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# An Evaluation of Recently Developed RANS-Based Turbulence Models for Flow Over a Two-Dimensional Block Subjected to Different Mesh Structures and Grid Resolutions

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Understanding, analyzing and predicting meteorological phenomena related to urban planning and built environment are becoming more essential than ever to architectural and urban projects. Recently, various version of RANS models have been established but more validation cases are required to confirm their capability for wind flows. In the present study, the performance of recently developed RANS models, including the *RNG k-$\varepsilon$, SST BSL k-$\omega$* and *SST* $\gamma - Re_\theta$, have been evaluated for the flow past a single block (which represent the idealized architecture scale). For validation purposes, the velocity streamlines and the vertical profiles of the mean velocities and variances were compared with published LES and wind tunnel experiment results. Furthermore, other additional CFD simulations were performed to analyze the impact of regular/irregular mesh structures and grid resolutions based on selected turbulence model in order to analyze the grid independency. Three different grid resolutions *(coarse, medium and fine)* of $N_x \times N_y \times N_z = 320 \times 80 \times 320$, *160 × 40 ×160* and *80 × 20 × 80* for the computational domain and $n_x \times n_z = 26 \times 32$, *13 × 16* and *6 × 8*, which correspond to number of grid points on the block edges, were chosen and tested. It can be concluded that among all simulated RANS models, the *SST* $\gamma - Re_\theta$ model performed best and agreed fairly well to the LES simulation and experimental results. It can also be concluded that the *SST* $\gamma - Re_\theta$ model provides a very satisfactory results in terms of grid dependency in the *fine* and *medium* grid resolutions in both regular and irregular structure meshes. On the other hand, despite a very good performance of the *RNG k-$\varepsilon$* model in the *fine* resolution and in the regular structure grids, a disappointing performance of this model in the *coarse* and *medium* grid resolutions indicates that the *RNG k-$\varepsilon$* model is highly dependent on grid structure and grid resolution. These quantitative validations are essential to access the accuracy of RANS models for the simulation of flow in urban environment.