IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
PP 01-05

Analysis of Supercritical Airfoils for Increasing Critical Mach number for Subsonic Aircrafts

K.Soundarya[1],K.Sriram[2],M.Divya[3],G.Muralidharan[4]
[1]*(Department of Aeronautical Engineering,Surya Group of Institutions/Anna university,India)*
[2]*(Department of Aeronautical Engineering,Surya Group of Institutions/Anna university,India)*
[3]*(Department of Aeronautical Engineering,Surya Group of Institutions/Anna university,India)*
[4]*(Department of Aeronautical Engineering,Surya Group of Institutions/Anna university,India)*

Abstract: *The aerodynamic characteristics of an airfoil plays a vital role in terms of design aspects and experimental valuation This led to increasing of critical Mach Number with the help of comparing various performance characteristics of supercritical airfoils at cruising conditions .The main objective of this project is to carry out design and analysis of various supercritical airfoils with same cruising local velocity along with the study of aerodynamic characteristics such as drag co-efficient and critical Mach number.The objective is to improve the Mach number of a subsonic aircraft at transonic Mach speeds. The design profile chosen is based upon existing airfoils used in Airbus A380-800 .*
Keywords – *Supercritical airfoils, Critical Mach number, Co-efficient of drag,Cruising Speed Velocity*

I. Introduction

A flow over a supercritical airfoils is very from the flow over an cambered airfoils Airbus A380-800 fly at maximum speed of 0.83 Mach number at the local velocity reaches sonic velocity somewhere over the wing and compressibility effects start of two grow up the free stream Mach number at which local sonic velocities develop is called critical Mach number. It is always better to increase the critical Mach number. It is always better to increase the critical Mach number so that formation of shockwaves can be delayed. This can be done either by sweeping the wings but high sweep is not recommended in passenger aircrafts as there is loss in lift in subsonic speed and difficulties during constructions.

II. Mach Number And Critical Mach Number

2.1Mach Number

Named after the Austrian physicist Ernst Mach, a means of recording the speed of a body as a ratio of the speed of sound in the same ambient conditions .Mach Number(M) = velocity of object/speed of sound
M=v/a.

2.2Critical Mach Number

In aerodynamics, the critical Mach number of an aircraft is the lowest Mach Number at which the airflow over some point of the aircraft reaches the speed of the sound, but does not exceed it .At the low critical number, airflow around the entire aircraft is subsonic. In other words,the free-stream Mach number at which sonic Flow is first encountered on the airfoil is known as Critical Mach number.

2.3 Drag Divergence Mach number

The drag divergence Mach number is the Mach number at which the aerodynamic drag on an airfoil or airframe begins to increase rapidly as the Mach number continues to increase .we now turns our attention to the airfoil drag coefficient C_D. The figure sketches the variation of C_D with M_∞. At low Mach numbers, less than M_{cr}, C_D is virtually constant and is equal to its low speed value .The flow field about the airfoil for this condition.

III. Description

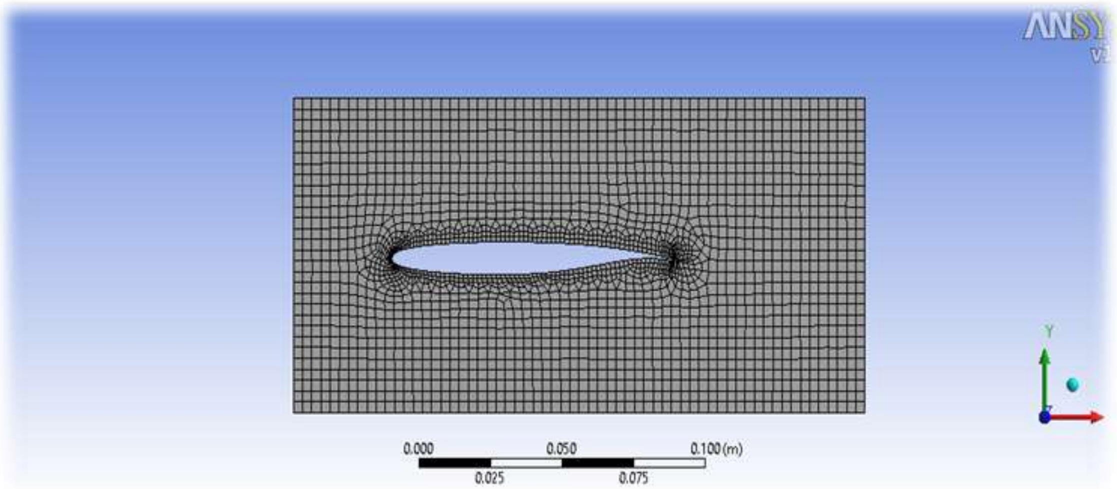
3.1 Airfoil Nomenclature used in Airbus A380-800

Airfoil Name	NASA SC (2) -0610
Maximum Thickness	10% at 38% chord
Maximum Chamber	1.8% at 32% chord
Maximum C_D	0.012
Critical Mach Number	0.83
Cruising Velocity	288.4 m/s

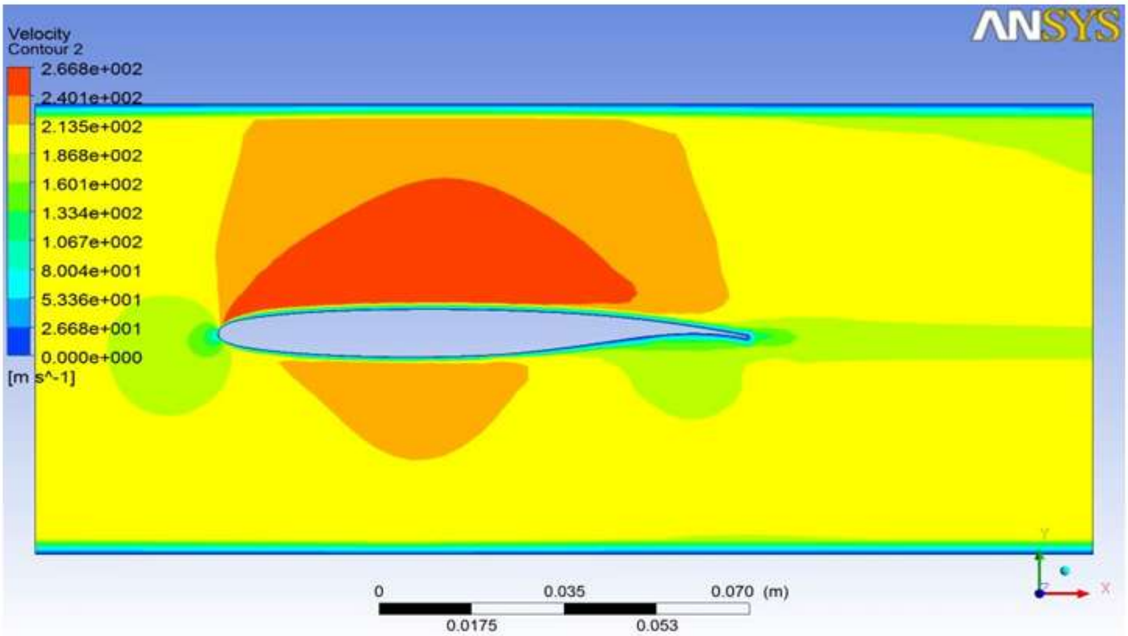
3.2 Airfoil nomenclature of supercritical airfoils

Airfoil Name	NACA – 2412
Maximum Thickness	12% at 30% chord
Maximum Chamber	2% at 40% chord
Maximum C_D	0.0090
Critical Mach Number	0.88

IV. Design And Analys

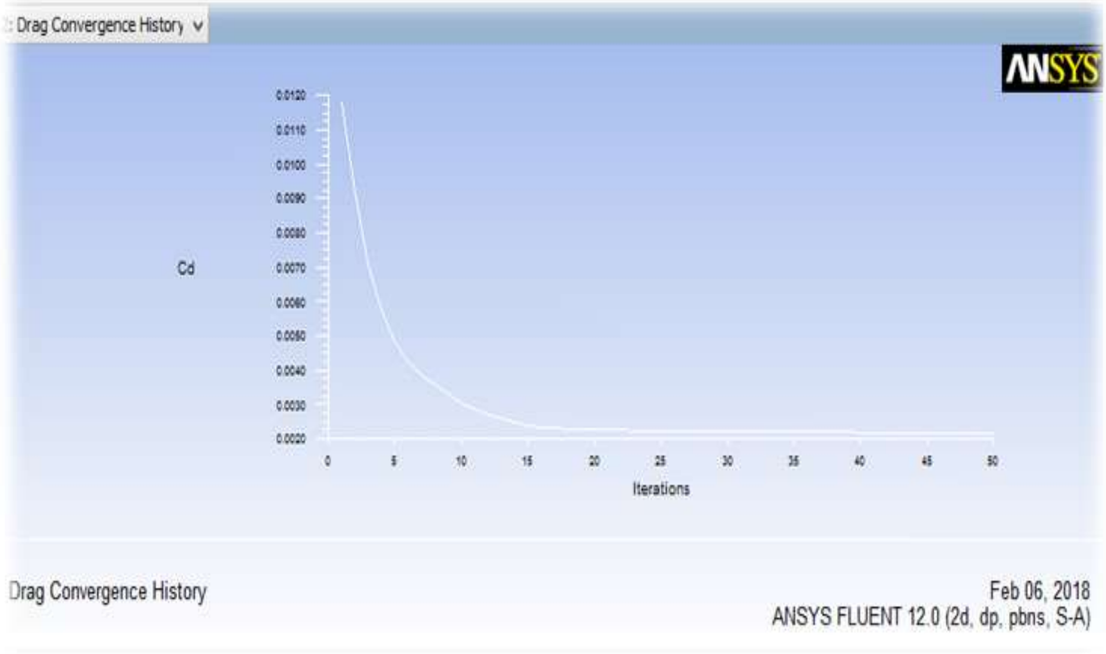


4.1 NASA SC (2) – 0610 Mesh Geometry
NASA S-0610 Velocity Profile Diagram

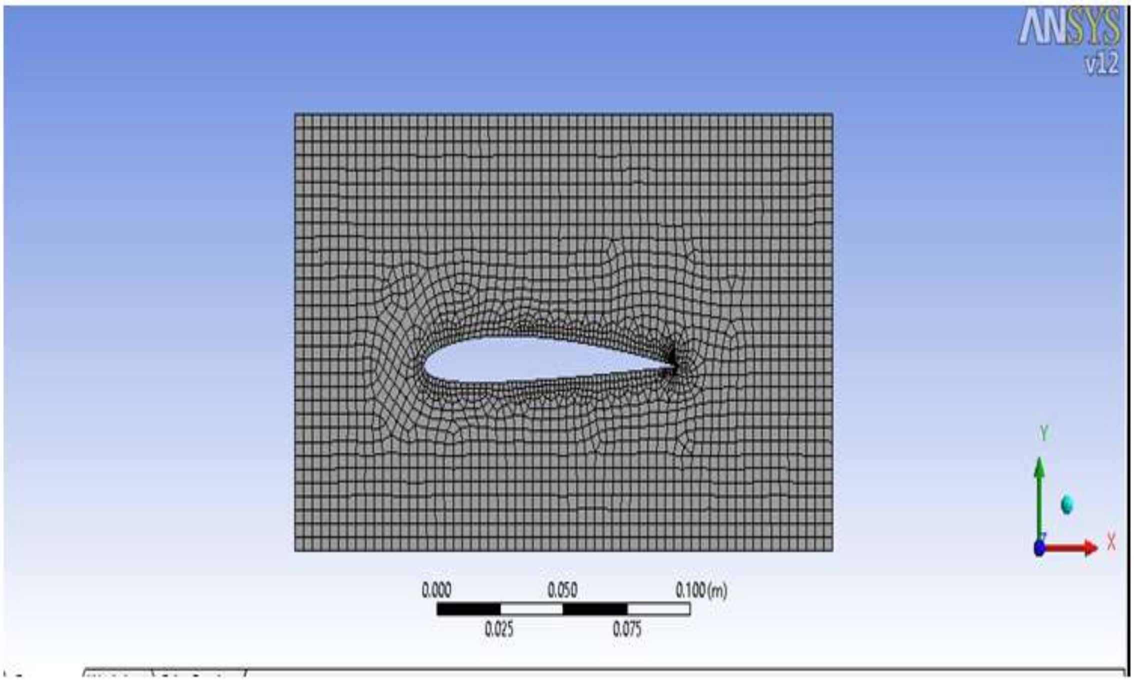


Minimum velocity:26.68m/s
Maximum velocity:266.8m/s

NASA S-0610 Co-efficient of Drag Diagram

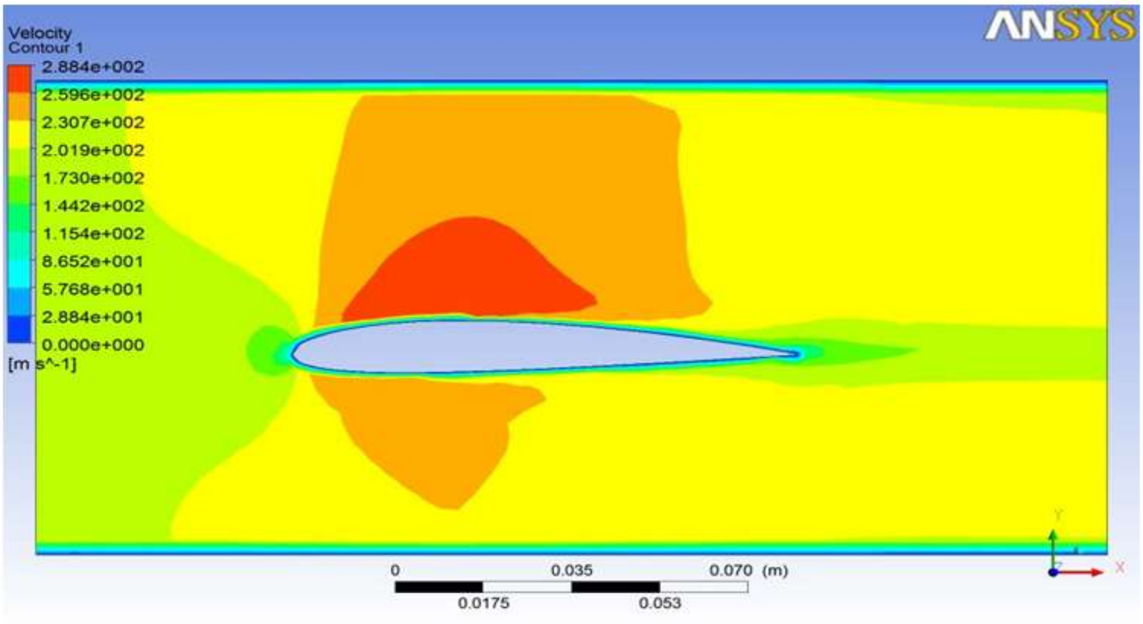


NACA – 2412 Mesh Geometry

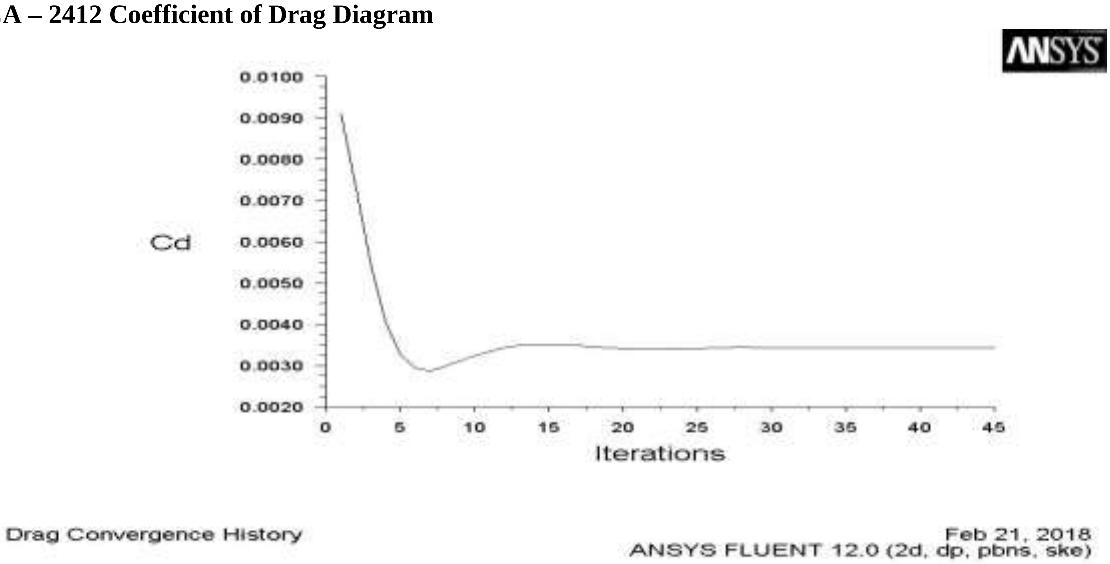


NACA – 2412 Velocity Profile Diagram

Minimum velocity:28.84m/s
Maximum velocity:288.4m/s



NACA – 2412 Coefficient of Drag Diagram



V. Conclusion

Analytical investigations have been examined to check the performance of the varies supercritical airfoils to improve the cruising velocity in subsonic flow. Combining the computational Analysis results with the existing airfoil. NACA-2412 as produced Maximum Cruising Velocity of 288.4 m/s and maximum design drag coefficients are 0.009.

From NACA – 2412 supercritical airfoil we conclude that produces maximum cruising velocity and lesser drag coefficient compared to other supercritical airfoils.

Acknowledgements

We express our thanks to the Management, Director and Dean- Surya Group of Institutions for providing all the necessary facilities and the support required for completion of the project.

We are obliged to our **Dr.V.Kalyana Chakaravarthy, Principal/Head of the Department, Department of Aeronautical Engineering** for his motivation and encouragement in carrying out the project successfully.

We express our sincere thanks and gratitude to our project guide **Mr.G.Muralidharan , Assistant Professor, Department of Aeronautical Engineering** for his through guidance and suggestions offered during the course of the project work.

Refrences

[1]. Whitcomb, Richard T.; and Beasley, William D.: Low-Speed Aerodynamic Charateristics of a 17-Percent-Thick Airfoil Section Designed for General Aviation Applications. NASA TNB D- 7428, 1973.

[2]. McGhee, Robert J.; and Beasley, William D.: Effects of Thickness on the Aerodynamics Characteristics of an Initial Low-speed Family of Airfoils for General Aviation Applications. NASA TM X-72843,1976.

[3]. McGhee, Robert J.; and Beasley, William D. " Low-Speed Aeodynamic Characteristics of a 13-Percent- Thick Medium – Speed Airfoil Designed for General Aviation Applications. NASA Tp-1498, 1979.