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DESIGN OPTIMIZATION OF LANDING GEAR OF AN AIRCRAFT- A REVIEW

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Abstract *: Landing gear of an aircraft is an equipment that serves two primary functions. First, it allow aircraft to safely and successfully land and second is to support aircraft at rest condition. Landing gear is designed according to requirement and nature of work of aircraft. In this project, we will first study all functional specifications and parts of landing gear which can affect purpose an aircraft . Some of these parts to be consider are :*
1. Type (e.g. nose gear (tricycle), tail gear, bicycle)
2. Fixed (faired, or un-faired), or retractable, partially retractable
3. Height 4. Wheel base
5. Wheel track 6. The distance between main gear and aircraft cg
7. Strut diameter 8. Tire sizing (diameter, width)
9. Landing gear compartment if retracted.
In this project work, we will optimise design of landing gear by considering different material properties ,loading conditions and dimension optimization with different landing conditions during operation. For modelling of landing gear we will use CREO element/pro 5.0 version of PROE. After this, we will perform structural analysis ,dynamic mechanism analysis and fatigue analysis and compare results using ANSYS-11.0.We will also try to validate the results with available research papers and manufacture's specification.

Keywords: *Ansys11.0,Displacement, Landing gear, Pro-E , stress, top down assembly.*

I. INTRODUCTION

Aircraft's major component that is needed to be designed is landing gear (undercarriage). The landing gear is the structure that supports an aircraft on the ground and allows it to taxi, take-off, and land. In fact, landing gear design tends to have several interferences with the aircraft structural design. In this book, the structural design aspects of landing gear are not addressed; but, those design parameters which strongly impact the aircraft configuration design and aircraft aerodynamics will be discussed. In addition, some aspects of landing gear such
shock absorber, retraction mechanism and brakes are assumed as non-aeronautical issues and may be determined by a mechanical engineer. Thus, those pure mechanical parameters will not be considered in this chapter either. In general, the followings are the landing gear parameters which are to be determined in this chapter:

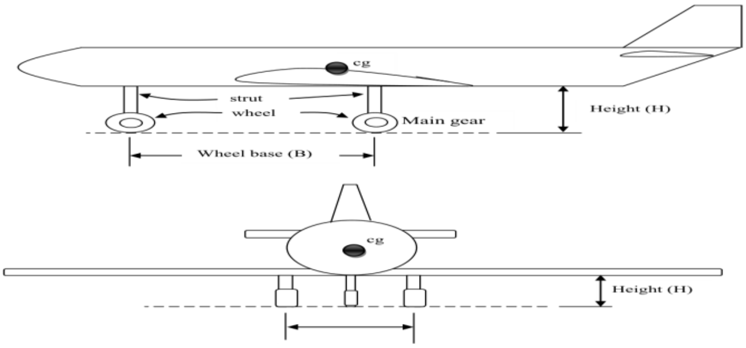
1. Type (e.g. nose gear (tricycle), tail gear, bicycle)
2. Fixed (faired, or un-faired), or retractable, partially retractable
3. Height
4. Wheel base
5. Wheel track
6. The distance between main gear and aircraft cg
7. Strut diameter
8. Tire sizing (diameter, width)
9. Landing gear compartment if retracted

The landing gear usually includes wheels, but some aircraft are equipped with skis for snow or float for water. In the case of a vertical take-off and landing aircraft such as a helicopter, wheels may be replaced with skids. Figure 9.1 illustrates landing gear primary parameters. The descriptions of primary parameters are as follows. Landing gear height is the distance between the lowest point of the landing gear (i.e. bottom of the tire) and the attachment point to the aircraft. Since, landing gear may be attached to the fuselage or to the wing; the term height has different meaning. Furthermore, the landing gear height is a function of shock absorber and the landing gear deflection. The height is usually measured when the aircraft is on the ground; it has maximum take-off weight; and landing gear has the maximum deflection (i.e. lowest height).

II. LITERATURE REVIEW:

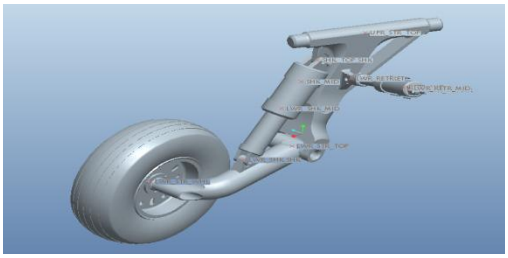
Landing gear torque arm position analysis and the optimization design[3]

The influence of the torque arm position of shock-strut landing gear on the potential seizure phenomenon of the shock absorber is analyzed, and the general calculation formula of reaction force of the piston rod for forward stretching and lateral stretching landing gear is also derived in the paper. Based on above research, the optimization design method of the torque arm position is put forward, which solving the torque arm position to make the piston rod counterforce minimum. Namely, for the optimal design method, the target function is piston rod counterforce, and the design variable is the position of torque arm in relation to the strut of landing gear. Finally, a set of computer programs of the optimal design method are compiled, which has been proved that is totally applicable for the inside or outside wheel of strut and forward or lateral stretching shock-strut gear.



III. METHODOLOGY:

CAD modeling by using CREO-ELEMENT/PRO 5.0 Software.



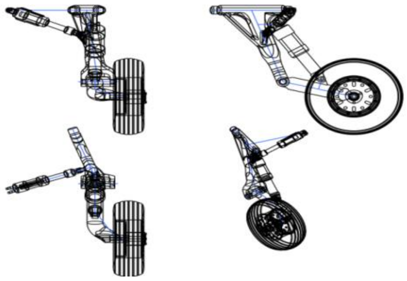


Fig : exploded view with BOM

Assembly is the process in which two or more objects are joined together to achieve the desired function.

Assembly modeling is the process of creating designs that consist of two or more components assembled together at their respective work positions. The components are brought together and assembled in the Assembly Design environment by applying suitable parametric assembly constraints to them. The assembly constraints allow to restrict the degrees of freedom of the components at their respective work positions.

IV. TOP DOWN DESIGN

Assembly-Design Approaches

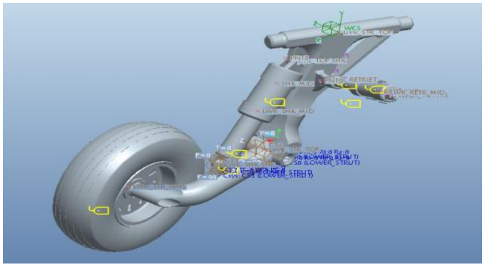
I analyze assembly from the finished assembly and work down. So, begin with the master assembly and break it down into assemblies and subassemblies. Then, identify the main assembly components and their key features. Finally, understand the relationships within and between assemblies, and assess how the assembly will be assembled. With this information, I can plan a design and leverage overall design intent into our models. Top down design is the industry paradigm for companies that design assemblies that undergo frequent design modifications or for those companies that design diverse assemblies.

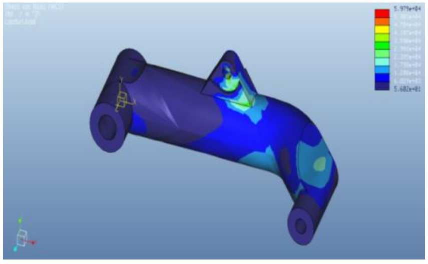
Adopting the top-down design approach gives the user the distinctive advantage of using the geometry of one component to define the geometry of the other component. Here, their construction and assembly take place simultaneously. As a result, the user can view the development of the assembly in real time. This design approach is highly preferred while working on a conceptual design or a tool design where a reference of the previously created parts is required to develop a new part.

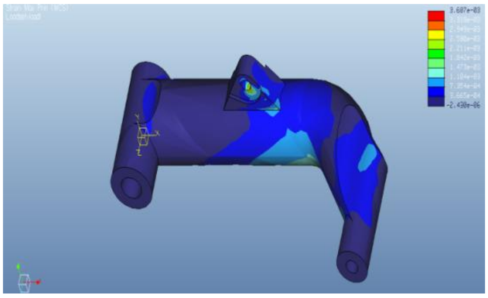
Analysis By Using ANSYS 11.0 Software:

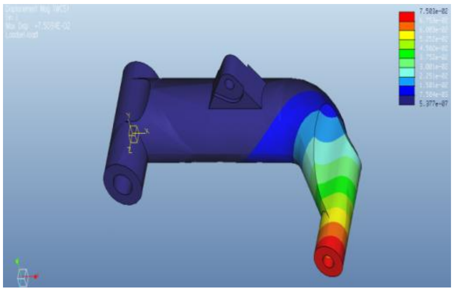
Structural analysis is probably the most common application of the finite element method. The term structural (or structure) implies not only civil engineering structures such as bridges and buildings, but also naval, aeronautical, and mechanical structures such as ship hulls, aircraft bodies, and machine housings, as well as mechanical components such as pistons, machine parts, and tools.

Structural Analysis is a multi-discipline Computer Aided Engineering (CAE) tool that analyzes the physical behavior of a model to better understand and improve the mechanical performance of a design. It can be used to directly calculate stresses, deflections, thus to predict the behavior of the design in the real world. Structural Analysis is available in the integrated mode of Pro/E and analysis can be performed within the Pro/E environment. Pro/E Structural Analysis and Pro/E Thermal Analysis share a very similar approach. Most of the procedures presented in this tutorial, such as model creation, constraints definition and load specification, are also applicable to Thermal Analysis.









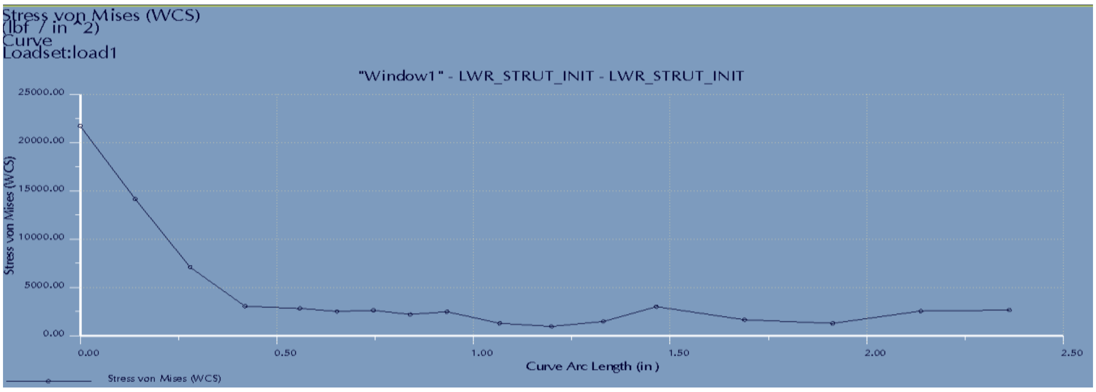


Fig: Von Mises Stress Vs Curve Arc Length

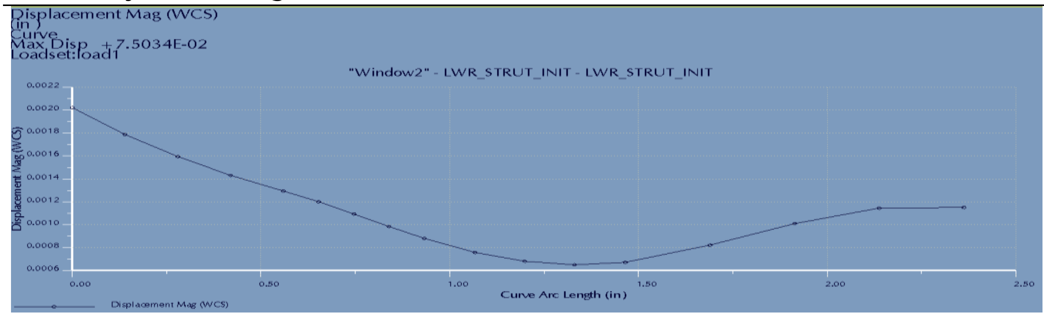


Fig: Displacement Vs Curve Arc Length

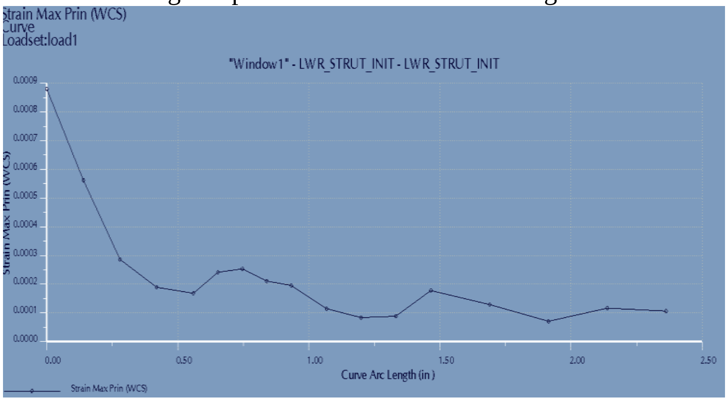


Fig: Von Mises Stress Vs Curve Arc Length

V. CONCLUSION

From above work, it has been clear that the landing gear can be design and modeled using PRO-E as per requirements. We can perform integrated simulation on a Pro/E assembly and automatically meshed model can be generated containing very small sections. From above analysis, one can get early insight as to its performance and can analyze a concept model to automatically obtain accurate stresses and displacements. On this basis one can optimize the design by changing relevant parameters and material. In this way, one can design a landing gear for a greater performance to suit for the purpose.

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