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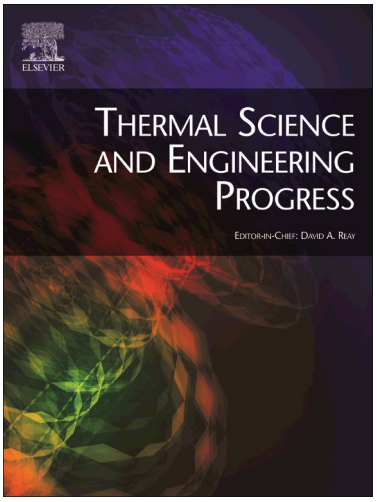

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Numerical investigation of an inclined rectangular cavity for ventilated roofs applications

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Abstract

The present paper illustrates a numerical investigation on natural convection within an inclined rectangular cavity, which can be considered as a prototypal ventilated roof for residential use. Three different two dimensional cases are considered, namely a symmetric geometry where half of the domain is considered, a symmetric geometry taking into account the complete ridge and a complete geometry. The length of the roof is 6.0 m, inclined with respect to the horizontal plane of 30° and the ventilated channel has a height of 10 cm. The investigation is performed in order to evaluate the thermal and fluid dynamic behaviors of the ventilated roof as a function of the following parameters: 1) exit section of the channel; 2) heat flux on the top wall of the cavity; 3) boundary condition on the bottom wall of the cavity.

The problem is solved numerically by using of the commercial code Ansys-Fluent by considering a two-dimensional steady model in turbulent conditions. Results are determined for a uniform heat flux on the top wall and the turbulence is taken into account by using the k-ε model.

Different cases are proposed in terms of variation of the outlet section, boundary conditions on the lower surface of the roof and heat flux on the top wall according to the sun position. Results are given in terms of wall temperature distributions, air velocity and temperature profiles in different cross section of the roof, so that the differences among the various configurations can be appreciated.

Nomenclature

b: channel width, [m]

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