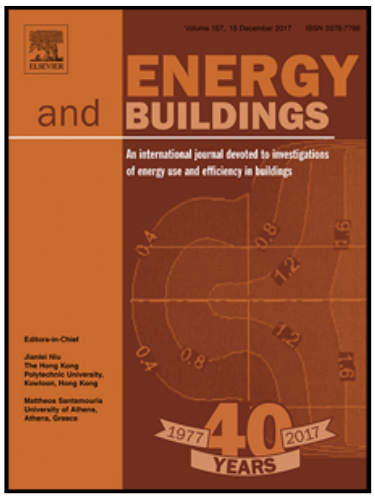

THE EFFECT OF THE USE OF RADIANT BARRIERS IN BUILDING ROOFS ON SUMMER COMFORT CONDITIONS – A CASE STUDY

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THE EFFECT OF THE USE OF RADIANT BARRIERS IN BUILDING ROOFS ON SUMMER COMFORT CONDITIONS – A CASE STUDY

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Abstract

A brief analysis on radiant barriers applied in building roofs, included in a wider study, is presented. A case study which involves experimental measurements carried out in a single-family house, located in a mild climate, specifically in the North of Portugal, where radiant barriers were applied and monitored is described.
A computer program (CAPSOL) was also used to carry out a sensitivity analysis and to verify if the results pointed to conclusions similar to those of the experimental measurements.
In the experimental part of this work, which took place in the summer periods of two consecutive years, two different roofs were monitored in the same house. Values of temperature, relative humidity, solar irradiance, heat fluxes among other parameters were measured. This article presents some of the collected data.
In the numerical simulation, the comparison between the situation of the inclusion of a radiant barrier underneath the roof tiles and over the attic floor slab is presented and compared with another situation without this barrier.
In general, it was concluded from this brief analysis that the application of a radiant barrier in the roof of a building proves to be advantageous, especially in what regards the attenuation of the maximum temperatures reached at the roof attic, thus mitigating the risk of overheating.

Keywords: Radiant barrier; low emissivity; roofs, summer thermal comfort.

1. Radiant barrier systems

Vittorino, Sato and Akutsu [1] among others present one possible definition of thermal insulation material. They report that thermal insulation of roofs was traditionally limited to the use of resistive materials which, mainly due to the large amount of air between fibers or confined in small cells, reduce heat transfer by conduction. French Standard NF P 75.01 (AFNOR cit. In [1]) defines as thermal insulation exclusively that material having a thermal resistance greater than or equal to 0.5 m^2.K/W and a thermal conductivity less than or equal to 0.065 W/(m.K).

Later, materials promoting the reduction of heat exchanges by radiation, as it is the case of radiant barriers, were also considered. For example, in the US, several technical standards have been developed, such as ASTM C 727-01 [2], which defines rules for the installation and use of reflective insulation in building constructions, such as metallic films confronting closed air spaces. A solution like a radiant barrier, which minimizes heat transfer by radiation, increasing the air space thermal resistance close to it, due to its low emissivity [3], is of course and by definition a thermal insulation, such as an insulation material which acts primarily by thermal resistance to heat conduction. Thus, the evaluation of insulation materials cannot be carried out solely because of their characteristics related to pure conduction.

From the above, thermal insulation materials can be grouped into two main groups: resistive ones, which act predominantly on heat transfer by conduction and low emissivity reflective ones (radiant barriers) which act mainly on the transfer of heat by radiation.

In the field of radiant barriers Al-Homoud [4] addresses metallic or metallized reflective membranes that may be aluminum films and also ceramic with special radiation control coatings which in order to work properly must confront a space filled with air, gas or vacuum and must be installed in such a way as to avoid the negative interference caused by the accumulation of dust.