FSI analysis of turbulent flow around a vertically mounted elastic plate

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This paper presents a numerical fluid-structure interactions (FSI) investigation of turbulent flow around a surface-mounted vertical elastic plate. The problem is modelled as a 3D airflow with 10 m/s velocity past the elastic plate using the $k-\omega$ turbulence model. This study is performed using the commercial CFD software STAR-CCM+ utilizing its single platform coupling methodology for the coupling of fluid dynamics and solid mechanics. To understand and analyse FSI characteristics of the flow and the plate, the structural deflection of the plate and fluid forces exerted on are computed and observed under different parametric conditions considering the plate is subjected to large deformations. The results are validated by comparisons with another published numerical study performed with a different coupling methodology and it was found that both results match well for the deformation of the plate. After validating the results, a grid sensitivity study and then an extensive parametric study are performed. Different material selections for the flow and the plate, modifications of the plate geometry, changes in inlet velocity, and different turbulence models are used to simulate the problem for the parametric study. It was found that the elastic deformation of the plate relatively depends on fluid and solid material properties, the geometry of the plate, velocity definition at the inlet, and the selection of turbulence models. The formation of flow-induced oscillations of the plate is also investigated and the results are analysed. This study indicates that full-scale FSI problems that exist in engineering applications can be successfully modelled using methodology used in this study.