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Flow Development over a Circular Cylinder with a Stepwise Discontinuity CHRIS MORTON, SERHIY YARUSEVYCH, University of Waterloo — Cross-flow around a step cylinder is common in various engineering applications, for example, heat exchangers and buildings, where understanding flow development is often of critical importance for engineering design. Moreover, the relatively simple geometry of a step cylinder allows modeling complex vortex interactions. For a step cylinder in uniform flow, the flow development is dependent on the Reynolds number (Re_D) and the ratio of the large cylinder diameter (D) to the small cylinder diameter (d). In this study, vortex shedding phenomena occurring in the wake of a step cylinder is investigated using an unsteady RANS based numerical approach for Re_D = 300 and D/d = 2. Based on the numerical results, three distinct spanwise vortex cells were identified in the step cylinder wake: one vortex shedding cell in the wake of the small cylinder and two vortex shedding cells in the wake of the large cylinder. A comparative analysis with available experimental data showed that the numerical simulations adequately modeled wake vortex development and interactions in the near wake region. One of the vortex cells forming downstream of the step was found to have a cyclic appearance, with the periodicity being linked to downwash fluctuations near the step. In addition, the results suggest that streamwise vortices develop at the step and unsteady interactions between the streamwise and spanwise vortices occur in the near wake.

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