MONO COMPOSITE LEAF SPRING FOR FOUR WHEELER LIGHT WEIGHT VEHICLE DESIGN

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Abstract : The suspension system is used to isolate the chassis from the shock loads due to Irregularities of the road surface. This must be handled without impairing the stability, Steering or general handling of the vehicle. Suspension system for the cab is placed between the chassis using bolts. The loads coming from the floor and the chassis are taken by the suspension. The model is designed in PRO- E and translated to Ansys 14.0.The model is simplified in Ansys by using the preprocessor. Constraint equations and couples are used to connect various regions of the suspension system. The loads are applied on the top flange of the suspension system. Static analysis is made to study the deflection of the suspension system. Model Analysis is made to check the natural frequencies. Harmonic analysis is also done to plot various graphs between frequency and amplitude. Results and discussions are made from the results obtained from the Ansys and conclusions are given and scope for future work is also given.

***IndexTerms* - Ansys 14.0, PRO-E, Suspension**

1. INTRODUCTION

The complete suspension system is to isolate the vehicle body from road shocks and vibrations which would otherwise be transferred to the passengers and load. It must also keep the tires in contact with the road, regardless of road surface. A basic suspension system consists of springs, axles, shock absorbers, arms, rods, and ball joints. The spring is the flexible component of the suspension. Basic types are leaf springs, coil springs, and torsion bars. Modern passenger vehicles usually use light coil springs. Light commercial vehicles have heavier springs than passenger vehicles, and can have coil springs at the front and leaf springs at the rear. Heavy commercial vehicles usually use leaf springs, or air suspension. Solid or beam, axles connect the wheels on each side of the vehicle. This means the movement of a wheel on one side of the vehicle is transferred to the wheel on the other side. With independent suspension, the wheels can move independently of each other, which reduce body movement. This prevents the other wheel being affected by movement of the wheel on the opposite side, and this reduces body movement.

2. LITERATURE REVIEW

Putti Srinivasa R, et alSushilB.Chopade, et al, [1] this paper Study to reduce the weight of product while upholding its strength. To solve the problem using E-glass/Epoxy composite materials. And finally reached to the conclusion of the study that shows the comparative weight reduction of E- glass/ Epoxy composite material between 30-40%. Also, the stresses produced in composite material are also less as compare to conventional steel material.

Prakash E. J, et al, [2] in this paper the researcher study to suggest the best composite material for design and fabrication of complete mono composite leaf spring. The researcher consider a single leaf with variable thickness and variable width for constant cross sectional area of different composite materials, with similar mechanical and geometrical properties to the multi leaf spring. The design constraints were stresses and displacement. Compared to the steel spring, the composite spring has stresses and deflection that are much lower, and the spring weight nearly 78% lower. Finally the researcher conclude his work that a comparative study has been made between different composite materials and with the steel in respect of weight, deflection and stress. It can be observed that Boron Aluminum is the best suitable material for replacing the steel in manufacturing of mono leaf spring. The saving in the weight is 90.3%

V. K. Aher, et al, [3] in this study the researcher predicted the fatigue life of semi-elliptical steel leaf spring along with analytical stress and deflection calculations. In addition to this the researcher described static and fatigue analysis of a modified steel leaf spring of a light commercial vehicle (LCV). The dimensions of a modified leaf spring of a LCV were taken and verified by design calculations. The non-linear static analysis of 2D model of the leaf spring is performed using NASTRAN solver and compared with analytical results.

3. METHODOLOGY

The vehicles must have a good suspension system that can deliver a good ride and good human comfort suspension system separate the axle from the vehicle chassis, so that any road irregularities are not transmitted directly to the driver and the load on the vehicle. This is not only allows a more comfortable ride, and protection of the load from possible damage, but it also helps to prevent distortion and damage to the chassis frame.

4. MODELLING OF LEAF SPRING

Modelling and numerical simulation are essential aspects of today's automotive sector. They are necessary in order to reduce the time-to-market for new products and the costs associated with experimental testing. A good modeling and simulation in design and analysis give many benefits such as: minimizing product manufacturing time, material scrap and material cost. In vehicle structure design, the automotive sector has been undertaking structural analyses (static, dynamic, safety, noise and vibration, handling, etc.) for many years. Gradually, the precision and accuracy of models increase in its quality, but until now except metals and a few polymer components composite materials does not involved. The polymer components, in the majority of cases, have only been modelled as isotropic materials. However, as the use of structural composite materials in the automotive sector increased, it has now become necessary to model composites more rigorously.

4.1. 2D sketching and 3D Modeling of Leaf Spring

The 3D Modeling is a geometrical representation of a real object without losing information which the real object has. Various mechanical design and manufacturing operations modeled using CREO. This software allows the user to make changes very easily without having to go to back at the beginning and update all the drawings and assemblies. Generally CREO is easy to use and feature based parametric solid modeling software with many extended design and manufacturing applications. In this specific research, based on the dimension obtained from theoretical calculation and direct measuring data 3D modeling and 2D sketching of the leaf spring was created with the help of CATIAV5 R19 solid modeling software and analysis is done by using ANSYS 16 workbench for stress and deflection

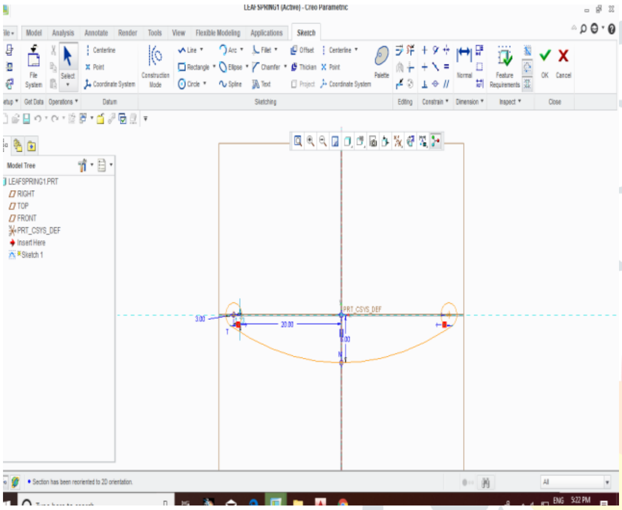

Figure: 2D sketch of mono leaf spring

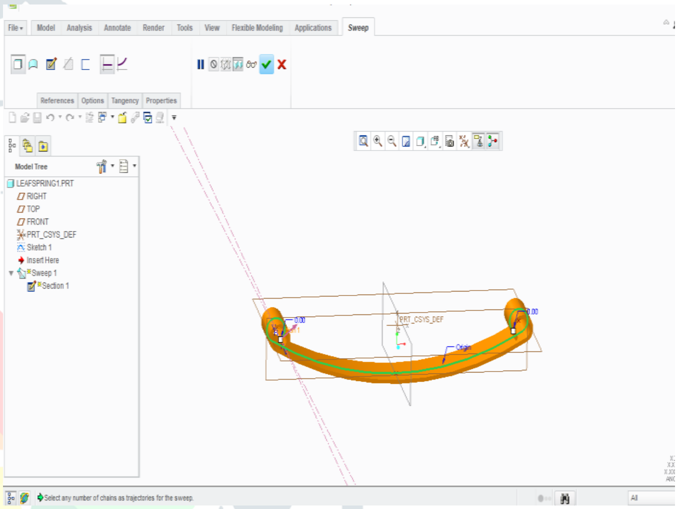

Figure: 3D modeling of mono leaf spring

5. RESULTS AND DISCUSSION

5.1. Results of Cast iron Mono Leaf spring

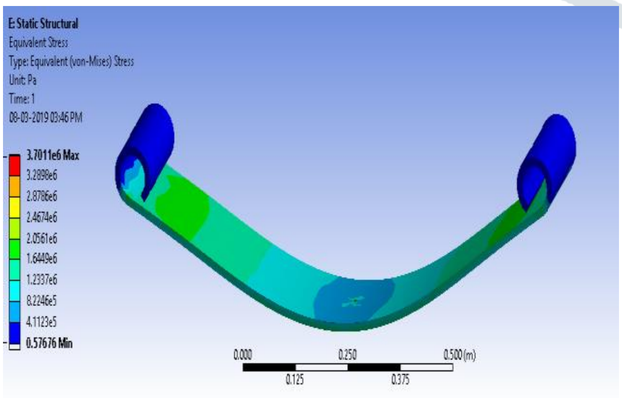

Figure: Von misses stress

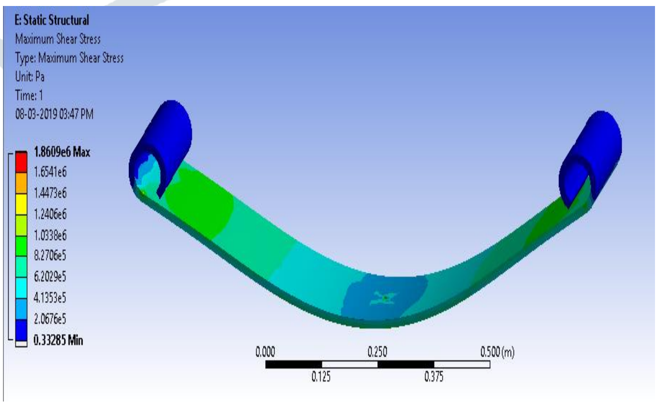

Figure: shear stress

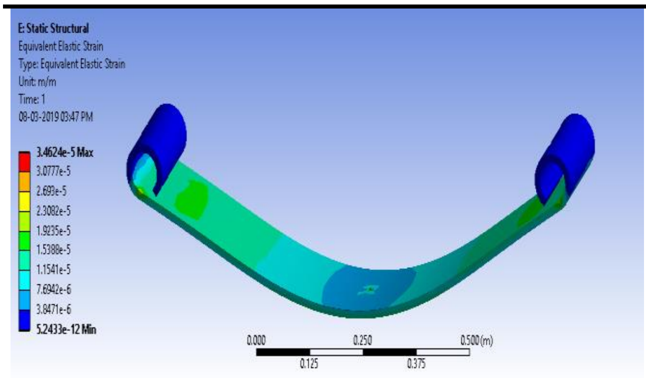

Figure: elastic strain

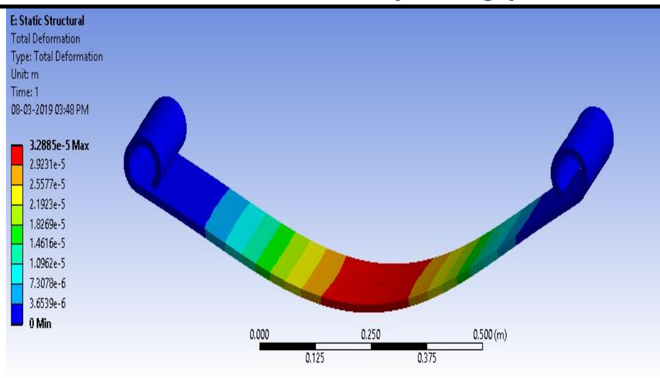

Figure: total deformation

5.2. Results of Steel Mono Leaf spring

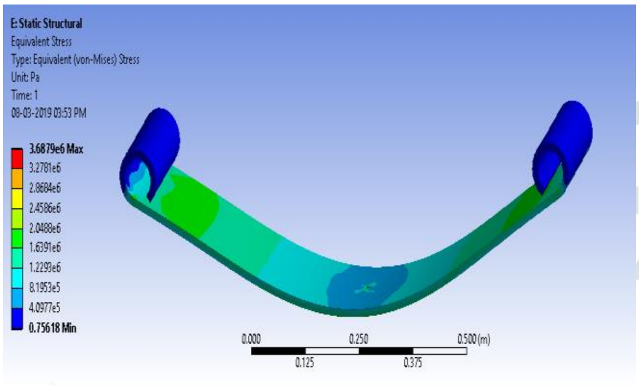

Figure: Von misses stress

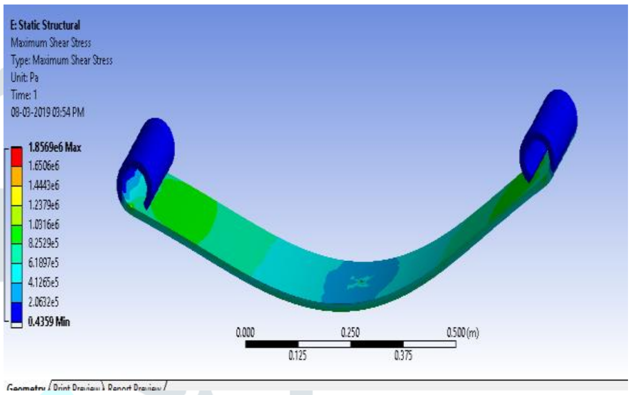

Figure: shear stress

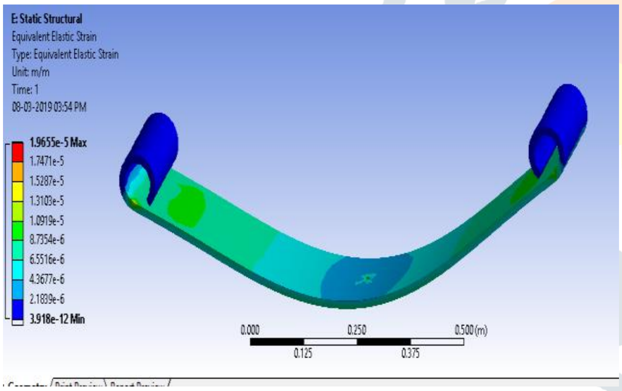

Figure: elastic strain

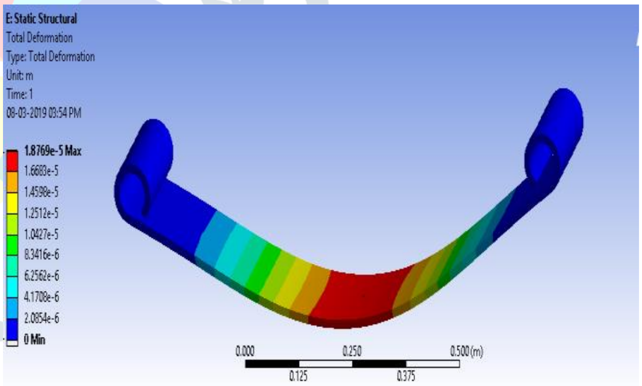

Figure: total deformation

5.3. Results of Carbon/epoxy composite Mono Leaf spring

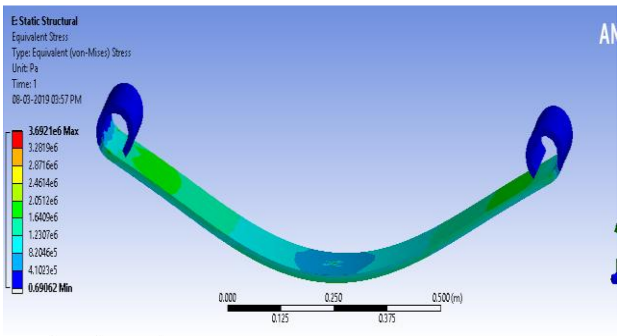

Figure: Von misses stress

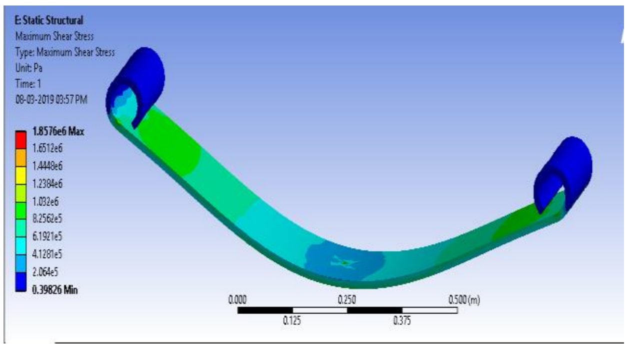

Figure: shear stress

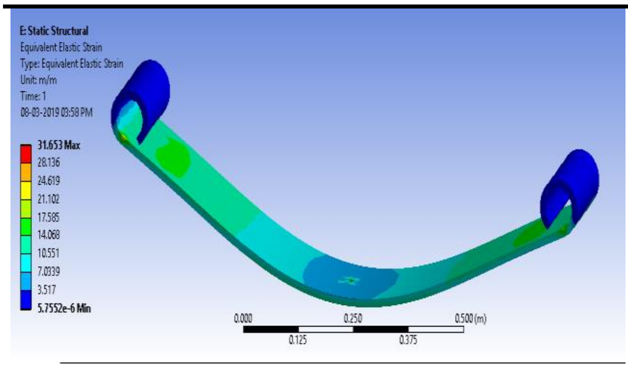

Figure: elastic strain

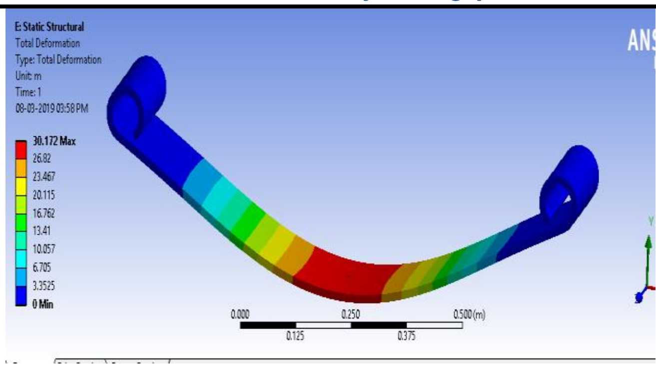

Figure: total deformation4.4 Comparison

Results:

Material	Von-misses stress (MPa)	Shear stress (MPa)	Weight (Kg)
Cast iron	3.7011	1.8609	24.091
Steel	3.6879	1.8569	25.931
Carbon/epoxy	3.6892	1.8573	5.3535

Table: overview results

Comparison plots:

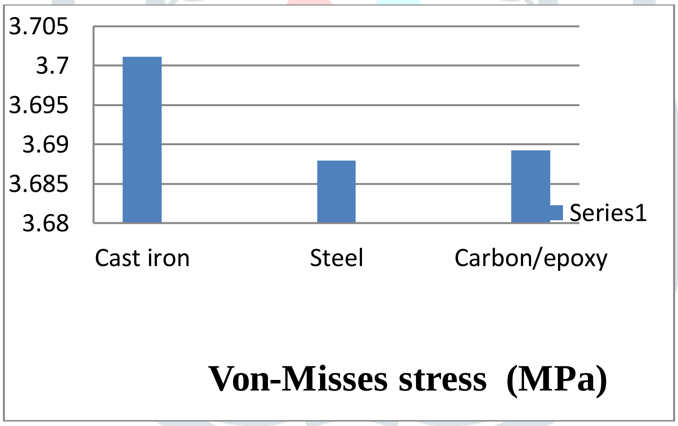

Figure: Comparison plot for Von-Misses stress

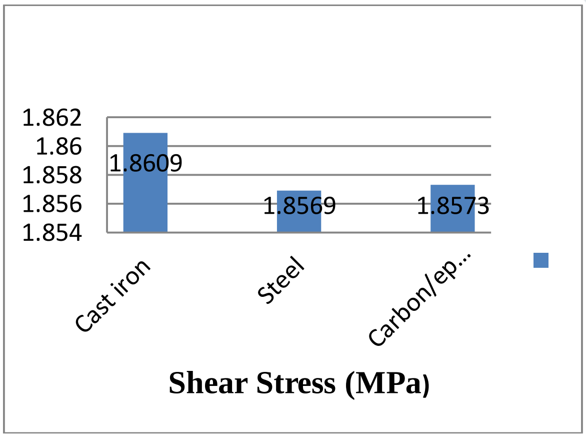

Figure: Comparison plot for shear stress

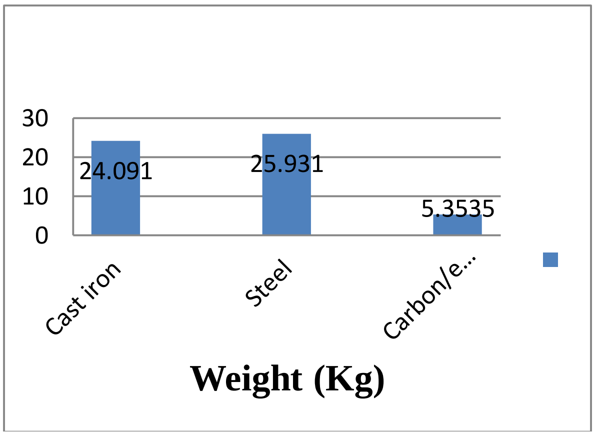

Figure: Comparison plot for Weight

6. CONCLUSIONS

As reducing weight and increasing strength of products are high research demands in the world, composite materials are getting to be up to the mark of satisfying these demands. In this project reducing weight of vehicles by 68.14% and increasing the strength of their spare parts is considered. A mono composite leaf spring for the vehicular suspension system was designed using E-Glass/Epoxy with the objective of minimizing weight of the leaf spring. And it is shown that the resulting design stresses are much below the strength properties of the material satisfying the maximum stress failure criterion. The deflection of the leaf spring along its transverse direction, which is very small compared to the considered maximum deflection.. This particular design is made specifically for the case study/Mahindra/light weight vehicles.

ACKNOWLEDGEMENT

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[1] Daugherty R L (1981), "Composite Leaf Springs in Heavy Truck Applications", Proceedings of International Conference of Composites Material, ISBN 493113601X, Tokyo.

[2] Khurmi R S and Kupta J K (2000), A Text Book of Machine Design, Chapter 23, pp. 866-874.

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