УДК 533.6

CALCULATION OF AIRFOIL DRAG USING DIFFERENT TURBULENCE MODELS

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In this project, aerodynamic coefficients of NACA 0012 airfoil at different angles of attack from 0 to 19 degrees with a Reynold number of 1.9e6 were presented. Moreover, the transonic phenomenon of the same airfoil was also studied at freestream Mach number from nearly 0.4 to 0.8 at zero and six angles of attack. The $k-\omega$ Model, the $k-\varepsilon$ Model, and the Shear Stress Transport (SST) Model were used in calculation. After that, results were compared with experimental data from Ladson, who studied performance of this airfoil with 2e6 Reynold number in 1988.

At the first step, a geometry model was created and then the computational domain was composed of 420000 cells emerged in a structured way with software ICEM-CFD. The program ANSYS-CFX was used to obtain results. At last, the aerodynamic performances, especially for the drag coefficient, were discussed and compared with the experimental data.

After analysis, it can be seen that when the angle of attack is zero, pressure distribution around the airfoil is symmetry and thus the lift coefficient is zero. But there is still a tiny drag exist because of the viscosity of air. As the angle of attack increase, the lift coefficient goes up with a nearly straight line and the drag coefficient only has a little raise until the stall angle of attack, after which the lift coefficient goes down quickly and drag coefficient increase suddenly. All three lift coefficient curve of turbulence models have a good agreement with experimental data. But the SST model is the most appropriate one to calculate that, and the predicted drag coefficients of all three turbulence models are all a little higher than experimental data for one angle of attack although they have a consist movement. The conclusion from the second task is that shock wave will be developed when the Mach number is high enough, and for different angles of attack, the inflection Mach number is unequal. At the same time, shock wave makes the lift coefficient decrease slowly and the drag coefficient increase obviously. At one angle of attack, the position of the shock wave is different for various Mach number. That will move afterward, close to the trailing edge as the Mach number increase.