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Flow-pattern analysis in open and closed square ducts: A comparative investigation of corner vortices[1] JOCHEN KRIEGSEIS, Intitute of Fluid Mechanics, Karlsruhe Institute of Technology, MARKUS VAAS, Institute for Hydromechanics, Karlsruhe Institute of Technology, BETTINA FROHNAPFEL, Intitute of Fluid Mechanics, Karlsruhe Institute of Technology — In the present study secondary flows in straight square ducts are investigated experimentally for open and closed geometries. The flow of the closed square duct typically consists of a set of eight equal-sized counter-rotating vortices. In contrast, the flow in an open flume of (identical) square geometry is considered, where the development of secondary vortices is strongly affected by the presence of the free surface. Stereo Particle Image Velocimetry (SPIV) experiments have been performed so as to measure the flow in both geometries for varying Reynolds numbers. From the resulting 2D3C velocity information secondary vortices (superimposed onto the mean primary flow) are identified. As expected, the upper bisectors' flow topology differs significantly between open and closed ducts, where typical inner and outer vortices are identified from the open-duct data. Interestingly, the secondary vortices of the lower bisectors of both duct flows reveal a similar topology. In order to study this seeming similarit more rigorously, a modal analysis of the respective flow data is performed by means of proper orthogonal decomposition (POD). As such, similarities and limitations of the comparability of the respective corner vortices are uncovered and discussed as function of Reynolds number.

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