EXPERIMENTAL STUDY OF A ROOF SOLAR COLLECTOR TOWARDS THE NATURAL VENTILATION OF NEW HABITATIONS

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ABSTRACT

The paper discusses the possibility of offering thermal comfort, without inducing mechanical energy cost, in new habitations, built in European style and situated in a hot and humid climate, by means of a construction element : the Roof Solar Collector (RSC), which is made by using concrete roofing tiles on the outer side and gypsum board on the inner one. With this RSC it is possible, on the one hand, to minimize the fraction of the solar flux absorbed by the dwelling (insulation) and, on the other hand, to induce a natural ventilation which allows thermal comfort. The influence of length and tilt angle of the RSC on the performance of the RSC is studied experimentally. The results of the study, with regard to the natural ventilation of habitation, were that the optimum length of roof solar collector must be shorter than about 100 cm and the tilt angle should equal 30^o. The natural ventilation rate was about 0.08 - 0.15 $m^3.s^{-1}.m^{-2}$.

KEYWORDS

Roof solar collector; design; natural ventilation; thermal comfort.

INTRODUCTION

Among the problems of modern houses built in European style and situated in tropical countries, the most important one might concern the heat accumulation under the roof structure making the rooms upstairs hot in the afternoon.

In Thailand, the roofs are constructed by using iron structure and concrete roofing tiles (In our experiment we used CPAC monier concrete tiles made by The Siam Cement Company LTD.) usually of dark color like red, blue, and black which can absorb heat well. The lower beam uses concrete with iron foundation, supporting wooden framing of the ceiling covered with microfibre. Due to solar radiation, the temperature of air within the enclosure formed by the roof and ceiling structure will increase over the day and the stored heat is transmitted into the interior through the ceiling. This leads to an uncomfortable feeling of warmth of the residents due to the high temperature of the upper space in room.

By far the most effective means of "solar cooling" is to keep the sun's energy out of the building. This is most effectively accomplished by shading the dwelling's windows, walls, and roof but most designs deteriorate rapidly in many hot and humid climates. The other passive techniques such as thermal mass in buildings, evaporative cooling, and radiative cooling cannot be advantageous in tropical countries because the mean daily temperature is relatively high.

At temperatures below 34^oC, which is the average summer temperature in many hot and humid conditions, air movement might be one of the most useful and least expensive methods to provide a comfortable indoor climate. Air movement at a speed of up to 0.25 m/s (ASHRAE, 1973; Mcquiston et al., 1977) goes unnoticed. The most common way to create air movement without using mechanical power is to open window and allow breezes to