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Design and Analysis of Opto Wing of an Aircraft using Ansys Workbench

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ABSTRACT-Aircraft wing could be a reasonably fin and it produces the carry of an aircraft. These wings typically expertise mechanics forces among thus it's terribly essential for an engineer to judge this force so as to avoid the failure of fatigue of the wings In current work, it is designed for trainer craft wing by mistreatment CATIA V5 (CADD software) and to reckon stress at wing structure, stress analysis is dispensed in ANSYS tool. In AN framework structure, fatigue cracks are typically gift at the placement wherever tensile stresses are high. During this project, the trainer craft structure with skin, spar and ribs are thought of for coming up with and analysis.

1. INTRODUCTION-Aircrafts influence of itself, the fuel, the passengers, and also the freight. For each craft to fly, the carry is generated by their wings. The carry generated by wings hold the plane within the air. The craft must be pushed through air thus as to generate carry, and also the motion within the sort of mechanics drag is resisted by air.

1.1 sorts of Wing structure

Different wing structures are in observe. They are

- Fixed-wing
- rotor blade
- ornihopters

A fixed-wing craft , like associate aeroplane, is in a position to flight with the assistance of wings that turn out carry caused by the aircraft's forward rate of air and wings form. Fixed-wing craft differ from rotary-wing aircraft(the wings kind a rotor mounted on a turning shaft or "mast"), and ornithopters (machine designed during which undulation wings are getting used to attain flight). In mounted wing aircrafts, it's not necessary for wings to be rigid. Kites, aeroplanes, variable-sweep wing craft and droop gliders that use wing morphing are all samples of fixed-wing aircraft[1][3]. Gliding fixed-wing craft, together with free-flying gliders of varied types and bound kites, will use moving air to achieve altitude high powered paragliders, high-powered droop gliders that receive forward push from associate degree engine are being employed by high-powered fixed-wing craft (aeroplanes). Most fixed-wing craft are flown by a pilot on board the aircraft, however some are specifically designed to be remote-controlled and controlled either remotely or autonomously onboard computers[1].

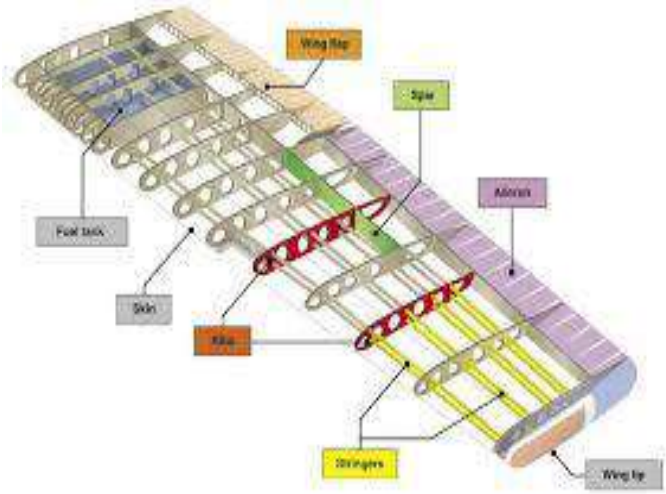


Fig.1.1 Wing structure with ribs and spars

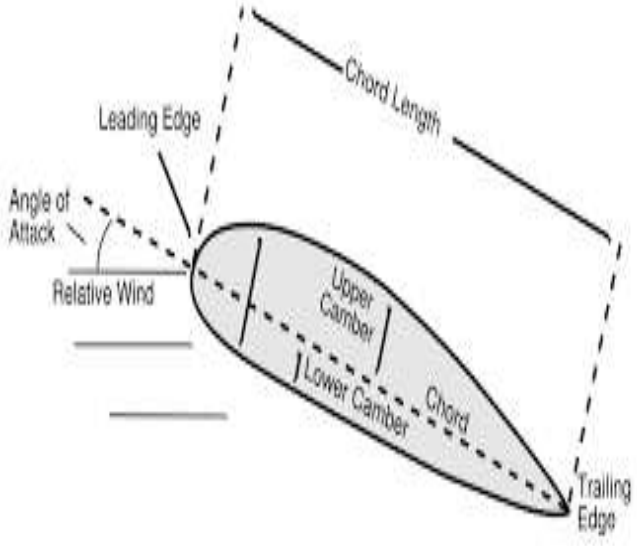


fig.1.2 aircraft wing

Fig1.3 Fixed wing aircraft

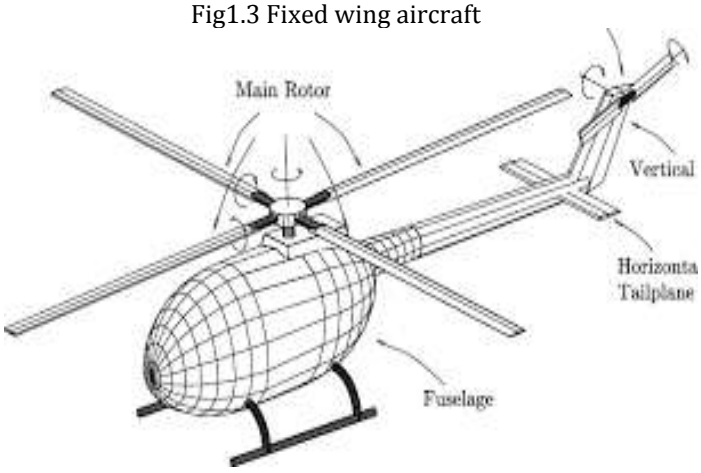


Fig.1.4 Rotary wing aircraft

1.2 Materials utilized in current work are

Following three completely different materials are being employed in current work and best one is chosen for craft wing construction.

• Aluminum

• Carbon epoxy composite, and

• stainless-steeCorresponding stress(von- mises) and total deformation below applied load are computed for all the higher than materials and suggestions are provided for the choice of fabric for higher results.

1.3 Properties of Materials

• aluminium Alloys: aluminium alloys are most preponderantly used material within the construction of craft components since they're accessible copiously in nature once steel. they're light-weight in weight additionally they need smart strength necessary for craft to flight. within the section we've mentioned some favorable physical properties of aluminium alloy[8]. They are

a. Density: aluminium alloys have nearly 3 times higher density as that of steel

b. Strength: once aluminium alloyed with alternative parts like metal, silicon, copper and Mn, the strength is magnified.

c. Corrosion resistant: as we have a tendency to all apprehend that aluminium are less vulnerable to corrode. The formation corundom layer material is exposed to air prevents the fabric from obtaining corrode. They act corrosion resistive material and so increase lifetime of half.

d. Thermal conductivity: aluminium alloys have concerning 3 times bigger thermal conductive property in comparison therewith of steel.

e. Reflectivity: this property of aluminium makes material ideal as associate building material once subjected to rays of sun particularly throughout summer.

Table 1.1 Properties of aluminum alloy

Property	Unit	Value
Density	g/cm^3	2.6898
Modulus of elasticity	GPa	68.3
Thermal conductivity (0-100 ^{o}C)	cal/cms. °C	0.57
Poisson's Ratio		0.34
Property	**Unit**	**Value**
Coefficient of thermal expansion	x10^{-6} K^{-1}	2.1
Compressive Strength	MPa	570
Density	g /cm^3	1.6
Shear strength - in-plane	MPa	90
Young's Modulus	GPa	70
Shear modulus	GPa	5
Ultimate Compressive Strain	%	0.8
Ultimate Shear Strain	%	1.8
Ultimate Tensile Strain	%	0.85

2. METHODOLOGY

Method adopted to hold out the project is

• produce model of wing exploitation CATIA V5 tool

- Import the draft to ANSYS
- Static Analysis to seek out stress (voon-mises) and total deformation exploitation ANSYS

2.1 Introduction to CATIA V5

CATIA an acronym of Computer Aided Three Dimensional Interactive Application is a multi-function design software and ibest suited for computer aided drawing(CAD), computer aided manufacturing(CAM), computer aided engineering(CAE), PLM and 3D models. CATIA was developed by the French company called Dassault Systems in the year 1981[11].

CATIA is being used wide range of companies since it supports stages of product development from conceptualization to design to engineering and manufacturing. This software enables user to create 3D models from 2D drawings or sketches, sheet metal models, molded parts, composites etc can be created up to the definition of mechanical assemblies. Kinematic definitions as well as the functional tolerances of product can also defined in the drawing using CATIA.

Tools Available in CATIA V5

- Product Design
- Surface design
- Wireframe
- Assembly design.
- Structure design
- Composite grid design
- Piping
- Kinematics
- Ergonomics
- Drafting
- Analysis and simulation

Application of CATIA

- It has got wide application in mechanical industries. To name few,
- Automotive industry
- Aerospace
- Piping
- Ship building
- Industrial equipments etc

2.2 Introduction ANSYS Workbench

ANSYS workbench is finite element analysis tool used in conjunction with CAD system and design modeler. ANSYS is used for analyzing structural, thermal and electromagnetic performances [12]. The CAD model created in any CAD software is imported to ANSYS to compute static and dynamic stress acting on material.

DESIGN and ANALYSIS OF WING

2.1 2D and 3D models of aircraft wing

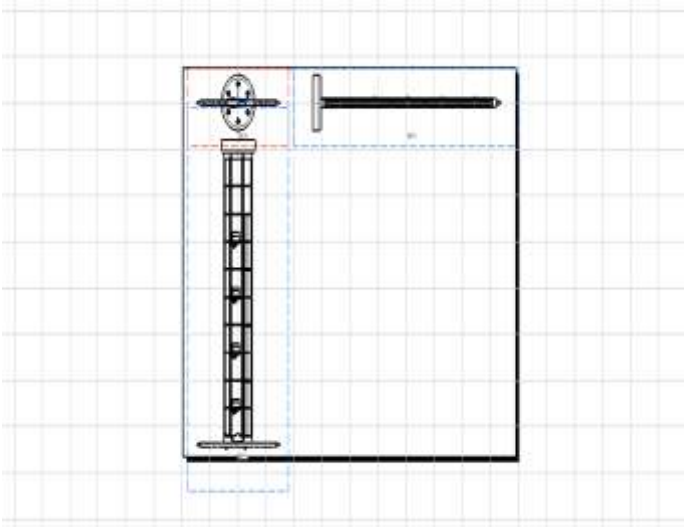


Fig.2.1 Aircraft wing 2D drafting

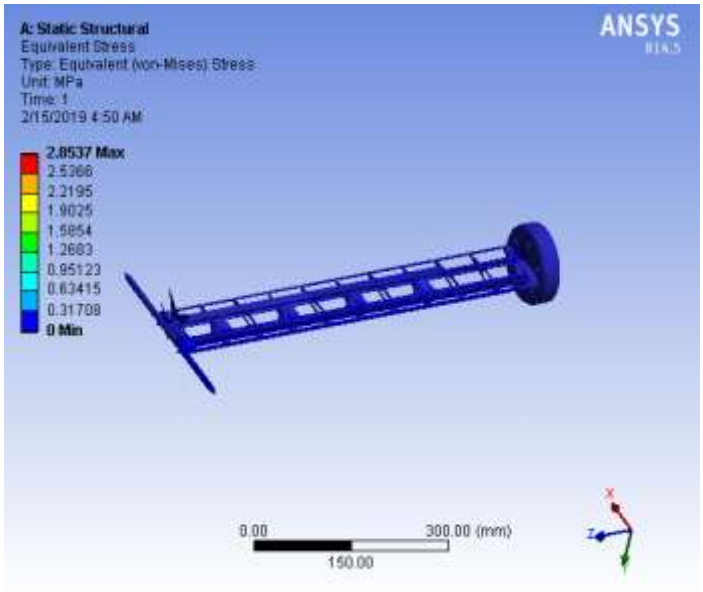


Fig. 2.2 Equivalent stress for Carbon epoxy

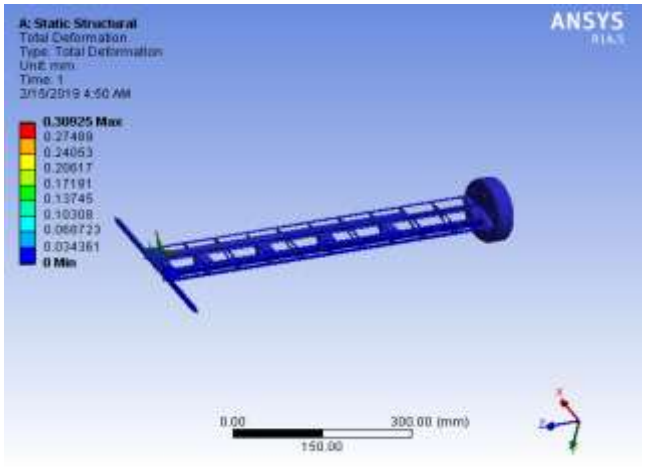


Fig. 2.3 Total deformation of Carbon epoxy

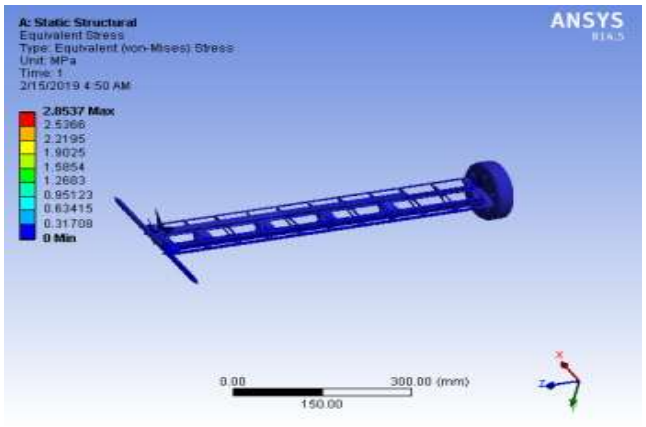


Fig. 2.4 Equivalent stress for Aluminum

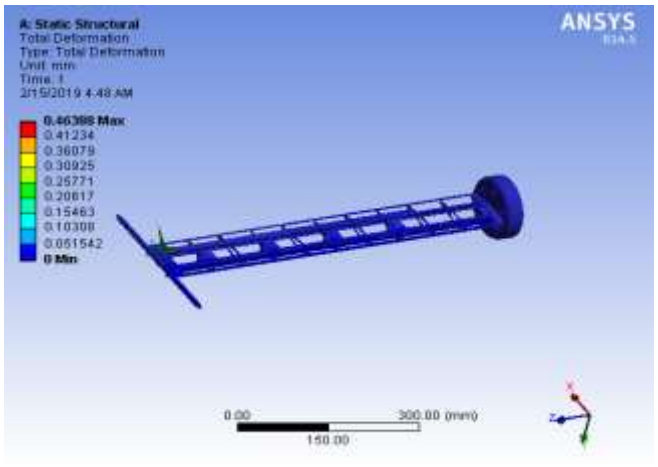


Fig.2.5 Total deformation for Aluminum

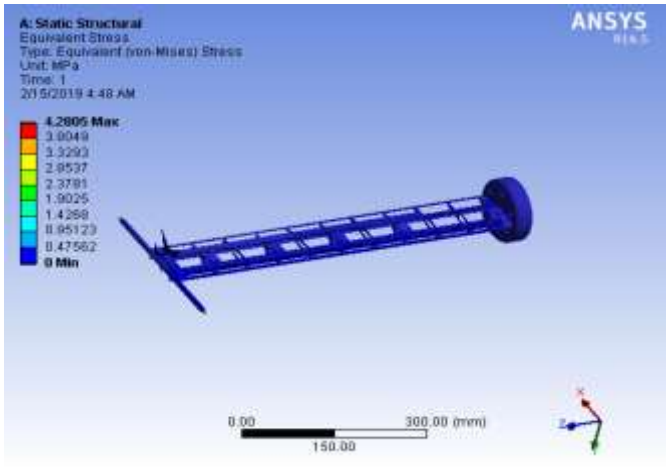


Fig. 2.6 Equivalent stress for Aluminum

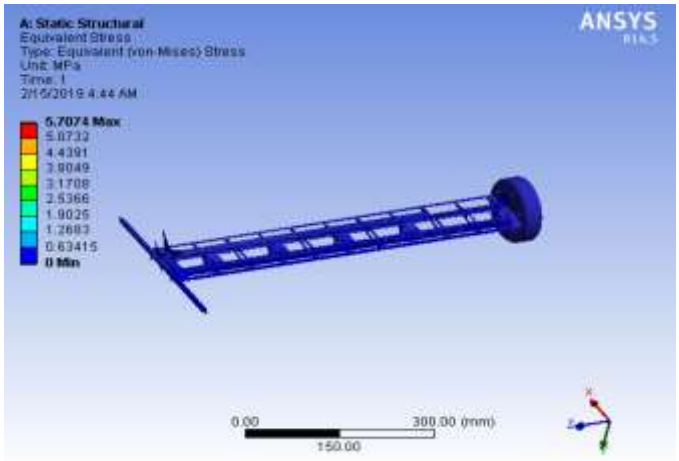


Fig.2.7 Equivalent Stress for Stainless steel

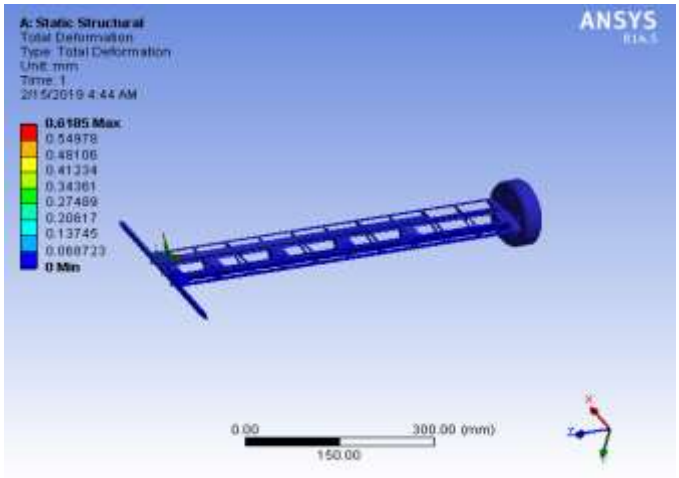


Fig.2.8 Total deformation of stainless steel

RESULT TABLES AND GRAPHS

Result Tables

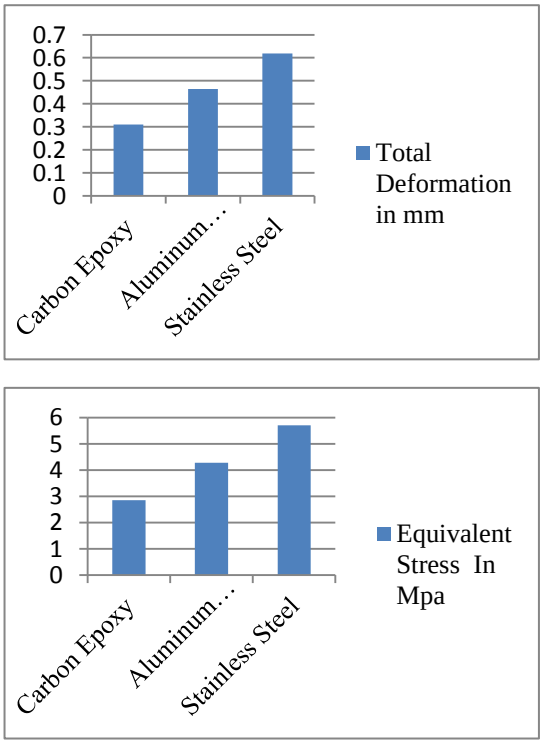
Table 3.1 Comparison of equivalent stress for different materials

Sl No	Material	Equivalent Stress In Mpa
1	Carbon Epoxy	2.8537
2	Aluminum Alloy	4.2805
3	Stainless Steel	5.7074

Table 3.2 Comparison of total deformation

Sl No	Material	Total Deformation in mm
1	Carbon Epoxy	0.30925
2	Aluminum Alloy	0.46388
3	Stainless Steel	0.6185

3.2 Graphs



Graph 7.2 Total deformation of material

CONCLUSION

The present work was performed to spot the most effective appropriate material for construction of craft wing. Use of metal could be a ancient follow since it's on the market extravagantly and is lightweight in weight that supports craft to flight however the recent studies on composite materials proves that, these will really replace the metal in construction of craft wing. We tend to conducted experiment on metal alloy, carbon epoxy and chrome steel for identical and are analyzed mistreatment ANSYS. The obtained results from computer code are valid.

Since the distinction between obtained values is minimal , we are able to conclude that Carbon epoxy composite that has von-mises stress of two.8537 MPa. And total deformation of zero.30925 is accustomed turn out the craft wing instead of metal alloy. Carbon epoxy composite really possesses higher strength when put next with metal alloy and it's additionally lightweight in weight. Thence we tend to conclude that carbon epoxy composite is best appropriate material for craft wing.

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