DESIGN AND ANALYSIS OF AIRCRAFT WING AT DIFFERENT WING GEOMETRIES

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ABSTRACT: A wing is a type of fin with a surface that produces aerodynamic force for flight or propulsion through the atmosphere, or through another gaseous or liquid fluid. As such, wings have an airfoil shape, a streamlined cross-sectional shape producing lift. A wing's aerodynamic quality is expressed as its lift-to-drag ratio. The lift a wing generates at a given speed and angle of attack can be one to two orders of magnitude greater than the total drag on the wing. A high lift-to-drag ratio requires a significantly smaller thrust to propel the wings through the air at sufficient lift. The requirements for the aircraft wing are High stiffness, High strength, High toughness and Low weight.

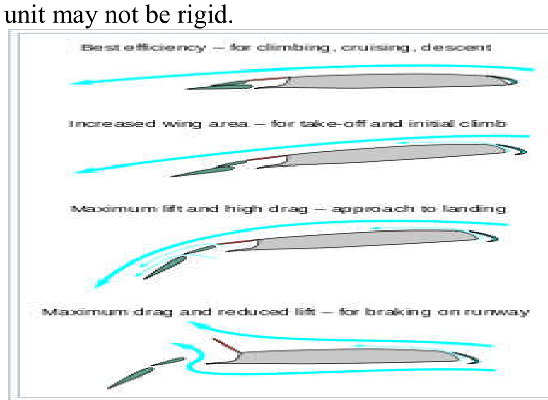
In design and finite element analysis of aircraft wing is designed and modeled in 3D modeling software CREO. The wing is modified by three major planform geometries relating to taper ratio are rectangular, trapezoidal and delta shape in order to increase the strength of the wing. The materials used for aircraft wings are mostly metallic alloys. In this thesis, the materials are replaced by composite materials S Glass and Kevlar 49.

Static analysis is done to determine the stresses produced by applying loads. Modal analysis is done on the aircraft wing to determine the frequencies and deformations, stress due to frequencies. Fatigue analysis to estimate the life of the wing. Analysis is done in ANSYS.

INTRODUCTION

A constant-wing craft is Air craft, like AN plane. A set wing craft is able to flight exploitation wings by producing improve resulting from the automobile's ahead air pace and consequently the shape of the wings. Fixed-wing craft location unit definitely unique from rotary-wing craft, within which the wings kind a rotor hooked up on a spinning shaft, within which the wings flap in the same way to a fowl.

Aero plane constant-wing craft, in addition to loose-flying gliders of assorted sorts and certain kites, will use moving air to understand peak. Steam-powered constant-wing craft profits ahead thrust from AN engine (aero planes) that embody steam-powered paragliders, steam-powered stoop gliders and a few carry vehicles. The wings of a set-wing craft location unit may not be rigid.



LITERATURE REVIEW

Design and Structural Analysis of the Ribs and Spars of Swept Back Wing

The aim of this paper work is to design and analyse the ribs and spars of a 150 seater regional aircraft for the stresses and displacements due to the applied loads. For this we did a comparative study on particular 150 seater regional aircraft. The optimum design parameters are suitably selected and then the model was designed using the CATIA software. The airfoil coordinates for the model to be designed, were generated by design foil software. The major wing design parameters were explained in detail and the wing configuration has been described. Different types of loads acting on the aircraft and the wing are determined and the moments, displacements, etc., are also determined. The wing structure was also explained and functions of each component and their arrangement are also studied. The methodology of finite element method and the detailed description about various FEM tools have been studied and implemented in this work.

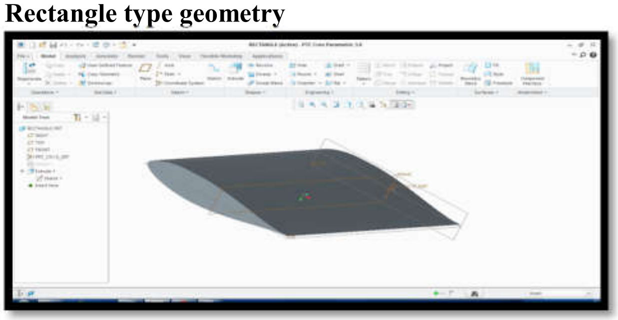
INTRODUCTION TO CAD

Computer-aided design (CAD), also known as computer -aided design and drafting (CADD), is using computer technology for the method of layout and design-documentation. Computer Aided Drafting describes the system of drafting with a computer. CADD software program, or environments, provide the person with input-gear for the motive of streamlining layout approaches; drafting, documentation, and production techniques. CADD output is frequently in the form of digital documents for print or machining operations.

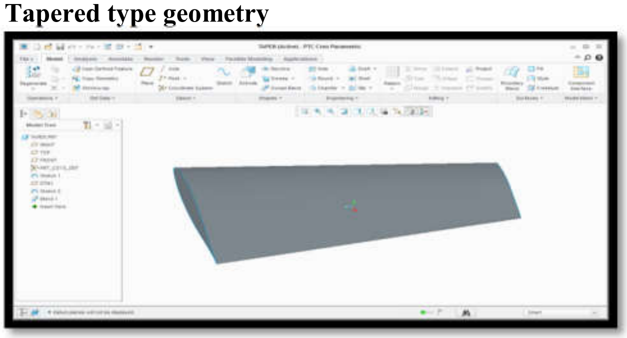
INTRODUCTION TO CREO

3.2 CREO, formerly known as Pro/ENGINEER, is 3D modeling software used in mechanical engineering, design, manufacturing, and in CAD drafting service firms. It was one of the first 3D CAD modeling applications that used a rule-based parametric system. Using parameters, dimensions and features to capture the behavior of the product, it can optimize the development product as well as the design itself.

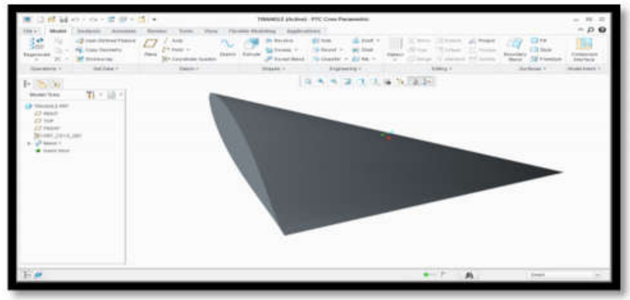
Rectangle type geometry



Tapered type geometry



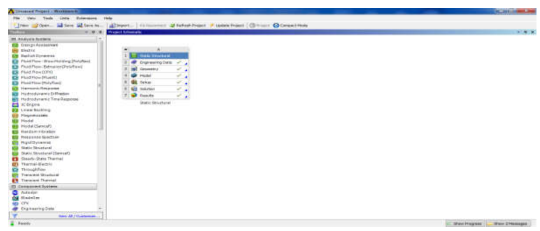
Triangular type geometry



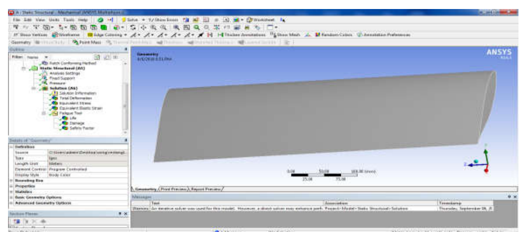
CASE: 1 RECTANGULAR TYPE

MATERIAL- ALUMINUM ALLOY

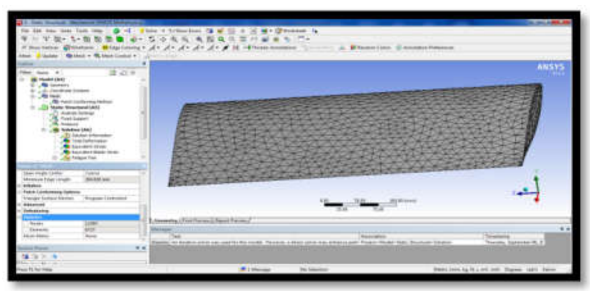
STATIC ANALYSIS OF AIRCRAFT WING



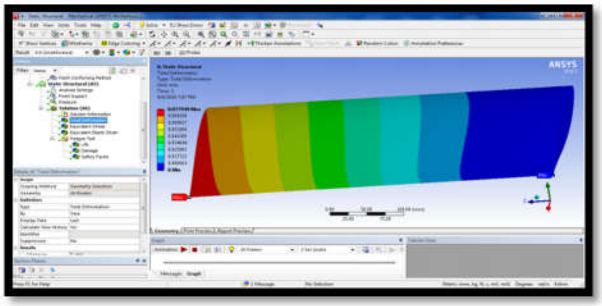
Imported model



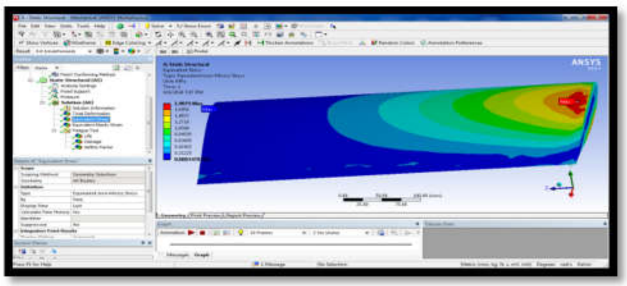
Meshed model



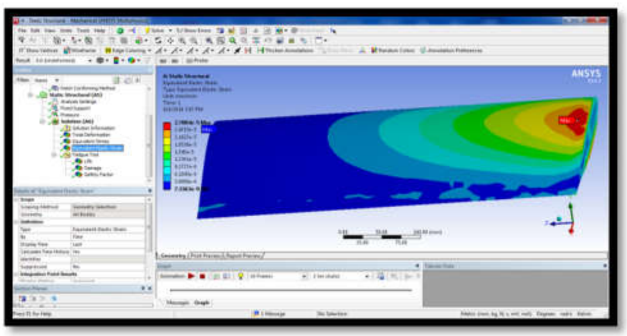
Deformation



Stress

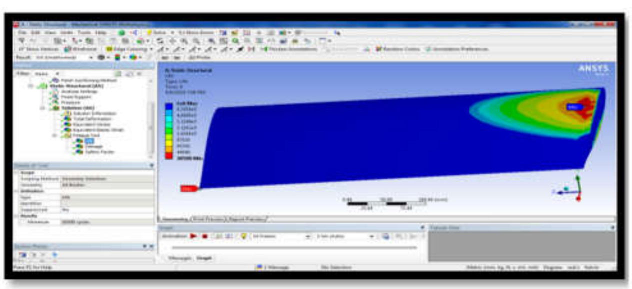


Strain

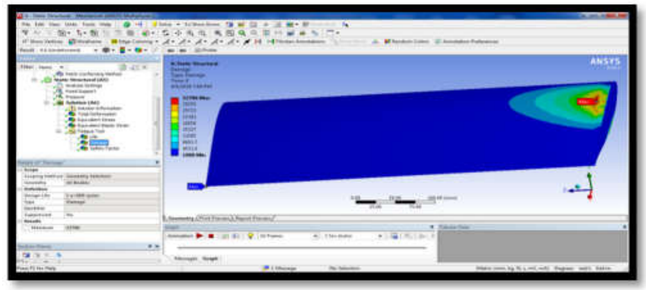


FATIGUE ANALYSIS OF AIRCRAFT WING

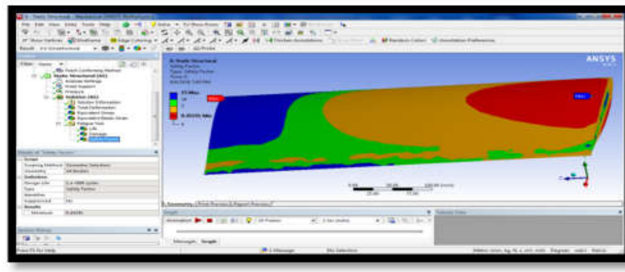
Life



Damage

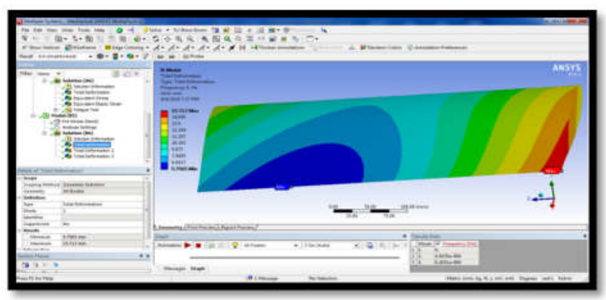


Safety factor

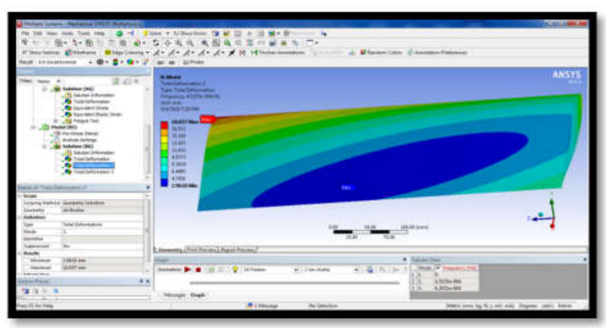


Modal analysis of air craft wing

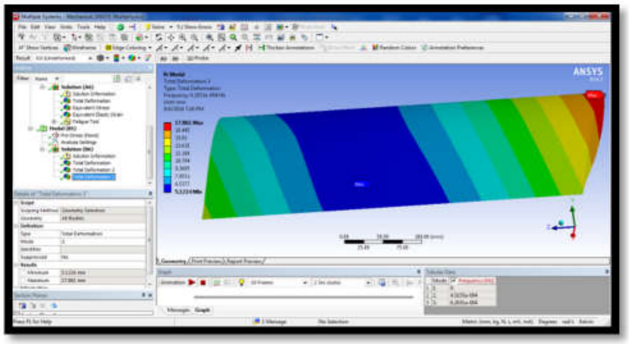
Mode shape -1



Mode shape -2



Mode shape -3

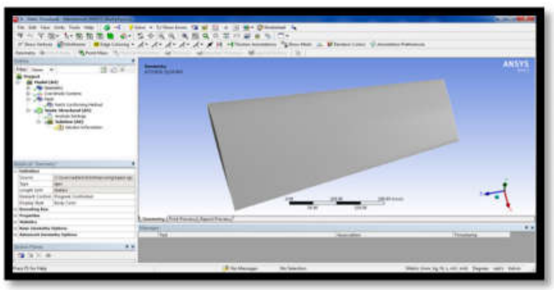


CASE: 2 TAPERD TYPE

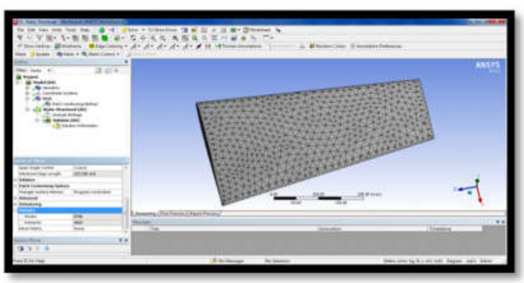
MATERIAL- ALUMINUM ALLOY

STATIC ANALYSIS OF AIRCRAFT WING

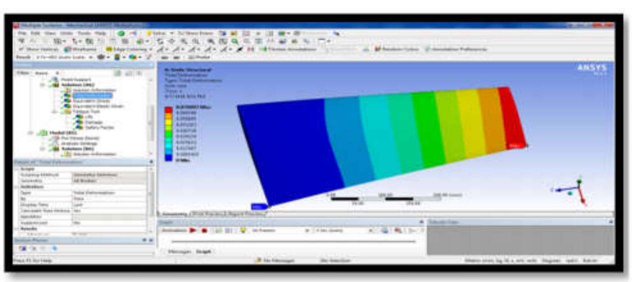
Imported model



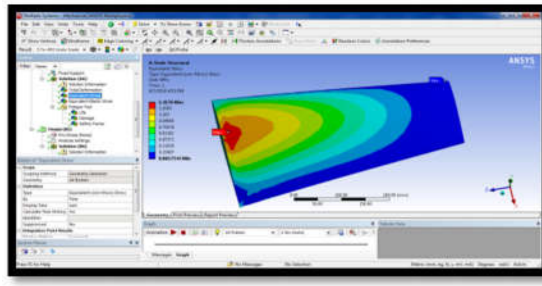
Meshed model



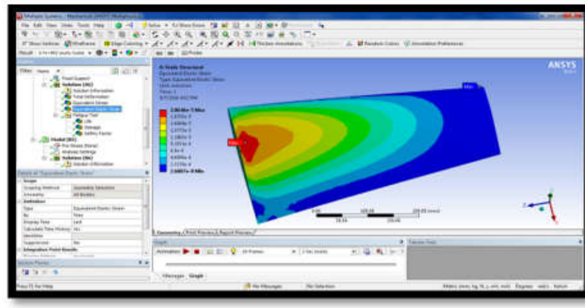
Deformation



Stress

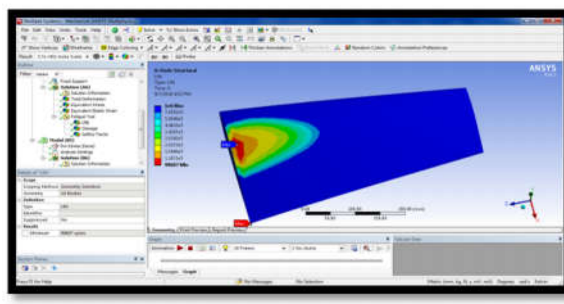


Strain

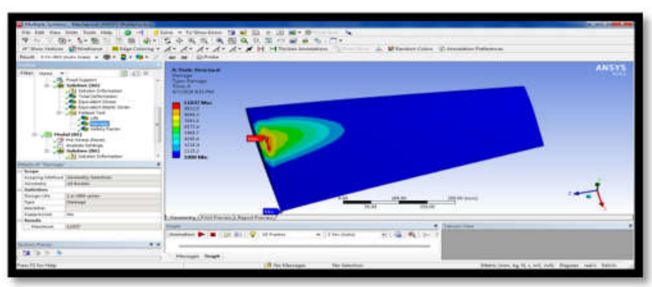


FATIGUE ANALYSIS OF AIRCRAFT WING

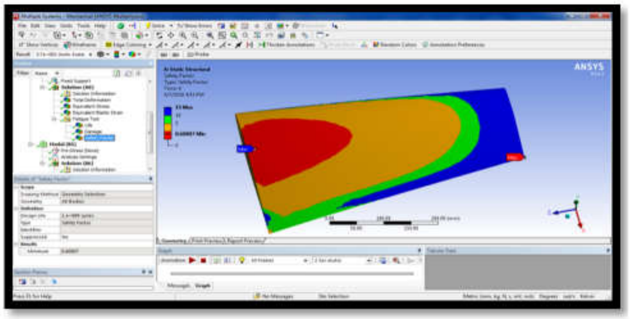
Life



Damage

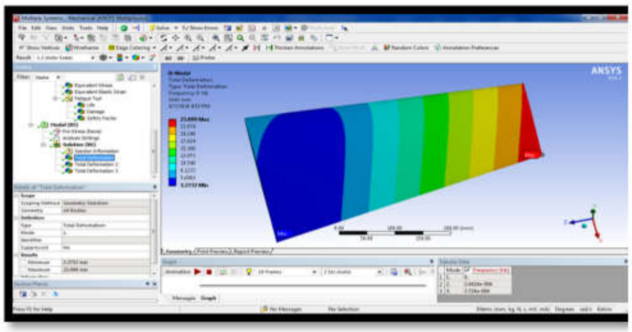


Safety factor

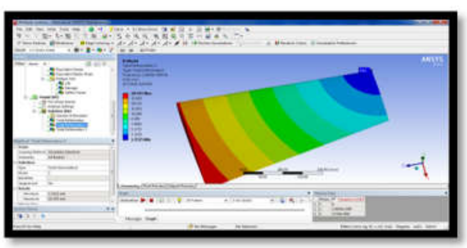


Modal analysis of air craft wing

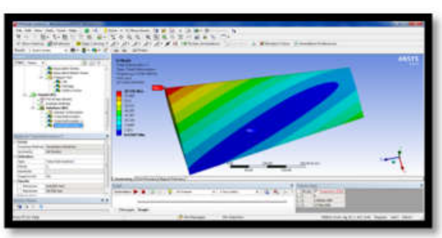
Mode shape -1



Mode shape -2



Mode shape -3

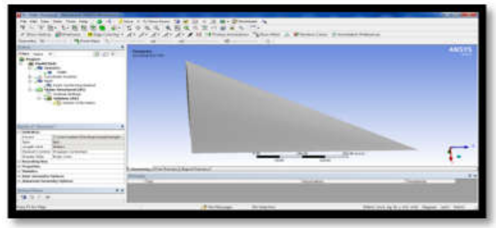


CASE: 1 TRIANGULAR TYPE

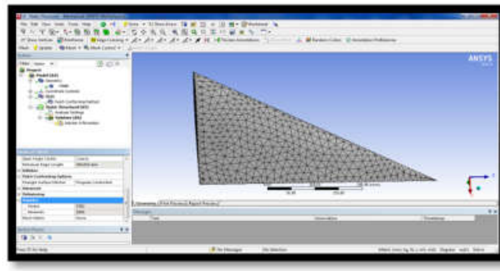
MATERIAL- ALUMINUM ALLOY

STATIC ANALYSIS OF AIRCRAFT WING

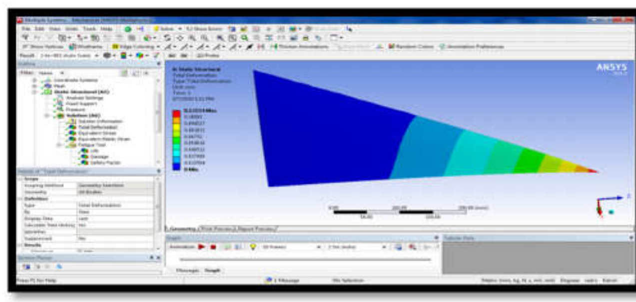
Imported model



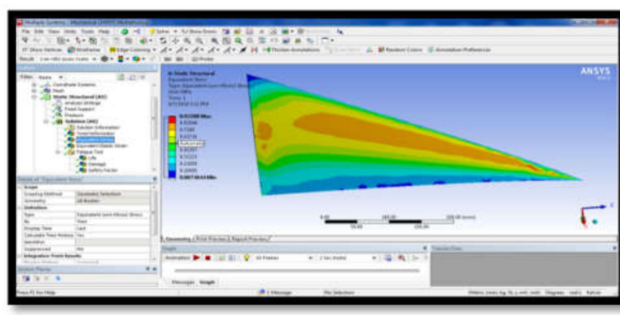
Meshed model



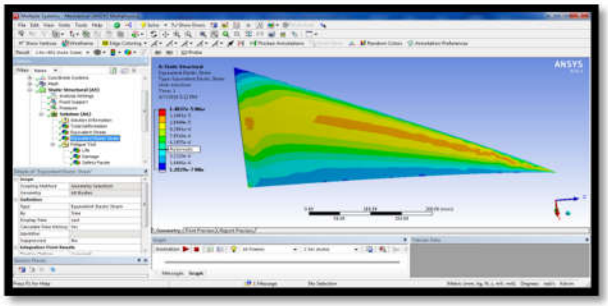
Deformation



Stress



Strain



Wing model	Material	Displacement (mm)	Stress (MPa)	Strain
rectangular	Aluminum alloy	0.077949	1.9075	2.780e-5
	S2-glass	0.058424	1.9052	2.0486e-5
	Kevlar-49	0.040492	1.9342	1.4046e-5
tapered	Aluminum alloy	0.076892	1.4176	2.0605e-5
	S2-glass	0.057516	1.4062	1.5154e-5
	Kevlar-49	0.040038	1.4369	1.1007e-5
triangular	Aluminum alloy	0.12154	0.92208	1.4037e-5
	S2-glass	0.098495	0.93858	1.0497e-5
	Kevlar-49	0.63553	0.91216	7.3098e-6

Fatigue analysis results

Wing models	Materials	Life	Damage	Safety factor
Rectangular	Aluminum alloy	1xe6	32786	0.45191
	S2-glass	1xe6	32644	0.45245
	Kevlar-49	1xe6	34507	0.44565
tapered	Aluminum alloy	1xe6	11037	0.60007
	S2 glass	1xe6	10714	0.613
	Kevlar -49	1xe6	11598	1
Triangular	Aluminum alloy	1xe6	1479	0.93484
	S2 glass	1xe6	1553.9	0.9263
	Kevlar -49	1xe6	1385	0.94501

Modal analysis results

Wing models	Materials	Mode shapes	deformation (mm)	Frequency (Hz)
Rectangular	Aluminum alloy	1	15.712	0
		2	18.657	4.5155e-004
		3	17.861	6.2031e-004
	S2-glass	1	16.55	0
		2	18.107	0
		3	19.056	5.1321e-004
	Kevlar-49	1	20.02	0
		2	24.577	0
		3	24.509	7.9867e-004
tapered	Aluminum alloy	1	25.099	0
		2	18.555	2.4424e-004
		3	28.536	3.724e-004
	S2 glass	1	21.757	0
		2	26.072	0
		3	18.253	4.4425e-004
	Kevlar -49	1	26.825	0
		2	42.323	8.159e-004
		3	27	9.7289e-004
Triangular	Aluminum alloy	1	51.621	0
		2	17.221	0
		3	29.882	0
	S2 glass	1	37.389	0
		2	41.962	0
		3	26.071	6.9506e-004
	Kevlar -49	1	51.767	0
		2	41.286	8.2857e-004
		3	33.285	1.0540e-003

CONCLUSION

A wing is a type of fin with a surface that produces aerodynamic force for flight or propulsion through the atmosphere, or through another gaseous or liquid fluid. As such, wings have an airfoil shape, a streamlined cross-sectional shape producing lift.

In design and finite element analysis of aircraft wing is designed and modeled in 3D modeling software CREO. The wing is modified by three major planform geometries relating to taper ratio are rectangular, trapezoidal and delta shape in order to increase the strength of the wing. The materials used for aircraft wings are mostly metallic alloys. In this thesis, the materials are replaced by composite materials S Glass and Kevlar 49.

Static analysis is done to determined the stresses produced by applying loads. Modal analysis is done on the aircraft wing to determine the frequencies and deformations, stress due to frequencies. Fatigue analysis to estimate the life of the wing. Analysis is done in ANSYS.

By observing the static results the stress value is less for s2-glass material compare with aluminum alloy and keVlar-49. The wing triangular shape has better strength.

So it can be concluded the s2 glass material is better material for aircraft Wing

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