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A Study of Mixed Convection in a Heated Channel M.Z. HOSSAIN, JERZY M. FLORYAN, University of Western Ontario — Mixed convection in a channel subject to a spatially periodic heating along one of the walls has been studied. The pattern of the heating is characterized by the wave number α and its intensity is expressed in terms of the Rayleigh number Ra_p. The primary convection occurring in response to the applied heating has the form of counter-rotating rolls with the wave vector parallel to the wave vector of the heating. The resulting net heat flow between the walls increases proportionally to Ra_p but the growth saturates when $\mathrm{Ra}_p = 0(10^3)$. The most effective heating pattern corresponds to $\alpha \approx 1$ as this leads to the most intense transverse motion. The primary convection is subject to transition to secondary states with the onset conditions depending on α. Conditions leading to transition between different forms of secondary motions have been determined using the linear stability theory. Three patterns of secondary motion may occur at small Reynolds numbers Re, i.e., the longitudinal rolls, the transverse rolls and the oblique rolls, with the critical conditions varying significantly as a function of α. Increase of α leads to the elimination of the longitudinal rolls and, eventually, elimination of the oblique rolls with the transverse rolls assuming the dominant role. For large α the transition is driven by the Rayleigh-Bénard mechanism while for $\alpha = 0(1)$ the spatial parametric resonance dominates. It is shown that the global flow characteristics are identical regardless of whether the heating is applied either at the lower or at the upper walls.

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