MODELING & SIMULATION OF AIRCRAFT WING TO STUDY FLUTTERING PHENOMENON.

REPORT PRESENTATION

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AGENDA

INTRODUCTION TO AERODYNAMICS.

BRIEFFING ABOUT FLUTTERING PHENOMENON.

MODELIING & SIMULATION

RESULT DISCUSSION

CLOSING

INTRODUCTION

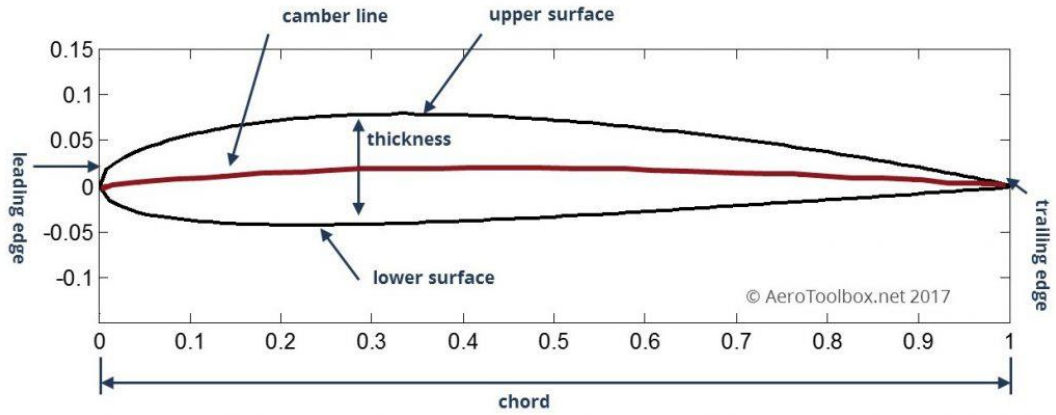
AERODYANAMICS

a science that studies the movement of air and the way that objects (such as airplanes or cars) move through air

HOW AERODYANAMICS RELATED TO AEROPLANES

THE UNIQUE BUILD STRUCTURE AND ARRAGEMENTS MADE DURING THE BUILDING OF AIRCRAFT BODY WHICH HELPS AEROPLANE TO FLOAT STEADY & BALANCED ON AIR MOLECULE IS CALLED AERODYMANIC STRUCTURE OF THE AIRCRAFT.

HOW AIRCRAFT FLY IN THE AIR



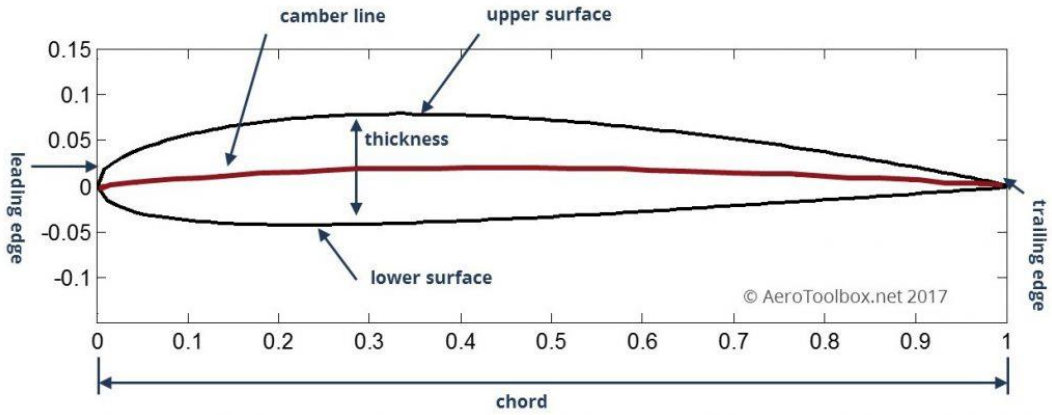
-Initially on the runway, angle of the wing w.r.t. Ground is 0. this angle is known as angle of attack. Which helps to aircraft to float on the air.

-As the angle of attack is directly propotional to the elevation gain by aircraft.

-Wings of the aircraft is very responsible part in whole aircraft body which helps aircraft to float in the air.

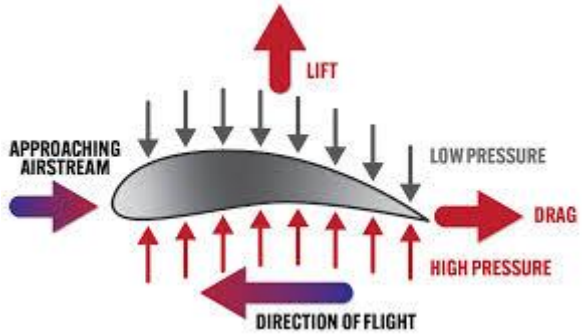
-These wings are also responsible to perform different actions by aircraft such as : Take-off, Hovering, Row & Pitch etc.

HOW AIRCRAFT FLY IN THE AIR



-As the air passes over the wing of the aircraft when the angle of attack is (theta), Low pressure area and High pressure area is created over and beneath of the surfaces of the aircraft wing.

-This air pressure difference helps aircraft to float on the air.

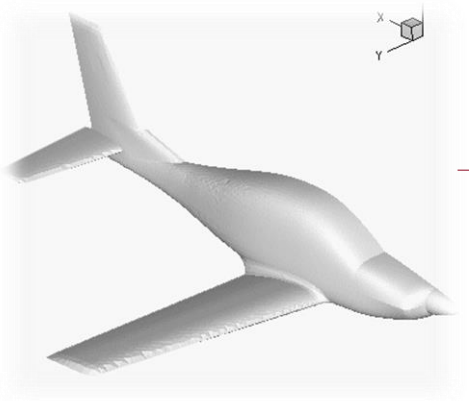


FLUTTERING

FLUTTERING

1. Aerodynamic
2. inertial forces
3. Aero Speed
4. Weight Associated with wings

Vibration of Wings With Frequency xHZ



Wing vibrating with some natural frequency lead to resonance effect due to unavoidable dominant external parameter.

Failure

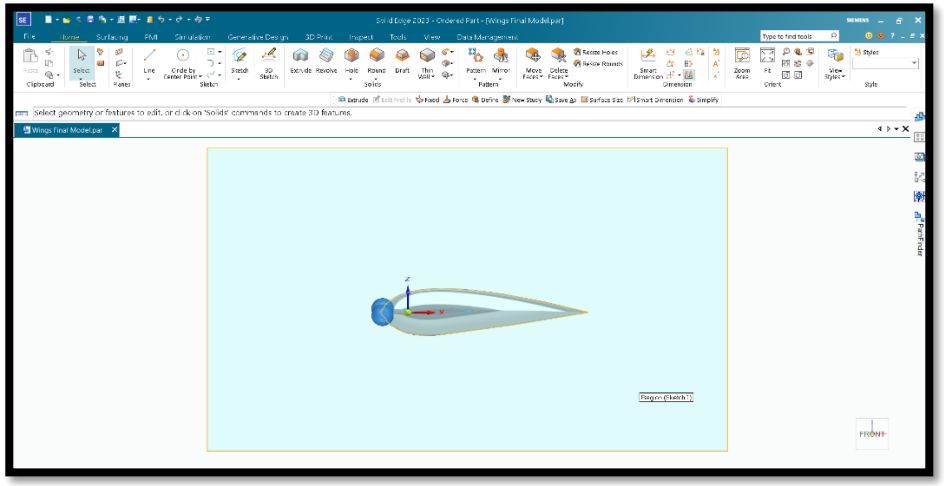
MODELIING & SIMULATION

To analyze the fluttering phenomenon of aircraft wing and impact on different stages of flights such as: Take-off, Hovering & Landing by calculating the different natural frequencies which usually encounter during flutter effect and causes aircraft wing to detach from main body.

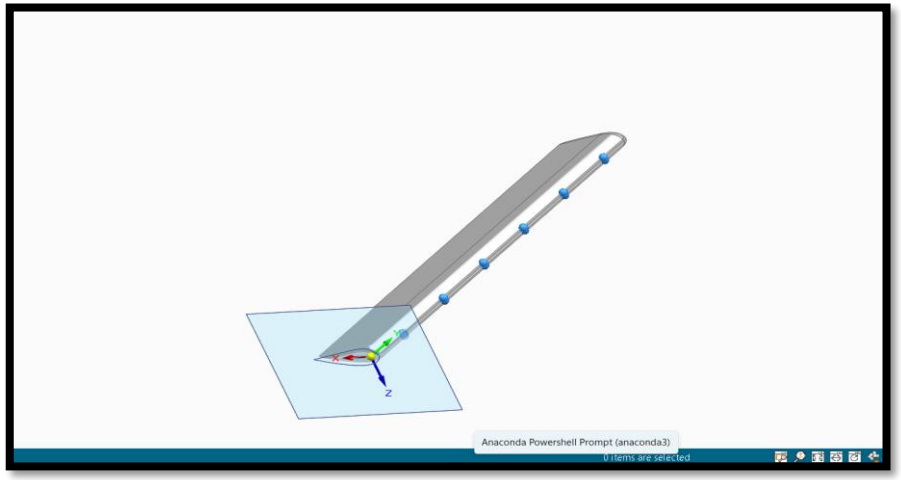
This analysis has been studied and simulated by two different softwares.

1. Solid Edge by Siemens (Modelling).
2. Ansys (Workbench).

MODELIING & SIMULATION



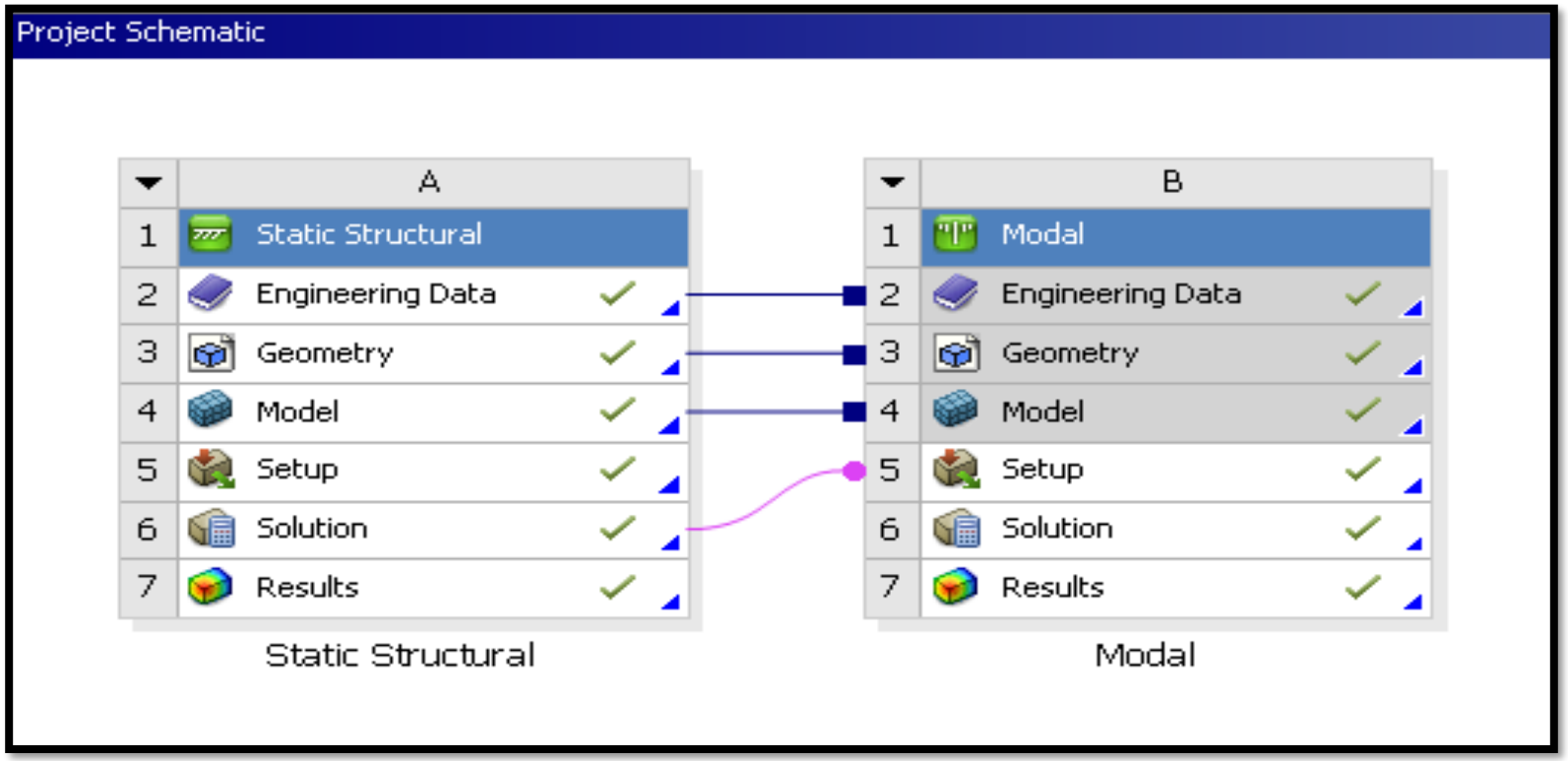
2D



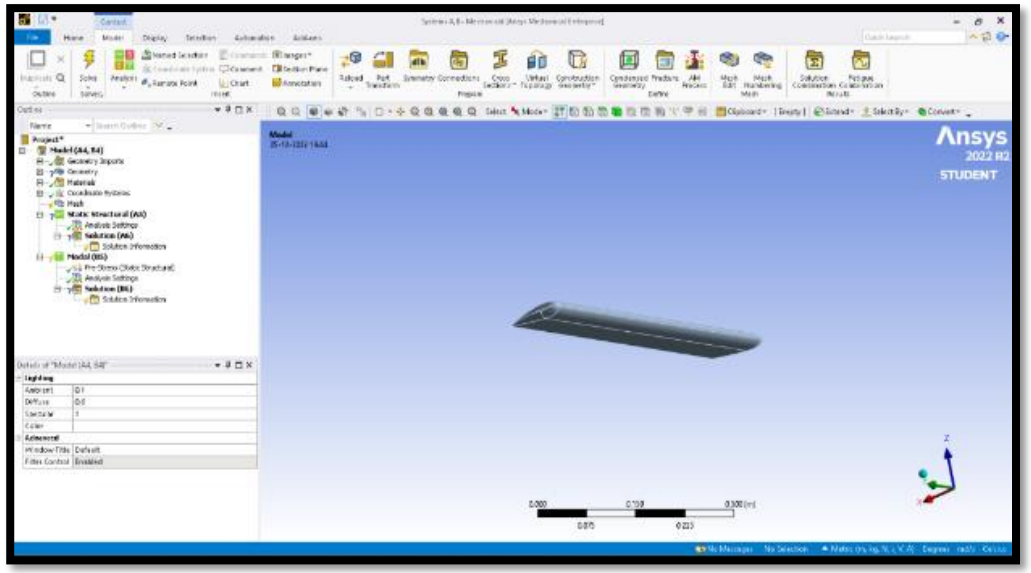
3D

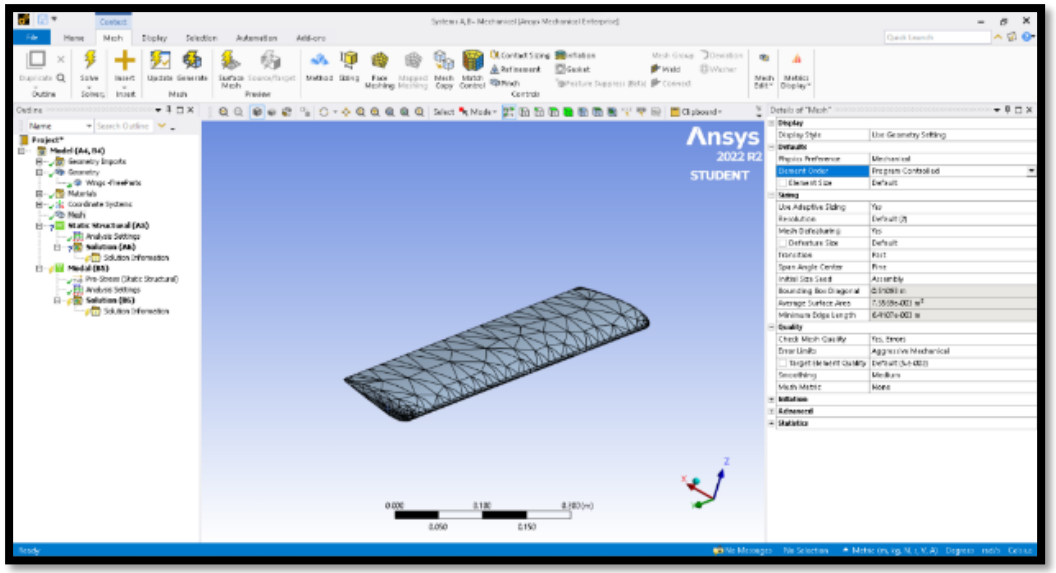
MODELIING & SIMULATION

Open Ansys Workbench and select “Static Structure” & “Modal” for the static structure analysis and behavioral characteristics of static structure.



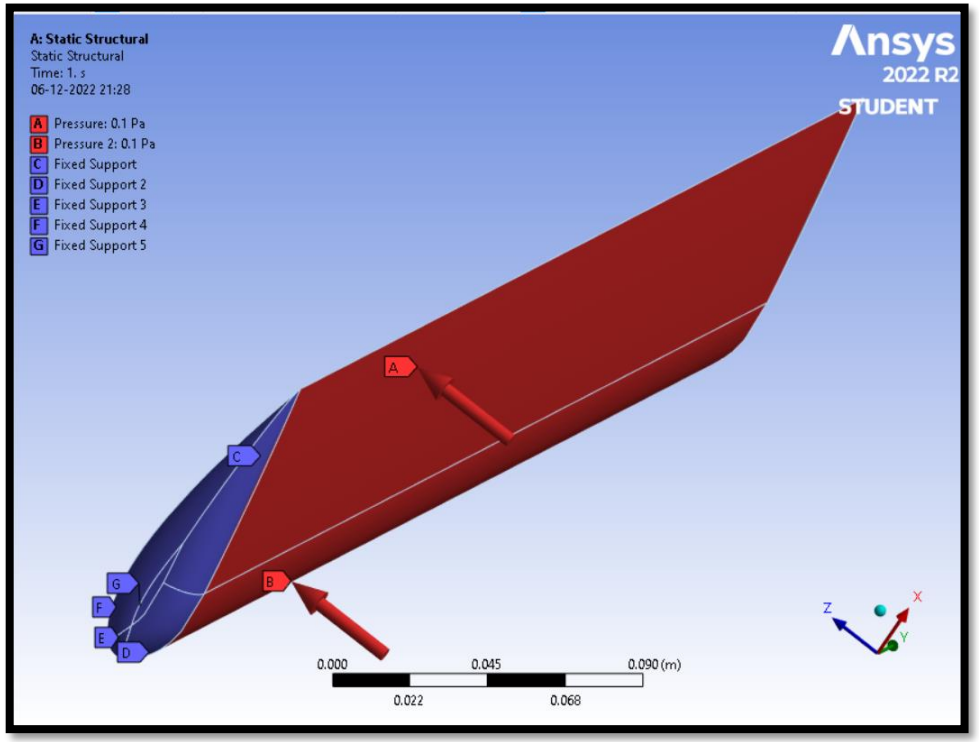
Geometry Import: Click on geometry and import .igs format to Ansys.





Model Setup:

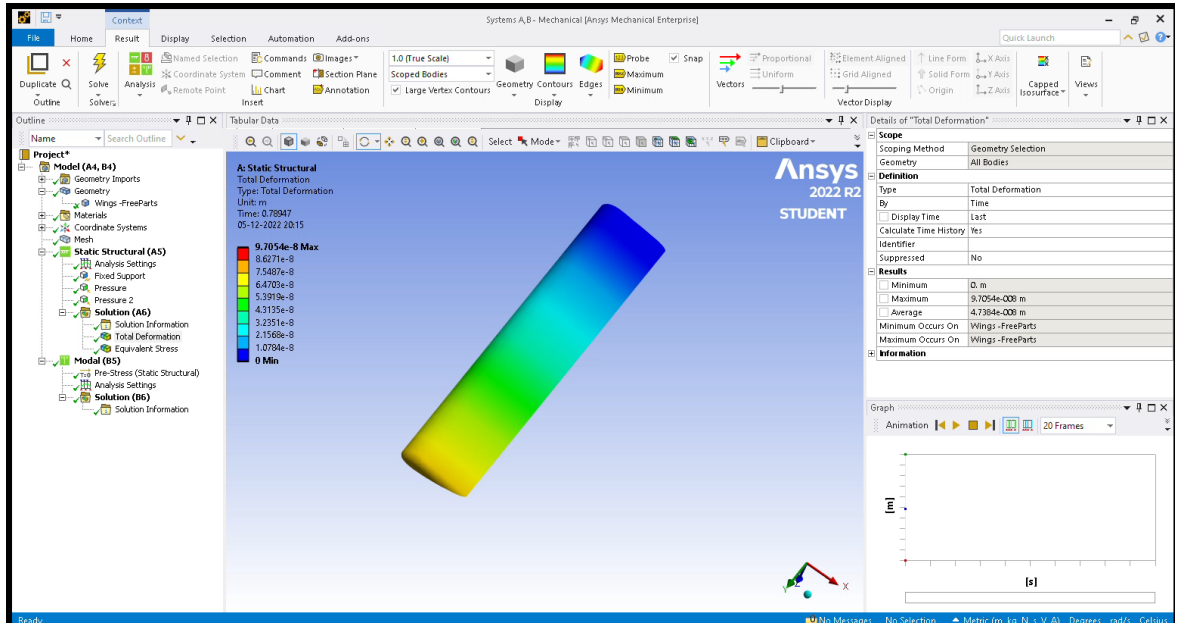
This option allows you to enable access for creating fixed end support and force magnitude & Direction.



RESULT

Result:

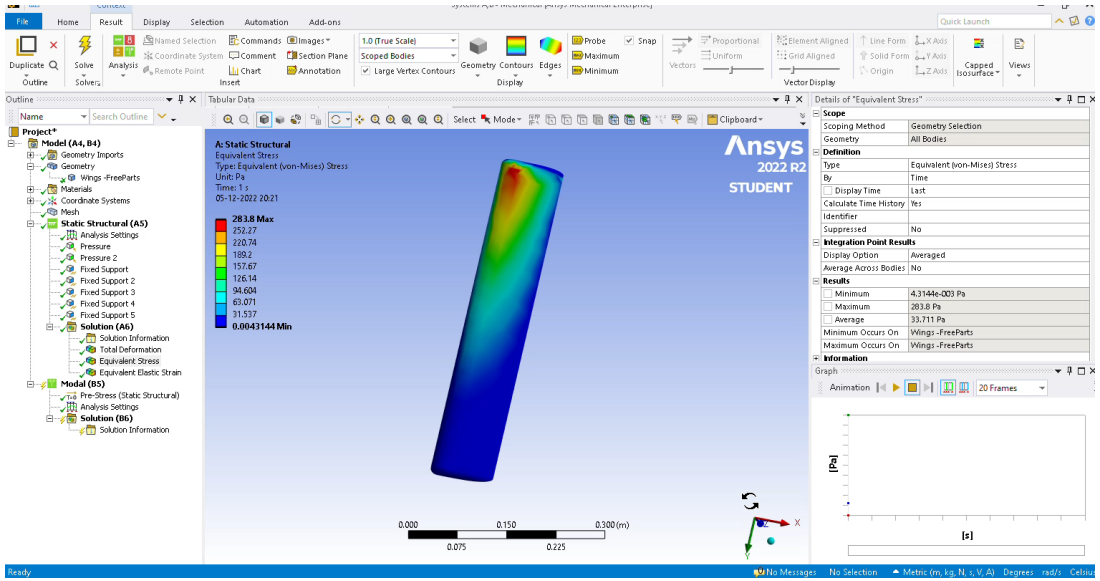
1. The wing has fixed support and load application at two different location and the behavior of total deformation is shown as follows. The deformation is more likely will noticed at the red portion of the wing which is a fixed support (wing attached to the main body). Whereas, Blue colored region has very less magnitude to deformation in terms of stress accumulation.



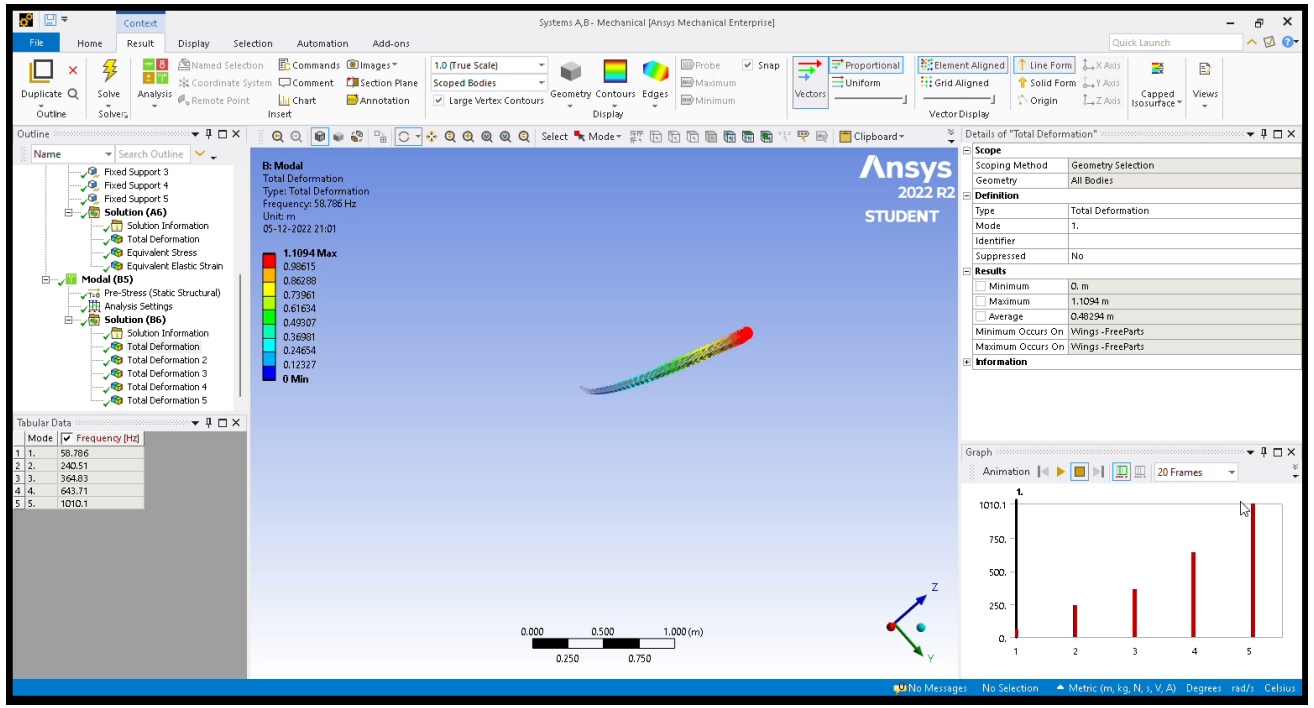
RESULT

Result:

2. Below images states that the equivalent stress saturation in whole structure of the wing is marked with red color region on the wing. This equivalent stress behavior throughout the wing is shown as below.
If we observed carefully, maximum stress accumulation is near to the fixed support. Which might cause wing to vibrate wing at higher extent and results in to fluttering effect.

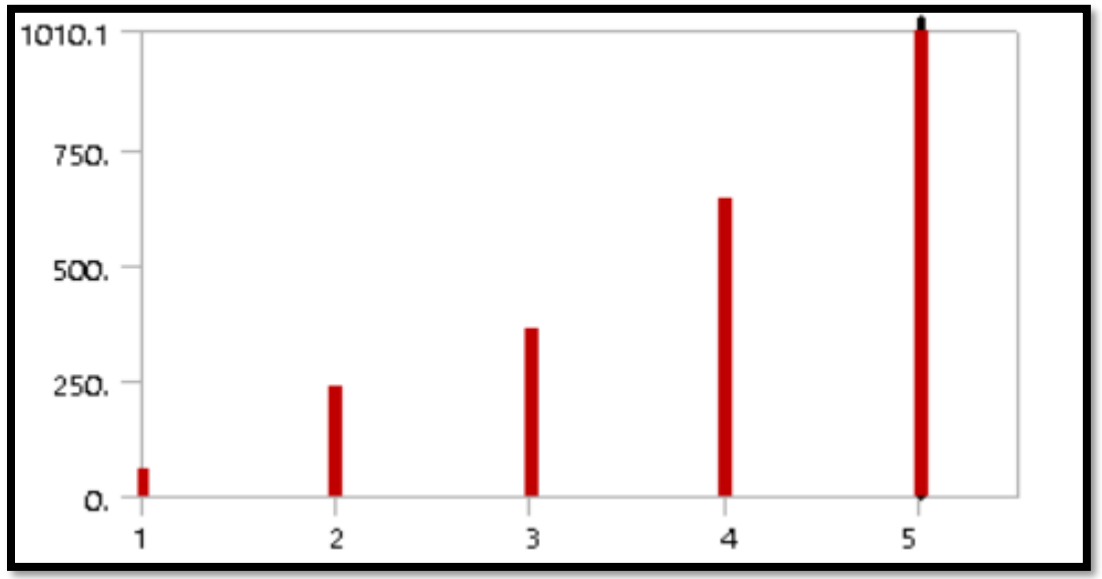


Behaviour of wing under stress accumulation



RESULT

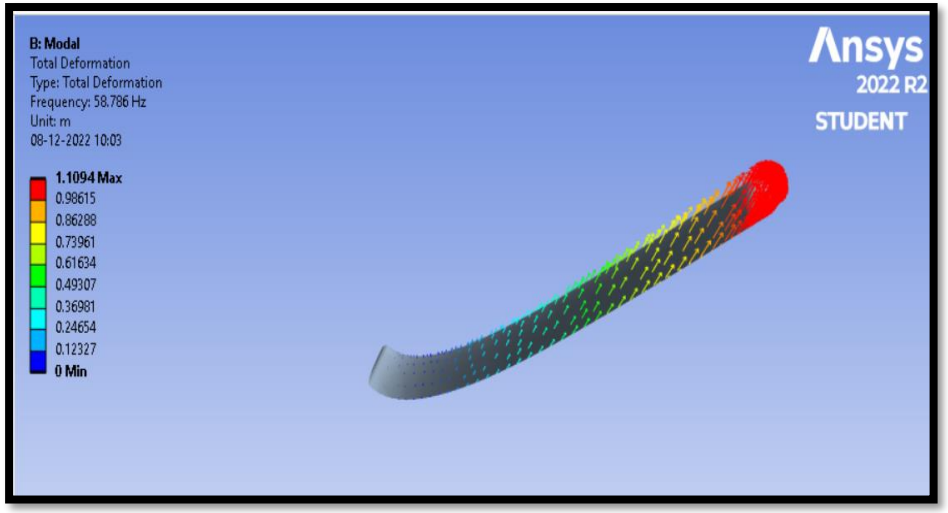
We obtain five natural frequencies are as follows :



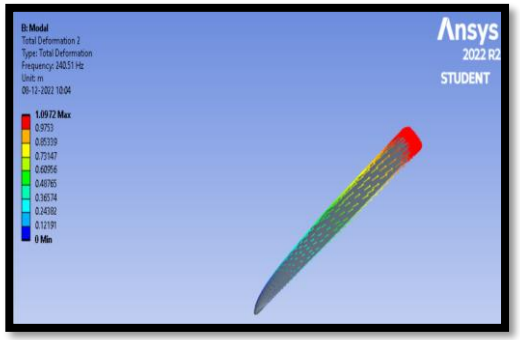
Tabular Data

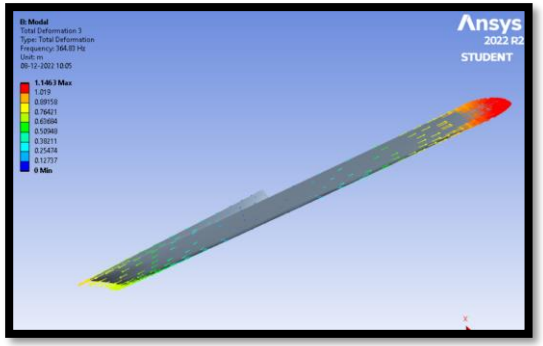
	Mode	Frequency [Hz]
1	1.	58.786
2	2.	240.51
3	3.	364.83
4	4.	643.71
5	5.	1010.1

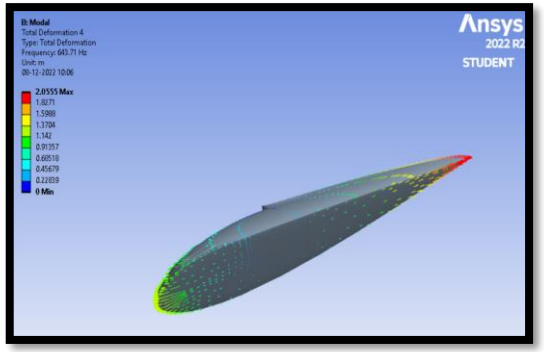
RESULT

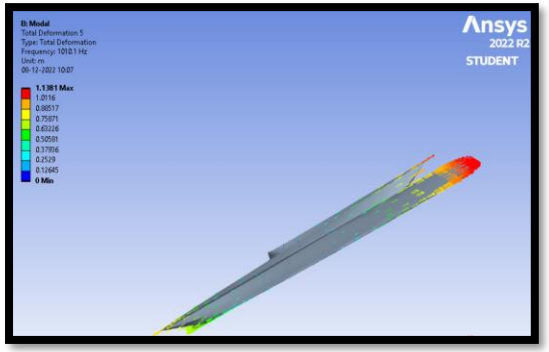


We have analyzed the five different types of natural frequencies which causes aircraft wing to vibrate in five different patterns of fluttering vibration. Which can lead to cracking of aircraft wing from main body









CONCLUSION:

- Aircraft Technology is solely relay on the concept of aerodynamics. Which helps aircraft or any flying object to into the air without any rigid support.

- Similarly, the science of take off phenomenon is based on aircraft aerodynamic aspect, mainly depend upon three main crucial parameters such as Lift, Drag & Thrust Generated. To generate these three parameters to have a successful take off from runways aircrafts need to undergo different mechanical and challenges such as momentum gain & change of state of inertia which causes unavoidable vibrations in the main frame of the aircraft and can be cause *resonance* effect in the wing joints. As soon as the aircraft loses the contact with ground, the whole weight of the aircraft is taken by the wings of the aircraft and this results in the vibration of the wings. Other than weight of the aircraft many other parameters are responsible for the fluttering effect such as air resistance, Turbulence, Jet Engine Vibration. This fluttering effect can not be eliminated completely but can be reduced at certain extent.
- The increase in the weight of aircraft wing or addiction external weight attached to the wing can be result into the reduced fluttering.


THANK YOU