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Design and Analysis of Aero Cargo Fin Blade

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***Abstract*— The aero planes are designed for many uses on our nature, most of the people know aero planes are used for passenger purposes only, but only 1/3 rd of the percent only the aero planes are used for travelling of mankind, but most of the cargo flights run daily. Even there are many types of aero planes. These are even called by many names such as jets, flights, powered flights, army flights etc. As if you see the aero planes fly with the help of horizontal and vertical wings. The fin is a main surface of the Aerospace vehicle. It is used to ensure the stability when it is subjected to aerodynamic forces. In general, this fin used to move the vehicle in different directions with different materials aluminum 7475, carbon fiber and E- glass fiber. The static analysis is performed to estimate deflections, stresses & strain. The wings are the most important lift- producing part of the aircraft. The design of wings may vary according to the type of aircraft and its purpose. 3D model done in CATIA and analysis done in ANSYS.**

***Keywords:* Aerospace, Composites, FGM, CNT.**

I. INTRODUCTION

Air cargo is any property carried or to be carried in an aircraft. Air cargo comprises air freight, air expresses and airmail. A cargo aircraft (also known as freight aircraft, freighter, airlifter or cargo jet) is a fixed-wing aircraft that is designed or converted for the carriage of cargo rather than passengers. Such aircraft usually do not incorporate passenger amenities and generally feature one or more large doors for loading cargo. Freighters may be operated by civil passenger or cargo airlines, by private individuals or by the armed forces of individual countries (for the last see military transport aircraft).

Aircraft designed for cargo flight usually have features that distinguish them from conventional passenger aircraft: a wide/tall fuselage cross-section, a high-wing to allow the cargo area to sit near the ground, a large number of wheels to allow it to land at unprepared locations, and a high-mounted tail to allow cargo to be driven directly into and off the aircraft. Cargo aircraft represent a small proportion of the overall air freight market. The majority is carried in special ULD containers in the cargo holds of normal passenger aircraft.

In the years following the war era a number of new custom-built cargo aircraft were introduced, often including some "experimental" features. For instance, the US's C-82 Packet featured a removable cargo area, while the C-123 Provider introduced the now-common upswept tail to allow for a much larger rear loading ramp. But it was the introduction of the turboprop that allowed the class to mature, and even one of its earliest examples, the C-130 Hercules, is still the yardstick against which newer military transport aircraft designs are measured. Although larger, smaller and faster designs have been proposed for many years, the C- 130 continues to improve at a rate that keeps it in production.

II. LITERATURE SURVEY

Material selection is a very critical issue when it comes to aerospace engineering. Materials should have good qualities like light weight, high strength and corrosion resistance with economic viability. Over the period, Aluminium blends of composite are used for variety of applications. Carbon Nanotube reinforced Aluminium composites and Functionally graded composites(FGC) are the new developments in materials engineering. Gradual but continuous variation in composition and structure over volume, results in corresponding changes in the properties of material in contrast to homogeneous mixing of CNT in case of composite. FGM promises to be more suitable in the future. This paper focuses on brief review of CNT reinforced Aluminium composite and FGM application in aerospace. Keywords: Aerospace, Composites, FGM, CNT.

Electronic data center cooling using hot water is proposed for high system exergetic utility. The proof-of-principle is provided by numerically modeling a manifold micro-channel heat sink for cooling microprocessors of a data center. An easily achievable 0.5l/min per chip water flow, with60°C inlet water temperature, is found sufficient to address the typical data center thermal loads. A maximum temperature difference of ~8°C wasfound between the solid and liquid, confirming small exergetic destruction due to heat transport across a temperature differential. The high water outlet temperature from the heat sink opens the possibility of waste heat recovery applications. Keywords: Hot water cooling, Exergy, data center, micro-channel manifold, heat sink.

The blended wing body (BWB) is the hottest one of the aerodynamic shapes of next generation airliner because of its' high lift- drag ratio, but there are still some flaws that cut down its aerodynamic cal performance. One of the most harmful flaws is the low efficiency of elevator and direction rudder, this makes the BWB hard to be controlled. In this paper, we proposed a new control M method to solve this problem by morphing wing—that is, to control the BWB only by changing its wing shape but without any rudder. The pitching moments, rolling moments and yawing moments are plotted versus the parameters section and the wing shape in figures and are discussed in the paper. The result shows that the morphing wing can control the moments of BWB more precisely and in wider range. The pitching moments, rolling moments and yawing moments increases or decreases linearly or almost linearly, with the value of the selected parameters. These results show that using morphing wing is an excellent aerodynamic control way for a BWB craft.

Kim et al (1999) conducted an experimental study on heat exchangers having plain fins on a staggered array of circular tubes. Correlations are developed to predict the air side heat transfer co-efficient and friction factor as a function of Reynolds number and geometric variables.

Chi el al. (1998) conducted an experimental investigation of the heat transfer and friction characteristics of plate fin and tube heat exchangers. The effect of varying fin pitch on the air-side heat transfer performance and friction characteristics was studied.

Wang et al. (1998) also collected experimental data on a plate fin and tube heat exchanger configuration. They examined the effect of the number of tube rows, fin pitch, tube spacing and tube diameter on heat transfer and friction characteristics. This study found that the effect of fin pitch on the air-side friction pressure drop was negligibly 27 small for air-side Reynolds numbers greater than 1000. It was also found that the heat transfer performance was independent of fin pitch.

III. MODELLING AND ANALYSIS

CAD (Computer Aided Design) is the use of computer software to design and document a product's design process. Engineering drawing entails the use of graphical symbols such as points, lines, curves, planes and shapes. Essentially, it gives detailed description about any component in a graphical form.

Objects in engineering are represented by a technical drawing (also called as drafting) that represents designs and specifications of the physical object and data relationships. Since a technical drawing is precise and communicates all information of the object clearly, it has to be precise. This is where CAD comes to the fore.

CAD stands for Computer Aided Design CAD is used to design, develop and optimize products. While it is very versatile, CAD is extensively used in the design of tools and equipment required in the manufacturing process as well as in the construction domain. CAD enables design engineers to layout and to develop their work on a computer screen, print and save it for future editing. When it was introduced first, CAD was not exactly an economic proposition because the machines at those times were very costly. The increasing computer power in the later part of the twentieth century, with the arrival of minicomputer and subsequently the microprocessor, has allowed engineers to use CAD files that are an accurate representation of the dimensions / properties of the object.

Use of CAD: CAD is used to accomplish preliminary design and layouts, design details and calculations, creating 3-D models, creating and releasing drawings, as well as interfacing with analysis, marketing, manufacturing, and end-user personnel. It can be used to produce either two-dimensional or three-dimensional diagrams. The use of CAD software tools allow the object to be viewed from any angle, even from the inside looking out. One of the main advantages of a CAD drawing is that the editing is a fast process as compared to manual method. Apart from detailed engineering of 2D or 3D models, CAD is widely used from conceptual design and layout of products to definition of manufacturing of components. CAD reduces design time by allowing precise simulation rather than build and test physical prototypes.

Integrating CAD with CAM (Computer Aided Manufacturing) streamlines the product development even more.

Types of CAD Software

Since its introduction in late 1960's, CAD software has improved by leaps and bounds. A broad classification of CAD is:

- 2D CAD
- 3D CAD
- 3D Wireframe and Surface Modelling
- Solid Modelling

3D CATIA MODEL FOR CARGO AERO FIN

Model 1

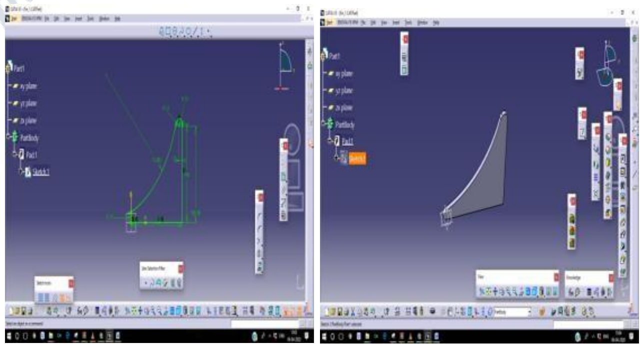

Fig. 1 Describes the 2D and 3D Design for Cargo Aero Fin

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Model 2

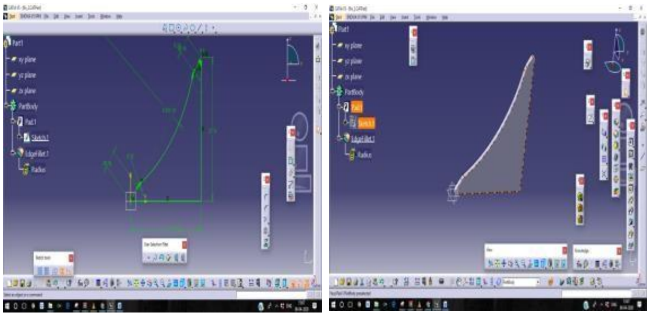

Fig. 2 Descibes the graphical view of 2D and 3D Cargo Aero Fin

Model 3

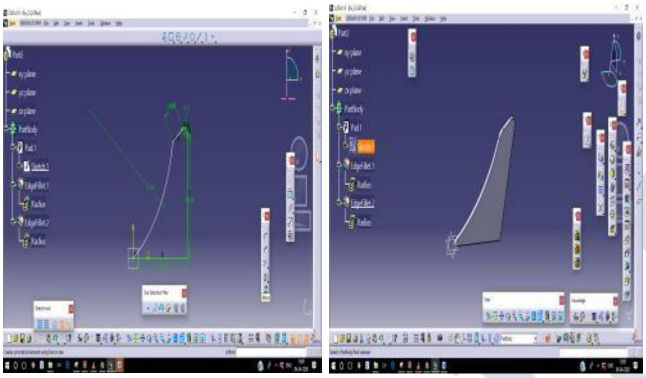

Fig. 3 Final Design of Cargo Aero Fin

IV. SOFTWARE USED

CATIA is an acronym for Computer Aided Three-dimensional Interactive Application. It is one of the leading 3D software used by organizations in multiple industries ranging from aerospace, automobile to consumer products.

CATIA is a multiplatform 3D software suite developed by Dassault Systèms, encompassing CAD, CAM as well as CAE. Dassault is a French engineering giant active in the field of aviation, 3D design, 3D digital mock-ups, and product lifecycle management (PLM) software. CATIA is a solid modelling tool that unites the 3D parametric features with 2D tools and also addresses every design-to-manufacturing process. In addition to creating solid models and assemblies, CATIA also provides generating orthographic, section, auxiliary, isometric or detailed 2D drawing views. It is also possible to generate model dimensions and create reference dimensions in the drawing views. The bi-directionally associative property of CATIA ensures that the modifications made in the model are reflected in the drawing views and vice- versa.

Benefits of ANSYS:

The ANSYS advantage and benefits of using a modular simulation system in the design process are well documented. According to studies performed by the Aberdeen Group, best-in-class companies perform more simulations earlier. As a leader in virtual prototyping, ANSYS is unmatched in terms of functionality and power necessary to optimize components and systems.

Over-view of steps in a static analysis:

The procedure for a modal analysis consists of three main steps:

1. Build the model.
2. Apply loads and obtain the solution.
3. Review the results.

Basic Steps in ANSYS:

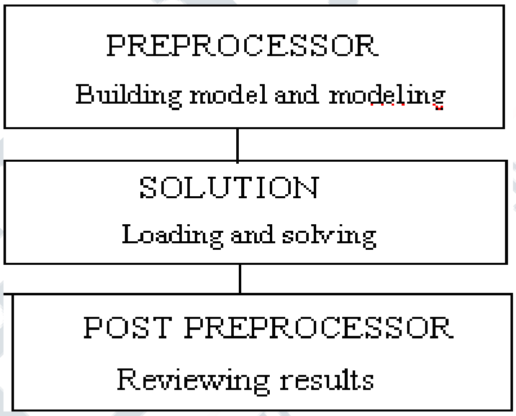

Fig. 4 Steps for ANSYS Software

V. RESULTS AND DISCUSSION

1. Material – ALUMINUM ALLOY 7475

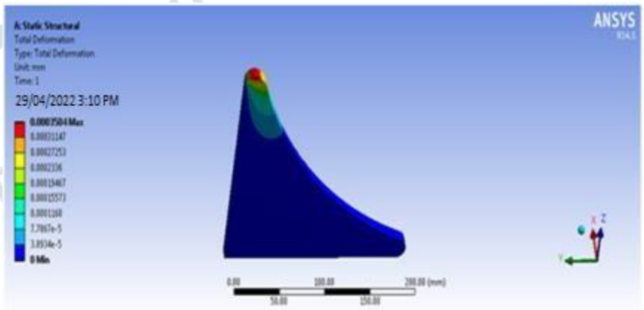

Fig. 5 Deformation of Aluminum alloy 7475

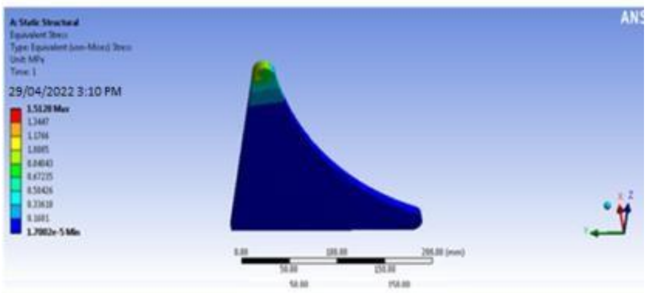

Fig. 6 Stress of Aluminum alloy 7475

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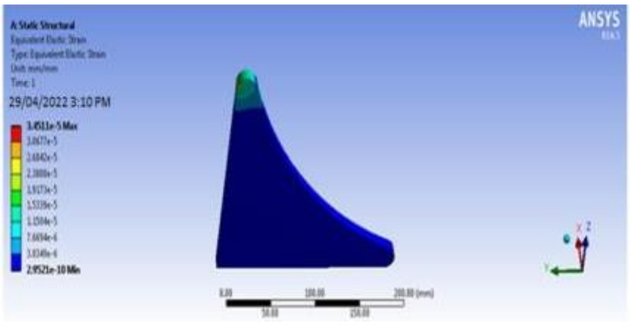

Fig. 7 Strain of Aluminum alloy 7475

2. **MATERIAL – E-GLASS**

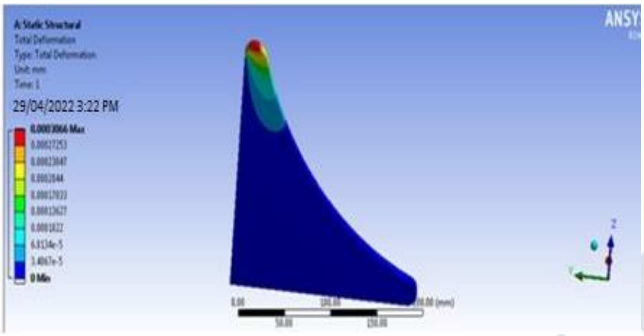

Fig. 8 Deformation of E-GLASS

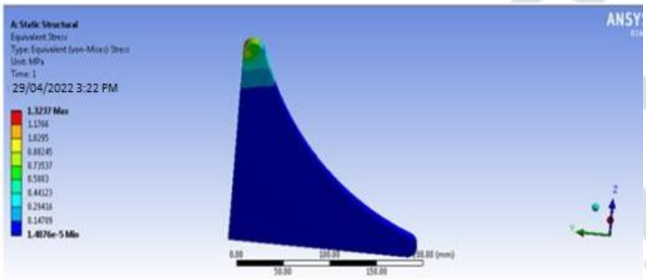

Fig. 9 Stress of E-GLASS

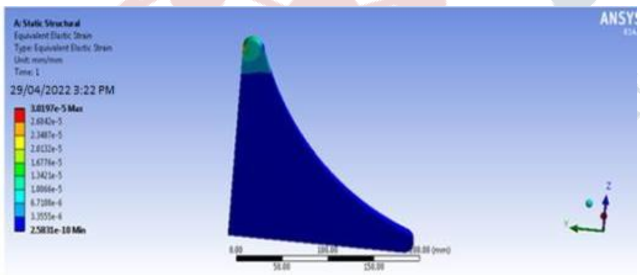

Fig. 10 Strain of E-GLASS

3. **MATERIAL – CARBON FIBRE**

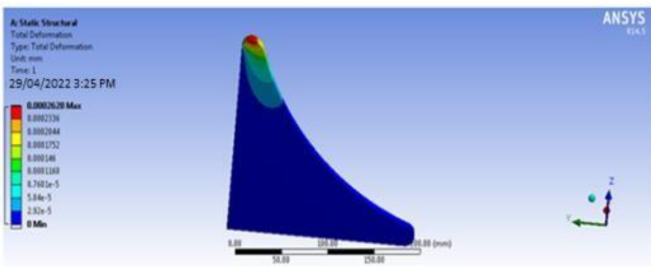

Fig. 11 Deformation of Carbon Fibre

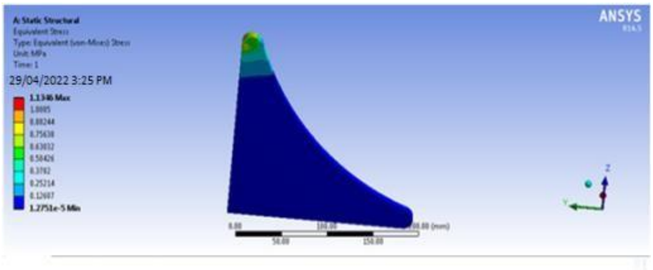

Fig. 12 Stress of Carbon Fibre

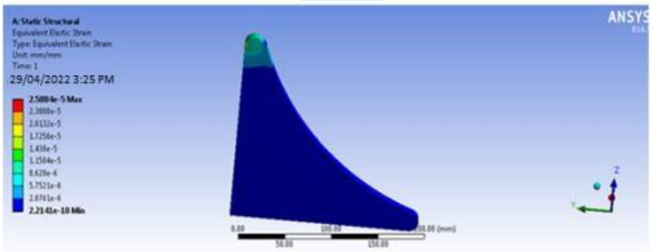

Fig. 13 Strain of Carbon Fibre

Table. 1 Comparison of 3 materials in model wise

Models	Materials	Deformation (mm)	Stress (Mpa)	Strain
Model-1	Aluminum alloy 7475	0.0003504	1.5128	3.45e-5
	E-glass	0.0003066	1.3237	3.019e-5
	Carbon fiber	0.0002628	1.1346	2.5584e-5
Model-2	Aluminum alloy 7475	0.0021905	1.3885	2.286e-5
	E-glass	0.00019167	1.215	2.003e-5
	Carbon fiber	0.00016429	1.0414	1.7145e-5
Model-3	Aluminum alloy 7475	0.0066258	1.8655	3.9775e-5
	E-glass	0.00054556	1.6323	3.4803e-5
	Carbon fiber	0.00046934	1.3991	2.9831e-5

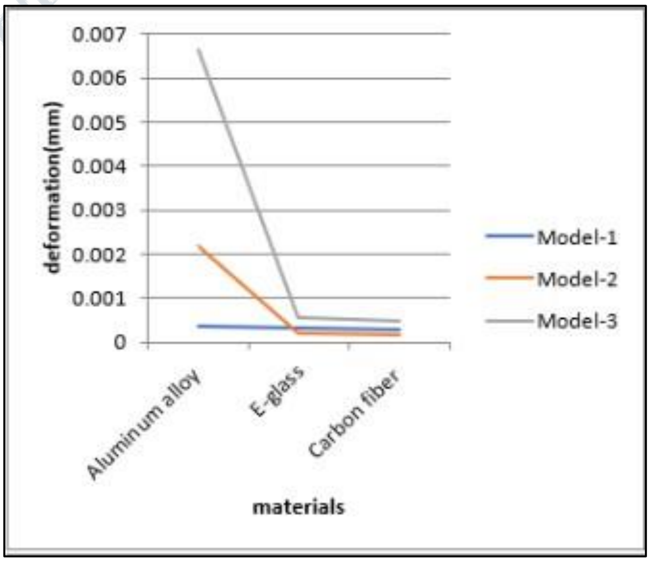

Fig. 14 Graph of Deformation vs Materials

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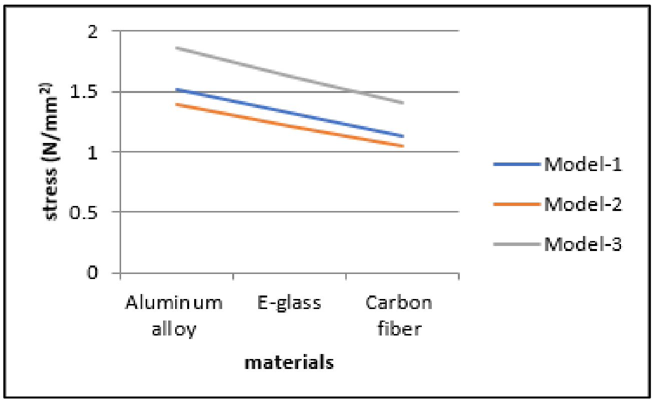

Fig. 15 Graph of Stress vs Materials

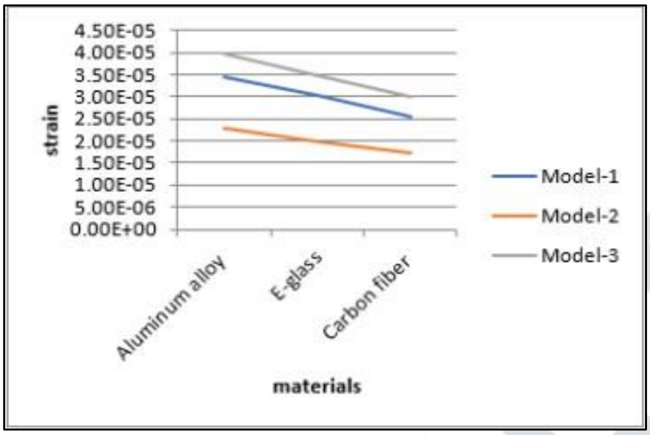

Fig. 16 Graph of Strain vs Materials

VI. CONCLUSION

The fin is a main surface of the Aerospace vehicle. It is used to ensure the stability when it is subjected to aerodynamic forces. In general this fin used to move the vehicle in different directions with different materials aluminum 7475, carbon fiber and E- glass fiber.

By observing the static analysis results the stress less for carbon fiber material compare with E-glass and aluminum alloy materials for model-2. So it can be conclude the glass fiber materials is better material and model-3 is better model for aero fin blade.

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