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Design and Analysis of Modified Oleo Strut Shock Absorber System in Aircraft Landing Gear

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Abstract : Aircraft landing gear is a unique subsystem which is actuated to land the airframe without a depredation to the airframe. The critical parts of the landing gear shock strut are inner metal tube as piston, cylinder and tapered rod assembly. A suspension system or shock absorber is a mechanical device designed to smooth out or damp shock impulse, and dissipate kinetic energy. This work aims at understanding to improve the performance characteristics of modified oleo strut shock absorber for lighter aircraft application. The usage of solid spring and lever bungee type shock strut in lighter aircraft offers relatively poor shock performance.

Introduction

Over the past few years there has been an increase in undercarriage failures which has emphasized the need to design future undercarriages with longer fatigue lives. The landing gear shock absorber is an integral component of an aircraft's landing gear[1-10]. The role of the shock absorber is to absorb and dissipate energy upon impact, so that the forces imposed on the aircraft's frame are tolerable. These accelerations must be acceptable not only to structural components, but also to everything contained within the aircraft. The shock absorber may be an independent element or integrated with the landing gear strut.Landing gear has to withstand take-off velocities and landing impacts. An aero plane must be capable of maneuvering on the runway, platform and taxiways. The objectives of this work involved are,

- Replacing Oleo shock strut in lighter aviation aircraft.
- To compare and evaluate the performance characteristics of solid spring and oleo shock absorbers.

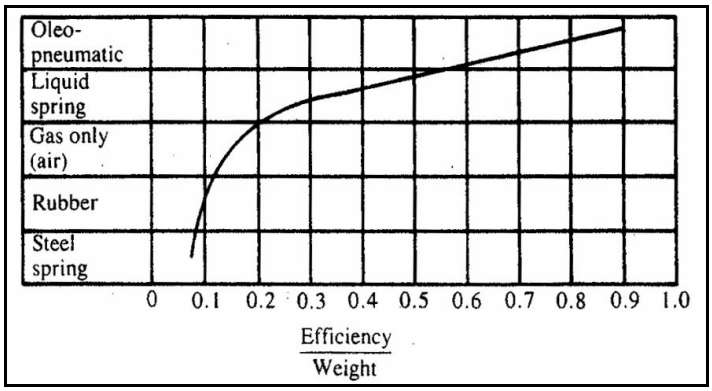

Fig 1 Shock absorber efficiency

Shock Absorber Efficiency

Comparison of all shock absorber types based on a weight normalized efficiency calculation. This plot shows the significant advantage of using an oleo-pneumatic system.

Problem Description

From case study, the big problem with bungee or spring systems is that the return or recovery rate is very fast and has a rubber band or slingshot effect. The problem with compressed rubber wafers is just the opposite, sometimes the recovery is too slow or even worse the compression reaches its max and thus turns into a solid rather than continuing to work. Although such a system is cost effective and therefore appropriate for general aviation aircraft, it offers relatively poor shock performance. The result is an aircraft that tends to bounce.

In this work, two analyses were performed. The first was the kinematic evaluation of a front nose gear such as the Lockheed F-16. The second analysis was a structural study of a main gear for a light weight aircraft such as the Berkut. The Berkut with simple leaf spring gear was a good starting point for the evaluation of landing gear using hand and finite element computer analysis. The first analysis was performed to understand the F-16 front gear. The gear was modeled using stick diagrams based on dimensions furnished by Lockheed Martin Tactical Aircraft Systems.The landing gear shock absorber is an integral component of an aircraft's landing gear. The role of the shock absorber is to absorb and dissipate energy upon impact, such that the forces imposed on the aircraft's frame are tolerable. These accelerations must be acceptable not only to structural components, but also to everything contained within the aircraft (passengers, cargo, etc).The shock absorber may be an independent element, or integrated with the landing gear strut.

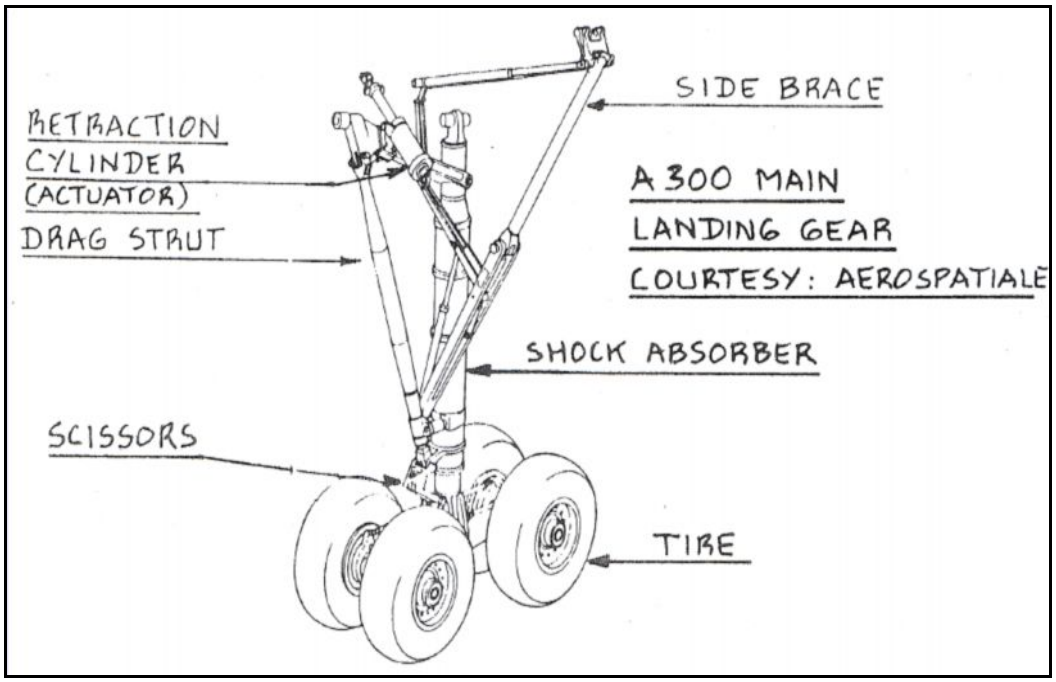

Fig 2 Example of shock absorber and tyre

Solid spring shock absorbers are still very common as the main landing gear on light civil aviation craft, such as Cessna aircraft, due to their simplicity and low cost. For any application involving a combination of high aircraft weight, high sink speed or minimum gear space an oleo pneumatic strut should be considered for its obvious gains in performance, small size and low weight.The shock absorber analyzed in this thesis is the most current and modern type of shock absorber available. It provides the highest efficiency in absorbing energy during landing compared to other types of conventional shock absorbers. This type of absorber is called "oleo-pneumatic." It works inside an enclosed system where oil and air are being used.

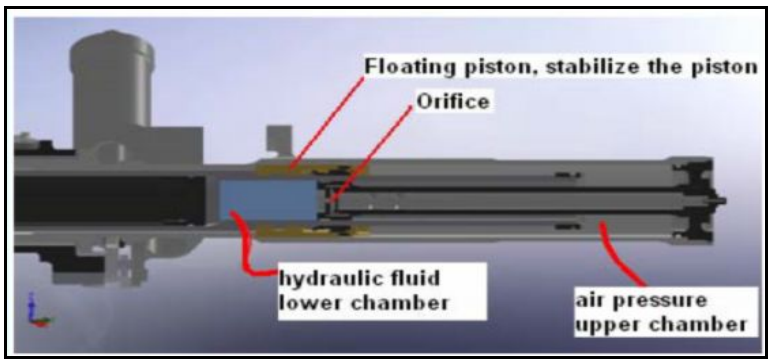

Fig 3 Shock Absorber cross section

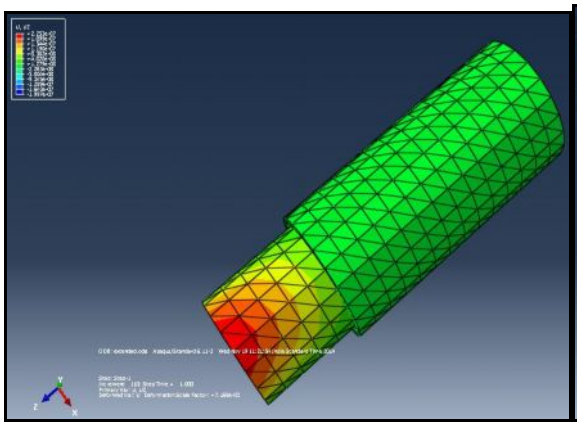

Fig 4.Deflection in oleo shock absorber

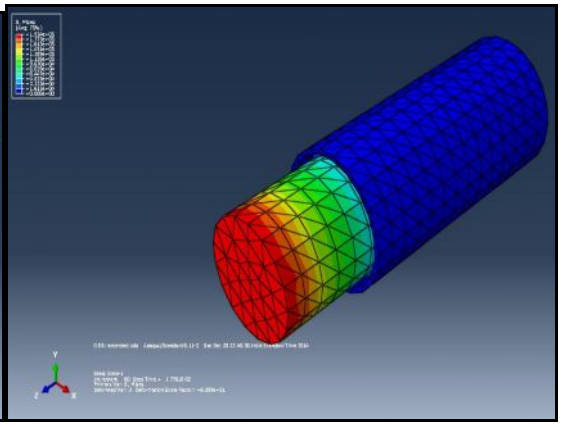

Fig 5.Von mises stress in oleo shock absorber

Comparative result of solid spring and Oleo strut shock absorber

Values	Solid spring	Oleo strut
Displacement in m	1.486e-05	3.104e-007
Von mises Stress	1.320GPa	0.264Mpa

Evolution of the landing is studied right from the rigid axle landing arrangement which was commonly used in World War I planes. Rigid axle landing gear uses tires for absorbing the shocks during landing. Thus the efficiency of absorbing shocks depends only on tires not on any other components. This limits its usage in conventional aircraft. Levered bungee landing gear employs a gear leg pivoted at the fuselage. This arrangement thus deflects upward and outward by means of stretching of bungee cords attached to it. This pivoting arrangement results in protuberances drag as it hangs from the aircraft.

Conclusion

The objective of reducing the landing shocks leads to the selection of solid spring shock absorber. Solid spring shock strut is commonly used in lighter aircraft because of its simplicity in design. However, it absorbs lateral shocks by scrubbing of tire. This problem is eliminated by replacing it with oleo strut in lighter aircraft and its analytical solution is evaluated by employing titanium material for both. Oleo shock absorber proves to be an efficient arrangement for absorbing landing shocks in aircraft because of its reduced deflection with the applied load in comparison with solid spring shock absorber.

References

1. Raymer D. P., 'Aircraft Design: A Conceptual Approach 3rd Edition, AIAAEducation Series', New York(1999).
2. Rosam J., 'Airplane Design, Part IV 2nd edition, Lawrence (1989).
3. RaymerD.P.,'Aircraft Design: A Conceptual Approach, American institute of Aeronautics and Astronautics', Washington (1992).
4. Benjamin Chartier, 'Landing gear shock Absorber' (2008).
5. Derek Morrison, 'Aircraft Landing Gear Simulation and Analysis',American Society for Engineering Education, Annual Conference Session (1997).
6. Daniel B., 'Some Aspects Regarding Impact Absorbers Applied on Aircraft Landing Gears', International Conference of Scientific paper *AFASES*, *Brasov* (2011)
7. Hall, 'Some theoretical studies concerning oleo damping characteristics',Aeronautical Research Council(2000).
8. Thoai D. and Nguyen, 'Finite Element Analysis of a Nose Gear during Landing' University of North Florida(2010).
9. Curry and Norman. S., 'Aircraft landing gear design, Principles and practices, Washington: American Institute of Aeronautics and Astronautics (1998).
10. Albana A.S., 'Stress analysis on main landing gear for small aircraft', Al-Rafidain Engineering, 22, 1 (2014).

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