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Vibrational Analysis of Composite Leaf spring

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ABSTRACT

Leaf springs probably are the oldest automobile suspension gadgets still in active use. Weight reduction has been the main focus of automobile manufacturers in the present scenario. Weight reduction can be achieved primarily by the introduction of better material, design optimization and better manufacturing processes. The main objective of this paper is to carry out experimental and finite element analysis of composite leaf spring. The comparative simulation analysis was done in ANSYS. Similar mechanical properties for Kevlar epoxy composite material were considered for all simulation procedure. The design constraints and meshing being similar for all conventional and composite models of leaf spring. This paper covers experimental and finite element analysis of mono Kevlar epoxy composite leaf spring.

Keywords: Composite, Kevlar Epoxy, Optimization, Nonlinear.

I. INTRODUCTION

The experimental analysis is compared with a numerical analysis of the system using ANSYS program, a comprehensive finite element package, which enables to solve the nonlinear differential equation and to obtain the modulus of elasticity of the beam material. For this purpose fit the experimental results of the vertical displacement at the free end to the numerically calculated values for different values of the modulus of elasticity or Young's modulus by minimizing the sum of the mean square root. Using the modulus of elasticity previously obtained, and with the help of the ANSYS program.

II. FINITE ELEMENT ANALYSIS OF A STEEL AND COMPOSITE LEAF SPRING

The experimental analysis is compared with a numerical analysis of the system using the ANSYS program. ANSYS is a finite element modeling and analysis tool. It can be used to analyze complex problems in mechanical structures, thermal processes, computational fluid dynamics, magnetic, electrical fields, just to mention some of its applications. ANSYS provides a rich graphics capability that can be used to display results of analysis on a high-resolution graphics workstation. The free vibration of fixed fixed beam is investigated by using ANSYS.

The physical problem typically involves an actual structure or structural component subjected to certain loads. The idealization of the physical problem to a mathematical model requires certain assumptions that together lead to differential equations governing the mathematical model. Since the finite element solution technique is a numerical procedure, it is necessary to access the solution accuracy. If the accuracy criteria are not met, the numerical solution has to be repeated with refined solution parameters until a sufficient accuracy is reached.

2.1 FE Analysis of Steel Leaf Spring

Figure 1: CAD Model of Steel Leaf Spring

The numerical results were obtained by using ANSYS are as shown in Table 1

Table 1 Natural Frequency of Steel Leaf Spring for different Modes.

Mode	Numerical Frequency in Hz
1	24.54
2	91.095
`3	196.58

The mode shapes of free vibration of Steel Leaf Spring are shown in Figure 2, Figure 3 and Figure 4.

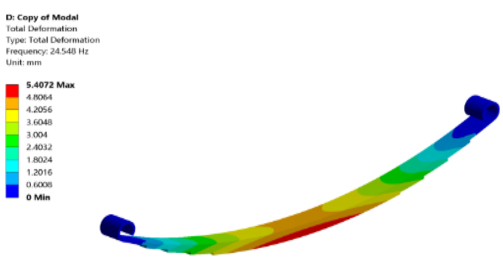

Figure 2 1st Mode Shape of Free Vibration of Steel Leaf Spring

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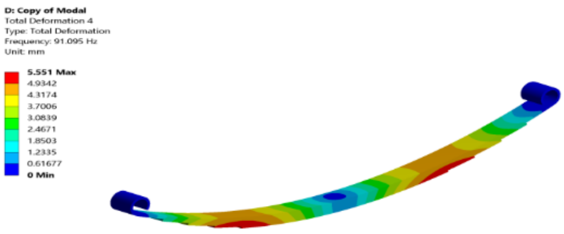

Figure 3 2nd Mode Shape of Free Vibration of Steel Leaf Spring

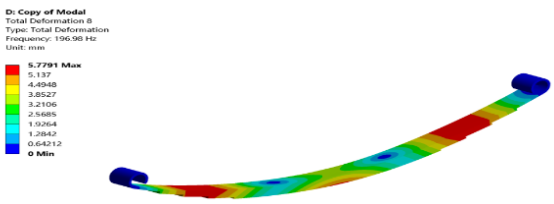

Figure 4 3rd Mode Shape of Free Vibration of Steel Leaf Spring

2.3 FE Analysis for Composite Leaf Spring

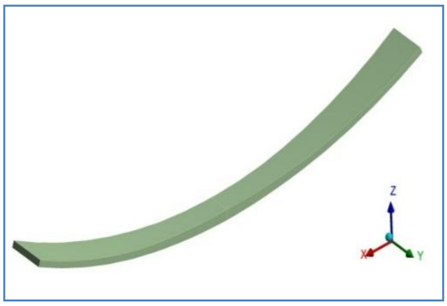

Figure 5 Cad Model of Composite Leaf Spring.

The numerical results were obtained by using ANSYS are as shown in Table 2

Table 2 Natural Frequency of Composite Leaf Spring for different Modes

Mode	Numerical Frequency in Hz
1	58.625
2	117.9
3	278

The mode shapes of free vibration of Composite Leaf Spring are shown in Figure 6, Figure 7 and Figure 8.

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Figure 6 1st Mode Shape of Free Vibration of Composite Leaf Spring.

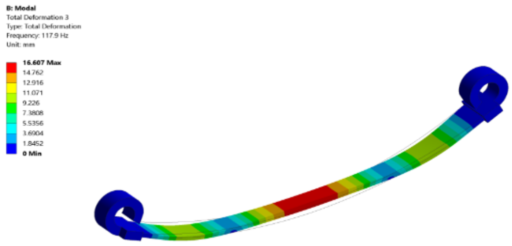

Figure 7 2nd Mode Shape of Free Vibration of Composite Leaf Spring.

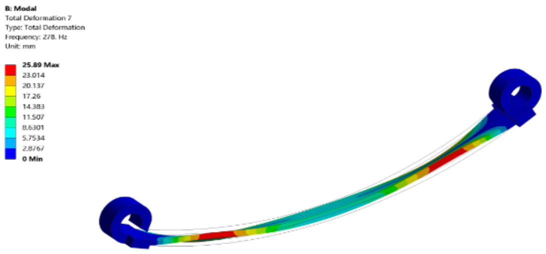

Figure 8 3rd Mode Shape of Free Vibration of Composite Leaf Spring.

III. EXPERIMENTAL ANALYSIS OF COMPOSITE AND STEEL LEAF SPRING

Frequency Analysis based on the Fast Former Transform (FFT) Algorithm is the tool of choice for measurement and diagnostic of vibration. The FFT Analyzer is recently developed pc based virtual instrument. It uses impulse execution and either frequency domain analysis or time – domain analysis to entrant the model parameter from the response measurement in real time. Following impulse are executions of the specimen the measured analog response signal may be digitalized and analyzed using the domain techniques or transformed for analysis in the frequency domain using FFT Analyzer. The peaks in the frequency response spectrum are the location of natural frequency.

The model parameter can be entranced from a set of frequency response function (FRF) measurements between one or more reference positions and measurement position required in model. The response frequency and damping value can be found from any of the FRF measurements. On the structure the execution of the model parameter from FRF can be done using a variety of mathematical curve fitting algorithm. The FRF can be obtained using multichannel FFT measurements.

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3.1 Experimental Procedure for Composite and Steel Leaf Spring

- The connections i.e accelerometer, modal hammer, laptop and other power connections were made. The surface of the both the Leaf Spring were cleaned for proper contact with the accelerometer. The accelerometer was then attached with the surface of the Leaf Springs. The above connections were made for free vibrations. The experimental results are compared with FEM package ANSYS.

3.2 Graphical Free Vibration Result (Static Test Results)

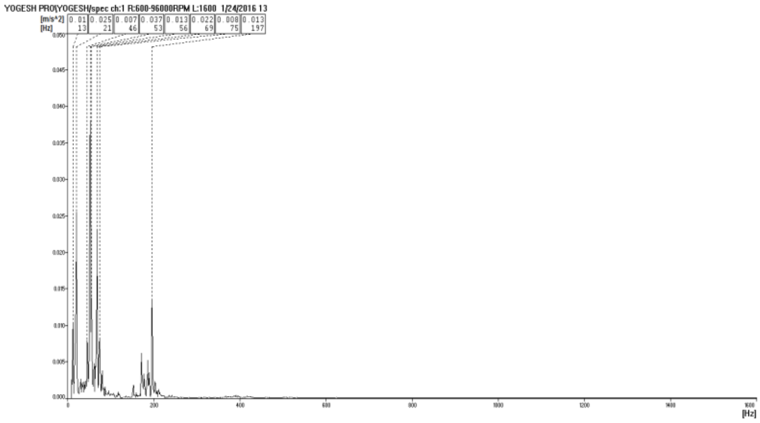

Figure 9. Graphical Free Vibration Result for Steel Leaf Spring.

Table 3 Natural Frequency of Composite Leaf Spring for different Modes

Mode	Frequency (Experimental) in Hz
1	21
2	75
3	197

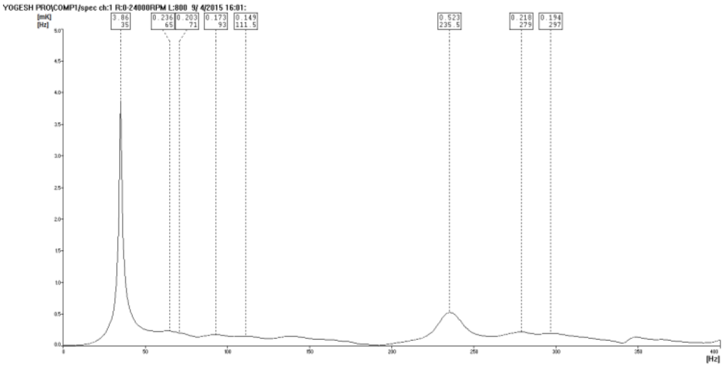

Figure 10 Graphical Free Vibration Result for Composite Leaf Spring.

Table 4 Natural Frequency of Steel Leaf Spring for different Modes

Mode	Frequency (Experimental) in Hz
1	58.625
2	117.9
3	278

V. RESULTS AND DISCUSSIONS

5.1 For Composite Leaf Spring and Steel Leaf Spring

Table 3 and 4 shows the values of natural frequencies calculated numerically with the aid of the ANSYS program. The relative error of the frequency is calculated by comparing these values with experimental results.

Table 3 Percentage Error in Natural Frequency obtained by Linear and Non Linear Numerical Analysis for Composite Leaf Spring

Sr. No.	Frequency (Experimental) in Hz	Frequency (Numerical) in Hz
1st Mode	35	58.625
2nd Mode	111.5	117.9
3rd Mode	235.5	278

Table 4 Percentage Error in Natural Frequency obtained by Linear and Non Linear Numerical Analysis for Steel Leaf Spring

Sr. No.	Frequency (Experimental) in Hz	Frequency (Numerical) in Hz
1st Mode	21	24.54
2nd Mode	75	91.095
3rd Mode	197	196.58

VI. CONCLUSION

Comparative static analysis of Composite Leaf Spring as well as Steel leaf Spring is carried out. Nonlinearities present in Composite Leaf Spring and Steel Leaf Spring were found out. The numerical results from FEM showed in general a good agreement with the experimental values. However, differences appeared indicates the necessity to improve the model input data and the experimental procedure due to nonlinearities present in the system.

VII. ACKNOWLEDGEMENTS

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REFERENCES

[1.] Hiroyuki Sugiyama, Ahmed A. Shabana, Mohamed A. Omar, Wei-Yi Loh. "Development of Nonlinear Elastic Leaf Spring Model for Multibody Vehicle Systems," Computer Methods in Applied Mechanics and Engineering, February 2005.

[2.] M. M. Patunkar, D. R. Dolas. "Modelling and Analysis of Composite Leaf Spring under the Static Load Condition by Using FEA," International Journal of Mechanical and Industrial Engineering, Volume 1, Issue 1, 2011.

[3.] Mahmood M.Shokrieh, Davood Rezaei. "Analysis and Optimization of a Composite Leaf Spring," Composite Structures, 2003.

[4.] K. K. Jadhao, Dr. R.S Dalu. "Experimental Investigation and Numerical Analysis of Composite Leaf Spring," International Journal of Engineering Science and Technology (IJEST), Volume 3, June 2011.

[5.] Y. N. V. Santhosh Kumar, M. Vimal Teja, “Design and Analysis of Composite Leaf Spring,” International Journal of Mechanical and Industrial Engineering (IJMIE), ISSN No. 2231-6477, Vol-2, Issue-1, 2012.

[6.] 6. Ganesh. K, Gembiram. M, Elayaraja. R, Saravanan. R, Murali .K. “Design and Analysis of Multi Leaf Springs Using Composite Materials,” IJRASET, Vol. 2 Issue IV, April 2014.