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CFD Investigation of Turbulent Mixed Convection Heat Transfer in a Closed Lid-Driven Cavity

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Abstract : Both steady and unsteady turbulent mixed convection heat transfer in a 3D lid-driven enclosure, which has constant heat flux on the middle of bottom wall and with isothermal moving sidewalls, is reported in this paper for working fluid with Prandtl number Pr = 0.71. The other walls are adiabatic and stationary. The dimensionless parameters used in this research are Reynolds number, Re = 5000, 10000 and 15000, and Richardson number, Ri = 1 and 10. The simulations have been done by using different turbulent methods such as RANS, URANS, and LES. The effects of using different k-□ models such as standard, RNG and Realizable k-□ model are investigated. Interesting behaviours of the thermal and flow fields with changing the Re or Ri numbers are observed. Isotherm and turbulent kinetic energy distributions and variation of local Nusselt number at the hot bottom wall are studied as well. The local Nusselt number is found increasing with increasing either Re or Ri number. In addition, the turbulent kinetic energy is discernibly affected by increasing Re number. Moreover, the LES results have shown a good ability of this method in predicting more detailed flow structures in the cavity.

Keywords : mixed convection, lid-driven cavity, turbulent flow, RANS model, large Eddy simulation
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