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Flow Characteristics around Rectangular Obstacles with the Varying Direction of Obstacles

Authors : Hee-Chang Lim

Abstract : The study aims to understand the surface pressure distribution around the bodies such as the suction pressure in the leading edge on the top and side-face when the aspect ratio of bodies and the wind direction are changed, respectively. We carried out the wind tunnel measurement and numerical simulation around a series of rectangular bodies (40^d×80^w×80^h, 80^d×80^w×80^h, 160^d×80^w×80^h, 80^d×40^w×80^h and 80^d×160^w×80^h in mm³) placed in a deep turbulent boundary layer. Based on a modern numerical platform, the Navier-Stokes equation with the typical 2-equation (k-ε model) and the DES (Detached Eddy Simulation) turbulence model has been calculated, and they are both compared with the measurement data. Regarding the turbulence model, the DES model makes a better prediction comparing with the k-ε model, especially when calculating the separated turbulent flow around a bluff body with sharp edged corner. In order to observe the effect of wind direction on the pressure variation around the cube (e.g., 80^d×80^w×80^h in mm), it rotates at 0º, 10º, 20º, 30º, and 45º, which stands for the salient wind directions in the tunnel. The result shows that the surface pressure variation is highly dependent upon the approaching wind direction, especially on the top and the side-face of the cube. In addition, the transverse width has a substantial effect on the variation of surface pressure around the bodies, while the longitudinal length has little or no influence.

Keywords : rectangular bodies, wind direction, aspect ratio, surface pressure distribution, wind-tunnel measurement, k-ε model, DES model, CFD

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