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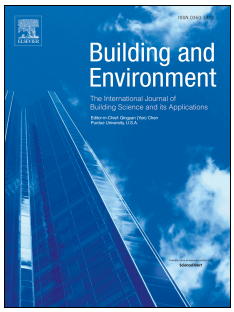

A field study of thermal and hygric inertia and its effects on indoor thermal comfort: Characterization of travertine stone envelope

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A field study of thermal and hygric inertia and its effects on indoor thermal comfort: Characterization of travertine stone envelope

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Abstract: Energy consumption in Algerian residential buildings is very high, especially during the summer season. The thermal inertia of the building envelope may contribute to improving the thermal comfort and even lead to replacing air conditioning systems. This passive process is typically associated with an external wall made of heavy construction counteracting the strong changes in temperature. In reality, other parameters are acting to influence this property. The present paper describes a three-year field case study devoted to monitoring an inhabited stone house, dating from the colonial era in the town of Guelma (Algeria), exposed to a hot and sub-humid climate. Results from the monitoring program indicate that the passive process called "hygric inertia", in association with the "thermal inertia" of porous and hygroscopic local materials adapted to the regional climate, has led to improving thermal comfort and humidity regulation: a drop of more than 14.5 K was recorded. Permeable coverings may have exerted an impact on indoor hygrothermal conditions, in generating a temperature drop of 1.5 K, which corresponds to a 31.5% energy savings rate. Other parameters, including the construction system, are also involved in stabilizing the indoor temperature and moisture. The results of a modeling run using the TRNSYS software showed good agreement between simulated and measured air temperature readings, which validates the effect of thermal inertia. The two humidity models implemented in this software do not take moisture transfers in the wall into account. The low spreads in relative humidity measurements however have confirmed that the effect of hygric inertia on ambient temperature inside this house is not as significant as that of thermal inertia. It can be concluded that a 100% hygroscopic house does not actually exist.

Keywords: Hygrothermal inertia - thermal comfort - travertine stone - hygroscopic material - TRNSYS.

Contents

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