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Vortices Structure in Internal Laminar and Turbulent Flows

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Abstract : A numerical study of laminar and turbulent fluid flows in 90° bend of square section was carried out. Three-dimensional meshes, based on hexahedral cells, were generated. The QUICK scheme was employed to discretize the convective term in the transport equations. The SIMPLE algorithm was adopted to treat the velocity-pressure coupling. The flow structure obtained showed interesting features such as recirculation zones and counter-rotating pairs of vortices. The performance of three different turbulence models was evaluated: the standard k- ω model, the SST k-ω model and the Reynolds Stress Model (RSM). Overall, it was found that, the multi-equation model performed better than the two equation models. In fact, the existence of four pairs of counter rotating cells, in the straight duct upstream of the bend, were predicted by the RSM closure but not by the standard eddy viscosity model nor the SST k-ω model. The analysis of the results led to a better understanding of the induced three dimensional secondary flows and the behavior of the local pressure coefficient and the friction coefficient.

Keywords : curved duct, counter-rotating cells, secondary flow, laminar, turbulent
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