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Numerical simulation of heat and fluid flow in a cur ed pipe partially filled with a anisotropic porous matrix

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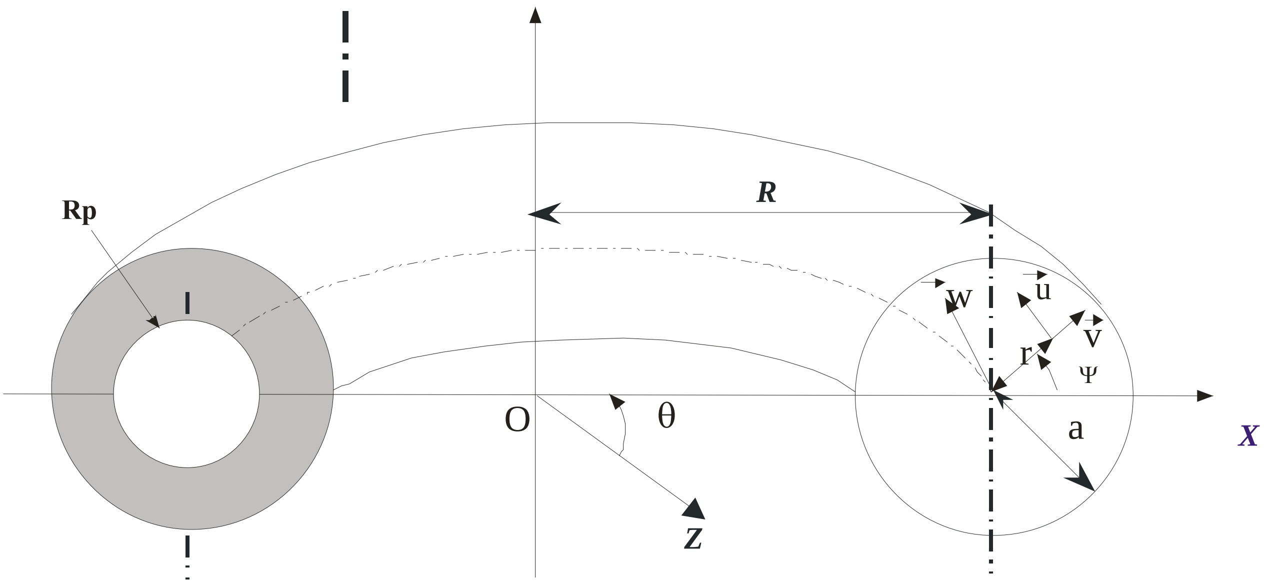
Curved ducts are frequently encountered in industrial flow applications such as heat exchangers, cooling systems for rotating electrical machinery, etc. As known, one of the main features of flows in a bend conduct is the secondary flow organized in the form of two identical vortices in the cross section of the conduct. Several studies put in evidence the effect of the secondary flow on the heat transfer in the bend conducts Yao (1984), Yao *et al*. (1978) and Prusa and Yao (1982). Otherwise, numerous studies Alkam *et al*. (1999) and Alkam *et al*. (2001) showed that the insertion of a porous matrix in the cross section of a channel or a pipe tube has a positive effect on the heat transfer.

With respect to flow in curved pipe in presence of porous medium, it appears from the literature that very few studies have been achieved. Cheng and Kuznetsov (2005a) presented a theoretical analysis of a forced laminar convection in a helicoidally duct filled with a porous medium, for that case where the curvature and the torsion of the duct are both small. They used the model of Darcy and considered the uniform flux and uniform temperature conditions. Cheng and Kuznetsov (2005b) analysed numerically this flow by using the model of Darcy Brinkman Forchheimer. Their investigation showed that the increase of the Darcy number intensifies the secondary flow.

In this communication, we present a numerical study of the effect of the insertion of an anisotropic porous layer on the laminar forced convection in a curved pipe. The general model DBF (Darcy, Brinckman, and Forchheimer) is used. The governing equations based on the conservative equations of mass, momentum and energy are discretised with the control volume method. The effects of the dimensionless porous thickness, the permeability ratio and the Darcy number (Da) on the streamlines and isotherms as well as the axial velocity, temperature distributions and the variation of the Nusselt number are analysed.



Physical Model