ANALYSIS OF EXISTING LEAF SPRING AND LEAF SPRING WITH VARYING THICKNESS AND WIDTH USING FEM

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ABSTRACT

The main function of leaf spring is not only to support vertical load but also to isolate road induced vibrations. It is subjected to millions of load cycles leading to fatigue failure. In the present work improvement areas where more stress acting on the leaf spring one can improve the product quality while keeping the minimum cost. In the present work varying the thickness of leafs depending on the stress acting on the springs. The upper leafs of the spring get more stress then the bottom leafs. That way the project is modifying the leaf thickness, and width. The modified design was rectified conventional leaf spring's problem. The modified leaf spring improved the fatigue life of the leaf spring. In this project two method of the modification was taken, first one was upper leafs are containing more thickness than the lower leafs thickness. Second method was upper leafs are containing more width than the lower leafs. The modified leaf springs ware modeling by SOLID WORKS, and analysis using ANSYS14.0.Software.

Keywords: *fatigue failure, stress, leaf spring, modified design*

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1. INTRODUCTION

The spring is a machine part used to absorb sudden loads and to accumulate elastic energy. There are different mechanical designs and forms of springs. The spring under consideration is called a leaf spring. This type of spring has an advantage over other kinds of springs because of its compact design and essential structural role. Its importance, first and foremost, comes from the part's unique role, utilized in motor vehicles to provide the absorption of irregular loads caused by uneven roads. The leaf spring is also used in other machines such as heavy presses that operate under loads at large displacements. Since the displacements undergo inter- mitten absorptions and releases, a sturdy design of the part must be provided the design that combines optimum strength with a needed elasticity. This is achieved by an assembly of narrow leaves acting in unison as bending beams. The top leaf is designated as the main leaf. The leaves are bent with the ends facing upward. When a spring is designed to be used in a reversed position, the main leaf is at the bottom. The load is applied simultaneously at each end of the main leaf, while the reaction forces concentrate in the center of the spring, or vice versa.

2. LITERATURE REVIEW

Jadhav Mahesh V, ZomanDigambar "Performance Analysis of Two Mono Leaf Spring Used for Maruti 800 Vehicle" [1] In this paper we look on the suitability of composite leaf spring on vehicles and their advantages. Efforts have been made to reduce the cost of composite leaf spring to that of steel leaf spring. The achievement of weight reduction with adequate improvement of mechanical properties has made composite a very replacement material for convectional steel. Material and manufacturing process are selected upon on the cost and strength factor. The design method is selected on the basis of mass production. From the comparative study, it is seen that the composite leaf spring are higher and more economical than convectional leaf spring**.** **Ganesh.K, Gembiram "Design and Analysis of Multi Leaf Springs Using Composite Materials" [2]**

Weight reduction has been the main/primary focus of automobile manufactures. The automobile industries have shown interests in replacement of steel springs with composite leaf springs due to high strength to weight ratio. The objective of this paper is to compare the load carrying capacity, stiffness and weight savings of composite leaf spring with that of steel leaf Spring. This work is carried out on multi leaf of commercial vehicle. Mathematical calculations are carried out for design the multi leaf spring.

3. PROPOSED DESIGN

Constant Width, Varying Thickness Design concept is using in the new design. The thickness is varying to length of the leaf basis the longer leaf having more deflection so it is should be having more strength otherwise the long more deflected leafs are damaged shortly. The above problems are rectifying the new design. First leaf is longer so the thickness of the main leaf is more than the bottom leafs, it has 8 mm thickness and below two leafs has 7.5mm and the other below leafs are having thickness are 7mm,7mm,6.5mm,6.5mmand last two are 6mm thick . The other values of the leaf springs like width length and radius of curvature are maintain constant leaf spring of Mahindra - commander 650 di. Second design is Constant thickness and varying width Design concept is using in the new design. The width is varying to length of the leaf basis the longer leaf having more deflection so it is should be having more strength otherwise the long more deflected leafs are damaged shortly. The above problems are rectifying the new design. First leaf is longer so the width of the main leaf is more than the bottom leafs, it has 52 mm width and below two leafs has 51mm and the other below leafs are having thickness are 50mm, 50mm, 49mm, 49mm and last two are 48mm width the other values of the leaf springs like thickness length and radius of curvature are maintain constant leaf spring of Mahindra - commander 650 di.

4. DESIGN OF EXISTING AND VARYING THICKNESS LEAF SPRING

Pro Engineer software was used for this particular model and the steps are as follows:

- Start a new part model with Metric units set.
- Initially draw the existing Leaf spring as per the dimension.
- The existing leaf spring has constant thickness (7mm) width (50mm) for all leaf.
- Then draw the varying thickness leaf spring as fallowing steps.
- Draw the sketches of the trajectories of each leaf of spring with the radius obtained from calculations with span 1120mm.
- Using sweep command draw a section 50 mm X 8 mm thick sweep along the above drawn curves of leaf.
- The spring design manual the eye diameter is formed on the first leaf.
- Thickness of leaves = 6-8mm.
- After all the features of all leaves as are modeled, generate family table for each leaf.
- Generate models for U-clams, Axle rod, etc.
- Assemble each of the leaf in an assembly model and assemble all other models.
- Export the model to IGES – solid – assembly – flat level.

Figure 1.Isometric view of existing leaf spring

Figure 2.Varying thickness leaf spring

Figure 3.Varying width leaf spring

5. ANALYSIS OF THE EXISTING LEAF SPRING AND VARYING THICKNESS AND WIDTH LEAF SPRING

The leaf spring is first all Leaf spring were modeled in SOLID WORKS and then exported to ANSYS14.0.Where it is further meshed, constrained and loaded and simulated further. All the analysis for the steel leaf spring is done by using ANSYS14.0

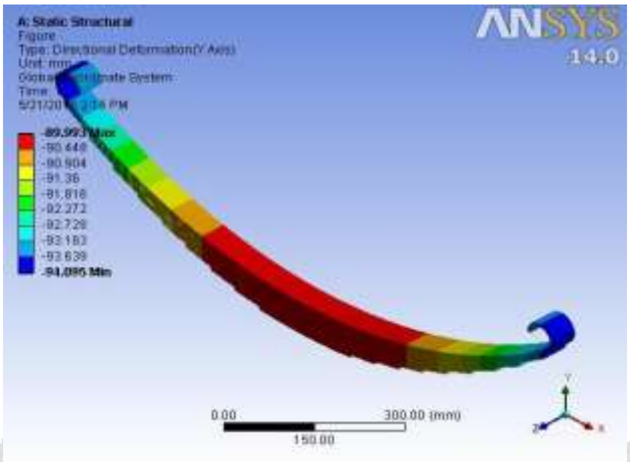

Figure 4.Deformation of existing spring

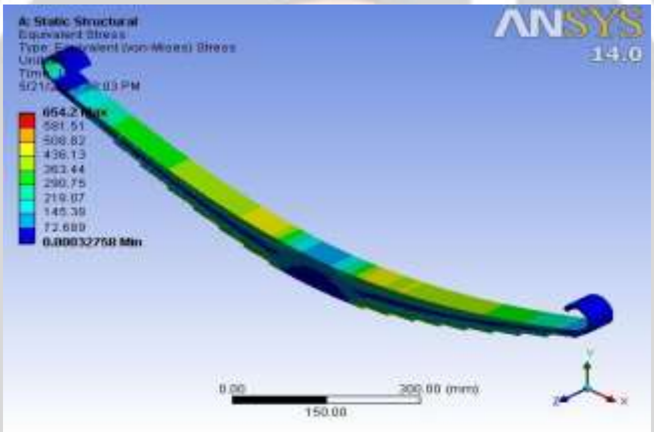

Figure 5.Equivalent stress of existing spring

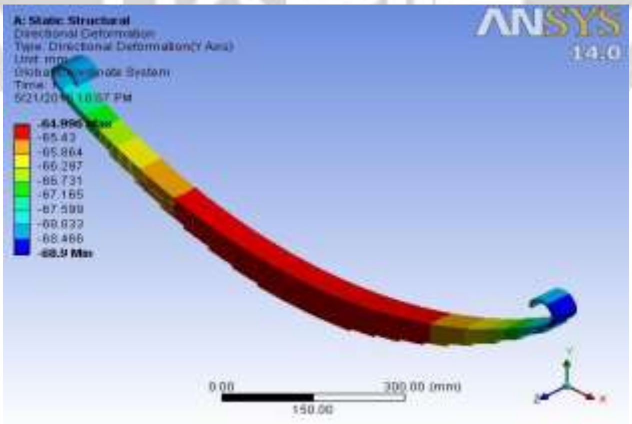

Figure 6.Deformation stress of varying thickness spring

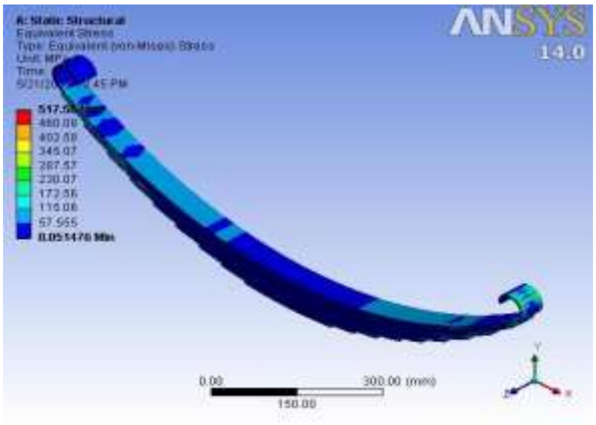

Figure 7.Equivalent stress of varying thickness spring

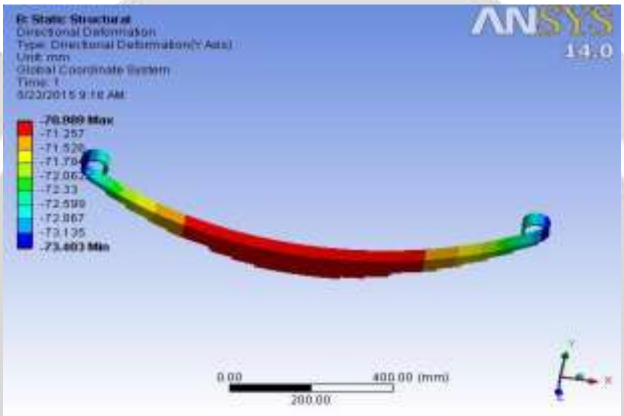

Figure 8.Deformation of varying width spring

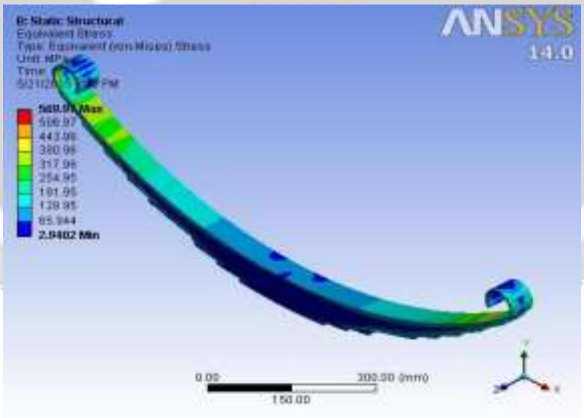

Figure 9.Equivalent stress of varying width spring

6. RERESULT AND DISCUSSION

From the results of static analysis of steel leaf spring, it is seen the displacement and maximum Von- Mises stress, The FEA results are compared with the theoretical results. The theoretical value of the stress and deflection compared with the ANSYS result which is used to find out the best design. From the comparison of the deflection and stress values the ANSYS result and theoretical result are nearly same. The varying thickness leaf spring has very lower stress and deflection then the varying width leaf spring.

7. CONCLUSION

From the static analysis results it is found that there is a maximum displacement of Existing leaf spring 94.09mm in the modified leaf spring and the corresponding displacement of the varying thickness and varying width leaf spring are 68.9mm and 73.4mm. The maximum equivalent stress of the Existing leaf spring is 654.2N/mm^2. The maximum equivalent stress of The modified leaf spring and the corresponding von-mises stress in varying thickness leaf spring and varying width leaf spring is 517.58N/mm^2 and 569.97N/mm^2 respectively. Among the three steel leaf springs, only the varying thickness leaf spring has very lower stresses than varying width leaf spring and Existing leaf spring. Varying thickness leaf spring can be suggested for replacing the Existing leaf spring for improving fatigue life. It is selected from stress and deflection point of view. A comparative study has been made modified leaf spring and Existing leaf spring with respect to stress and deformation. Modified leaf spring improved the fatigue life by 60000cycle for varying thickness leaf spring and 40000cycle for varying width leaf spring over Existing leaf spring.

8. REFERENCES

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