Structural and Fatigue Analysis of Naca4412 Wing Using Ansys workbench

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Abstract: -

Analysis of Structure and its mechanical properties gives us the strength as well as Capability of the material. Structural Analysis over a Body gives us about various properties like its load baring capacity as well as Deformation to the load. Wings plays a crucial role in an aircraft, so it is important to analyze parameter such as Weight, load and deformation to load in order to increase its efficiency and for high performance. Wing is made of Aluminum Material.in this paper certain analysis was carried out over the NACA 4412 airfoil wing structure and gone through structural analysis of the wing using ANSYS. Static structural analysis was done, and results of various stresses are obtained.

INTRODUCTION: -

Wings are the main components of aircraft which produces lift. In order to get high performance, the airfoil which is chosen to manufacture wing must be capable enough to generate lift without stalling. Symmetric airfoil does not generate any lift at 0^o Angle of attack because there is no pressure difference top and bottom surfaces of the airfoil at 0^o unlike symmetrical airfoil Chambered airfoil generates lift at 0^o Angle of attack, as the surface area in the bottom side of the airfoil is more compared to the top side which leads to pressure difference in top and bottom sides and generates a force resultant in the upward perpendicular direction which is called as Lift. Cambered airfoil produces more lift compared to Symmetrical airfoil.

NACA4412 airfoil has Extreme chamber of 4% located 40% (0.4 of chord) from leading edge with an extreme thickness of 12% of chord. It is a cambered airfoil. Stall angle is 11^o for Re 150000 drag is independent of Reynolds number. The wing with NAC4412 was chosen for its static structural analysis. which gives the parameters such as Fatigue tool damage, Fatigue tool damage, total deformation, shear elastic strain, shear strain and shear energy of a wing with NACA4412 airfoil undergoes a load of 100KN.

RESULT ANALYSIS: -

Consider the wing as cantilever beam (1-D) structure which is fixed at one end and free to move at the other end. Load is applied at the free end of the wing with 100KN. It shows a drastic deformation to the load. Material for the construction wing was chosen to be Aluminum. Wing fatigue life, damage along with Total deformation was analyzed and shear of the material gives the idea about the performance of the structure as well as its strength and internal, external resistances of the wing.

TOTAL DEFORMATION: -

The change of material dimensional to its original is said to be Deformation. It is component of displacement. Total deformation of the wing gives us the Deformation and the stress intensity as well as the concentration of the wing when it is subjected to load.

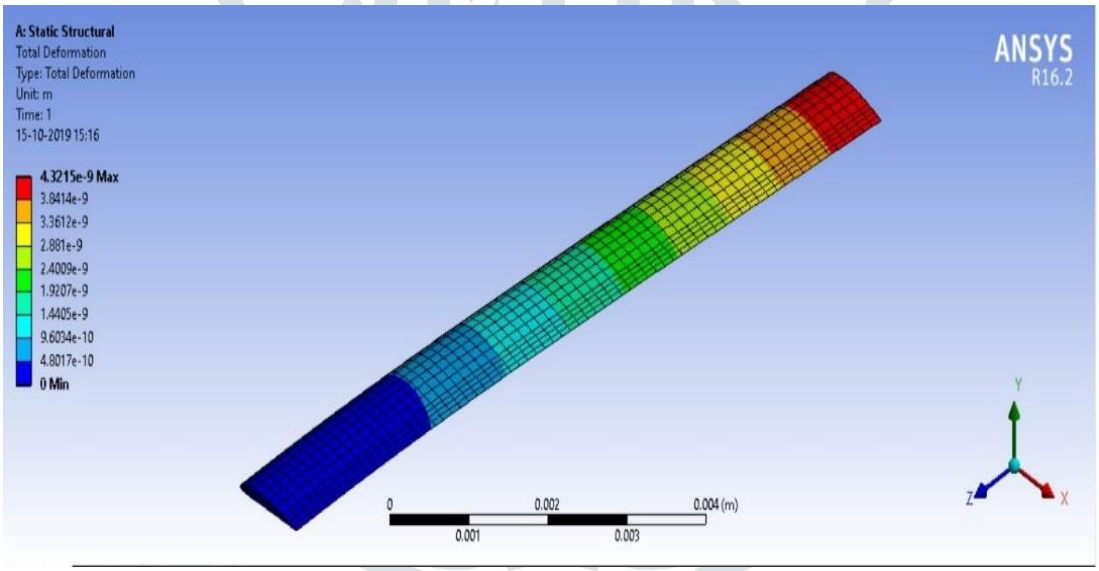

Fig 1. TOTAL DEFORMATION OF THE WING

It shows that when the load is applied are the free end of wing cantilever internal resistance forces to the applied load was developed which are termed as stresses. The stress concentration is high at the fixed surfaces than the free one

SHEAR PROPERTIES: -

It tells about the shear strain, elastic strain and shear energy of the wing naca4412.

i. SHEAR ELASTIC STRAIN: -

It is the strain at which body can regain its original shape and size after the removing of deformed load. Shear elastic strain is an elastic stain of the wing under shear load.

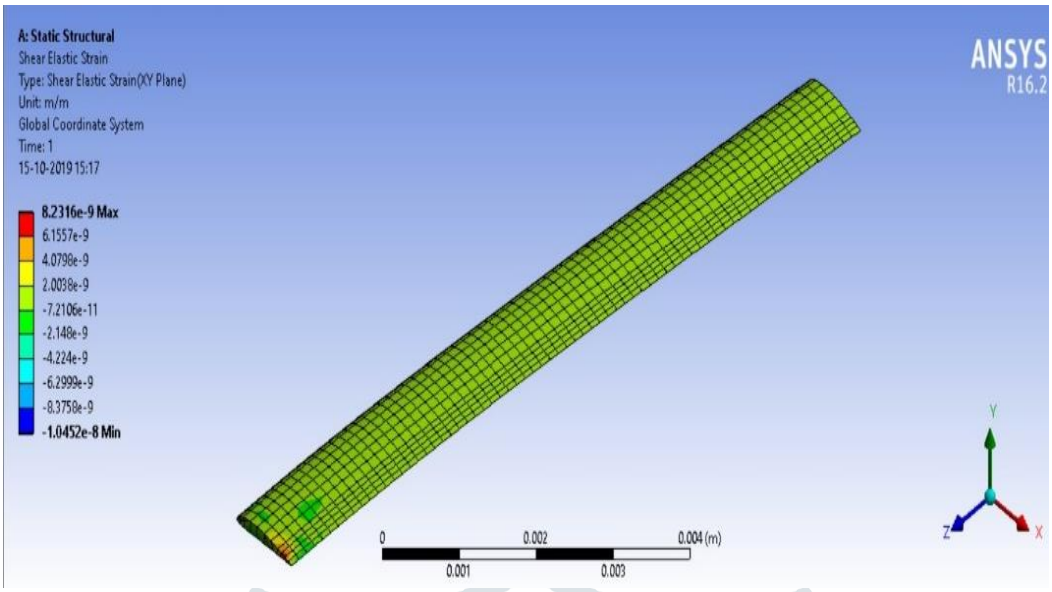

Fig 2. SHEAR ELASTIC STRAIN

ii. SHEAR STRAIN: -

Shear strain is the angle tangent and the overall duration of the deformation is separated into the stress distribution plane by the perpendicular dimension. Ratio of deformation to its original dimensions.

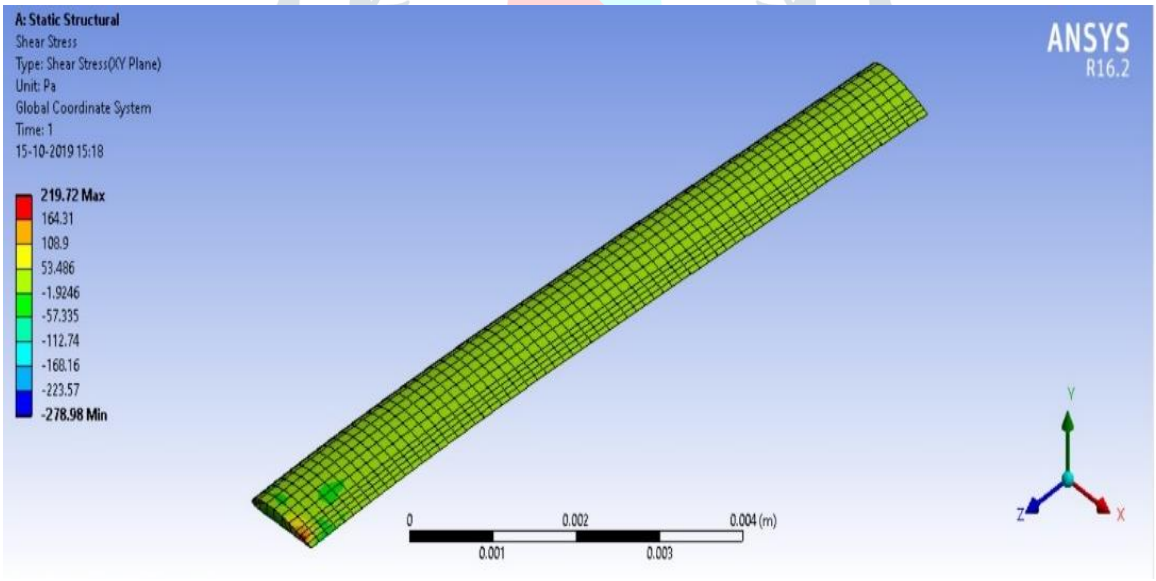

Fig 3. SHEAR STRAIN

iii. SHEAR ENERGY: -

The following diagram shows us the shear energy inside the wing when it is subjected to a point load at the free end of the wing.

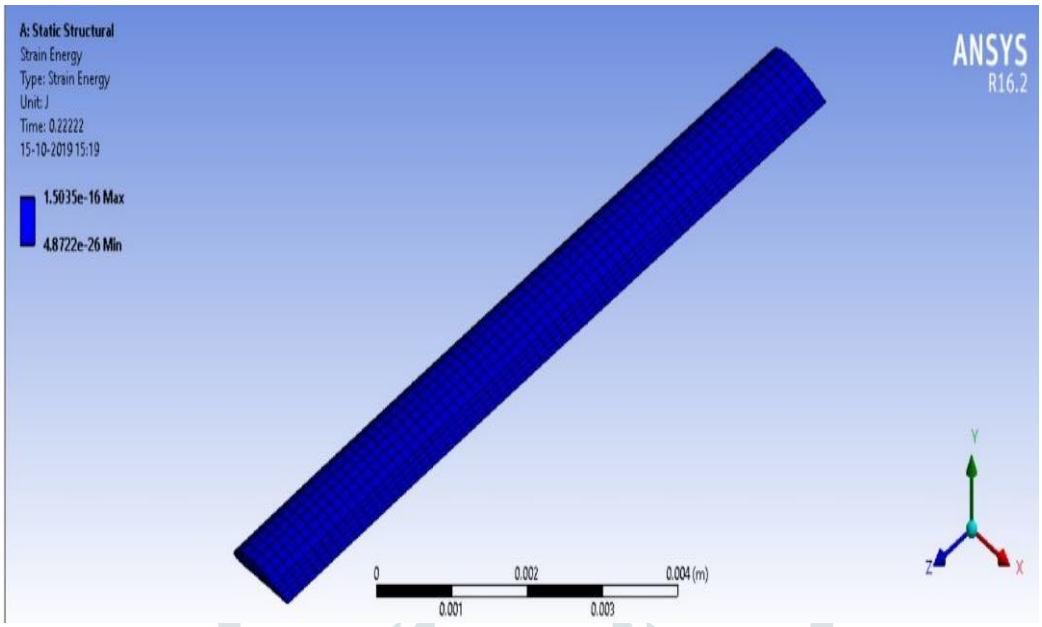

Fig 4 . SHEAR ENERGY

FATIGUE PROPERTIES: -

I. TOOL LIFE: - FATIGUE

Fatigue is a material weakening caused by cyclic load, leading to progressive and localized structural damage and crack growth.

Fatigue life is the number of stresses that a specimen maintains before a specific nature failure occurs. It is dependent on the cycle history of the loading magnitude. Since the crack initiation requires a larger stress than crack propagation.

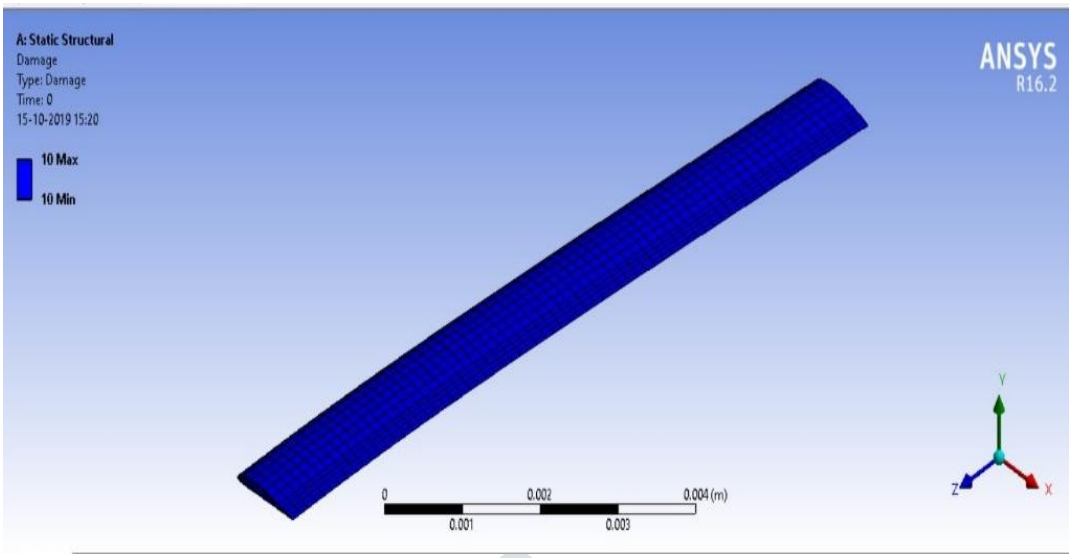

Fig 5. FATIGUE TOOL LIFE

II. **FATIGIE TOOL DAMAGE**: -

The damage to the fatigue tool is caused by a fully closed loading cycle, that is to say, the damage depends on the scope of the hysteresis loop.

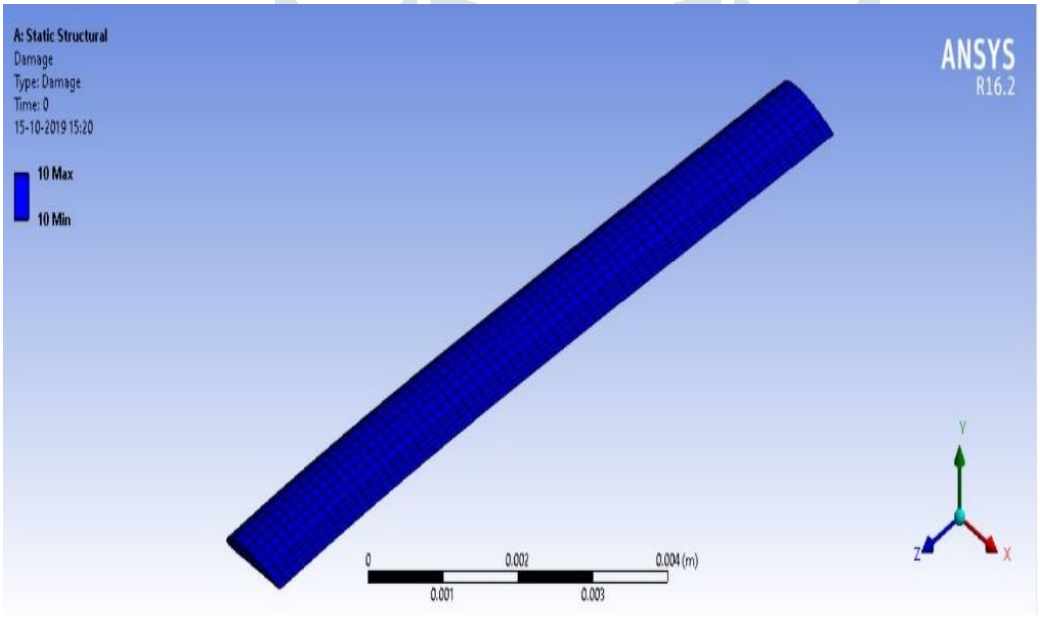

Fig 6. FATIGUE TOOL DAMAGE

CONCLUSION: -

The above results show the structural analysis of NACA4412 airfoil wing section which is subjected to a load. From this it is examined that the Stresses developed internally effect the structure of the material, they lead the structure to deform from its original as of their concentration over it, and finally it leads to the damage of the material. From this we can conclude that the structural deformation and tool

life should be greater for the structure in order to obtain better performance. This kind of aero foils provides more amount of ability while utilizing the high lifting devices. So this NACA4412 without geometrical twist provides the better performance over other for high lifting device attachments

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