LAMINAR MIXED CONVECTION IN VERTICAL SEMICIRCULAR DUCTS WITH UPWARD AND DOWNWARD FLOWS

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ABSTRACT Laminar fully developed mixed convection in vertical semicircular ducts with upward and downward flows is investigated. Numerical solutions, obtained by using a control volume based finite difference approach, are presented for solving the governing equations. Results are obtained for the two limiting thermal boundary conditions H1 and H2. These results include the velocity and temperature fields and data for the friction factor and Nusselt number. Increasing *Gr* is found to reduce the circumferential variation of the wall temperature for the upward case, while for the downward case the circumferential variation of the wall temperature is nearly the same as the one for pure forced convection with slightly hotter temperature at the top and bottom corners of the cross-section. Due to the disappearance of the thermal stratification in H2 at higher values of *Gr*, it is noted that, for upward flow, $(fRe)_{H2}$ exceeds $(fRe)_{H1}$, and it reverses with $Nu_{H1} > Nu_{H2}$, for any value of *Gr* but with a slight difference between them at high *Gr*. However, for downward flow the values of the friction factor and Nussult number decrease as *Gr* increases for both H1 and H2.