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Design and Analysis of a Hybrid Suspension System

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ABSTRACT:

Leaf springs are one of the oldest suspension components they are still frequently used, especially in commercial vehicles. The commonly used leaf springs in the vehicle suspension system are subjected to millions of varying stress cycles leading to fatigue failure. A lot of research has been done for improving the performance of leaf spring. Here in this project also we did an attempt of designing hybrid suspension system which was used in autos by using that concept of designing we designed a hybrid leaf spring. For this thesis we took Tata ace auto leaf spring as a reference and designed it by using modeling software. In the analysis we used ansys package and the results are compared with the hybrid suspension system for the same load. The main objective of the project is that to increase the load capacity of the leaf spring from this project we are trying to achieve this and further suggestions are made by observing the results.The model was designed by using Pro-E and analyzed using Ansys.

KEYWORDS : *Ansys, Fatigue , Hybrid Leaf Spring , Pro-e, Suspension system.*

I. INTRODUCTION

A spring is defined as an elastic body, whose function is to distort when loaded and to recovers its original shape when the load is removed.Semi- elliptic leaf springs are almost universally used for suspension in light and heavy commercial vehicles. For cars also, these are widely used in rear suspension. The spring consists of a number of leaves called blades. The blades are varying in length. The blades are us usually given an initial curvature or cambered so that they will tend to straighten under the load. The leaf spring is based upon the theory of a beam of uniform strength. The lengthiest blade has eyes on its ends. This blade is called main or master leaf, the remaining blades are called graduated leaves. All the blades are bound together by means of steel straps.

- **Objective of Suspension**
- ✓ 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
- ✓ Basic Considerations for vertical loading

II. INTRODUCTION TO ANSYS

ANSYS is general-purpose finite element analysis (FEA) software package. Finite Element Analysis is a numerical method of deconstructing a complex system into very small pieces (of user-designated size) called elements. The software implements equations that govern the behaviour of these elements and solves them all; creating a comprehensive explanation of how the system acts as a whole. These results then can be presented in tabulated, or graphical forms. This type of analysis is typically used for the design and optimization of a system far too complex to analyze by hand. Systems that may fit into this category are too complex due to their geometry, scale, or governing equations. ANSYS is the standard FEA teaching tool within the Mechanical Engineering Department at many colleges. ANSYS is also used in Civil and Electrical Engineering, as well as the Physics and Chemistry departments. ANSYS provides a cost-effective way to explore the performance of products or processes in a virtual environment. This type of product development is termed virtual prototyping

III. MODELING BY USING PRO-E

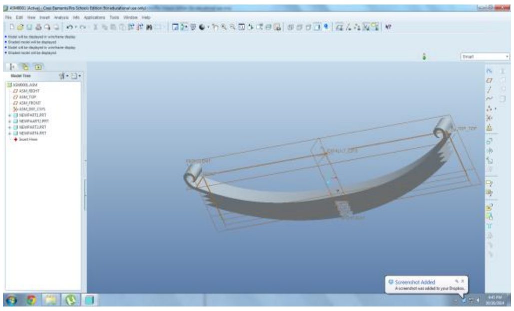


Fig 1. Actual model of Leaf spring suspension system

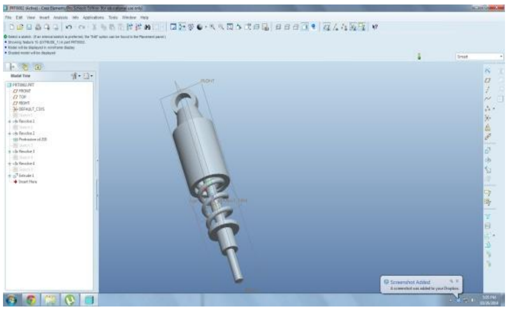


Fig 2.Helical Spring suspension system

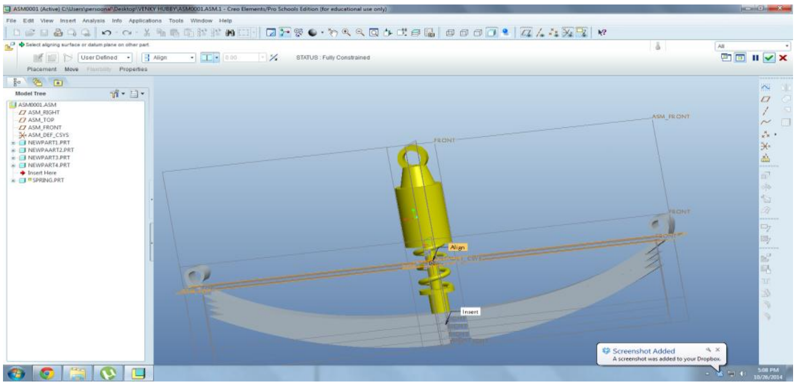


Fig 3. Assembly of the Hybrid suspension system

IV. RESULTS & DISCUSSION

i. **Leaf spring for steel 65Si7 material** **(**2tons load)

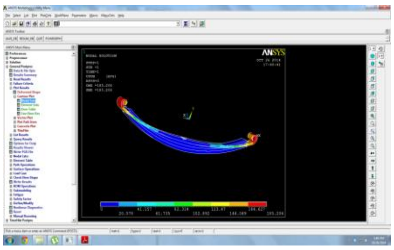


Fig 4. Total deformation

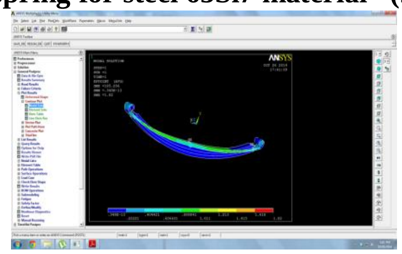


Fig 5.Stress intensity

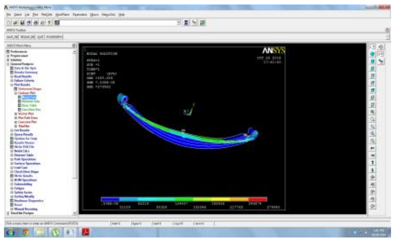


Fig 6.Strain intensity

ii. **Leaf spring for steel 65Si7 material (**3tons load)

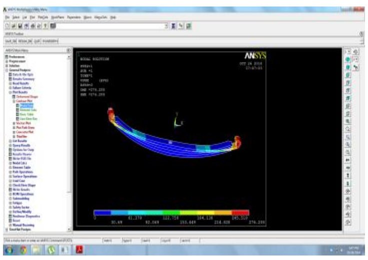


Fig 7.Total deformation

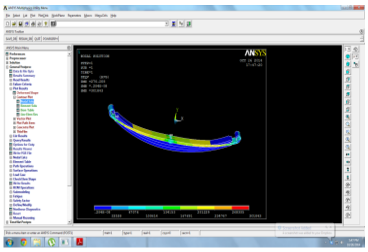


Fig 8.Stress intensity

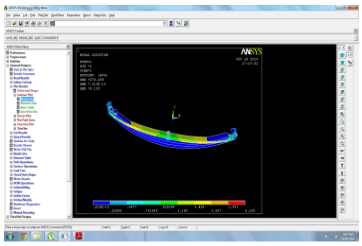
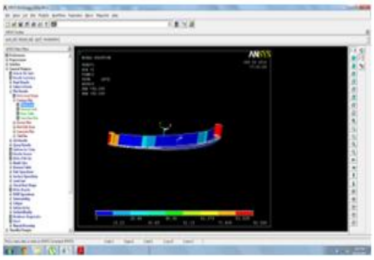
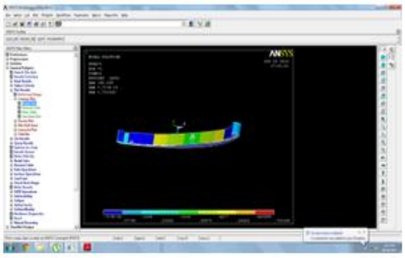


Fig 9.Strain intensity

iii. **Leaf spring for steel 65Si7 material (**1tons load)





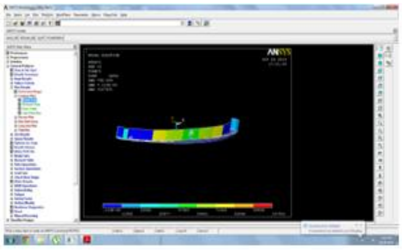


Fig 10. Total deformation

Fig 11.Stress intensity

Fig 12.Strain intensity

4.2.1. Composite Leaf spring (2tons load)

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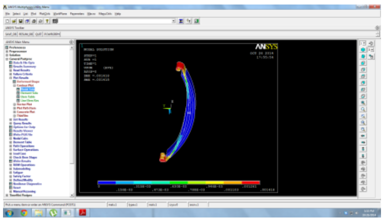
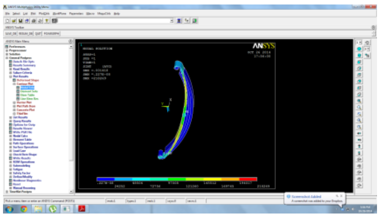




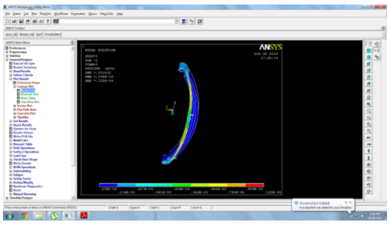
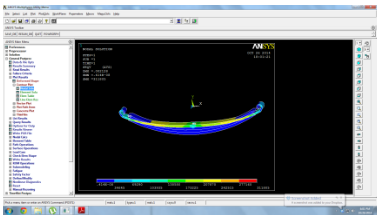


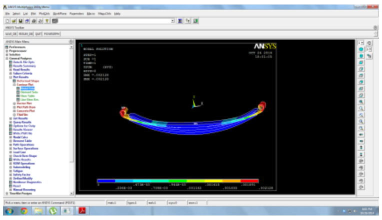
Fig 13. Total deformation

Fig 14.Stress intensity

Fig 15.Strain intensity

4.2.2. Composite Leaf spring (3tons load)





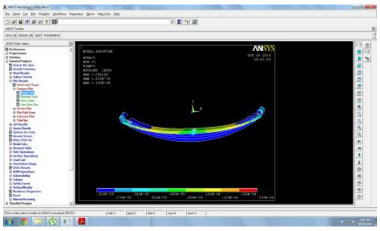
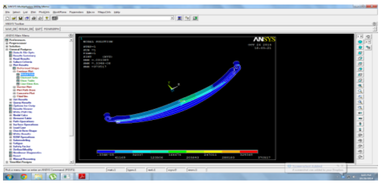


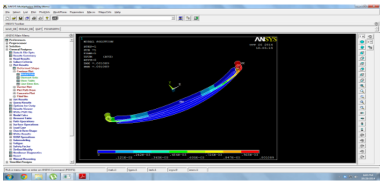
Fig 16. Total deformation

Fig 17.Stress intensity

Fig 18.Strain intensity

4 .2.3. Composite Leaf spring (1tons load)





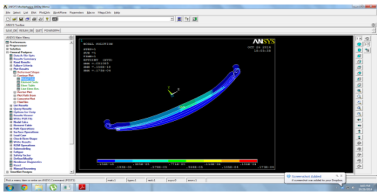
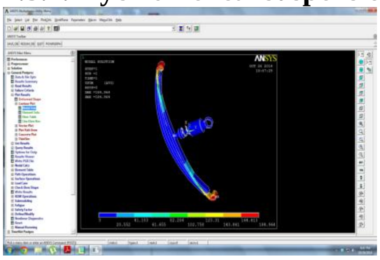


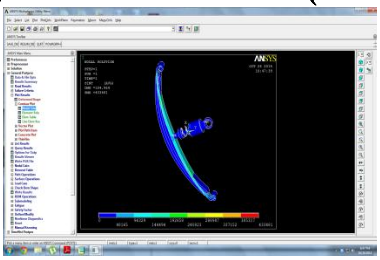
Fig 19.Total deformation

Fig 20.Stress intensity

Fig 21.Strain intensity

4.3.1. Hybrid helical suspension system for 65Si7 material (For 2 tons)





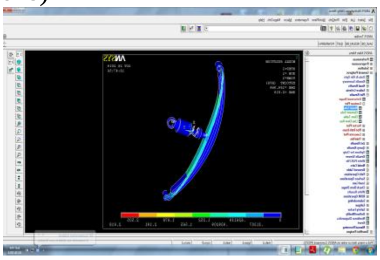


Fig 22.Total deformation

Fig 23.Stress intensity

Fig 24.Strain intensity

4.3.2. Hybrid helical suspension system for 65Si7 material (For 3 tons)

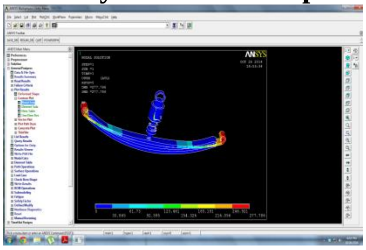


Fig 25.Total deformation

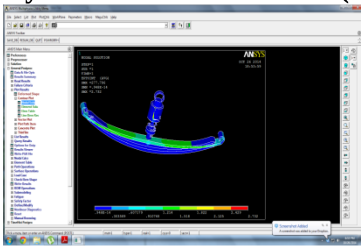


Fig 26.Stress intensity

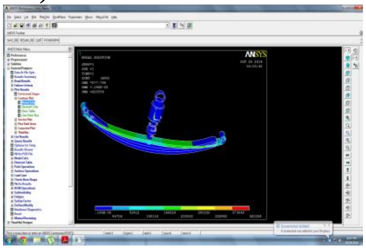


Fig 27.Strain intensity

4.3.3. Hybrid helical suspension system for 65Si7 material (For 1 tons)

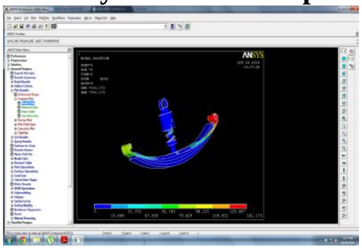


Fig 28.Total deformation

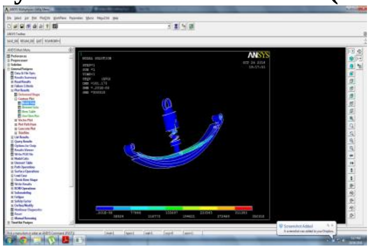


Fig 29.Stress intensity

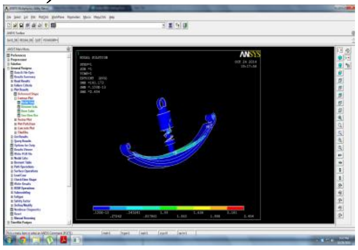


Fig 30.Strain intensity

4.4.1. Composite Hybrid helical suspension system (For 2 tons)

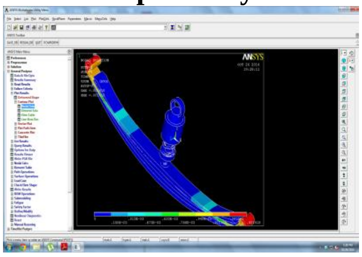


Fig 31.Total deformation

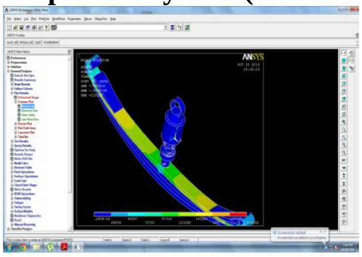


Fig 32.Stress intensity

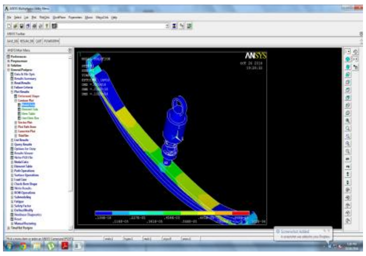


Fig 33.Strain intensity

4.4.2. Composite Hybrid helical suspension system (For 3 tons)

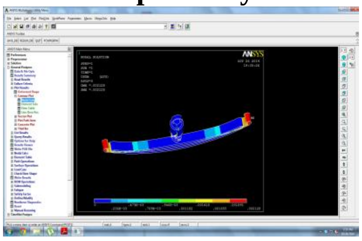


Fig 34.Total deformation

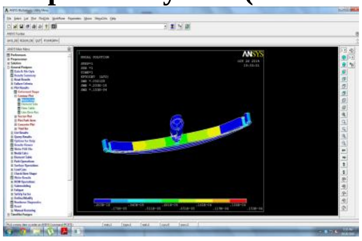


Fig 35.Stress intensity

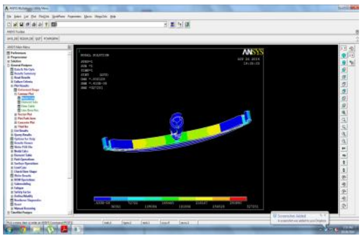


Fig 36.Strain intensity

4.4.3. Composite Hybrid helical suspension system (For 1 tons)

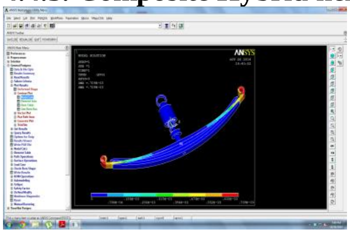


Fig 37.Total deformation

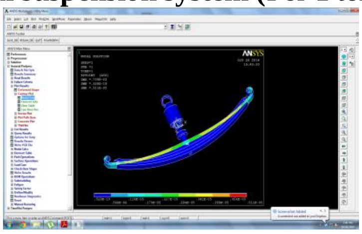


Fig 38.Stress intensity

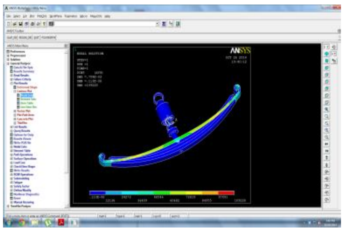


Fig 39.Strain intensity

V. STRESS RESULTS SUMMARY

Stress values						
Used material	Steel			Composite		
Applied weight	1 ton	2 tons	3 tons	1 ton	2 tons	3 tons
Actual leaf suspension	92	185	276	.00108	.00212	.00414
Hybrid suspension	90.2	184	277	.0079	.00212	.00418

VI. CONCLUSION

In this thesis we designed actual leaf suspension and hybrid suspension system with 3d modeling software and analyzed the stress values using Fea package.Here the actual leaf model was designed and analyzed for different stresses at different loads by changing the materials.As the same the hybrid suspension system was designed and analyzed for different stresses at different loads by changing the materials.After the analysis the stress values of the actual suspension system with two materials are compared the stress values are less for composite material compared to actual so composite material can be used for designing the actual suspension system.The stress values of the hybrid suspension system are also compared with two different materials then we came to know that the stress values are less for composite material compared to actual so composite material can be used for designing the hybrid suspension system.Finally the results of the actual suspension with the hybrid suspension are compared so we observed that for composite there is little difference and for actual there is more difference in stress values from this we conclude that by using hybrid suspension system we can add more weight that the actual suspension.The actual truck capacity is 2 tons for actual suspension by using hybrid suspension system we can add more than 2 tons. And the design best under load of 3 tons.

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