

DESIGN AND ANALYSIS OF LANDING GEAR FOR ESTIMATE MECHANICAL PROPERTIES

Landing gear, Strut bearing, Fatigue, Corrosion

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ABSTRACT

Landing gear is a vital structural unit of an aircraft which enables to take off and land safely on the ground. A variety of landing gear arrangements are used depending on the type and size of an aircraft and they were classified by their retractability. So our objective is to modify the fixed wing aircraft into retractable landing gear. In turn joints are to be provided such that heavy concentrated loads are first received by the airframe and subsequently diffused to the surrounding areas. Normally heavy concentrated loads are received through a lug joint. Therefore design of a lug joint against failure under static and fatigue loading conditions assumes importance in the development of an aircraft structure.

Keywords: Landing gear, Strut bearing, Fatigue, Corrosion

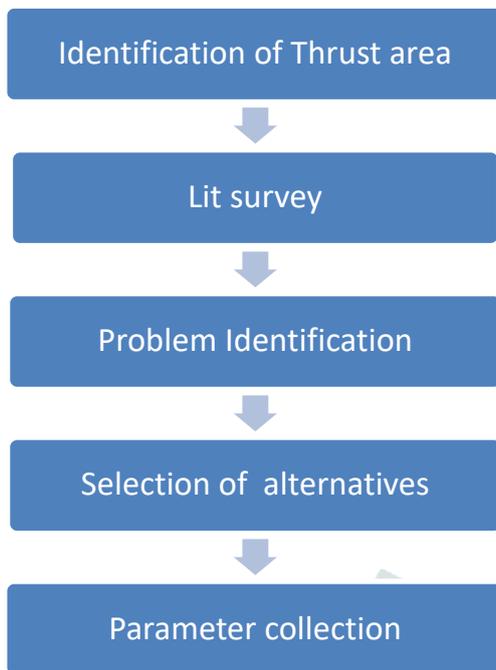
Introduction

Aircraft landing gear supports the entire weight of an aircraft during landing and ground operations. They are attached to primary structural members of the aircraft. The type of gear depends on the aircraft design and its intended use. Most landing gear have wheels to facilitate operation on hard surfaces, such as airport runways. Other gear feature skids for this purpose, such as those found on helicopters, balloon gondolas, and in the tail area of some tail dragger aircraft. Aircraft that operate to and from frozen lakes and snowy areas may be equipped with landing gear that have skis. Aircraft that operate to and from the surface of water have pontoon-type landing gear. Regardless of the type of landing gear utilized, shock absorbing equipment, brakes, retraction mechanisms, controls, warning devices, cowling, fairings, and structural members necessary to attach the gear to the aircraft are considered parts of the landing gear system. Numerous configurations of landing gear types can be found. Additionally, combinations of two types of gear are common. Amphibious aircraft are designed with gear that allows landings to be made on water or dry land. The gear features pontoons for water landing with extendable

wheels for landings on hard surfaces. A similar system is used to allow the use of skis and wheels on aircraft that operate on both slippery, frozen surfaces and dry runways. Typically, the skis are retractable to allow use of the wheels when needed. The landing gear is a retractable tricycle type consisting of two, wing root mounted, main landing gear assemblies and a forward, fuselage mounted, steerable, nose landing gear assembly. The main landing gear assemblies retract inboard and the nose landing gear assembly retracts forward. Each landing gear has a nitrogen filled shock strut to absorb and dissipate the shock loads encountered when the aircraft landing.

Methodology

This project is summarizes the design and performance of retractable landing gear analysis in drag performance on which SOLIDWORKS is used for design of model of the retractable landing gear with the help of SIMSCALE software analysis of retractable landing gear. This project specifies how the retractable landing gear is analysis and the best selection of reducing parasite drag.



FLOW CHART: METHODOLOGY OF PROJECT

Flow chart deals with the flow chart procedure of our project phase 1. Thrust area is found then the literature survey is carried on our problem is identified and the solution is given as retractable landing gear parameters and components for modal is collected for the reducing the parasite drag.

ADAM Software

ADAMS (acronym of Automated Dynamic Analysis of Mechanical Systems) is a multi-body dynamics simulation software equipped with Fortran and C++ numerical solvers. ADAMS was originally developed by Mechanical Dynamics Incorporation which then was acquired by MSC Software Corporation. Adams has been proved as very essential to VPD (Virtual Prototype Development) through reducing product time to market and product development costs.

LANDING GEAR PARAMETERS

Parameter	Value	Unit
Structure parameters		
Caster length, e	0,1	m
Gear height, lg	1,0	m
Strut torsional stiffness, $k\psi$	-1,105	Nm.r ad-1
Strut torsional	-45	Nm.s.

damping, $c\psi$		rad-1
Strut moment of inertia about z-axis, I_z	1	kg.m ²
Strut later bending stiffness, $k\delta$	-	Nm.r ad-1
Strut later bending damping, $c\delta$	-150	Nm.s. rad-1
Strut moment of inertia about x-axis, I_x	1	kg.m ²
Rake angle, ϕ	4	rad
Tyre parameters		
Radius of nose wheel, R	0,2286	M
Contact patch length, h	0,1	M
Elastic tyre damping coefficient, $c\lambda$	-270	Nm ² r ad-1
Elastic tyre self-aligning coefficient, $k\alpha$	-2	m/r ad
Elastic tyre restoring coefficient, $k\lambda$	20	rad-1
Relaxation length, L	0,2	M
Self-aligning moment limit, α_m	0,1745	rad
Continuation parameters		
Vertical force on the gear, F_{zn}	8-13	kN
Forward velocity, V_x	90-70	m/s

Solidworks Model



Isometric view of Landing Gear

RESULTS AND ANALYSIS
STATIC ANALYSIS

Material Selection

For Static Analysis the material we are using is titanium alloy. We are using it for the Gears, Strut, and Connecting rod. In this the main material we are using is the aluminium and the titanium alloy.

Table Material Properties for Landing Gear

S.NO	Description	Landing Gear
1	Material	Titanium alloy
2	Density	2.88Kg/m
3	Poission Ratio	0.33
4	Yield Strength	95Mpa
5	Young’s Modulus	80Gpa

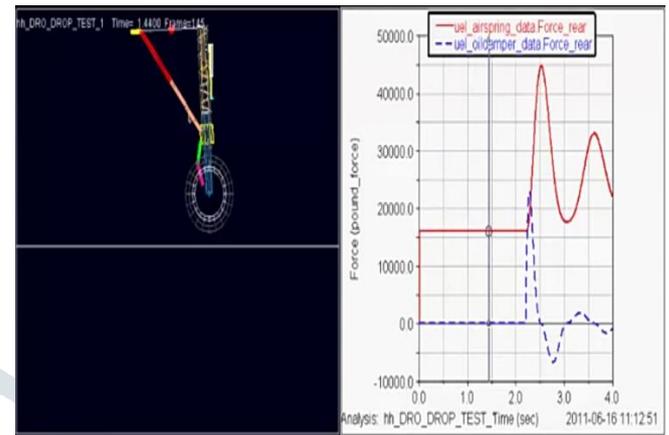
SUMMARY

The landing gear design parts like strut, connecting rod, torque links and tyers are all have been designed by using SOLIDWORKS and then the designing parts are assembled and further imported to the ADAM SOFTWARE via IGS file. The landing gear main wheel diameter is 177.8 mm and the patch length h is 1000mm . Titanium alloy is used to design a landing gear in SolidWorks.

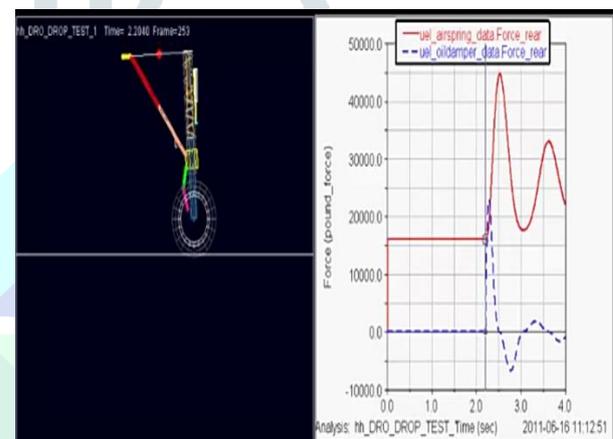
Result for Static Analysis

Stress analysis plays very important role in finding structural safety and integrity of assemblies. The prior estimation of stress helps in finding suitable material and geometrical dimensions. Even optimizations of dimensions are

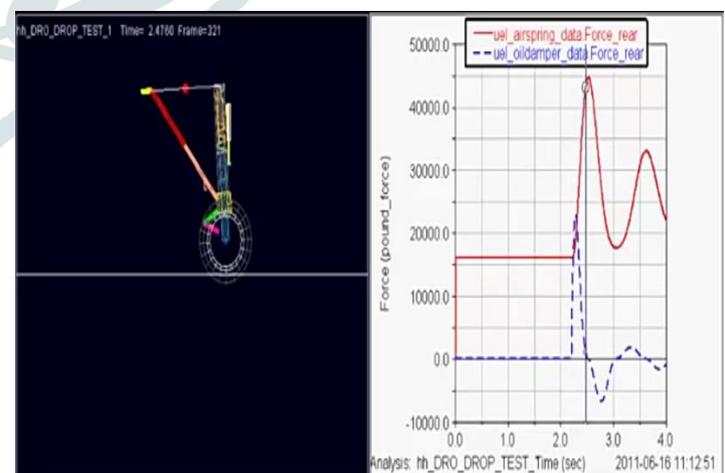
possible with stress estimates along with factor of safety calculations. Here, we have the results of various deflections to bear the given load. It also includes displacement analysis.



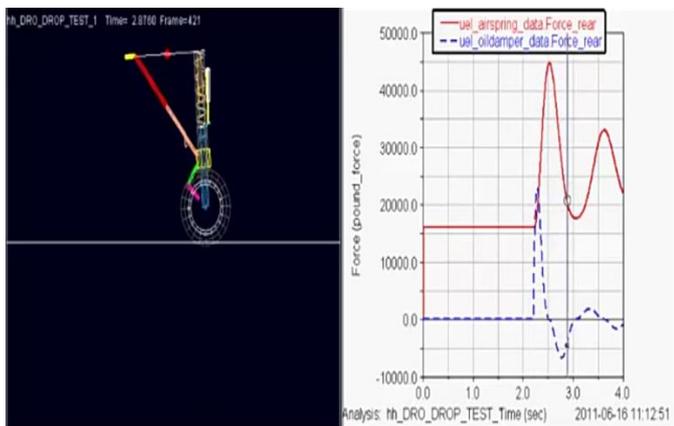
During midflight –Deflection



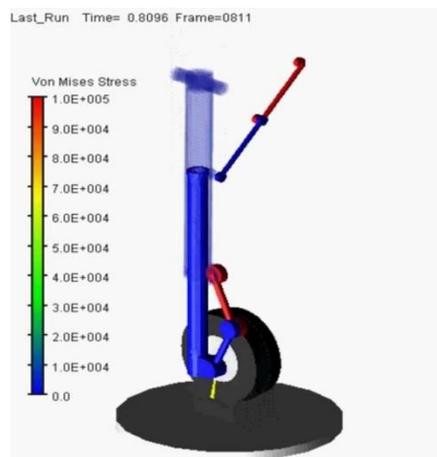
Deflection –when landing gear touch the ground



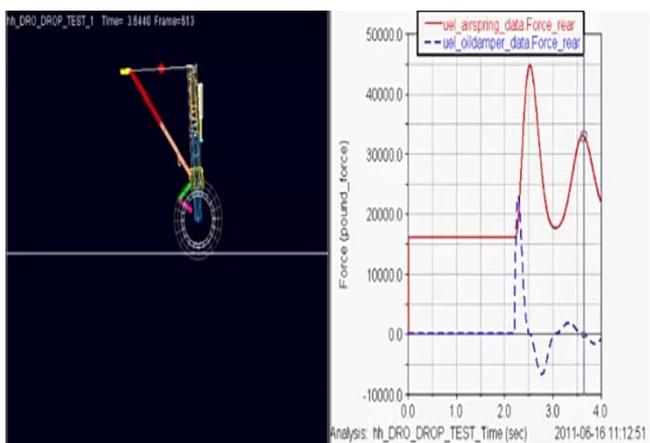
Deflection during impact load applied on the landing gear.



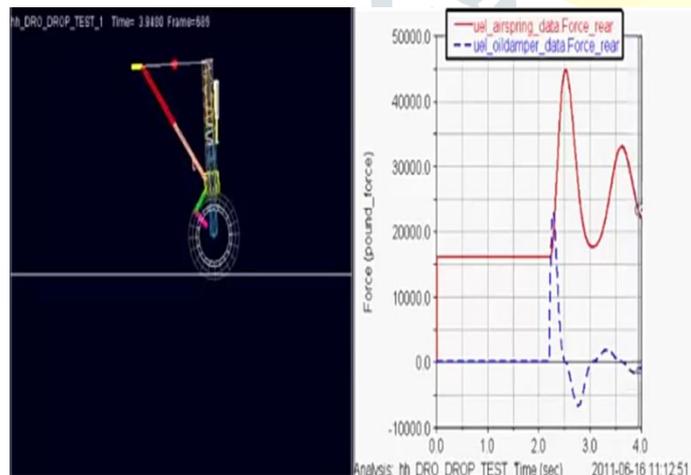
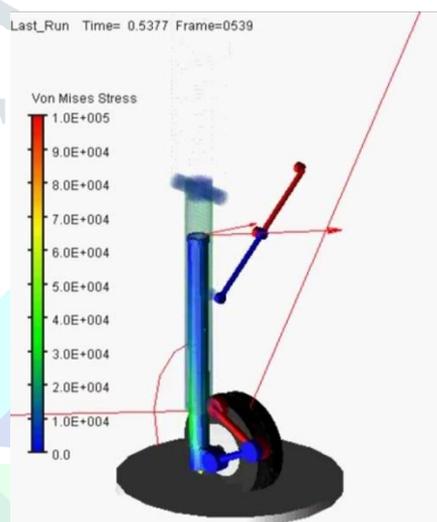
Deflection reduced by unloading



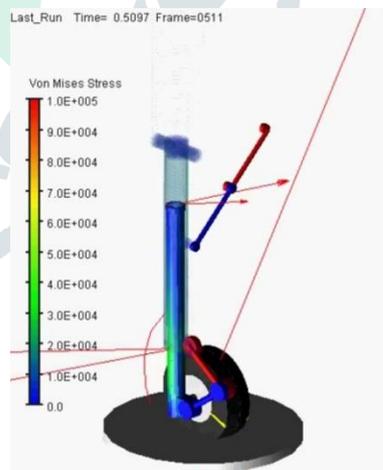
The stress while the rod moves in piston.

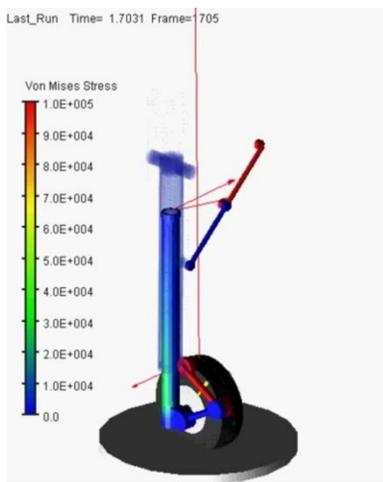


Landing gear deflection when minimum amount of load applied



Deflection when 2.5 N force given
Stress Analysis.





The stress produced while the landing gear hits the ground.

Conclusions

Thus the result shows that the various deflections and von misses stress in different part of landing gear under the impact load when the landing gear touches the ground.

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