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Conjugate local thermal non-equilibrium heat transfer in a cavity filled with a porous medium: Analysis of the element location
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Abstract
The problem of conjugate natural convection heat transfer in a cavity filled with a porous medium is addressed by considering the local thermal non-equilibrium effects. The thickness of the solid walls of the cavity is taken into account, and the vertical walls are assumed to be partially active. The effect of the heat transfer bifurcation in the interface of the solid walls and the porous medium is also taken into account. The governing equations for the heat and momentum of the fluid in the porous space, heat transfer in the porous matrix, and heat transfer in the solid walls are represented in the form of partial differential equations. The governing equations along with the corresponding boundary conditions are transformed into a generalized form of the non-dimensional equations and solved by the finite element method. Considering various values of the non-dimensional parameters, the effect of the location of the active walls on the flow patterns and the local and overall heat transfer are addressed. The results demonstrate that the location of the active walls can significantly affect the streamlines and the fluid isotherm contours in the porous space and the isotherms in the solid walls. Moreover, it is found that in most of the cases the highest total rate of heat transfer corresponds to the case in which the elements are in the center of the active wells. In contrast, the lowest total rate of the heat transfer corresponds to a case, in which the active hot element is at the top of the wall, and the cold element is at the bottom. © 2019 Elsevier Ltd

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