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CHANGING COMPOSITE MATERIAL IN MAIN HELICOPTER ROTOR BLADE

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ABSTRACT: To determine the load distribution in main helicopter rotor blade in study Computational Fluid Dynamics (CFD) and Finite Element Method (FEM) software is used. The aim of the present investigation is the development of a CFD and FEM by using CFD computation procedure capable of accurately simulating the pressure distribution test and velocity test of main helicopter blade and using FEM to simulating flow of thermal behavior test. For this purpose the complete of main rotor blade in CATIA model are used in CATIA modeling. Primary attention in this investigation is focused on defining load on main helicopter rotor blade because of metal trailing edge segments of these blade were replaced with a new segments made from honeycomb composite materials. As critical structural parts with greetings to strength here are glued joints between metal and composite segments of trailing edge are considered. For precise stress analysis of these segments, including glued joints, the finite element method is used.

KEYWORDS: ANSYS FLUENT, CATIA, CFD, FEM, ROTOR BLADE.

1 INTRODUCTION

Nowadays, aerodynamic interaction between the main rotor of helicopter still remains a challenging task. The flow around a helicopter is dominated by complex aerodynamics and flow interaction phenomena. Lifting-line theory with two dimensional (2D) airfoil records as a function of angle of attack and Mach number were usually used for blade aerodynamic loads. But in such approach, experiential corrections had to be integrated because of the effects of dynamic stall, compressibility and blade interaction with trailing vortex. Today, powerful computational fluid dynamics (CFD) methods are progressively more used in the analysis of the whole helicopter avoiding experiential corrections. The additional complexity appears to result from blade dynamics and elastic deformations. The problem of main rotor analyzed in relatively ANSYS FLUENT (ANSYS FLUENT 18.0 Users Guide) commercial software is applied in obtaining influence of the fuselage on the main rotor blade sectional loads for the Mi-8 helicopter. The main rotor blades are modelled whereas rotor hub is not included.

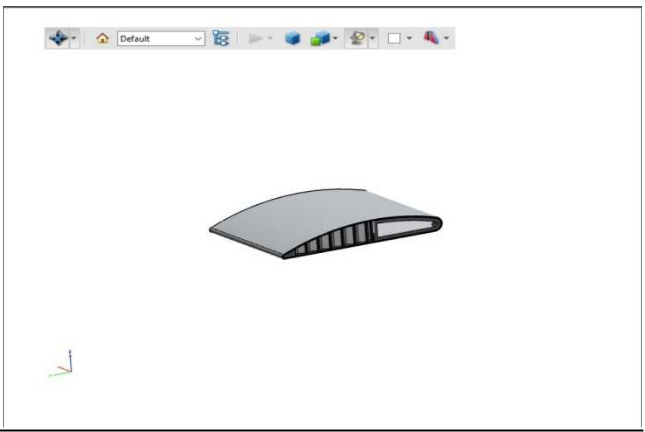

Fig 1 Structure of main Helicopter Rotor Blade

2 MODELING AND EXTRACTION OF FLOW DOMAIN

The data points of airfoil for the rotor model and the computational domain were collected. The 3D model of the main rotor blades are designed by using CATIA. Figure 2 show model of our rotor blade which can design in CATIA are decided to place on the 3D model of the main rotor blade. Figure 3 shows the 3D model of the main rotor blade along with the structure of honey comb inside of main rotor blade. The values for the generated mesh near the wall zones are maintained at too which is as per the turbulence modeling requirements. A single passage approach is modeled and numerically solved with the assumption that flow is periodic

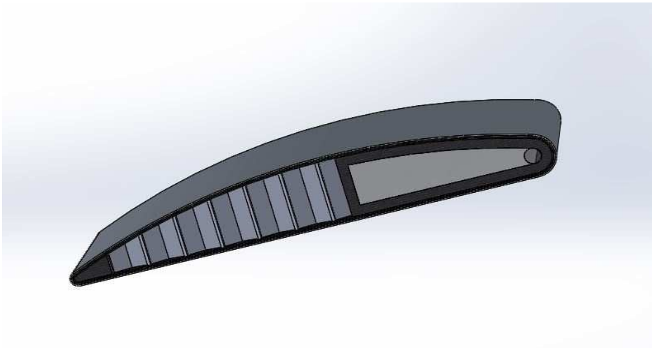

Fig 2 Model of Main Rotor Blade

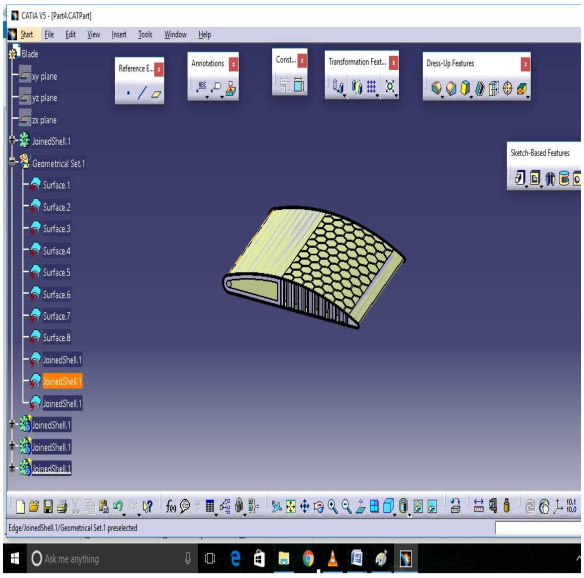

Fig 3 CATIA Modelling

3 MESH GENERATION

Meshing of the computational domain is made using CFD as shown in Figure 3.Thus, the discretisation of the Hybrid structured grid elements were generated. To mesh the composite material boron epoxy for analyzing the material in ansys software.

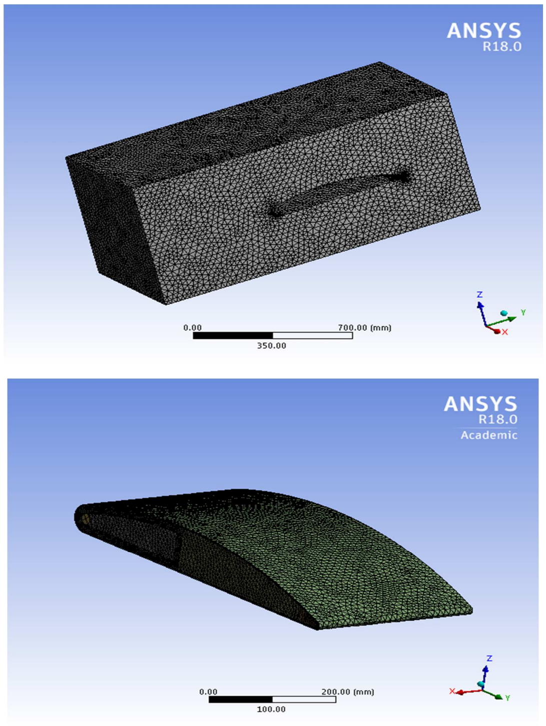

Fig 4 Meshing of Rotor Blade using Boron Epoxy

4 RESULT

4.1 PRESSURE

In figure5 pressure flow over the boron epoxy honeycomb composite material by using ansys software for increasing the pressure while changing composite material in helicopter main rotor blade for producing more lift in rotor blade while comparing with Nomex honeycomb composite material. In below figure pressure flows in boron epoxy honeycomb composite materials by using ansys software.

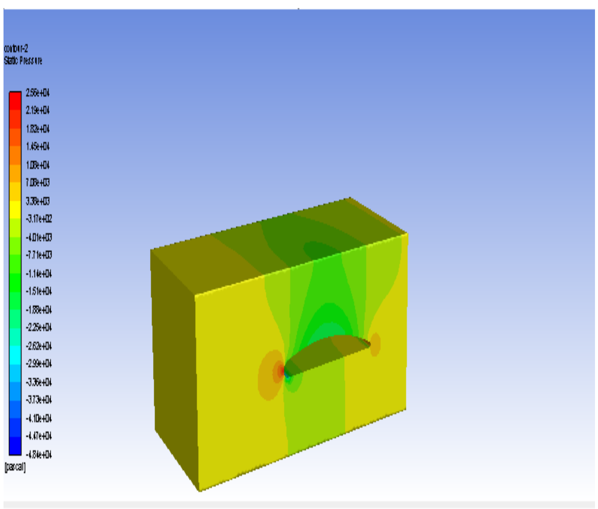

Fig 5 Pressure Flow over Rotor Blade

4.2 Velocity

In figure 6 compeer the velocity flow over the boron epoxy composite material by using ansys software for decreasing the velocity while changing composite material in helicopter main rotor blade for producing more lift in rotor blade. In below figure we find out the various velocity flows in composite materials by using ansys software.

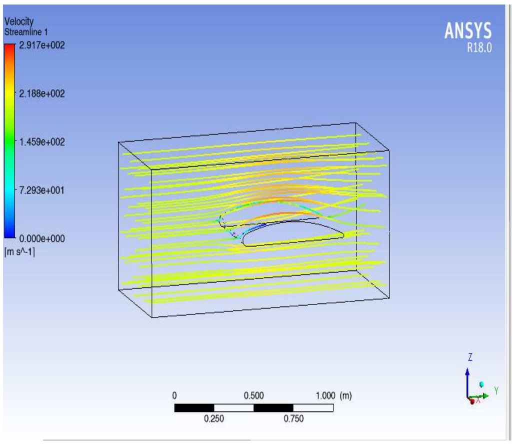

Fig 6 Velocity Distribution in Boron honeycomb

4.3 Stress

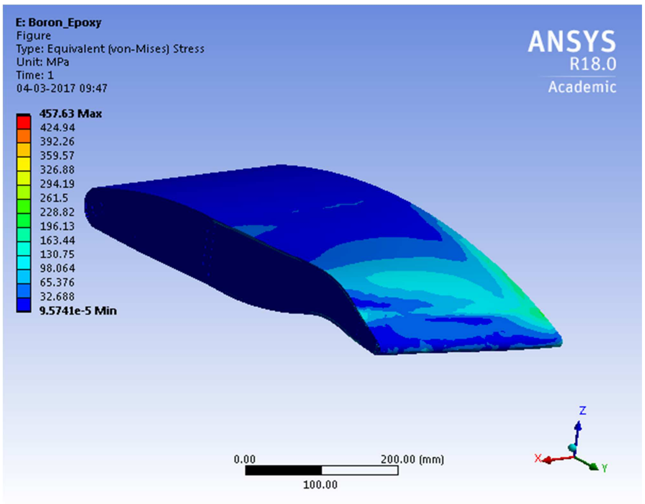

Fig 7 Stress applied in Boron Epoxy

4.4 Safety Factor

The below figure represents the safety factor of the boron composite respectively.

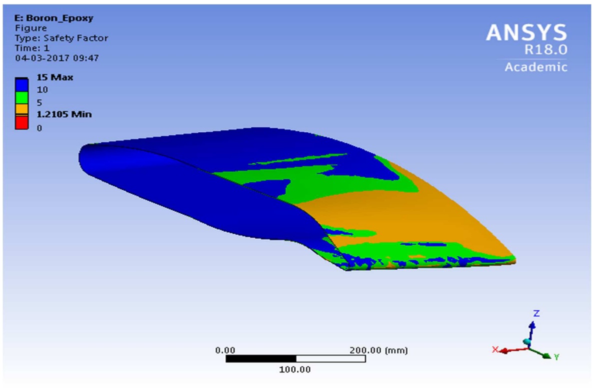

Fig 8 Safety Factor of Boron Honeycomb

5 Conclusion

Finally by using the software life CATIA, CFD (Computational Fluid Dynamics) and FEM. We are changing the boron composite honeycomb structure in main helicopter blade. By using the software's we can designing the main rotor blade and we can also found pressure distribution, velocity distribution. The purpose of this paper was to study the flow and performance parameters for better understanding over the design condition.

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