ABSTRACT

ESTIMATION OF SKIN-FRICTION DRAG REDUCTION ON FLAT PLATE WITH RECTANGULAR RIBLET USING $k-\omega$ SST TURBULENCE MODEL

by

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The development of boundary layers on smooth plate and riblet flat plate have been investigated by CFD simulation using OpenFOAM and ANSYS Fluent (student version). A straight rectangular riblets in streamwise direction are arranged periodically along the span ($y-z$ plane). The height h and thickness of riblets t are 0.8 mm and 0.064 mm, respectively. The peak-to-peak distance between riblets s is 1.6 mm. The Reynolds-Averaged Navier-Stokes (RANS) $k-\omega$ SST model was used to solve steady, incompressible, and viscous flow near the wall. In OpenFOAM simulation for the smooth wall, several cases of Reynolds numbers 185, 18 500, 500 000 based on the plate length were selected to confirm the viscous drag coefficient using $k-\omega$ SST solver. These result showed a good agreement between OpenFOAM simulation and theoretical result. Around 3 000 000 hexahedral meshes were generated using *snappyHexMesh* for a good discretization near the riblet wal. For the riblet result, the flow characteristics on the boundary layer are different significantly compare to those in smooth wall. At low Reynolds numbers 185, the velocity profile at the vicinity of riblet surface shows the deviation from the Blasius boundary layer profile downstream of the leading edge (L.E), that is starting from the location 0.025 m after L.E. For higher Reynolds number $Re = 500\,000$, a significant friction velocity difference u_τ was observed, consequently, the shear stress on the riblet is less than that in smooth wall which is resulted in the viscous drag reduction, that is $\sim 5.4\%$.

Keyword: *riblet, drag reduction, shear stress*