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GVT, UPDATING AND CORRELATION ON SCALE AIRCRAFT MODEL

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Abstract - *The GVT is a modal test of the entire airframe, which determines the resonant frequencies, mode shapes, and damping. This is performed on the aircraft before first flight while it is still on the "ground". GVT modal results are compared with the structural Finite Element Model used for flutter predictions. If the models and test results agree, the aircraft is cleared for the next round of tests, which usually includes ground runs and a flight flutter investigation. Ground Vibration Test (GVT) plays an important role in the certification process of any new or extensively modified aircraft. GVT results provide experimental data which are essential in flutter prediction as well as to validate and update analytical aircraft models. The GVT of an aircraft structure determines its natural frequencies, normal mode shapes and generalized parameters (mass, stiffness and damping) over a specified frequency bandwidth. There are several methods for carrying out the GVT.*

Key Words: Resulting Frequency Response Function(RFRF), Ground Vibration Test, (Size 10 & Bold) Key word1, Key word2, Key word3, etc (Minimum 5 to 8 key words)…

1. INTRODUCTION

Main objective of the test is to obtain experimental vibration data of the whole aircraft structure for validating and improving its structural dynamic models. Among other things, these models are used to predict the flutter behavior and carefully plan the safety-critical in-flight tests. Flutter is an in-flight phenomenon which causes the wings and other key components to vibrate uncontrollably, due to the convergence of multiple modes as the resonance and damping shift due to aero-elastic loading, making flight impossible. Before flying an actual aircraft, flutter performance is predicted, so the flight envelope (altitude and speed) of the aircraft is safely bounded. This is later verified by performing a flutter test with the actual aircraft.

1.1 CAD MODEL

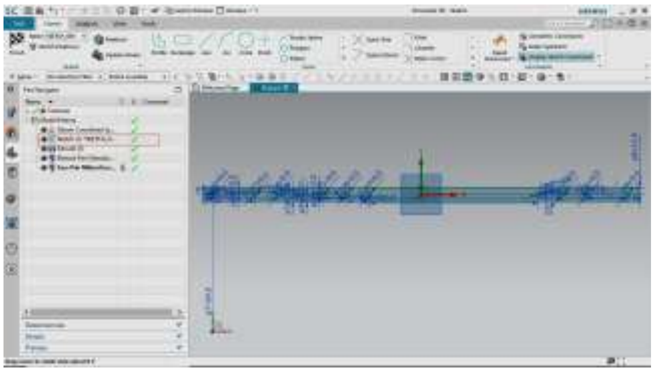
Before a product is physically build a CAD model is created - defining the products dimensions – which is used later on to build a Finite Element Model. This model embodies a topology (nodes, elements), properties and boundary conditions. With this information, dynamic characteristics such as mode shapes and resonance frequencies can be derived. Modifications to the Finite Element Model can then be applied to look for design changes that result in a better simulated behavior of the structure.

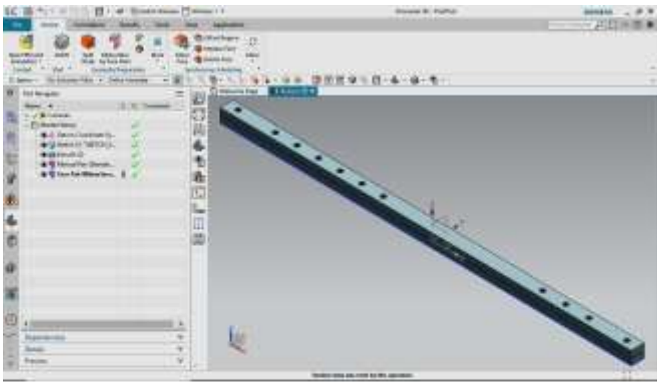
- Creation of CAD model can be done by using simcenter 3D/NX software
- Creating different parts of scale aircraft structure using different tools and commands in simcenter 3D/NX software. In our project we named different parts of scale aircraft model as:

1.2 ROD

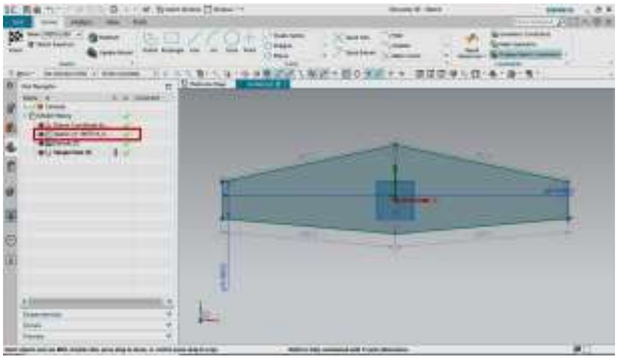
- To create different parts of geometry we will be using part navigator.
- Creation of sketch of rod is based on the dimensions noted from physical model.
- Sketch dimensions are shown in figure 4.1
- Figure 4.2 shows finished part of rod.

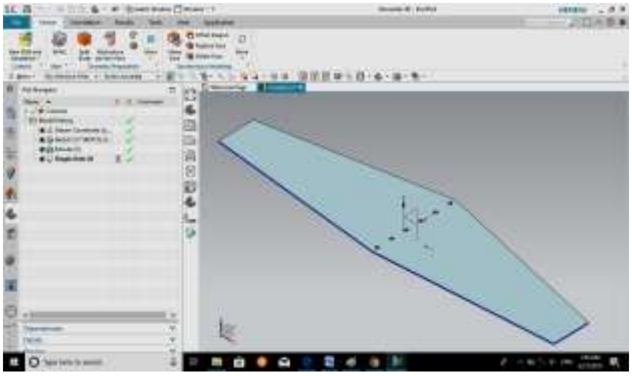
NOTE: Similarly create different parts (wing1,wing2, L shape and vertical) with the aid of part navigator.



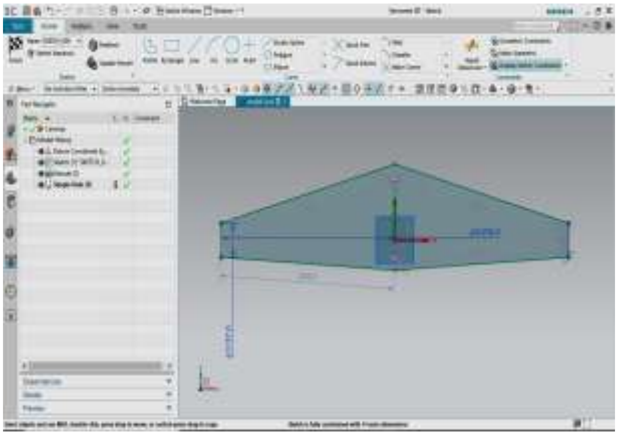


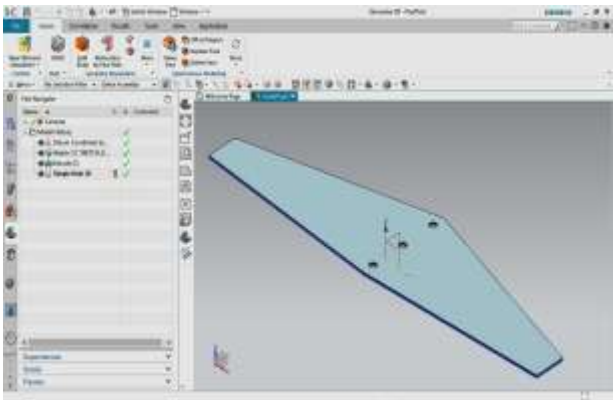
1.3. WING1 (LARGE)



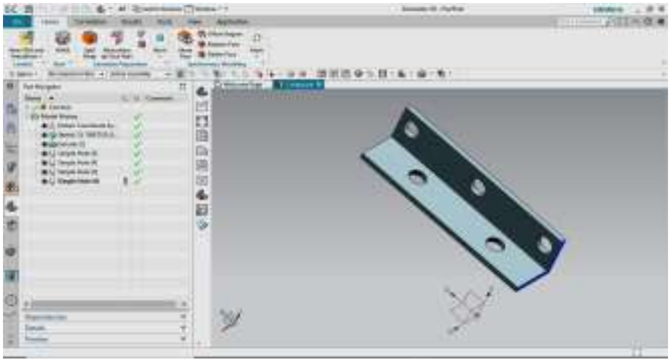


1.4. WING2 (SMALL)

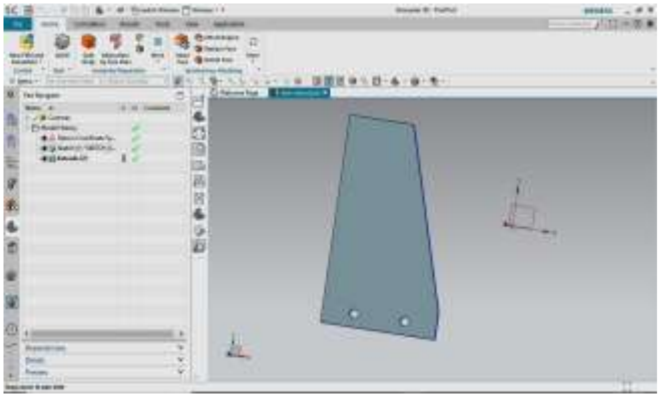




1.5. L SHAPE



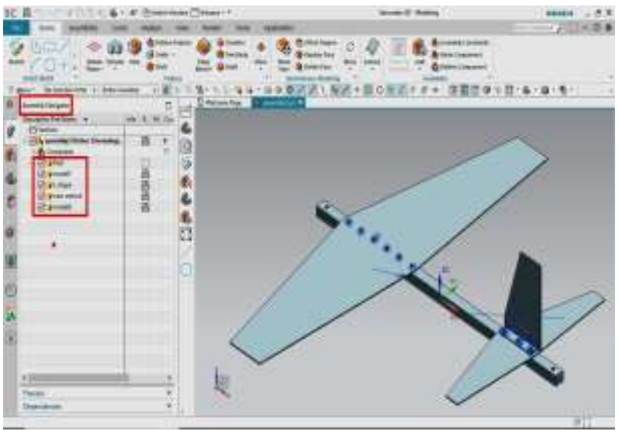
1.6. VERTICAL PLATE



1.2 .ASSEMBLY OF ALL PARTS(CAD MODEL)

2 Different parts of scale aircraft structure can be assembled in ASSEMBLY NAVIGATOR.

3 The below figure shows assembly of all parts.



APPLICATIONS

1.Structural vibration testing

2.Shock and drop testing

3.Vibration testing and shaker testing

4.Acoustic testing

5.Rotating machinery diagnostics

6.Aerospace

7.Military and Defense

8.Automotive and commercial vehicle

3. CONCLUSIONS

We performed a ground vibration test, modal parameter extraction, FE analysis and correlation analysis on an aircraft structure model. The test was carried out by hammer and shaker in a frequency range of 0 to 100Hz in free-free configuration and modes were extracted. A high correlation between various test excitations was achieved, confirming the accuracy of the experimental approach. Correlation between experimental and analytical modes, except for mode pairing, was fairly high indicating the FE model represents the dynamic behavior of the structure properly. Good correlation between phase resonance and phase separation test results demonstrates a high reliability on the applied technique. A sine test with shaker was also conducted to recognize the close modes of the structure. Comparison between the results obtained from shaker and hammer recommends that the hammer test can accurately predict the close modes of the structure. Correlation analysis between modified and unmodified structures was also investigated. It was shown that small changes in the symmetry of the structure can cause fundamental changes in mode pairing and mode shapes. Also, the change in symmetry can cause major shifts in some natural frequencies.

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