"A REVIEW ON CAD MODELLING AND ANALYSIS OF LEAF SPRING"

[1]MR. ASHISH PANCHWATE
G. H. Raisoni Amravati University, Department of Mechanical Engineering (CAD/CAM), Anjangaon Bari Road, Amravati, India
panchwateashish@gmail.com

[2]PROF. AMOL BHELKAR
G. H. Raisoni Amravati University, Department of Mechanical Engineering (CAD/CAM), Anjangaon Bari Road, Amravati, India
amol.bhelkar@raisoni.net

ABSTRACT: *Automobile industries are using mostly a composite material for making of leaf spring instead of conventional materials since composite material have high strength to weight ratio, and corrosion resistance and high strain energy storing capacity. For coming the problems occur in the vehicles which should have low cost but better fuel efficiency reduce weight and comfort rid. For that research has been done for improving the performance of leaf spring. Lot of materials are used for leaf spring, but it is found that fiberglass material has better strength characteristic and lighter in weight as compare to steel for leaf spring. In this paper the author is reviewed few papers on use of alternate materials and effect of material on leaf spring performance.*

Keywords: steel leaf spring, CAD modeling (CREO OR CATIA, ANSYS) software.

1. INTRODUCTION

In Automobile industries due to new innovations and competitions tends to modify the old parts with new advanced materials. In order to conserve economy and natural resources weight reduction is one of the important research issues today. Advanced composite material and design optimization is require to increase fuel efficiency and weight reduction new manufacturing technique,. A composite material is combination of fiber such as carbon, Kevlar, graphite or e-glass in matrix when they combined they shows excellent mechanical properties rather than individual .application of composites are marine engineering, space crafts, aircrafts etc. Leaf spring is one of the types of suspension system which absorbs shock and vibrations in automobile. It is one of the weight reduction parts which contribute for 10-20%of un-sprung weight. composite leaf spring help reduce weight and improving smooth ride comfort and fuel efficiency without losses load carrying capacity and stiffness.

Leaf spring is classified as:

- Elliptic
- Three quarter elliptic
- Semi elliptic
- Quarter elliptic

Leaf spring is elastic spring body used as a type of suspension system in automobile .on application of load it get expanded and regain its original shape and size .Therefore initial curvature is provided so that they get straighten under the load .The leaves are held together with the help of center bolt. The uppermost leaf is the main or master leaf and has an eye at the ends for supports. One part is connected with axle and other with shackle with the help of bush using antifriction material like bronze or rubber. Rubber is more preferred due to noncorrosive property. The number of leaves is provided to master leaf in the number of trimmed form called as graduated leaves .the master leaf has to withstand vertical load and the load due to sideway and twisting .rebound clip are provided at intermediate position so that graduated leaves will share the stress which on coming on the master leaf**.**

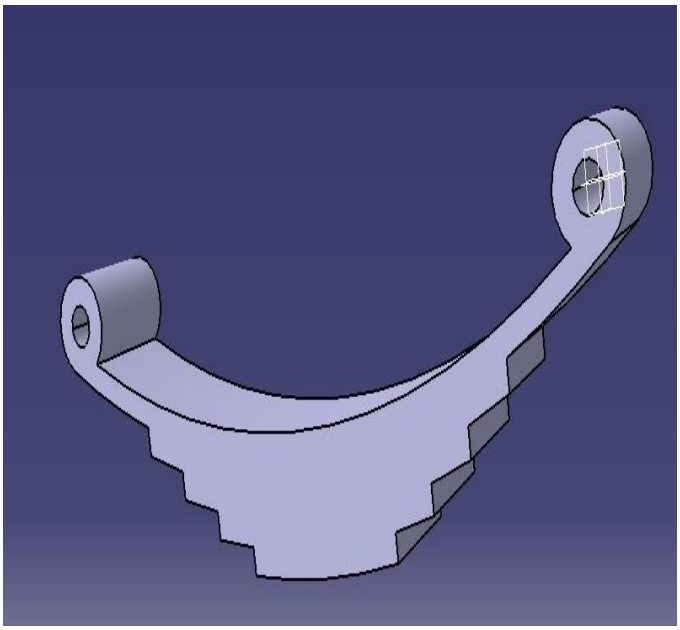

Figure 1: CAD Model of leaf spring

2. LITERATURE REVIEW

Lau KJ et al. [1] found that multi leaf spring having two full length leaves in which one is with eyed ends and remaining

seven graduated length leaves. Such multiple leaves for leaf used by a loading vehicle. The material of the leaf spring is E-glass. Bending stress and deflection are the target results. A comparison of both i.e. experimental and FEA results have been conducted. When the leaf spring was fully loaded, the variation in the defection was 0.632 % in experimental and FEM results.

R. Zemann et al. [2] They discussed the analysis and the modification of the leaf spring used in tractor trailer using FEA. The theoretical calculations were used for finding out the correct dimensions of the multi leaf spring for given loading conditions. The stress distribution was observed in FEA for the same spring modeled. It has been found that if number of leaf springs were reduced from 20 to 13 in this case there is not much difference in the stress distribution and also the design is safe. This can be achieving by weight reduction approximately by 6 Kg and cost reduction by 20%.

Kumar Krishan et al. [3] studied The FEA results compare with the existing experimental solutions optimization of the composite leaf spring. Then shape and the weight optimization were carried out. It has been observed that E-glass saves the 80% of the weight.

Venkatesan and Devrajan et al. [4] In their paper they discussed the analysis of the composite leaf spring in vehicle. The objective of the work was to compare the load carrying capacity, stiffness and the weight reduction. The study shown that leaf spring can be made using composites material for light weight vehicles which in turn reduce the weight and meet the requirements, together with substantial weight savings. This ie achieved with 3-D modelling and analysis cho using ANSYS (software) for the composite leaf spring. Finally in this study comparison has been made weight, cost and strength between steel leaf soring and composite leaf spring. From comparative the results, it has been found that the composite leaf spring is lighter and better than the conventional steel spring with similar design specifications.

3. OBJECTIVE

- To prevent the road shocks from being transmitted to the vehicle components.
- To safeguard the occupants from road shocks
- To preserve the stability of the vehicle in pitting or rolling, while in motion
- To design and static Analysis of steel leaf spring and Composite leaf spring.

4. METHODOLOGY

The process of work and comparison between composite and steel is carried out. Weight reduction .stress, deflection strain energy, modulus of elasticity such parameters are calculated through the theoretical calculation and compare using software through modelling and analysis.

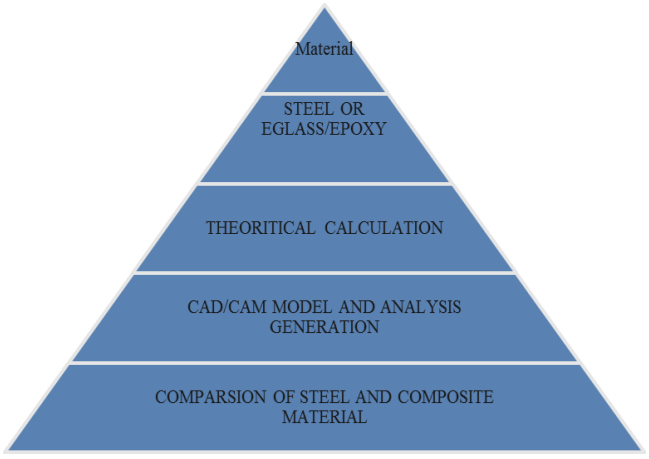

Figure 2: Pyramid diagram of Methodology

5. CALCULATIONS

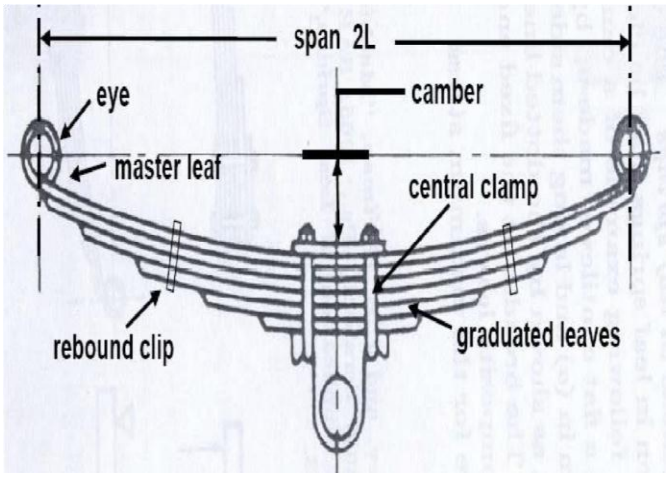

Figure 3: Schematic of Laminated semi-elliptic leaf spring

Theoretical calculation are performed by keeping the value of stiffness constant and verifying by

W – Weight of leaf spring
2L – Span length of leaf spring
F – Maximum load on the spring
b – Width of all leaves
t – Thickness of the spring
n – Number of springs
E – Young's modulus of the material
C – Camber length

Length of Leaf $= \frac{Effective\ Length}{n-1} + Ineffective\ lengt$

Number of leaf springs = Overall length of the spring = $2L_1$

Maximum bending stress of leaf spring $\sigma b = \frac{6FL}{nbt^2}$

Total deflection of leaf spring$\delta mxa = \frac{6FL^3}{Enbt^3}$

6. SCOPE OF FUTURE WORK

This study will help in comparison between leaf spring for finding out the result on deflection, weight and frequencies, displacement with help of ANSYS software. Further work can be done for finding bending stress and deformation in steel leaf spring performance.

7. CONCLUSION

From the literature review it is seen that the objective was to obtain a spring with minimum weight that is capable of carrying given static external forces by constraints, limiting stresses and displacements. For that the steel leaf spring is replaced by composite leaf spring. Composite leaf spring is better than steel leaf spring. Because of result has showed that

1) It's superior.
2) Have more flexible strain.
3) High quality to weight ratio that the reason composite leaf spring is more successful in trade then that of current leaf spring

8. ACKNOWLEDGEMENT

I take this opportunity to thanks Prof. Amol Bhelkar (guide) for his valuable guidance and for providing all the necessary facilities, which were indispensable in completion of this work. I am also thankful to Prof. Yogesh Deshmukh (HOD) to give us presentation facility. I am also thankful to all staff member of the mechanical Engineering Department. I would also like to thank the college for providing required journals, books and access to the internet for collecting information related to the project. Finally I am also thankful to my friends and well-wishers for their valuable comments and suggestions.

9. REFERENCE

[1] Tse PC, Reid SR, Lau KJ, Wong WH. Large deflections of composite circular springs with extended flat contact surfaces. Compos struct 2004; 63:253–603.

[2] R. Zemann, F. Bleicher, Helical Composite Springs, Proceedings of the 29th Danubia-Adria Symposium, Belgrad, 2012, p 10 - 11.

[3] Kumar Krishan, Aggarwal M.L, "Computer aided FEA comparison of mono steel and mono GRP leaf spring", International Journal of Advanced Engineering Research and Studies, Vol. I, Issue II, 2012, pp 155-158.

[4] M. Venkateshan, D. Helmen Devraj, Design and analysis of leaf spring in light vehicles, IJMER 22496645 Vol.2, Issue.1, pp.213-218, Jan-Feb 2012.

[5] Prof. N.V. Hargudee, Mr. J.G. Herekar and Prof. P.P. Awate. Analysis of Composite Mono Leaf Spring, International Journal of Advanced Research in Engineering and Technology, 5(5), 2014, pp. 09-1

[6] T. N. V. Ashok Kumar, E. Venkateswara Rao, S. V. Gopal Krishna, Design and Material Optimization of Heavy Vehicle Leaf Spring, International Journal of Research in Mechanical Engineering & Technology, 4(1), 80-88.

[7] K.A. SaiAnuraag and BitraguntaVenkataSivaram, Comparison of Static, Dynamic & Shock Analysis for Two & Five Layered Composite Leaf Spring, Journal of Engineering Research and Applications, 2(5), 692-697.

[8] E. Mahdi a, O.M.S. Alkoles a, A.M.S. Hamouda b, B.B. Sahari b, R. Yonus c, G. Goudah, Light composite elliptic springs for vehicle suspension, Composite Structures, 75, 24–28.

[9] Y. N. V. Santhosh Kumar, M. VimalTeja, Design and Analysis of Composite Leaf Spring, International Journal of Mechanical and Industrial Engineering (IJMIE), Vol-2, Issue-1, 2012.

[10] Pankaj Saini, Ashish Goel, Dushyant Kumar, Design and analysis of composite leaf spring for light vehicles, International Journal of Innovative Research in Science, Engineering and Technology 2(5), May 2013.

[11] Manas Patnaik, Narendra Yadav, Ritesh Dewangan, Study of a Parabolic Leaf Spring by Finite Element Method & Design of Experiments, International Journal of Modern Engineering Research, 2(4), 19201922 .

[12] S. Arun Kumar," Design and Analysis of Leaf Spring Using Composite Materials," International Journal for Research in Applied Science & Engineering Technology (IJRASET), Volume 4, Issue V, May 2016.