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Structural Analysis Of A UAV Fuselage

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Abstract: ***This project is all about the analysis on the vibrational characteristic of a fuselage structure of an unmanned ariel vehicle (UAV). Aluminium materials are used in all structural componenets.The vibrational characteristic will be analysed using the modal analysis in Ansys and the modal characteristic of the fuselage structure is determined for free and forced configuration. Thus we can find out the natural frequency and dynamic stresses on the designed fuselage. Also we can find out the the total deformation and equivalent stress using stress analysis. Thus by the modal analysis of this structure, results can be produced for varying inputs.***

Keywords: ***Aluminium, Natural frequency, Dynamic stresses, Ansys, CATIA V5 R20.***

I. INTRODUCTION

Now-a-days the Unmanned Ariel Vehicles are gained much interest as an alternative instrument in the field of military and civil applications and scientifically in the field of intelligence, surveillance and reconnaissance missions that are difficult for the manned aircraft. The aircraft interest in this study is based on the unmanned aerial vehicles fuselage which the structural component is made up of aluminium material. This paper describes about the detail of an analytical investigation focusing on the vibration analysis of the fuselage to obtain the natural frequency and dynamic stresses and also the total deformation and equivalent stress by stress analysis. The description of the fuselage structure, material properties and analytical method is described in the following sections and the vibrational analysis and stress analysis results are presented.

II. MATERIALS AND METHODS METHODOLOGY

The 3D modelling of an UAV fuselage is conventionally done using CAD software's like CATIA V5 R20.
1. Problem definition.
2. Generate the 3-dimentional computer model
3. Prepare finite element model of the 3D computer model
4. Pre-process the 3D model for the defined geometry
5. Mesh the geometry model and refine the mesh considering sensitive zones for results accuracy
6. Post process the model for the required evaluation to be carried out
7. Determine the natural frequency and dynamic stresses along the fuselage.
8. Determine the total deformation and equivalent stress.
9. Conclude the results.

FINITE ELEMENT MODELLING OF UAV FUSELAGE

Using CATIA V5 an UAV fuselage has been created. After establishing the model it is meshed using meshing tool by Ansys. Material properties re applied before the meshing. The fuselage is considered as a solid body and the material properties assigned for the fuselage table 2.1

S.NO	CONTENT	PARAMETER
1	Element Type	Solid 187
2	UAV fuselage mass	1.959 kg
3	UAV fuselage volume	7.0468e+005 mm^3
4	UAV fuselage Density	2.78 g/cc

5	UAV fuselage length	0.958m
6	Young's Modulus	73000 MPa
7	Bulk Modulus	71569 MPa
8	Shear Modulus	27444 MPa`
9	Poisson's Ratio	0.3

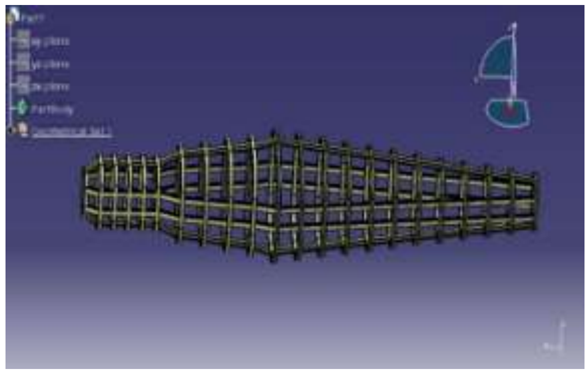

Fig. 1 CATIA model of an UAV Fuselage

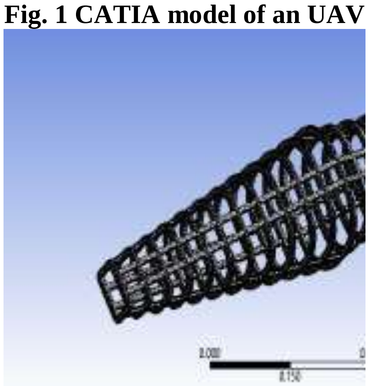

Fig. 2 meshing of Uav fuselage

DIFFERENT UAV FUSELAGE SIMULATION

Analysing the uav fuselage is done using Ansys. The analysis has been done for finding out the natural frequency and the dynamic stresses are done and the total deformation and equivalent stress using stress analysis.

Static Analysis

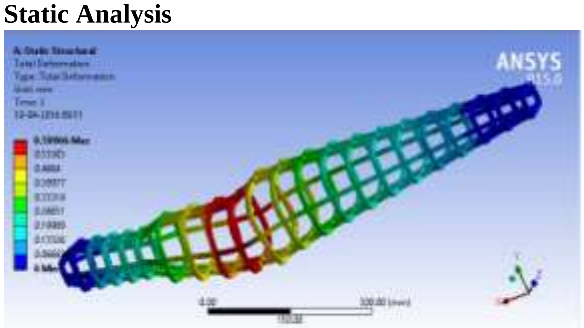

Fig. 3 Total deformation

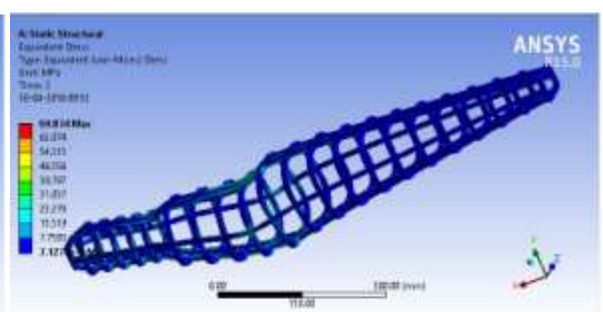

Fig. 4 Von mises stress

Dynamic Response

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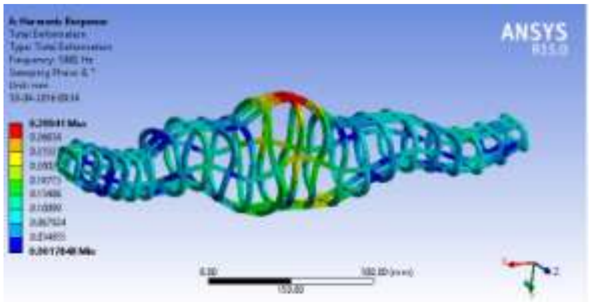

Fig. 5 Total deformation

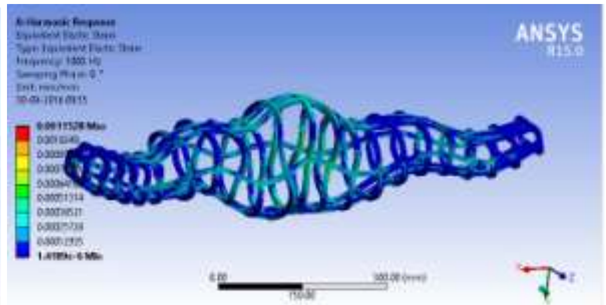

Fig. 6 Equivalent elastic strain

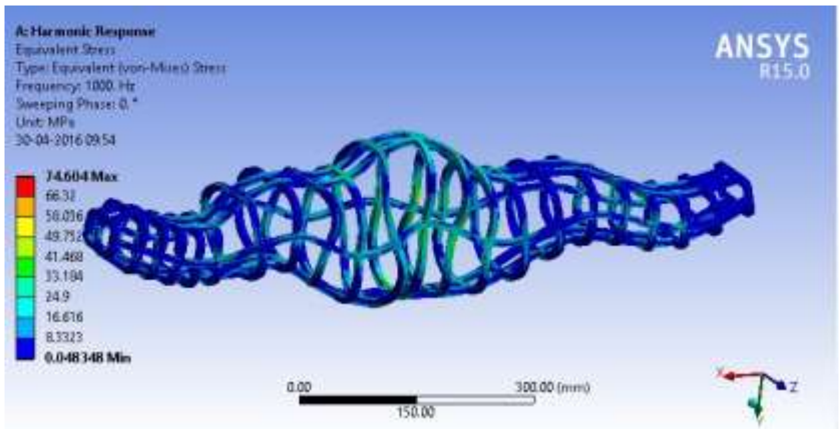

Fig. 7 Von mises stress

Modal analysis

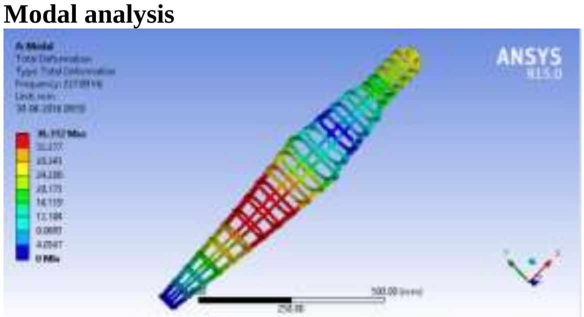

Fig. 8 Total deformation

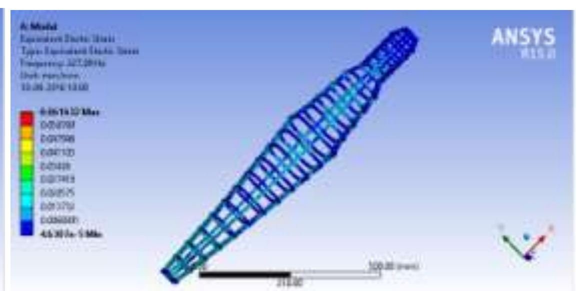

Fig. 9 Equivalent elastic strain

III. RESULTS

The result from analysis is depicted graphically. A frequency- Amplitude is plotted and the Frequency- phase angle is also plotted. Both the graphs are shown below.

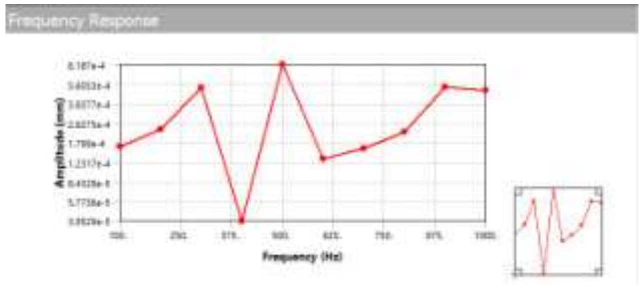

Fig. 10 Frequency vs. Amplitude

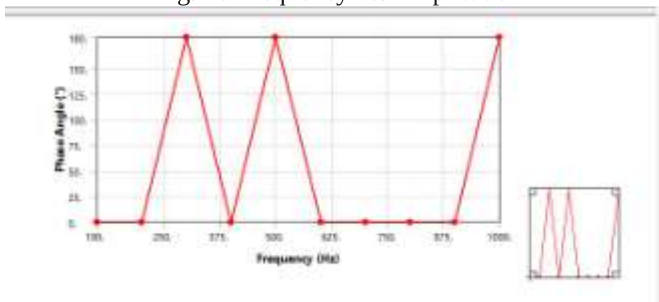

Fig. 11 Frequency vs. Phase angle

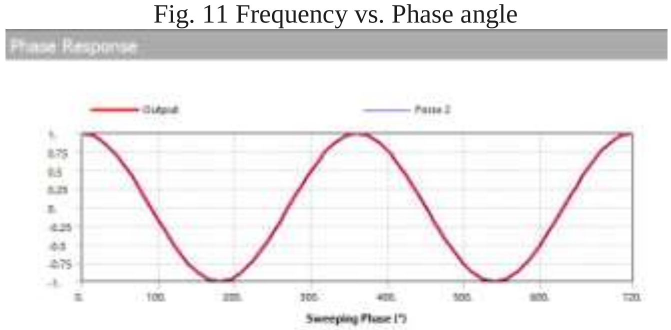

Fig. 12. Sweeping Phase

IV. CONCLUSIONS

The modal characteristics of the aluminum of an UAV are determined. Using Ansys the natural frequency according to range can be obtained and the stress values are obtained using static analysis. The methodology is presented here and proved to be simple and effective procedure from which the modal characteristics of a large component are determined.

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