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A Comparison of RANS-Based Turbulence Modeling for Flow over a Wall-Mounted Square Cylinder

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Abstract:

Using experimental data from a study of flow over a wall-mounted square cylinder ($h=4d$) as a baseline, three Reynolds-Averaged Navier-Stokes turbulence models are used in a commercial CFD code Star-CCM+ to compare the relative accuracy of the tested models. In virtually every standard of comparison applied in this study, the Realizable $k-\epsilon$ with a two-layer treatment proved to be far superior to both the $k-\epsilon$ V2F (All y^+ hybrid wall treatment) and the $k-\omega$ models.

To observe mesh dependence for each of the models, all three were run on three different polyhedral mesh cases. Resulting first prism-layer heights of $y^+=12$, $y^+=5$, and $y^+=1$ allowed comparison of results with the mesh resolved to the buffer layer, the buffer layer/viscous sublayer transformation, and into the viscous sublayer, respectively. In all cases, the Realizable $k-\epsilon$ proved superior.

The mesh study also suggests that applying the two-layer treatment to Realizable $k-\epsilon$ allows it to operate well into the viscous sublayer, an area in which $k-\epsilon$ models are traditionally expected to suffer degradation in accuracy. The $k-\omega$ scheme, however, does not show improvements with increased mesh quality. In contradiction to the expected results, mesh independence is reached by $y^+=5$ for $k-\omega$ in this study.

 [PRU_2012.pdf](#)^[1]

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