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STRUCTURAL ANALYSIS OF AIRCRAFT LANDING GEAR DURING ROUGH LANDING BY USING DIFFRENT LOADS

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Abstract— Landing gear is an aircraft or spacecraft's undercarriage that is used for both takeoff and landing. The landing gear shock absorber is an important part of an aircraft's landing gear. The shock absorber's role is to absorb and dissipate energy upon impact, allowing the forces imposed on the aircraft's frame to be tolerable. The shock absorber can be a separate component or integrated into the landing gear strut. The aircraft may land in a smooth or even a rough manner. The landing gear components must be strong enough to withstand the full force. The goal of this project is to create a landing gear that is also suitable for rough landings. The landing gear is modelled in catia v5 and the modelled component is analysed in Ansys to study its structural performance. The same characters are studied in order to compare the results obtained by both cases during the same landing conditions.

Keywords—Landing gear, shock absorber, loads, stresses, rebound chamber models

I. INTRODUCTION

An aircraft landing gear shock absorber is a mechanical structure, pneumatics, and hydraulic damping system that is used to transmit impact loads. This project focuses on shock absorber energy modelling. An aircraft mass with wing lift, shock absorber piston and cylinder structure, three hydraulic chambers representing the air chamber, hydraulic chamber and rebound chamber, and tyre are all part of a landing gear shock absorber model. The goal of the design is to minimise ground reaction loads. The primary design variables revolve around fixed or variable orifice definitions. Aircraft landing gear supports the entire weight of an aircraft during landing and ground operations.

1. They are attached to primary structural members of the aircraft.
2. For snow it will be skis type
3. For water it may of pontoon type
4. For ground and water An amphibious aircraft with retractable wheels

Types Of Landing Gear Arrangement

A. Tail wheel type (Conventional)

B. Tandem loading gear (longitudinally Aligned)

Tricycle type landing gear

Retraction Type –Stowed in fuselage or wing compartments while in flight . As speed of aircraft increases the drag caused by the landing gear becomes

Greater and a means to retract the gear to eliminate parasite drag is required. landing gear.mp4

Shock Absorbing-The shock energy is altered and transferred throughout the airframe at a different rate and time than the single strong pulse of impact.

Non Shock Absorbing- The shock is absorbed by converting the energy into heat energy.

II.DESIGN OF LANDING GEAR USING CATIA:

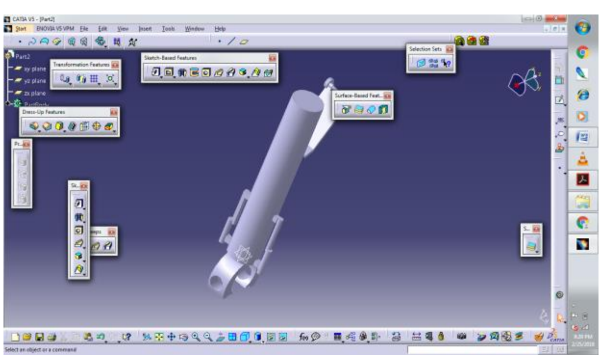

Fig 1: Parts modelled using catia v5

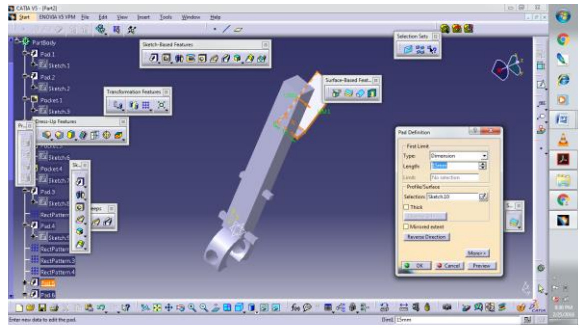

Fig 2:Landing Gear padding

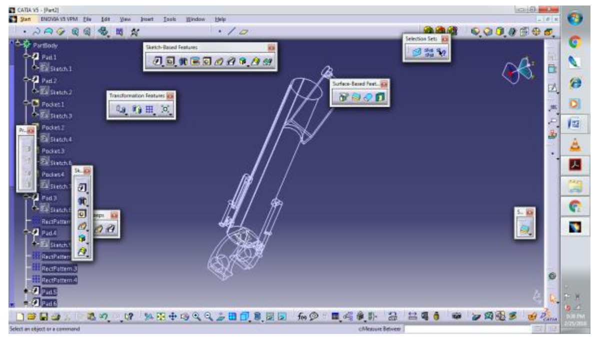

Fig 3: Landing Gear 2d

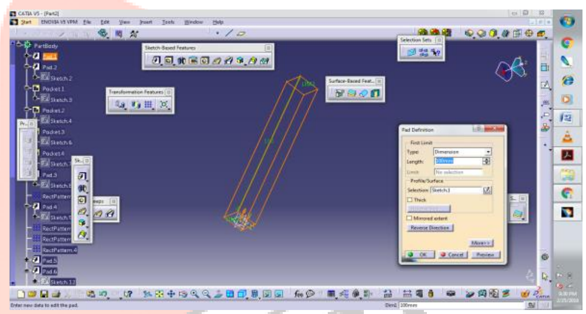

Fig 4: Landing Gear padding rod

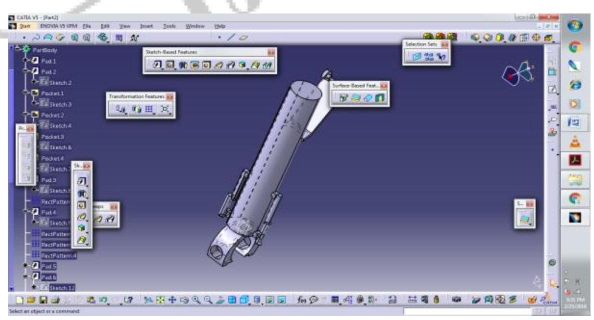

Fig 5:Landing Gear 3d

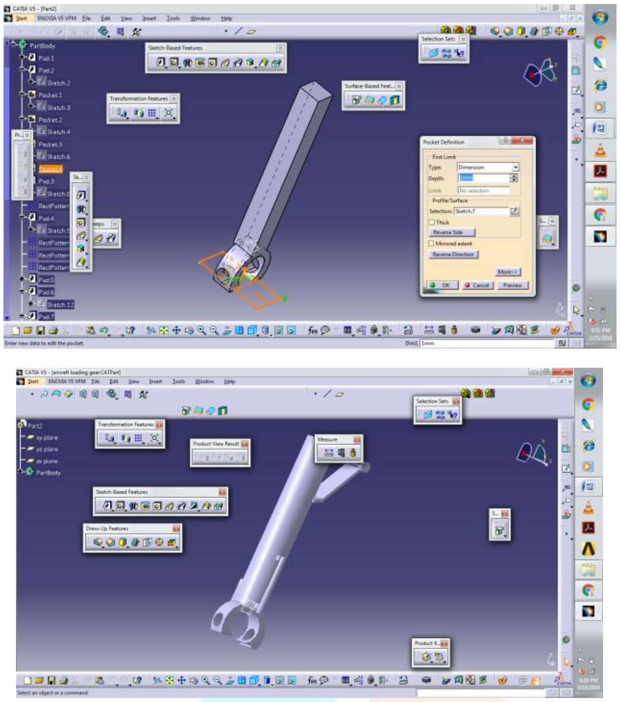

Fig 6:Landing Gear pocket

III.NUMERICAL ANALYSIS

A. *FEA*:

Finite Element Analysis (FEA) employs numerical methods and algorithms to solve and analyse problems involving structural or object analysis using computers.

B. *Outline Finite Element Analysis Process*

The three basic elements are

i) Pre-processor

ii) Solver

iii) Post-Processor

C. Material Selection

Materials selection for the Landing Gear is made using Ansys.. In general the landing gear is made of metal substrate which is a Titanium alloy Ti-6 Al – 4V. The SAE 1035 steel and 7075-76 aluminium alloy is replaced to improve the structural behaviour of the Landing Gear assembly. The properties of these materials are listed in below table.1

D. *Geometry Creation*

In this process, geometry for the Landing Gear assembly is created. The Landing Gear and its components are modelled in CATIA V5 earlier which is a 3D model. The Landing Gear assembly has to be imported as an IGS file format to get a proper structure. The imported Landing Gear assembly model is as shown in figure.3.

TABLE I

MATERIAL PROPERTY

Property	Ti-6Al –4v	SAE1035	7075-76 Al alloy
Density	7.87 g/cm^3	4.43 g/cm^3	2.81 g/cm^3
Young's Modulus	196 GPa	113.8Gpa	71.7 GPa
Coeff. of Thermal Expansion	11.9 μC^{-1}	8.6 μC^{-1}	23.6 μC^{-1}
Reference Temperature	20°C	20°C	20°C
Poisson	0.29	0.342	0.33
Tensile Yield Strength	550 MPa	880 MPa	503 MPa
Tensile Ultimate Strength	620 MPa	950 MPa	572 MPa

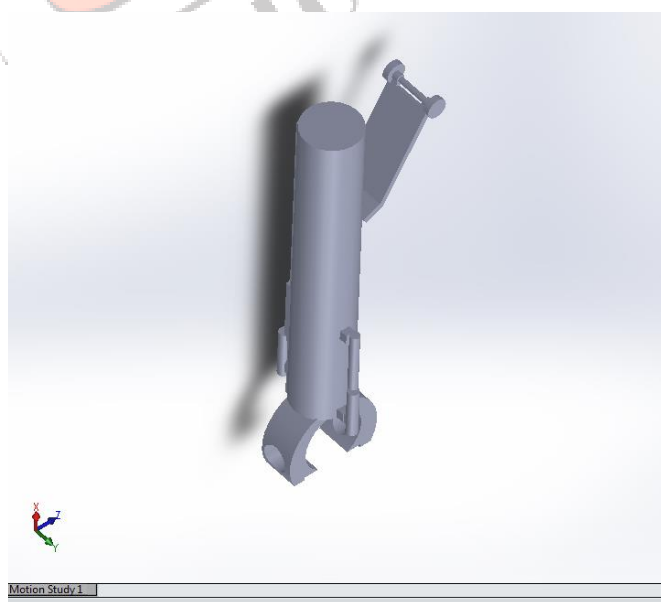

Fig. 7: Piston assembly

E. *Meshing*

Different meshing characteristics were used for the domain. In the simulations, the piston component surfaces were discretized with triangular mesh elements.

G. Boundary Condition

The problem is a structural analysis problem. The boundary condition for the problem is Force of 10 KN with the arm to be fixed.

H. Numerical Results

The structural behavior of the Landing Gear has been studied for the above mentioned boundary conditions. The results obtained by these are shown below. The Table. II shows the structural behaviour of the Landing Gear assembly. From the table it's clear that holds a very good structural property. The stress concentration over the SAE 1035 Steel is more than the Titanium alloy 6A1-4V and 7075-76 Aluminium alloy.

TABLE II
STRUCTURAL BEHAVIOUR

Case	Material	Deformation n (mm)	Stress (MPa)	Strain
1	Ti- 6A1- 4V	1.7734	232.03	0.0021
2	7075-76 A1	2.8162	232.7	0.0033
3	SAE 1035	1.0318	235.05	0.0012

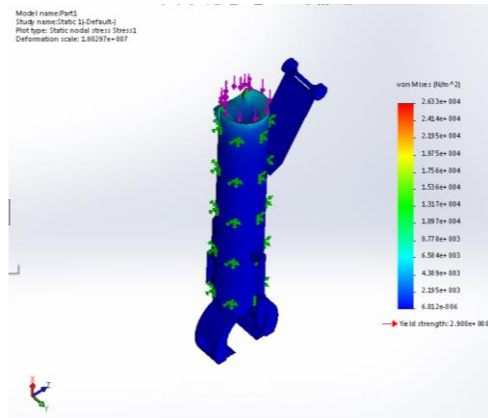

Fig. 8: Deformation for case-1

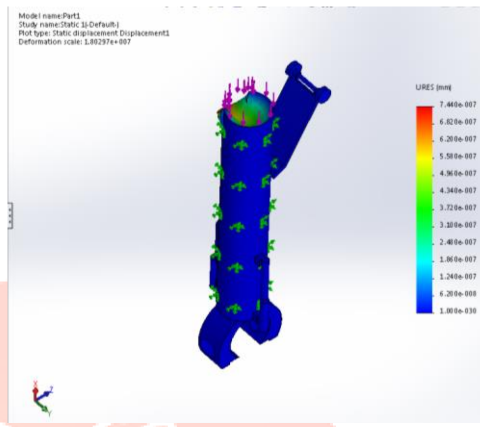

Fig. 9 :Deformation for case-2

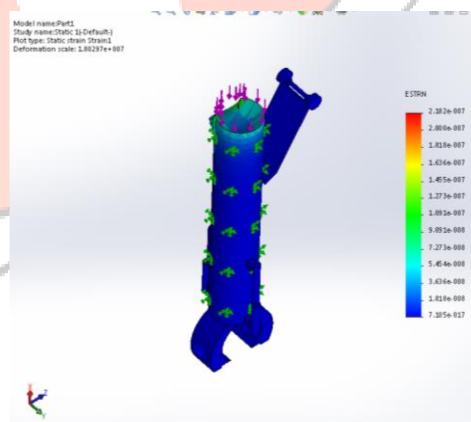

Fig. 10: Deformation for case-3

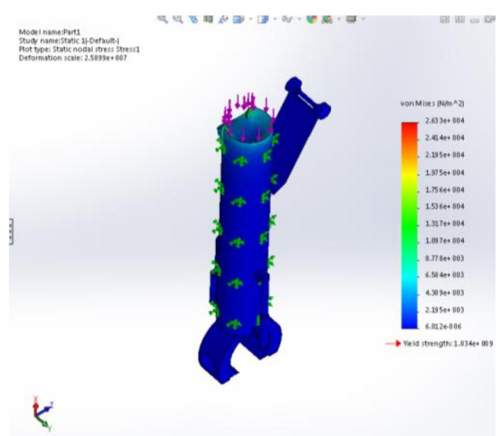

Fig. 11: Stress for case-1

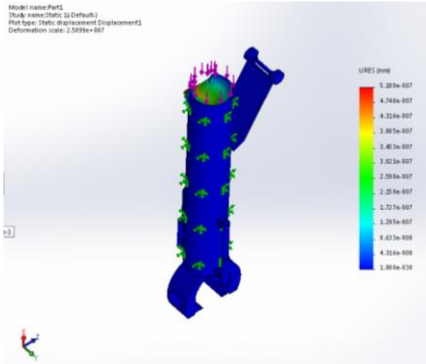

Fig . 12 Stress for case-2

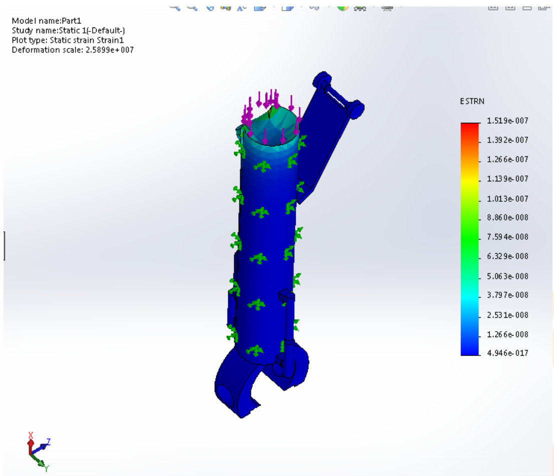

Fig.13: Stress for case-3

From figure 8,9 and 10 the values of deformation for three cases were observed. The deformation contour clearly shows that the deforamtion is high for the aluminium alloy when compared to other two materials.

The SAE 1035 holds a less deformation even blow that of titanium. So interms of deformation the SAE 1035 holds a better performance than the other two materials. From figures 11,12 and 13 the value of stresses are determined. The stress concentarion over the SAE 1035 is higher than the other cases. The SAE 1035 holds a higher yield value than the other materials.

So the higher stress doesn’t affect the SAE 1035, so interms of stress concentation over the model its recommended to us SAE 1035 material. From figures 14,15 and 16 the value of strain are observed. Since the stress is directly proportional to strain the performance of the strain also will be better for the SAE 1035 material. So in terms of all structural paramters the SAE 1035 material holds a good performance.

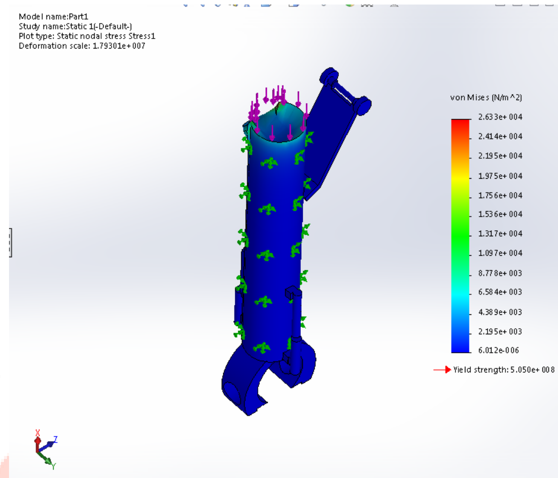

Fig. 14: Strain for case -1

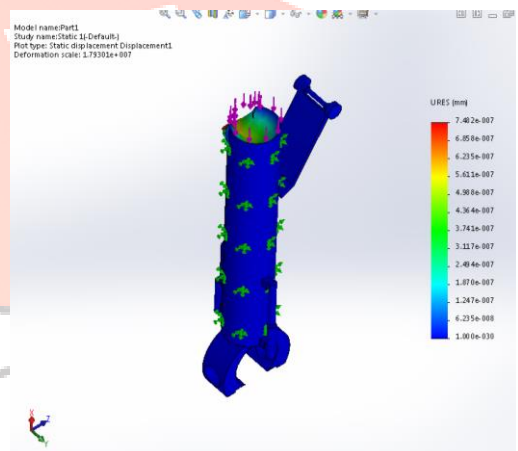

Fig. 15: Strain for case -2

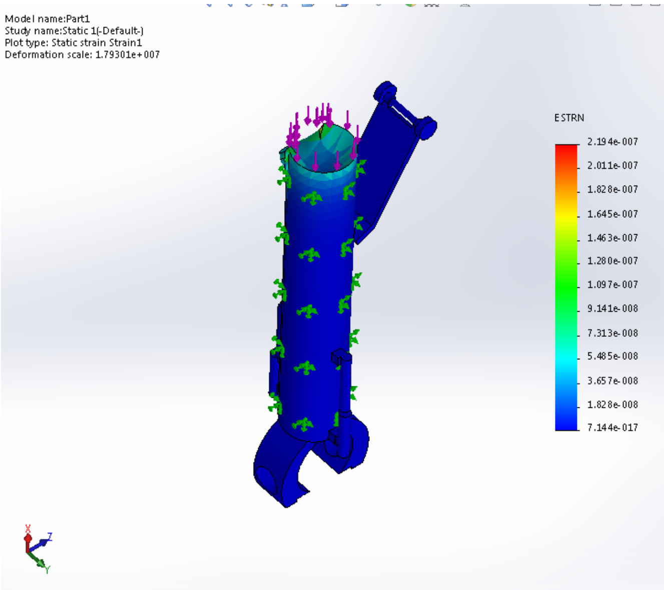

Fig.16: Strain for case-3

IV.CONCLUSION

The landing gear is modeled and assembled using CATIA V5. The assembled CAD model has been considered to perform structural analysis by finite element approach using the ANSYS package. In general the accuracy of the solution depends on the mesh quality. Each component has been checked for its mesh quality to ensure the solution accuracy. Also before the meshing process model has been simplified. After these processes the structural analysis has been carried for the landing gear assembly for three different materials Titanium alloy 6A1-4V, 7075-76 Aluminum alloy and SAE 1035 Steel. The results show that the SAE 1035 steel holds a good performance when compared to other materials. The result has been compared on the basis of the parameters like deformation, stress and strain. The SAE 1035 steel has a less deformation when compared to other materials; around 35 % of the deformation has been reduced when compared. So the implementation of this material would help to avoid the landing gear damage and also it can have a better life than the other materials due to its less damage**.**

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