Role of Vortex Generators in the Aerodynamic Enhancement of Lift - An Experimental Investigation

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1. INTRODUCTION & OBJECTIVE

In this study, the role of vortex generators (VG) on the aerodynamic properties of a wing has been studied by an experiment. Numerous studies [1][2] have been carried out to design and optimize VGs [3] in various ways. VGs have proven their effectiveness not only in aircrafts but also in cars [4]. The effect of VGs on the pressure distribution can also be measured experimentally and used for validation of the CFD simulation [5][6]. In this study an experimental investigation has been carried out to measure the pressure variation around a given airfoil under the influence of VG. At the same time the effect of flow separation and stall is also visualised using tufts and smoke flow visualisation.

Experimental Set-up

A 3D printed wing with pressure ports has been used to measure the distribution of pressure around the wing. The wing having the airfoil NACA 2412 has been pasted on the top surface of the wing and tufts are attached such that each thread is 20mm away from each other on the grid precisely with glue. Rectangular vortex generators, 12mm in length and 3mm in height have been used in the wing..

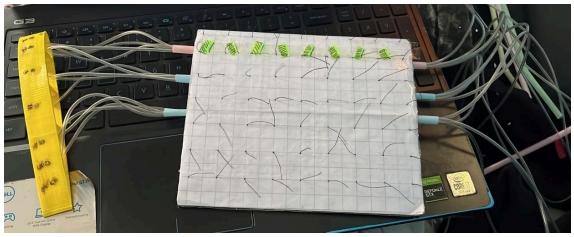


Fig. 1. (a) The wing manufactured from CNC hot wire cut EPS sheet and 3D printing

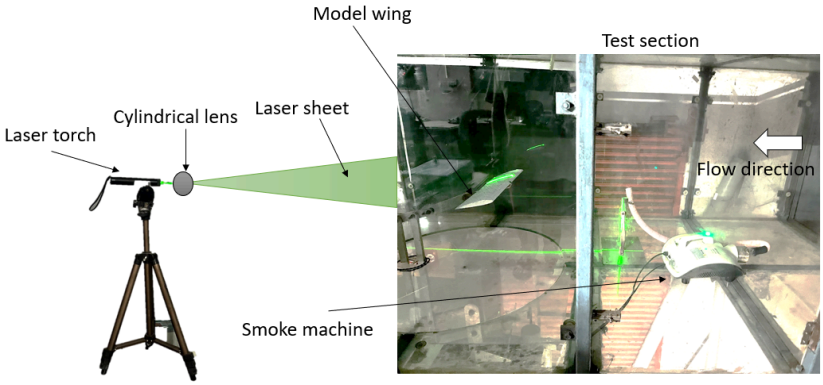
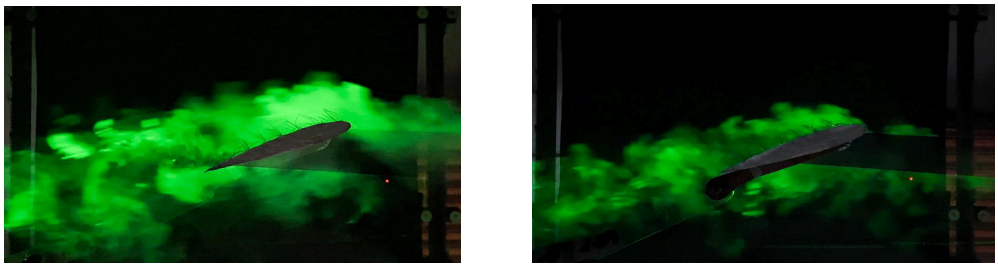


Fig. 2. Experimental setup

The setup (shown in fig 2) is placed in the wind tunnel on a 2 axis automatic model mounting system at speeds ranging from 2.5m/s to 10 m/s. A green laser with cylindrical lens is used to make a laser sheet. A smoke generator with 30% ethylene glycol solution as smoke generating fluid. Smoke flow visualisation has been carried out on the wing with and without the vortex generators. Load cell, attached to DAQ, records 1000 samples per second and its maximum capacity for lift measurement is 60N. To calculate lift and drag coefficient we take help of the load cell setup placed in the wind tunnel at 4 m/s air velocity. The surface pressure distribution has been measured at different critical spanwise locations around the airfoil.

2. RESULTS & HIGHLIGHTS OF IMPORTANT POINTS

It is observed that the wing with the vortex generator significantly delays the stall and separation when compared with the clean wing. In fig 3, it can be seen that the flow is getting separated near the leading edge for the wing without vortex generators, while for the wing with vortex generators, the flow remains attached to the wing comparatively.



(a) Wing without the vortex generator (b) Wing with the vortex generator

Fig. 3. Smoke Visualisation Results at 19 deg Angle of Attack

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