

Design/Modeling of Helicopter Rotary Blade and Its Analysis.

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ABSTRACT

Structural Problems are a major hazard and limitation for a Helicopter rotor blade, the main aim of the project is to reduce structural problems (Stresses) in Helicopter rotor blade. Composite materials are mainly used in the aerospace industry why because they have high strength-to-weight ratios. Military aircraft, including Navy aircraft, are constructed using considerable amounts of composites. Present paper proposes a methodology to model a propeller with a metal and composite material to analyze its strength and deformation using Finite Element Analysis.

In order to evaluate the effectiveness of composite over metals, stress analysis is performed on both composite and metal propeller. Proposed methodology showed substantial improvements in metal propellers. The mean deflection, normal stress and shear stress were found for both metallic and composite propeller were found and compared. Here fatigue and Dynamic analysis is also carried out along with structural analysis and compared the results with the composite materials.

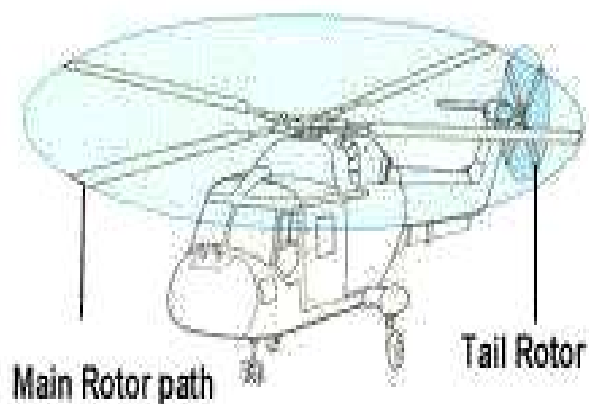
INTRODUCTION

In a number of structures, structural integrity is of paramount concern, and a thorough and precise knowledge of the dynamic characteristics is essential. There is also a wider set of components or assemblies for which vibration is directly related to performance either

by virtue of causing temporary malfunction or by creating disturbance, discomfort or noise. Therefore, it is important that the vibration levels encountered in service or operation be anticipated and brought under satisfactory control.

Main rotor blades produce thrust to balance the inertia of the helicopter and the propulsive force for the translational motion. The tail rotor produces thrust to counter main rotor reaction torque and to produce yawing acceleration. The aerodynamic and dynamic design parameters of the blade are the following.

Helicopter, Lift is obtained by means of one or more power driven horizontal propellers which called Main Rotor..



MAIN ROTOR

The lifting force is produced by the main rotor. As they spin in the air and produced the lift. Each blade

produces an equal share of the lifting force. The weight of a helicopter is divided evenly between the rotor blades on the main rotor system. If a helicopter weight 4000 lbs and it has two blades, then each blade must be able to support 2000 lbs. In addition to the static weight of helicopter, each blade must be accepting dynamic load as well. For example, if a helicopter pulls up in a 1.5 g manouver (1.5 times the gravity force), then the effective weight of helicopter will be 1.5 times of static helicopter weight or 6000 lbs. due to gravitational pull



USES OF HELICOPTERS

Helicopters can be used for many things. They can be used as flying ambulances to carry patients. They can be loaded with water to fight large fires. Military forces use helicopters to attack targets on the ground and move troops. Helicopters are used to get supplies to ships. Helicopters can be used to transport large objects from place to place. Helicopters can rescue people in hard-to-reach places like mountains or in rough seas. Television and radio stations use helicopters to fly over cities and report on traffic. Helicopters are used by police and by people on vacation. These uses are just some of the many things that can be done with helicopters.

Helicopter Vibration

The rotor system has inherent vibratory load generating characteristics which are a function of the design of the rotor. Since the blade has its own

dynamic characteristics which are a function of its mass and stiffness distribution together with centrifugal effects, it responds to these loads as a forced dynamic system, generating shear forces and moments at the hub centerline.

In practice, the magnitudes of these loads diminish significantly with increasing frequency and in general the most important source of vibratory loading for the rotor is at a frequency of n /revolution.

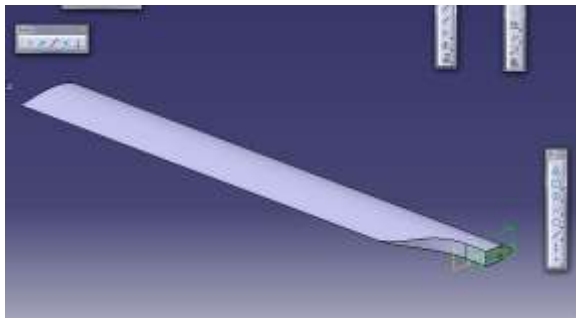
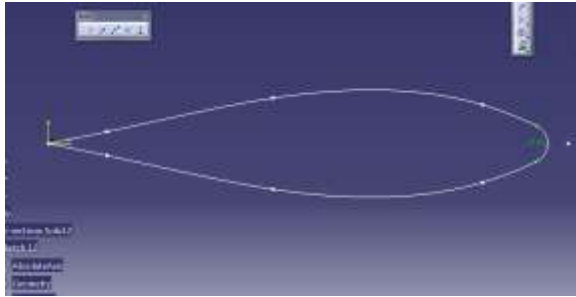
CATIA

CATIA - which stands for Computer Aided Three-dimensional Interactive Application - is the most powerful and widely used CAD (computer aided design) software of its kind in the world. CATIA is owned/developed by Dassault Systems of France and until 2010, was marketed worldwide by IBM.

Mechanical engineering

CATIA enables the creation of 3D parts, from 3D sketches, sheet metal, composites, and moulded, forged or tooling parts up to the definition of mechanical assemblies. The software provides advanced technologies for mechanical surfacing & BIW. It provides tools to complete product definition, including functional tolerances as well as kinematics definition. CATIA provides a wide range of applications for tooling design, for both generic tooling and mould & die.

DESIGNING OF BLADE IN CATIA



ANSYS

ANSYS is general-purpose finite element analysis (FEA) software package. Finite Element Analysis is a numerical method of deconstructing a complex system into very small pieces (of user-designated size) called elements. The software implements equations that govern the behaviour of these elements and solves them all; creating a comprehensive explanation of how the system acts as a whole. These results then can be presented in tabulated or graphical forms. This type of analysis is typically used for the design and optimization of a system far too complex

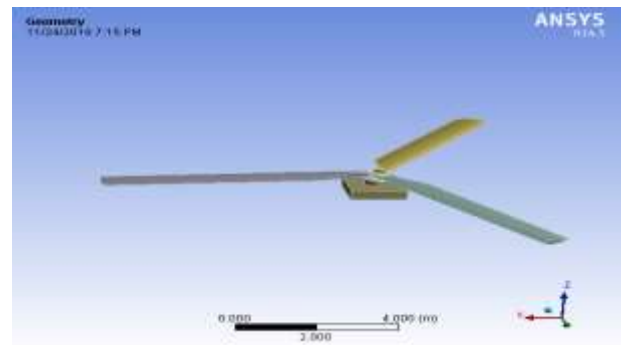
to analyse by hand. Systems that may fit into this category are too complex due to their geometry, scale, or governing equations.

General Steps to Solving any Problem in ANSYS

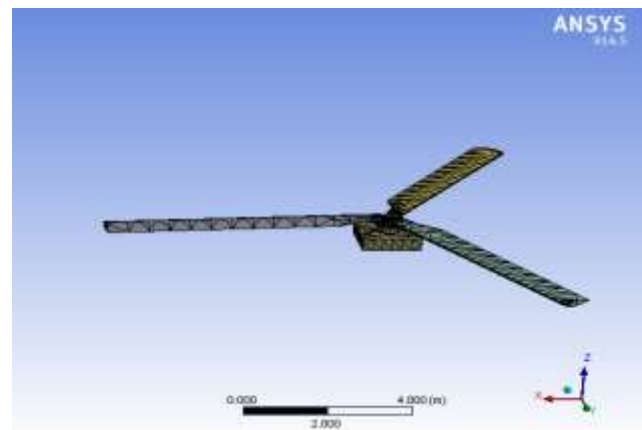
Like solving any problem analytically, you need to define (1) your solution domain, (2) the physical model, (3) boundary conditions and (4) the physical properties. You then solve the problem and present the results. In numerical methods, the main difference is an extra step called mesh generation

Model (STRUCTURAL ANALYSIS WITH STRUCTURAL STEEL)

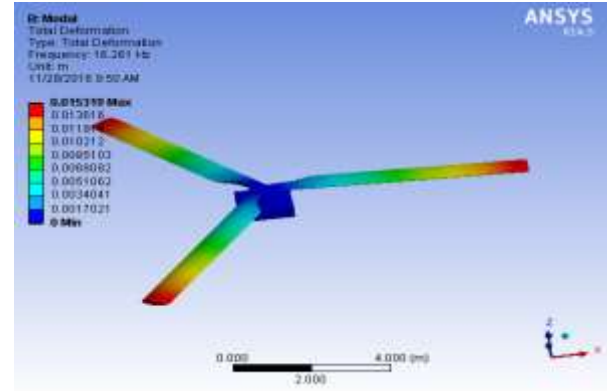
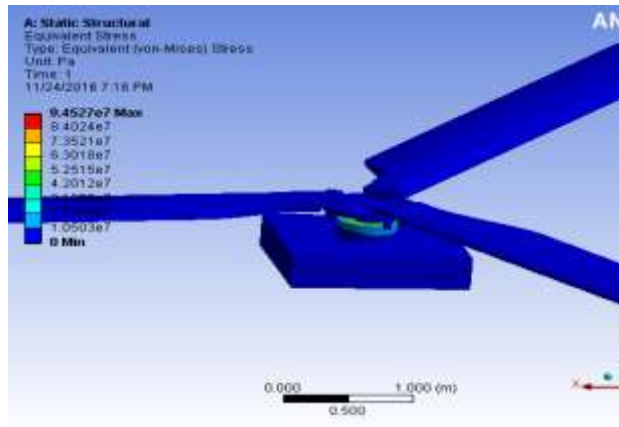
Geometry



Mesh

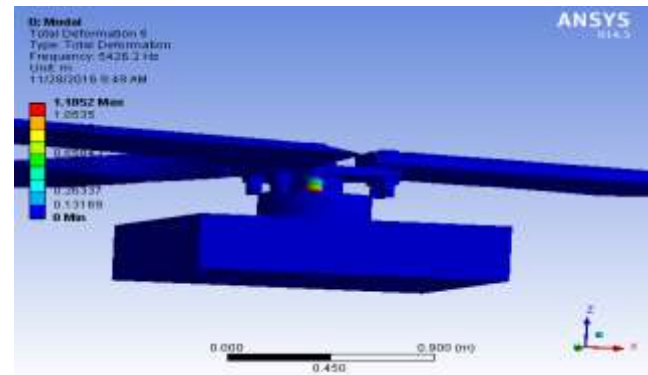


STRESS



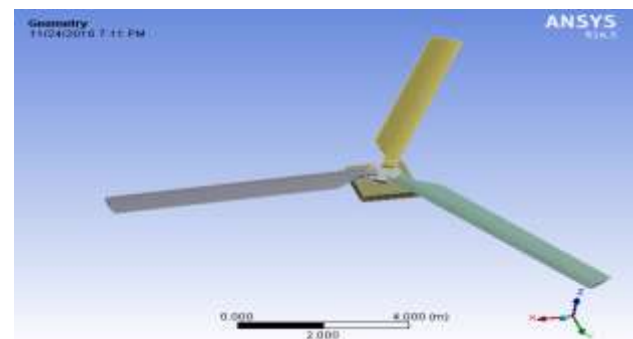
MODAL ANALYSIS OF BLADES USING STRUCTURAL STEEL

As here the modal analysis is carried out for the total assembly of the helicopter blades using the material structural steel, as we can do many types of MODAL analysis using different methods according to the application. As if we see here the modal analysis is carried out for 5 modal frequencies, as here the input data is totally considered from the results obtained from the structural analysis, as here with the results of the STRESS, STRAIN obtained in the structural analysis the modal analysis is carried out and the 5 deformations are resulted according to the resulted frequencies.

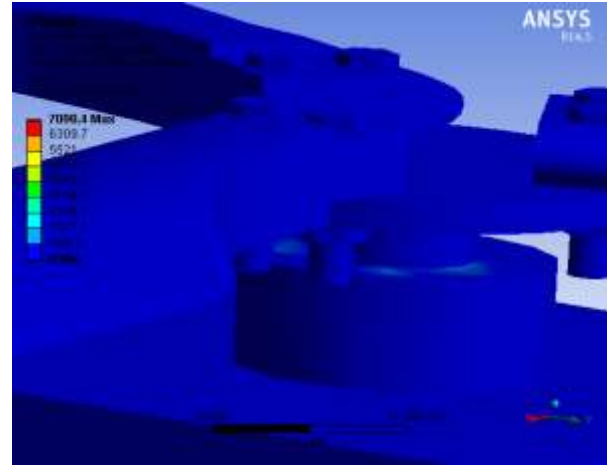
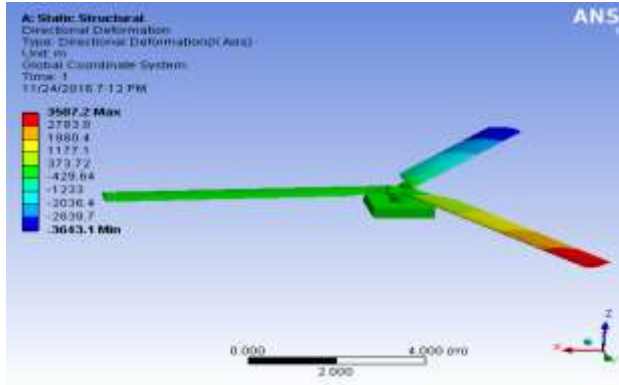


Model (STRUCTURAL ANALYSIS WITH CARBON EPOXY)

IMPORTED FILE



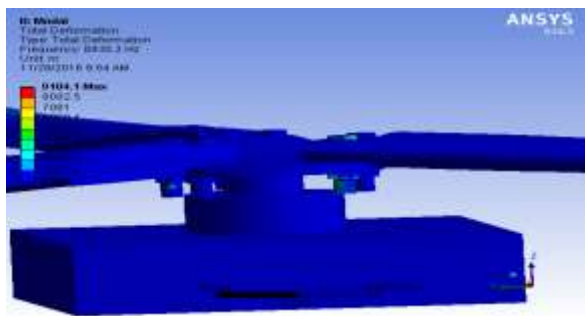
DIRECTIONAL DEFORMATION



MODAL ANALYSIS OF BLADES USING CARBON EPOXY

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DEFORMATIONS



CONCLUSION

Here in this thesis we have developed a helicopter blade rotor assembly using Catia software and analysis is carried out using ANSYS software. As if we see the analysis results, here the structural analysis is carried out using 3 materials structural steel, carbon epoxy and carbon – carbon composites.

As if we compare the results obtained for the structural analysis here the stress ($9.4336e^7$) is very less for the carbon – carbon composites while comparing with remaining materials. As if we go check the strain, here also the same repeated as the strain (0.001038) is also less for the carbon – carbon composites while comparing with remaining materials. As if we see the results for the deformation, here the deformation is very high for carbon epoxy and very negligible difference for the materials c-c-c and structural steel.

So by observing all the results obtained from the structural and modal analysis we can conclude that if the blade is manufactured with c-c-c , it will have high good strength with better life properties.

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