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TURBULENT FREE CONVECTION IN A VERTICAL CHANNEL WITH ISOTHERMAL WALLS: A THREE-TEMPERATURE PROBLEM

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ABSTRACT

A study of turbulent free convection in a vertical channel with isothermal walls using a resistor-network framework is presented. The resistor-network formulation is advantageous in that it leads to a simplified presentation of the solution and reveals more details about the heat transfer phenomenon. The dQdT technique is used to evaluate the paired resistances that characterize the resistor network of a multi-temperature convection problem. This technique entails a baseline solution to the full set of governing equations and subsequent solutions to the energy equation with perturbed boundary conditions. In this paper, dQdT is for the first time applied to a variable-property turbulent convection problem. The low-Reynolds k-ε turbulence model was used to obtain baseline solutions which were validated against experimental data from the literature. dQdT was then applied to obtain the paired resistances. Sample results are presented for different heating scenarios and channel aspect ratios. This work is part of an ongoing research project on the resistor-network formulation of multi-temperature convection problems.