Microclimatic Effects of Habitat Reconstruction in Ksour

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Abstract. The traditional Saharan habitat, named ksar, was characterized in the past by a favorable microclimate conditions; however this habitat is transformed with time by reconstruction with modern materials and techniques which destructed it adaptation with hot climate. The morphologic transformation in construction procreate an unfavorable conditions of microclimate in the transformed tissue, which are affected by the warming of the heat transferred from the energy consumed by buildings and the sensible heat stored in the building materials.

Keywords: Ksar, Saharan habitat, Microclimate adaptation, Morphologic transformation.

1. Introduction

The Saharan ksour meet the weather conditions by adapting the physical environment and protection against adverse climatic factors. This adaptation involves several levels (in the form of houses, the rail system, fragmented system, the facade and building materials). The ksar of Ouargla (Algerian Saharan city) knows recently a various transformations generated by the socio-economic changes of modern life which alter the microclimatic adaptation getting by its genius design with environment and climate.

In this paper we introduce the results of a comparative study based on an experiment applied to the case of the Ksar Ouargla between transformed and untransformed urban space.

2. Study Description

2.1. Case Study

This study is applied to the case of the city of Ouargla, chosen for its representativeness of the Saharan cities with hot, dry climate in Algeria. Ouargla includes a vast area of over 180,000 square kilometers, almost in its entirety desert, which stretches between 28 and 32 north latitude and the meridians 4 and 8 East. It is bounded on the north by the municipality of Touggourt, east by that of El Oued, the south by those of Ajjer Tidikelt and to the west by those of El Gole and Ghardaia 1

The climate in Ouargla is "one of the hardest of the North Eastern Sahara". The average annual temperature is 23.4 °C, 35.7 °C for the warmest month (July) and 11.6 °C for the coldest month (January), this figure masks extreme high, exceeding 50 °C under shelter.

Fig. 1: Location of Ouargla, height: 1630 km. Source: Google earth 2010.
2.2. Methodology of This Study

This work is based on a comparative study through an experimental method, the microclimatic factors measured are: air temperature, radiant temperature, relative humidity and air velocity. The purpose of this study is to evaluate the negative microclimatic effects in the urban ksouran, caused by the different morphological changes inadequate and inappropriate to the local context and which have varied levels of discomfort. The desire to work on urban microclimatic condition necessarily involves recourse to both measures of its physical parameters (climate). To do this, it was mainly used metrology (measurement campaign) to identify the different parameters of the thermal environment in order to be able to assess in a quantitative and objective. This method was elaborated and explored by many authors researches such as A. Bennadj (1999) [2], F. Ahmed Ouameur (2007) [3] and S.D. Boutabba (2007) [4], etc.

We choose two tissues for this study which makes subject of campaigns of microclimatic measurement, we refer to oppositions showed by the differences existed between the two tissues for selecting areas of measurement in order to avoid the duplication and to be representative of all the tissue. Among these oppositions are: Traditional / planned, cement / clay, winding / straight, wide / narrow, open / closed, indoor / outdoor, sunny / shaded, compact / loose, etc. The choice of these two trajectories is motivated by:

- The diversity of the urban tissue between the two axes (traditional and modern) and the distinct characteristics of the physical structure (density built-up factor of the sky seen through the surface, factor of ground reflectivity, etc ... ) of each of the urban tissue.
- The joint ownership of the urban tissues promoting dynamic investigation using a route explored by the investigator.

This experiment was performed on two different tissues inside the Ksar of Ouargla. So we divided the measures to be implemented on two companions in each set was five points. Measurements of four climatic factors must have taken parallel to an altitude of: 1.60 m above the ground [5]. The measurement points were chosen so as to be distributed along the two trajectories which represent transformed and untransformed tissues.

2.3. Instruments and Moments of Measurement
In this study the measurements are taken using two instruments that are: An Environment Meter model 8820 and a Hot Wire Anemometer.

These devices are used to obtain direct measurements of climatic factors. Like any measuring instrument Multi-Function Environment Meter model 8820 and Hot Wire Anemometer have its own characteristics relating to the conduct of its operation and harvesting quantities of which they is able to measure. The first is designed to acquire four sizes using different probes and by switching each time a switch for either: the air temperature, relative humidity, noise or lighting, the second is designed to acquire: the air temperature and the air velocity. These materials are the only elsewhere in the possession of the Department of Architecture at the University of Biskra.

The chosen moments are related to daily temperature regime:
- Before sunrise: first heat gain.
- After the sunrise: early gain.
- At noon: when the sun is directly overhead.
- Before the sun: after a maximum accumulation of heat.
- After the Sunset: Beginning the return of the stored heat.

The moments chosen for comparison are those extracted: 5:00, 9:00, 12:00, 17:00 and 21:00.

3. Comparison of Results between the Two Tissues

3.1. Comparison of Mean Values of Air Temperature and Radiant Temperature between the Two Trajectories

The graphs below show the evolution of daily mean values of air temperature and radiant temperature in the two trajectories (traditional tissue +transformed tissue) during a summer day.
The graphs below show the evolution of daily mean values of gap in air and radiant temperature of two trajectories (traditional tissue +transformed tissue) during a summer day.

### Graph 3: Variation of mean values of radiant temperature differences between the two trajectories

### Graph 4: Variation of mean values of air temperature differences between the two trajectories

**Analysis of these results shows that:**

- The air temperature measured in the two paths is slightly above that measured in the trajectory 1, in exception of the value measured at 9 o’clock which recorded a gap of 1.38 °C.
- From 9 to 12: the mean values of air temperature coincide with those of the radiant temperature in each trajectory, the values of either the air or radiant temperature measured in the trajectory 02 exceed those measured in the trajectory 01, they increase under the effect of beginning of heat gain, but they are close to the value measured by the meteorological station.
- A 17 o’clock: the mean air temperature is confused with the value measured by the station in each trajectory with a very small gap, while the value of the radiant temperature exceeds the value measured by the station. Radiant temperature in the trajectory 2 takes its maximum value of 44 °C, exceeding the value measured by the station with a gap of 3 ° C, while the radiant temperature in the trajectory 1 slightly exceeds that of a station with a difference 0.5 °C.

### 3.2. Comparison of Mean Values of Relative Humidity between the Two Trajectories

### Graph 5: Comparison of mean values of relative humidity between the two trajectories

### Graph 6: Variation of mean values of relative humidity differences between the two trajectories

**Comparison of mean values of relative humidity shows:**

- The decrease in mean values of relative humidity from the station throughout the day in each course, apart from the value measured at 9 o’clock.
• The average relative humidity measured in the trajectory 2 exceeds those measured in the course by bringing one of the values measured by the station in most of the time.
• The value of relative humidity measured in the course a slightly above the value of HR measured in the trajectory 02

3.3. Comparison of Mean Values of Relative Air Velocity between the Trajectories

**Graph 7:** variation of mean values of air velocity differences between the two trajectories

**Graph 8:** Comparison of mean values of air velocity between the two trajectories

Comparison of mean values of air velocity shows:
• The significant decrease in the values of air velocity in the two courses from the value measured by the station throughout the day.
• The values of the air velocity measured in the course an overlap with those measured in the two courses, registering a significant departure from the station.
• The maximum air velocity is recorded in a course at noon, when we recorded a minimum value in the two courses at this time.
• Minimum values are recorded in the two paths after sunset, observed with a maximum value recorded by the station.

3.4. Synthesis

This investigation allowed us to make a comparison between the processed and unprocessed ksouran tissue in terms of the urban microclimate conditions. The temperature is mainly affected by sunlight, wind, and altitude and soil type. The rate of heating and cooling of the earth's surface is the main factor that determines the air temperature which is in contact \(^7\). In the transformed tissue, we identify a thermal effect characterized especially the period of the afternoon, which is manifested in the increase of the average values of air temperatures close to those of the meteorological station with a slight difference of 0.34 °C (at noon and before sunset), while the average values of the radiant temperatures exceed those of the resort with a significant difference of 2.98 °C (before sunset).

4. References
