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DESIGN AND ANALYSIS OF COMPOSITE PROPELLER BLADE FOR AIR CRAFT

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Abstract: Propeller blade is a major part of the aircraft. The main function of a propeller in the design of aircraft is to convert the power delivered by an engine into propulsive thrust in order to propel an aircraft. This is achieved by acceleration of large mass of air backwards there by producing forward thrust. Materials should sustain the loading conditions and should be light weight as well .The objective of this study is to evaluate the strength and vibration characteristics of the Propeller blade design for metal and composite material. Also compare the performance under different operating loading conditions. In current years the increased need for the light weight structural element with acoustic insulation, has led to use of fiber reinforced multi- layer composite propeller. The present work carries out the MODAL analysis of a CFRP (carbon fiber reinforced plastic) propeller blade which proposed to replace the Aluminum propeller blade. This work basically deals with the modeling and design analysis of the propeller blade of a torpedo for its strength. A propeller is complex 3D model geometry. This requires high end modeling CREO-4.0software is used for generating the blade model. By using ANSYS WORKBENCH 15.0 MODAL ANALYSIS is done.

Introduction:

Thrust is the force that move the aircraft through the air. Thrust is generated by the propulsion system of the aircraft. There are different types of propulsion systems develop thrust in different ways, although it usually generated through some application of Newton's Third Law. Propeller is one of the propulsion system. The purpose of the propeller is to move the aircraft through the air. The propeller consist of two or more blades connected together by a hub. The hub serves to attach the blades to the engine shaft. .

FIGURE1

The blades are made in the shape of an airfoil like wing of an aircraft. When the engine rotates the propeller blades, the blades produce lift. This lift is called **thrust** and moves the aircraft forward. most aircraft have propellers that pull the aircraft through

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the air. These are called **tractor** propellers. Some aircraft have propellers that **push** the aircraft. These are called **pusher** propellers.

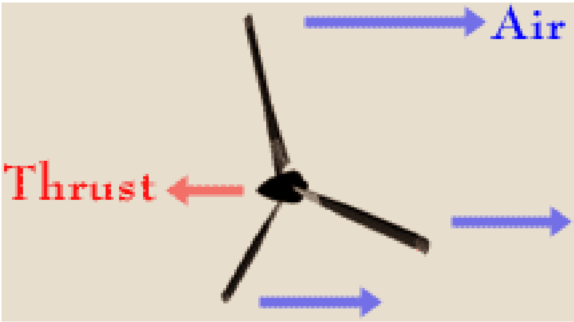

FIGURE2

Description

Leading Edge of the airfoil is the cutting edge that slices into the air. As the leading edge cuts the air, air flows over the blade face and the cambe side.

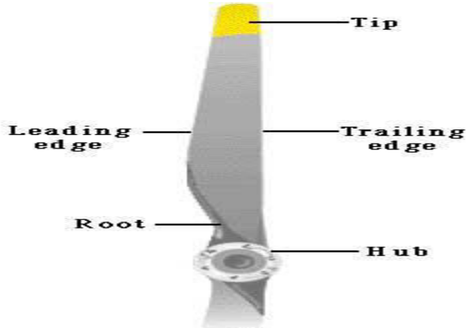

FIGURE3

Blade Face is the surface of the propeller blade that corresponds to the lower surface of an airfoil or flat side, we called Blade Face.

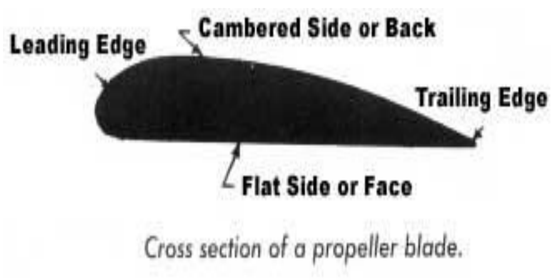

FIGURE4

Blade Back / Thrust Face is the curved surface of the airfoil.

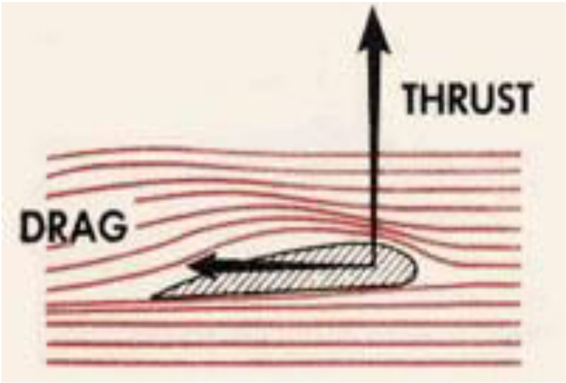

FIGURE 5

Blade Shank (Root) is the section of the blade nearest the hub.

Blade Tip is the outer end of the blade farthest from the hub.

Plane of Rotation is an imaginary plane perpendicular to the shaft. It is the plane that contains the circle in which the blades rotate.

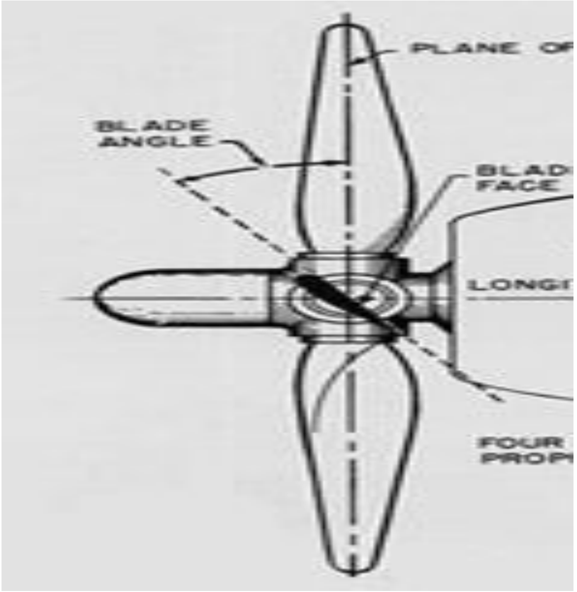

FIGURE 6

Blade Angle is formed between the face of an element and the plane of rotation. The blade angle throughout the length of the blade is not the same. The reason for placing

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the blade element sections at different angles is because the various sections of the blade travel at different speed. Each element must be designed as part of the blade to operate at its own best angle of attack to create thrust when revolving at its best design speed

LITERATURE SURVEY

Benjamin viney et. Al. [1] has presented the flow around the enshrouded marine propellers operating in the wake of an axisymmetric body is rotational and tridimensional. An inverse method based on the model of inviscid and rotational fluid and coupling two complementary steps (axisymmetric computation +3D panel method) is proposed for the design of the marine propellers. The maridional flow computation leads to the determination of axisymmetric stream sheets as well as the approximate camber surface of the blades and gives a good estimation of the surface of the free vertex wake.

J.E Connolly et al [2]: Address the problem of wide blades tried to combine both theoretical and experimental investigations, the author carried out measurements of deflection and stress on models blades subjected to simulated loads, with an aim to develop a theoretical model calibrated against the laboratory experiments, the model was then validated by measurements of pressure and stress distribution on the blade of a fullscale ship propeller at sea. based on the experimental results it was concluded that wide blades subject to tensile stress strength on the face and compression stress of similar magnitude in the back was pointed out that the accuracy of the prediction from the modal depends on the accuracy of the working load determined.

Tergesontvcdt et al [3] has focused on the application of finite element methods for frequency response and improve to the frozen type of hydrodynamic loading The thin shell element of the triangular type and the super parametric shell element are used in the finite element model it presents the realistic an dynamic stresses in marine propeller blades. Stresses and deformations calculated for ordinary geometry and highly skewed propellers are compared with experimental results.

MODAL ANALYSIS

7.1.1 DEFOROMATION AT DIFFERENT MODES:

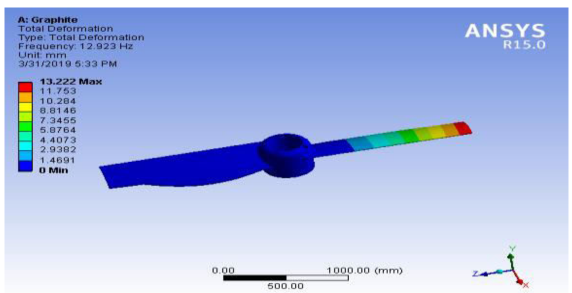

Fig 7.01: GRAPHITE AT MODE 1

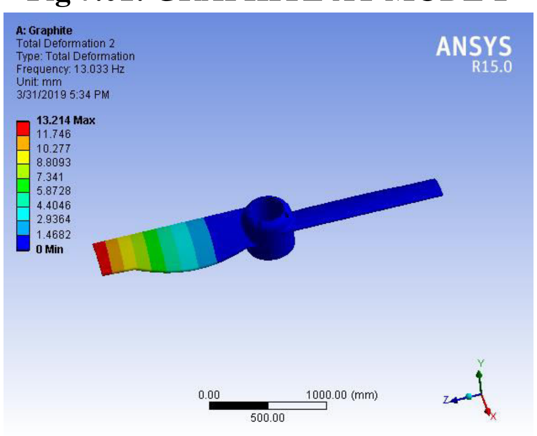

Fig 7.02: GRAPHITE AT MODE 2

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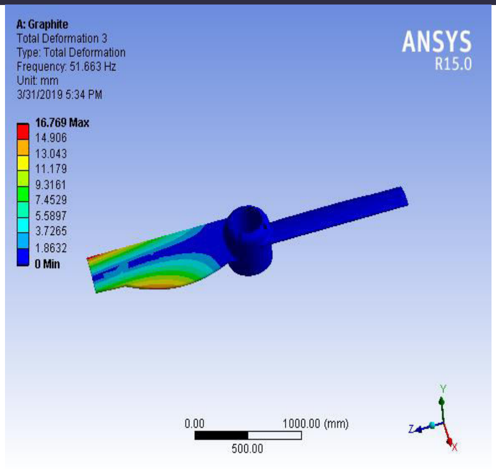

Fig 7.03: GRAPHITE AT MODE 3

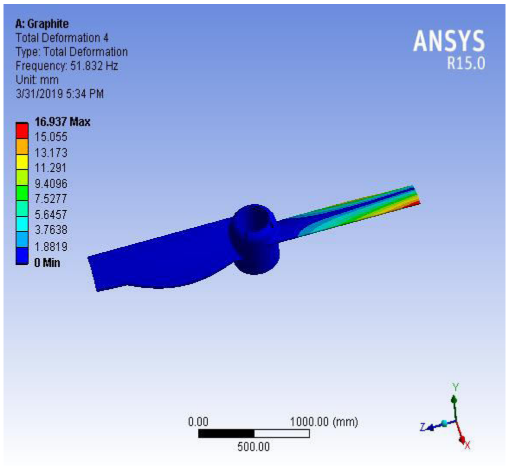

Fig 7.04: GRAPHITE AT MODE 4

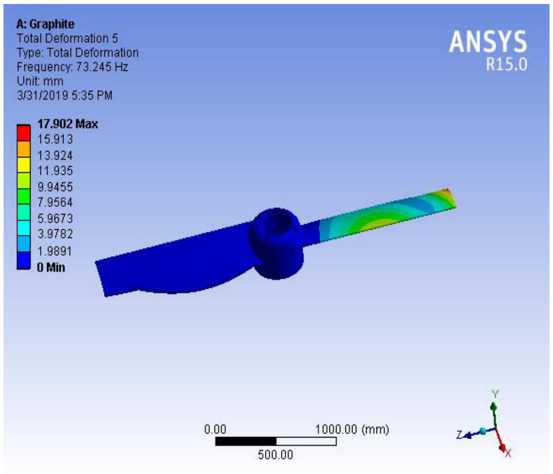

Fig 7.01: GRAPHITE AT MODE 5

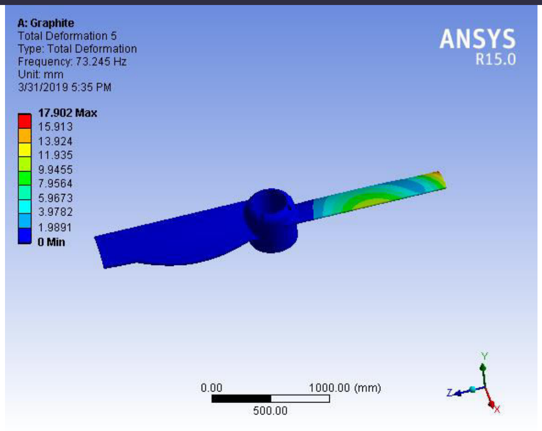

Fig 7.01: GRAPHITE AT MODE 5

RESULTS FOR STRUCTURAL ANALYSIS:

MATERIAL	MODE	FREQUENCY(HZ)	TOTAL DEFORMATION (mm)
	1	12.923	13.222
	2	13.033	13.214
GRAPHITE	3	51.663	16.769
	4	51.832	16.937
	5	73.245	17.902

Table 8.1: Results for Structural analysis

RESULTS FOR STRUCTURAL ANALYSIS:

MATERIAL	MODE	FREQUENCY(HZ)	TOTAL DEFORMATION (mm)
	1	24.616	14.41
	2	24.816	14.405
JUTE	3	93.704	18.068
	4	94.067	18.212
	5	138.16	19.262

Table 8.2: Results for Structural analysis

CONCLUSIONS

- Model analysis is carried out on both graphite and jute propellers it was observed maximum displacement for jute propeller is less than the graphite propeller.

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- The natural frequencies of graphite and composite propeller were compared. The natural frequencies of graphite propeller were found 2 times more than the jute composite propeller. Frequency obtained from FEA analysis graphite=73.245 Hz Frequency obtained from FEA analysis jute Composite=138.16 Hz
- From this project we conclude that graphite propeller is the best material when compared to jute composite propeller.

8.FUTHER SCOPE

- In this project, only the modal analysis on aircraft propeller blade has been performed by the use of the software ANSYS15.0.
- This work can be extended to study the effect of load on the propeller blade under dynamic conditions.
- Experimental stress analysis can be used to compare the different values obtained.
- The study can be extended to dynamic analysis and transient structural analysis of the propeller blade.