Geophysical Research Abstracts
Vol. 20, EGU2018-2386, 2018
EGU General Assembly 2018

Flow field characteristics around a surface-mounted finite square cylinder at low Reynolds numbers

Di Zhang, Yakun Liu, Qiuyi Wang, Shuo Zheng, and Qi Gao
Dalian University of Technology, School of Hydraulic Engineering, Dalian, 116024,China (di.zhang@dlut.edu.cn)

Abstract:Serving as an extension of the paper "Zhang et al. Direct numerical simulation of flow around a surface-mounted finite square cylinder at low Reynolds numbers. Physics of Fluids 29.4(2017):045101", this paper provides a further analysis on the flow characteristics around a finite square cylinder, with an aspect ratio (AR) of 4, at three low Reynolds numbers (i.e. Re=250, 500 & 1000). As expected, the Re number plays a significant role on the time-averaged velocity and pressure fields, the root-mean-square (RMS) velocity, the power spectral density (PSD) function of the fluctuating velocity and the instantaneous vortex-shedding pattern. Firstly, by presenting the negative pressure isosurface, this study further validates the occurrence of "C & Reverse-C Vortex Model", observed in the aforementioned paper by employing the criterion, when it comes to the instantaneous three-dimensional spanwise vortices. Secondly, it is found that only one dominant peak frequency can be observed along the vertical direction for each test case in terms of the PSD function of the transverse velocity fluctuation on the symmetry plane at various spanwise locations, being consistent with the observation of Wang and Zhou[3], Bourgeois et al.[4], Sumner et al.[5], McClean and Sumner[6], Hosseini et al.[7] and Sattari et al.[8]. However, one or two other secondary frequency peaks are also noticeable for most of the span in these cases, being (to some degree) in accordance with the viewpoint of Okajima[9], Ayoub and Karamcheti [10], Kitagawa et al.[11] and Kanaris et al.[12], namely two or more frequency peaks are possible even for a prescribed test-condition and at a fixed location. Additionally, in order to further analyze the dynamics of the cylinder wake, this study illustrate the distribution of the first-order and second-order turbulence statistics.

Keywords: Direct Numerical Simulation; Spanwise Vortices; Power Spectral Density; Root-Mean-Square; Turbulence Statistics

The study is supported by the National Natural Science Foundations of China (51479022), the Fundamental Research Funds for the Central Universities (DUT17RC(3)100) and the National Key R & D Project (2016YFC0402504) .

Electronic mails: di.zhang@dlut.edu.cn; liuyakun@dlut.edu.cn.