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STATIC AND DYNAMIC ANALYSIS OF AIRCRAFT WING SECTION USING ALUMINIUM SILICON CARBIDE COMPOSITE

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ABSTRACT

Composite materials area the foremost successful materials employed in the advance Engineering Industries. Metal composite possesses considerably improved properties together with high durability, toughness, hardness and less density compared to other two different materials.

Wings area unit is the foremost vital element in the aircraft. The potency of the craft will increase, once the weight of the aircraft reduces. Hence decided to analyze the wing for this Beechcraft NACA0012 wing section is chosen. The CAD model of a wing is established by victimization CATIA. The structural and model analysis area unit done using ANSYS package. Structural parameters like total deformation, equivalent stresses, Von-Misses stress, shear stress, shear intensity on the skin of the aircraft wing are calculated and then results of the structural analysis of Aluminum 6061siliconcarbide is compared to the structural analysis of Aluminum 6061.

Keywords : Beech craft, Silicon carbide, Aluminium 6061, ANSYS

INTRODUCTION

In order to conserve natural resources and economize energy, weight reduction has been the main focus of manufacturers in the present scenario. Weight reduction can be achieved primarily by the introduction of better material, design optimization and better manufacturing processes. The wing is one of the potential items for weight reduction in aircrafts as it accounts for 10% - 20% of the unstrung weight. The introduction of composite materials was made it possible to reduce weight of wing without any reduction on load carrying capacity and stiffness. The composite material have more elastic strain energy storage capacity and high 'strength to weight ratio' as compared with those of aluminium.

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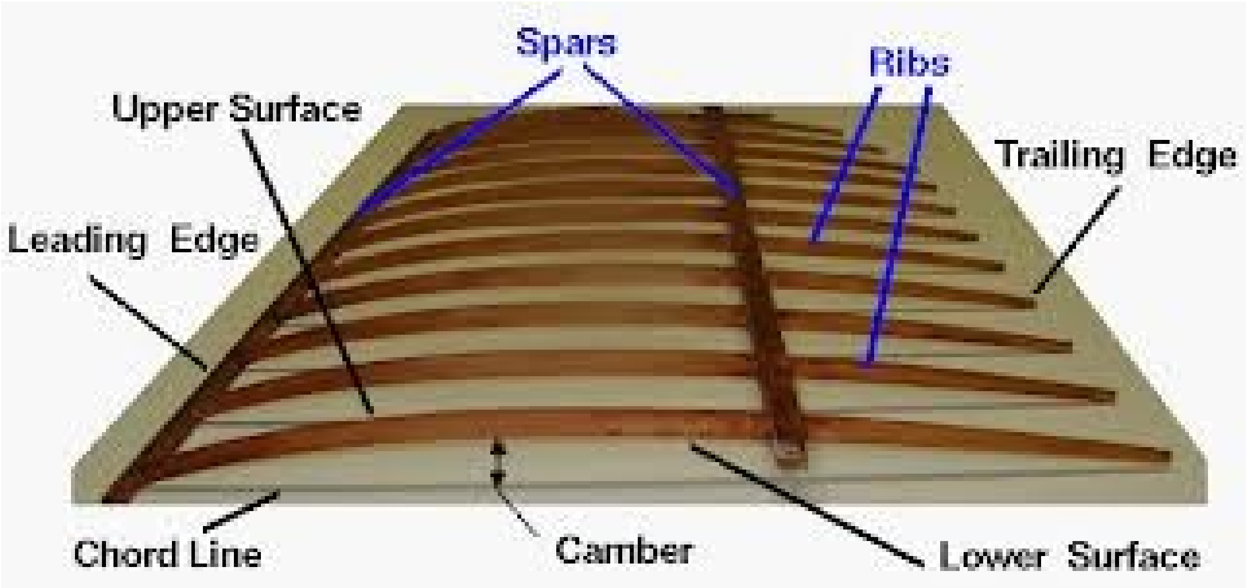
WING IN AIRCRAFT :



Cad Modeling

Xfoil software is highly used to find co-ordinates of an aerofoil whatever we want. From this software we got the co-ordinates of Beechcraft T-34 aerofoil for our project. By using the co-ordinates the aerofoil are developed in a CATIA V5 R18.The geometry was created in CATIA V5 R18 and imported. The static and model analysis are carried out in analysis software ANSYS. The result of from the static analysis refers to the total deformation, equivalent stress, shear stress and shear intensity on the skin of the aircraft wing. The model analysis will be carried out to find out the first six modes of vibrations and the different mode shape in which wing can deform without the application of load.

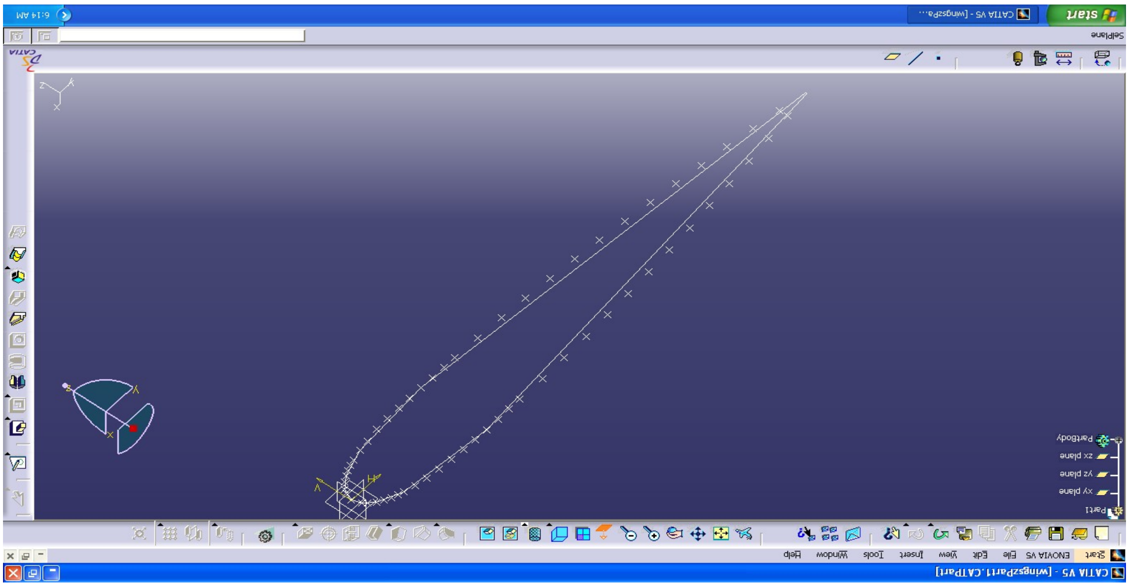


Figure : Airfoil NACA0012

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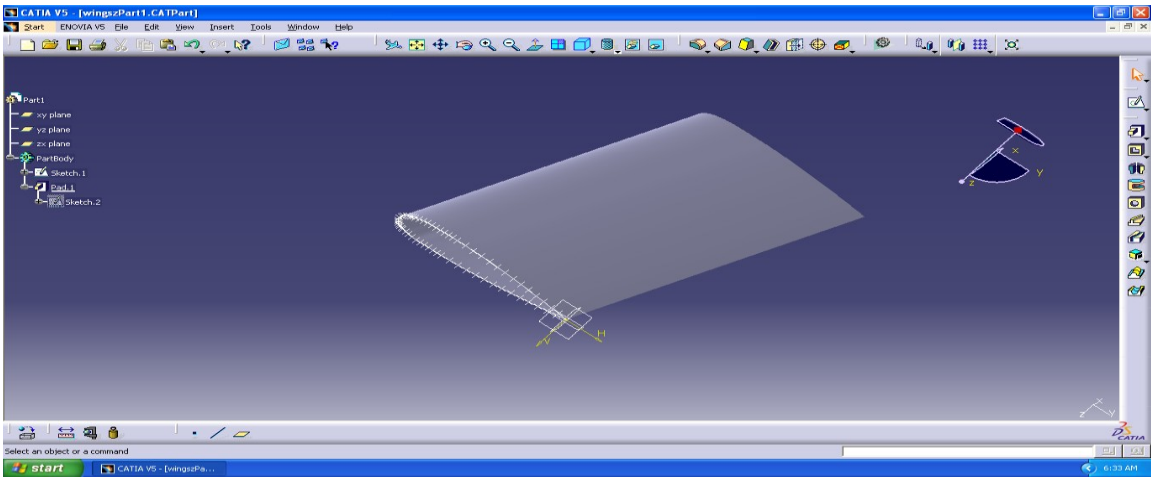

Analysis :

Field Emission Scanning Microscope (FESM):
The ball milling process is carried out and the particles size conversion are checked by FESM. The result conformed that size of SiC changed to nano particles.

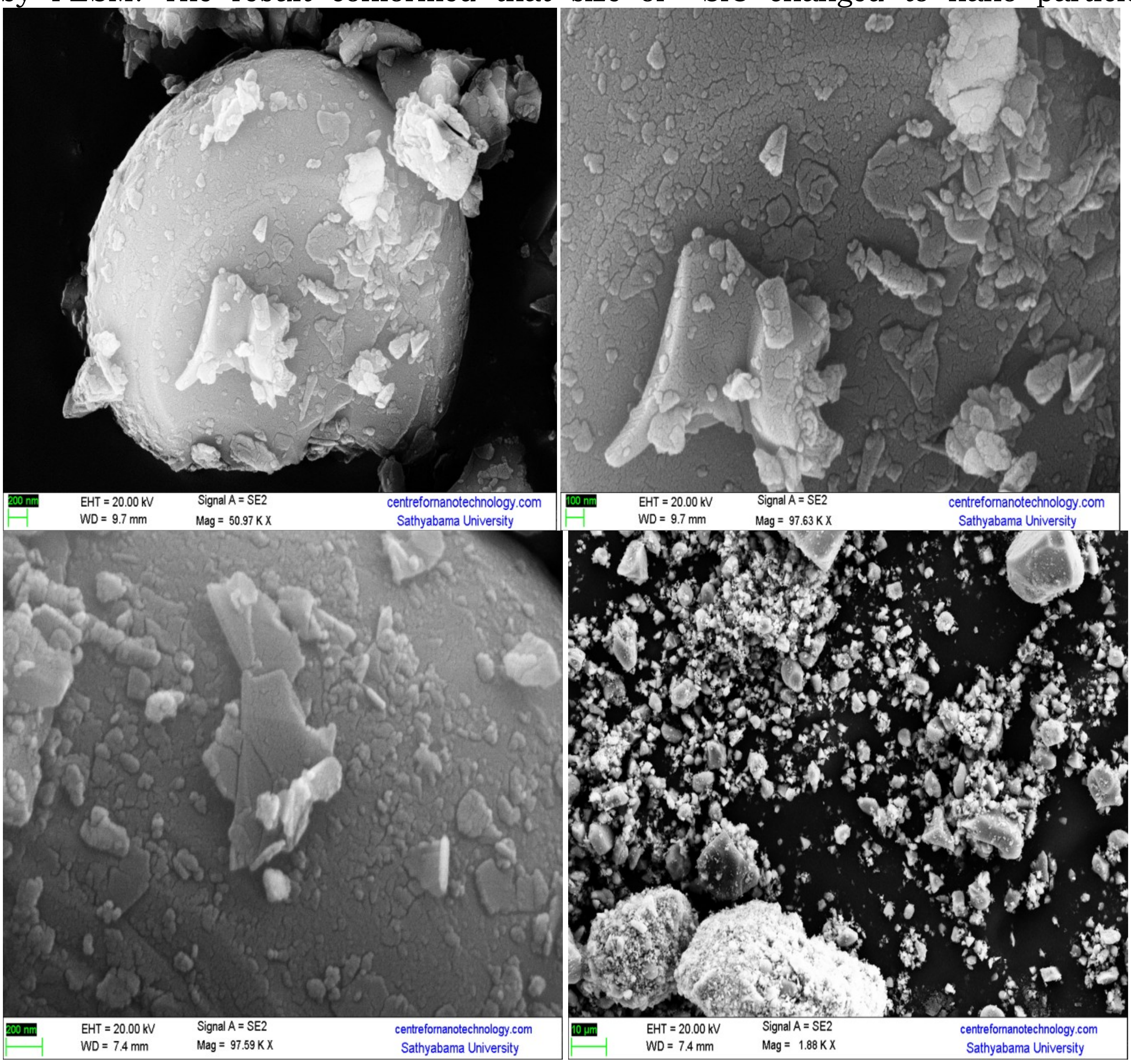

Figure : FESMimage of SiC particles below 100nm

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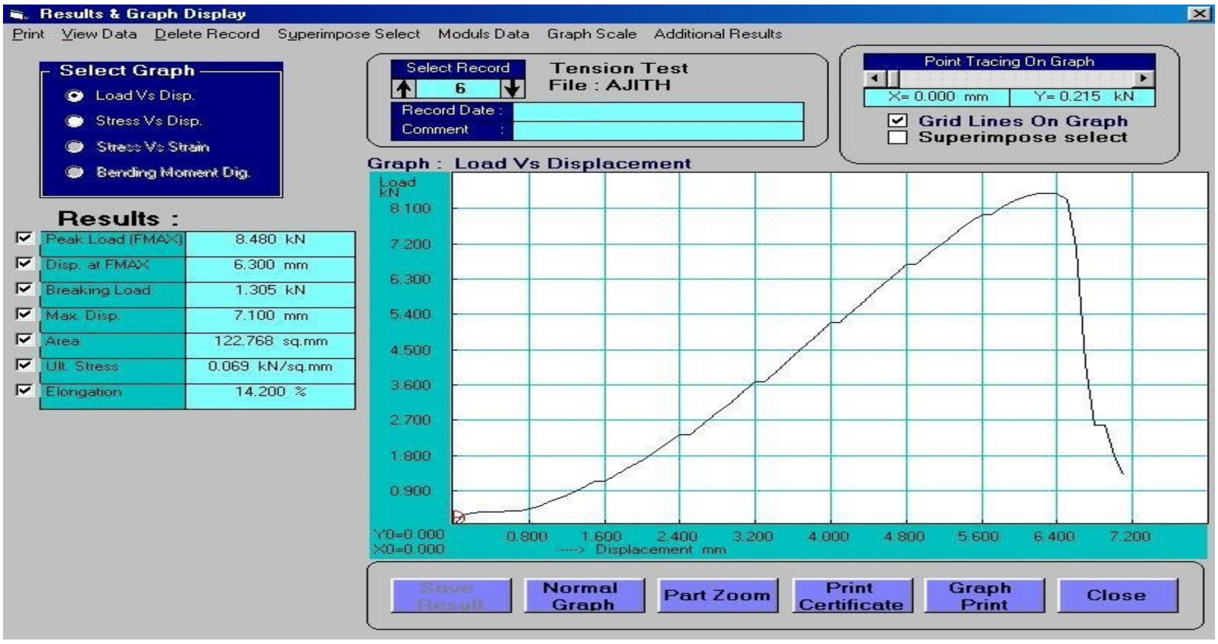
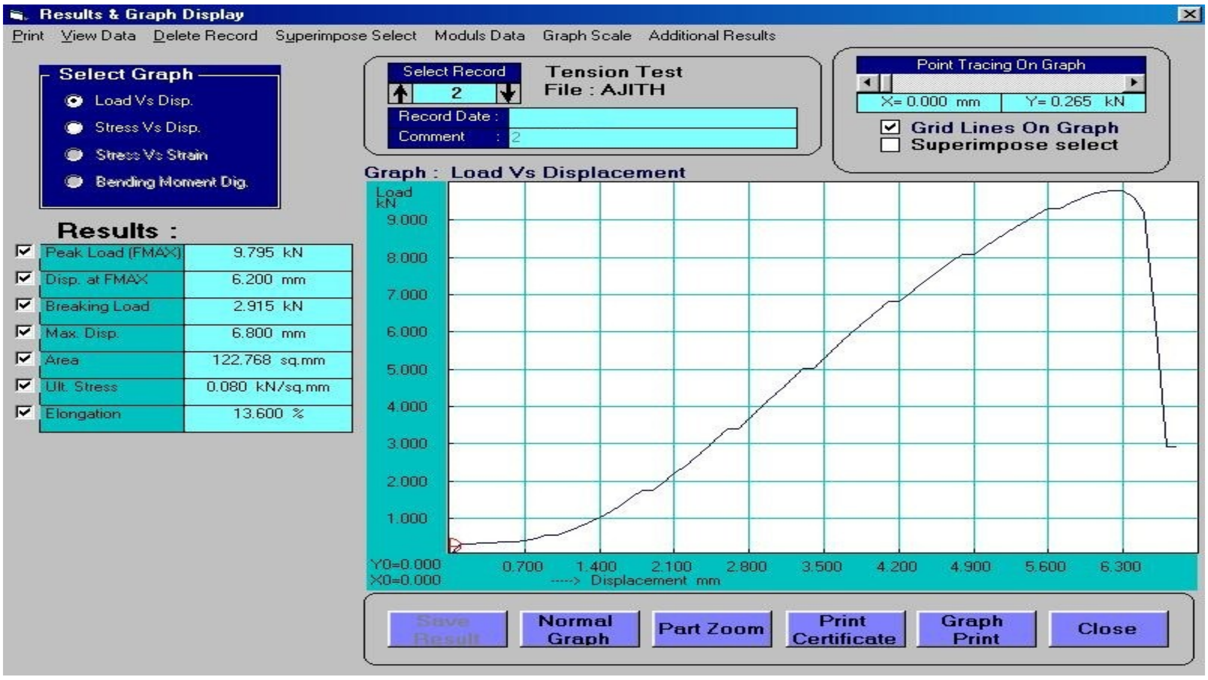
Result obtained from tensile test:

The results from the test are commonly used to select a material for an application, for quality control, and to predict how a material will react under other types of forces. Properties that are directly measured via a tensile test are ultimate tensile strength, maximum elongation and reduction in area. From these measurements the following properties can also be determined: Young's modulus, Poisson's ratio, yield strength, and strain-hardening characteristics. From the tensile test we obtained a two load Vs displacement graph and stress Vs displacement graph.



(a) Aluminium6061+0%SiC



(b) Aluminium6061+4%SiC

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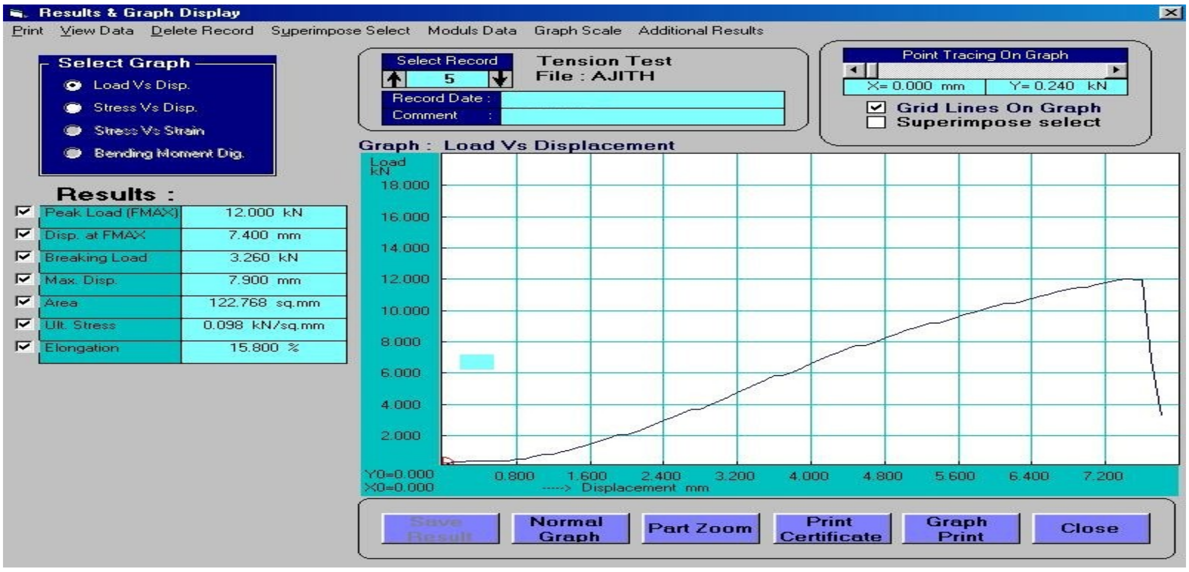
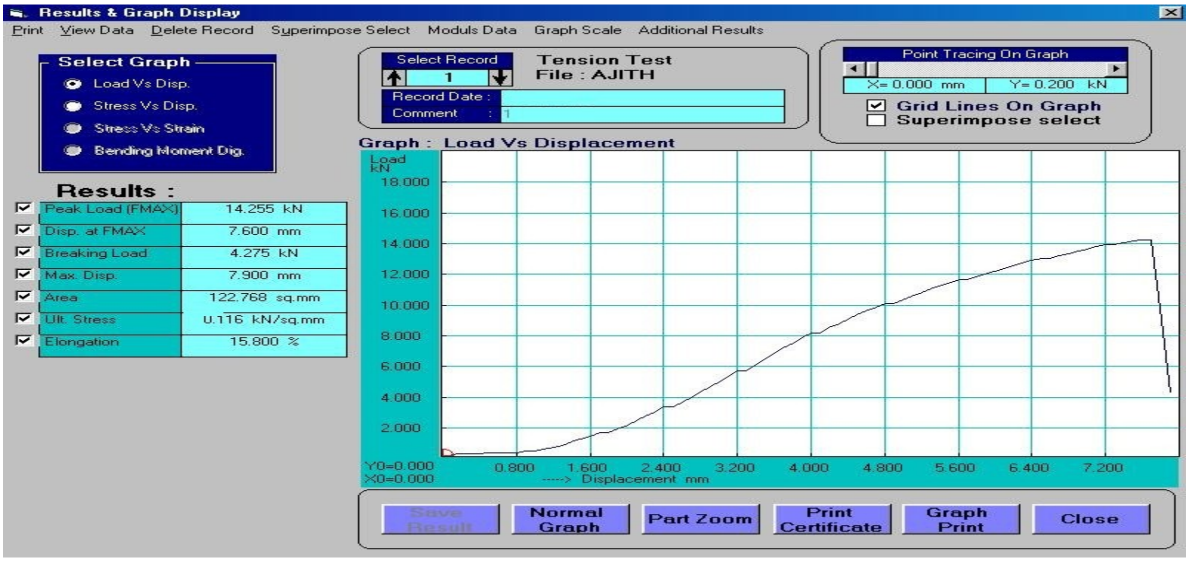
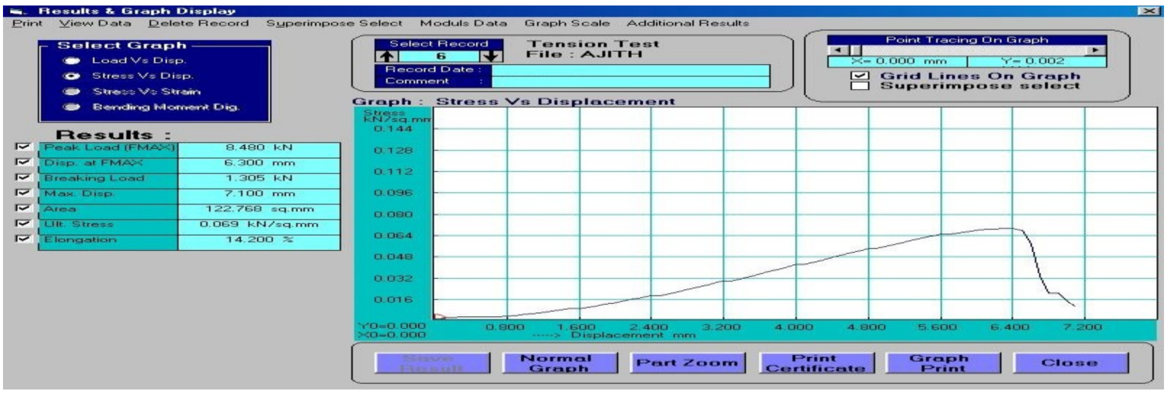


Aluminium6061+8%SiC



(d) Aluminium6061+12%SiC



Alminium6061+0%SiC

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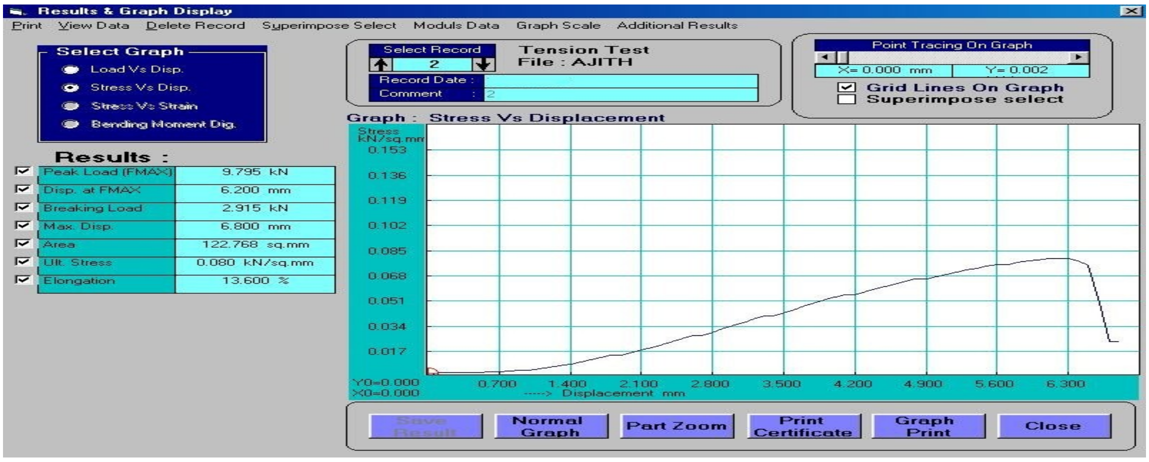
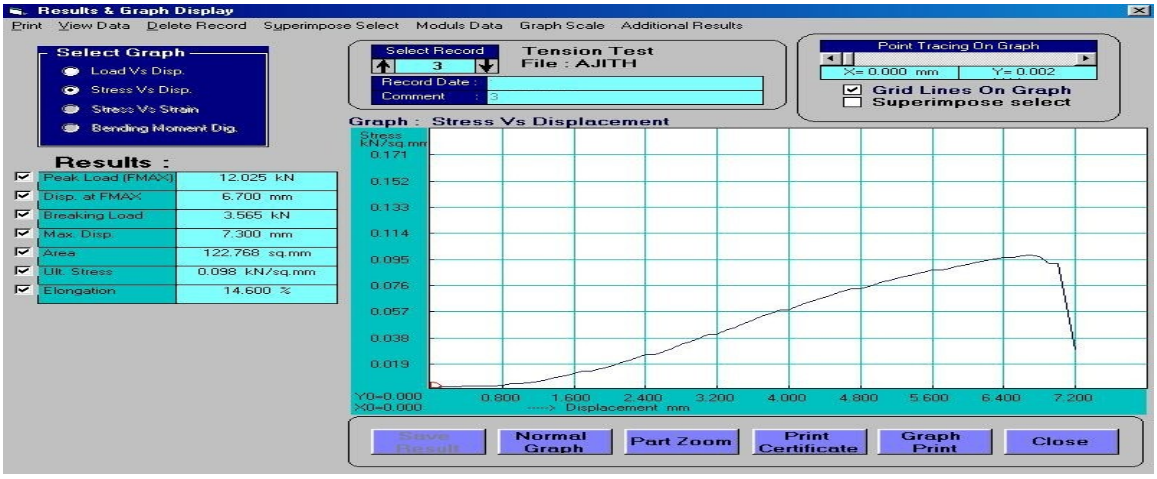
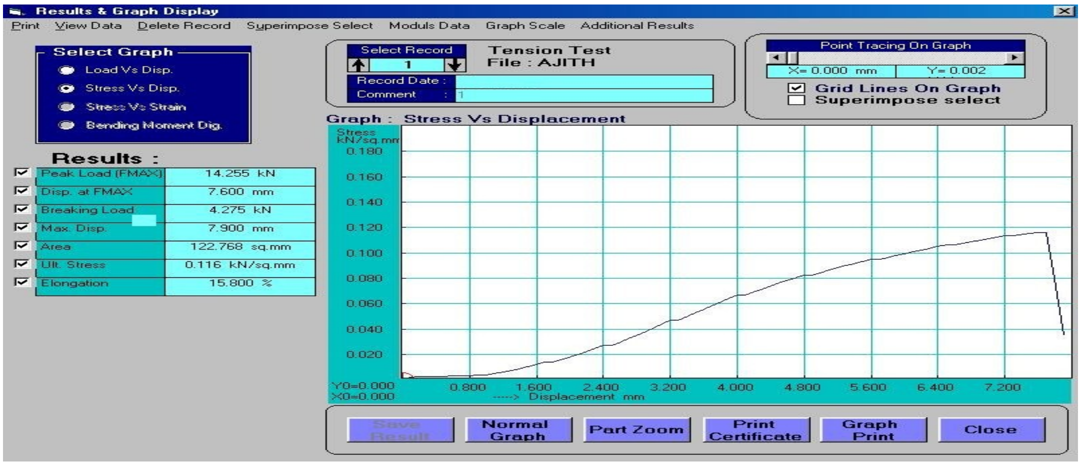


(b) Aluminium6061+4%SiC



(c)Aluminium6061+8%SiC



(d) Aluminium6061+12%SiC

The graph shows the tensile strength of the aluminum6061 with SiC of 0%,4%,8%,12% from that peak load ,breaking load ,elongation, ultimate stress, maximum displacement of the specimen are calculated .Tensile test graph generated for load Vs Displacement and stress Vs Displacement in the monitor itself.

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Composite material	Peak load (KN)	Breaking load (KN)	Elongation (%)	Ultimate stress (KN/Sq.mm)	Maximum Displaceme nt (mm)
Aluminium6061+0 %SiC	8.480	1.305	14.200	0.069	7.100
Aluminium6061+4 %SiC	9.795	2.915	13.600	0.080	6.800
Aluminium6061+8 %SiC	12.000	3.260	15.800	0.098	7.900
Aluminium6061+1 2%SiC	14.255	4.275	15.800	0.116	7.900

Graph the value give the peak load, breaking load, elongation, ultimate stress, maximum displacement for four specimens are tabulated. From that tabulation find that Nano Al6061-12% SiC exhibit good mechanical properties compared to the other type of composites. And it will be better replacement of aluminum in Beechcraft T-34 and the obtained result of Nano Al6061-12% SiC are compared with micro structural Al6061-12% SiC by referring a journal .

MESHING :

The designed wing session is import into the ANSYS multi physics. After the material properties are given, the next stage of the modeling is to create meshing of the created model.

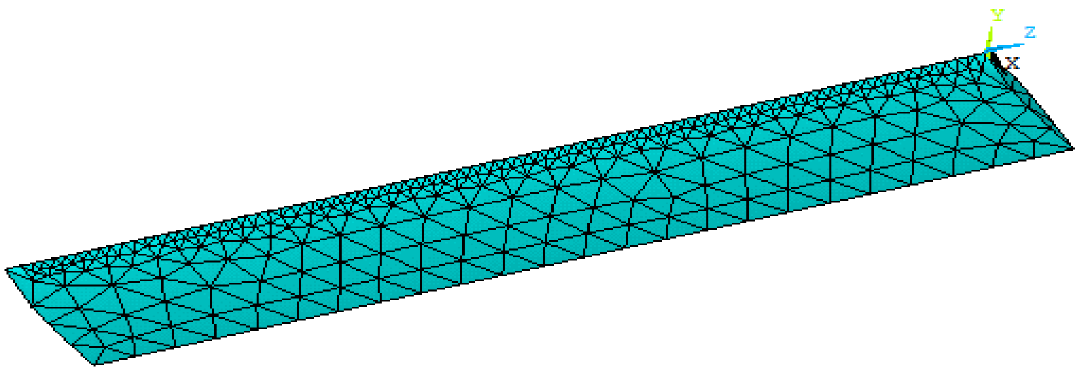

Figure . Triangular mesh generated in a wing section

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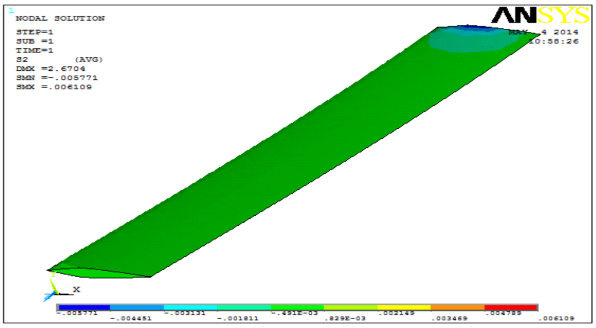
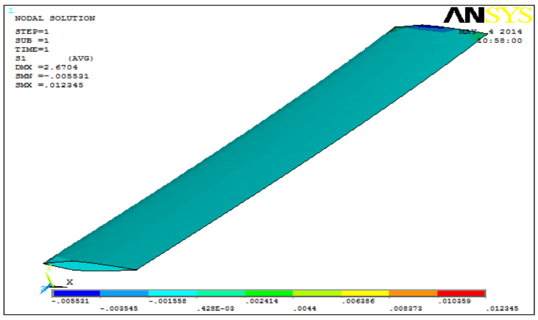
Structural and modal Analysis of Aluminium 6061

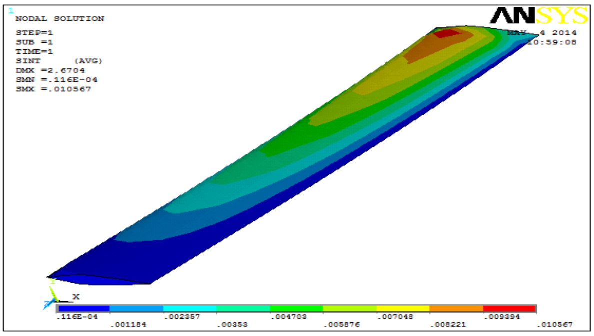
From the structural analysis the following structural parameters such as total deformation, equivalent stresses which is also known as Von -mises stress, shear stress, shear intensity on the skin of the aircraft wing by using the properties of Al6061.The modal analysis carried out in the main menu general post procedure .The modal analysis will be carried out to find out the first 6 modes of vibrations and the different mode shape in which wing can deform without application of load. For modal analysis of different mode vibration the displacement of wings are studied from that frequency increases gradually from first mode to sixth mode of vibration and maximum deformation occurs at the fifth mode of vibration, medium deformation occurs at the third mode of vibration and the minimum deformation occurs at the second mode of vibration.



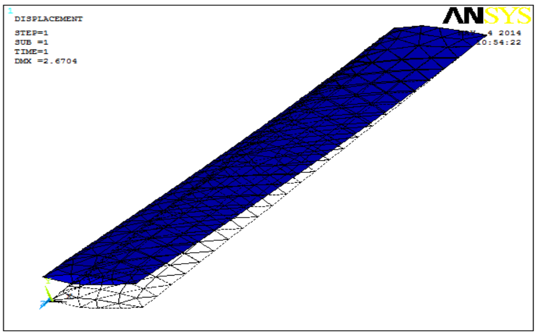
Principle stress 1



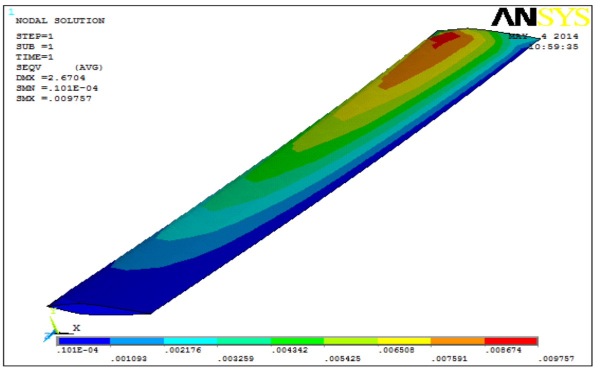
(b) Principle stress 2



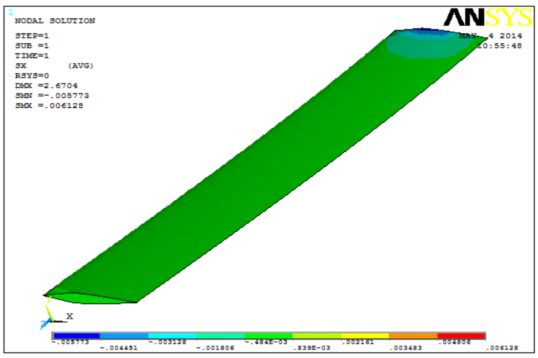
(c) Stress intensity



(d) Total deformation



(e) Von miss stress



(f) X Stress

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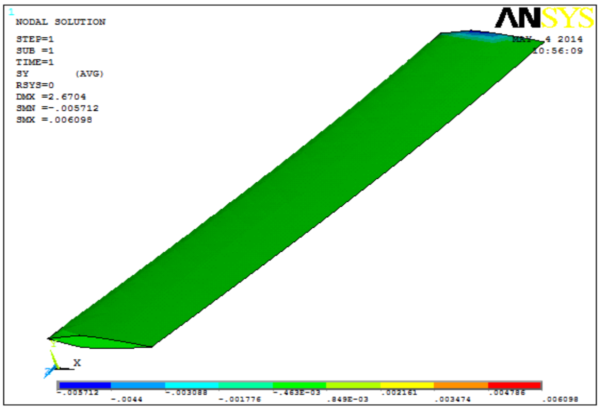
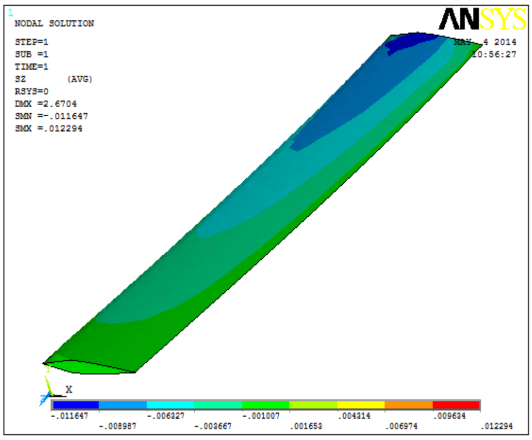
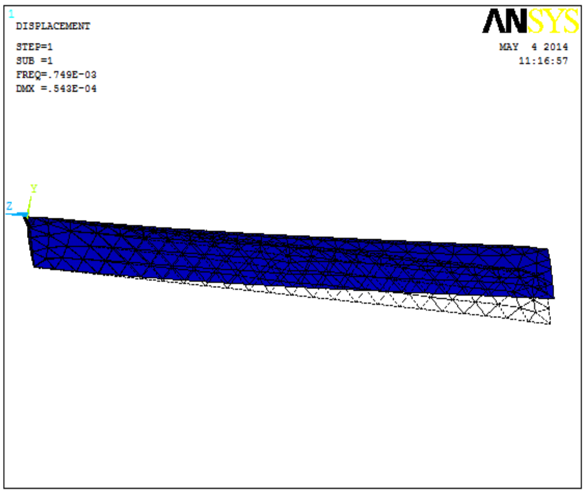


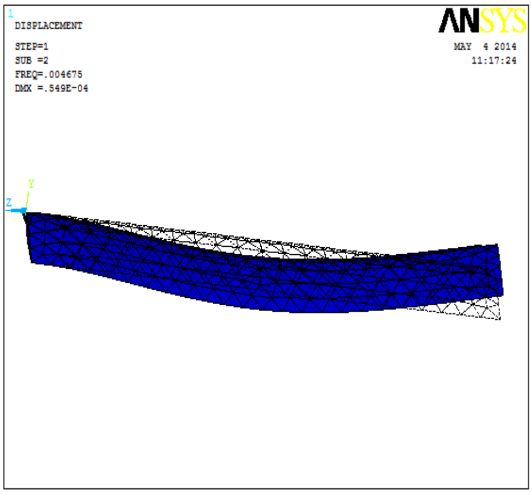
(g) Y stress



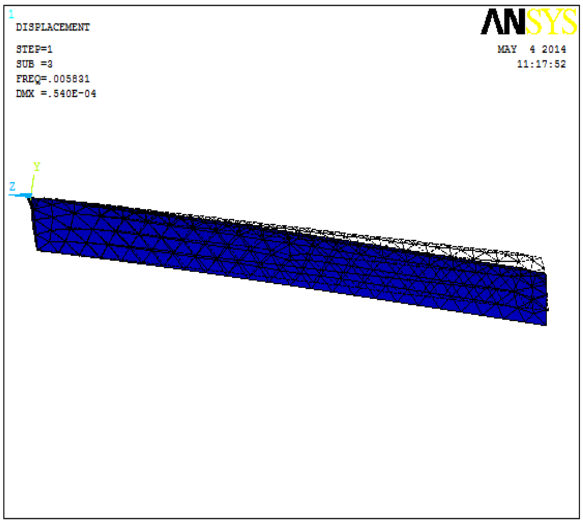
(h) Z Stress



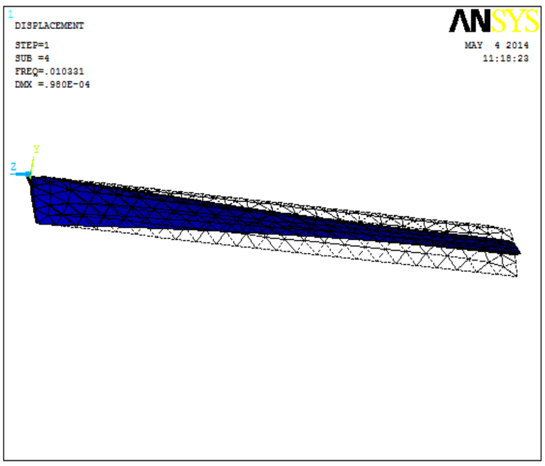
Mode 1



(b)Mode 2



(c) Mode 3



(d) Mode 4

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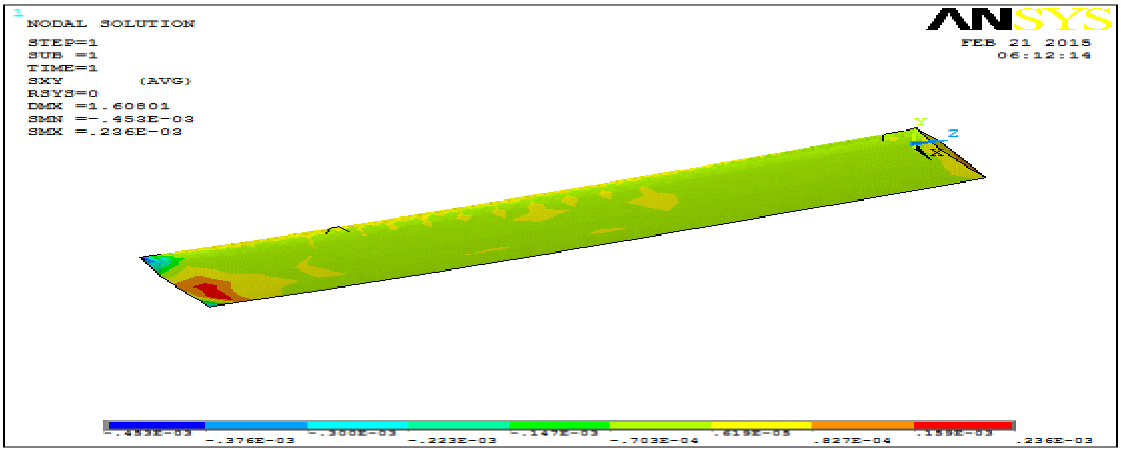
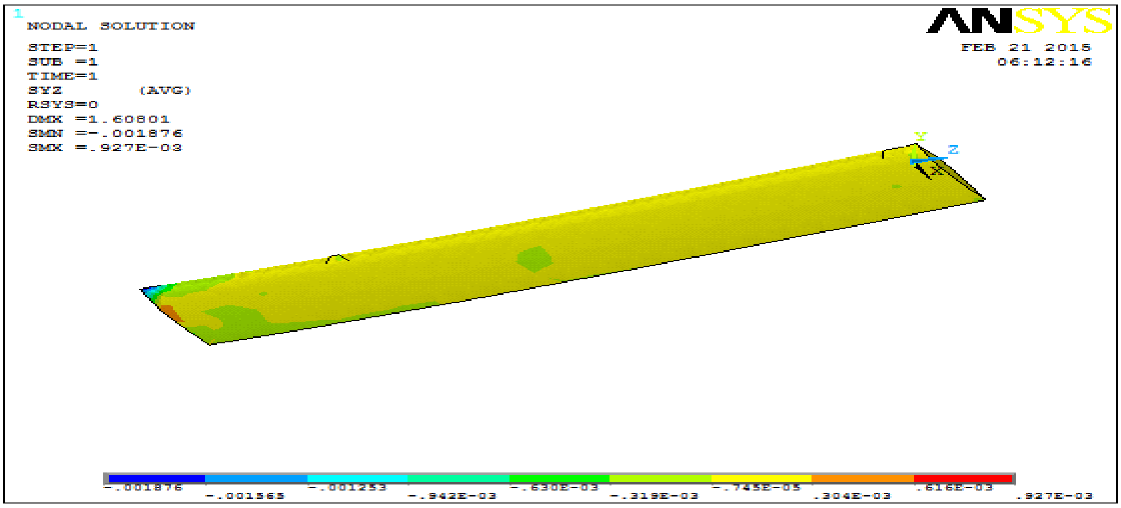
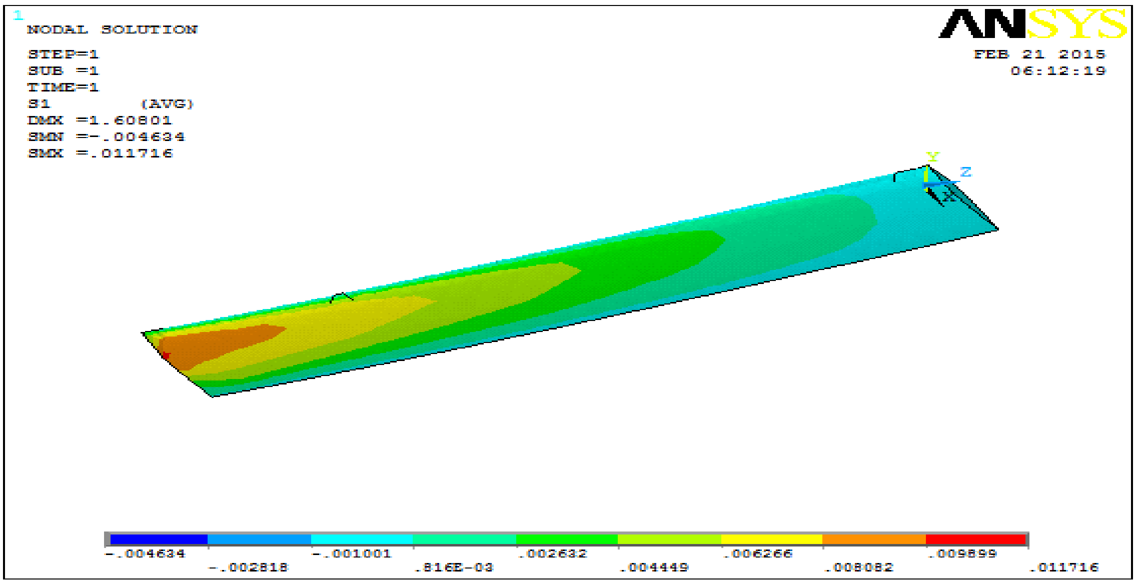
Structural and modal Analysis of NanoAluminium6061 SiC



(a) Principle stress



(b) Principle stress



c(C) Stress intensity

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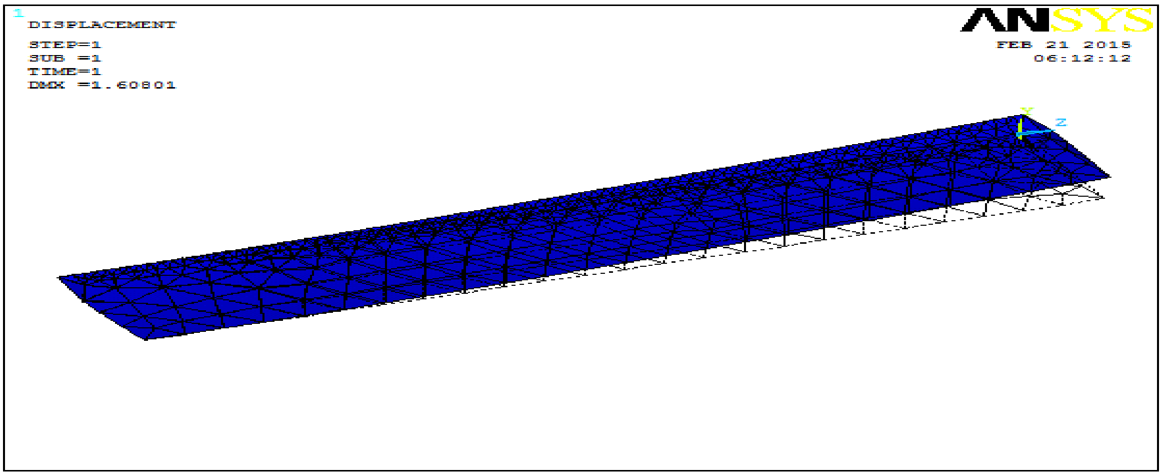
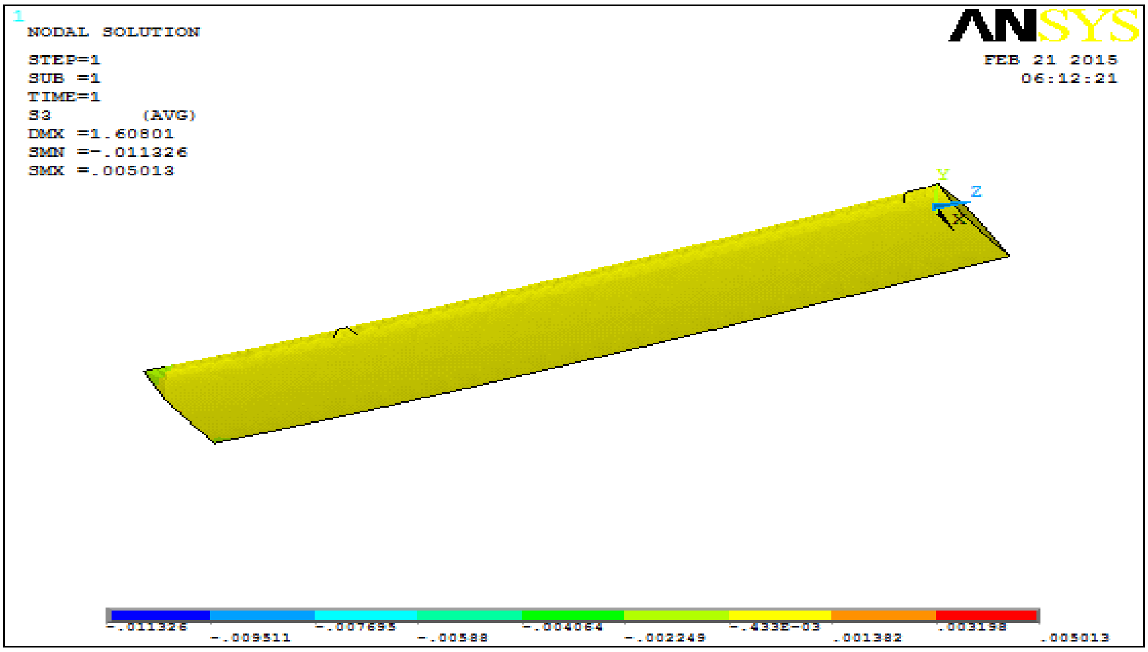
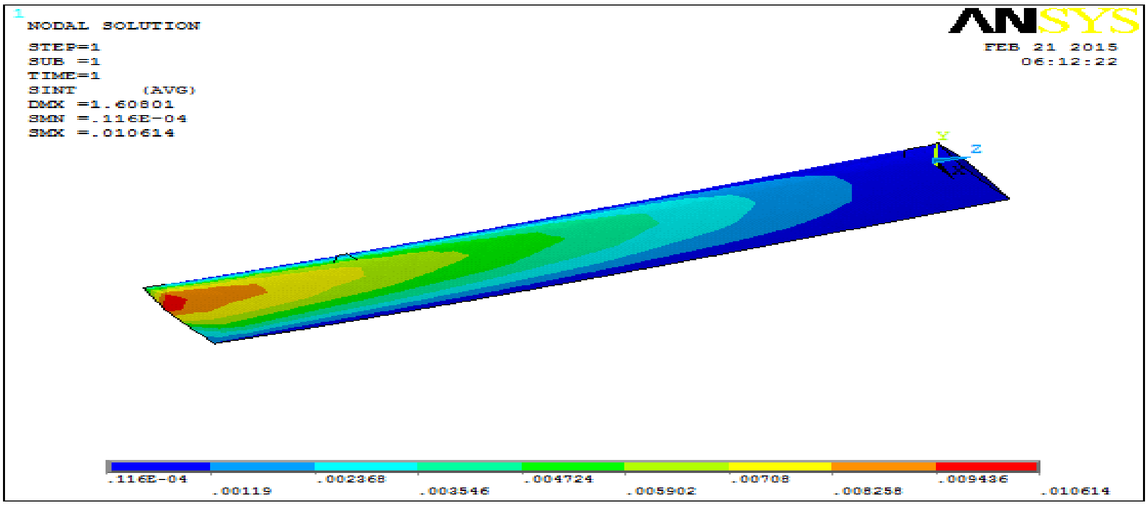


(d) Total deformation



(e) Von miss stress



(f) X Stress

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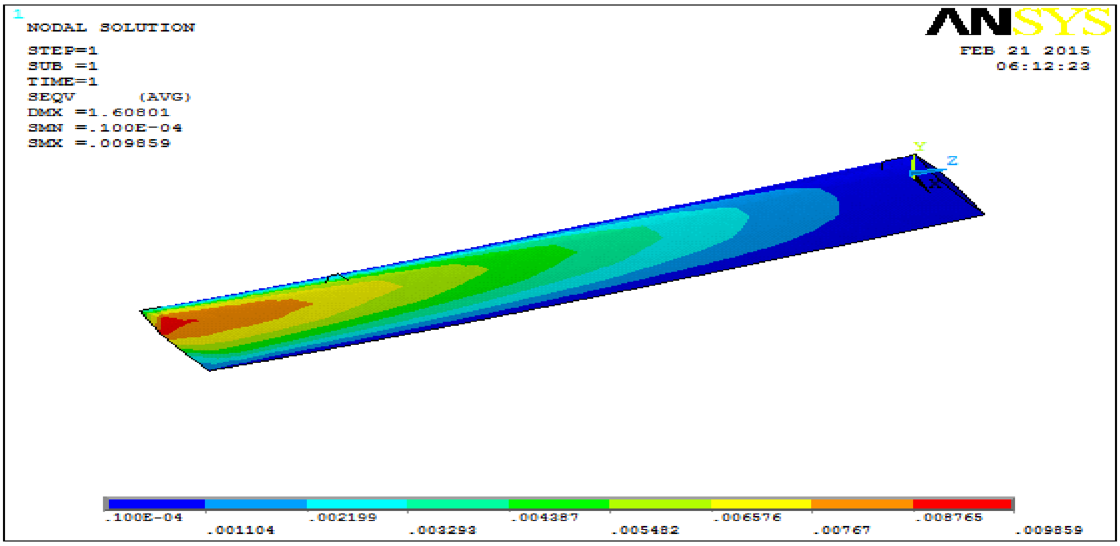
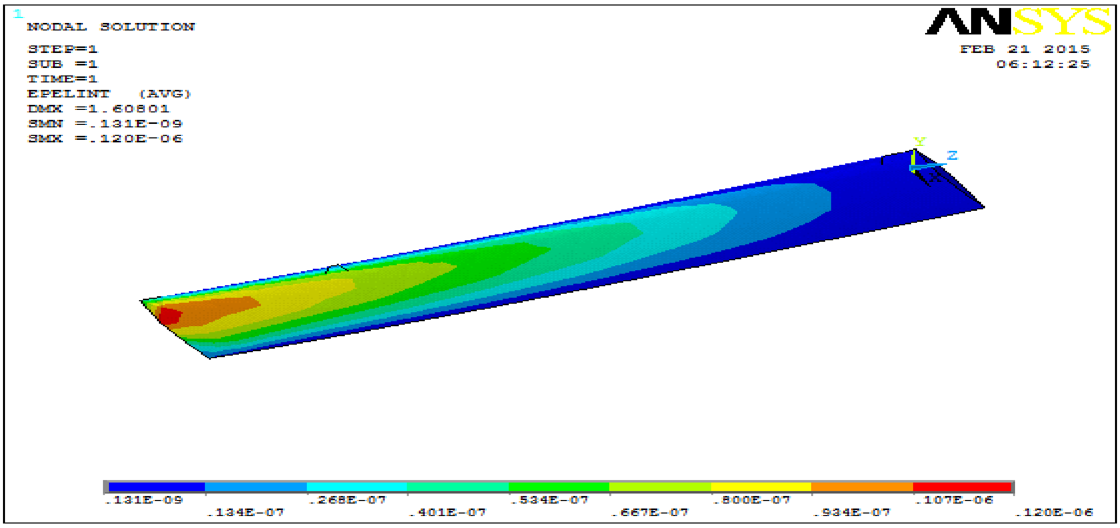


(g) Y stress



(h) Z Stress

Material	Principle stress	Stress intensity	Total deformation	Von miss stress
Al 6061	0.123	0.105	2.670	.009
Nano Aluminium6061+12%SiC	0.117	0.106	1.881	.009

Table. Comparison of static analysis of Aluminium composite

The designed wing session is imported into the ANSYS multi physics. After that Structural and modal Analysis of Aluminium 6061, MicroAluminium6061+12%SiC,Nano Aluminium6061+12%SiC are carried out ,from that comparison are made among the specimens. From that comparison it show that Nano Aluminium6061+12%SiChaving good mechanical properties and it will be the better replacement aluminium in the Beechcraft so that the weight of an

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aircraft is reduced and deformation of the wing section are also comparatively lower than aluminium.

CONCLUSION

The CAD model of a wing is established by victimization CATIA. The structural and model analysis are done using ANSYS package. Structural parameters like total deformation, equivalent stresses, Von Mises stress, shear stress, shear intensity on the skin of the aircraft wing are calculated. From that analysis the 6061 Silicon carbide composite have high strength, low density, maximum deformation when compared to Aluminum 6061.Hence proved that the wing section of Aluminum Silicon carbide composite in aeronautical field will increase the strength and also reduce weight compared to the Aluminum

REFERENCES

1. Eng.bogdancaloian, Eng.Dorinlozici and eng.Radubisca, 2009“Stress and Modal Analysis Report for Avert Program”, DOI 10.13111/ 2066-8201.
2. Mayurkymarkevadiya, 2013“CFD Analysis of Pressure Coefficient for NACA 4412”, IJETT Vol. 4 ISSUE 5
3. Shamim Mahmud D, 2013 “Analysis of effectiveness an airfoil with BicamberSurface”,ISSN 2049-3444, Vol 3, No 5.
4. Dr.R.Rajappan, V.Pugazhenthi,2013”Finite element analysis of aircraft wing using composite structure”,IJES, Vol 2, issue2.
5. Vikram Singh and R.C. Prasad , 2004 “Tensile And Fracture Behavior Of 6061 Al-Sicp Metal Matrix Composites”International Symposium of Research Students on Materials Science and Engineering
6. Geetha Mable Pinto, JagannathNayak, A NityanandaShetty, 2009“Corrosion Behaviour of 6061 Al - 15vol. Pct. SiC Composite and its Base Alloy in a Mixture of 1:1 Hydrochloric and SulphuricAcidMedium”International Journal of ElectrochemicalScience
7. N R Prabhu Swamy, C S RAMESHand T CHANDRASHEKAR ,2010 “Effect of heat treatment on strength and abrasive wear behavior of Al6061–SiCp composites”
8. Prashant S N, MadevNagaral and V Auradi, 2012 “Preparation And Evaluation Of Mechanical And Wear Properties Of Al6061 Reinforced With Graphite And Sic Particulate Metal Matrix Composites”IJMERR