

The onset of longitudinal vortex rolls in the thermal entrance region of plane Poiseuille flow heated with a constant heat flux

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The onset of longitudinal vortex rolls due to buoyancy forces in the thermal entrance region of plane Poiseuille flow heated from below with a constant heat flux is investigated theoretically. In the present study, the Boussinesq equations are solved numerically by using the finite volume method to examine this roll-type convection. In order to observe the behavior of the vortex rolls aligned along the streamwise position x , the local growth rates of mean fields and fluctuations, r_0 and r_1 , are defined. We suggest that the critical condition of the onset of convective instability would be $r_0=r_1$. Also, we clarify the characteristic positions for the onset of convective motion and the undershoot of Nusselt number as well as the above intrinsic instability in comparison with available experimental data.