3-D Numerical Modeling of Unsteady Heat Transfer in a Rectangular Duct

In order to simulate heat producing elements on electronic circuits, heat input at the inlet of a rectangular duct is supposed to vary sinusoidally and transient forced convection for laminar flows are investigated numerically. This study focuses on a numerical and experimental analysis of unsteady forced convection in hydrodynamically developed and thermally developing laminar air flow in rectangular duct, subjected to periodic variation of the inlet temperature. The experiments are conducted on the range of Reynolds numbers of 1122, 1478, 1764 and 2225 for laminar flow and inlet frequencies (?) of 0.02, 0.04, 0.08, 0.16 and 0.24 Hz of the periodic heat input. Numerical results are obtained for the fully developed parabolic velocity profile under the developing temperature profile for the fifth kind boundary condition which is verified by computational fluid dynamics (CFD) code called STAR-CCM+. Temperature variations along the centerline of the rectangular duct are observed to be thermal oscillations with the same frequency as the inlet periodic heat input and amplitudes those decayed exponentially with distance along the duct.

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