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Potential Effects of Microclimatic Factors in Environmental Design of Building in Iraq Context

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Abstract-At the present the building designers and researchers in the region often find it is difficult to identify reliable and current weather data and information. Although available free meteorological data are available, not always applied correctly and well understood by the users, because data complicity and the abstraction of sustainable design concept.

This study discusses a novel study and develops the important climatic data in Iraq for sustainable building design. Base for analysing the long term weather data over the past 50 years and examine the practical issues of building design, useful climatic information and patterns are identified.

The provided information will enable people to better understand the trends of local climate and build up the resources for assessing important issues of renewable energy and environmental design and to determine indoor environmental quality.

The results indicated that the annual average of monthly mean during 50 years recording of global solar radiation incidents increased by 3.3%. While the results of the ambient temperature analysis show that mean annual temperatures measured Baghdad over the long term at increased by 7%.

During the long-term (50 years) recording period, the annual cooling degree-day value has increased by 16%, while the analysis of annual degree-day data over the same period indicates an even greater reduction of 26%.

The climatic data currently being used for energy design calculations leads to inaccuracies in predictions of energy use.

Heating coefficients were consistently positive and their values varied between 0.1, in 0.46, while albedo values varied between 0.19 and 0.37. The results indicated that there is little monthly variation in the values of nocturnal net radiation.

Keywords- *Albedo, Cooling degree-day, Microclimatology, Sustainable building*

I. Introduction

Using the climatic conditions of the site locality might be avoiding electro-mechanical devices and the starting point of architectural and house technical design.

The climatic Data information is great interest in sustainable building with respect to its renewable energy potential and in obtaining an idea of the local climate. Sustainable practices in building design and operation are becoming more and more important in the world [1]. Even though it varies in detail from day to day, it is nevertheless uniformly composed of three contributing influences, solar heating - wind - moisture mixed to varying degrees.

One of the most important factors affecting sustainable design of buildings is the consideration of climate change contributing to all the dynamic and life-giving processes and challenges to the present and future generations' characteristics.

Without better information and understanding of the local climate, it is not possible to study and achieve optimal building design and efficient building service operation [2]

In arid fringe climate areas the design of buildings for comfort must address resisting summer heat inflow from outside - ejecting the heat buildup emanating from the occupants and appliances inside the building. This approach is appropriate for comfort design for the majority of Iraq.

As a result of solar inflow variation with latitude, the summer winds flow over the substantial land area is warm. The western infiltrates cool air changes across Iraq in the general west to east flow of weather pattern. Recent studies show that best results in energy saving can be achieved through passive design and recycling strategies. It has been estimated that warm southern slopes will reduce annual heat consumption about 1.6-3.2 kWh/m^2 [3].According to Yeang [4] the new green skyscrapers and intensive building types should seek to achieve energy use of about 100 kWh/m^2 / year or less, compared with 230 kWh/m^2 / year for fully air-conditioned – and in the temperate zone heated – buildings and about 150-250 kWh/m^2 for air-conditioned offices.

The objectives of this study were to analyze of the microclimatological factors and to evaluate and assess the development needs of building climatic design. This information will help people to understand the trends of local climate and build up the resources for assessing important issues of energy and environmental design.

II. DATA SOURCES

The climate responsive building design in the Iraq context is the synthesis of theoretical hypothesis - backed by empirical evidence - applied to building designs both in concept and real life applications. The hypotheses will be developed from basic meteorology and physics theory.

The general weather patterns in Iraq are typified by cool winters with southwest winds and moisture, and hot summers with northerly winds, either dry and dusty, or tropical in the south. The climate is characterized as temperate', with temperatures outside the normal human comfort range (above 45C) principally in the summer. This is an arid fringe climate.

The collection of the data for this study was governed by the availability of free data from the Central Iraqi Weather Bureau, Baghdad Station. Due to the nature and scope of the study, it was realized that the analysis could only be carried out in a single geographical region in Iraq. This region is loosely referred to Baghdad although the sources of data are from different locations within this region**.**

The study identified basic calculations, which rely on climatic data for their calculation includes total energy, heating coefficient, net solar radiation, and albedo .

The climatic data collected for the study includes degree-day data for a Baghdad annual average of monthly mean air temperature, global solar radiation, net solar radiation, wind direction, wind speed, relative humidity, evaporation, soil temperature.

Hourly data files for building energy analysis and simulation actual sunshine hours and luminance parameters, as well as statistical summaries and seasonal variations are often provided to indicate the key climate concept. The initial analysis of the collected data involved identifying and quantifying trends over the four decades. The collected degree-day data to a base temperature of 26.6 °C in Baghdad were collected for the last 50 years.

III. CLIMATIC DATA ANALYSIS

Figure 1 shows the collected mean monthly temperature data together with similar moving average and linear trend lines. The results of the analysis show that the annual average of mean temperatures measured at Baghdad over the last 50 years have increased of 7%. During the last 50 years, monthly degree-day value has decreased by some 9%.

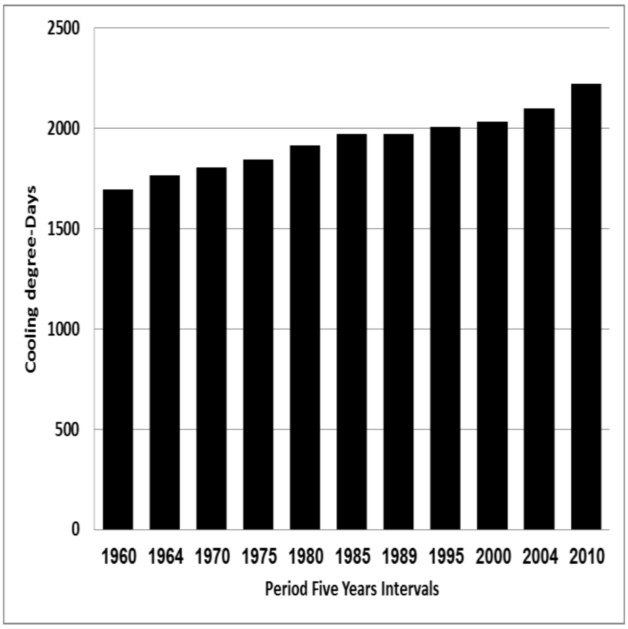

Fig. 1. annual average of monthly cooling degree days of Baghdad, 1960 to 2010.

From the yearly cooling and heating degree-days over the 50 year period (calculated for a reference temperature of 26.6 °C). It can be seen that the city is warmed up as indicated by the increasing cooling degree-days and decreasing heating degree days. This has significant implications to urban climate and energy use.

TABLE I. MONTHLY AVERAGE OF MEAN DAILY VALUES OF ALBEDO WERE CALCULATED FOR EACH MONTH OF THE RECORDED PERIOD

Jan	Feb	March	April	May	June
0.37	0.33	0.30	0.28	0.25	0.20

July	Aus	Sept	Oct	Nov	Dec
0.19	0.18	0.16	0.19	0.27	0.32

The degree-day method is commonly used to estimate energy consumption in the early stages of thermal design [5]). To evaluate the long-term variation of degree-day temperatures in Baghdad, a comprehensive set of degree-day figures have been established (Fig. 2).

Winter months, albedo rise quite significantly during the summer months.

However, a large portion of the rise in albedo value at low solar altitude is undoubtedly a real effect of the surfaces themselves. Most of the monthly change could due to the change of solar altitude angle from month to month. Some of these changes may be due to the material itself.

Figure 3: Theoretical changes in air temperature for a range of albedo conditions at 1200hrs on the third day of a spell of

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fine weather. High values of albedo mean that much of the incoming energy from the sun is reflected back into the atmosphere. This means that low albedo or non-reflective surfaces, absorb large amounts of energy from the sun. The energy is usually held or stored in the upper layers of the absorbing material and later released once air temperatures become less than the surface of the absorbing material (often after sunset). Albedo also has a significant impact on air temperature with high air temperatures associated with dark low albedo surfaces such as tarmac.

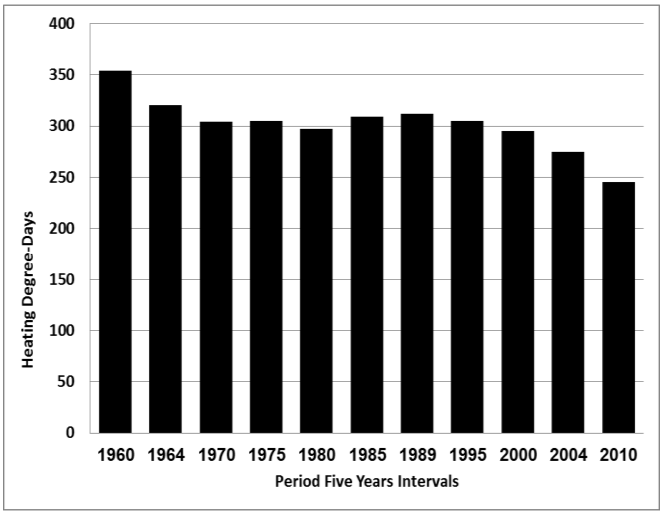

Fig. 2. Annual average of monthly heating degree days of baghdad, 1960 to 2010.

Adaptation of buildings and cities for climate change, it is necessary to construct design weather data for future climates [6]. The selection of extreme and near-extreme data based on risk assessment is suggested by [7] and a rational approach considering system reliability is proposed by [8]. In order to evaluate the risk level and allow for climate change, inherent properties and limitations of the weather data must be analyzed and understood [9]. In some situations, long-term weather data will be required for assessing energy performance of a specific year or over a long-term period [10]. For example, multi-year building energy simulation may be used for measurement and verification in energy saving performance contracts. Microclimatological data are significantly needed for assessing the energy input [10]. Using the right typical weather year is also important for meeting different needs and various applications such as renewable energy systems.

IV. ALBEDO

It is well known fact that part of the shortwave radiation reaching earth's surface is reflected. The fraction of radiation reflected by the surface depends on the nature of the surface as well as on the density of the materials. The monthly average of mean daily values of albedo was calculated based on measurements for each month of the recorded period are listed in Table 1. This table shows there is noticeable diurnal variation in each month. Whereby for low solar elevations (solar altitude less than 30^{o}) and during

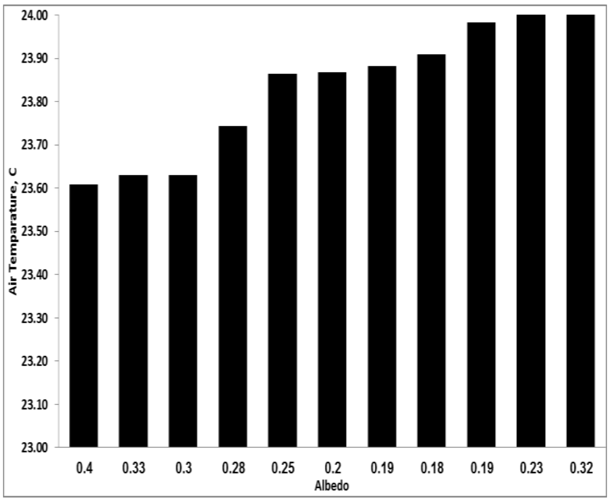

Fig.3. Relationships between air temperature and albedo at baghdad site.

V. NIGHT TIME NET RADIATION

The night –time net radiation represents a significant portion of the day-time net radiation, which indicates that the most of the energy gained during the day time is lost again during the night. The maximum negative net radiation occurred immediately after sunset and decreased gradually, with the usual decrease of surface temperature during the night, reaching its minimum at sunset. The ground and building conditions were the main factors affecting long-wave net radiation. The annual average of mean monthly night-time net long wave radiation were listed in table 2.

The fact that the values of net long wave radiation at night only varied between, -0.36 and – 1.71 MJ/m^2 indicates that there is a little monthly variation in the value of nocturnal net radiation. Thus, the effective outgoing radiation, which forms the only component of net radiation at night, remains fairly constant throughout the period.

TABLE II. ANNUAL AVERAGE OF MEAN MONTHLY NIGHT-TIME NET LONG WAVE RADIATION.

Jan	Feb	March	April	May	June
-0.36	-0.55	-0.74	-1.11	-1.19	-1.49

July	Aus	Sept	Oct	Nov	Dec
-1.71	-1.33	-1.01	-0.97	-0.71	-0.59

IV. HEATING COEFFICIENT

The heating coefficient is defined as the rate of change in long wave radiation loss for a unit change in net radiation. The heating coefficient (β) was calculated from the slope of the regression line of run plotted against Rs.

A good linear regression equation is deducted for each annual average monthly good correlation confidants (R2 = 0.55 – 0.97).

The values of (β) [β = (1-slope) / slope] obtained for each month summarized in Table 3. There is some indication from the data in this table that there are considerable differences in the values of the heating coefficient for each month. Whatever the explanation, it seems that the heating coefficient should not be considerable a characteristic exclusively of the surface, but rather as representing between properties of the building surface and the atmosphere [11].

TABLE III. MONTHLY AVERAGE OF MEAN DAILY VALUES OF HEATING COEFFICIENTS EACH MONTH OF THE RECORDED PERIOD.

Jan	Feb	March	April	May	June
0.1	0.22	0.28	0.39	0.41	0.45

July	Aus	Sept	Oct	Nov	Dec
0.46	0.43	0.38	0.33	0.25	0.12

V. CONCLUSIONS

This study shows the beneficial effects of long term microclimatological data is significantly needed for sustainable building design assessing energy input. It has been shown that information will determine the effectiveness of building design strategies.

Significant changes have taken place in Baghdad region during the last 50 years. Annual cooling degree-days have reduced by 500 in 50 years (16%). Annual heating degree days have reduced by 360 in 50 years (26%).

Mean annual temperatures have increased 7% in 50 years. Annual solar radiation has increased by 3 W/m^2 in 50 years (3.3%).

The use of historical climatic data significantly overestimates building energy requirements:

Climatic data used for building design calculations should be regularly reviewed and updated, otherwise its use may result in buildings not suitable for this region environment.

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