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Simulation and Analysis of Leaf Spring Using Titanium Alloy Material

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A B S T R A C T

Titanium alloy is used for leaf spring analysis. This titanium alloy material is mostly used in the manufacturing industry. The 3D model of leaf spring has been created in solid works. Total 10 leaf has been consider for the analysis along with the full length leaf. In this study, 5 mm deformation has been consider for all three material. Equivalent mesh size has been implemented for all three material leaf spring. Ansys workbench software has been used to analyze is the stress and stain development in the leaf spring under the 5 mm deformation condition.

Keywords: Leaf Spring, titanium alloy, simulation

1.Introduction

As an elastic body, a spring plays a role in a vehicle. When the vehicle is in a dynamic state, it is subjected to a constant load of varying intensities, causing the spring to distort. When a vehicle is in a static state, it returns to its previous shape. As shown in Figure 1, the laminated or leaf spring (also known as flat spring or carriage spring) is made up of a number of flat plates (known as leaves) of varied lengths connected together by clamps and bolts. The majority of these are found in autos. Tensile and compressive stresses are the most common stresses produced by leaf springs. Flat plates are used to make leaf springs (also known as flat springs). The advantage of a leaf spring over a helical spring is that the spring's ends can be steered along a certain path as it deflects, acting as a structural member as well as an energy absorber. In addition to shocks, the leaf springs may handle lateral loads, brake torque, driving torque, and so on. Existing work on light composite elliptic springs for automobile suspension by E. Mahdi a and O.M.S. Alkoles [1]. They collaborated on a project that combined an elliptical design with woven roving composites. The effect of elasticity ratio on the performance of woven roving wrapped composite elliptical springs has been studied both experimentally and numerically in this research. The substance developed by S Amare et al. [3] plays an important role in each assembling interaction. Using the composite material E-Glass/Epoxy composite, the article also displays and addresses the critical challenges of vehicle weight. Their work focuses on maintaining a stable cross segment arrangement, weight loss, and a strategy.

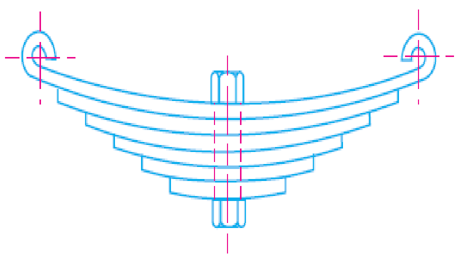

Figure 1: Schematic diagram of leaf spring

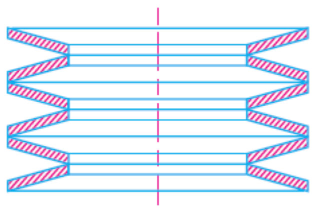

Figure 2: Disc or bellevile springs

2.0 Simulation of process

A spring is an elastic body with the function of distorting when loaded and returning to its original shape when the load is removed. The following are some of the most common uses for springs:

1. In automotive springs, railway buffers, air-craft landing gears, shock absorbers, and vibration dampers, to pad, fascinate, or regulate energy owing to shock or vibration.
2. To exert force, such as in brakes, clutches, and spring-loaded valves.
3. To control motion by keeping two parts in touch, as in cams and followers.
4. In spring balances and engine indicators, to measure forces.
5. To store energy in watches, toys, and other devices.

The 3D model of the leaf spring analysis was created using Solidworks software. The created 3D model was then imported into Ansys workbench software for additional examination using the processes below.

1. Open Ansys and import the 3D model of the leaf spring file.
2. The static structural module has been chosen for examination.
3. The resulting model was subjected to meshing.
4. The 3D model of a leaf spring has been subjected to boundary conditions.

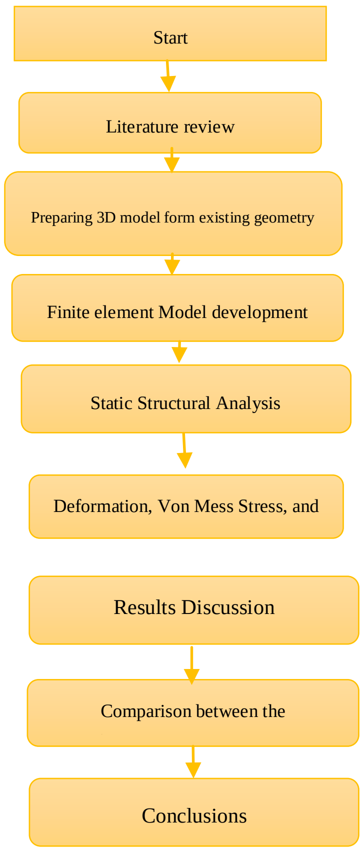

Figure 3 Flow chart of the process

3.0 Simulation & Modeling

Almost all the problems related with the engineering and sciences are governed by the differential or integral equation. With the help of this equation, the user get an exact or closed to the solution to the particular problem being studied. Stiffness is generally expressed as ratio of force to deflection as, K = force / deflection. Spring stiffness is important parameter to monitor spring deflection and its attributes. To improve the handling of vehicle the value of stiffness should be high.Stress is the second important element for leaf springs. Equivalent Stress generally co-relate with durability of leaf springs

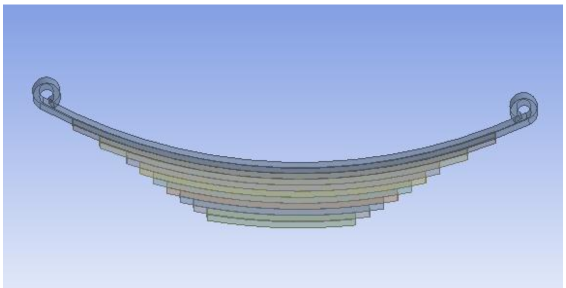

Figure 3. 3D model of Leaf spring

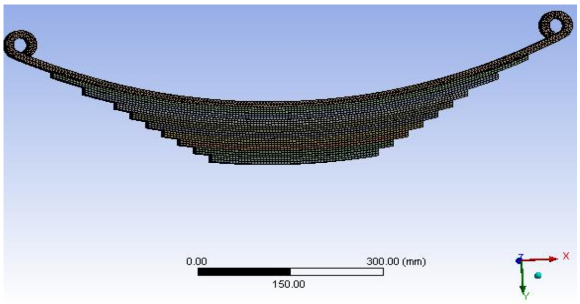

Figure 4 Meshed surface of 3D leaf spring

4. Results and Discussion

In this study, 242301 nodes and 66084 element has been selected in meshing zone for 3D leaf spring model. The node is the junction of the elements. This numbers are clearly indicate the density of the meshing.

4.1 Effect of Titanium alloy material on characteristics

Figure 5 shown the total deformation in the leaf spring. The maximum total deformation 5.02 mm has been recorded as shown in Figure 5.

Figure 6 depicts the equivalent stress in leaf spring. Maximum 1126 MPa equivalent stress has been observed. Figure7 shown the normal stress developed in the leaf spring. 894.02 MPa has been observed during the analysis.

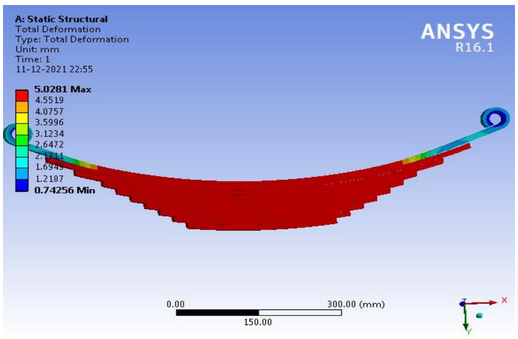

Figure 5 Total Deformation in the Titanium alloy leaf spring

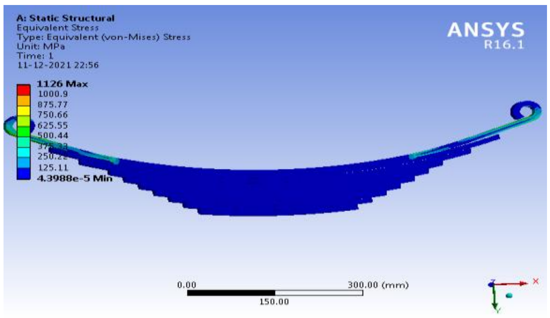

Figure 6 Equivalent stress in the Titanium alloy leaf spring

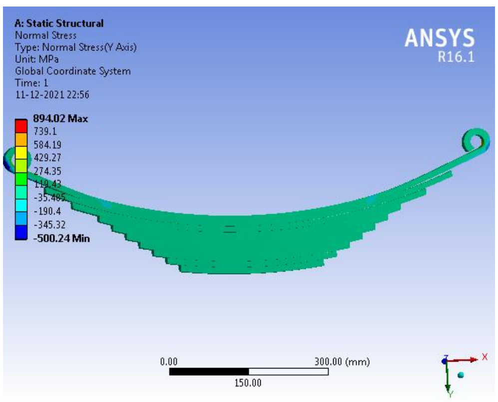

Figure 7 Normal stress in the Titanium alloy material leaf spring

Table 1 Titanium alloy leaf spring results

S. No	Characteristics	Values
1	Deformation (mm)	5.02
2	Equivalent Stress (MPa)	1126
3	Normal Stress (MPa)	894.02

5. Conclusion

The following conclusions has been drawn for the finite element analysis of Titanium alloy. Deformation, normal stress and equivalent stress has been determined by the analysis.In the case of equivalent stress, value 1126 MPa has been recorded. In the case of normal stress 894.02 MPahas been recorded**.** The total deformation 5 mm has been noted

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