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RADIATION EFFECT ON TRANSIENT NATURAL CONVECTION IN VENTILATED ROOFS

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ABSTRACT This paper illustrates a numerical investigation on a prototypal ventilated roof for residential use, under summer and winter conditions. The roof is modeled as a single flap, due to its geometric and thermal symmetry, and it is analyzed as two-dimensional, in air flow, thanks to the commercial code Ansys-Fluent. The governing equations are given in terms of k-ε turbulence model taking into account the radiation effect inside the channel. The analysis is performed in order to evaluate thermofluidodynamic behaviours of the ventilated roof, in transient regime with radiative heat transfer presence, as a function of the solar radiation applied on the top wall of the ventilated roof. The discrete transfer radiation model (DTRM) is chosen. Typical summer and winter conditions with heat transfer from the channel top wall toward the external ambient are examined. The bottom wall of the ventilated channel is simulated as isothermal, considering optimal temperature values for the internal ambient in summer and winter regimes.
Results are given in terms of temperature and pressure distributions, air velocity and temperature profiles along longitudinal and cross sections of the ventilated layer, in order to estimate the differences between the various conditions. Ventilated roof configuration results significant to reach optimal thermal and fluid dynamic conditions in summer and winter regimes. In summer period, when the effect of solar radiation is more evident thanks to the convective effect within the channel, temperature values are higher and the effect of the ventilated channel is significative to reach comfort conditions. In winter, the effect of the ventilated layer is very important to reach optimal thermal and hygrometric conditions.