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Fluid Dynamics Research 32 (2003) 179–191

FLUID DYNAMICS RESEARCH

Vortex shedding from a row of square bars

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Received 8 July 2002; received in revised form 30 January 2003; accepted 30 January 2003
Communicated by S. Kida

Abstract

Interactions of wakes in a flow past a row of square bars, which is placed across a uniform flow, are investigated by numerical simulations and experiments on the assumption that the flow is two-dimensional and incompressible. At small Reynolds numbers the flow is steady and symmetric with respect not only to streamwise lines through the center of each square bar but also to streamwise centerlines between adjacent square bars. However, the steady symmetric flow becomes unstable at larger Reynolds numbers and make a transition to a steady asymmetric flow with respect to the centerlines between adjacent square bars in some cases or to an oscillatory flow in other cases. It is found that vortices are shed synchronously from adjacent square bars in the same phase or in anti-phase depending upon the distance between the bars when the flow is oscillatory. The origin of the transition to the steady asymmetric flow is identified as a pitchfork bifurcation, while the oscillatory flows with synchronous shedding of vortices are clarified to originate from a Hopf bifurcation. The critical Reynolds numbers of the transitions are evaluated numerically and the bifurcation diagram of the flow is obtained.

Keywords: Row of square bars; Synchronous shedding of vortices; Transition; Bifurcation

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0169-5983/03/$30.00
doi:10.1016/S0169-5983(03)00016-9