ISSN (O): 2393-8609

International Journal of Aerospace and Mechanical Engineering

Volume 2 – No.1, January 2015

FEM Analysis of Landing Gear Strut

Shivam Chopra
B.E. Mechanical Engineering
PEC University of Technology
Chandigarh
chopra_s17@hotmail.com

Shrikant Nawani
B.E. Mechanical Engineering
PEC University of Technology
Chandigarh
shrikantnawani@gmail.com

Kartik Bisht
B.E. Mechanical Engineering
PEC University of Technology
Chandigarh
kartikbisht71@gmail.com

ABSTRACT

Landing gear is the undercarriage of an aircraft or spacecraft and is often referred to as such. For aircraft, the landing gear supports the craft when it is not flying, allowing it to take off, land and usually to taxi without damage. Wheels are typically used but skids, skis, floats or a combination of these and other elements can be deployed depending both on the surface and on whether the craft only operates vertically (VTOL) or is able to taxi along the surface. Faster aircraft usually have retractable undercarriage, which folds away during flight to reduce air resistance or drag. For launch vehicles and spacecraft landers, the landing gear is typically designed to support the vehicle only post-flight, and are not used for takeoff or surface movement.

There is a need to design landing gear with minimum weight, minimum volume, high performance, improved life and reduced life cycle. Many technologies have been developed over the years to meet these challenges. The most critical part in the landing gear is the strut. This paper presents the FEM analysis of a landing gear strut which is acted upon by landing load.

General Terms

Catia V5, Nastran 2010, Patran 2010

Keywords

Nose Landing Gear, Landing Gear Strut, FEM, Analysis, Mesh, Nastran, Patran

1. INTRODUCTION

Landing gear system is one of the critical subsystems of the aircraft and is often configured along with aircraft structure because of its substantial influence on the aircraft structural configuration itself. The purpose of the landing gear in an aircraft is to provide a suspension system during taxi, take-off and landing. It is designed to absorb and dissipate the kinetic energy of landing impact, thereby reducing the impact loads transmitted to the airframe.

There are two landing gears in an aircraft: Nose Landing Gear and Main Landing Gear. The nose landing gear is not only needed for safe landing, but also for steering the aircraft when taxiingon the ground. The main landing gear is aimed essentially at allowing a safe landing of the aircraft. Both these landing gears work in making landing free of jerk.

This paper presents an analysis of the strut of a nose landing gear. The strut was designed keeping in view the safety and aesthetics.

2. ANALYSIS METHODOLOGY

Firstly a model of a nose landing gear is made in CatiaV5. It consists of various components of the landing gear like the wheel, shock strut, tyre torque links, etc. as shown in Fig.1.

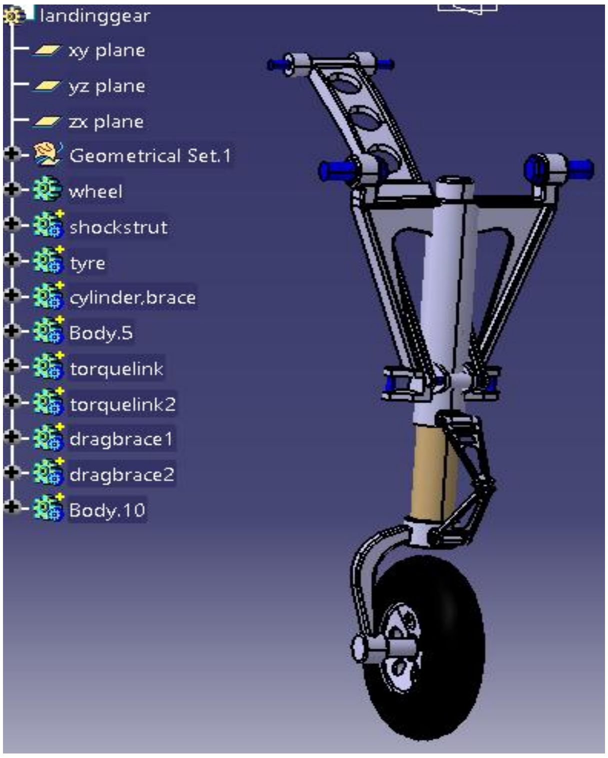
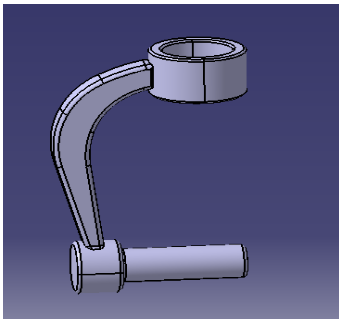


Fig.1: CatiaV5 model of a nose landing gear

Once modelling is done design is analyzed by Finite Element Method. We have used Nastran and Patran for this purpose. We have analyzed the most critical part in the landing gear i.e. strut.



Strut

ISSN (O): 2393-8609
International Journal of Aerospace and Mechanical Engineering
Volume 2 – No.1, January 2015

3. MATERIAL USED

Table 1: Properties of 300M Alloy Steel

Elastic Modulus	30×10^{6} psi
Poisson's Ratio	**0.3**
Minimum Tensile Strength	2.8×10^{5} psi
Minimum Yield Strength	2.3×10^{5} psi
Rockwell Hardness	**B 311 Max.**

4. FEM ANALYSIS

We have first imported the Catia file (.igs file) in Patran. The model is then tet-meshed with global edge length 0.5 (as shown in Fig.2).

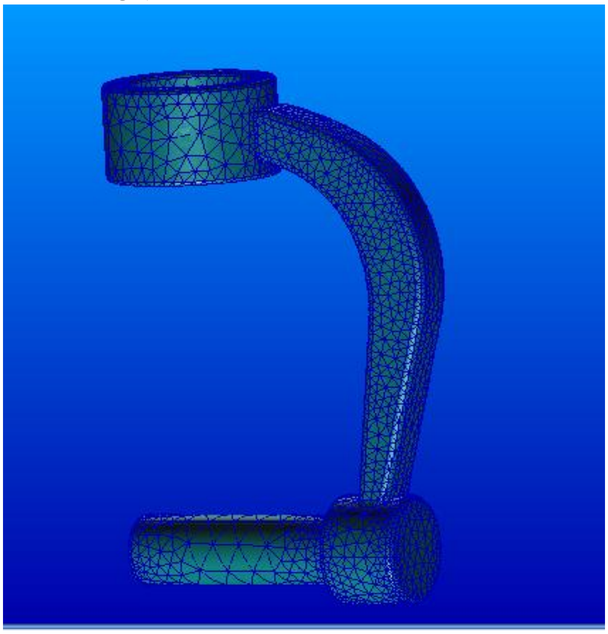


Fig.2: Meshed strut

4.1 Applying loads and supports

After meshing is done loads and supports are applied. Firstly we apply support to the hub cylinder for zero displacement (as shown in Fig.3). We have applied the supports (in blue colour) to elements of hub cylinder to increase the accuracy of analysis.

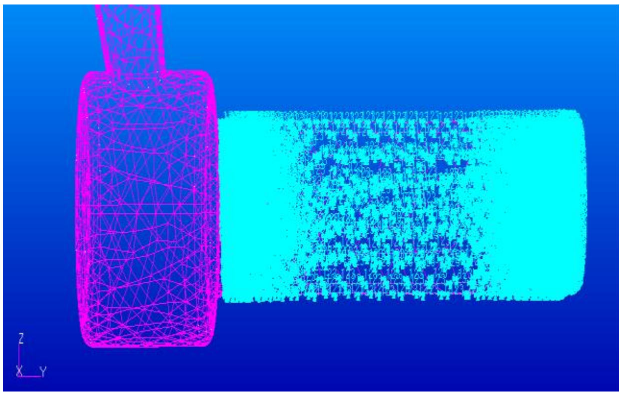


Fig.3: Supports applied to the hub cylinder

After applying supports we apply the landing load on the top surface. The landing load is applied as Total Load of 708lbs. in downward direction. (As size of the strut taken is small thus taking load according to the size)(As shown in Fig.4)

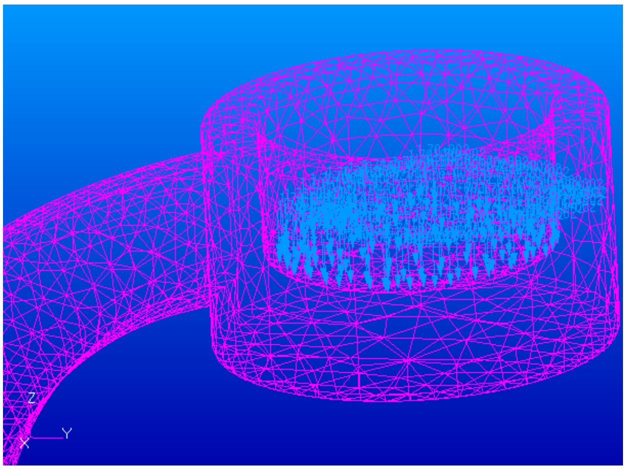


Fig. 4 Applied total load

After applying loads and supports the strut will look as shown in the following figure.i.e.Fig.5

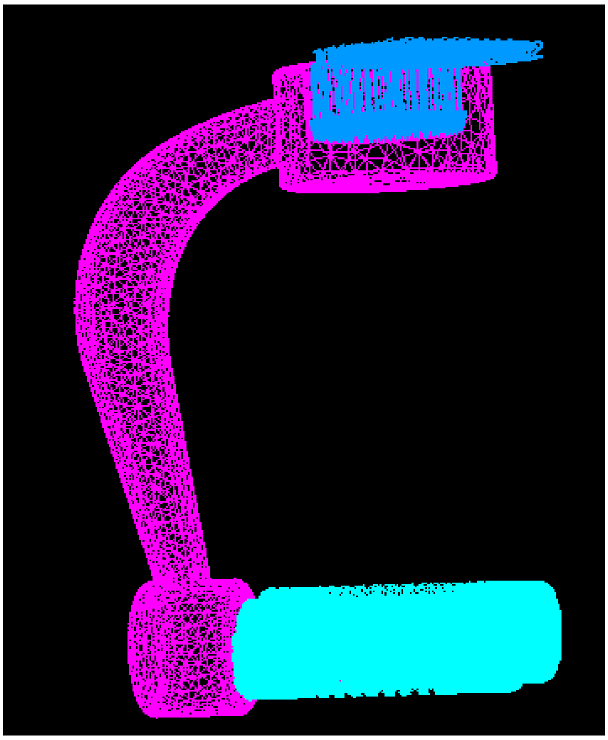


Fig. 5

4.2 Creating material properties

The material specified is according to the table shown (Table1). The material created is isotropic. Only two properties are required to be specified i.e. Poisson Ratio and Elastic Modulus. The Poisson Ratio is taken as 0.3 and Elastic Modulus for the material as 30E6 psi. This created material is then applied to the strut to be analyzed.

4.3 Analysis Procedure

We have chosen Linear Static as solution type and Analysis Deck method of analysis. After giving a job name the saved file is run in Nastran. Firstly before going to the results we should check and review .f06 file for errors. If no "fatal" is found then we open the results file in Patran.

4.4 Analysis Results

Two types of results are calculated in Patran i.e. Deformation and Von Mises Stress as shown in Fig.6 and Fig.7.

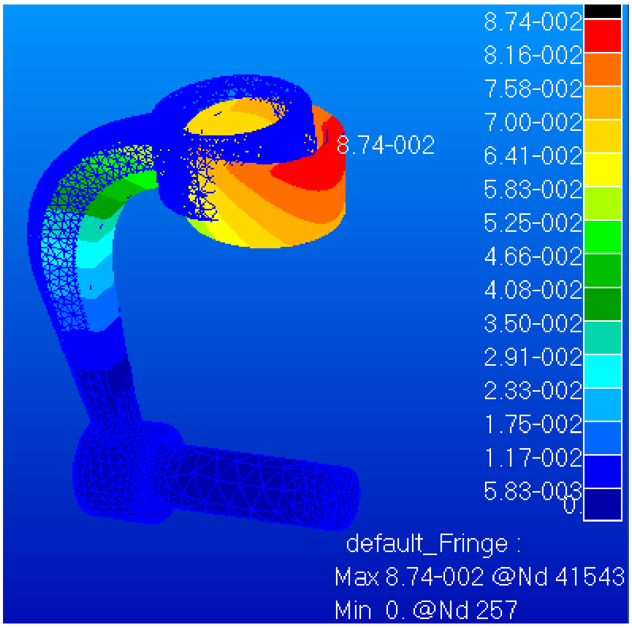


Fig.6: Deformation

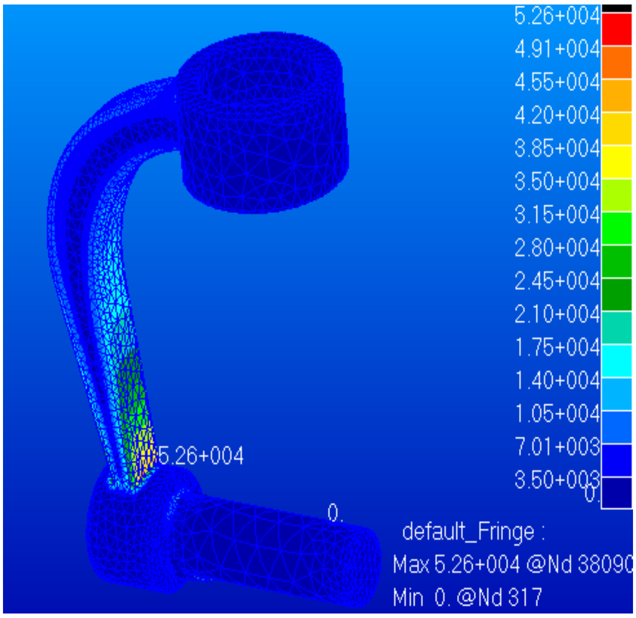


Fig.7: Von-Mises Stress

5. CONCLUSION

Maximum Deformation is 0.0874 inch as in Fig. 6
Maximum Von-Mises Stress is 5.26×10^4 psi as in Fig.7

We can see that the design is safe as both Max. Deformation and Max. Stress are within permissible limits.

6. ACKNOWLEDGMENTS

I am highly grateful to Mr. Sandeep Sharma,Technical head, AeroSphere, Chandigarh for providing this opportunity to carry out the research work. I would like to express a deep sense of gratitude to my colleagues and friends, without them it would not be possible to pursue my research work in this manner. I also would like to thank my parents for their support. Finally, I express my indebtedness to all who have directly or indirectly contributed to the successful completion of my research work.

7. References

[1] Airframe Structural Design by Michael Chun-Yung Niu

[2] http://www.twmetals.com/300m-bar-rod-wire.html

[3] Aircraft Landing Gear Design and Development- How advanced technologies are used to meet the challenges by 1.Divakarn V.N. 2.Ravi Kumar G.V.V. 3.Srinivasa Rao P.

[4] http://faculty.dwc.edu/sadraey/Chapter%209.%20Landing%20Gear%20Design.pdf