DESIGN OF SINGLE NORMAL PROBE HOT WIRE ANEMOMETER FOR MEASURING STROUHAL NUMBER IN FLOW CHARACTERISTICS BEHIND CIRCULAR CYLINDER DISTURBED BY I-TYPE CYLINDER

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Abstract

Flow phenomenon across a cylinder has been studied, especially in understanding the flow characteristic such as, drag coefficient, lift coefficient, and vortex shedding. An example of its application is in the shell and tube piping in heat exchanger system. Vortex shedding phenomenon is very interesting for a further study. Measurement using pitot static tube couldn’t explain this phenomenon well, this is why an accurate measurement device was needed. So, a hot wire anemometer (HWA) would be designed and fabricated in this research, to investigate vortex shedding phenomenon by acquiring the vortex shedding frequency and computing the Strouhal number.

Experimental method used includes HWA design for flow instability and Strouhal number measurement of single cylinder and main cylinder disturbed by I-type cylinder. HWA calibration was done to acquire the response equation and measurement device’s performance in which HWA output was compared to reference velocity measured using pitot static tube. Validation is important to know the reliability of the device. The testing of HWA on single cylinder to get the Strouhal number by varying
Reynolds number compared to existing results in the previous research. Then, the HWA was used to measure the Strouhal number behind a circular cylinder (D = 60 mm) disturbed by a small circular (d = 7.5 mm) and a small I-type 65° cylinder (d = 7.5 mm). This measurement was done by varying the distance between center to center of cylinders (0.55 ≤ S/D ≤ 3.0) and by positioning HWA probe at distance x/D=3 and y/D=1. Fast Fourier Transform (FFT) Method was used to convert the time domain into frequency domain in order to obtain the vortex shedding frequency.

HWA design result has met the requirements, so it can be used in flow measurement. Furthermore, simple power law response equation is obtained from HWA calibration with a value of power constant n = 0.5 as HWA output value conversion. The turbulent intensity measurement carried out in the wind tunnel gave a great value, so a repairing of wind tunnel is recommended. The measurement using HWA resulting constant Strouhal number for Reynolds number variety of 3 x 10^4 ≤ Re ≤ 6.4 x 10^4. The Strouhal number (St) of the main cylinder disturbed by small cylinder in tandem arrangement greater than the one in single arrangement. The Strouhal number of the main cylinder in tandem arrangement tend to increase with increasing the distance between the both cylinder for S/D ≤ 1.375. The highest value of St is 0.254. It is gave by the main cylinder disturbed by I-type cylinder 65° for the distance of S/D = 1.375.

**Keywords:** hot wire anemometer, calibration, turbulent intensity, vortex shedding, Strouhal number.