FLOW VARIATION OVER BI-CONIC NOSE PROFILE AT DIFFERENT ANGLE OF ATTACK

Amandeep Singh

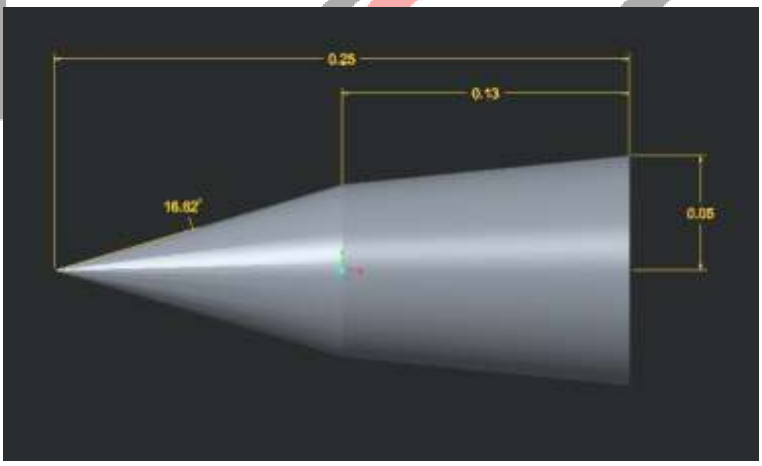
Student,
Department of Aerospace Engineering,
School of mechanical engineering
Lovely Professional University, Punjab, India

***Abstract*: The object moving at high speed induced the drag which decrease the velocity and affect the efficiencies of object. Now days we are moving towards the high speed vehicle. By the high speed vehicle we save our time and more accurate on trget like in defence system we use the different ballistic missile for targeting the object .In Aerospace Industries the main problem is drag and some time is usefull for us like example in re-entry of object to the earth atmosphere .In that situation we want more drag and less lift. Designing field give the ability to make more efficient body design for Aerospace Industry .By which we tackle the decelerate problem in moving object.The motivation for such a work is caused by lack of data on aerodynamic profile for biconic nose cone. This paper deals with computational analysis on biconic nose cone design profile for rocket and missiles. The effect of nose shape on the drag is studied at sonic level its mean that the object should move with the mach1.0 at velocity of 343m/sec .The scope of this paper develop projects on satellite mssion rockets and increasing their efficiency and effect on target also. By this paper we develop prototype profile with accurate aerodynamics. It also represent the variation of lift,drag with different angle of attack.**

***Keywords*: Angle of Attack (AOA), Mach Number, Nose cone, Drag, CFD**

1. INTRODUCTION

In sonic conditions nose cone shape plays an important role reducing drag force on entire body and not allowing flow separation which are adverse effects on efficiency of an aircraft. It also accounts on the efficiency of an aircraft that can be increased by producing least drag on aircraft [1]. Providing optimum shape to nose is not a difficult when compared to other designs but little care must be taken in account. We also discussed in paper about different Angle of Attack on conic design and experiences different values of drag and lift. The mostly used nose profiles now-a-days are majorly used are conical, parabolic ogive and elliptical as per commercial purpose [2]. For the analysis, we have chosen conic shape and is done by using PTC Creo parametric 3.0 software and analyzed using computational fluid dynamics on ANSYS Software2020R1 for different Angle of Attack under sonic boundary conditions. This work totally based on CFD analysis but used in real world which brings a difference in efficiency of missiles and not only this flow separation also plays an important role in rockets which can be controlled by usage of optimum nose cone [1].



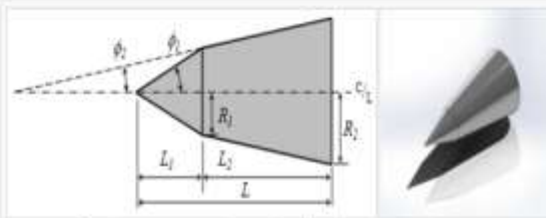
Bi-conic [edit]

A bi-conic nose cone shape is simply a cone with length L_1 stacked on top of a frustum of a cone (commonly known as a *conical transition section* shape) with length L_2, where the base of the upper cone is equal in radius R_1 to the top radius of the smaller frustum with base radius R_2.

$$L = L_1 + L_2$$

$$\text{For } 0 \le x \le L_1 : y = \frac{xR_1}{L_1}$$

$$\text{For } L_1 \le x \le L : y = R_1 + \frac{(x - L_1)(R_2 - R_1)}{L_2}$$



Bi-conic nose cone render and profile with parameters shown

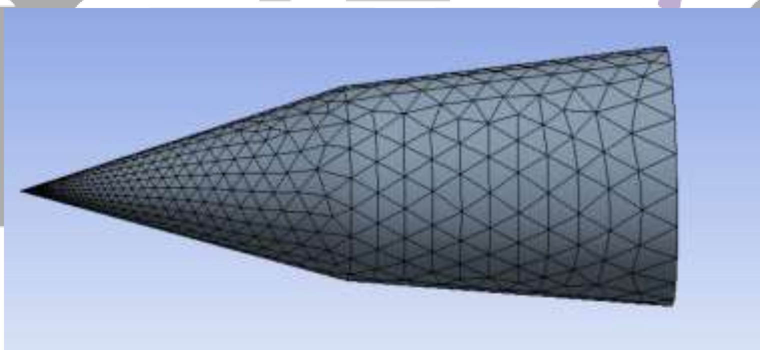
NOTE:**ALL DIMENSION USED IN PTC CREO 3.0PARAMTERIC IN SI UNIT.**

2. PROBLEM STATEMENT

The objective of this paper is to show the variation in drag force on entire body that can be achieved by the shape of the nose of rocket & missiles. For a space vehicle like an ballistic missile or satellite rocket's the shape of the nose cone has a significant effect on the drag of the vehicle. So, to increase overall efficiency, we need to give an optimum shape to nose cone which can reduce drag force and provide a streamline structure to an aircraft. Now a days the main problem faced by space system are not having optimum shape or geometry that chooses the arbitrary rockets. So, in this paper, we will discuss about basic nose cone structures used in this era and how can we improve efficiency by providing optimum geometry to the nose cone.

3. METHODOLOGY

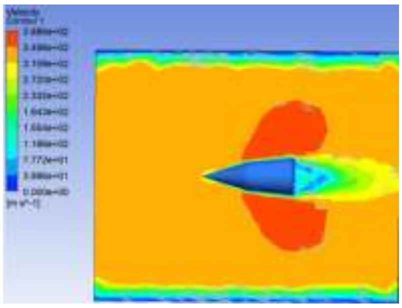
In this paper nose cone shape are designed using PTC Creo parametric 3.0 software. The first step is to create a 2D model as per the equations mentioned above and convert into a 3D model for CFD testing. The commonly used tools to create a model in Creo 3.0 parametric are- Extrude, extrude cut, Revolve, revolve cut Sweep, Swept cut, Fillet, Chamfer, Mirror. CFD Analysis is carried out in three steps i.e. (i) Preprocessing, geometry, – Designing, meshing, boundary conditions and numerical method, (ii) Processing – Solving fluid flow governing equations by numerical method till the convergence is reached and (iii) Post processing – extracting results in terms of graphs, contours which explains the physics of flow and required results [4]. The above three steps are carried out in ANSYS using fluid fluent CFD for designing and meshing with Hybrid grid that is prismatic layer around nose and unstructured grid. Simulations are carried out using ANSYS fluent a finite volume solver at with inlet conditions Mach 1.0 i.e. sonic condition [5]



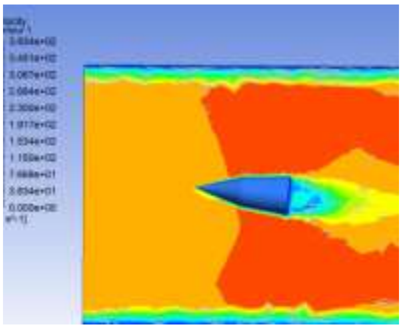
This is how the mesh look like after generate in ANYS2020R1.ANSYS Software generate mesh automatically but if you want change mesh cell generation or cell size you can also do that according to the result accuracy. I choose automatic mesh generation in my analysis.

4. RESULTS AND DISCUSSION

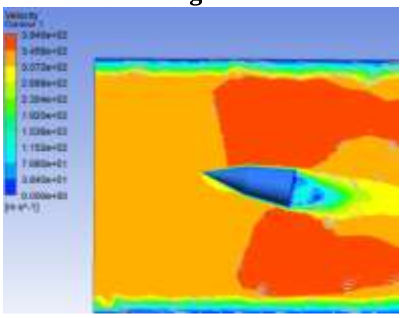
4.1) Velocity Distribution



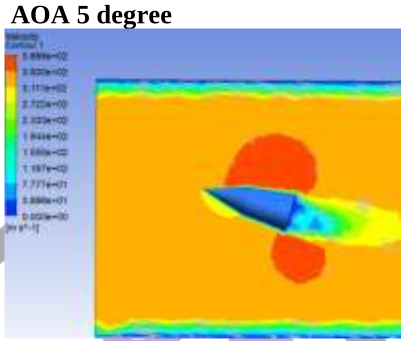
AOA 0 degree



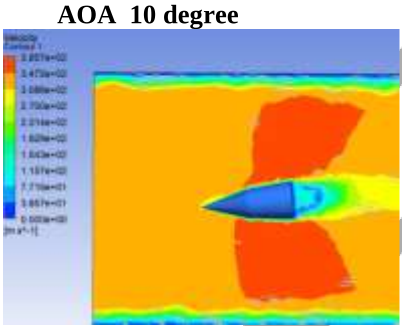
AOA 5 degree



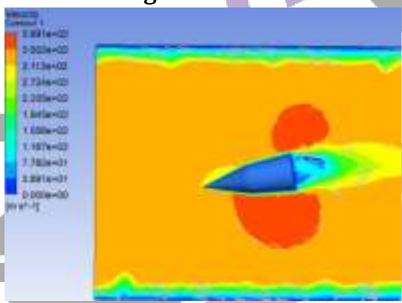
AOA 10 degree



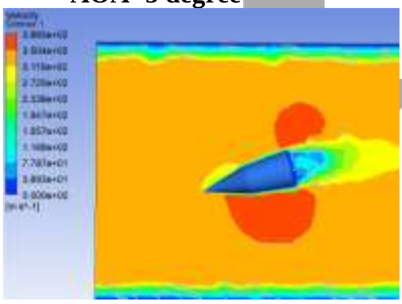
AOA 15 degree



AOA -5 degree



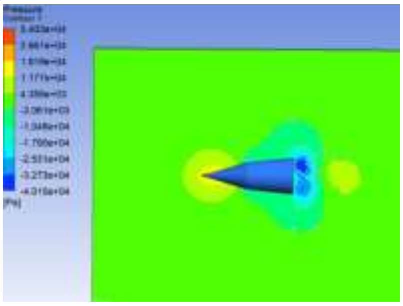
AOA -10 degree



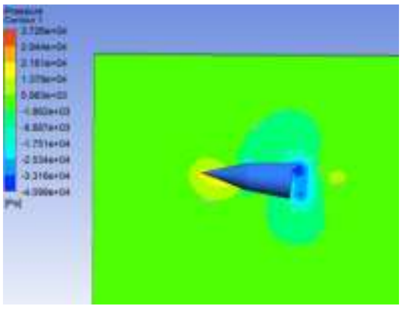
AOA -15 degree

Fig 4.1

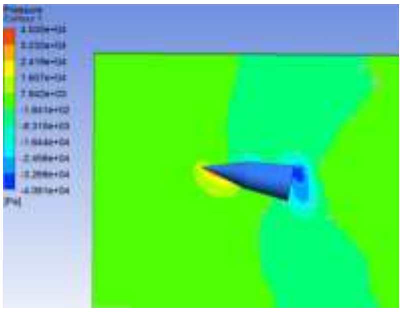
4.2) pressure distribution



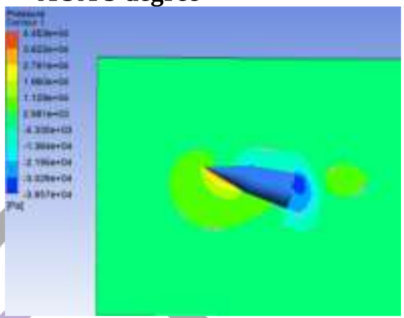
AOA 0 degree



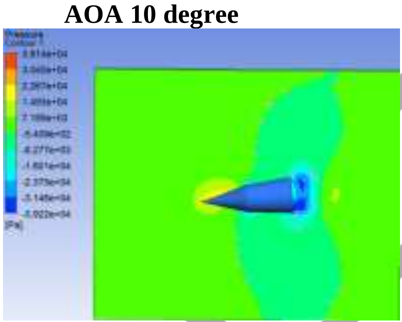
AOA 5 degree



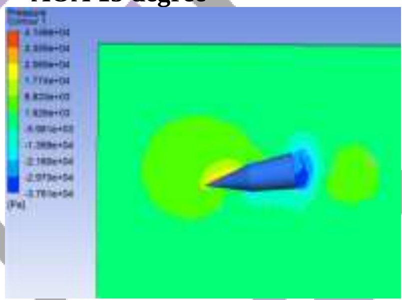
AOA 10 degree



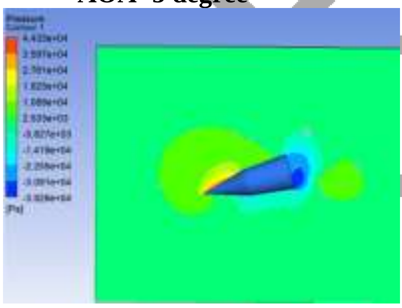
AOA 15 degree



AOA -5 degree



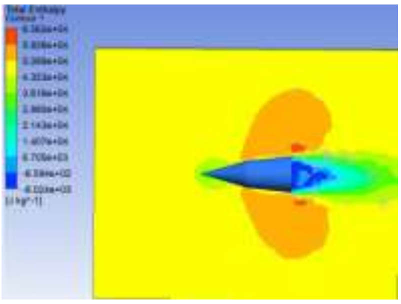
AOA -10 degree



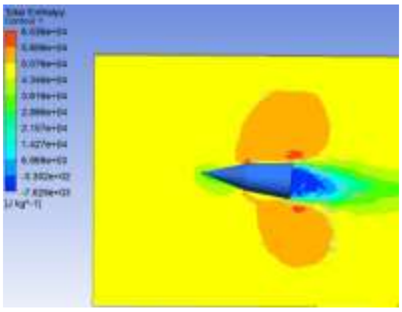
AOA -15 degree

Fig 4.2

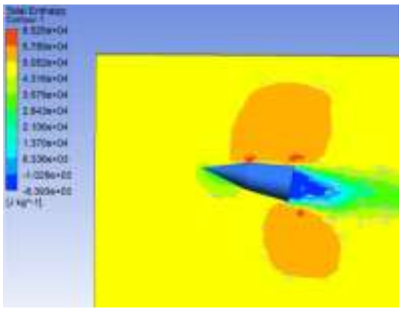
4.3) Total Enthalpy Distribution



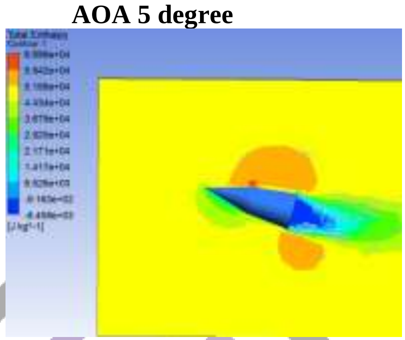
AOA 0 degree



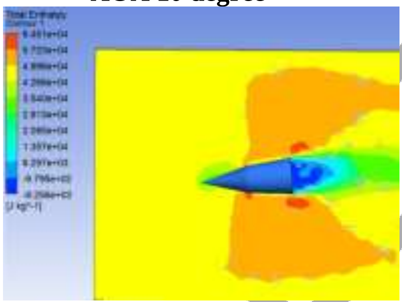
AOA 5 degree



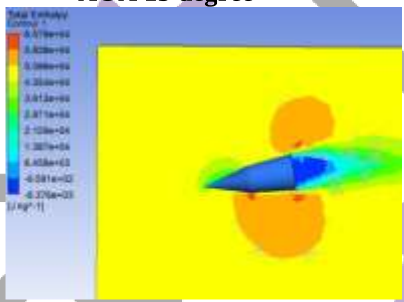
AOA 10 degree



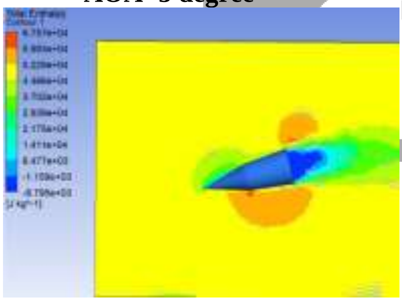
AOA 15 degree



AOA -5 degree



AOA -10 degree

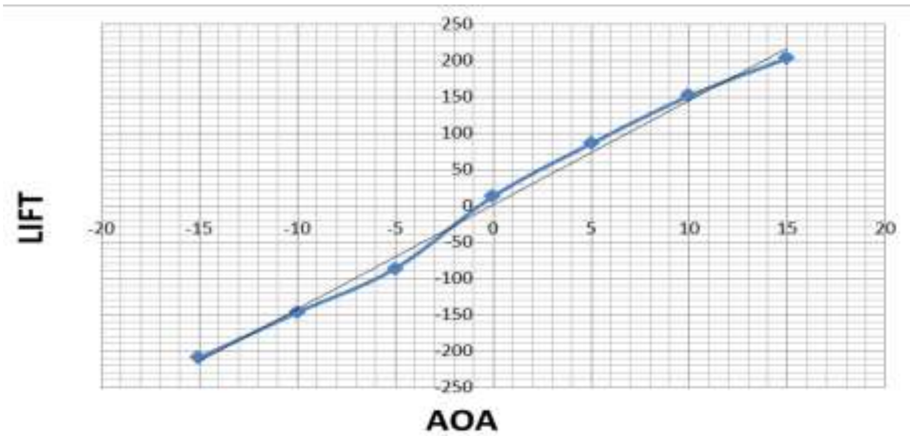


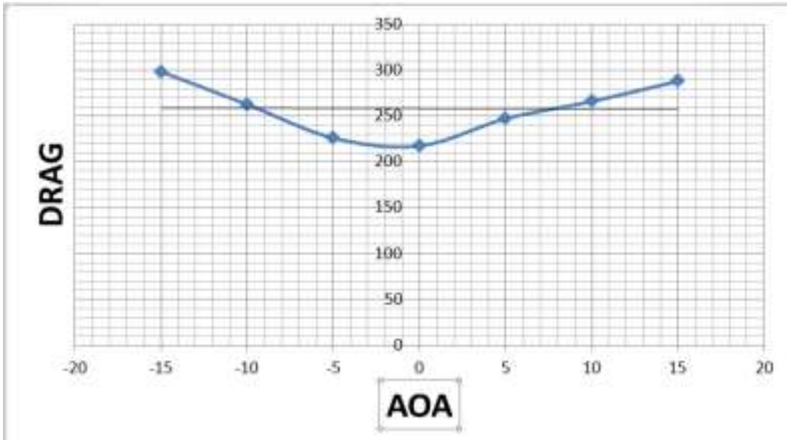
AOA -15 degree

Fig 4.3

TABLE1 Lift and Drag variation with AOA

AOA (degree)	LIFT (N)	DRAG (N)
15	203.1	287.93
10	151.24	265.94
5	85.58	247.12
0	13.1	217.39
-5	-86.3	225.9
-10	-146.9	262.6
-15	-200.94	298.1





The above results show the variation of pressure, velocity, dynamic pressure. at Mach 1.0 over different Angle of Attack (AOA). As from the table plotted above, we see the variation between lift and drag values at different AOA and also see the increasing and decreasing points of lift and drag values from the graph and we can also see that the pressure increase with different AOA as result that increase in the temperature which effect the material of a body.

5. CONCLUSION

The overall presentation of this paper concludes about the variation of flow over a nose cone at different AOA. From results, we conclude that the Lift and Drag values are increasing with AOA which results in formation of induced drag over the body surface which increases as well. It also proposes the solution for re-entry object in which we want more drag and less lift as we see our above data in which the lift value is less as compared to drag at different AOA so by this we conclude that this type of nose design is good for re-entry vehicle.

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