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MODELLING AND ANALYSYS OF COMPOSITE MATERIALS REINFORCEMENT OF LEAF SPRING

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Abstract - Increasing competition and innovation in automobile sector tends to modify the existing products by new and advanced material products. A suspension system of vehicle is also an area where these innovations are carried out regularly. Leaf springs are one of the oldest suspension components that are being still used widely in automobiles. Our aim is to design a Composite Leaf Spring which helps in reduction of weight and better performance than Conventional Steel Leaf springs. Dimensions of the composite leaf spring are to be taken as same dimensions of the conventional leaf spring. The objective is to compare the bending stress, total deflection and percentage of weight saving of different types of composite materials such as Aluminum, Structural Steel, Grey Cast Iron.

Key Words: suspension, compression, aluminium, structural steel, grey cast iron.

1.INTRODUCTION

Leaf springs also referred to as semi-elliptical springs or cart springs are one of the oldest forms of suspension used in vehicles, especially heavy vehicles. A leaf spring looks similar to a bow minus the string. It consists of a stack of curved narrow plates of equal width and varied length clamped together with shorter plates at the center to form a semi-elliptical shape. The center of the arc provides location for the axle, tie holes are provided at either end for attaching to the body

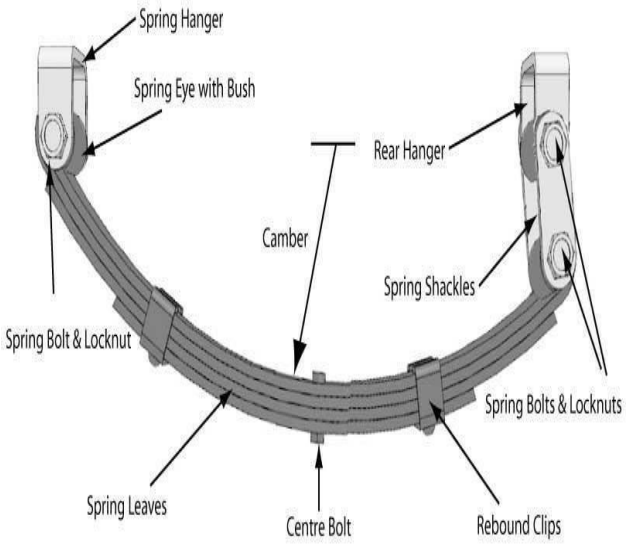
A leaf spring is a simple form of spring commonly used for the suspensionin wheeled vehicles. Originally called a laminated or carriage spring, and sometime referred to as a semi elliptical spring or chart spring, it is one of the oldest forms of springing, dating back to medieval times.

A leaf spring can either be attached directly to the frame at both ends or attached directly at one end, usually the front, with the other end attached through a shackle, a short swinging arm. The shackle takes up the tendency of the leaf springto elongate when compressed and thus makes for softer springiness. Some springs terminated in a concave end, called a spoon end (seldom used now), to carry a swiveling member.

For very heavy vehicles, a leaf spring can be made from several leaves stacked on top of each other in several layers, often with progressively shorter leaves. Leaf springs can serve locating and to some extent damping as well as springing functions.

2. Body of Paper

M. M. Patunkar, et al. Vinkel Arora, et al. [1]in their work has done design and analysis of conventional mono leaf spring standard eye end and casted eye end. CAD modeling was done in CATIA and analysis was done in ANSYS under similarloading conditions for parameters like deformation, von-mises stress, normal stressetc. They have concluded that for similar static load application, when standard eye is replaced with casted eye deflection was increased by 5.4%. von-mises stress wasreduced by 3%. Normal stress was increased by 19.08% and minimum factor of safety reduced by 13.1%. Further they have concluded that CAE tools are economicand less time consuming with result variation in a specified range as compared to experimental testing.

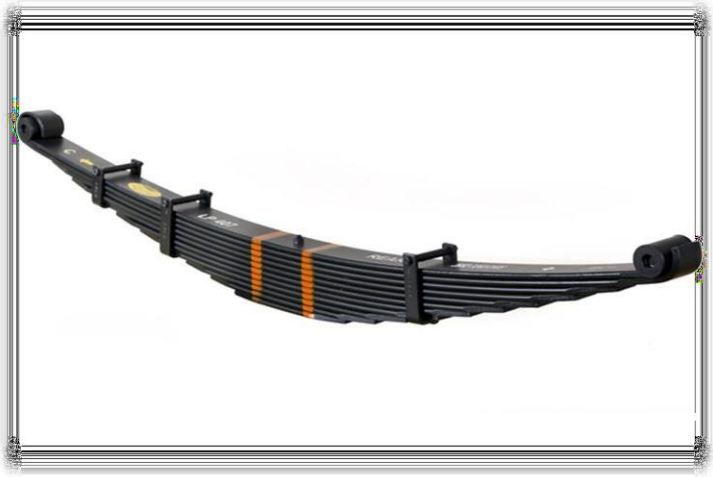


EYE/EYE SPRING COMPONENTS

Kumar Krishan, et al. [2] in their work has done design and finite element analysis of conventional SUP9 steel multi leaf spring including two full length leaves in which one is with eyed ends and seven graduated length leaves. Finite element modeling was carried out in CATIA V5 R17and was imported in ANSYS11 for finite element analysis. Bending stress and deflection observed from the finite element analysis was compared with the experimental results under full and half load application. They have observed 0.632% variation in deflection and 10.11% variation in bending stress under full load application and 0.632% variation in deflection and 17.95% variation in bending stress under half load application which is negligible. They have concluded that CAE tools give batter results with negligible variation and the design was safe from failure under given load conditions.

There were a variety of leaf springs, usually employing the word "elliptical". "Elliptical" or "full elliptical" leaf springs referred to two circular arcs linked at their tips.

This was joined to the frame at the top center of the upper arc; the bottom center was joined to the "live" suspension components, such as a solid front axle.



Additional suspension components, such as trailing arms, would usually be neededfor this design, but not for "semi-elliptical" leaf springs as used in the Hotchkiss drive.

That employed the lower arc, hence its name. "Quarter-elliptic" springs often had the thickest part of the stack of leaves stuck into the rear end of the side pieces of ashort ladder frame, with the free end attached to the differential, as in the Austin Seven of the 1920s.

Parts of leaf spring:

Parts

1) Spring eye with bush
2) Spring bolt &locknut
3) Camber
4) Spring leaves
5) Centre bolt
6) Rear Hanger
7) Spring Bolts and locknuts
8) Eye spring components
9) Rebound clips.

Types of leaf spring

Multi Leaf Springs:

The most common kind of leaf spring for LCVs and HGVs is the multi leaf spring.This type of spring gets its name because it is made of multiple metal plates, placedone on top of the other. These are engineered to take a greater amount of load and stress for a vehicle.

Mono Leaf Springs:

Not designed for heavier vehicles, a mono leaf spring is a single plate of metal, slightly thicker in the middle, thinning out at the ends. This single leaf spri1ng system was once popular but can dangerous if the spring breaks, hence why it is not used on any vehicle requiring protection against a heavy load or the weight of the vehicleitself.

3. CONCLUSIONS

In the present work, a steel leaf spring was replaced by a composite leaf spring due to high strength to weight ratio for the same load carrying capacity and stiffness with same dimension as that of steel leaf spring. But when compare with Grey Cast Iron (GCI) the standard Aluminum Material and Structural steel material is not performing well but when compare with the weight of leaf spring grey cast iron has very high density when compare with the composite material. The stress and deformation values shown below.

The stress and deformation values ;

Material	Stress Mpa	Deformation mm
Grey Cast Iron	146.46	0.72549
Aluminium	145.22	1.1286
Structural Steel	145.97	0.39963

Aluminium material giving very close values to the GCI material and Aluminium is very light weight when compare to GCI. So, Aluminium is the best suitable material for leaf spring.

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