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AERODYNAMIC PERFORMANCE ANALYSIS ON A WING WITH "M" SHAPED SERRATED TRAILING EDGE.

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Abstract - - *The objective of this work is to investigate the flow over the NACA0012 air foil with "M" shaped serrated trailing edge configuration. Investigation is carried through wind tunnel with the consequence of the variation of speed and angle of attack. The adaption of blunt trailing edge air foils for the inboard region of large turbine blades has been proposed. Blunt trailing edge air foils not only provide a number of structural benefits, such increased structural volume and ease of fabrication and handling, but they have also been found to improve the lift characteristics of thick air foils. Therefore incorporation of blunt trailing edge air foils would allow blade designer to more freely address the structural demands without having to sacrifice aerodynamic performance. These air foils do have the disadvantage of generating high levels of drag as a result of low pressure steady or periodic flow in the near wake of the blunt trailing edge. Hence this device sought that mitigate the drag of these air foils. This report summarizes the literature on bluff body vortex shedding and bluff body drag reduction device.* ***Application/improvement:*** *further studies can be carried out with the alternative designs and a rigorous research can contribute in efficient designs in high lift devices.*

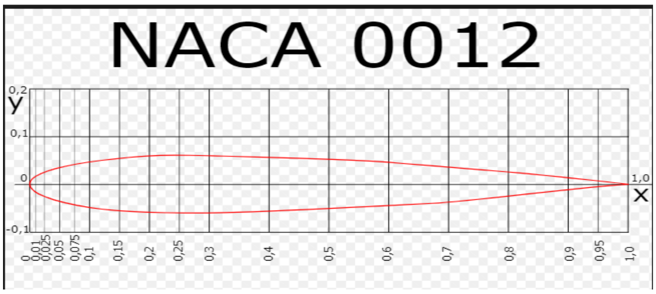
Key Words: "M" shaped serrated trailing edge, blunt body, high lift devices, and wind tunnel.

1. INTRODUCTION

Optimization of the aircraft performance has been the motive behind the ever-expanding aircraft industry. Slightest of the design improvements has the potential to boost the performance of the aircrafts in the long run. In the past, many investigations have been conducted on blunt trailing edge airfoils with some of the earliest work by hoerner indicated that maximum lift to drag ratio of thick aerofoils could increase by incorporating a blunt trailing edge and suggesting application in the blade root region of rotors such as propellers. Most of these studies simply truncated the trailing edge to achieve the required blunt trailing edge shape. However, the change in camber created by the truncation may cause a loss in lift. Instead, the shape of these blunt airfoils seem to be optimal when the trailing edge is thickened as demonstrated by Standish & van Dam. This results in a reduced adverse pressure gradient on the suction side thereby creating more lift and mitigating flow separation due to premature boundary-layer transition. Unfortunately, this trailing-edge shape also creates a steady or periodic low-pressure flow in the near-wake of the airfoil that gives rise to a drag penalty and this explains why blunt trailing edges have been largely avoided in the design of subsonic airfoils. Solutions to minimize the base drag penalty have been investigated for many years. The literature on these trailing-edge modifications was studied and the main findings are presented in the following section.

1.1 METHODOLOGY:

Due to the experimental constraints of the wind tunnel, Experiments were carried out on a scaled model width chord length of 25 cm.



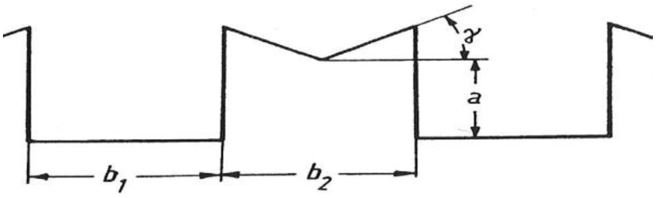
Conducted detailed flow measurements of the system that originates at the blunt trailing edge. From the point of view of drag reduction, he observes that an M-shaped serrated trailing edge is optimal with the following dimensions:

$a/h = 1.9$

$\gamma = 33.42°$

$b1/h = 5$

$b1/b2 = 1$



Where h is the thickness of the trailing edge. The effectiveness of a ventilated cavity was not studied here, but other researchers have found them to be less effective than a broken trailing edge. At low subsonic Mach numbers, this shape is the most effective means of base drag reduction.

1.2 RESULTS AND DISCUSSION:

Blunt trailing edge airfoils are of interest in the engineering of large wind turbine blades because they allow for a strong structure with a high aerodynamic lift to structural weight ratio. However, these airfoils also have a high drag because of the low pressures in the wake acting on the blunt trailing edge. The goal of the present research effort is to find the most effective way of reducing the base drag while retaining the favorable characteristics of the airfoil that make it of interest for application in the inboard region of large wind turbine blades. In the current section results are presented for the sections of trailing edge modification of NACA0012. The test results are compared with normal airfoil tests which were carried using the sub-sonic research tunnel facility.

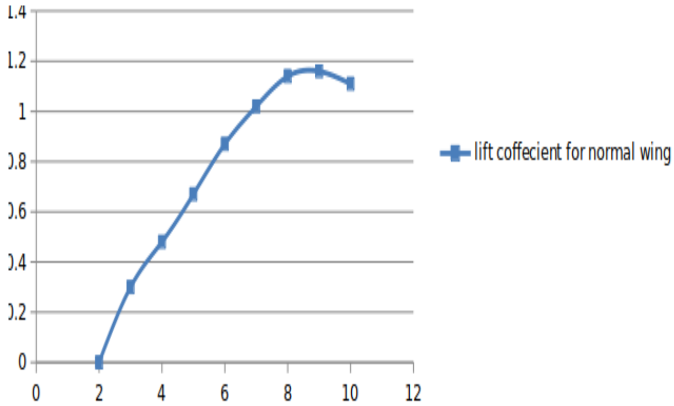
Table -1: **angle of attack vs lift coefficient**

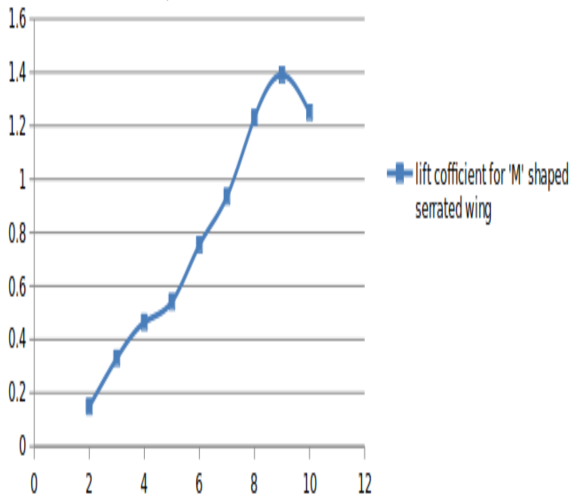
s.no	**Angle of attack**	**Lift coefficient**
1	0	0.14
2	2	0.33
3	4	0.46
4	6	0.54
5	8	0.75
6	10	0.93
7	12	1.23
8	15	1.39

Table-2: angle of attack vs drag coefficient

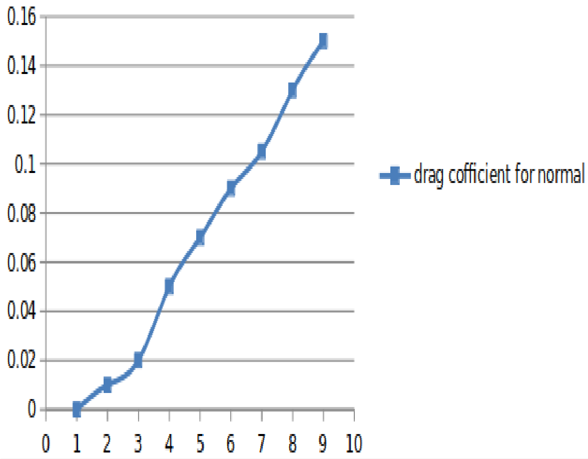
s.no	**Angle of attack**	**Drag coefficient**
1	0	0
2	2	0
3	4	0.02
4	6	0.034
5	8	0.063
6	10	0.07
7	12	0.078
8	15	0.092

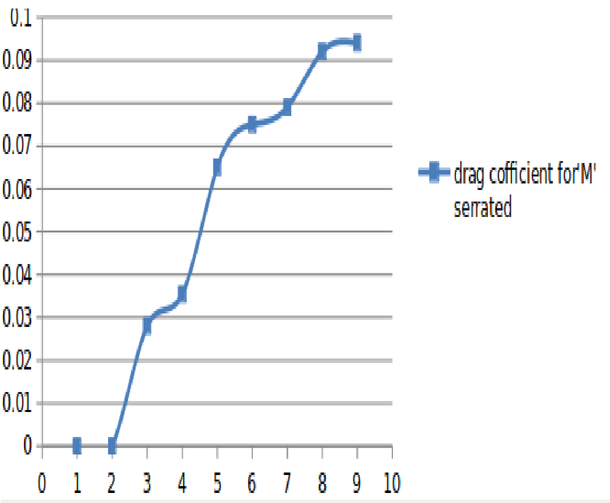
LIFT COEFFICIENT GRAPHS OF NORMAL AND "M"-SERRATED WING:





DRAG COEFFICIENT GRAPHS OF NORMAL AND "M-" SHAPED WING:





1.3 CONCLUSION:

- Coefficient of lift vs angle of attack ,we can observe that the change of slope is maximum at 10degrees
- The increase in CL value is approximately 25%.
- Also we have calculated the change in coefficient of drag at 10degrees .It is found to be approximately 61.33%.
- From the plots we can observe that aerodynamic performance on wing enhanced due to serrations.
- More amount of lift is produced by "M"- serrated wing.

1.4 REFERENCE:

1 Hoerner, S.F., "Base Drag and Thick Trailing Edges," Journal of the Aeronautical Sciences, Vol. 17, No. 10, Oct. 1950, pp. 622-628.

2 Hoerner, S.F., Fluid-Dynamic Drag, Hoerner Fluid Dynamics, Bricktown, NJ, 1965.

3 Standish, K.J., van Dam, C. P., "Aerodynamic Analysis of Blunt Trailing Edge Airfoils," Journal of Solar Energy Engineering, Vol. 125, 2003, pp. 479-487.

4 Nash, J., "A Review of Research on Two-Dimensional Base Flow," ARC R&M No. 3323, Aeronautical Research Council, 1963.

5 Nash, J., Quincey, V., and Callinan, J., "Experiments on Two-Dimensional Base Flow at Subsonic and Transonic Speeds," ARC R&M No. 3427, Aeronautical Research Council, 1966.

6 Molezzi, M.J., and Dutton, J.C., "Study of Subsonic Base Cavity Flowfield Structure Unsing particle Image Velocimetry," AIAA Journal, Vol. 33, No. 2, Feb. 1995, pp. 201-209.

7 Nash, .J, "A Discussion of Two-Dimensional Turbulent Base Flows," ARC R&M No. 3468, Aeronautical Research Council, 1967.

8 Tanner, M., "New Investigation for Reducing the Base Drag of Wings With a Blunt Trailing Edge," Aerodynamic Drag, AGARD-CP-124, 1973, pp. 12-1–12-9.

9 Gai, S. and Sharma, S., "Experiments on the Reduction of Base Drag of a Blunt Trailing Edge Aerofoil in Subsonic Flow," Aeronautical Journal, Vol. 85, No. 844, 1981, pp. 206-210.

10 Rodriguez, O., "Base Drag Reduction by Control of the Three-Dimensional Unsteady Vortical Structures," Experiments in Fluids, Vol. 11, No. 4, 1991, 218- 226.