NUMERICAL AND EXPERIMENTAL INVESTIGATION OF HIGH-SPEED WIND TUNNEL FLOW DISTURBANCE MEASUREMENT

[1]War War Min Swe, [2]Aung Myat Thu, [3]Khin Cho Thet, [4]Hidechito HAYASHI

[1, 2, 3]Department of Mechanical Engineering, Mandalay Technological University

[4]Department of Mechanical Engineering, Nagasaki University, Japan

The main aim of the research is to reduce the turbulent phenomena inside the wind tunnel. The wind tunnel is constructed in Fluid Mechanics lab: Mechanical Department, MTU, (Fig. 1 is reference wind tunnel in Nagasaki University, Fluid Dynamic Lab:). The flow characteristics inside the wind tunnel is analyzed with numerically and experimentally. The velocity field and turbulent intensity is reduced by setting up the honey comb. The flow velocity and statics pressure are calculated with the software ANSYS-CFD (CFX). In experimental measurement, the flow velocity is measured with hotwire anemometer and the static pressure is measured with manometer.

A. Numerical Analysis

The turbulent flow phenomena are analyzed with ANSYS 17.0-CFD-CFX software packet. The turbulent flow phenomena is occurred inside the wind tunnel as shown in Fig.2. The square shaped honey comb (in Fig. 3) is fitted inside the tunnel to reduce the turbulent phenomena. The uniform flow pattern (in Fig.4) is generated after passing the honey comb and the flow velocity is higher than without honey comb. The flow velocity is calculated in the downstream of orifice section, the value is about 8 m/s.

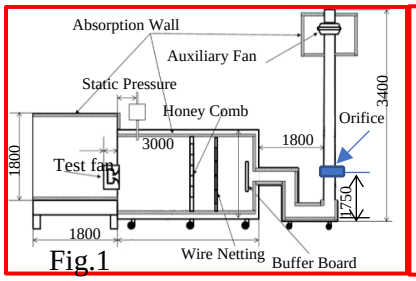

Fig.1

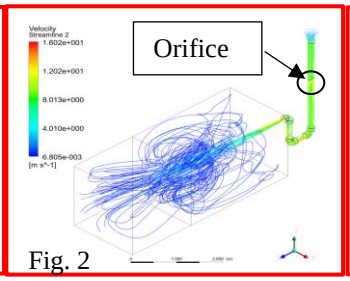

Fig. 2


Fig. 3

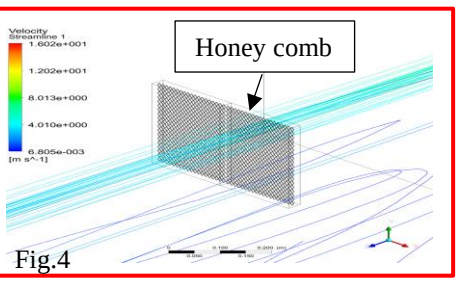

Fig.4

B. Experimental Setup

The air flow is thrown to the duct with axial fan. The flow rate in the orifice section is measured with vortex flow meter (refer to Fig. 5 and 6), its value is Q = 536.84 m^3/hr = 0.149 m^3/s. The flow velocity is at this section is about 8.16 m/s. According to result of Reynold number listed in Table 1, Re = 18.02 $\times 10^5$ which is larger than 4000, the flow is turbulent flow along the duct. The tunnel flow velocity is measured 360 mm apart (refer to Fig. 7) with the hot wire anemometer prob (refer to Fig. 8 and Fig. 9), its velocity is about 0.3 m/s. The static pressure is detected 640 mm from the test fan location (refer to Fig. 7) with the manometers. The maximum static pressure is about 0.18 kPa from the manometer reading.

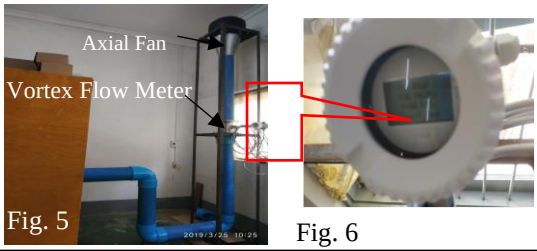

Fig. 5

Fig. 6

Reynold Number

$$R_e = \frac{VL}{v} \quad (1)$$

Table 1

Duct	D or L	Re
Dia:	152.4 mm	0.77×10^5
L: Duct length from downstream of VFM to entrance of tunnel	35550 mm	18.02×10^5

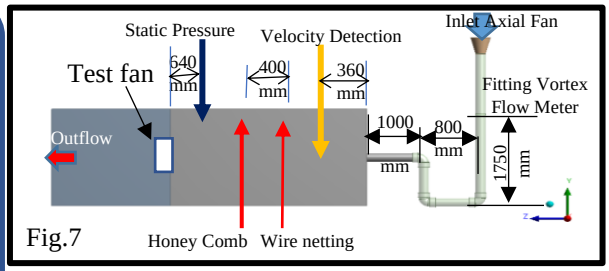

Fig.7

Fig.8

Fig. 9

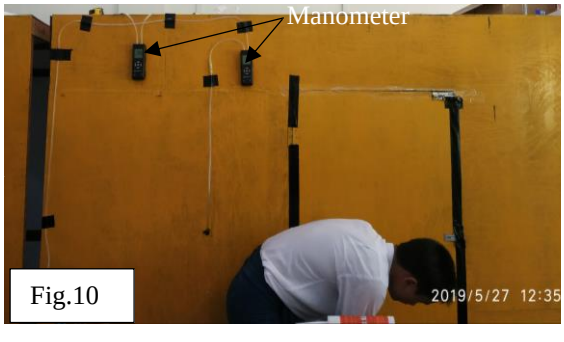

Fig.10