FLOW CHARACTERISTICS OF THE FLOW AROUND A SQUARE PRISM AND A CIRCULAR CYLINDER IN TANDEM ARRANGEMENT

Yahya Erkan Akansu[1], Mustafa Sarıoğlu[2] and Tahir Yavuz[3]

[1] Department of Mechanical Engineering, Niğde University, Niğde, 51200, Turkey,
e-mail: akansu@nigde.edu.tr

[2] Department of Mechanical Engineering, Karadeniz Technical University, Trabzon, 61100, Turkey
e-mail: sarioglu@ktu.edu.tr

[3] Department of Mechanical Engineering, Başkent University, Etimesgut, Ankara, Turkey,
e-mail: baskent@ktu.edu.tr

Aerodynamic characteristics of flow around two bluff bodies of square and circular section in a tandem arrangement have been investigated experimentally at a Reynolds number of 2.2×10^4. Experiments were carried out in wind tunnel for the various values of distance between the bodies. The upstream square prism side length and downstream circular cylinder diameter were equal to 25 mm with a 5.5% blockage ratio of test section. In the range of center to center distance between the two bodies, $1 \leq L/D \leq 10$, the characterizations of the vortex shedding, flow separations and reattachments from the bodies were examined.

This study includes flow characteristics obtained by several experimental measurement techniques, such as surface pressure measurement by using pressure transducer, unsteady velocity measurements by using CTA Hot-wire anemometer and flow visualizations by smoke-wire method. Vortex shedding frequencies of the bodies were produced from spectral analyzes of the velocity fluctuations. The drag coefficients of the square prism and the circular cylinder were obtained by integration of the pressure distributions along the surface of the bodies. According to these results, there are three basic flow structures in the case of the two tandem body arrangement depending on the distance between two bodies. These are “pattern I: single body behavior”, “pattern II: shear layer reattachment” and “pattern III: vortex shedding between two bodies”. The characteristics of transition at the flow structure were obtained and there is a strong difference between the flow characteristics. A step increment in the drag coefficients have been seen changing from pattern-II at L/D=2.4 to pattern-III at L/D=2.6. Especially in the case of pattern-II, the total drag coefficients of the prism and the cylinder decreased 26% even than the value of the square prism alone.

Keywords: Vortex Shedding, Bluff Body, Flow Separation, Tandem Arrangement, Flow Visualization