

A REVIEW ON DESIGN AND ANALYSIS OF COMPOSITE LEAF SPRING

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ABSTRACT

Recently, automobile industries have been attracting toward cost saving of a vehicle by weight reduction while maintaining/improving vehicle performance. Small amount of weight reduction in a vehicle can result in saving a lot of tons of fuel. Weight reduction can be achieved by replacing conventional material with the composite materials. Composite material has remarkable material characteristics, including high strength to weight ratio, good corrosion resistance, light weight and high stiffness. The objective of this paper is to present the literature review on suitability of composite materials for leaf spring, by presenting literature review, gap in literature, future scope.

INTRODUCTION

In order to cost saving and increase the performance of weight reduction has been main focus of automobile industries. Reducing weight while increasing or maintaining strength of products is getting to be highly important research issue in this modern world. Composite materials are one of the material families which are attracting researchers and being solutions of such issue. An automobile industry has an interest in replacement of conventional leaf spring with composite leaf spring to get better performance with less weight

A composite is a material made from two or more constituent materials with significantly different properties that, when combined, produce a material with characteristics different from the individual components.

BENEFITS OF COMPOSITES:

In comparison to common materials used today such as metals, composites can give a distinct advantage. The main advantage in the adoption of composites is the lightweight properties. In transportation, less weight equates to more fuel savings and improved performance. Besides weight savings, the most important benefits of composites include:

- Non-corrosive
- Non-conductive
- Flexible, will not dent
- Low maintenance
- Long life
- Design flexibility

Engineering Composites Mechanical Properties

	Ultimate Tensile Strength (MPa)	
	Unfilled	With 30% Glass Fiber
Polyetheretherketone	90	150
PolyphenyleneSulfide	70	140
Epoxy	70	150

LITERATURE REVIEW

A number of researches have been done and published on design and analysis of leaf springs. A review has been presented into two parts a design and analysis and the proposed composite material.

A: DESIGN AND ANALYSIS OF LEAF SPRING:

A number of research paper have been published on composite leaf spring. Brief review of some selected references on this topic is presented:

M.VENKATESAN & D.HELMEN DEVARAJ [1]: in this researcher paper he shows the development of a composite leaf spring having constant cross sectional areas done of conventional steel and composite material. The study demonstrated that composites can be used for leaf springs for light weight vehicles. The 3-D modelling of composite leaf spring is done and analysed using ANSYS. A comparative study has been made between composite and steel leaf spring with respect to weight, cost and strength. From the results, it is seen that the composite E-glass epoxy leaf spring is lighter and more economical than the conventional steel spring with similar design specifications. Composite leaf spring reduces the weight by 85 % for E-Glass/Epoxy, over conventional leaf spring.

RAJAGOPAL D, VARUN S, MANIKANTH M, BYSANI SOMASAI SRIRAM KUMAR [2]: The study shows that composites can be used for leaf springs for light weight vehicles and better performance. The 3-D modeling of composite leaf spring is done and analyzed using ANSYS. A comparative study has been made between composite and steel leaf spring with respect to weight, cost and strength. From the results, it is observed that the composite leaf spring is lighter and more economical than the conventional steel spring with similar design specifications. Composite leaf spring reduces the weight by 85 % for E-Glass/Epoxy, over conventional leaf spring.

PARKHE RAVINDRA, MHASKE RAMAN, BELKAR SANJAY[3]: he published paper on “Modeling and Analysis of Carbon Fiber Epoxy Based Leaf Spring under the Static Load Condition by Using FEA” A comparative study has been made between composite leaf spring and steel leaf spring with respect to weight and strength. By using a composite carbon/epoxy leaf spring for the same load carrying capacity, there is a reduction in weight of 22.5% than the conventional steel spring. Based on the results, it was inferred that carbon/epoxy composite mono leaf spring has superior strength and stiffness and lesser in weight compared to steel material.

SAGAR B MAHAJANI, M.C.SWAMI2, PARMESHWAR PATIL3 [4]: in his research on “Experimental And FEA Analysis Of Composite Leaf Spring By Varying Thickness” he done theoretical as well as experimental analysis with Glass Fiber reinforced composite (E-glass fiber and resin epoxy) Experimental analysis of the leaf spring is done on Universal Testing Machine and comparative study has been made of GFRC by varying thickness. GFRC leaf spring has been successfully fabricated by simple hand lay-up technique. Under static loading condition Deflection and stresses of GFRC are found with great difference with varying thickness.

PATUNKAR AND DOLAS [5]: in their research paper discussed the analysis of composite mono leaf spring made of glass fiber reinforced plastic. Initially conventional leaf spring has been tested for static conditions. Then simulation was done.

VENKATESAN AND DEVRAJAN [5]: in their paper discussed the analysis of the composite leaf spring in light commercial vehicles. The objective of the work was to compare the load carrying capacity, stiffness and the weight reduction. The development of a composite leaf spring having constant cross sectional area, where the stress level at any station in the leaf spring has been considered constant due to the parabolic type of the thickness of the spring, has proved to be very effective. The study demonstrated that composites can be used for leaf springs for light weight vehicles and meet the requirements, together with substantial weight savings. The 3-D modeling of composite leaf spring is done and analyzed using ANSYS. A comparative study has been made between composite and steel leaf spring with respect to weight, cost and strength. From the results, it has been observed that the composite.

leaf spring is lighter and more economical than the conventional steel spring with similar design specifications. Composite leaf spring reduces the weight by 85 % for E-Glass/Epoxy, over conventional leaf spring.

B: COMPOSITE MATERIALS FOR LEAF SPRING [6]-

Table1 shows various composite materials proposed by researchers for leaf spring.

Sr no	Composite Materials	Researcher
1	CFRP) Carbon Fiber Reinforced Plastic	P.Beardmore(1986)
2	S2-glass fiber/Epoxy and E-glass/Epoxy	W.J. Yu. Kim(1988)
3	Glass fiber, Carbon fiber	AndraCorvi(1990)
4	E-glass fibre with two layer of idirectional fabric	ErolSancatar (1999)
5	E-glass/Epoxy	Max. X.Sardou et.al (2000), Senthil (2007),Mahmood Shokrieh (2003), Dara Ashok (2012), Laxinarayana (2012),AsishAmrute(2013), Shishay AmareGebremeskel(2012)
6	E-glass/Epoxy and carbon fiber/Epoxy	H.A.Al. Qureshi(2001)
7	E-glass/Epoxy and Woven roving/Epoxy	G GularSiddaramanna et.al(2006)
8	Woven glass fiber baric	E.Mahdi et.al (2006); Abdul Rahim (2010)
9	20% glass fiber reinforced polypropylene	C.Subhramian ,et.al (2011)
10	Glass/Epoxy,Graphite/Epoxy,arbon/Epoxy, Kelvar/ Epoxy,Boron /Aluminum	B.Ragu Kumar et.al (2013)
11	E-Glass/Epoxy,C-Glass/Epoxy, S-Glass/Epoxy	B.Vijaya Lakshmi I. Satyanarayana(2012)
12	Carbon/epoxy	ParkheRavindra and Sanjay Belkar (2014)
13	Bidirectional carbon-glass reinforced plastic(C-GFRP) and bidirectional glass carbon reinforced plastic (G-CFRP	S.Rajesh I and G..B.Bhaskare (2014)
14	C-glass/epoxy composite leaf spring	Mhaske Raman, Nimbalkar et.al (2014)

CONCLUSION

Reducing weight and increasing strength of products are high research demands in the automobile industries. Composite materials are getting to be up to the mark of satisfying these demands. Leaf spring is design by considering it as cantilever beam .Ansys software used by researcher as it gives good results. Hand lay-up manufacturing method are used which is economical and most suitable method. In almost all paper it is concluded that composite with the E-glass / epoxy leaf spring are lighter, high strength, more economical than conventional leaf spring.

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