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Inclined Lander for Shock Alleviation

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Abstract – paper gives a theoretical solution of shock absorption and represents behavior of inclined Lander during the process of impact landing. It shows a clever mechanical design for shock alleviation and also decreases the chances of accidents during the landing impact. For a long period of time, landing gear or Lander is an important area of research. This paper use theoretical force deflection method for shock alleviation and an analysis of equilibrium of Lander (with help of mass spring damper system at a constant damping) when landed on finite degree inclined. The Inclination of landing gear and effect of wheel spin-up loads is characteristics of dynamic force deflection.
Keyword- Equilibrium, Inclination, Force-deflection, Spring-mass system, Shock Absorption.

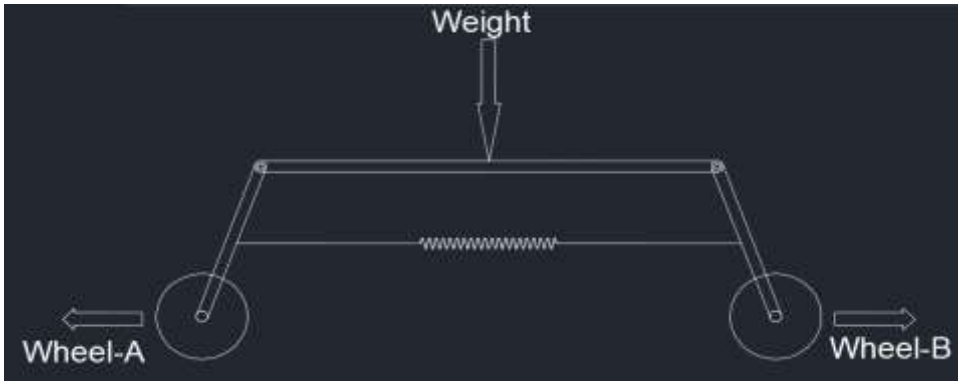
INTRODUCTION

Landers in 21century uses for planetary entry and reentry missions. Passive landing gear is important for Lander or in commercial aircraft such as helicopter, small aircraft, hovercraft, UAVs etc. for soft landing. Landing gears are also important for comfort of passengers which travel in such type of aircraft. One important requirement is always necessary for any Lander is ability of aircraft to land safely, and ability of Lander to land on uneven surface.

Landing gear main work to reduce shock during normal or impact landing, for this landing gear uses many shock absorption methods such as oleo-pneumatic method, spring shock absorption method etc. many research are running during and after the invention of aircraft and planetary missions and lot of research paper publish on analysis the many different type mechanics of landing gear. Many aspect of landing impact behavior related with the mechanics of landing gear. Practical landing gear analysis is very complicated mathematical calculation so many paper before simplify mathematical calculation.

This paper present general form and take into account such factor as spring behavior, force forces analysis in shock struts, non-linier dynamic force deflection analysis of the wheel, the inclination of landing gear and equilibrium analysis of landing gear at a certain load.

Theoretical analysis design- The main concept of mechanical, Lander works like a sock absorption spring in him and reduce shock. The design shows by equation



$$force_{spring} = constant_{spring} \mathrm{X} \, (travel_{wheel\ A} + travel_{wheel\ B})$$

The initial 2-D design shows the concept, the Lander work when we take load as a concentrate load. Both struts are hinged and connected with a spring when force is applied on the system leg A and leg B are expanded while spring want to take it back in equilibrium position so it is vibrating on a frequency and spring and wheel friction damped the frequency until the system reach in equilibrium . So the full system work like mass-damped system and reduce the shock in him.

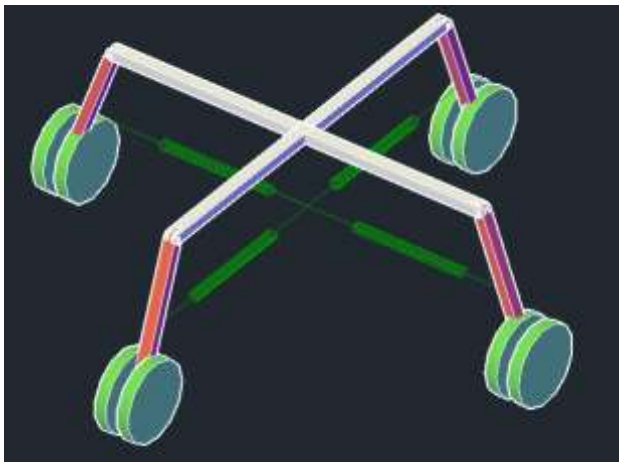


Figure shows the 3-d view of the system in this four leg is uses. we can use more than three leg according to requirement of Lander.

Behind inclination concept of Lander to deflect the forces direction and reduce the shock during the landing impact. It is very basic and clever mechanical design concept for reducing the shock. In this design the impact load deflect in two side of first component of impact load work on the struts which is main cause for shock and second component of impact load is cause for deflection in wheels of Lander. Angle at which strut incline is function of impact lode if we are increase angle at constant load shock load in struts are decrease while system failure chances are increases so the selections of angle of Lander according to requirement of mission

Equilibrium analysis - The theoretical analysis of Lander, take Lander as a mass-spring system. When Lander land on the surface according to design concept Lander legs are expanded but legs are also attached from spring so Lander legs want to return our initial position. This cause system vibrates at a frequency and spring damp this frequency until it is return in equilibrium position. Damping of Lander such that it is come to in equilibrium as soon as possible. Lander has three main points when take it as mass-spring, acceleration by mass, and velocity by damping co-efficient and position by spring constant.

Mass (acc.) + damping (vel.) + spring (pos.) = 0

CONCLUSION

The advantage of this design is that take advantage of mechanical system for reducing shock of the Lander. This system also useful for stability of Lander when it is operates under the limit load. In this system no extra power needed for reducing the shock of Lander and it is very simple design for manufacturing point of view. In this system we can also use of oleo-pneumatic piston in strut of Lander and also in the place of spring.

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