IJFEAT
INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

# Design and Analysis of Mono Composite Leaf Spring for Suspension in Automobile

*Mr.Chetan D. Jambhulkar, Mr. Sandeep K. Survase, Mr. Akash R. Maksane*
Department of Mechanical Engineering
SKN Sinhgad Institute of Technology and Sciences,
Lonavala, Maharashtra, India.
cjambhulkar13@gmail.com

*Prof. Pawan R. Ingole*
Department of Mechanical Engineering
SKN Sinhgad Institute of Technology and Sciences,
Lonavala, Maharashtra, India.
pawaningole5@gmail.com

***Abstract* –Suspension framework is a standout among the most critical frameworks in present day vehicle. It essentially adds to the vehicle accessibility and well being; keeps vehicle inhabitants agreeable; likewise shields the vehicle from harm and wear. In this present work is done on displaying and examination of mono chromatic composite leaf spring to supplant the prior customary steel leaf spring. The work is to decrease the general weight of suspension framework and enhance load using so as to convey limit of the leaf spring the composite material. The outline contemplations for this study are anxiety and redirection. The composite materials utilized for this leaf spring are polymer epoxy as network stage and glass filaments as support stage. The percentage of the glass filaments utilized for this are E-glass epoxy, graphite-epoxy, Kevlar-epoxy. The correlation is made between steel leaf spring of light weight vehicle and composite leaf spring regarding quality and firmness. The static examination is done and contrast and hypothetical qualities with ANSYS. The demonstrating is produced on proe-5 and examination is done on ansys-14.**

**Keywords-Composite materials-leaf spring-displaying static examination correlation, Von Mises stress by utilizing Ansys 14.5, Pro E, CATIA-V5, Material lessening, Cost productive.**

## I. INTRODUCTION

Composite materials are the one of the principle uses of the aviation, vehicles and marine Industries, in view of their less weight great firmness and less destructive properties. Weight decrease is one of the central points of that one. It results in less fuel utilization; manage upkeep of vehicle and ideal use of regular assets. Leaf springs are utilized as a suspension frameworks to retain stun loads. The suspension leaf spring is one of the potential things for weight diminished in vehicles as it records for ten to twenty percent of the unstrung weight. This assists in accomplishing the vehicle with enhance great riding qualities. As we realize that springs, are intended for assimilate and store vitality after it discharges gradually. Thus, the strain vitality of the material turns into a main consideration in planning the springs. The routine steel leaf spring is supplanted with composite material, as a result of their more versatile strain vitality stockpiling limit, great quality to weight proportion, great riding properties and, thickness great modulus of flexibility.

*Leaf Spring:*

Leaf springs are primarily utilized as a part of suspension frameworks to retain stun loads in autos such as light engine vehicles, overwhelming obligation trucks and in rail frameworks. It conveys horizontal burdens, brake torque, driving torque notwithstanding stun engrossing. The upside of leaf spring over helical spring is that the finishes of the spring might be guided along an unequivocal way as it avoids to go about as an auxiliary part notwithstanding vitality retaining gadget. The leaf springs should convey loads, brake torque, driving torque. The leaf springs utilized are single or multi leaf springs arrive. Today leaf springs are still utilized as a part of business vehicles, for example, autos, vans and trucks, and railroad carriages. For substantial vehicles, they have the upside of spreading the heap all the more generally over the vehicle's suspension. The primary significance of leaf spring is to convey knock loads (i.e. because of street inconsistencies), bolsters the case weight, controls pivot damping, controls braking powers, and to give better suspension. Leaf springs are planned in two ways:

1. Multi leaf
2. Mono leaf

The multi-leaf spring is comprised of a few steel plates of various length stacked together, while mono-leaf spring is comprised of single steel plate. Amid ordinary operation, the spring packs to retain street stun. The leaf spring curves and slide on one another permitting suspension development. Leaf springs can serve finding and to some degree damping and in addition springing capacities. The leaf spring ingests the vertical vibrations and effects because of street inconsistencies by method for vibrations in the spring avoidance so that the

potential vitality is put away in spring as strain vitality and after that discharged gradually.

## II. AIM AND SCOPE OF THE WORK

The target of the present work is to outline, investigate and propose a strategy for manufacture of E-Glass/Epoxy mono composite leaf spring for car suspension framework. This is done to accomplish the accompanying. This outline helps in the substitution of routine steel leaf springs with E-glass/Epoxy composite mono-leaf spring with better ride quality. To accomplish significant weight diminishment in the suspension framework by supplanting steel leaf spring with mono composite leaf spring.III.

## III. SPECIFICATIONS OF MONO LEAF SPRING

The mono leaf steel spring specifications as follows-

The chemical composition of the material is 0.565C, 1.8%Si, 0.7%Mn, 0.045%P and 0.045% S. [5]

Table 1 shown various parameters of steel leaf spring

| Sr. No. | Parameter | Value |
|---|---|---|
| 1. | Total length of the spring(Eye to Eye) | 965mm |
| 2. | Free camber (At no load condition) | 68mm |
| 3. | No. of full length leave (Master Leaf) | 01 |
| 4. | Thickness of leaf | 10mm |
| 5. | Width of leaf spring | 50mm |
| 6. | Maximum load given on spring | 794.54 N |
| 7. | Young's Modulus of leaf spring | 2.1e5 N/mm2 |

- *The Analytical Calculations for Steel Leaf Spring:*

The maximum deflection of the mono leaf spring is limited to 34mm, and then the allowable load on the spring is given by

Deflection

$\delta = 12*W*L3 / E*b*t3*(2nG+3nF)$

$34= 12*W*L3 / E*b*t3*(2nG+3nF)$

Weight W=795N

Stress

$\sigma = 6*W*L / n*b*t2$

$= 6*794.5*483 / 1*50*102$

Stress $\sigma$=451.5Mpa.

## IV. COMPOSITE MATERIALS

A composite material is characterized as a material made out of two or more constituents joined on a naturally visible scale by mechanical and concoction bonds. Composite materials are made out of incorporations suspended in a grid. The constituents hold their personalities in the composite. By and large the parts can be physically recognized and there is an interface between them. A percentage of the composite materials offer a mix of quality and modulus that are either practically identical to or superior to any conventional metallic materials which we have prior. In view of their low particular gravities, quality weight proportion and modulus of flexibility, these composite materials are superior to those of metallic materials. The exhaustion quality and weight proportions and weakness harm resistances of composite overlays incredible. For this reasons, fiber composite have risen as a noteworthy class of basic material and are either utilized or being considered as substitutions for metal in numerous weight-basic segments in aviation, car and other industries.[2] Some other normal for some fiber strengthened composites is their high inner damping. Among the other natural components that might bring about debasement in a portion of the mechanical properties of some polymeric lattice composites are lifted temperatures, destructive liquids, and bright beams. In numerous metal framework composites, oxidation of the lattice well as unfavorable synthetic response in the middle of strands and grid are of awesome worry at high temperature applications. [1]

## V. SELECTION OF REINFORCEMENT FIBER

Strands are accessible with broadly varying properties. Audit of the outline and execution necessities typically manage the strands to be utilized.

*A.* Carbon/Graphite strands: Their focal points incorporate high particular quality and modulus, low coefficient of warm development and high weariness quality. Graphite, when utilized alone has low effect resistance. Its downsides incorporate high cost, low effect resistance and high electrical conductivity. [9]

*B.* Glass strands: The principle point of preference of Glass fiber over others is its minimal effort. It has high quality, high compound resistance and great protecting properties. The detriments are low flexible modulus poor bond to polymers, low weakness quality and high thickness, which expand leaf spring weight and size. Additionally split discovery gets to be difficult. [6]

*C.* Kevlar filaments: The favorable circumstances incorporate low thickness, high rigidity, and ease and higher effect resistance. The impediments are low compressive quality, peripheral shear quality and high water ingestion. Kevlar is not suggested for burden conveying application in view of its low quality in pressure and shear. [6]

## VI. SPECIFICATIONS OF COMPOSITE MATERIALS

Table 2 shown various parameters of composites

| Material properties | E-Glass Epoxy | Graphite Epoxy | Kevlar Epoxy |
|---|---|---|---|
| E11 | 34 | 142.6 | 80 |
| E22 | 65.3 | 96.0 | 55 |
| G12 | 24.33 | 6.00 | 2.2 |
| G23 | 16.98 | 3.10 | 1.8 |
| V12 | 0.217 | 0.25 | 0.34 |
| V23 | 0.366 | 0.25 | 4 |

## VII. FINITE ELEMENT ANALYSIS

Limited component auxiliary investigation is a technique for foreseeing the conduct of a genuine structure under determined burden and uprooting conditions. The limited component displaying is speculation of the removal or framework strategy for basic investigation to two and three-

dimensional issues and three - dimensional issues. The fundamental idea of FEM that structure to be broke down is thought to be a gathering of discrete pieces called "components" that are associated together at a limited number of focuses or hubs. The limited component is a geometrically rearranged representation of a little part of the physical structure. Discrediting the structure requires encounter and finish comprehension of the conduct of the structure can carry on like a pillar, truss, plate, and shell. [3]

## VIII. ANALYSIS OF STEEL AND COMPOSITE LEAF SPRING

The examinations are done on steel leaf considering so as springing as cantilever shaft. The cantilever shaft is altered toward one side and load is acting at another end. The investigations of composites are likewise considered as cantilever. The chosen material for composite is SHELL181.This ability of demonstrating laminar composites up to 255 layers. We can adjust the properties of every layer in the Properties Section. The upside of utilizing layered shell components is awesome since an intricate CAD model with filaments need not be developed. We can store the consequences of every layer from the Top, Middle, and Bottom Lamina in SHELL181.Since we have 4 layers. The introduction of e-glass, graphite, Kevlar filaments to grid stage is considered as (0-90°). [4]

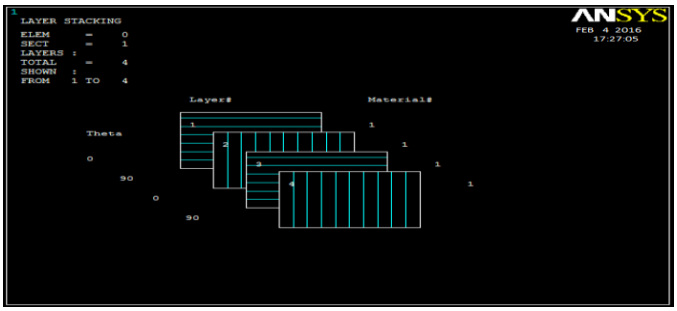


Fig No.1Fibers orientations on composite material

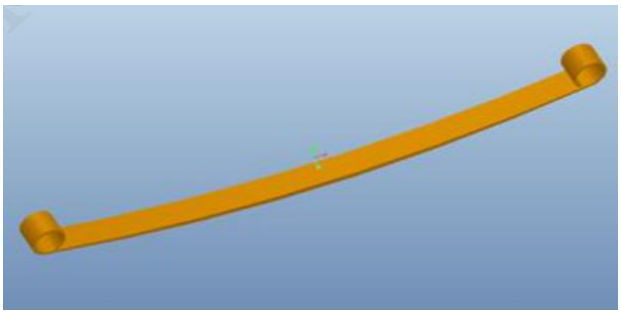

Fig No.2 Leaf spring Pro E model

The results obtained on Ansys:

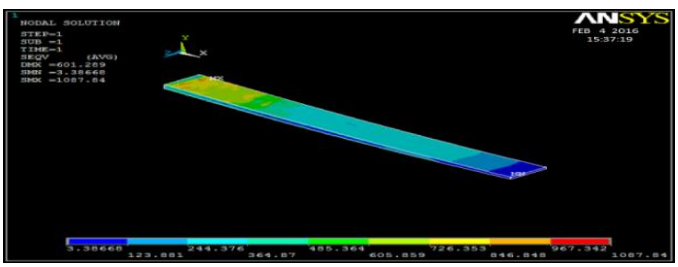


Fig.3 Steel leaf spring vonmises stress

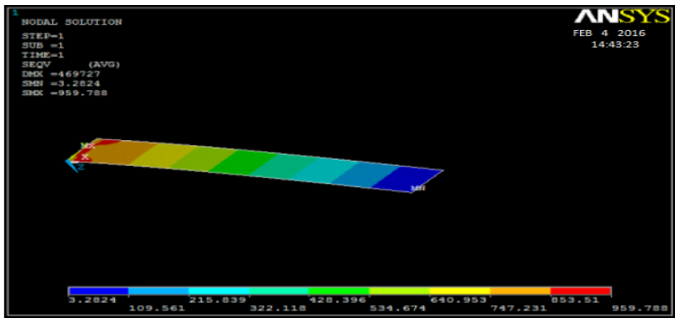


Fig.4 E-glass epoxy vonmises stress

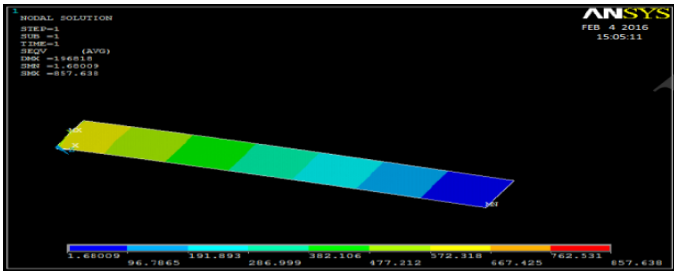


Fig.5 Graphite epoxy vonmises stress

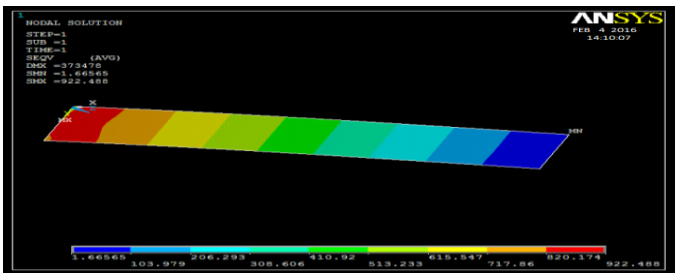


Fig.6 Kevlar epoxy vonmises stress

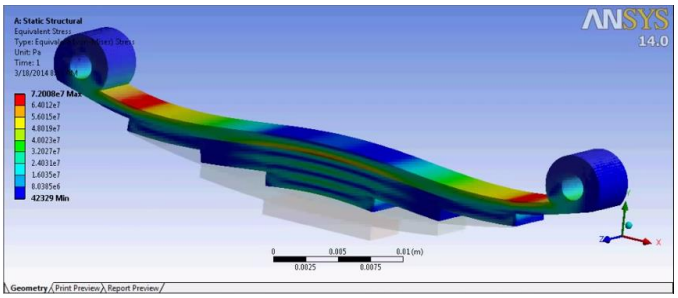


Fig.7 Vonmises stress in Ansys 14.0 (Workbench)

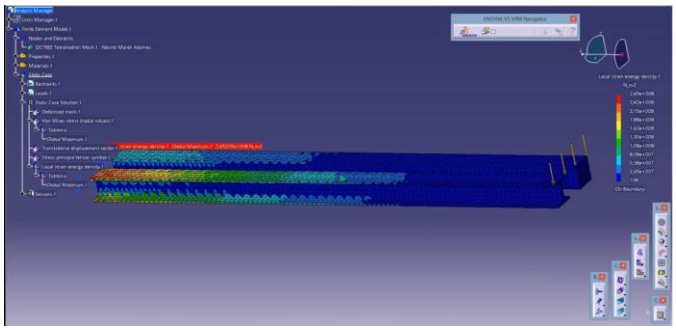

Fig.8 Vonmises stress in Catia V5

The vonmises stress obtained as follows:

| Parameter | Steel | E glass | Graphite epoxy | Kevlar Epoxy |
|---|---|---|---|---|
| Vonmises stress (N/mm2) | 1087 | 959 | 857 | 922 |

## IX. CONCLUSION

- The analytical study has been made between steel and composites.
- It is observe that the graphite epoxy having lower stress value with compare to steel and all other composites.
- By observing results composite leaf spring have good strength to weight ratio, good stiffness.

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