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Static analysis on mono composite leaf spring for Maruti 800 light vehicles

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In this paper design and analysis of composite leaf spring made of glassfiber reinforced polymer (GFRP) and sisal fiber reinforced polymer (SFRP). In addition, to compare the load carrying capacity, stiffness and weight savings of composite leaf spring with that of steel leaf spring. The dimensions of conventional steel leaf spring are used to fabricate a composite mono leaf spring using GFRP unidirectional laminates. Static analysis of 2-D model of conventional leaf spring is also performed using Finite Element Analysis (FEA) and compared with experimental results. and the analytical results are compared with experimental results from the analysis it is observed that Sisal fiber /Epoxy mono composite leaf spring showing best results as compared to the other materials.

Key words: Glassfiber reinforced polymer and sisal fiber reinforced polymer.

1. Introduction

A mono leaf spring consists of various lengths with a numerous steel plates arranged together. Also, during working condition of the the mono leaf spring is to carry the both static and dynamic loads. M.Raghavendra et al [1] investigated analysis of mono leaf spring made of GFRP, and CFRP can be enhanced the strength and stiffness R.Kumar et al [2] studied an replacement of steel leaf spring by natural fiber to reduction of weight can be improvement of more absorption of elastic strain energy. D. H.Deva raj et al [3] studied modified of stacking layers of made of GFRP leaf spring composites can be improved the more resistance to the applied load. S.K M.Eswaran et al [4] modeled and FEA of GFRP polymer multi-spring subjected to static and dynamic loading conditions. G.S.Ramanna et al [5] studied modeled and FEA of mono leaf spring made by with bonded end connections gives an optimization of mono leaf spring. Patunkar et al [6] studied about comparison between modeled and FEA of conventional spring / a mono spring dynamic mechanical loading conditions only. Karlus et al [7] carried the optimal design parameters such as suspension, length and width to optimization of mono leaf- spring for the various design stress factors. P.Ravindra et al [8] investigated FEA CFRP epoxy based single spring to decrease the load and enhanced stress values. B.R. Kumar et al [9] mechanical dynamic loading FEA of spring with various combinations of composite constituents to compare with conventional and its reduce the low load to strength values. D.Pande et al [10] investigated comparison between GFRP/JFRP composites filled with various wt% of jawbone and coconut powder. S Mehul et al [11] studied about replacing steel and substitute the composite type spring, can be enhanced a strength/weight ratio, and good corrosion resistance. A.C. Baviskar.et al [12] modeled, vibration/ fatigue FEA analysis of leaf spring characteristics to withstand the various stress cycles. P.Moulali et al [13] analysis of fatigue characteristics of leaf spring can be showed that weight decrease and it can with stand the various cyclic loads.

2. Objectives of the work

The main highlighted points are presented below.

- Fabrication of composite mono leaf spring by wet lay-up method process.
- To develop a three dimensional model of a mono leaf steel spring as well as GFRP/SFRP types leaf spring.
- To study the behaviour of mono steel leaf spring under predefined static- load condition.

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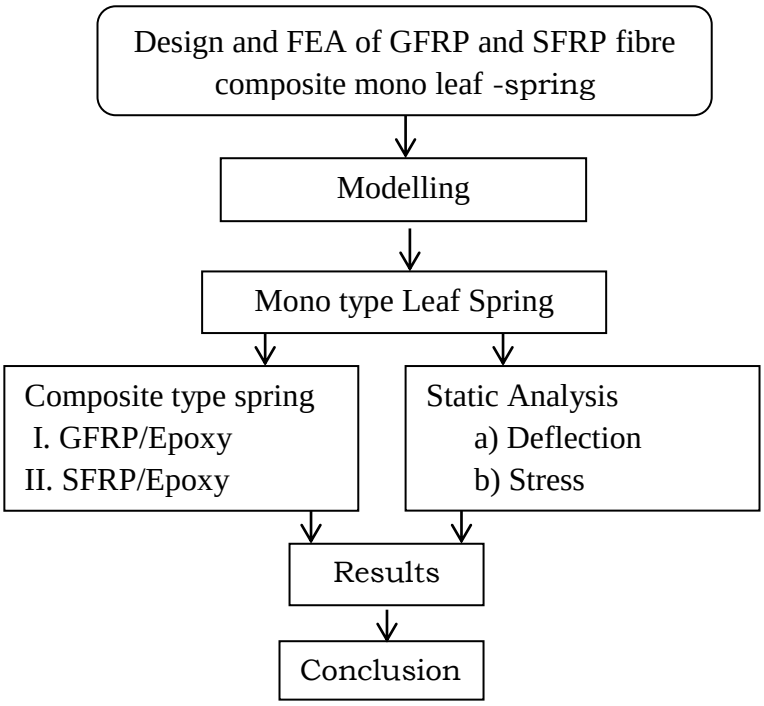
- To study the performance analysis (i.e. determination of deflections and stresses) of mono leaf spring made of two different composite materials via, GFRP and SFRP composites.

2.1 Scheme of Investigation



3. Modelling of Steel/GFRP/SFRP mono leaf spring

Modelling a conventional Steel/GFRP/SFRP leaf spring is modelled in CATIA by taking dimensions (leaf spring) of Maruti 800 passenger cars. In this case only half part of spring is considered about neutral axis. A modeled and static/dynamic loads are applied at the end of the modeled spring in downward direction is shown in the Fig. 3.1.

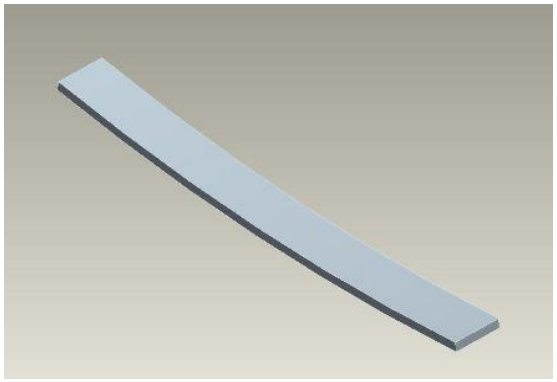


Fig. 3.1 Solid model of conventional type (steel) leaf spring

Similarly modelling of mono laminated types of (GFRP/SFRP) springs is done using CATIA modeled software, by considering the same dimensions as that of steel leaf spring. The composite leaf spring models of three different leaf springs (viz., GFRP,SFRP) are shown from Fig. 3.2 to 3.3.

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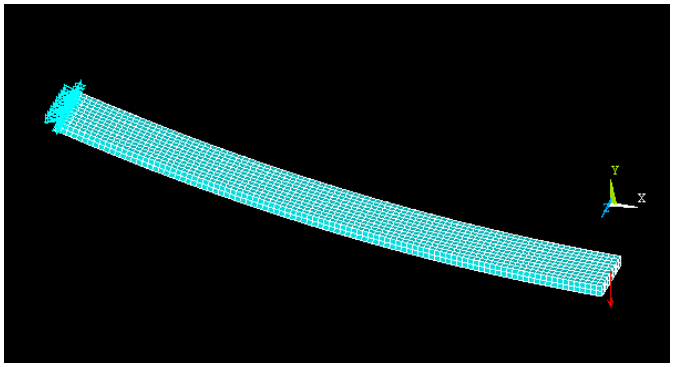

Fig.3.2 Model of E-Glass / Epoxy composite Leaf spring.

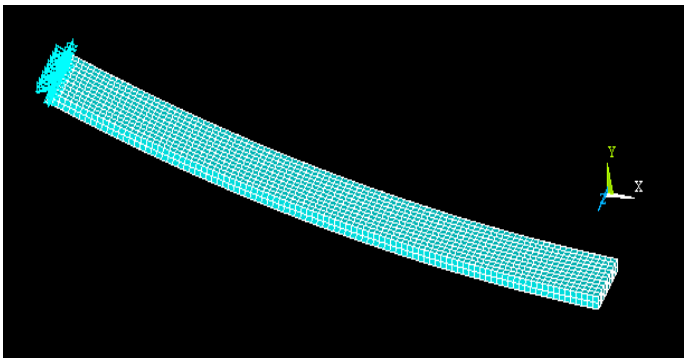

Fig.3.3 Model of Sisal fiber / Epoxy composite Leaf spring.

4. Results and Discussion

From the static FE analysis results, displacements of E-glass/Epoxy, Sisal fibre /Epoxy are 7.101mm, 39.829 mm and their equivalent Von-Misses stresses are 26.35 MPa, 19.65 7MPa. The contour plots obtained from FE-ANSYS are shown from Figs 4.1 to 4.8.

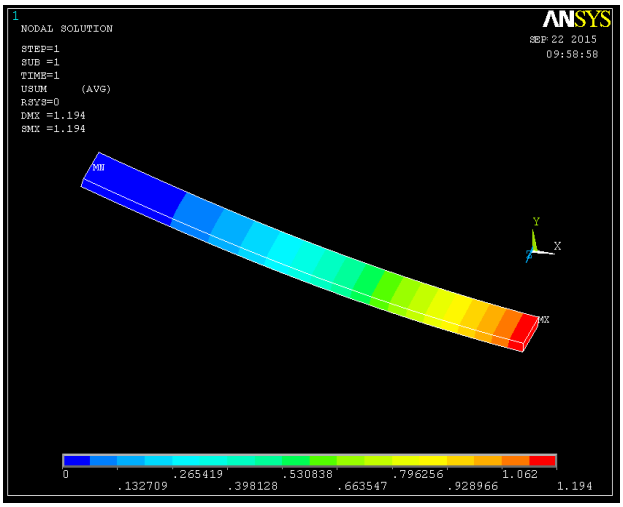

Fig 4.1 Deflection plot of steel leaf spring

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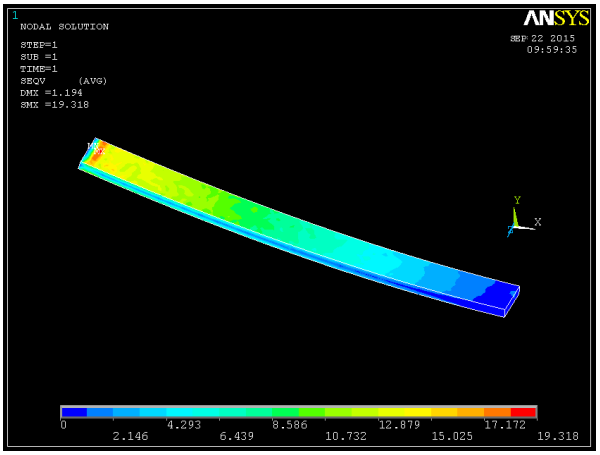

Fig 4.2 Equivalent Von-Misses stresses for conventional leaf spring (steel)

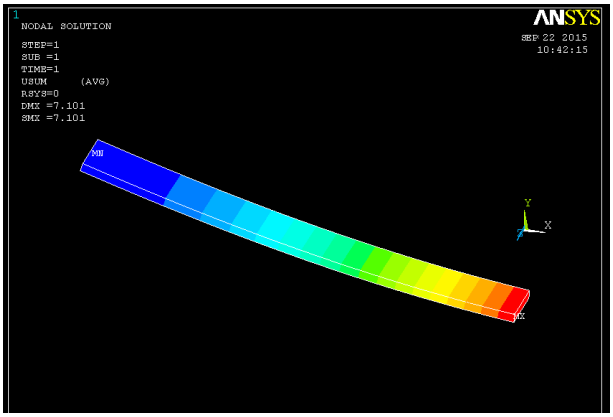

Fig 4.3 Deformation for GFRP type mono leaf spring

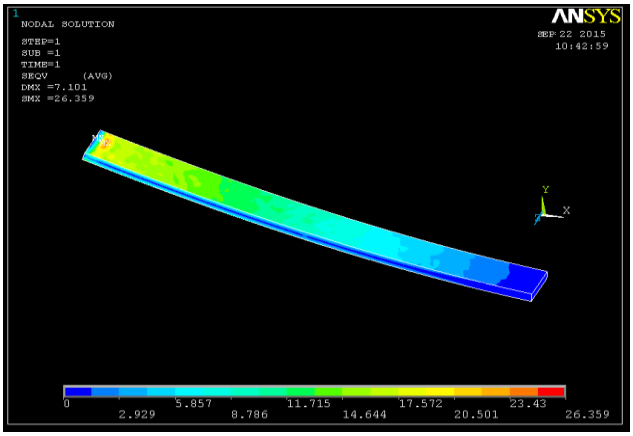

Fig 4.4 Equivalent Von-misses stress GFRP leaf spring

Table 4.1.Static Analysis Results

Material Type	Deflection (mm)	Stress Max (MPa)
Steel	1.194	19.31
E-glass/Epoxy	7.101	26.35
Sisal fibre/epoxy	39.82	19.65

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Table 4.2.Comparsion of FE Analysis Results

FEA			
Parameters	**Steel**	**E Glass/Epoxy**	**Sisal/Epoxy**
Load(N)	49.05	49.05	49.05
Deflection (mm)	1.194	7.101	39.82
Maximum stress(MPa)	19.31	26.35	19.65

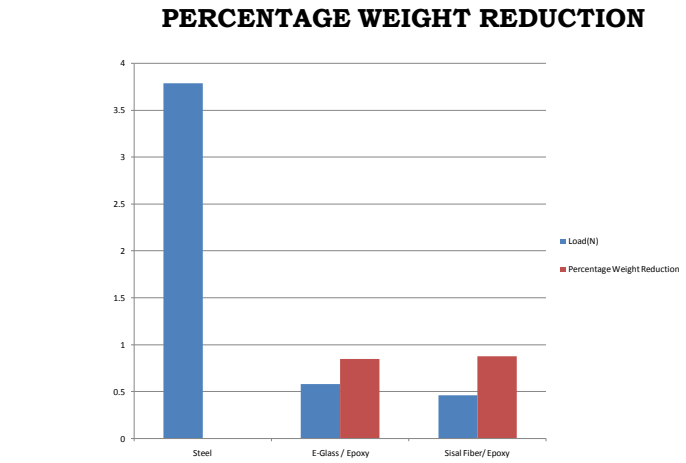

Fig.4.7 Wt% of Composite Vs GFRP/SFRP/Steel

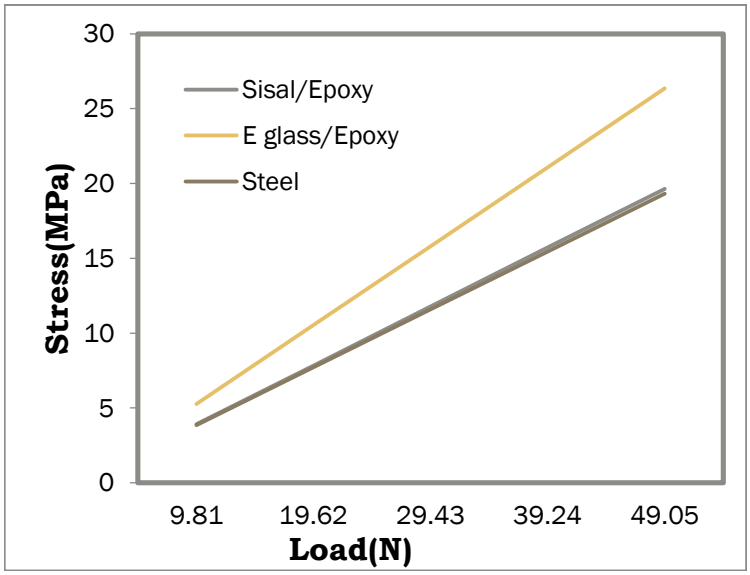

Fig.4.8 Stress Vs Load for GFRP/SFRP/Steel

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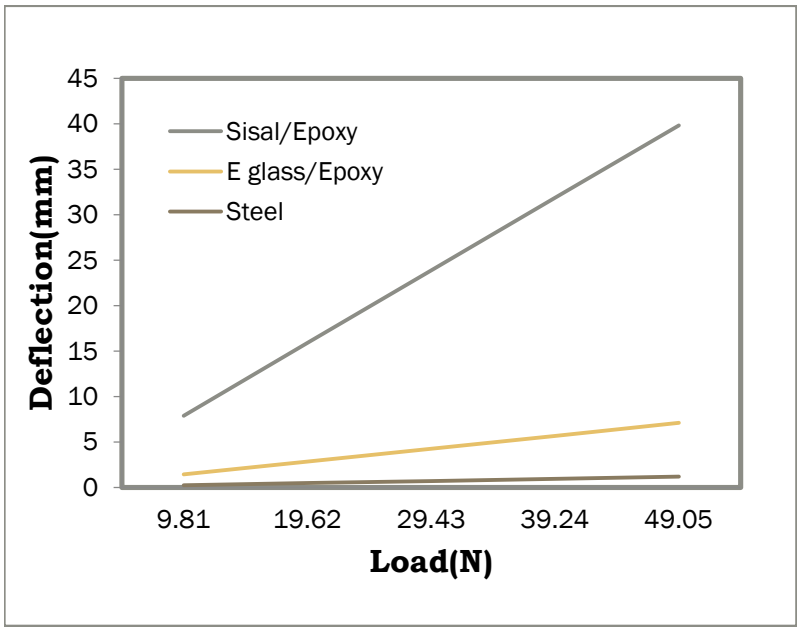
4.1 Variation of Deflection with respect to Load

Static analysis has been performed on steel as well as layer wise combination leaf springs through of 3-dissimilar materials (composite type i.e. GFRP,, SFRP at different loads varying from 9.81 N to 49.05 N. The variation of deflection w.r.t load applied is shown in Fig. 4.9.



5. Conclusions

From the FE analysis of composite leaf spring the resulting ends are drawn.

- From the results of point load (static) analysis, it was perceived equivalent Von-Misses stresses in the conventional (steel) leaf spring is 19.31 MPa, that of one (viz., E-glass / epoxy, Sisal fibres/ epoxy) are 26.35 MPa, 1.65 MPa.
- From the results of static analysis, it was perceived that the deformation in steel leaf spring 1.194 mm and that of one (viz., E-glass /Epoxy, Sisal fibre / Epoxy) are 26.35 mm, 39.82 mm.
- From the analysis, it is observed that Sisal fibre/epoxy mono leaf spring showing best results as compared to the other materials considered in this work.

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