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Design and structural analysis of missile nose cone using different materials

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ABSTRACT

A new nose cones concept that promises a gain in performance over existing conventional nose cones is discussed in this paper the term nose cone is used to refer to the forward most section of a rocket, guided missile or aircraft. The cone is shaped to offer minimum aerodynamic resistance. Nose cones are also designed for travel in and under water and in high-speed land vehiclesGiven the problem of the aerodynamic design of the nose cone section of any vehicle or body meant to travel through a compressible fluid medium (such as a rocket or aircraft missile or bullet), an important problem is the determination of the nose conegeometrical shape for optimum performance. For many applications, such a task requires the definition of a solid of revolutionshape that experiences minimal resistance to rapid motion through such a fluid medium, which consists of elastic particles This project evaluates missile nose cone is analysis using the materials are Titanium Ti-6Al-4V most commonly used alloy. Titanium ti -6al-6v-2sn, titanium grade 1 the remainder titanium. These are significantly stronger than commercially pure titanium. While having the same stiffness and thermal properties a structural-loaded, a pressure sudden impact loads and a foam nose-cone concept Results from analysis of the nose cone are used in structural analysis performed with ANSYS. A naval model is designed for from the concepts of blunt nose cone and analyzed with the commercial software catia. The nose concept conforms to the requirements for structural integrity, weight, functionality.

Keywords: Missile nose cone design, Titanium Ti-6Al-4V, Titanium ti -6al-6v-2sn, titanium grade 1, Structural loads, impact loads, Catia, Ansys.

INTRODUCTION

In modern usage, a **missile** is a self-propelled precision-guided munition system, as opposed to an unguided self-propelled munition, referred to as a rocket (although these too can also be guided). Missiles have four system components: targeting and/or missile guidance, flight system, engine, and warhead.

Nose cone design

Given the problem of the aerodynamic design of the nose cone section of any vehicle or body meant to travel through a compressible fluid medium (such as a rocket or aircraft, missile or bullet), an important problem is the determination of the nose cone geometrical shape for optimum performance. For many applications, such a task requires the definition of a solid of revolution shape that

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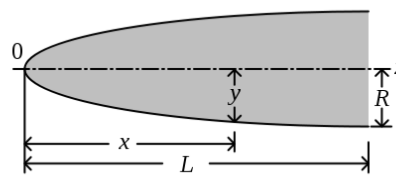
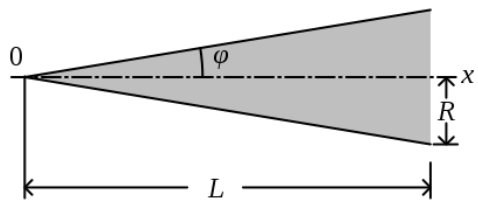
experiences minimal resistance to rapid motion through such a fluid medium, which consists of elastic particles.

General dimensions

In all of the following nose cone shape equations, *L* is the overall length of the nose cone and *R* is the radius of the base of the nose cone. *y* is the radius at any point *x*, as *x* varies from 0, at the tip of the nose cone, to *L*. The equations define the 2-dimensional profile of the nose shape. The full body of revolution of the nose cone is formed by rotating the profile around the centerline *(C/L)*. Note that the equations describe the 'perfect' shape; practical nose cones are often blunted or truncated for manufacturing or aerodynamic reasons.



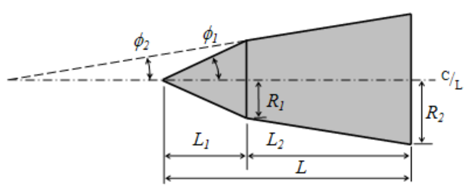
Conical



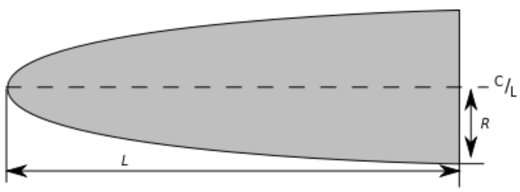
A very common nose-cone shape is a simple cone. This shape is often chosen for its ease of manufacture, and is also often (mis)chosen for its drag characteristics.

Bi-conic

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.



Elliptical



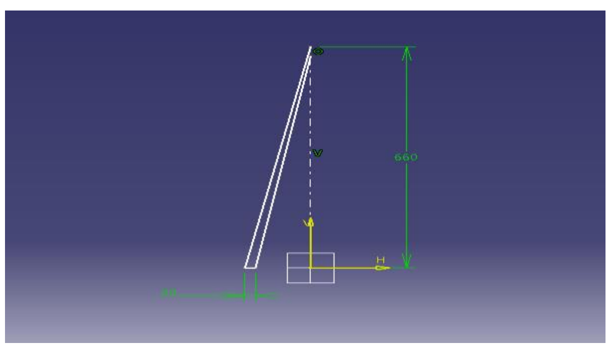
The profile of this shape is one-half of an ellipse, with the major axis being the centerline and the minor axis being the base of the nose cone. A rotation of a full ellipse about its major axis is called a prolate spheroid, so an elliptical nose shape would properly be known as a prolate hemispheroid. This shape is popular in subsonic flight due to the blunt nose and tangent base. This is not a shape normally found in professional rocketry, which almost always flies at much higher velocities where other designs are more suitable. If *R* equals *L*, this is a hemisphere

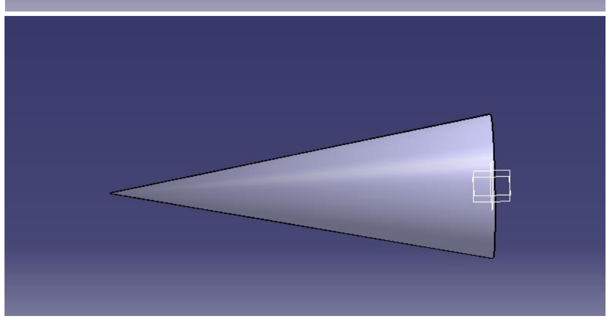
LITERATURE REVIEW

- Md.Akhtar Khan, Karrothu Vigneshwara, Suresh Kukutla investigated and analyzed the flow field over an aero foil section integrated with spikes at supersonic speed (Mach number greater than
- Lawrence D. Huebner NASA Langley Research Center Anthony M. Mitchell and Ellis J. Boudreaux Wright [Laboratory/Eglin Air Force Base conducted experiment on feasibility of an aero spike for hypersonic missiles, series of wind tunnel tests have been performed on an aero spike-protected missile dome at a Mach number of 6 to obtain quantitative surface pressure and temperature-rise data, as well as qualitative flow visualization data.
- R. C. Mehta Nanyang tells significantly changes in its flow field and influences aerodynamic drag and wall heat flux in a high speed flow. The effect of the spike length, shape, and spike nose configuration on the reduction of drag and heat flux is numerically evaluated at Mach 6 at zero angle of attack and different aero spike shape.
- Dennis M. Bushnell Langley discusses Advanced Aircraft configurationally approaches, across the speed range, which are either enabled, or greatly enhanced, by clever Flow Control.

DESIGN

CATIA offers a solution to shape design, styling, surfacing workflow and visualization to create, modify, and validate complex innovative shapes from industrial design to Class-A surfacing with the ICEM surfacing technologies. CATIA supports multiple stages of product design whether started from scratch or from 2D sketches. CATIA is able to read and produce STEP format files for reverse engineering and surface reuse

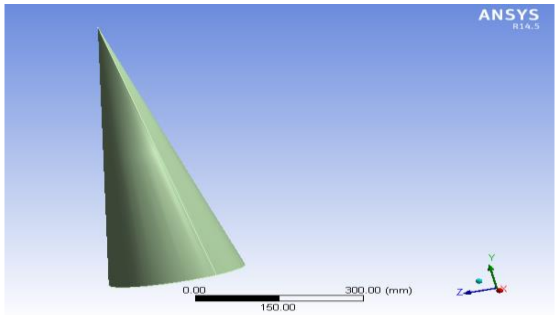




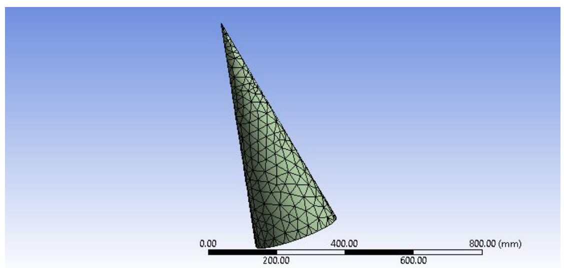
ANSYS

Structural analysis

After the aerodynamic analysis was completed, values regarding the loading of the nose cone were resolved. From this loading data, structural analyses were able to be completed to strengthen designs and prove their ability to resist these pressures. As each nose cone design is fundamentally deferent from each other, they can not all be analysed by employing the same method. Tests have been selected in order to produce either comparable results or essential data for each design type. Much like CFD, computer assisted engineering software can use Finite Element Analysis (FEA) to provide numerical solutions to the mechanical environment. This allows for models to be analysed as to their physical strengths and weaknesses in the virtual environment. As loads are introduced to a structure, FEA can calculate the resulting stresses and deformations. By inputting material properties for each specific model, FEA can accurately produce solutions providing necessary information about the design.

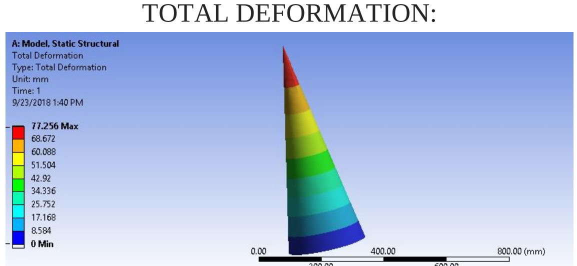


MESH:

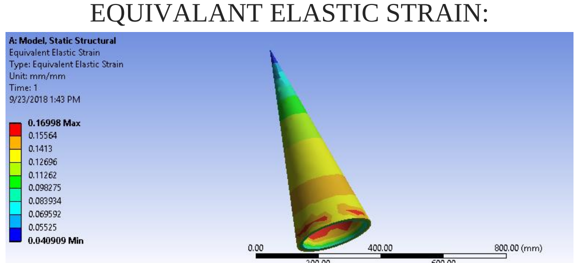


Titanium Ti-6Al-4V:

TOTAL DEFORMATION:



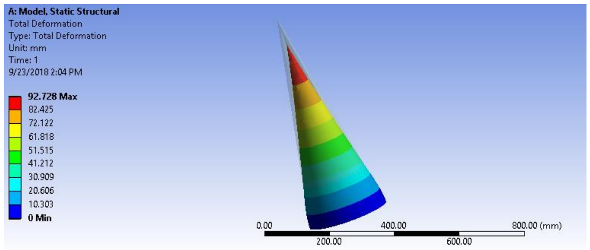
EQUIVALANT ELASTIC STRAIN:



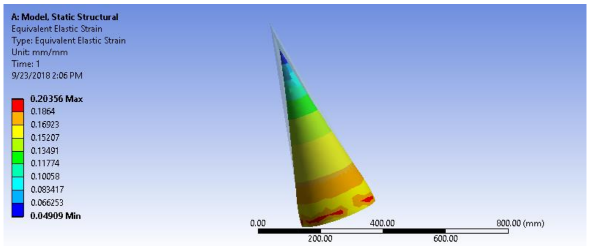
	MINIMUM	MAXIMUM
TOTAL DEFORMATION	0. mm	463.53 mm
EQUIVALANT ELASTIC STRAIN	0.24545 mm/mm	1.0199 mm/mm
DIRECTIONAL DEFORMATUON	-29.984 mm	29.959 mm

TITANIUM GRADE-1

TOTAL DEFORMATION:



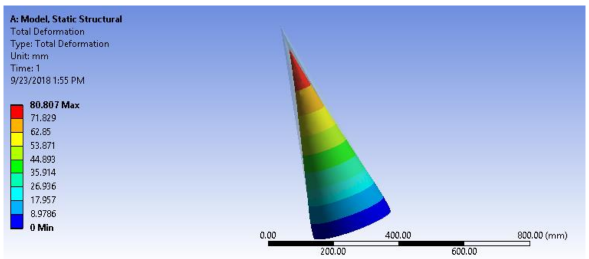
EQUIVALANT ELASTIC STRAIN:



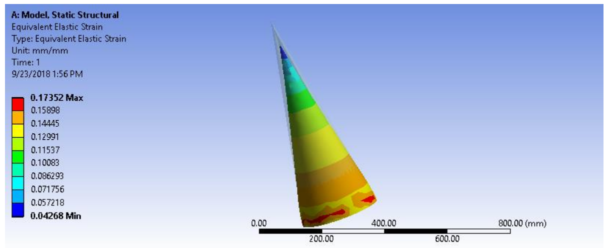
	MINIMUM	MAXIMUM
TOTAL DEFORMATION	0. mm	556.35 mm
EQUIVALANT ELASTIC STRAIN	0.29453 mm/mm	1.2213 mm/mm
DIRECTIONAL DEFORMATION	-35.743 mm	35.713 mm

TITANIUM TI-6AL-6V-2SN

TOTAL DEFORMATION:



EQUIVALANT ELASTIC STRAIN:



	MINIMUM	MAXIMUM
TOTAL DEFORMATION	0. mm	484.83 mm
EQUIVALANT ELASTIC STRAIN	0.25607 mm/mm	1.0411 mm/mm
DIRECTIONAL DEFORMATION	-29.017 mm	28.99 mm

CONCLUSION

From the above results are obtained from ansys software and design is done using catia v5 software. And with the help of ansys software done structural analysis so the results are

- Titanium Ti-6Al-4V is less deformation value *77.256 mm* and high withstand value in von misses stress and less weight 15.948 kg comparing with two other materials
- Equivalent elastic strain is max in titanium grade 1
- Titanium Ti-6Al-4V is better suitable material to missile nose cone

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