Vibration Analysis of Composite Leaf Spring by FEA

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Abstract— The automobile industry has shown interest in to replace the conventional leaf spring with composite leaf springs. The aim of this paper is to present the design and analysis of composite leaf spring. A mono leaf spring of glass fiber reinforcement plastics (GFRP) with same mechanical properties as that of multileaf steel spring is designed, fabricated and tested. This work has been made to predict the vibration behavior of GFRP leaf spring using ANSYS.

Key words: Glass Epoxy, Leaf Spring, Vibrations, FEA, Modal Analysis

I. INTRODUCTION

A spring is an elastic body which distorts when loaded and recover its original shape when load is removed. Leaf spring absorbs the vibrations, shocks and bumps by means of spring deflections. A leaf springs one end is directly attached to the frame and other end is attached through shackle. Spring is crucial suspension elements in car necessary to minimize the vertical vibration, Impact and bumps due to road irregularities and create a comfortable ride. Composite materials are ideal for structural application where high strength to weight and stiffness to weight ratio are required. These materials are basically hybrid materials formed of multiple materials in order to utilize their individual structural advantages in a single structural material. The composite material has the properties of the two materials that have been combined. The advantage of composite materials is that they usually exhibit the best qualities of their components or constituents and often some qualities that neither constituent possesses. Some of the properties that can be improved by composite material are Strength, Fatigue life, Stiffness, Corrosion resistance, Thermal insulation, Weight, Wear resistance, Attractiveness, Thermal conductivity, Acoustical insulation. Naturally, not all of these properties are improved at the same time nor is there usually any requirement to do so.Modern composites using fiber-reinforced matrices of various types have created a revolution in high-performance structures in recent years. Advanced composite materials offer significant advantages in strength and stiffness coupled with light weight, relative to conventional metallic materials.

II. MATERIAL

Glass is the most common material for fiber used in polymer matrix composites. The main types of glass are E-glass (also called "fiberglass") and S-glass. The "E" in the word E-glass stands for electrical as it was designed for electrical applications. However, E-glass is used for many other purposes now, like decorations and structural applications. The "S" in the word S-glass stands for higher content of silica. S-glass retains its strength at high temperatures compared to E-glass and has higher fatigue strength. It is used mainly for aerospace applications.

Other types of glass available commercially are C-glass ("C" stands for corrosion) which is used in chemical environments, for example storage tanks; R-glass used in the structural applications such as buildings and construction; D-glass (dielectric) is used for applications requiring low dielectric constants, A-glass (appearance) is used to improve surface appearance.

III. RESULT AND DISCUSSION

A. Finite Element Analysis (FEA)

FEA analysis is done by changing the fiber orientation.

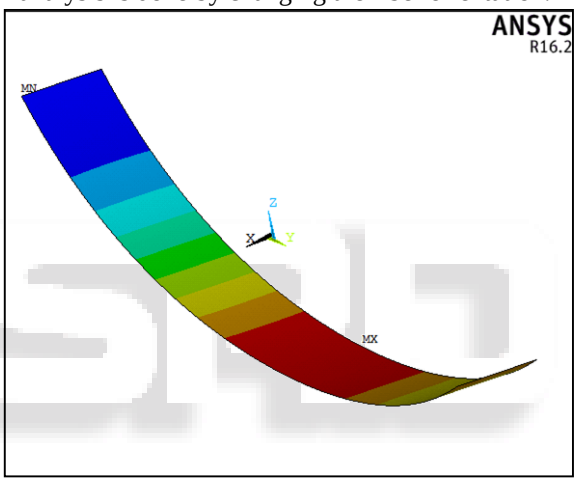

Fig. 1: First mode shape of 0-90 configuration is 31.05 Hz

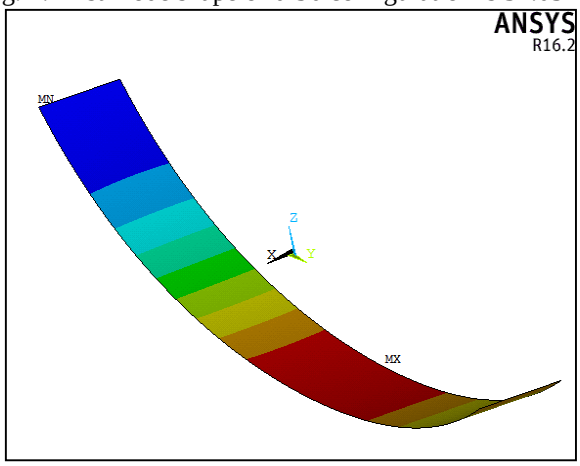

Fig. 2: First mode shape of 0- 45 configuration is 29.18 Hz

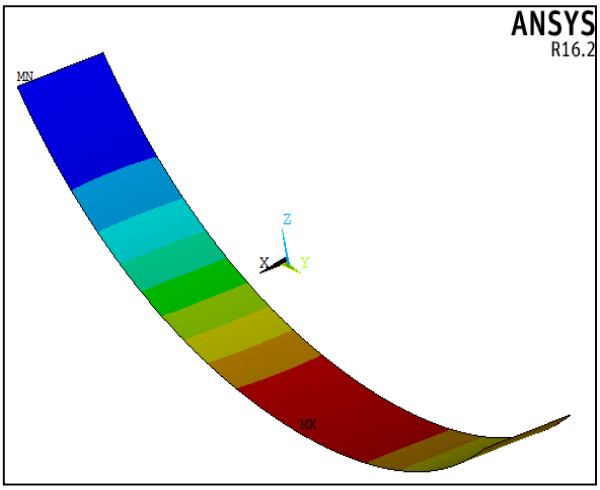

Fig. 3: First mode shape of 45- 45 configuration is 25.41 Hz

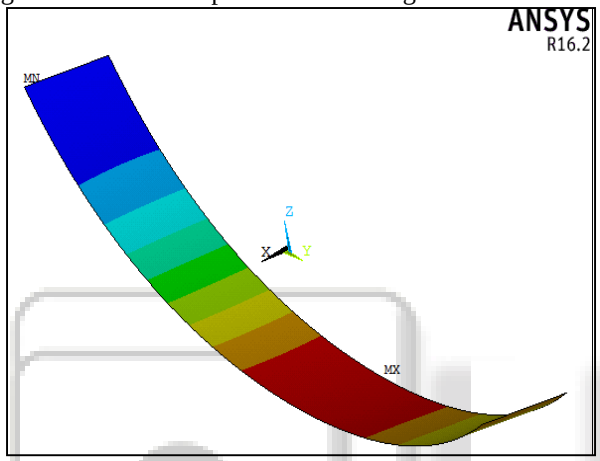

Fig. 4: First mode shape of 30-60 configuration is 26.27Hz

Sr.No.	Fibre Orientation	Natural Frequency of First Mode in Hz
1	0-90	31.05
2	0-45	29.18
3	45-45	25.41
4	30-60	26.72

Table 1: Results of Natural Frequency of Glass Fiber Epoxy Composite Leaf Spring.

The above table shows that the natural frequency is higher for 0-90 fibre orientation and minimum for 45-45 fibre orientation.

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