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Effect of the Vortical Structure on Heat Transfer in the Transitional Flow over a Backward-facing Step

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Highlights

- The heat transfer along the bottom wall is enhanced in the transitional flow regime.
- The vortical structure downstream of the reattachment region is effective on heat transfer enhancement.
- The relationship between the vortical structure and heat transfer enhancement is clarified.

ABSTRACT

This paper presents a direct numerical simulation of the vortical structure along the bottom wall and its effect on heat transfer enhancement in the transitional flow over a backward-facing step. The governing equations are solved with a computer program using FORTRAN code according to finite volume method. The heat transfer of the bottom wall is enhanced greatly for the transitional Reynolds numbers, especially in the range $6 \leq x/H \leq 14$. In this range, the local Nusselt number distributions for various time instants of the periodic cycle exist three peak values at $Re=1200$. The corresponding locations of Nu peak values in the vorticity contours are all between the negative vortex and the adjacent downstream positive vortex. This vortical structure appears due to the flow instability which causes the heat transfer enhancement of the bottom wall in the transitional flow.

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