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Impact of the typology of school buildings on the internal thermal conditions, in a hot and dry climate

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Abstract

In Algeria, the construction of school buildings is unfortunately not subject to any regulatory requirements in terms of heat and energy, and often done through a standard plan proposed by the Ministry of Education National level. The generalization of the standard plan throughout the national territory is used regardless to the thermal environments. To build a healthier, comfortable, and sustainable learning environment, buildings must be designed with comfort and environmental and climatic conditions in mind. The purpose of this article is to evaluate thermal comfort in the most recurring typologies of college buildings, in the climatic and environmental context of Biskra city. The questionnaire survey and the in situ measurement campaigns are the means used to address the problem.

The main results revealed a dissatisfaction with the thermal environment in the internal spaces and that environmental quality is ignored in the buildings' design.

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Keywords: School buildings; Thermal and energy plan; Thermal comfort ; Classroom ; Typologies; Configuration; Interior conditions; Sustainable development.

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1. Introduction

The issue of summer thermal comfort raises the problem of controlling sunlight in buildings. If the sun penetrates the building, then this can reduce the heating consumption, but in summer time, it causes overheating and thermal discomfort, especially under climatic conditions specific to the arid and warm regions.

In school buildings, comfort has an impact on students' intellectual capabilities and behavior [1]. For thermal comfort in classrooms where the density of occupancy is very high and where large windows are used for a functional purposes, the problem that often arises is that of overheating, especially in mid-season and in summer.

The study by Wong N.H., Khoo S.S., (2002) was conducted in the classrooms of a high school in Singapore. These rooms are mechanically ventilated by fans. It is recommended that the layout of the classroom block should be in such a way that the long facades should be North and South. This orientation would also increase the potential use of natural ventilation to create an acceptable thermal environment [2]. Givoni, in 1998, suggests that inertia is a necessary recommendation for the sustainable buildings in hot diurnally warm climates [3]. Other studies, such as Appah-Dankyi's, 2012; focused on assessing the thermal comfort of an educational building in the hot, humid climate in Accra, Ghana. In this case, it is recommended that future school buildings should use sustainable design principles (shape, orientation, shade, large window areas, high room heights, etc.). In addition, the installation of low energy consumption ventilators in classrooms is beneficial to promoting health and easing learning [4].

The aim of this article is to study the comfort in classrooms under Biskra climate influence (Latitude 34 ° 51'01 "North and Longitude 5 ° 43'40" East). The city is at an altitude of 120m above sea level), the on-site measurements took place during the hottest days of September 2016, when classrooms were occupied while the climatic conditions were close to those of the summer period.

1.1. The climatic characteristics of Biskra city

Biskra city is located in the south-east of Algeria. It belongs to a region classified arid with cold winters and hot summers. The maximum temperature reaches 42C ° during the month of July and the minimum temperature decreases to 7C ° in winter during the month of January. The average annual temperature is 21.7 ° C while the average annual humidity is 46%. Very low precipitation is recorded with a maximum of 20mm / year, and an annual average of about 8.8mm / year. The prevailing winds are north-west in winter, south-east in summer at a speed of 6 to 10 m/s (Fig.1).

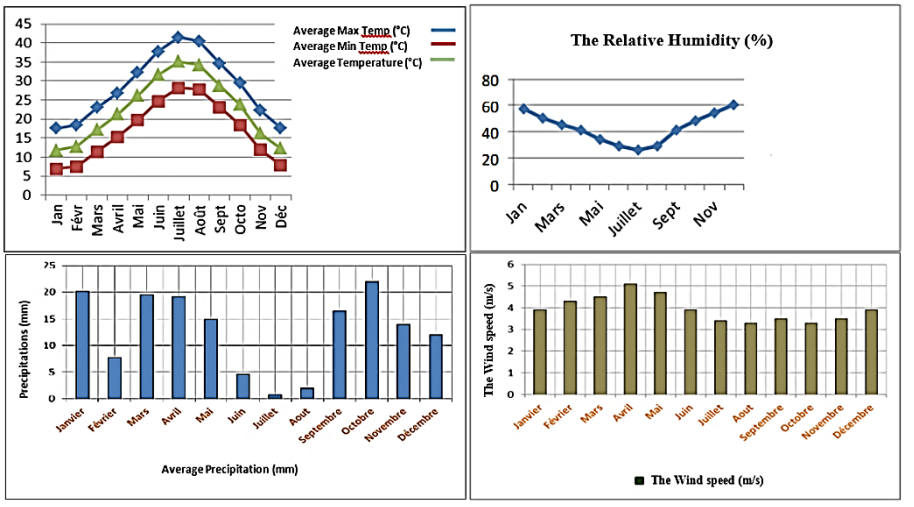

Fig. 1. Biskra city climate data (Source: Weather station data Biskra, 2003-2013).

According to Givoni, in order to ensure hygrothermal comfort in a hot arid climate, buildings must be adapted to summer conditions and this assuming that winter requirements will be met accordingly. In this study, we will limit ourselves to the presentation of the results obtained during the warm period. [3]