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ANALYSIS OF COMPOSITE MATERIAL FOR WING OF AIRCRAFT

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ABSTRACT

Design of aircraft take in consideration Many factors like safety, efficiency, reliability, and comfort. However, the importance all of these aspects depend on the type of the aircraft where the designed can vary from fighter to commercial airplanes.

As a result, the design of aircraft has to meet with requirements that effect on the materials used in its construction and complexity of its structure. Many from materials can be used in the design of the aircraft to get good properties such as, elasticity, strength, weight, specific, and corrosion resistance.

Also can be used Different materials in the design the parts of the aircraft, as a function of the initial requirements of the strength -to -weight ratio and the preferential directions of the applied loads.

In this paper, the aircraft wing is modeled by 3D modeling software Pro/Engineer. The material that which used for aircraft wings is mostly metallic alloys. In this paper, the materials change by composite materials Carbon Fiber and Aramid Fiber.

Static analysis done to determine the stresses and strain and deformation produced by applying loads. Analysis done in Ansys.

KEYWORDS: Aircraft Wing, Composite Materials, Stress, Strain, Deformation

INTRODUCTION

AIRCRAFT STRUCTURE

Modern aircraft wings can to designed from different types of materials, depending on the structural function. The wing aircraft is structure comprised of more different parts, such as skin, spar, and ribs, as well as flight control surfaces, like ailerons and flaps.

Each of these parts supported by different loads and, thus, the right material must to be select. Aluminum alloys can be used to manufacture the ribs, while the design of the control surfaces wing skin fabricate by composite materials

Wing Structure

Design of aircraft depend on some factors, like size, weight, use of the aircraft, desired rate of climb and desired speed in flight and at landing distance. The wings are of full cantilever design. This means they are built so that no external bracing is needed. They are supported internally by structural members assisted such as spar and ribs of the aircraft. Other aircraft wings use external struts or wires to the assist in carrying the aerodynamic and landing loads and supported. Wing support cables, struts and they make from steel alloy. The struts and their attach by fittings that have fairings to reduce drag force.

Aluminum and aluminum alloy are common material from which to construct wings, but it can be wood covering by fabric, and some time a magnesium alloy has been used as well as, modern aircraft are tending to using lighter and stronger materials throughout the airframe and in wing construction. Wings made entirely of composite materials like carbon fiber or other composite materials exist.

NACA AIRFOIL

Airfoils

An airfoils shape is defined by several parameters, which are shown in the figure below.

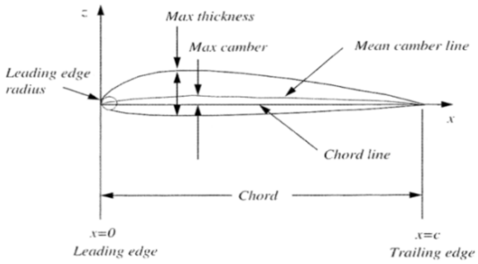

Figure 1: Airfoil Definitions

In the paper selected NACA 2412

NACA 2412 Airfoil

Table 1

X axisy	axis
1.000084	0.001257
0.993984	0.002524
0.946027	0.012110
0.905287	0.019752
0.728228	0.048000
0.579155	0.065609
0.344680	0.079198
0.203313	0.072947
0.091996	0.054325
0.004833	0.014049
0.000000	0.000000
0.002223	-0.006689
0.123281	-0.039546
0.241131	-0.042294
0.903730	-0.008033
0.985978	-0.002265
0.999916	-0.001257

MATERIALS

Carbon Fiber

Carbon fiber described as fiber contain at 90% from carbon prepared by control pyrolysis and thermal treatment for selected feed stocks and fibers. The ability for fabricate nanomaterial strictly controlled size,

Structure and shape has inspired the application for Nano chemistry to numerous fields including electronics and optics and catalysis.

Synthesis of well-defined of nano particles had result in several prominent milestones in progress for Nano science; include the discovery of fullerenes and carbon nanotube. The latter material represents the link between well-established carbon material and a new field of the nanotechnology. The application for that carbon material in the areas as diverse as construction, electronics, medicine, energy and transportation, because that suggests the first technology age of the 21st century will be "carbon age."

Carbon Fiber Composites

Carbon fiber Composites are five times stronger than steel for structure parts, carbon fiber composite five times lighter than steel. In comparison with aluminum are seven times stronger and two times stiffer. Carbon fiber have good corrosion resistant materials. Carbon fiber composites have fatigue properties is superior comparison with all known metals.

Carbon Fiber Composite Applications

By using carbone fiber lead to low cost for system by decrease of maintenance and fast treatment for the fail our and improved reliability and its considered suitability for the applications where stiffness, strength, outstanding fatigue, and lower weight, characteristics are critical requirements. And its also ideal for the application which high temperature operation**.**

- **Automotive**: liquefied natural gas tank age, specialty auto and drive shaft struck panels, and all are made from carbon fiber and thermo sets.
- **Satellites**: the carbon fiber composite using in satellites because it have very high modulus stiffness- to-weight ratios, and partly for their negative axial coefficient of thermal expansion.
- **Aerospace**: Early development of the carbon fiber was driven almost by the higher performance of aircraft are made possible with carbon fiber composites.
- **Sporting goods**: carbon fiber have light weight and high stiffness and that due to increases club head speed for improved distance.
- **Carbon fiber fabrics**: saturated with resin are applied in bridgs columns in some countries for seismic protection. Because high stiffness of the carbon decrease the movement of the concrete.

Aramid Fiber

Aramed fiber have special properties like high stiffness and high strength and limet in creep. The main reason for using aramed fiber that it have high toughness and low cost. Unlike carbon composites, aramid composites loaded in flexure, compression, or shear fail in a non-brittle manner. Their fatigue strength is also excellent. Aramid fibres is use in more applications.

The Important Aramid Fibers Properties are:

- High resistance to organic solvents
- No melting point (its start at 500 C)
- Aramid fiber has High resistance for abrasion

- Aramid fiber has good Tough as well as strong
- Aramid fiber has Non-conductive
- Its Sensitive to acids, and solvents
- Low flammability

Applications

Aramid fiber applications are divided for two section

A) Reinforce such as goods of sport, military vehicles and aircrafts, and more other

B) Fabrics in clothing like bullet proof clothes and fire protection clothes. More uses of aramid are:

- Sail cloth
- Snowboard
- In pressure vessels
- Resistant clothing for flammable.
- Cables and Ropes
- Systems of Optical fiber cables
- Enclosures of Jet engine
- Wind instruments
- Tyres Reinforcement for and rubber goods

WING MODEL

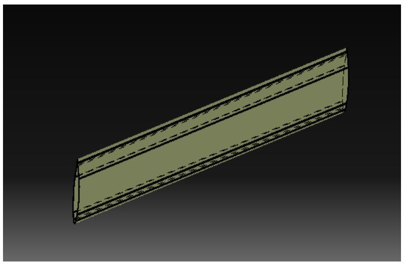

Figure 2: Stratural Analysis of Wing

Aramid Fiber

Density	**:**	**1.43 g/cm3**
Young's Modulus	**:**	**70.0 Gpa**
Passions Ratio	**:**	**0.36**
Pressure Value	**:**	**0.02 N/mm2**

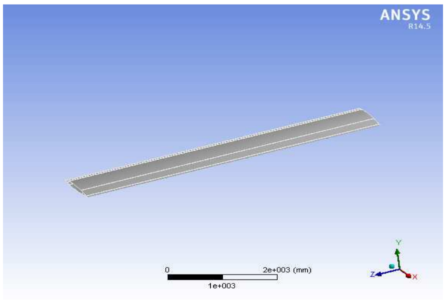

Figure 3

Mesh Generation

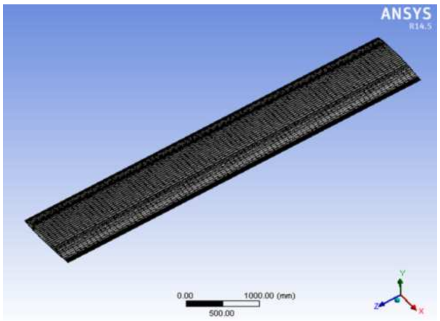

Figure 4

Deformation

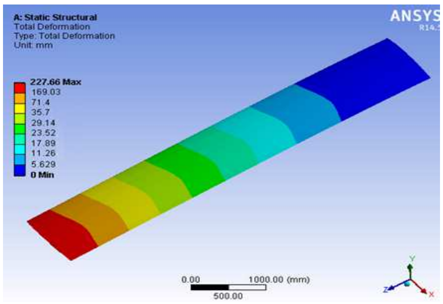

Figure 5

Strain

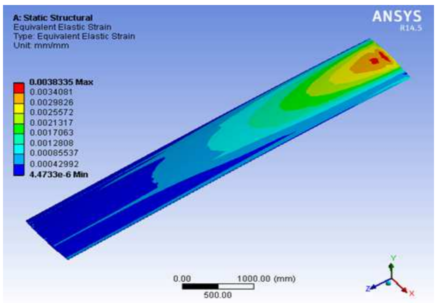

Figure 6

Stress

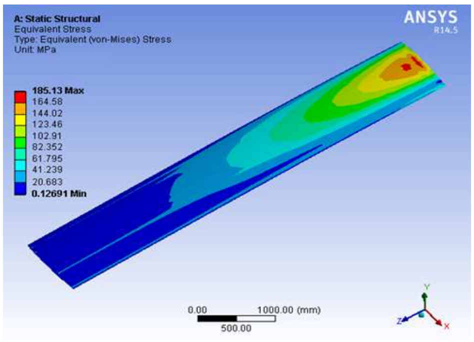

Figure 7

Carbon Fiber

Density	:	1.55 g/cm^3
Young's modulus	:	70Gpa
Passions ratio	:	0.28
Enter pressure value	:	0.02 N/mm2

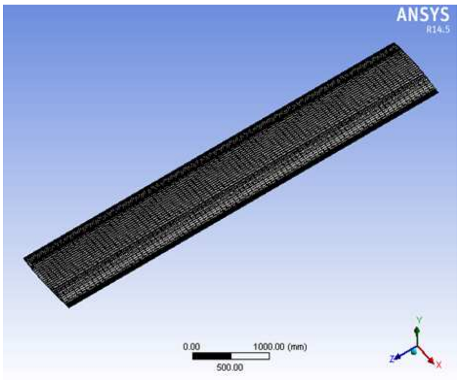

Figure 8

Deformation

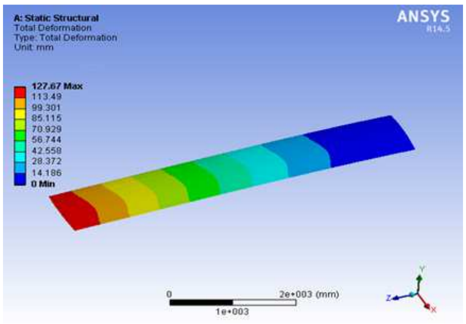

Figure 9

Strain

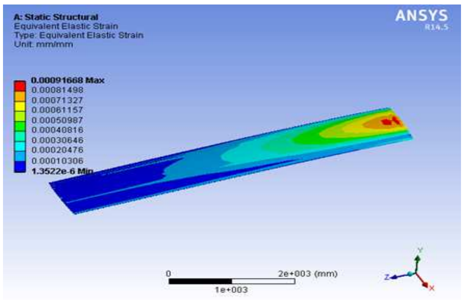

Figure 10

Stress

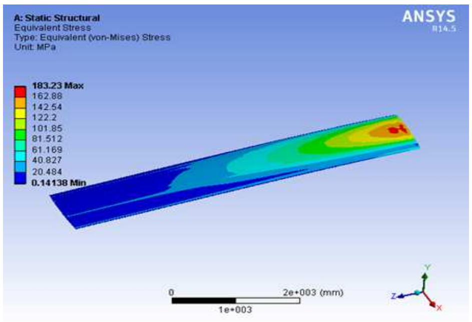

Figure 11

RESULT TABLE

Table 2: Stratural Analysis

	Deformation (mm)	Strain	Stress
Aramid Fiber	227.66	0.0038335	185.13
Carbon Fiber	127.67	0.000916	183.23

CONCLUSIONS

The analyses shows when using aramid fiber get the result for parameters (deformation, strain, stress) (227.66, 0.0038335, 185.13) respectively

But when using carbon fiber get best result for (deformation, strain, stress) (127.67, 0.000916, 183.23) respectively

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