

Experimental Investigation of Multi Aerofoil Configurations Using Propeller Test Rig

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ABSTRACT

This paper briefs about the performance test on multi aero foil configuration on propeller test rig. The airfoils used are a conventional airfoil, a airfoil with stepped configuration and a Clark y airfoil. They were tested for various speed and blade angles using propeller test rig. The result are compared and studied with the conventional airfoil configurations. In future Such Aerofoils can be used for wind Mills for producing the high Voltage Power.

I. INTRODUCTION

Primary task of a Multi airfoil which has vital role in generating the lift. There are various methods of for determine the lift generated by the aerofoil proposed over the years. Flow separation over the suction surface of the airfoil at high angle of attack can create a loss of lift. This type of aerofoil is made by Al 8011 material so that it would be to generate more power and lift compared to the of normal Aerofoil. The design objective is to develop an improved airfoil configuration with enhanced lift, drag and stability characteristics and adaptability over a wide range of speeds.

II. EXPERIMENTAL APPROACH

The equipment consists of an AC motor with drive to vary the speed. It is fixed on a load cell intern is connected to the thrust digital meter. The aerofoil designed to above system of three blades is mounted on a L frame chassis. Portable anemometer is supplied to measure the speed of the motor with electronic knobs to control the speed. Wattmeter is provided to measure the motor power.

The propeller having the blade geometry of conventional airfoil was initially mounted on the test rig. The motor was then switched on to turn the propeller. Rpm of the motor is then varied using the knob. Maximum speed given was 1500rpm. Corresponding thrust values are measured. This aerofoils are attached in the propeller test rig and are tested at various R.P.M. From the obtained values thrust will be calculated and finally its efficiency. The blade angle is set to 0 to 5° (+/-).

Power Supplied to the Propeller $P_{\text{motor}} = 0.7 \times \text{motor wattage}$

Propeller Efficiency $\eta = P_{\text{actual}} / P_{\text{motor}}$



Fig1: Propeller Test Rig



Fig2: Conventional Airfoil



Fig3: Stepped Airfoil



Fig4: Clark y airfoil

III. TABULATION AND CALCULATION

Tabulation of Readings:

The maximum value for propeller efficiency was obtained at Blade Angle= +3° for multi airfoil configuration with 1 conventional airfoil & 2 stepped airfoils.

Sl.no	Speed (rpm)	Power (watts)	Thrust (Tactual)	Velocity of incoming airflow v(m/s)	Velocity behind the propeller (Δ v) m/s	Thrust (N)	Power actual (ω)	Power motor (ω)	Propeller efficiency (η) in %
1	600	7	-0.17	1.2	2.1	0.3657	0.7679	4.9	15.69
2	800	12	-0.37	1.7	3.1	1.1291	3.5002	8.4	49.66
3	1000	18	-0.62	2.6	3.7	2.46	9.102	12.6	59.57
4	1200	28	-0.69	3.2	4.6	4.6799	21.52	19.6	62.41
5	1500	47	0.68	3.8	6.2	9.2987	57.65	32.9	72.75

Calculation:

Momentum theory thrust is given by,

$$T = \frac{\pi}{4} (0.4)^2 (3.7+5.8/2) 1.1(5.8)$$

$$= 8.6026 \times 5.8$$

$$= 49.89 \text{ N}$$

Actual thrust power = P_{actual} = T_{actual} × Δv

P_{actual} = 49.89 × 30

$P_{\text{actual}} = 95.2$

Power supplied to the propeller

$P_{\text{motor}} = 0.7 \times \text{motor wattage}$

$= 0.7 \times 46$

$P_{\text{motor}} = 72.75$

Propeller Efficiency

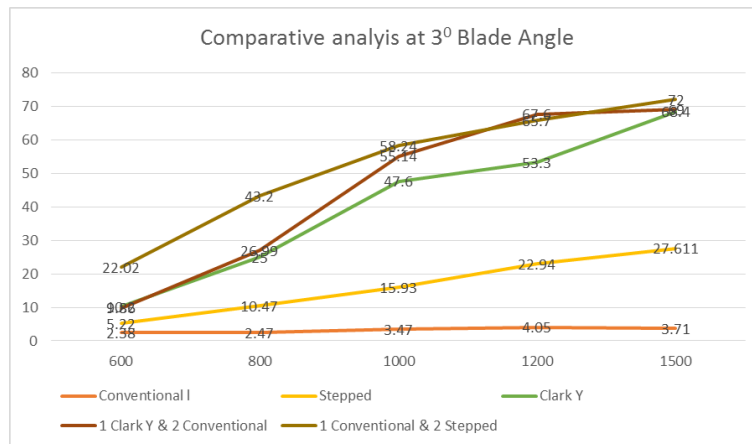
$\eta = P_{\text{actual}} / P_{\text{motor}}$

$= (31.5 / 72.75) \times 100$

$\square = 72.75\%$

Thus the maximum efficiency was found to be **72.75%**

Comparative Study:



IV. RESULT

The data's were compared, the propeller using multi airfoil configuration found to give improve efficiency with a maximum value of 72.75%. The Results showed that there is an improvement in the performance of the propeller when multi airfoils configuration replaced conventional airfoils and stepped airfoil.

V. REFERENCE

1. Experimental Investigation Of Stepped Aerofoil Using Propeller Test Rig, Arun Prakash J, Sweta S Radhakrishnan, Ramavijay N, Vishnupriya S, International Journal of research in Engineering and Technology (2014)
2. FLOW CONTROL ON A HIGH THICKNESS AIRFOIL BY A TRAPPED VORTEX CAVITY Fabrizio De gregorio¹, Giuseppe Fraioli² International Symposium on Application of Laser Techniques to Fluid Mechanics (2008)
3. LIFT ENHANCEMENT ON UNCONVENTIONAL AIRFOILS: W.W.H. Yeung International Journal of Research in Engineering and Technology (2006)