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DESIGN AND STRUCTURAL ANALYSIS OF AIRCRAFT WING

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Abstract

The structure of the skin, ripples and spares. The spar is charged to the ground and the weight of the wings. Other structural and formative components, such as the ribs, are linked tospare skin. The wings of the Aeroplan are the main lift. Depending on the aircraft type and mission, the design of the wing may change. PRO-ENGINEEERWILDFIRE 5.0, an aircraft trainer's wing structure, has developed this theory in depth. In order to compute the stresses in the wing structure, the wing structure will then be analyzed. The stress is assessed by ANSYS, using a finite element technique to determine the structural safety factor. A fracture of fatigue may occur if the tensile stress in a structure such as the airplane is severe.3D-model of aircraft wing is created using modelling software CATIA parametric software and structural analysis is done in the wing with the help of ANSYS software to determine the deformation, stress and strain for estimate the life of the component. This thesis explores the wing architecture of the trainer aircraft with skin, spares and ribs for a thorough study. The wing consists of fifteen ribs and two skin spars. "I" front spar and "C" section back spar. A stress and fatigue analysis is done across the entire wing sectionto identify the stresses and life spans and ribs due to the pressurized load.

Keywords: Air craft wing, Structural analysis, FEM for aircraft wing

1. INTRODUCTION

A fixed-wing aircraft is an aircraft such as a plane. A fixed wing aircraft can fly by winging the car's front speed and wing shape by generating a lift. The fixed aircraft are different from rotating aircraft in which a rotor, mounted on a rotating shaft and flapping wings in the same way, forms a rotary aircraft on the bird. Fixed air gliders, including free flying gliders of several sorts and kites, can be used to enhance their height. The (aeroplane) motor, including powered paragliders, gliders and certain vehicles with a grounding impact, is gaining pace by motorized fixed-wing aircraft.

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There may not be rigid wings on a fixed-wing aircraft. Examples of aircraft with fixed wings are kites, slide gliders, aircraft with variable sweeps and wing warping aeroplanes. The majority of fixed-wing aircraft are piloted on the aeroplane; however, some designs are remotely operated or computerized.

A vehicle for ground effect (GEV) is also an aeroplane which reaches the earth's surface level by using the soil effect. Aerodynamic interaction between wings and earth's surface is characterised as the ground effect. Ground effect Some GEVs are known as fixed-wing powered aircraft as they can fly more out of the soil (OGE) if necessary.

Static planes extending on both sides of the aircraft are the wings of a fixed aircraft. When the aeroplane proceeds, air flows across the aircraft's lifting wings. Drafts and some lightweight gliders and aviators feature flexible wing surfaces stretched across a frame, which are reinforced by airflow lifting forces. Larger aircraft include steep wing surfaces, greater strength.

Very strong and lightweight early aeroplane motors were. Early aero foil components were also quite thin and no sturdy frame was established. Most wings were too light for them to be sturdy, and outside straps and wires were added until the 1930s. In the 1920s and 1930s, when the motor power available rose, the wings could be strong enough to prevent bracing. This form of wing is known as a knob.

A single aircraft is a monoplane, two of them are stacked on top of one another, and two of them are stacked behind each other. The unbraced or cantilever monoplane became the most frequent powerful design when the available motor power rose in the 1920's, and bracing was no longer essential.

Nevertheless, the aviation industry is based on stringent safety tests and standards that are applied to innovative technology which are continues to emerge. Therefore, a long interval is generally used before a fresh concept is introduced by the major aviation industry that inhibits the use of next generation material.

This paper presents the methods for the structural design of the wing of an aircraft unmanned. This study successfully examines the employment of computational tools in design. The UAV

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wing was analyzed using FEA software ANSYS for strength and rigidity. As a design input were used the available CAD model and aerodynamic CFD study. The loads of Aerodynamics were used on the structure in a new manner using artificial neural networks as pressure functions. The effects of geometry, materials and lay-up variations were also investigated to discover the optimal mix of strength, rigidity and minimal weight. The wing has two spars and has been developed with a composite structure of all. The wing weighs lighter than a similar aluminum wing and is sturdy enough to meet all criteria of in-flight stress and safety factor.

2. Materials and Methods

The following materials were selected for the analysis.

- ALUMINUM 6061-T8, Density = 2.7g/cc, Young’s modulus = 69.0, GpaPoisson's ratio = 0.33
- S2 GLASS, Density = 2.46g/cc, Young’s modulus = 86.9Gpa, Poison’s ratio = 0.28
- CARBON EPOXY, Density = 1.60g/cc, Young’s modulus = 70.0Gpa, Poison’s ratio = 0.3
- TITANIUM ALLOY, Density = 4.4g/cc, Young’s modulus = 113Gpa, Poisson’s ratio = 0.33

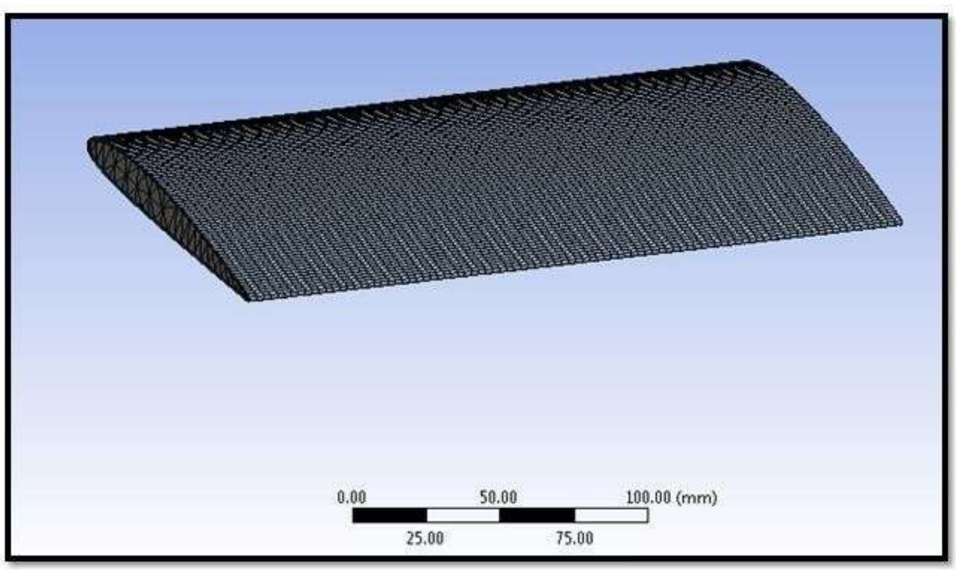

Figure 1 Diagram of Mesh of Aircraft Wing

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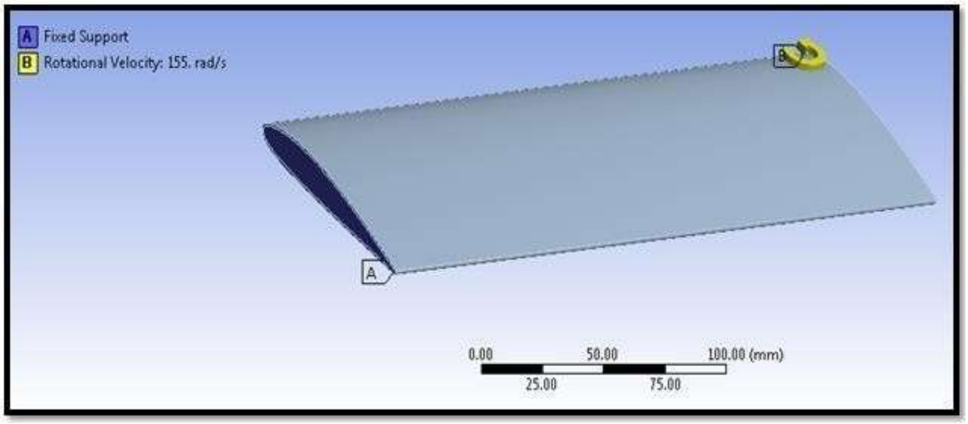

Figure 2 Diagram with Boundary Conditions

3. Results and Discussion

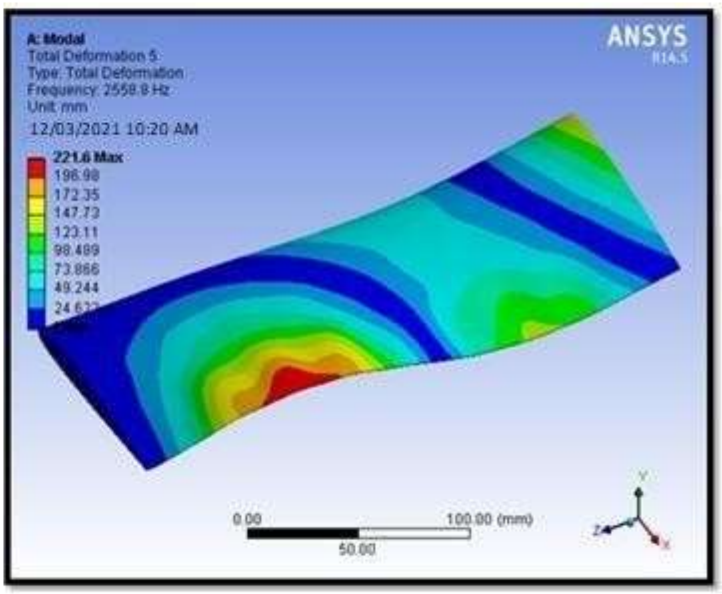

Figure 3 5th mode Deformation shape

STATIC ANALYSIS RESULTS TABLE

Material	Speed km/hr	Deformation (mm)	Stress (Mpa)	strain
Aluminum 6168-T8	400	0.034562	83.399	0.0012383
	600	0.045865	110.68	0.0016433
	800	0.081535	196.75	0.0029214
S2 glass	400	0.027463	83.545	0.00098035
	600	0.036445	110.87	0.001301
	800	0.064789	197.09	0.0023128
Carbon epoxy	400	1.9943	48.896	0.00071355
	600	0.026808	65.726	0.00095914
	800	0.04706	116.85	0.0017052
Titanium alloy	400	0.027463	83.545	0.00098035
	600	0.036445	110.87	0.001301
	800	0.064789	197.09	0.0023128

Table 1: Fatigue analysis results table

Material	Speed km/hr	LIFE	DAMAGE	SAFETY FACTOR
Aluminum 6168-T8	400	$1xe^{6}$	$1xe^{32}$	0.010336
	600	$1xe^{6}$	$1xe^{32}$	0.0077885
	800	$1xe^{6}$	$1xe^{32}$	0.0043812
S2 glass	400	$1xe^{6}$	$1xe^{32}$	0.010318
	600	$1xe^{6}$	$1xe^{32}$	0.007775
	800	$1xe^{6}$	$1xe^{32}$	0.0043736
Carbon epoxy	400	$1xe^{6}$	$1xe^{32}$	0.017629
	600	$1xe^{6}$	$1xe^{32}$	0.013115
	800	$1xe^{6}$	$1xe^{32}$	0.0073769
Titanium alloy	400	$1xe^{6}$	$1xe^{32}$	0.010318
	600	$1xe^{6}$	$1xe^{32}$	0.007775
	800	$1xe^{6}$	$1xe^{32}$	0.0043736

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4. Conclusion

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When looking at an aviation wing static analysis, air velocity (400,600&8000 km/h) increases stress values, which is the lower carbon epoxy stress than 2-glass alloy 6061-T8 and titanium alloy. Carbon epoxy is stronger as it's a composite.

By monitoring the module analysis of the aircraft wing, the deformations and frequency values for the carbon epoxy material are better. For carbon epoxy material, the safety element is more significant when looking at the aeroplane tiredness test.

For the aeroplane wing, the carbon epoxy compound is superior. That is why it can be inferred.

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