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Effect of Vibration on the Health of Driver of Three Wheeler Using ISO 2631

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ABSTRACT

The majority population in India depends on vehicle- 3 wheeler for transportation due to their poor economic condition. These vehicles are exposed to vibrations due to irregular surface of road or soil profile, engine vibration and condition of vehicle which affects the health as well as discomfort of the driver and passengers. These oscillations are transferred into the body of driver and passenger through the body tissues, organs and systems of the individual causing various effects on the structures within the body before it is dampened and dissipated. The literature review reveals that the vibrations are most hazardous to the health if it exceeds the limit. The experimental analysis is carried out to measure the magnitude of the vibrations acting on driver as well as passenger for the different road profile at different speed. The methodology adopted is as per the International Organization for Standardization (ISO) guidelines for whole body vibration (WBV) exposure having frequency ranges from 0 to 100 Hz. The study emphasis on vibration tests for different road and speed conditions by referring, ISO 2631 and human comfort charts.

***Keywords*— FFT analyzer, ISO-2631,acceleration level**

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I. INTRODUCTION

The composite materials represent an excellent possibility to design components with requirements of dynamic behavior show applications of these materials to several types of structures. The stiffness of the component can be changed according to stacking sequence which allows for the tailoring of the material to achieve the desired natural frequencies and respective mode shapes without changing its geometry drastically or increasing its weight. Thus, the main objective of this work is to contribute for a better understanding of the dynamic behaviour of components made from fiber reinforced composite materials, specifically for the case of plates. The composite materials are well known by their excellent combination of high structural stiffness and low weight. Their inherent anisotropy allows the designer to tailor the material in order to achieve the desired performance requirements. Thus, it is of fundamental importance to develop tools that allow the designer to obtain optimized designs considering the structural requirements, functional characteristics and restrictions imposed by the production process. Within these requirements, this work considers the dynamic behaviour of components manufactured from fiber reinforced composite materials. To this end, some plates of different dimensions will be taken for analysis. Experimental dynamic tests will be carried out using specimens with different numbers of layers of fibers & different orientations. From the results, the influence of the fibers orientations & number of layers on the natural frequencies and modal damping will be investigated. These experiments will be used to validate the FEM results obtained from the finite element analysis. Also FEM Results of steel plates will be compared with the

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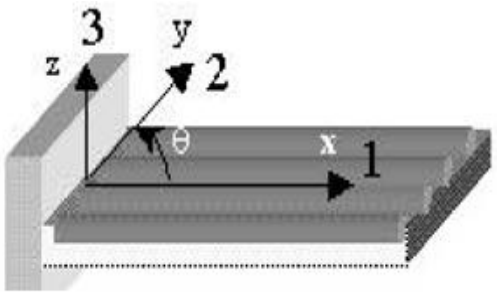
composite plate results. To avoid structural damages caused by undesirable vibrations, it is important to determine:

1. The natural frequencies of the structure to avoid resonance;
2. The mode shapes to reinforce the most flexible points or to determine the right positions to reduce weight or to increase damping; the main objective of this work is to contribute for a better understanding of the dynamic behavior of components made from fiber reinforced composite materials, specifically for the case of plates. In order to investigate the influence of the fiber orientations on dynamic behavior of the components, experimental and numerical analysis using the Finite Element Method is carried out. Different natural frequencies for the same geometry, mass and boundary conditions are obtained. This gives the designer one additional degree of freedom to design the laminate - the possibility to change fiber orientations in order to get a more (or less) damped structure. This possibility makes once more these materials very attractive since it makes possible to obtain the desired natural frequencies without increasing mass or changing geometry.

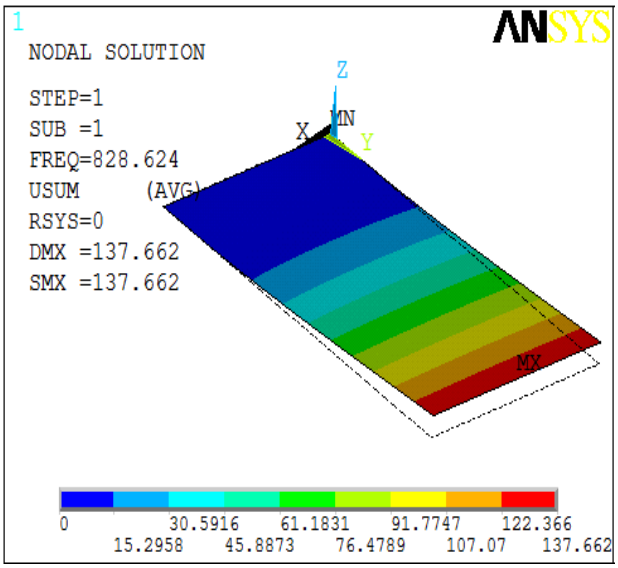
II. MATERIALS

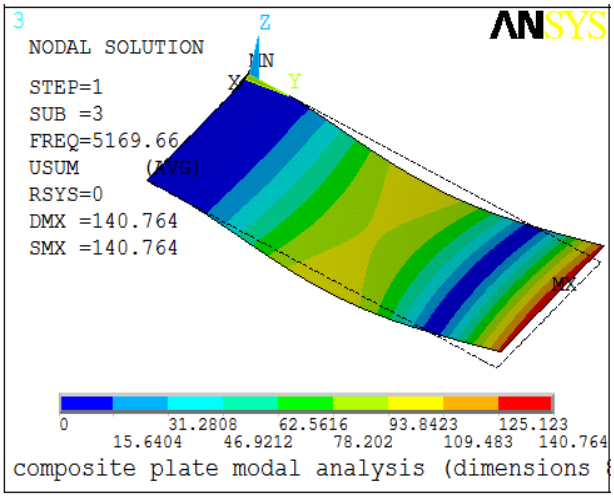
Glass fiber is to be used as reinforcement in the form of bi-directional fabric and epoxy resin with catalyst addition as matrix for the composite material. The mechanical properties of the composite will be calculated analytically using the simple rule-of-mixtures. More accurate values can be further obtained with some mechanical testing.

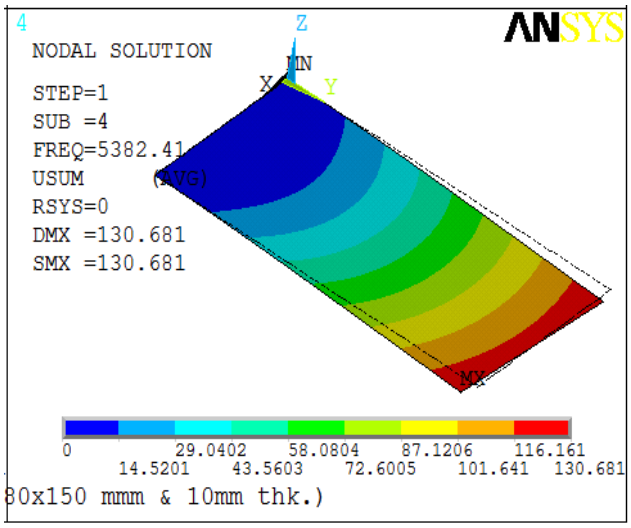
III. MODAL ANALYSIS USING THE FINITE ELEMENT METHOD



Material properties of composite material
Modulus of Elasticity (E)
in x dir=185000 Mpa
in Y dir=185000 Mpa
in Z dir=110000 Mpa
Poisson's ratio in xy,yz,xz plane=0.25
Density of Material =1900 kg/m3
Modal Analysis Results of Composite Plate 80 x 150 thk. 10mm







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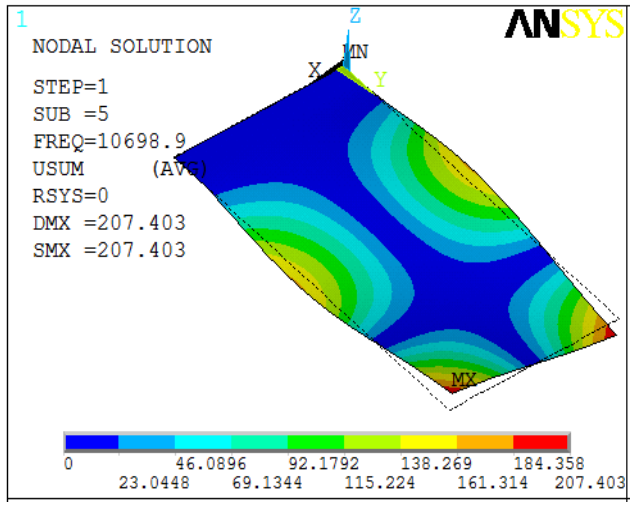

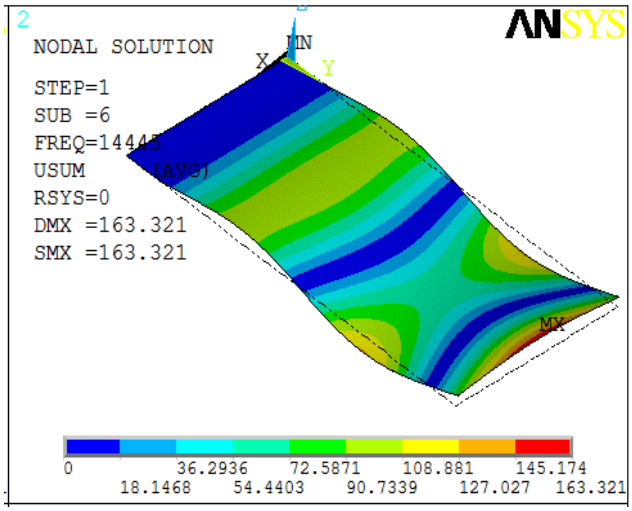

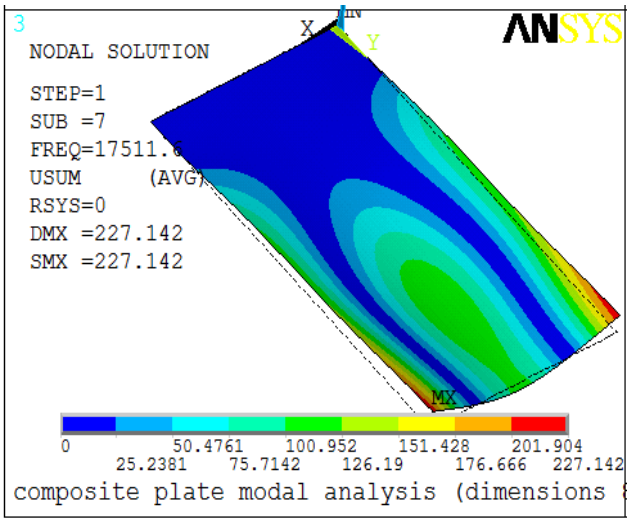

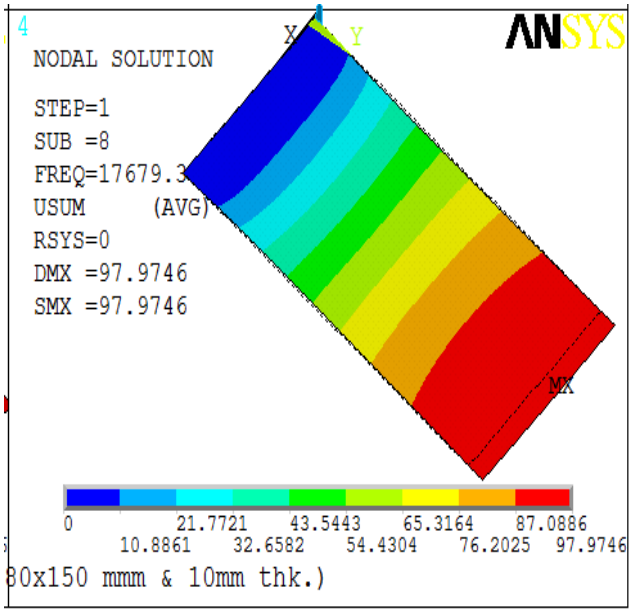

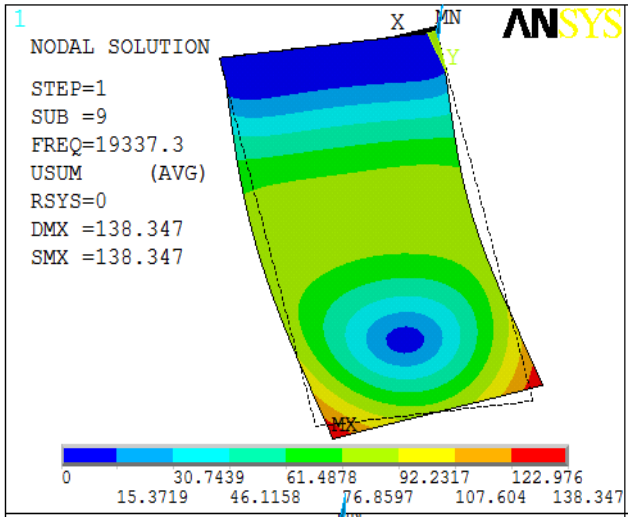

Fig.1 Different mode shapes of plate 10mm thickness

IV. EXPERIMENTAL ANALYSIS

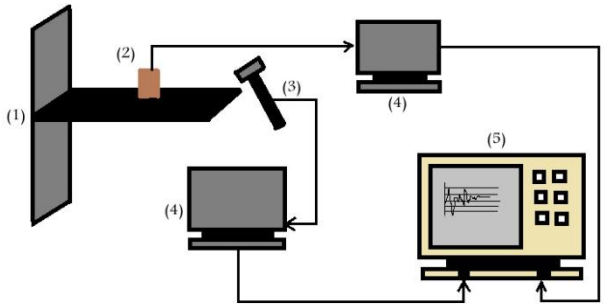

Fig.2 Experimental set up

Where,

(1) Cantilever beam
(2) Accelerometer
(3) Impact Hammer
(4) Power amplifier
(5) Spectrum Analyzer

The experimental set up for the analysis is as shown in fig.2. The cantilever plates are attached and impact hammers are used to hammer on the plate. Accelerometer

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gains the vibrations in the plate due to impact hammer and pass it to the power amplifier and then its is passed to the spectrum analyzer. Here we get the reading for natural frequency.

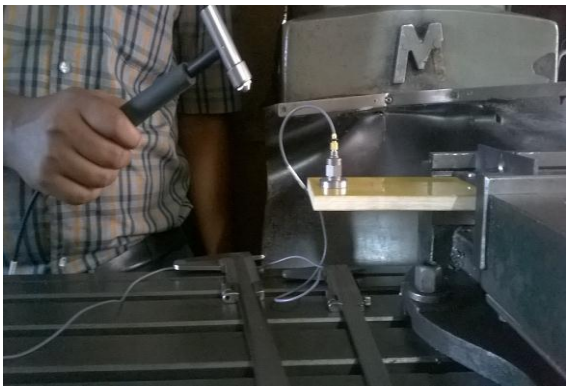

Fig. 3 Glass fibre plate under impact

IV. CONCLUSION

Experimental and Finite element analysis of cantilever plates made up of glass fibres has given significant results. These are stated as follows.

1. First 3 modes remains same still thickness is varied.
2. Natural frequency reduced by 50% when no. of layers are reduced by 50%. Thus study and analyze the effect of variables in composite cantilever work piece which increases the vibration levels in terms of natural frequencies. So that outcome data will be helpful to modify or redesign the plate in future. Similar ANSYS works for cantilever plates so as to save the time of experimentation for every new cantilever plates design or modification.
3. Approximately 8% difference is found in FEA & Experimental results due to damping's by the supporting material or imperfect tightening of nut bolts which is acceptable.

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