International Journal Of

Recent Scientific Research

ISSN: 0976-3031

Volume: 7(1) January -2016

FABRICATION AND STATIC ANALYSIS OF MONO COMPOSITE LEAF SPRING

Khalate R.N and Kale P.D

THE OFFICIAL PUBLICATION OF
INTERNATIONAL JOURNAL OF RECENT SCIENTIFIC RESEARCH (IJRSR)
http://www.recentscientific.com/ recentscientific@gmail.com

Available Online at http://www.recentscientific.com

ISSN: 0976-3031

International Journal of Recent Scientific Research
Vol. 7, Issue, 1, pp. 8198-8201, January, 2016

International Journal of Recent Scientific Research

RESEARCH ARTICLE

FABRICATION AND STATIC ANALYSIS OF MONO COMPOSITE LEAF SPRING

Khalate R.N and Kale P.D

[1]Department of Mechanical Engineering Baramati, India
[2]Vidya Pratishthan's College of Engineering Vidya Pratishthan's College of Engineering Baramati, India

ARTICLE INFO

Article History:

Received 16th October, 2015
Received in revised form 24th November, 2015
Accepted 23rd December, 2015
Published online
28st January, 2016

Key words:

E-glass fiber, conventional leaf spring, composite leaf spring.

ABSTRACT

The Automobile sector which is best in its class as per their suspension systems.The automobile industry has shown increased interest in the replacement of steel spring withE-glass/epoxy composite leaf spring due to its high strength to weight ratio. Therefore the aim of this work is to present a low cost fabrication of complete mono composite leaf spring. The dimensions of an existing conventional steel leaf spring of a light commercial vehicle are taken directly which we going to use as a basis for the fabrication of composite leaf spring. Experimental investigation performed on composite, which reveals the sound results between load and deformation as well as load and stresses also. Static analysis has been performed by using FEA software, discloses the good agreement between FEA and experimental results. Compare to mono steel leaf spring the composite mono leaf spring is found to have weight reduction of 66.87 % as well as 25% higher stiffness. It also shows lower value of stresses.

INTRODUCTION

The Automobile sector which is best in its class as per their suspension systems. suspension isolates the chassis or vehicle bodies from undesired shocks resulting due to road irregularities. Shocks due to such irregularities from road lead to excessive stresses upon the automobile parts. These parts later more sensitive's to reduce their operating life. All parts of automobile ensures the safety of occupant from undesired things such parts collectively called as suspension system.

Therefore leaf spring is a element which act as a intervention, in order to safety measure to occupants from shocks. It is more often that, vehicle vibrations pointed from road to occupant that has to be quickly absorbed by leaf spring and those stored in the form of strain energy though its deflection. Ability to store the energy make this spring more compliant. Leaf spring is highly responsible to carry, lateral load, Brake load, brake torque in addition to shock absorbing. [1, 2]

The suspension leaf spring is the one of the potential items for weight reduction in automobile as it accounts for 10% to 20% of the unsprung weight. A little consideration as per the theory is nothing but density and young's modulus of material is inversely proportional to the strain energy in the spring. To act as a solid support to strain energy, attention has been provided to make existing steel leaf spring lighter by alternative material. Finally composite material has been used to fabricate the leaf spring.

Material used for this is, E-glass Fiber Reinforced Polymer. Some properties of composite suggest the suitability of material those properties are, higher strength to weight ratio, higher natural frequency, superior fatigue strength. Major fact that is with composite is fatigue failure is the predominant mode of in service failure of many automobile components especially the leaf spring in automobile.

It is always been a tough task of fabrication of a composite leaf spring. Instead complicated methods to fabricate the leaf spring, hand layup method which is quite easy has been executed for the fabrication of composite leaf spring. Static testing has been carried out over the steel leaf spring and composite leaf spring by use of Universal Testing Machine. Experimental results shows good agreement with the FEA. results are in concern with the stresses and deflections. The introduction of composite materials has made it possible to reduce the weight of the leaf spring without any reduction in load carrying capacity and stiffness.

Corresponding author:* **Khalate R.N
[1]Department of Mechanical Engineering Baramati, India

LITERATURE REVIEW

Static testing on composite leaf spring reveals that, deflection obtained for composite spring is least as compare to conventional spring for same static load. This suggest that load carrying capacity of the composite without any reduction in stiffness. FEA results gives less figures for stresses in composite as compares to stresses values inside the conventional leaf spring. Current work also able to give good agreement with the literature. Conventional leaf spring used for the suspension is made from steel material. Many automobile manufacturer and part maker provide their attention towards the weight reduction, this can be achieved by introduction of composite material such as glass fiber reinforced polymer (GFRP).

The Composite is the term used for "matrix", material that is reinforced with the fibers. That is why fiber reinforced polymer indicating a thermosetting polyester matrix containing glass fibers. Many composites used today are at the leading edge of materials technology, with performance and costs appropriate to ultra demanding applications such as spacecraft. But heterogeneous materials combining the best aspects of dissimilar constituents have been used by nature for millions of years. The fibers may be oriented randomly within the material, but it is also possible to arrange for them to be oriented preferentially in the direction expected to have the highest stresses [3]. Compared to steel spring, the composite leaf spring is found to have 67.35 % lesser stress, 64.95 % higher stiffness [1]. Along with literature on static, fatigue strength is strongly influenced by the layer design. 0° laminates results have values 1.5-1.8 times higher than +45°/0°/-45° and +30°/-30°/0° laminates which exhibits similar fatigue strengths [6].

Fabrication of Composite Leaf Spring

Hand Layup Method

Cutting of Fibers

In current work, the fiber material as E-Glass. This fiber is available in sheet form in thickness of 0.5 mm. This fiber sheet is cut by metal scissor at a width of 50 mm.

Fig.1 E glass / Epoxy Sheet of 0.5 mm thickness

Preparation of matrix (Epoxy)

In preparation of matrix we used two solutions named resin and hardener. The resin is liquid diglycidyle ether of Bisphenol A type (Araldite). The hardener used is Triethylene Tetra Amine (TETA). The material is selected as per guidance of material expert.

Fig. 2 Preparation of matrix (resin & hardener)

Fabrication

First take the steel leaf spring, on which keep Plastic Bagging first as per the dimensions available. The bagging is required to leak proof fabrication or the resin should not be in contact with the steel leaf spring. Resin is sticky in nature and hence the contact to steel leaf spring should be avoided.

Now, keep first sheet of fiber on steel leaf spring, apply the matrix over the first fiber sheet. Apply matrix such that all air should be removed. Now, keep second lamina over the applied matrix and again apply matrix as discussed above. Continue this process till the last fiber sheet. After completion of 20 layers keep above it again with Plastic Bagging. After applying matrix keep this arrangement to dry at least for 24 hrs. The curing time of this matrix is 24 hrs.

Fig. 3 Fabrication of composite leaf spring

Final Model of Fabricated composite leaf spring

Fig. 4 Fabricated composite leaf spring

Technical Specification

Various types of cross sections are generally considered for the fabrication of mono composite leaf spring. Current work undertakes constant thickness, constant width design in order to ensure the ease of fabrication work. The dimensions of the composite leaf spring are taken as that of the conventional leaf spring tabulated as follows

Table 1 Dimensions Of Existing Leaf Spring.

Sr No	Parameter's	Values
1	Total Length of the spring	970 mm
2	Camber height	123 mm
3	No. of full length leave	01
4	Thickness of leaf	10 mm
5	Width of leaf	50 mm
6	Load	1200 N

Experimentation

Experimental work has been performed over the composite leaf spring as well as conventional leaf spring. The values of load applied taken from 100 N till 2050N. This test is experimentally accomplished by electro hydraulic test rig which gives the sound results between the load and deflection. Results are well tabulated and graph shows the behavior of the composite leaf spring. Experimentation reveals that composite leaf spring having higher value of stiffness as well as stresses are reduced in greater extent. weight reduction is the key aspect of current work.

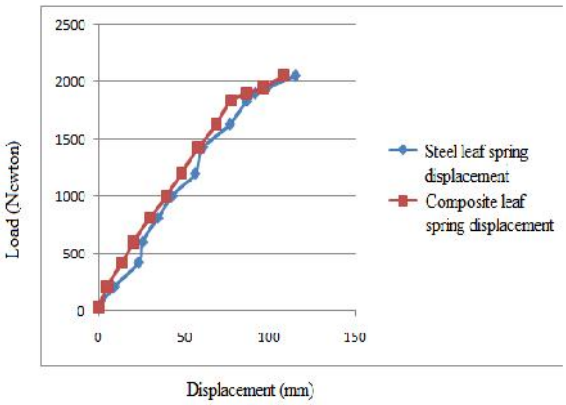

Fig. 5 Load Vs Deflection

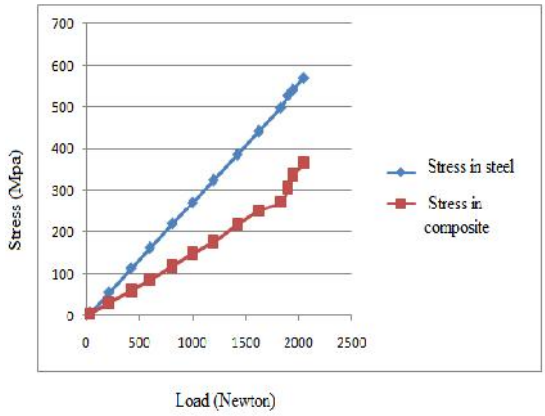

Fig. 6 Stress Vs Load curve

Finite Element Analysis

FEA analysis of mono composite leaf spring is done by using ANSYS 13.0. Dimensions of composite leaf spring taken as that of conventional leaf spring. Loading conditions assumed to be static. value of load taken for the static analysis obtained from the theoretical calculations is 1200 N. From the analysis the equivalent stress (Von-mises stress) and displacements were determined and are shown below. Following figures shows that, the value of stress and deflection is comparatively lower in case of composite leaf spring.

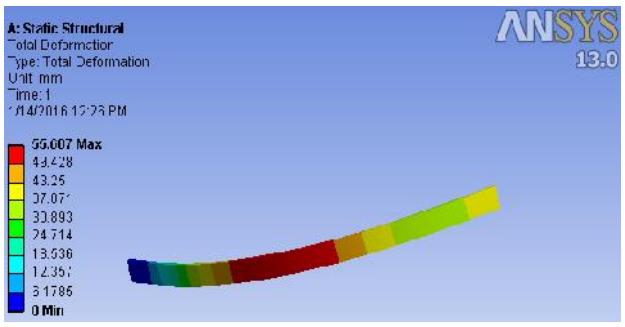

Fig. 7 Displacement pattern for steel leaf spring.

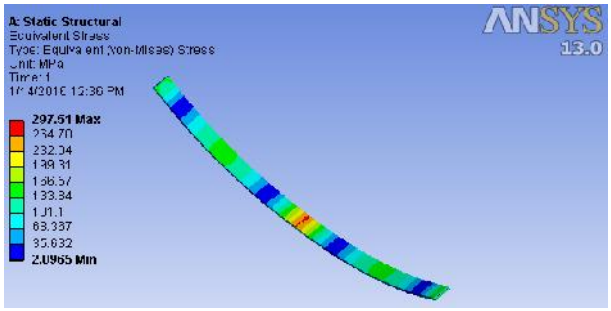

Fig. 8 Stress distribution for steel leaf spring.

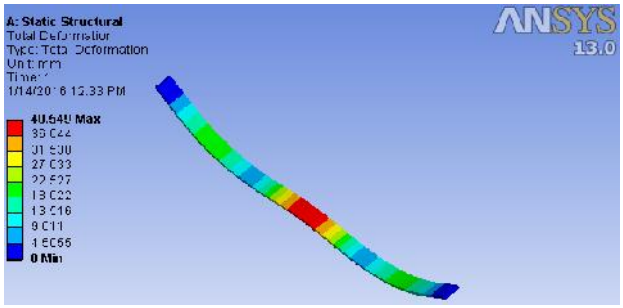

Fig. 9 Displacement pattern for E-glass / epoxy composite leaf spring.

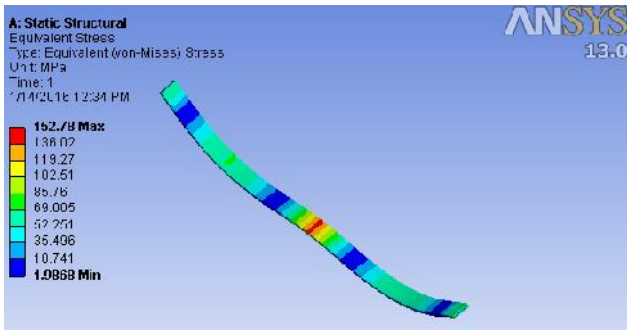

Fig. 10 Stress distribution for E-glass / epoxy composite leaf spring.

Table 2 Comparative Analysis between Steel and Composite Leaf Spring.

Sr No	Parameter's	Steel spring *(Exp)*	Composite leaf spring	
			Exp.	*FEA*
1	Weight (Kg)	4.7	1.51	-
2	Displacement (mm)	60	47	40
3	Stress (MPa)	366	167	152

CONCLUSION

A verdict mentioned in above table by comparative study indicates that, in case of composite leaf spring, for the same

load carrying capacity, there is reduction in weight by 66.87 %. Similarly composite spring shows less displacement which in turns its stiffness is 25% higher than steel leaf spring. At a glance, value of stress in composite is lower than steel.

Methodology used to fabricate the composite spring shows its easiness as well as its cost effectiveness. Composite spring is in light weight.

References

1. Mouleeswaran. S. Kumar, *et al*, "Analytical and Experimental Studies on Fatigue Life Prediction of Steel and Composite Multi Leaf Spring for Light Passenger Vehicles Using Life Data Analysis", Material Science, 2007,13, pp 141-146.
2. Ravi Kumar V, R. Lalitha Narayana and Ch. Srinivas, "Analysis of Natural Fiber Composite Leaf Spring",*Journal of Latest Trends in Engineering and Technology*, 2013, 3, pp 182-191.
3. Ahmed Naif Al-Khazraji, Ali Yasser Hassan, and Emad Abdul Hussein Abdul Sahib**,"**Mechanical Behavior of Polyester and Fiber Glass as a Composite Material Used in a Vehicle Under Dynamic Loading", *Tikrit Journal of Engineering Sciences*, 2014, 21(1), pp 19-28.
4. S. Rajesh S. Nakkeran and G. B. Bhaskar, "A Survey of GFRP Composite Leaf Spring", *International Journal of Engineering & Technology*, 2014, 3, pp 185-193.
5. Pankaj Saini, Ashish Goel and Dushyant Kumar, "Design and Analysis of Composite Leaf Spring for Light Vehicles", *International Journal of Innovative Research in Science, Engineering and Technology*", 2013, 2 , pp 1-9.
6. Amol Bhanage , K. Padmanabhan, "Design For Fatigue And Simulation Of Glass Fiber Epoxy Composite Automobile Leaf Spring", *ARPN Journal Of Engineering And Applied Science*, 2014,9, pp 196-203.
7. M. Raghavedra, *et al*, **"**Modeling and Analysis of Laminated Composite Leaf Spring Under The Static Load Condition By Using FEA", *International Journal of Modern Engineering Research*, 2012, 4, pp 1875-1879.
8. S. S. Chavan, R. Anandkumar A. Satpute, "Mono Composite Leaf Spring Design and Testing", *Indian Journal Of Applied Research*, 2013, 3, pp 282-284.
9. M.venkatesan, Dhelmen devaraj, "Design and Analysis of Composite Leaf Spring in Light Vehicle", *International Journal of Modern Engineering Research*, 2012, 2, pp 213-218.

****

How to cite this article:

Khalate R.N and Kale P.D.2015, Fabrication and Static Analysis of Mono Composite Leaf Spring. *Int J Recent Sci Res.* 7(1), pp. 8198-8201.

TSSN 0976-3031