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Introduction to control of solar gain and internal temperatures by thermal insulation, proper orientation and eaves

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ABSTRACT

In desert regions, the orientation of buildings, thermal insulation and eaves have an important influence in the inside air temperature. The main objective of the current work is to minimize interior temperatures by these three techniques. This study aims at assessing also the geographic parameter enhancing or damping the role of thermal inertia, providing a variety of results.

As result, this work proves that stones play a contradictory role on thermal comfort; it has been found that changing orientations of building is not beneficial in terms of thermal comfort particularly in the hot season in case of a building without insulation. Consequently, the insertion of the eaves is recommended to achieve a better thermal comfort in arid and semi arid regions and the habitation will have to be situated in south flan of a hill to satisfy the two strategies (hot and cold).

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1. Introduction

The seventies housing crisis had inspired the interest in bioclimatic architecture. As the most nowadays built houses are intact and combustible energy reserves are exhausted. Decline towards the bioclimatic architecture becomes an issue. This principle of architecture requires first an adequate choice of house location and orientation and then warmth and cold requirements. Numerical methods that predict the thermal behavior of the housing envelop have been elaborated. These models allow the evaluation of internal temperatures in terms of thermal comfort to be achieved [1,2].

However, it is not appropriate to consider air conditioning, or heating systems without tacking into account the outside temperature fluctuations, building orientations, and the strength of the insulating material to be used, internal charges and construction materials used. Classical methods used to compute the energy consumption and energy demand [3–7] are not adequate since the effect of interaction of different basic building constituents and the suggested solution are not dealt with [8].

Ghardaïa region (32.4°N, 3.8°E) is located 600 km from the coast, at an altitude of 450 m above sea level. It is influenced by a dry climate, characterized by very low precipitations (160 mm/year), very high temperatures in summer and low temperatures in winter (frosty from December to mid-February). The climate is hot and dry in the summer with temperatures variation between a maximum of around 45 °C and a minimum of 20 °C, thus giving a large diurnal temperature swing. Winter temperatures vary between a maximum of 24 °C and a minimum of 0 °C. Its normal temperature in January is 10.4 °C, it is 36.3 °C in July. And the average annual range is about 12.2° amplitudes of monthly average temperatures. They are more moderate in winter than in summer (average 11° in winter cons 13.5° in summer). The monthly maximum amplitudes are larger in summer than in winter fluctuates around 20 °C. Solar radiation is intense throughout the year with a maximum of 700 Wm^{-2} in winter and 1000 Wm^{-2} in summer, measured on the horizontal surface. This Saharan climate result that insulation is necessary, some requirements have been identified by Fezzioui et al. [9]. Chelghoum et al. [10] paper discusses adaptation for climate change through a local adaptation strategy at a variety of scales, showing how to manage high temperatures.

With the present studies, we can aim the optimal advantage of the sun for passive solar heating and cooling. The orientation effect of a non-air-conditioned building on its thermal performance has been analysed in terms of temperature index for hot-dry climates. The evaluation is derived from a series of computer simulations. At the end of study, we will give some solutions that can provide positive improvements.

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