International Journal of Scientific Research and Engineering Development-– Volume 5 Issue 1, Jan-Feb 2022

Available at www.ijsred.com

RESEARCH ARTICLE OPEN ACCESS

Design Modification and Analysis of Semi Elliptical Leaf Spring

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Abstract:

This paper proposed the methodology to analyse the modified leaf spring through the ANSYS 13.0 software. Conventional semi-elliptical leaf springs have higher frictional losses. Leaves in spring assembly have sliding contact increase wear and causes high frictional losses. To decrease the wear and frictional losses, a new design developed by introducing balls in between the leaves. Also to increase the load carrying capacity of the springs is increased without any change in the stiffness of the leaf material.

Keywords **—Leaf spring; ANSYS; Meshing; Displacement.**

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I. INTRODUCTION

In automobile industry weight reduction has been the main focus. Weight reduction can do by using better material, design optimization and better manufacturing processes [1-5]. Suspension leaf spring occupies 10%-20% of total un-sprung vehicle weight [6-8]. It is known that springs are designed to absorb and then release it. COF and frictional losses plays important role in designing of leaf spring [9]. It is observed that material having lowered co-efficient of friction will have greater load carrying capacity at same spring rate [10-11]. Therefore by reducing frictional losses, load carrying capacity can be increased and weight of the assembly can be reduced. Leaf springs carries lateral loads, breaking torque, driving torque in addition to shock absorbing. Parabolic springs A new innovative ideas are characterized by varying number of leaves by varying thickness from center to outer side following by parabolic pattern. The semi-elliptical leaf spring assembly of the Tata LPT 912R vehicle is considered as the base model. The front suspension system is taken for the study as it carrying the maximum torque when the vehicle is driven and when the brake is applied.

Table 1. Materials Properties

Parameter	Values
Young's modulus	$2.1x10^5$ N/mm^2
Poisson's ratio	0.266
Ultimate tensile strength	1272 Mpa
Ultimate yield strength	1158 Mpa
Spring stiffness	221.5 N/mm
Density	7850 kg/m^3
BHN	400-425

The vehicle details, deflection details and spring details are collected to perform study. It consists of only one plate, thick in center and tapers out at ends. The main disadvantage is that it can be only used to carry light loads.

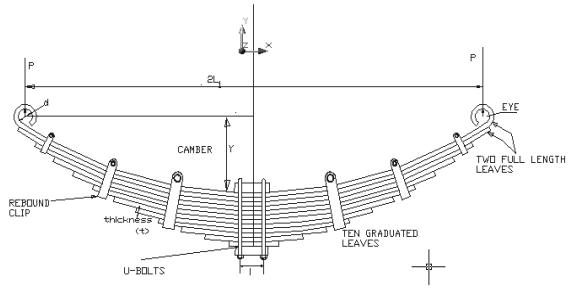

Fig. 1. Semi-Elliptical Spring Assembly

Generally conventional leaf springs are stacked together with pins and clips. Staked leaf spring has high inter leaf frictional losses. Increase in number of leaves leads to massive leaf spring assembly increase weight.

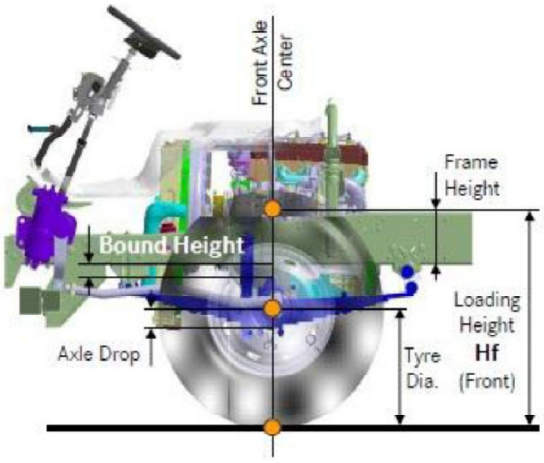

Fig 2. Assembly construction

II. DESIGN OF LEAF SPRINGS

Semi-elliptical leaf springs are modelled by using CREO 3.0. The model was executed in various loading condition. The ANSYS simulation software used to investigate the stress analysis during various loading condition.

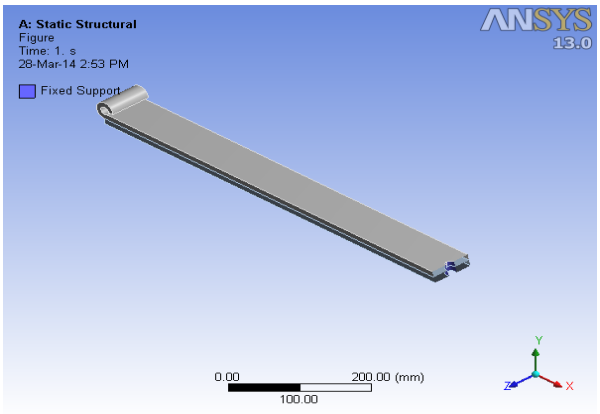

Fig. 3. Design of Leaf spring

The meshing and loading operation are done over the 3D model. The applied load will get from the

previous review. The design investigated in ANYS 13.0 software with various stress analysis.

III. RESULTS AND DISCUSSION

The stress value will decide the life time of the component. Normally in manufacturing Post heat treatment is preferred for the stress removal process. Here the ANSYS 13.0 can use to analyse the stress distribution range over the component shown in figure 4.

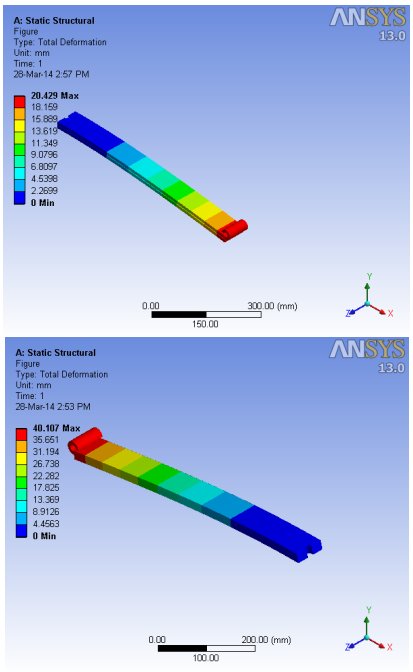

Fig. 4. a) Displacement for existing design b) Displacement for modified design

Figure 5 shows the comparison of existing and modified design displacement analysis is different loading condition.

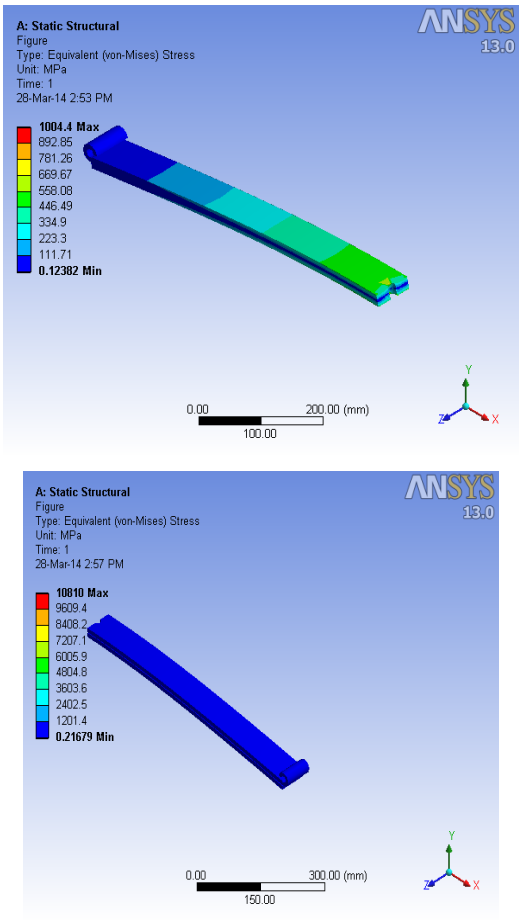

Fig. 5. a) Bending (Von-Mises) stress for existing design, b) Bending (Von-Mises) stress for Modified design

IV. CONCLUSIONS

Thus the existing design and modified design was modeled and imported on ANSYS 13.0.Report was generated on Ansys , to obtain the values of deflection and bending stress.

1. Analytical calculations were determined by using formulae.
2. Analytical results and FEA results were compared, It is found that deflection has

been reduced and bending stress are also within the limit.

3. Based on the results the modified design shown the uniform distribution of applied load.

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