <sup>(ix)</sup>.it is clear through the figures (2)-(3), that the place of parks or gardens ,which the individual can go to it in the residential neighboring within a period of not more than (15 mint) as the play ground of the neighborhood is the farthest distance of (1200m) and the garden of the neighborhood is (40m-800m) ,and areas allocated to green play ground in the vicinity will be (250m-500m) the children play ground is (150m-275m), while the groups gardens is (100m-200m), look at map(2).The natural water area is represented by the lower Najaf sea adjacent to the city, but the industrial is non –existent and can be established in the future to be added areas within the green areas.



Map (2) Scope of environmental impact of green spaces

Source: Based on Table (1)

Fifth: The effect of green areas to reduce the problems of the Urban Environment : the problem of degradation of the urban environment is one of the main problem. and the issue of maintaining human health and facing human beings ,especially at the present time ,and it is increasing day after day surrounding environment has started to face new problems in the introduction of diverse techno-logiest of the human environment and friction in the current era of economic and productive activities, and the growing service as area and density day after day <sup>(x)</sup>.

For this reason ,the water ,Green ,open spaces have gained importance within the exclusive environment to provide a healthy outlet for human being and increase his energy and health maintenance of it , is the function of government, which includes the stadiums ,sport gardens with different

sizes ,public gardens and parks and the tracks between the shops and the main street and industrial areas –It show the impact of green areas through the effectiveness of afforestation in the improvement of the environment of the city as many studies and experiments pointed to the effectiveness and afforestation to reduce the levels of environmental pollution in cities at the present time . Experiments have shown that



green plant reduce the concentration of carbon monoxide ,as they reduce these gases knowing that the quality and intensity of afforestation have an important impact as at the figure (4)

Table (2)-Reducing the level of air pollution by afforestation mode

sequence	Quality of tree planting	Reduce air pollution the level		Density	
		summer	winter	summer	winter
1-	Tree planting in one line	0,22	0,11	7-10	3-0-
2-	Tree planting in two lines	0,37	0,15	1-10	3-5
3-	Planting in two lines with medium trees	0,58	0,18	40-30	7-5
4-	Planning in three lines with planting two lines of medium trees	0,68	0,20	40-50	12-10
5-	Planting in four lines with planting two lines of medium trees	0,75	0,23	50-60	10-15

Source of table (3) ,Haider Abudl Razzaq kamouna ,the phenomenon of pollution in cities .oil and development magazine ,number 1,Baghdad press , Baghdad1977 ,p91  
The table shows that the form factor has an important effect in reducing the pollution levels ,so the process of reforestation in the summer reduces pollution level by (3-4) times more than the winter. this is due to the fact that trees may be missing leaves in winter , thus reducing tree density (the form factor) .other studies include the experiments of environmental scientists who have proved that planting trees and grass in green spaces helps to reduce air pollution as opposed to the absorption of gases and substances harmful to public health. It was found that non-afforestation of green belt area with a width of (500m) reduces the amount of dust in the air twice, if the atmosphere 3-4 times. Table (u) shows the effect of the afforestation pattern on reducing the concentration of sulfur dioxide, Hydrogen sulfide and Nitrogen Oxides depending on afforestation the green belts.

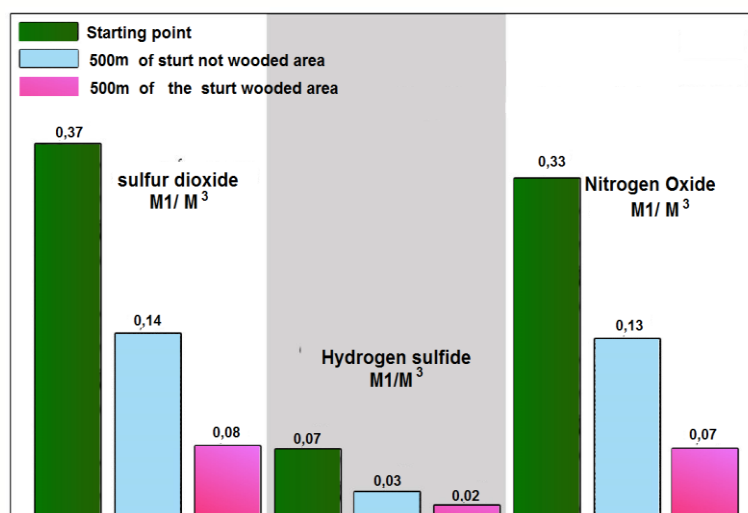


Figure (4)-Effect of green areas in reducing polluting gases

Source: Haider Abdul Razzaq Kamouna. Planning Methods for Preventing Arab Cities from Pollution, Afaq Magazine, Issue 8, Baghdad, 1976, p. 147

On the other hand the planning and organization of green areas within the city is on of the main ways in which to create climatic conditions more suitable for human life and rest ,especially in the hot dry regions ,so will highlight in this area the role of green plants in the main climate control of the local climate of the city of solar radiation and temperature ,humidity and wind <sup>(xi)</sup> .Green area and plant –covered areas have characteristics different from non-cultivated and buildup areas As the next notes

A : The ability of plants to reflect heat is weak compared to building materials and sharp surfaces .

B : A slow absorption of solar radiation from the beginning and the reflection of radiation is very small (Low Albedo).

C: The percentage of evaporation from green areas higher than non-cultivated areas and therefore less heat also less heat of the air that is connected to it and this is causing of human comfort compared to the barren non –cultivated surfaces.

D: plants reduce the speed of wind pollution and noise ,on the other hand green areas are a major within the urban type of recreational spaces .on of the planning goals for the landscaping and distribution of green spaces, parks, and green sport areas with the city is satisfying and satisfying the desire for recreation and recreation for citizens.

Sixth : The effect of green spaces in improving the hot and dry climate:

Green areas are one of the most important environmental treatments in city centers, and they have an impact in cities with hot dry climates more evident than in rural areas far from cities.

The role of green areas in controlling hot dry climate are one of the most important environmental treatments in the centers of urban settlements and have an impact on cities with a warm and dry climate more a evident than in rural areas away from cities where green areas protect the environment from pollution , which positively affects health for city dwellers As well as providing shade, raising air humidity, purifying it , reducing noise and adjusting heat etc. The neglect of green areas within cities as a result of lack of environmental and civilization awareness or as a result of abuses and poor distribution and management by the competent departments caused the emergence

of these problems which have a negative impact on the local climate of these cities can be high lighted these problems <sup>(xii)</sup>:

1-cities are turning into destructive concrete forests for their natural habitat that is green, which is the lung

and the only outlet for population.

2-poor distribution of exiting green areas.

3-Absence of dimension and human scale in design of existing open areas .

4-the tyranny of element built on the natural features of open areas.

5-Misuse of existing open areas <sup>(xiii)</sup>.

A: The role of green areas in controlling solar radiation and air temperature: The group of planets leaves absorb solar radiation in almost all , its components , thus reducing the temperature under it and their paper crowns work to keep the temperature and prevent it from radiant outside <sup>(xiv)</sup>.When solar radiation falls on plants , plants absorb or convert part of the process through photosynthetic process of food energy ,which benefits the plant and surplus part of solar radiation. There are a number of natural factors on which plants depend on to continue their life cycle and breeding ,

is considered one of the most important natural element which effect in plants life ,where a direct impact on range of functions performed by plants , the most important functions are.

1-Photosynthetic:

The process of photosynthesis is one of the most important processes that help them to get food and continue to grow, and there are number of factors the must be available to plants to do this process well , temperature is akey factor in the success of photosynthetic.

2-Breathing :

The temperature is directed to the respiratory process in the plants as the rise temperature may lead to increased breathing in plants and decrease in the breathing of the plants in breathing of the plants

3-Absorption

Very low temperature and close to (0c) are the most important factors that lead to a reduction in the absorption of plants, significantly of plants,

4—Germination

Plant species differ in terms of their environment for germination and growth ,Each type of plant needs an environment and certain condition to be able to grow , and temperatures are the main factors affecting the growth of plants ,there plants need high temperatures and other need medium.

5-Evaporation :

Extremely high temperatures lead to increased evaporation rates in plants leading to dehydration ,thus weakening and dying .But the plants have precaution taken in hot weather to protect them selves ,which are transpiration process that help plants to take from stems and roots to the leaves in order to do photosynthesis process and other vital processes needed by plants.

6-The Spreading: It's a process depends on the amount of thermal energy stored in the plants and its especially for plants with a temperature above zero Celsius (0). It is essential for plants to help spread the molecules and atoms in all parts of plant available to fill the voids and organize them in all parts of plant. Studies conducted in different times of the year have shown that the energy emitted from a cement land is( 35%) while the reflected radiation from green areas is estimated at (14%), the ratio

varies in plants over the reflection of solar radiation .long trees with light crowns , such as Duck trees ,reflect (60%-80%) of solar radiation .while medium length trees with dense thick crowns reflect 98% of the solar relation they receive . In general ,trees reduce temperatures between(5-6m) in all dense and non-desert trees. In other studies conducted in different regions of the world to measure the temperature of the surface of the soil with out vegetation cover and compared to the soil covered with plants found a significant difference in temperature (20-30c) <sup>(xv)</sup> .

According to some sources ,green spaces ,can reduce the maximum temperature of (2-5c) because the green areas fluctuate the solar radiation on the surfaces , thus cutting the way to solar radiation . One study indicated that forest trees can be absorb (60-80%)of the received radiation and also the amount of energy depends on the general shape of the single tree .While the single tree could absorb(40%) of solar radiation<sup>(xvi)</sup> .the trees are very color intensive and have high absorption potential, either short-waves radiated or long-wave thermal radiation ,because the solar radiation collides with tree umbrellas at the top of tree and it would be absorb or reflected temperatures pass to the lower layer ,so the air temperature above the top of the tree is greater than the temperature of the air below nearly (2.25m).the role that these trees play in providing continuous motion helps reduce the exposure of surrounding surfaces to radiation and then reduce their thermal acquisition .IT was found that the shading of the surface can reduce the temperature of the contact air by (3-11C) and reduce the heat of the deformed surface by at least (25%)compared to the temperature of the surface in not shading <sup>(xvii)</sup> as at the Figure(5).

second topic

Geographic distribution of Green Areas and water Bodies in the city of Najaf

First –Green Areas:

Despite the importance of green and open areas ,the city of Najaf lacks sufficient space to suit the actual needs of its population which it (791217) An individual . Where the green area occupy an area more than (613122m<sup>2</sup>) and (17%) of the total area of the city ,or(10,1%) of total area of recreational services. <sup>(xviii)</sup>

This is due to the development of population size and increasing demand for new spaces .As well as the decision of the relevant oath orifices in seventies of the twentieth century to convert (5%) of area and green land to the use of housing to solve the housing problem ,that reduced the opportunity of the presence of these areas in the city and spread the gardens and it is worth mentioning that some of these gardens and parks are only a small proportion of the recreational services for the population despite the stab lishment and availability of toys ,farming and surrounded by fence , Green spaces are considered one of the most important basic requirements in development of urban centers .the city witnessed a significant development in the size of urbanization and diversification in its economic and social activities ,which necessitates the availability of a suitable climatic environment<sup>(xix)</sup>



Table (3)- Names and spaces of the parks in Najaf city for the 2015

sequence	space/m2	Geographical location	Number of spaces	space/m2	Technical status
1-	The Gary park	Najaf Road - Karbala	1	4200	Eligible
2-	AlSabah Park	AlNasser	2	2192	Eligible
3-	Al Shurouk Park	AlMelead	4	10300	Eligible
4-	Al oroba Garden	Al oroba	1	1600	Eligible
5-	Al Karama Park	Al Karama	1	23374	Eligible
6-	Al Hindia Park	Al Hindia houses	2	2800	Eligible
7-	Al Wafa Garden	Al Wafa	3	2100	Eligible
8-	Paradise Park	Qadsia Al	2	16762	Eligible
9-	Askary Park	Al Askary	1	9996	Eligible
10-	Park Belt	Green Belt	2	6000	Eligible
11-	Al Ansar Park	Al ansar	4	8750	Eligible
12-	Al Ghadeer Park	Ghadeer Al	2	2500	Eligible
13-	Al Hussein Park	Al Hussein	1	10000	Eligible
14-	Park Salam Al	Salam Al	2	2500	Eligible
15-	Al Zahraa Park	Al Zahraa	2	700	Eligible
16-	Jamie Park	Jamie Al	1	2500	Eligible
17-	Dream Land Park	Al Tiebaa	1	1795	Eligible
	Total			63869	

Source: Researcher based on the Municipality of Najaf Governorate, Department of Environment (unpublished data) in 2015

It is clear from the table that the green areas occupies an area of (375) hectors ,equivalent to (%5,23) of the total area of city of Najaf and is planned to reach the area of green uses to an area of (1401,49) hector until 2030, It is worth mentioning that the capacity of green spaces for these purposes increases as we move away from them in general are characterized by imbalance is spatial distribution<sup>(xx)</sup>.

1-Parks: the area allocated to the parks gives an environmental and aesthetic value the city of Najaf ,where it is visited by individuals of various ages and social classes . the parks represent health importance and breathing lungs that limit pollution and

suffocation ,where they know as temporary visitors who stay less than (24 hours) in the host country . During their journey they were classified as (leisure , vacations , sports, spending time with family, friend forms of enjoyment and recreation) .<sup>(xxi)</sup>

2-Public Gardens : It is intended for the designed area within the basic residential neighborhoods ,where these parks provide a lot of recreational services as a main outlet for the residential unit and the area is visited by many families during the leisure and public holidays and therefore the design and coordination of gardens is very important and is the stages of building and planning cities ,small and large ,Taking into account international standards' and regional planning. Public garden take a distance which it is almost (25112) hectares in the city of Najaf that is a ratio of (%3,79) of the total city, but these areas do not distribute on a regular basis on the all neighborhoods-table (7) . In time it is noticed that green area in the modern neighborhoods, and the neighborhoods in the old city center are free of any public gardens or parks in spite of they are area with large population unlike neighborhoods far from the city center where there are more than one park or garden at the same neighborhood .

The most of the land designated as parks within the basic design of the city has not been rehabilitated and left as barren areas , which adversely affected the environment of residential areas. Most of squares, green areas and entertainment that have been established in the province of Najaf during the last period of lack of attention and the absence of the supervising authority because of the damage to the plant , drought and damaged most of the contents of children's toys and poles lighting and fences of their own.

#### Second : Industrials Water Bodies

The effect of Al Najaf Sea is a seasonal small and limited effect only of the adjacent zone of the city of Najaf to the sea , therefore we will discussed the Industrials Water Bodies only which it represented in the areas which the water element is the basic element in each entertaining activity , which is also small effected:

#### third topic

The Requirements of Thermal Comfort and the Impact of green areas in the improvement of the Najaf city

#### first- The concept of thermal comfort

It is a physiological condition that occurs when the central Nervous system is exposed to less than the amount of external influences and thus lift the burden of the body's thermal regulation to obtain the required heat exchange<sup>(xxii)</sup>.It can be described as a biological condition in which the person does not feel the temperature rise or decrease or any inconvenience caused by a defect in the thermal environment .the concept of thermal comfort is a relative concept linked to a number of internal and external factors that effect the sub-stance of human satisfaction or disturbed by the environmental conditions surrounding him. Factors which limit the thermal comfort can be divided in to two parts:

1- Environmental elements of thermal comfort : In front of it ,are dry temperature, humidity ,wind and solar radiation.<sup>(xxiii)</sup>

2: Human elements of thermal comfort : which are represented in human action and kind of clothes and covers . In order to achieve thermal comfort , the following conditions must be met.<sup>(xxiv)</sup>

A-Thermal balance of human body . (Heat gained =Heat lost)

B- The rate of sweating from human body: does not exceed a certain percentage depending on the physical activity exercised by the person.

C-The skin temperature should be within comfortable limits which it is (33-43) compatible with comfortable relative humidity ranging from (30%-50%) in summer and (40%-60%) in winter<sup>(xxv)</sup>.

Second -Graphic representation of thermal comfort :

Several studies have been concerned to represent the range of comfort on a curve or several curves by unifying many different climatic influences , and by stabilizing points representing the climatic factors on the curve , it is possible to determine the level of thermal comfort or not. The most prominent examples are factor okays biochemical representation , Masons thermal humidity table, Tom equation and Basel standard .

A: Olikai Graphic Chart: It is chart shows the relationship of climate variable with each other (temperature, humidity, the movement of air ,solar radiation) and their effect in achieving the thermal balance of the human body and depending on the temperature effect.<sup>(xxvi)</sup>

It reflects the degree of heat sensation in the relationship between the climatic variables of thermal comfort . figure(6) represents the diagram of the thermal comfort to factor okay.

-If (ET) located in area (A) then person would feel thermal comfort.

-If (ET) located in area (B) that represents the start of feeling with high heat and the need to the air movement with a speed (0.5-3.5m/s).

-If(ET) located in areas (c) the person will feel heat a not drought and that needs a slow air movement.

-If (ET) located in area (D) the person will start choking and not able to stats at high temperature . In this condition all the natural ways eligible to get to the limits of thermal comfort and this needs using mechanical ways to get to the thermal balance<sup>(xxvii)</sup>.

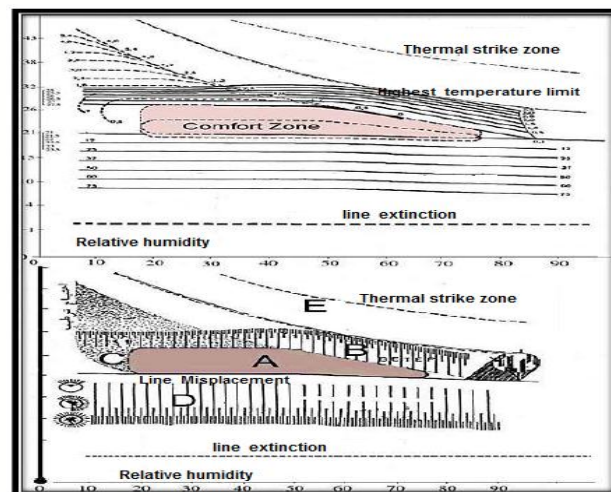


Figure (6)-Diagram (Olikai) Graphic

Source: Tantawi Abdul Hamid, Weather and Human Health General Authority

B- Mahoney thermal humidity table: This system was based on a set of tables that included data for the climatic elements of the site to be studied ,namely (temperature ,humidity ,rainfall and land within one year, and determination of the rates for each climate component . the results of the application of this system must be taken into

account by urban architects and designers. Now the use of this system would help significantly in putting environmental solvation's and treatments and make a perfect limits for the thermal comfort. Table (4) represent the suitable rates of humidity and temperature that are the closest to the thermal comfort.as Mahoney get.

Table (4)

The appropriate temperature when the humidity between these limits (thermal comfort)

Average R.H%	H.G	AMT.over20c	
		Day	Night
0-30	1	26-34	17-25
30-50	2	25-31	17-24
50-70	3	23-29	17-23
70-100	4	22-27	17-21

Source: Awny Kamel Shaban and Muaded Haider Aljawdi , climatic anylisis for Iraq, center of building researches ,National Research foundation .Global Bulletin number 3,37,July , 1973.

C-Thomas standard: It is one of easiest ways to measure the thermal comfort of humans in the hot

dry areas, and it is easy to apply or provide the measuring devices for the data in this standard and the accuracy of the results that can be obtained according to the following math metical formula<sup>(xxviii)</sup>.

$$Thi=0.4(Tw+Td)+4.8$$

(Thi)=Manual temperature and humidity (degree of human feeling on)

(Tw)=Wet thermometer temperature (Celsius).

(Td)=Dry thermometer temperature (c)

The result of this formula is the evidence to feel

-able for example if the result was less than (15) the weather is not comfortable because of coldness but if the results between (17-20) that means the weather is comfortable the thermal comfort be realized ,<sup>(xxix)</sup> as it represented at table (5).

Table (5)-degrees of comfortable feeling according to(Thai) directory values

Feeling comfortable	Directory value
The atmosphere is uncomfortable because of the coldness	less than15
The transition atmosphere is slanted to cold	17-15
The atmosphere is comfortable	20-17
of the people feel uncomfortable 10%	23-21
Of the people feel uncomfortable 50%	27-24
of the people feel uncomfortable 100%	29-27
The atmosphere is very cumbersome and leads to heat exhaustion	More than 29

Griffiths, j.F.1976.Applied Climatology .Introduction .London, Oxford University .

D-Basel and Sable standard: Thom equation was based on only two elements (Temperatures and Humidity) in extracting the degree of comfort . This equation ignored other climatic factors such as wind, which can cause special deviations in cold weather during the winter .So that another factor was used with this standard and



comparison to ensure the accuracy of the results is the standard used by (Sibil and Basel) which determines the impact of wind movement in cities. Air movement has a negative or positive impact on thermal comfort. In case of seasonal cold climate, the movement of the air to remove the warm air touching the human body and replace it with cooler air, increasing the thermal difference between them and lead to increase heat loss and a sense of cold. In the case of the seasonal hot climate, where the temperature is not less than (33°C) the movement of air leads to the removal of relatively moist air touching the human body and replace it with hot dry air helps to increase evaporation from the surface of the skin, leading to a sense of discomfort. In the very warm atmosphere, where the temperature is above (35°C), the movement of the air works to remove the air touching the skin and replace it with warmer air than the body due to evaporation, which increases the feeling of heat at a time when the body is in dire need of getting rid of excess heat<sup>(xxx)</sup>. Siebel and Basal identified the effect of wind in the sense of low heat according to their guide, which measures the amount of heat that a person's shell can absorb within an hour of exposed surface of (1m<sup>2</sup>). Determining the thermal comfort criterion for any area requires the identification of elements climatic directly related to human comfort such as temperature, air humidity, wind speed and the impact of each of these elements in the human body's thermal balance. Where the data of the elements referred to, are located within the zone of comfort limits. In these limits, the body's thermal balance mechanism is in the lowest activity conditions.

It represents the climate conditions in which a person feels comfortable in a hot climatic zone.

In general, the notional preferred range of thermal comfort levels is (18.5°C-29.5°C) while Olkey sided that the comfort region is located with in temperature (20.5°C-27.5°C) and humidity (18-77%) with an air movement gets to (3.5/s)<sup>(xxxi)</sup>. The world Health Organization (WHO) has also estimated the limits of the thermal comfort of the person who is active in simple activity and wearing light clothing during the winter (20°C-24°C) with the movement of the air up (15m/s), while during the summer it will be (23°C-26°C) with the movement of air up to (0.23m/s)<sup>(xxxii)</sup>. The comfort in some Eastern European countries for winter (19°C-22°C) was determined according to the area with relative humidity (40-60%) and air velocity (0.07-0.1m/s) while in summer it is (23°C-26°C) according to the specific area with relative humidity (30-60%) and air movement (0.1-0.5m/s)<sup>(xxxiii)</sup>. In warmer areas, the most suitable area for thermal comfort, is where the temperature achieved (23.3°C-29.4°C) with relative humidity ranging (%30-%70)<sup>(xxxiv)</sup>. The optimal performance of human thermal comfort in cities with dry climates in particular is as follow:

1-In winter the temperature is (20°C-22°C), humidity is (%40-%60) in time the higher amount of air movement is (0.07-0.1m/s)<sup>(xxxv)</sup>.

2-In summer the temperature is (26°C-28°C), humidity (%30-%50) and air movement is (0.25-0.1 m/s)<sup>(xxxvi)</sup>.

In order to assess the local climate of the city Najaf according to the requirements of thermal comfort has been studied and analysis of the thermal reality (1990-2012) which showed that the annual rate of temperature recorded in the study area for the period above was (23.8°C). the upper limits of temperature rates were recorded in July (36.2), though solar radiation in June is higher than July (9442 and 366 calories/cm<sup>2</sup>)<sup>(xxxvii)</sup>.

This is the result of accumulated thermal waste, which led to the month of July the highest temperature of June while the lowest recorded temperatures for the same period was recorded in January and reached (105c)

The highest temperatures were recorded in July , (447c) while in January for the same time the lowest temperature of the minimum of (49c).As for the rates of solar radiation within the same period, In June and July (6442 and 6363clcm<sup>^</sup>) respectively , the lowest rates of solar radiation reaching the study area in December and January is (2321 and 2294c/cm .s) while recorded the lowest speed in October (29m/s) , the rate of relative humidity in the city of Najaf during the months of the year is characterized by a rise in winter and decline in summer, reaching its proportion In June (347%), but in the month of January was (762%).<sup>(xxxviii)</sup> From the a bove we can conclude that Najaf city located within the hot dry scope , and we can determinate the main climatic characteristics for this scope.

1-High radiation intensity

2-There is a variation in daily and seasonal temperature which is due to the factor of the purity of the sky and the cold wind blowing.

3-Low humidity and rainfall

4-wind loaded with sand and dust.

These climatic characteristics are a source of thermal discomfort for the inhabitants of Najaf. For the purpose of improving the bio-mechanical characteristics, it is necessary to develop a range of environmental and engineering solutions and treatments to reduce the impact of climate factors. These solutions and treatments should deal with variably element( temperature, relative humidity, solar radiation ,wind ) are the most important strategies to reduce extreme environmental conditions are the use of vegetation such as trees, shrubs and water bodies.

Third: Effective temperature standard. The temperature control criterion was applied in Najaf city to determine the level of heat felt by humans. The general thermal comfort values were obtained from the monthly averages of temperature in months (December, January, February) (16,754-13,394 – 14,43- and for March is 12,316) in the quarterly order of months . As in table (2) the result of these months indicate that it will not be inconvenient temperature due to low temperatures' to the abnormal level of the human body while the result of monthly average for the months of April and October (21,503-24,553) and thus include the two months within the range of comfortable temperature .As for months (June, July , August) they had a thermal value of (29,172-29,520-28,06) these months were within the inconvenient range because of the significant increase in tempera tare. While temperatures are gradually decreasing diving September and November to reach (16,563-26,562) respectively.<sup>(xxxix)</sup> Table (6)

Table (6)The value of thermal comfort for the criterion of the effective temperature of Najaf Governorate for the period (1996-2015)

(Months thermal comfort ( night)				(Months thermal comfort (daytime				Months thermal comfort				Thermal comfort		General rate of thermal comfort	Months
Inconvenient / low the heat	Uncomfortable / high temperature	uncomfortable	comfortable	Inconvenient / low the heat	Uncomfortable / high temperature	uncomfortable	comfortable	Inconvenient / low the heat	Uncomfortable / high temperature	uncomfortable	comfortable	night	Day		
✓				✓				✓				4.92	16.45	14.43	January
✓				✓				✓				7.66	18.85	13.394	February
✓								✓	✓			13.14	22.57	16.754	March
✓					✓						✓	20.1	29.1	21.503	April
			✓		✓					✓		26.20	32.78	25.562	Mays
	✓				✓					✓		29.88	33.29	28.06	June
	✓				✓					✓		32.24	35.58	29.520	July
	✓				✓					✓		32.13	32.17	29.172	August
			✓		✓					✓		27.9	30.4	26.562	october
✓					✓						✓	22.3	29.48	24.553	October
✓								✓	✓			12.82	23.96	16.563	November
✓				✓				✓				7.28	17.5	12.316	December

Source: Depending on table (8)

The extraction of Vim temperature equation caloric of the months of the year in the city of Najaf is not sufficient to determine the level of thermal comfort, therefore the same thermal minerals should be used in the extraction of temperature .The maximum relative humidity was calculated based on the monthly equations of the maximum temperature. The minimum relative humidity values for the extraction of the thermal comfort values (Day) when the equation was applied , the results were consistent with the results of temperature equation (general thermal comfort) in the uncomfortable months due to heat or cold temperature values for the months (December ,January , February) (18,85-16,45-17,5)

These months are with in the rang of inconvenient due to coldness While the values of thermal comfort at a comfortable level during the months of (March, October ) were valued (22,57-23,96) while the value of temperature effecting the day of the months (April, March) (29,1-32,78) while the high temperature (Day ) began to rise during the months (June , July , August ,September and October) to reach (33.29-35,58-32,17-30,4-29,48)<sup>(x1)</sup> It is therefor within the scope of the climate is not comfortable because of the high temperature during the day but we can analyze the relation ship of climate has been the monitoring of climate elements one during the summer and the second pillar during the winter of 2018 if the results of clime monitoring as follows:Table(7)

Table (7)-Spatial and temporal conditions of climatic elements in the city of Najaf for the 2018/2/22-20 period winter season)(

Se qu en ce	Neighborh ood	Coordinates		Monitorin g time	Monitorin g date	Weather condition	tempe rature of air	Relativ e humidit y	Wind directio n	Wind speed
		N	E							
1-	Hussian Dis	32.07	44.33 5	14:20.15:1 1	2017/02/2 0	Partially cloudy	17.8	20-27%	N.W	Moderate
2-	Teacher Dis	31.95	44.42	14:20.15:1 1	2017/02/2 0	Partially cloudy	17.9	20-27%	N.W	Moderate
3-	Al shaheed As	32.07 2	44.33 2	14:20.15:1 1	2017/02/2 0	Partially cloudy	17.8	20-26%	N.W	Moderate
4-	Oruaba	32.05 1	44.33 9	14:20.15:1 1	2017/02/2 0	Partially cloudy	17.8	20-25%	N.W	Moderate
5-	Abo Talib	32.06 0	44.29	14:20.15:1 1	2017/02/2 1	Partially cloudy	17.7	20-24%	N.W	Moderate
6-	Hawraa zainab	32.98 9	44.35 2	14:20.15:1 1	2017/02/2 1	Partially cloudy	17.8	20-25%	N.W	Moderate
7-	AlGhdeer	32.02 2	44.35 1	14:20.15:1 1	2017/02/2 1	Sunny	18.1	20-26%	N.W	Moderate
8-	Al waffa	32.05 0	44.34 5	14:20.15:1 1	2017/02/2 1	Sunny	18.2	20-26%	N.W	Light
9-	Al adala	32.02 2	44.36 0	14:20.15:1 1	2017/02/2 2	Sunny	18.3	20-23%	N.W	Light
10 -	Salam Al	32.01 9	44.33 6	14:20.15:1 1	2017/02/2 2	Sunny	18.1	20-23%	N.W	Light
11 -	l ansar	32.35 5	44.98 9	14:20.15:1 1	2017/02/2 2	Sunny	18.3	20-23%	N.W	Light
12 -	Al Qadsia	31.00 7	44.37 5	14:20.15:1 1	2017/02/2 2	Sunny	18.3	20-23%	N.W	Light

Source: Researcher based on field work.

Temperatures of Thermal comfort (Night):In this equation, the lowest temperature and maximum relative humidity are obtained by extracting the value of the high thermal comfort in the study area.

After application the effective temperature of which (December ,February ,April and November which (7,28-4,92-7,66-13,14-15,3-12,85). Therefore, test months are within the uncomfortable temperature range due to the decrease in the temperature . In the months of (April and October) (20-22,3) Ideal thermal in the human comfort while the value of night time of the months of (June and July and August was (29,88,32,24-32.13)and therefore falls within the uncomfortable thermal range. <sup>(xli)</sup> While the temperature component was measured in the center of the green area which exceeded (500m2) and the environmental these distances during the same time (12 at night)and the following result. Table (8)



Table (8) Green area effect zone for the period from 20 -24/2/2018( winter season)

Air temperature in three ranges							The extent of the spatial difference
Sequenc e	Neighborhood	Green space	Space center A	100 m B	200 m C	300 m D	
1-	Hussian	park	17.3	17.5	17.7	17.8	8%
2-	Teacher	park	17.4	17.6	17.7	17.9	8%
3-	Al shaheed Asader	park	16.9	17.3	17.5	17.8	10%
4-	Oruaba	park	17.4	17.7	17.9	18.1	8%
5-	Abo Talib	park	17.3	17.4	17.6	17.7	8%
6-	Hawraa zainab	park	17.5	17.6	17.7	17.8	8%
7-	AlGhdeer	park	17.6	17.8	17.9	18.1	8%
8-	Al waffa	park	17.5	17.9	17.9	18.2	8%
9-	Al adala	park	17.3	17.5	17.8	17.9	8%
10-	Salam Al	park	17.4	17.7	17.9	18.1	8%
11-	Al ansar	park	17.6	17.8	18	18.2	8%
12-	Al Qadsia	park	16.9	17.3	17.7	18.1	10%

Source From field work.

From the result of the above table we find a difference in temperature estimated to decimal parts specified between the center of the green area and the outer perimeter and distances confirmed during the winter and for the day. Table (9)As the thermal monitoring during the summer , the results were as follows.

Table (9)-Spatial and temporal conditions of climatic elements in the city of Najaf for the 2018/6/22-20 period(summer season)

Sequenc e	Neighborhood	coordinates N E	Monitoring time	Monitoring date	Weather condition	temperatu re of air	Relative humidity	Wind direction	Wind speed
1-	Hussian	32.07 44.335	14:20.15:11	2017/02/20	Partially cloudy	20-27%	17.8	N.W	Moderate
2-	Teacher	31.95 44.42	14:20.15:11	2017/02/20	Partially cloudy	20-27%	17.9	N.W	Moderate
3-	Al shaheed Asader	32.072 44.332	14:20.15:11	2017/02/20	Partially cloudy	20-26%	17.8	N.W	Moderate
4-	Oruaba	32.051 44.339	14:20.15:11	2017/02/20	Partially cloudy	20-25%	17.8	N.W	Moderate
5-	Abo Talib	32.060 44.29	14:20.15:11	2017/02/20	Partially cloudy	20-24%	17.7	N.W	Moderate
6-	Hawraa zainab	32.989 44.352	14:20.15:11	2017/02/21	Partially cloudy	20-25%	17.8	N.W	Moderate
7-	AlGhdeer	32.022 44.351	14:20.15:11	2017/02/21	Sunny	20-26%	18.1	N.W	Moderate
8-	Al waffa	32.050 44.345	14:20.15:11	2017/02/21	Sunny	20-26%	18.2	N.W	Moderate
9-	Al adala	32.022 44.360	14:20.15:11	2017/02/22	Sunny	20-23%	18.3	N.W	Moderate
10-	Salam Al	32.019 44.336	14:20.15:11	2017/02/22	Sunny	20-23%	18.1	N.W	Moderate
11-	Al ansar	32.355 44.989	14:20.15:11	2017/02/22	Sunny	20-23%	18.3	N.W	Moderate
12-	Al Qadsia	31.007 44.375	14:20.15:11	2017/02/22	Sunny	20-23%	18.3	N.W	Moderate

Source: From field work.

In order to determine the level of impact of green areas during the long summer months ,the researcher monitored the center of these areas during the month of June and recorded temperature in three different ranges as in the following Table(10)

Table(10)-Green area effect zone for the period from 20 - 23/6/2018 (summer season)

Air temperature in three ranges							The extent of the spatial difference
Sequence	Neighborhood	Green space	Space center	100 m	200 m	300 m	
			A	B	C	D	
1-	Hussian	park	44.3	45.2	44.8	44.5	10%
2-	Teacher	park	44.4	45.4	45.2	44.8	8%
3-	Al shaheed Asader	park	44.5	45.2	44.9	44.7	10%
4-	Oruaba	park	44.3	45.3	44.9	44.7	8%
5-	Abo Talib	park	44.4	45.3	45.1	44.9	8%
6-	Hawraa zainab	park	44.2	45.4	44.9	44.6	8%
7-	AlGhdeer	park	44.7	45.2	45.1	44.9	8%
8-	Al waffa	park	44.4	45.2	45.1	44.9	8%
9-	Al adala	park	44.5	45.3	45.1	44.8	8%
10-	Salam Al	park	44.6	45.5	45.2	44.8	8%
11-	Al ansar	park	44.3	45.3	44.9	44.5	8%
12-	Al Qadsia	park	44.2	45.3	44.9	44.6	8%

Source: From field work.

From the .tables (6,7,8,9,10) its found that the effect of green areas is clear in (April ,March ,June ,October) during the day where the temperature reduces and that help to be within the limits of thermal comfort to the population.

Fourth :The effect of green areas in controlling air relative humidity: Which depends on the temperature and the movement of the air. In daytime, the solar radiation and reflectivity heat the air layer close to the surface of the earth. The air humidity decreases rapidly and the evaporation increases with increasing air movement , which helps to mix the air layers and reduce their variation in temperature and humidity. This is the situation at night and the air near the surface of the earth. With the highest relative humidity .However, in general the relative humidity equation in the urban areas of the city is different due to the lack of green spaces and the corers ponding increase in the cement area and tiled roads, which reduces evaporation and for the purpose of modifying the humidity in the air of cities with a hot dry climate ,plants are planted especially trees the water vapor released by the plants in the process of transpiration increases the water content in the air , which helps proven that trees help to raise the relative humidity in the tree cover areas almost (%11).

This ratio varies according to the types and density of trees. It was found that on a sunny summer day ,an area of (4050 liter) of grass evaporates at (10,900 liter) of water. This means that a green area which it (1012 liter) will have a cooling effect of about 166 tons ref (day) which is equivalent to work (20 air conditioner) large size working (2) hours per day . The vaporized tree (455 liters) of water per day occurs in a cooling capacity of (2500 kcal/hour) This is equivalent to five air conditioners of the Hormel size ,it works (20) hours per day .The evaporation rate increases with the

movement of the air , resulting in additional temperature reduction. The air is especially strong during the clear days free of clouds and wind because plants evaporate large quantities of water vapor and this leads to an increase in condensation of water vapor in the air touching the surface of the soil. Moreover , the increase in absolute air humidity is based on the fact that the vegetation reduces significantly the speed of wind and makes it different to process the vertical exchange of moisture in the air with the diver layers located above the vegetation and relative air humidity has emerged that the most valuable and its link were within the branches of trees that exceeded the height of (5,1m) and from that place the top begins to decrease humidity <sup>(xliii)</sup>. The smallest differences are observed at times before and during the sunrise, As the clock approaches (8-10)AM, the differences reach their maximum limits , and then the differences start to fall near the afternoon hours . the large difference is observed especially in the hour (1-3)pm(15-20%).The effect of the green spot begins to appear with the sunrise and increase the difference in temperature between the shadow areas trees and areas of cement , the higher the sun in the sky and increased the angle of fall of radiation continues to gain ground until the temperature reaches the (12-3) to the highest temperature and then return with the decline of the sun .As for the humidity , it behaves opposite behavior to heat the greater the evaporation the temperature of this note that the humidity is minimal at (12:00) and then increases with the absence of the sun and decreases with sunrise and this is also apposite for the dry climate <sup>(xliii)</sup>.The open water area of swimming pools and large public fountain has the effect raising air humidity this is reflected positively in improving the thermal comfort of the population

Fifth : Effect of green areas in wind control : The effect of green on the wind factor is clear compared to its uses in expanding the establishment of green ranges around cities and within them, with intensifying the pattern of rows of trees and shrubs in the spaces and streets have a significant impact on wind movement and direction and have a particular impact on the local climate Green ranges in desert area is to reduce the movement of strong warm and dry winds that often carry dust and soil <sup>(xliv)</sup>.

Green area around the cities ,known as the Green Belt ,are a vast green area around the city .the British Department of knowledge has identified the Green Belt as a piece of the open zone and constitutes an isolated zone with in urban a unto no my ,forming rows of trees and protecting the city center behind it of the harmful effect of dry wind as it impedes movement ,thus weakling the strength and change direction and reduce the speed and thus reduce the speed and thus reduce the proportion of dust and that can be borne by the wind in the direct , as long as the wind carries the atmosphere in the atmosphere upcoming ones, to account the effect of green spaces in wind speed is applied the following equation .

$10m+50=\text{wind area (wind still ness)}$

That is (M)=green range plant height

50=Fixed ratio

IF we assume that the height of the plants (20m) the wind stillness will be dis played as follow :

$10*20+50=250m$

The area of the province of Najaf suffer from the problems of creeping sand dunes and the large number of sand and dust storms which known as strong winds carrying large amounts of dust particulars It is a common climate phenomenon happens in dry and Simi dry areas. Dust storms arise as are salt of cold frats accompanying the air depressions that pass on environmentally weak areas such as the deserts and plateaus.

The wind moves the small sand with a diameter between (1-29 $\mu$ m). The wind speed increase from (7-14m/s) is at the very least to carrying larger dust particles. Therefore, visa researchers and specialists prefer the use of solutions for green belts in particular as the expansion of green areas helps to temper the temperature of the atmosphere especially in areas characterized by extreme extremism in their heat studies have shown that parks out side

the cities and suburban areas are cooler than the city center by several degrees Celsius and A study conducted in Kuwait showed that the green belts reduce the amount of dust deposits by( 26%) through a monthly monitoring for one year and by comparing the amount of dust rising from the dust traps that were developed before and after the green belts also proved that the green belts soften the atmosphere of the city .In a large Moroccan study found that the belts are able to stabilize the sand in the desert areas and reductive sand storms and also reduce the strength of wind speed as one study showed that the accumulation of sand in the streets of wooded area equivalent to three or four times the amount of accumulated sand in the streets of wooded area . the green areas also preserve soil and prevent erosion and thus reduce dust storm .

Sixth: The role of green areas in reducing pollution :Plants play an important role in the removal of gaseous pollutants as well as solid air, plants work to clean the air and reduce air pollution and improve the environment as following:

A : Air pollutants of gases : Plants work to clean the air from bad smells or poisoned gases by:

1-The absorption of a large part of these gaseous pollutions either directly or after melting in the rainwater through the openings of the respiratory gaps and from their optical presentation to the energy of growth and release of Pure oxygen gas , thus preventing their access to the soil and the organism microorganisms . 2-

Absorption of pollutants on the outside surfaces.

3-Blocking or Replacing odors with aroma therapy smells stronger and more beautiful out of the breath of leaves and flowers with the addition of oxygen , which increases the purity and revitalization of the air It has been found that the proportion of air pollution acceptable to humans should not increase about one part of the polluted air to about (3000)parts of almost pure air .However ,in many highways and major cities ,the pollution rate increases to( 3/3000), SO planting plants on the roads or in the middle of the streets actually helps to reduce noise and noise pollution at the same time .plants, especially trees, can absorb a large part of the toxic gaseous pollutants either directly or after melting in to rain water and then.

represent it and prevent it from reaching the soil .

From the most important gaseous pollutants which plants absorb from the air:

1-Carbon Dioxide: All types of plants to clean and purify the through the process of absorb carbon dioxide and release Oxygen gas that breathe the air of every living organism on earth and has the results of the laboratory in the university of Boston (the American) proved that the area of (10000m<sup>2</sup>) of different trees are purifying the equivalent of (18mil m<sup>3</sup>) of air throughout the days of the year as well as that an area of (150m<sup>2</sup>) of plants leaves can suffice the needs of one individual of oxygen gas for a period of one year .the area (300-400m<sup>2</sup>) of agricultural land or gardens with in the centers of the city centers can produce enough oxygen to the residents of the city centers today ,and the biological laboratories have determined that green area of trees (10,000m<sup>2</sup>) in side a city center can absorb (600kg)of pure Oxygen gas from the air within is hours and at the same time can absorb (900km) of Carbon dioxide air



It is noted that the amount of carbon dioxide from plants respiration ( which represent the release of plants ) is equivalent to only one fifth of the quantities consumed in photosynthesis so the consumption of plants for carbon dioxide far exceeds their production .this also indicates that the oxygen produced by photo synthesis is equivalent to the depletion of oxygen consumed in the process of breathing in the plant that carbon dioxide is one of the main greenhouse gases and cause of the phenomenon (House protected ),which accumulate these gases especially carbon dioxide in the upper atmosphere and do not leak the thermal radiation from the earth (Infrared) to outer space and thus raising the global temperature of the earth.<sup>(xlv)</sup>

2-Carbon Monoxide gas: absorbed by plants up to small atoms and converter to carbon dioxide is used in the process of photo synthesis so the absorption rate in the light is better than it is in the shade .it has been found that a (30m<sup>2</sup>) belt ager can reduce the concentration of carbon monoxide in the air by (65%).Environmental studies also indicate that the arena of (1km<sup>2</sup>) of trees can absorbs (15-20kg) of carbon monoxide daily .

3-Sulfur dioxide (SO<sub>2</sub>): the pants absorb this gas to varying degrees and turn it into saline sulfur , which reduces its toxicity as air gas and then moves to the roots rid of this parson gas .studies indicate that the trees with broad pores are better then the trees with the leaves in the absorption of this gas . the increase in air humidity and sunny atmosphere increase the rate of absorption of this gas it was also found that the rate of absorption of the plants of the evaporation of this gas increases with higher air temperature .it turns out that the surrounding green areas factories have significant impact on minimizing gaseous pollutions.

For example ,it was found that the area (500m<sup>2</sup>) of green area can reduce the concentration of sulfur Dioxide in the atmosphere by (70%)and concentration of Nitrogen oxides by (67%). It has also , been proved that parks, gardens , and street trees a large role in reduce the concentration of many toxic gaseous pollutants such as ( CO<sub>2</sub>,No<sub>2</sub>,SO<sub>2</sub>)

4-Nitrogen gas : plants absorb from the atmospheres ,especially Nitrogen dioxide , where absorbed Nitrogen enters the synthesis of amino acids in the plant. Plants also absorb Nitrates in the form of ions from soil with water

5-Ozone gas : plants play an important role in reducing the proportion of ozone gas in the atmospheres (in the troposphere where ozone is dangerous gaseous pollutants that cause severe damage humans , animals and plants. It causes poor vision and brae thing ,disturb acnes in brain function .the results showed that plants can absorb this gas by (60-20%)of its presence in the air the greater the number and size of respiratory gaps the more efficient the leaves in the absorption of these gases (O<sub>3</sub>,NO<sub>2</sub>,SO<sub>2</sub>). Table(11)

Table(11)-Spatial monitoring of polluted gases in Najaf city in 2018

		Carbon (monoxide (CO) Part million		Sulfur dioxide (SO <sub>2</sub> ) Part million		Hydrogen sulfide gas (H <sub>2</sub> S) part million		Oxygen gas (O <sub>2</sub> ) part million		Amonia gas (NH <sub>3</sub> ) part million		Methane gas (CH <sub>4</sub> ) part million
		winter season	summer season	winter season	summer season	winter season	summer season	winter season	summer season	winter season	summer season	
1-	Al Hussein	10	0,1	0,1	0,1	0,3	21,1	19,6	0,3	21,1	0,1	0,1
2-	Maaylmen	9	0,3	0,1	0,2	0,2	21,2	19,6	0,2	21,2	0,2	0,1
3-	Al Shahid al-Sadr	11	0,1	0,1	0,1	0,4	21,2	19,8	0,4	21,2	0,1	0,1
4-	Al Oruba	5	0,1	0,2	1,2	1,5	21,1	19,5	1,5	21,1	0,1	1,2
5-	Abu Talib	6	0,1	0,2	0,2	0,4	21,3	19,5	0,4	21,3	0,1	0,2
6-	Al Huraa Zeinab	10	0,1	0,1	0,2	0,4	21,1	19,1	0,4	21,1	0,1	0,1
7-	Al Ghadeer	10	0,1	0,3	0,3	0,5	21,3	18,6	0,7	21,3	0,1	0,3
8-	Al wafaa	14	0,2	0,2	0,1	0,5	21,1	18,7	0,5	21,1	0,2	0,2
9-	Aladali	16	0,1	0,1	0,2	0,4	21,2	18,9	0,4	21,2	0,1	0,1
10-	Al salam	11	0,1	0,1	0,1	0,3	21,3	19,9	0,3	21,3	0,1	0,1
11-	Al ansar	9	0,1	0,2	0,1	0,2	21,2	19,6	0,3	21,3	0,2	0,1
12-	Qadessey Al	9	0,1	0,1	0,3	0,3	20,8	18,7	0,3	20,8	0,1	0,1

Source: Researcher based on Najaf Environment Directorate, Air Pollution Division, Monitoring Unit, unpublished data 2018

There is a clear spatial variation in the concentration rate of carbon monoxide .It is noted in the

table that the highest concentration of gas was in Al- Ghadeer district (99) and was out side the environmental limit due to an increase in exhaust gases of cars and generators and then followed by the district of Algeria , which amounted to (44,5) ppm by transport movement and thus increase the income of the cities and then the teachers district and amounted to 25.5ppm because of proximity to the industrial neighborhood of Aden and the large movement of transport. And the neighborhood oroba and reached 24 ppm because of the movement of generators and then AL .Adele district which recorded (16)ppm and these concentrations are all within the environmental limit, as well as in the jihad neighborhood And Hassan district , Al Ha wrap Zane

neighborhood ,and the district of Martyr Al Sadr (14,5,14,14,14) is permitted .The spatial variation of sulfur dioxide is observed in table (9) and map(5) where the highest concentration of gas was recorded in the district of Algiers and yarmulke district (0,8-0,75)ppm) respectively ,which is higher than the environmental limit due to (0,56)ppm because of the increase in the movement of transport and the smoke of generators and then recorded the district of Al Adele and the neighborhood of Abu-Talia ,where it reached (0,6)ppm because of the large movement of transport .As for

Hydrogen supplied, which smells as the same as rotten eggs, we find that the spatial variation of most of the rates recorded in sites that were safe and within environmental determinants. Table (10) and map (6) recorded the highest concentration in Al-Oroba district and reached (0,45)ppm due to fermentation of liquid human waste followed by Martyr Al-Sadr district (0,4) ppm followed by the neighborhood of Abu-Talib and reached (0,35)ppm. The spatial variation of oxygen gas is noted in Table (11) said, all the registered signal that Oxygen gas in most materials within the environmental determinates (19,9%), Abu-talib neighborhood, Jihad, Al Hassan district (20%), Al Hussein, Al Sadr, Al oroba, Hawraa zainab, Al waffa, Al Ghadeer districts reached (20-50 %). The spatial variation of Ammonia gas (NH<sub>3</sub>) is showing in Table (11). Most of the registered concentration is safe and within the environmental determinates. The highest concentration of the gas was recorded in Al Oroba area and reached (0,07) ppm due to the fermentation of liquid human waste then Algr district and also Abu-talib district recorded (0,35)ppm because of the proximity of the stream of water for the irrigation of the which gives the air odors odious.<sup>(xlvii)</sup>

The only spatial variation in Methane (NH<sub>3</sub>) and which is the simplest type of hydrocarbons and through table (13) and map (9) it is noted that most of the concentrations below the limit of the environment allowed the highest concentration of Methane was in the districts of Al Agadir, Jihad, and Hassan (0,01)ppm because of combustion operations in complete fuel used in transportation, generators, furnaces and restaurants.

B: Solid air pollutants:

1-Solid air pollutants precipitation and filtering: The air conditioning techniques and means of air purification and filtration of dust by the exact filters and special preceptors. In nature the plants in this effective role, where works to remove, a lot of (Dust, ash, smoke, lead, copper, pollen) by depositing it on the surfaces of different parts of the plant. The leaves and hairs on them, the branches and stems, attract the atoms of these pollutants through different Electrical particles between pollutants to the surfaces of the prop various Tia) and is tallied and then get rid of them through the rain to the soil. Studies have shown that leaves of plants have a great potential for intercepting and depositing thousands of tons of portable dust with air molecules. The concentration of dust parotic is in parks and gardens was found to be (45%), in summer and (38%) in winter. Therefore the percentage of soil particles in the streets of the same city is (1000-12000kn/L air), Therefore plants can be used to improve air properties and purify them by planting them particularly in industrial areas (160mg/m<sup>3</sup>/day). Environmental studies indicate that the proportion of pollen scattered in air molecules especially in the spring can be reduced by (80%) and when the dependence in the cultivation of dense trees and more than a row with a dense forest of coniferous trees.

2-Air purification: plants lose large number or amount of water vapor during the process of transpiration through the respiratory pores on the surface of the leaves, working to increase the surrounding humidity in the plants and place and thus help to precipitate a lot of pollutants suspended in the air on the different surfaces of the plant. The dew drops formed on the surface of the leaves also help to wash the solid particles attached to the leaves and drop the soil to get rid of environmental damage.<sup>(xlviii)</sup>

3- Reduction of noise pollution(noise): This type of pollution is know on as annoying noise is desirable and work to disturb the nervous system of humans and effects not only the hearing system, but also has physiological and psychological effects on the psychological Truman.

High pressure ,which exceeds (70dB) affects the blood circulation of human body , increases the speed of the pulse and produces adrenaline . It leads to high blood pressure ,increases blood sugar ,insomnia and headaches. of the pathogenic or serious pathogens, and laboratory research has shown that the suffering of more than (35%) of patients with nervous tension, ulcers and heart attacks was due to exposure to high rates of high (noise) for a long time.

#### Conclusions

1-When applying the equation the results were as the same as the results of the temperature affecting thermal comfort (general thermal comfort) , The uncomfortable months wearer due to heat or coldness and these months falls with in the un comfortable range.

2-The affecting temperature (Day) begins to increase throughout ( June ,July , August, September ,October) so it is within the uncomfortable climate because of increasing heat during the day hours ,to form(41.7%) of the total months of the year

3-the value of thermal comfort is in a comfortable range (March- November) it is (22,57-23,96) for night ,while the value of temperature during day in months (April and March) (29,1-32,78).

4-The impact of green areas is clear during (April ,March ,June ,November) at day hours where the ratio of temperature is reduced, and that help to be within the thermal comfort limits for the population.

5-The impact of water bodies on the interior environment of city center of Najaf city is limited because its small space and less in number in addition of the technical problems which represented in the difficult of providing water in a continuous way or cutting the electricity of the pumps.

#### Recommendations

The green areas is Avery important spaces because it reduce the temperature and help to eliminate of air pollutants In addition , it is one of the basic strategies in the climatic resolutions

Of the external spaces of cities. Green spaces could be the element which work to balance the environmental systems inside the city in spite of the other urbanism uses .therefor we can give the following recommendations:

1-The need for designers and planners to design the foundation of Najaf city with the follow –up of competent authorities for the sustainability of the function performed by the green areas to work to raise the level of comfort in the city .

2- Expanding the cultivation of green areas in the city of Najaf and focusing on planting large trees as the most important environmental elements and the most influencing the climate by reducing temperatures in summer due to the increase in the percentage of moisture from the plant transpiration process.

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