Design and Optimization of Landing Gear for an Airbus A320

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Abstract— Landing and take-off from the surface of the ground is of paramount importance for any aircraft, there is very less room for error. As there is risk of valuable property and life, thus a general aviation aircraft is facilitated by the landing gear mechanism. The design of the landing gear is one of the most necessary and nonnegotiable aspects in terms of aircraft design. Hence main landing gear is considered in the present study. This current paper involves the design of the landing gear for subsonic (>1235 kmph) transport aircraft whose take-off mass is approx. 73.5 tones.

Key words: Aluminum Alloy (ASM7075-T6), Titanium Alloy (Ti-6AL-4V), Modeling in CATIA V5, FEA Analysis in ANSYS 14

I. INTRODUCTION

Landing gear is a structure which is installed on the aircraft for the purpose to support the weight of the aircraft whiles it on the ground and also allows the aircraft to land safely. Landing gear also provides mobility to the aircraft on ground or water. The landing gear's main function is to control the rate of compression/extension and to prevent damage to the fuselage. Hence, designing the main landing gear requires utmost care and precision. Thus, main landing gear is considered in the present paper. To design the main landing gear for an aircraft some important parameters are considered. Some of the important data are aircraft take off mass, diameter of fuselage, max cruise speed, stall speed etc. using these parameters the landing gear CAD models are prepared using CATIA V5 software (Tool). After the completion of CAD models the stress analysis is carried out using ANSYS 14.

II. METHODOLOGY

A. *Landing Gear Layout Design Parameters*

Using the available data, the size of landing gear is calculated such as, height of the landing gear, wheel base, wheel track, diameter of strut, the distance between main landing gear to nose landing gear.

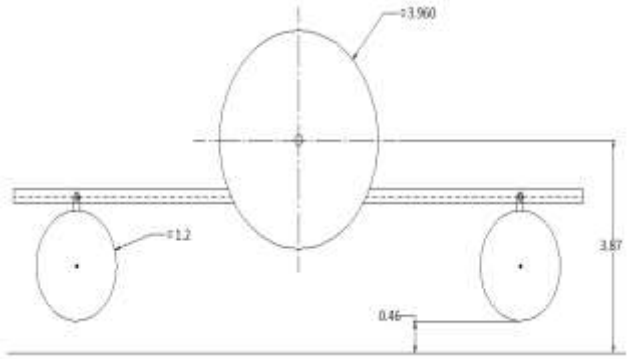

Fig. 1: Schematic showing different Clearances from the ground in meters.

$$H_{Lg\_F} = \Delta H_{Clear} + \frac{D_{Tfan}}{2} = 0.46 + \frac{1.2}{2}$$

$$H_{Lg\_F} = 1.06m$$

III. CAD MODELS OF LANDING GEAR

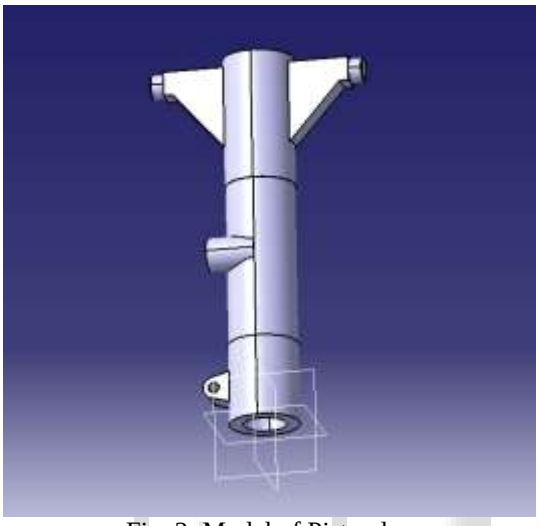

Fig. 2: Model of Piston leg

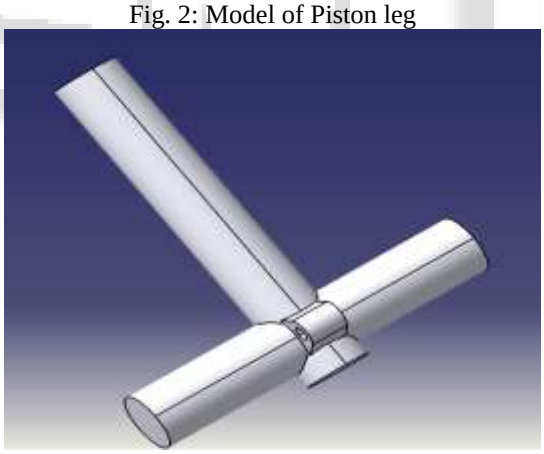

Fig. 3: Piston design

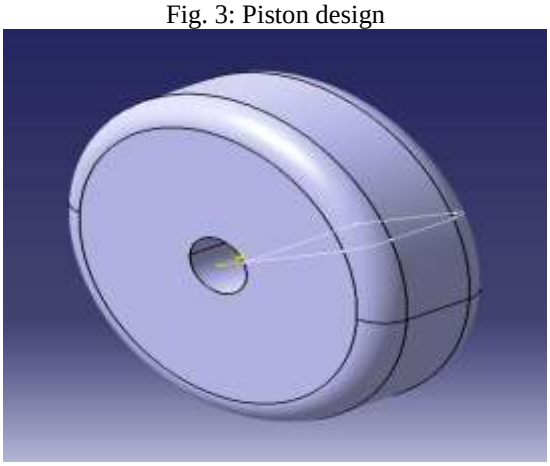

Fig. 4: Tire design

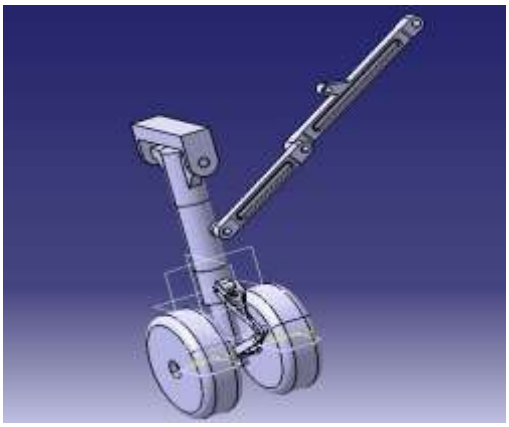

Fig. 5: CAD model of main Landing Gear

A. Stress analysis of main landing gear

Stress analysis is an engineering discipline which covers the methods of determining the stresses induced in structure when subjected to forces/loads. After the landing gear is designed, a method of analysis called stress analysis for the design of main landing gear. The stresses developed are obtained with the application of ANSYS analysis software.
Stress analysis were applied on two material such as,

- Titanium Alloy (Ti-6AL-4V)
- Aluminum Alloy (ASM7075-T6)

The reason for involving other alloys for stress analysis was to compare their effectiveness in the Landing Gear. Stress analysis for the landing gear can be performed both by static load analysis and dynamic load analysis. In our present study we have carried out static load analysis i.e., when this aircraft is parked on the concrete ground. The load includes the weight of the aircraft without passengers and the weight of the fuel.

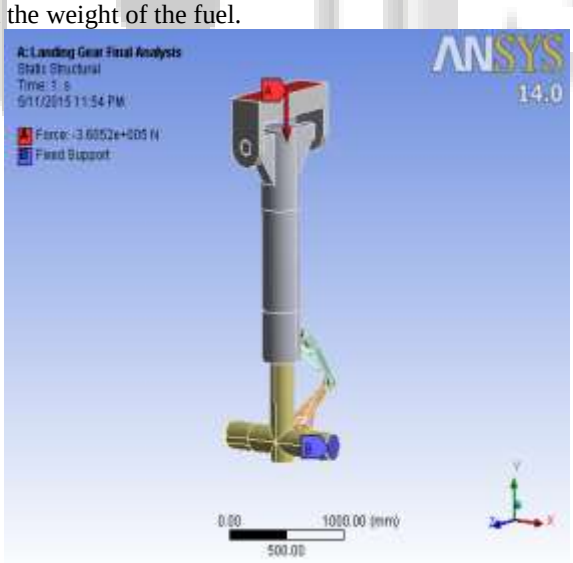

Fig. 6: Shock Absorber strut

B. Stress analysis for Titanium alloy (Ti-6AL-4V)

The properties of the Titanium alloy are:

- Titanium consists of aluminum, cobalt, copper, iron and nickel.
- This material is used for its high tensile strength, higher corrosion resistance, fatigue life resistance, crack resistance and the capability to sustain high temperatures without creeping.
- The most common titanium alloys are the titanium aluminum and titanium vanadium alloy.
- These alloys are mostly used for critical structure parts where high force works on the landing gear.
- Titanium's melting point is about 1668 degree Celsius.

C. Stress analysis for Aluminum Alloy (ASM7075-T6)

The properties of the Aluminum Alloy are:

- Aluminum alloy consists of aluminum, chromium, copper, iron.
- Aluminum counts in the second most metal widely used metal in the world.
- Aluminum has low weight due to its low density, high strength, easy machining, and superior malleability and also has an excellent corrosion resistance.
- Aluminum has a very good reflector of both visible light and radiated heat.

D. Meshing

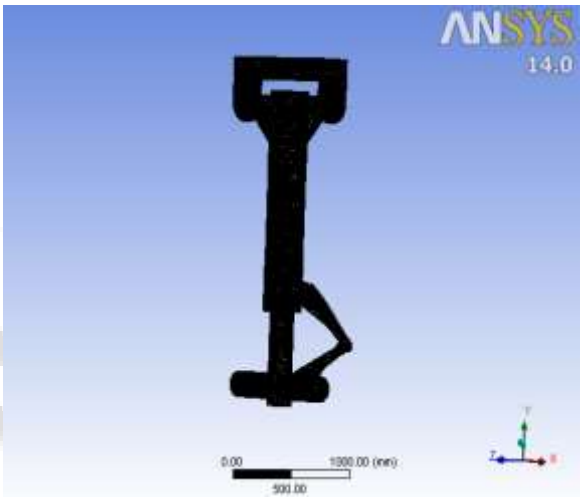

Fig. 7: Meshed model of the Landing Gear

IV. RESULTS AND DISCUSSIONS

A. Static Analysis Of The Landing Gear

The static analysis performed on different metals has yielded the following results.

1) Aluminum Alloy (ASM7075-T6)

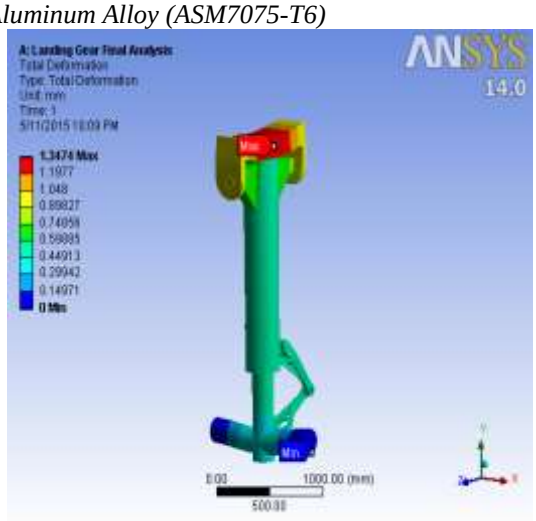

Fig. 8: Total deformation of Landing Gear

The maximum deformation is 1.3474 mm.

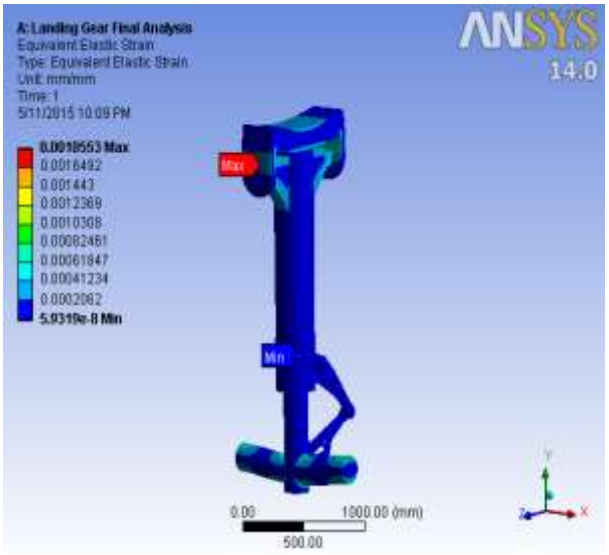

Fig. 9: Equivalent Elastic Strain of the Landing Gear.

The Maximum elastic strain is 0.0018553.

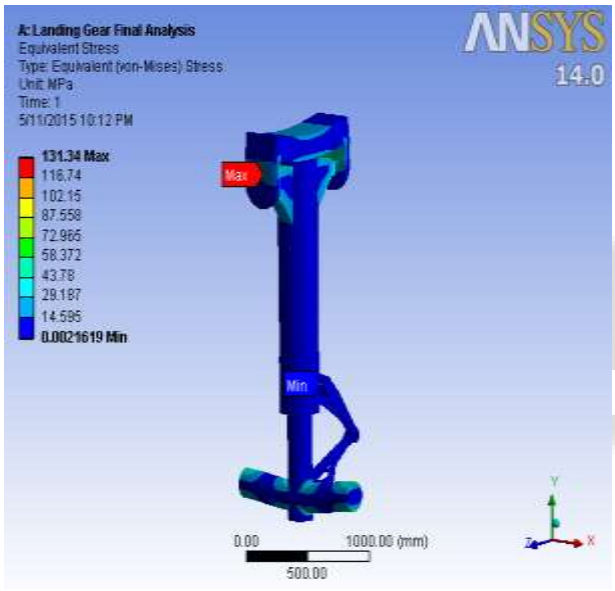

Fig. 10: Equivalent Von-Mises Stress of the Landing Gear.

Maximum stress is 131.34 MPa

2) Titanium Alloy (Ti-6AL-4V).

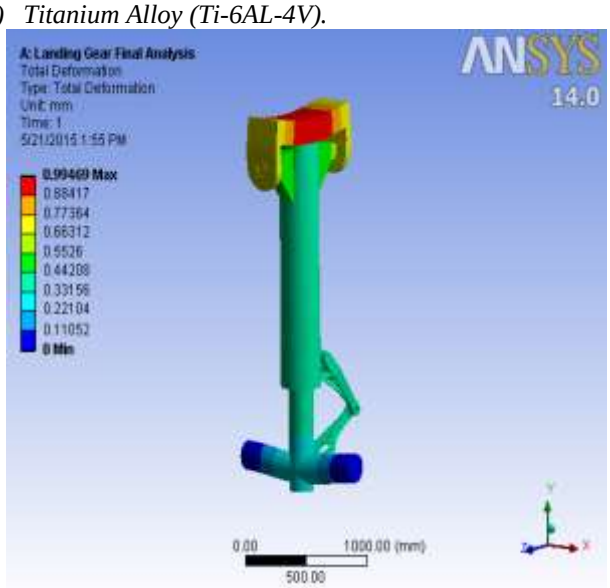

Fig. 11: Total deformation of Landing Gear

The maximum deformation is 0.99469 mm.

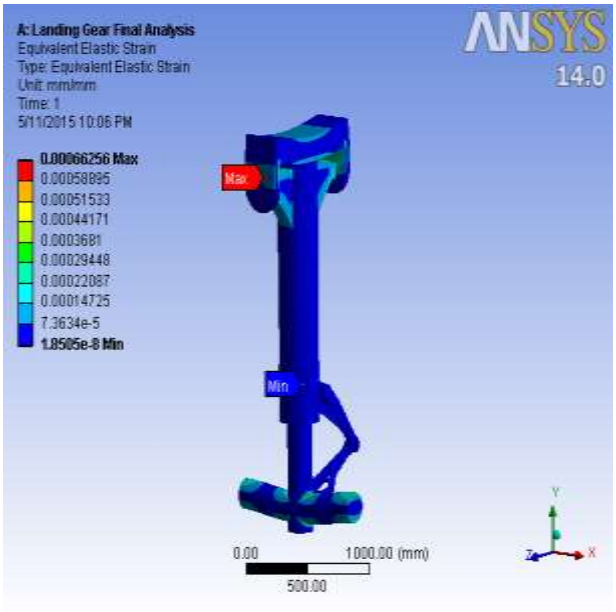

Fig. 12: Equivalent Elastic Strain of the Landing Gear

The Maximum elastic strain is 0.00066256.

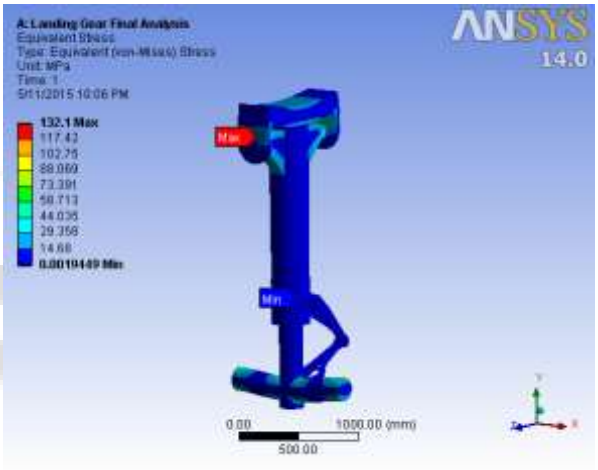

Fig. 13: Equivalent Von-Mises Stress of the main Landing Gear.

The Maximum stress is 132.1MPa

V. CONCLUSIONS

The standard tests were performed on the Aluminum Alloy (ASM7075-T6) and the Titanium Alloy (Ti-6AL-4V). It is observed that the Titanium Alloy shows a better and expected result as compared to the Aluminum Alloy.

After the experimentation it is seen that the Titanium Alloy has the maximum deformation of 0.99469mm, maximum elastic strain of 0.00066256 and maximum stress of 132.1MPa as compared to the Aluminum alloy, which had the maximum deformation of 1.3474 mm, maximum elastic strain of 0.0018553 and maximum stress of 131.34 MPa, this shows Titanium alloy is better.

As per the characteristics are concerned Titanium is better in terms of hardness, strength and stability. Titanium alloy requires less maintenance and the cost is reasonable, even though it has high weight as compared to Aluminum alloy, still the critical parameters are due to its nature, also compensated.

Titanium alloys have effective balance in spite of its weight and thus this preset project is based on the overall

effectiveness, it brings to the Landing gear as compared to the other alloy.

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