

Model of Natural Convection Above Horizontal and Inclined Plates

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Abstract

The boundary layer flow above an isothermal flat plate inclined at a small angle to the horizontal is analyzed. Inclination effects are initially investigated as a perturbation to the horizontal flow by obtaining a fourth order series solutions valid near the leading edge of the plate with the inclusion of variable fluid properties in the formulation. The focal point of the analysis is the recovery of the position of the separation point when the inclination is negative. Thus, the validity of the solutions is extended from the literature by numerically solving the full boundary layer equations using COMSOL Multiphysics®. However, the analysis presented here is differentiated to the present literature by allowing departures from the Boussinesq approximation and investigating the variable fluid properties effect on the flow. Furthermore, when the Boussinesq approximation is adopted, effects of Prandtl number and of inclination on the flow are investigated. Finally, when the inclination of the plate is set to be positive, the significance of the physical mechanisms responsible for the driving of the flow are investigated.