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Structural Analysis of Leaf Spring with Composite Material

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Abstract: The target of this research is reducing the weight and cost of leaf spring by changing the material of the leaf spring which is currently in use. Mani number of trial testing of composite leaf spring comprised of glass fibre reinforced polymer is tested and compared to the weight of the metal used in leaf spring. Compared to existing leaf spring is 34% less in cost. From the creation it was found that the weight reduction of 28% is accomplished by utilizing composite material without yielding the quality.

Key words: Leaf spring, composite, glass fiber, carbon fiber, metal, India

INTRODUCTION

Leaf spring is of one of important component in the vehicle. Every light vehicle and heavy vehicles have leaf spring suspension system. There are various types of suspension system available in the automobile field. They are shock absorber suspension system (Venkatesan and Devaraj, 2012) swing arm suspension, sliding pillar suspension, leaf spring suspension and etc. (Suprith *et al*., 2013) but the leaf spring suspension is commonly used in maximum vehicles. The multi leaf spring suspension is designed by the designing software and it is analyzed by the analysing software. After the analysis the leaf spring is fabricated in the correct material. In the analysis the leaf spring is analysed for its (Jambhulkar *et al*., 2016), deformation under load by the various materials. The suitable material is recommended to the fabrication. Composite is known as the combination of more than one material. Composite material is classified as two types they are natural composite and synthetic composite. Natural composite is made by the natural wastes like coir, jute, luffa and etc. (Adikesavalu *et al*., 2016; Sagadevan *et al*., 2016) synthetic composite is made by the glass fiber like e-Glass fiber, s-Glass fiber and carbon fiber, etc., synthetic fibers are have more strength than the natural fiber composite. The carbon fiber composite is the best fiber composite in the synthetic fiber composites. Carbon fiber composite is stronger than the steel. The composite is made by the carbon fiber and epoxy resin.

Suspension system: Suspension system is very important one in the vehicle. It helps to the safe journey and also the suspension system makes the comfortable journey. Due to the road condition, the vehicle will easily damage without suspension system in it. The suspension helps to overcome this problem in the automobile. Leaf spring suspension system has various types. They are conventional leaf spring (Sivaram *et al*., 2015), eye mounted leaf spring, progressive spring and etc., the conventional leaf spring system is analysed in this project. The conventional leaf spring is shown in Fig. 1.

Fig. 1: Leaf spring

Composite material: The mix of materials comprising of at least two strong stages which are in closely contact with each other on a minute scale. They can be likewise considered as homogeneous materials on a minute scale as in any bit of it will have the same physical property (Jambhulkar *et al*., 2016; Adikesavalu *et al*., 2016) illustrate the design and analysis of mono composite leaf spring for suspension in automobile, dynamic changes in immune effectors activities and endocrine network.

MATERIALS AND METHODS

The car business is at present under a great deal of investigation while considering the materials utilized as a part of a vehicle and the productivity of a vehicle. The heaviness of a vehicle can affect its productivity. In this manner if new items can be produced that diminish the heaviness of a vehicle this give leverage during the assembling of the vehicle when those parts are delivered and it additionally, decreases the cost to work the vehicle. During static load, spring leaf packs have grating between

the leaves, making the springs ride harsh over little knocks on the grounds that the spring must conquer the pack rubbing before it begins to flex. For instance, moving gradually over a hindrance at the base of the hindrance, the suspension is unbending with no dynamic suspension engrossing any of the effect. The spring packs are dangled from the edge rail by shackles (holders) which enable the springs to straighten out amid weight increment or load, the shackles would move or rotate, enabling them to retain the weight increment. The nearer the shackle is to a vertical point, the higher the viable spring rate. At the point when the shackle is laid back at an edge, it really turns into a moving connection with the spring, and the spring ride will feel milder.

Carbon fibers: Carbon fiber is a polymer and is also known as graphite fiber. Carbon fiber is five-times stronger than steel and twice as stiff and it is lighter than steel making it the ideal manufacturing material for many parts. Carbon fiber is basically very thin strands of carbon. The strands can be twisted together and can be woven together, like cloth. To make carbon fiber take on a permanent shape, it can be laid over a mould and then coated with a stiff resin to get the required shape.

Dimension of leaf spring: In Table 1, all the parameters of the leaf spring are given. The parameters are length,width, thickness and load. The values are taken from the present heavy vehicle. This parameters are helps to create the 3D Model of the leaf spring.

Analysis: The Leaf spring of 10 plates are modelled by using solidworks design software with the dimensions given in Table 1.

Figure 2 shows the 3D Model of the leaf spring is shown. It is designed by the modelling software. The below leaf sprig was combination of ten springs. Load of the leaf spring was acted in the bottom face of the leaf spring. The load direction was indicated by the red colour arrow.

Total deformation: The s-Glass fiber result was shown in Fig. 3. It was the total deformation of the leaf spring due

Table 1: Dimensions of the leaf spring

Parameters	Dimensions (mm)
Length of leaf spring	1250
Width of leaf spring	521
Thickness of leaf spring	81

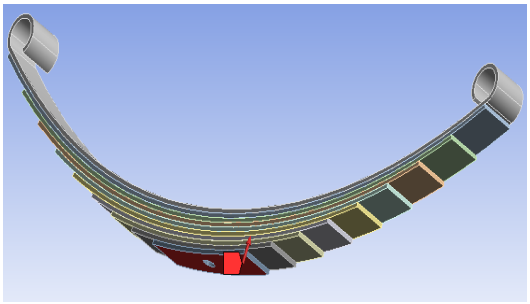

Fig. 2: 3D Model of the leaf spring

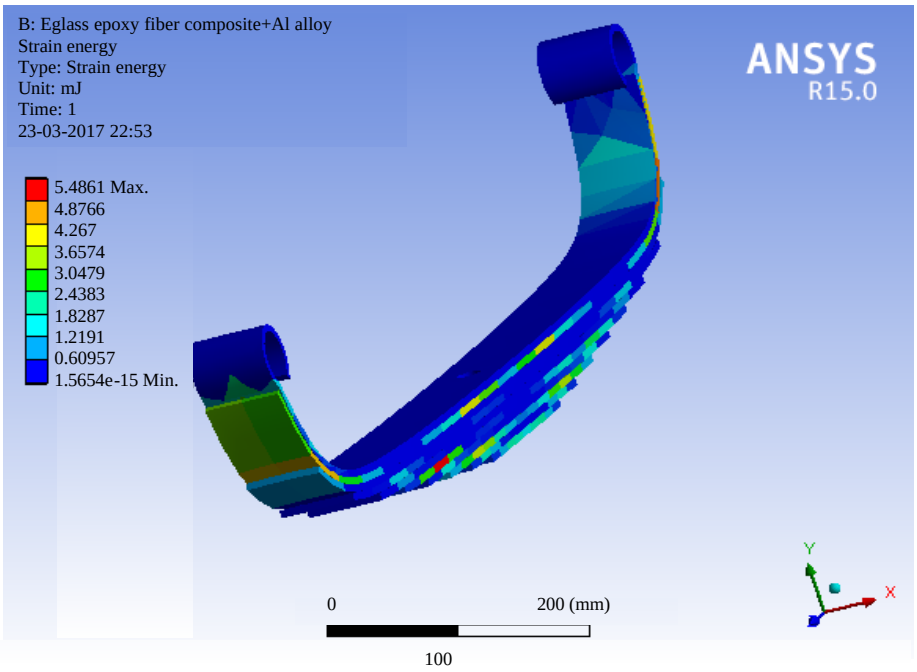

Fig. 3: Total deformations of s-Glass fibbers

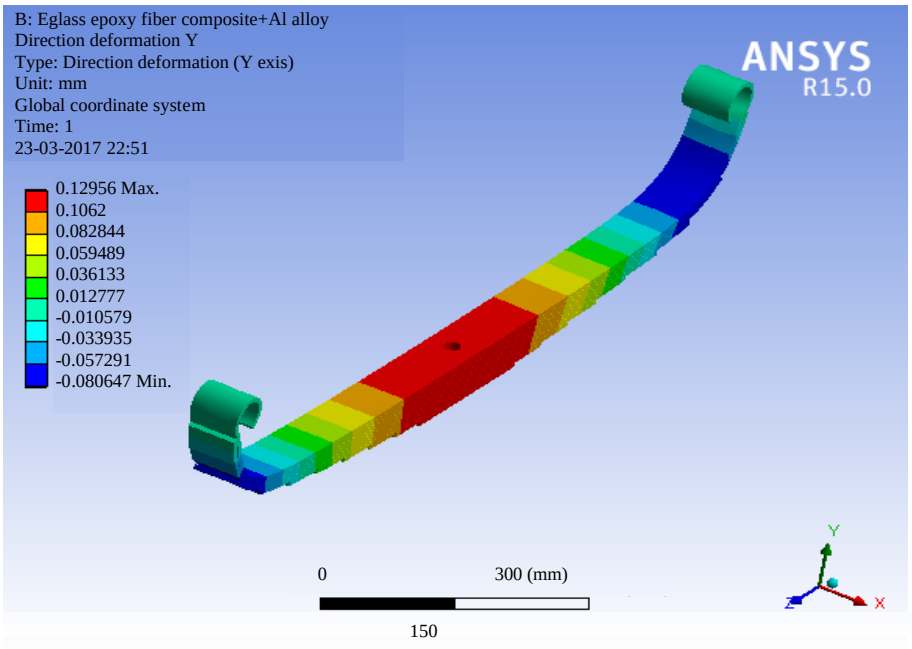

Fig. 4: Total deformations of e-Glass fibres

to the corresponding load which was acted in the bottom face of the leaf spring. The values of the leaf springs deformation are denoted by the various colours blue, red, yellow, green and etc., the blue colour denotes the safe area and the red colour denotes the unsafe area.

e-Glass fiber: The e-Glass fiber result was shown in Fig. 4. It is the total deformation of the leaf spring due to the corresponding load which was acted in the bottom face of the leaf spring. The values of the leaf springs are denoted by the various colours life blue, red, yellow green and etc., the blue colour was denoted the safe area and the red colour denotes the unsafe area.

RESULTS AND DISCUSSION

The results are taken from the ansys workbench software. The total deformation values of the e-Glass fiber and s-Glass fiber are noted in Table 2 and the values are compared with both. By the comparison of the e-Glass fier and s-Glass, the s-Glass fiber has less deformation than the e-Glass fiber. The s-Glass fiber has 15.462 m deformation it is lesser than the e-Glass fiber. So, we prefers the s-Glass fiber for fabricate the leaf spring. The s-Glass fiber was less economic than the steel.

Table 2: Comparison of e-Glass and s-Glass fiber

Materials	Deformation
e-Glass fibers	18.642
s-Glass fibers	15.462

CONCLUSION

As reducing weight and extending nature of things are high research asks for on the planet, composite materials are persuading the chance to be up to the indication of satisfying these demands. In this study lessening weight of vehicles and reducing their additional parts is considered. As leaf spring contributes critical measure of weight to the vehicle and has to be adequately strong, a composite leaf spring is designed. And it is shown that from the result, the arrangement and re-enhancement stresses are much underneath the quality and properties of the material satisfying the best tension qualities.

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