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Numerical Investigation of the Laminar Natural Convective Heat Transfer around a Heated Cylinder inside an Enclosure

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Extended Abstract

Natural convection in an enclosure is observed at many thermal engineering applications such as cooling of electronic equipment, solidification process, growing crystals, and solar collectors (Barakos et al., 1994; Arnab et al., 2006; Prasopchingchana et al., 2013). The natural convection flow is caused by heat transfer between a surface and a fluid. Since temperature variation of fluid leads to density change, there is complex fluid motion in the enclosed cavity (Xu et al., 2010; Asish, 2013). To understand the natural convection, the correlation between variables and dimensionless numbers is defined through numerical analysis of laminar natural convective heat transfer in a simplified shape. In this study, a thin and heated cylinder was assumed to be placed in a cubical enclosure. Due to the temperature difference between the heated cylinder and the cubical enclosure, natural convection occurred inside the enclosure. For setting the boundary conditions, the present numerical model assumed that the outer surface of the cubical enclosure was exposed to the ambient air. For laminar convective heat transfer modelling, the finite volume approach was used and the buoyancy effect was modelled by assuming the air in the enclosure as an incompressible ideal gas. The operating variable was the surface temperature of the cylinder and the geometrical variables were the size, location, and number of the cylinders. The effect of the natural convection flow in the enclosure was analysed in terms of the Nusselt number.

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Barakos, G., & Mitsoulis, E. (1994). Natural Convection Flow In A Square Cavity Revisited: Laminar And Turbulent Models With Wall Functions. *International Journal for Numerical Methods in Fluids,* 18, 695−719.

Arnab, K.D., & Amaresh, D. (2006). A Numerical Study Of Natural Convection Around A Square, Horizontal, Heated Cylinder Placed In An Enclosure. *International Journal of Heat and Mass Transfer,* 49, 4608−4623.

Prasopchingchana, U., Pirompugd, W., Laipradit, P., & Boonlong, K. (2013). Numerical Study Of Natural Convection Of Air In An Inclined Square Enclosure. *International Journal of Material, Mechanics and Manufacturing,* 1(2), 131−135.

Xu, X., Zitao, Y., Yacai, H., Liwu, F., & Kefa, C. (2010). A Numerical Study Of Laminar Natural Convective Heat Transfer Around A Horizontal Cylinder Inside A Concentric Air-Filled Triangular Enclosure. *International Journal of Heat and Mass Transfer,* 53, 345−355.

Asish, M. (2013). Numerical Study Of Natural Convection In An Enclosed Square Cavity Using Constrained Interpolated Profile (CIP) Method. *International Journal of Research in Engineering and Technology,* 2(9), 18−25.