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Vibration Analysis of Composite Internal Door Panel of a Car

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***Abstract:** The main objective behind this paper is to develop a suitable model of internal door panel for cars, to conduct a static structural analysis of internal door panel by finite element method and to compare the performance of glass fiber material with previously recommended materials of internal door panel. This paper deals with the mechanical behavior and vibration analysis of glass fiber-based polymer composite beam structures. Glass fiber has been widely used for many applications due to its high strength, flexibility, stiffness and resistance to chemical this extended work the inactive basic Limited Component Investigation of inside entryway board of a vehicle by considering glass fiber composite materials was conducted. The entryway board of the vehicle was utilized to create the geometric show of the inward entryway board by CATIA V5 R20 modeling program. This 3-D geometric demonstration was imported to utilize ANSYS Workbench 19.0. Model analysis of the internal door panel has been done using ANSYS software.*

I. INTRODUCTION

Composite materials are generally non-homogenous materials containing at least two individual materials. These components are clearly noticeable, and thus between two components a clear boundary line exists. There are two categories of constituent materials i.e. matrix and reinforcement. The network fabric encompasses and bolsters the fortification materials by keeping up their relative positions. The reinforcements impart their mechanical and physical properties to enhance the matrix properties. Examples of composites are reinforced concrete, car tires, multiplex, etc. High-grade composites are based on high-grade fibers inserted into a high-grade polymer, a metal or another material. This Fiber reinforced material is used as construction material due to its mechanical properties. This material has very good mechanical properties (strength and stiffness) in the direction of the fiber, combined with a low mass density.The firmness of a component implies how much it avoids beneath a given stack. The quality of a fabric is its resistance to disappointment by changeless misshaping mechanical properties depend on the direction of the fiber.

The rapid renewability and suitable mechanical properties make glass an excellent reinforcing material for natural fiber reinforced thermoplastic composites. In the last decade, several studies have been carried out on development and characterization of glass fiber filled thermoplastic composites. The usage of lightweight materials such as plastics and their derivatives continue to increase in automobiles driven by the urgency for weight reduction. Fiber reinforced composites are preferred over more conventional isotropic materials, because they have unique advantages of being able to be engineered to achieve high specific strength and specific stiffness. Aim is to increase the strength of the internal door panel by using Composite material without change in its design and weight of the panel.

Composite materials are made up of natural fibers and polymer matrix which provides a variety of properties along with improvement in strength and durability. Composite materials are desirable in automotive interior components because of their low weight, high rigidity and good thermal and sound insulation.

II. METHODOLOGY

In this project, we are using composite material glass fiber instead of using plastic material. The inside entryway board of a car is ordinarily made of distinctive materials. Unlike the materials used on the exterior side of the vehicle door, the material on the interior side serves a more prominent reason other than fair tasteful request. The inside entryway board of a vehicle contributes to the generally usefulness and ergonomics of the ride, such as: armrests, different switches, lights, electronic frameworks just like the window controls and locking mechanism. 3D Show and drafting will be done with the assistance of the CATIA computer program. The Analysis of the components is done with the help of ANSYS using FEA. Comparative analysis between the existing material and composite material is done and then analysis result and conclusion will be drawn.

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A. Glass Fiber

Glass fiber is made up of extremely small fibers of glass. Glass fibers are light weight in nature. Glass fibers can be molded in any structure of desirable shapes. It can be used along with epoxy resins (as a binding agent) in various applications like making composite materials which are light weight in nature. It is used in the automobile industry in large amounts. It Can used for repairing components of car, furniture etc.



Fig. a Glass Fiber

B. Epoxy Resin

Mainly epoxy resin is used for adhesive purposes. It is commonly used in construction of vehicles, vehicle components, snowboards, bicycles and also aircrafts. It is also used for protecting the surface of the material and gives them a glossy finish.

C. Hardener

Hardener is mostly used as a curing agent. Hardener added in proper proportion in epoxy resin is essential for proper curing. When the hardener is mixed to resign in proper proportion then the chemical reaction starts and it turns the liquid mixture into a solid state. The time taken by the mixture to transform from liquid to become solid is known as curing time.

D. CAD Modeling

3D CAD Modeling is a geometrical language of representation of real components without missing information of the component. In this paper 3D CAD modeling is done by using CATIA V5 R20 modeling software by taking the actual dimension of a selected type of vehicle's internal door panel

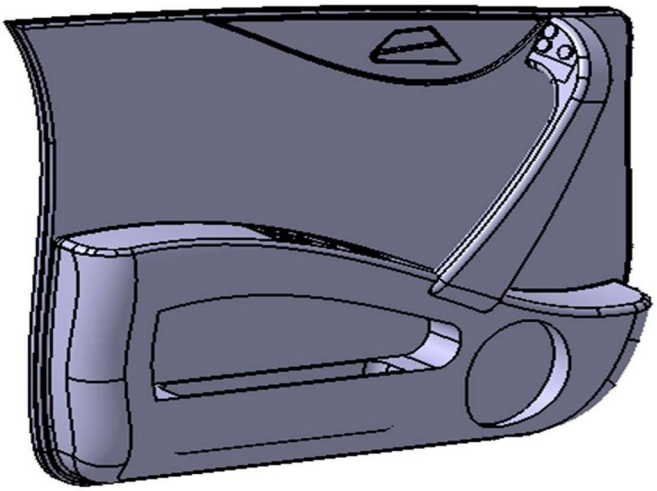


Fig. A. CAD Model

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E. Analysis

By using finite Element Method, analysis is done on software ANSYS Workbench 19.0. Purpose of this is getting maximum and minimum Equivalent stress and force reaction. Static structural analysis is used to determine stress, displacement, forces and strain. In it we have applied parallel meshing and given fixed support at edges of the door panel. While modal analysis is used for determining the natural frequency of a model at which the following structure will resonate. Later on, 5 mode shapes were generated. Material considered for analysis is existing material used in car door panels is plastic and new composite material is glass fiber composite material. Analysis of the door panel is shown in following figures.

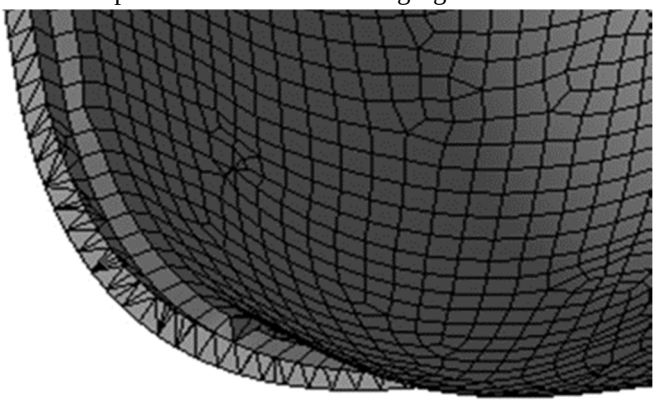


Fig. B. Meshing

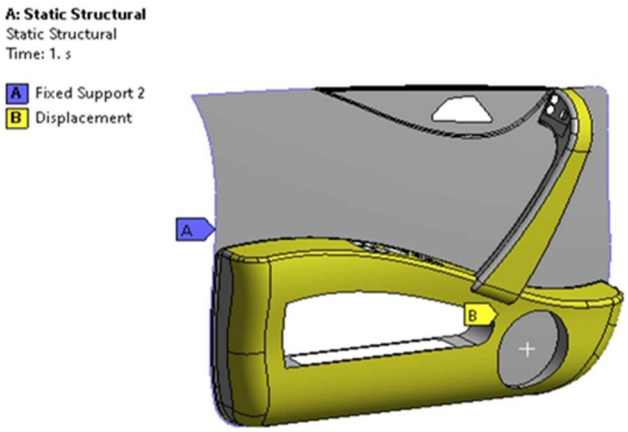


Fig. C. Boundary condition for plastic door

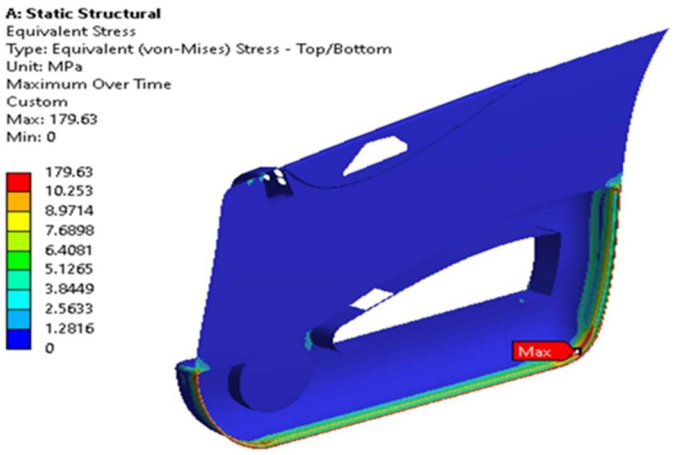


Fig. D. Equivalent stress result

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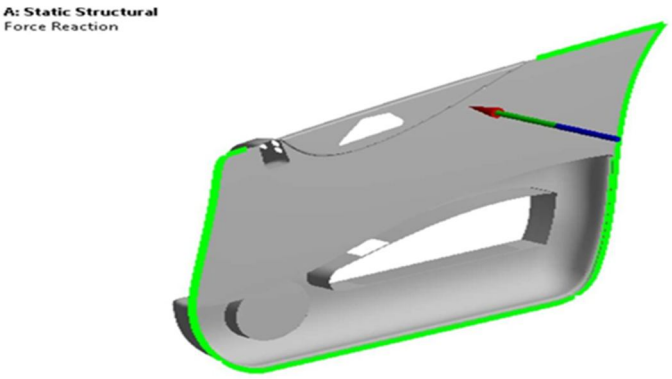


Fig. E. Force reaction for plastic door

Table: Plastic door force reaction results

Details of "Force Reaction"	
Maximum Value Over Time	
X Axis	1920.4 N
Y Axis	-1.4756e-007 N
Z Axis	1.8651e-007 N
Total	1920.4 N

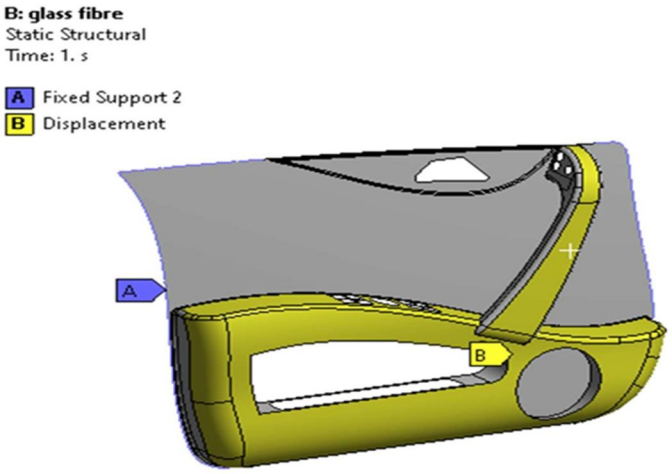


Fig. F. Boundary condition for glass fiber composite door.

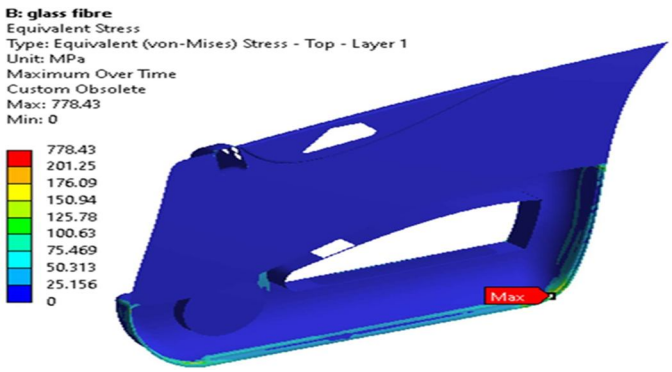


Fig. G. Equivalent stress result

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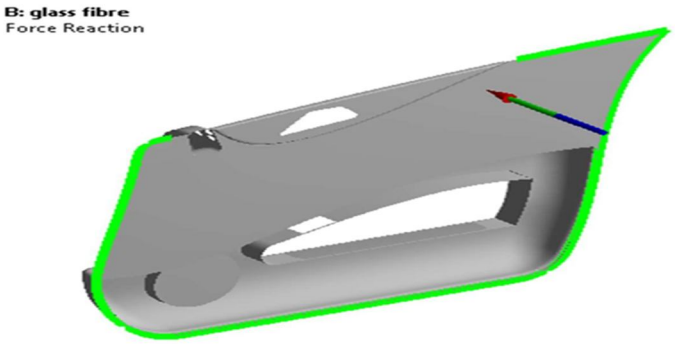


Fig. J. Force reaction for glass fiber composite door

Details of "Force Reaction"	
Maximum Value Over Time	
X Axis	30955 N
Y Axis	9.2299e-007 N
Z Axis	-1.6028e-006 N
Total	30955 N

Table: Glass fiber composite door force reaction results

III. CONCLUSION

Analysis of stresses and natural frequencies for different mode shapes for both existing plastic and proposed glass Fiber material done on ANSYS software using Finite Element Analysis. The 3D CAD model is prepared in Catia R20 using a surfacing tool.
Force Reaction developed in Glass Fiber is more than the existing plastic material hence it will be beneficial to use composite glass Fiber instead of plastic material. Also, natural frequencies at different mode shape for glass Fiber door panel are more than plastic door panel.

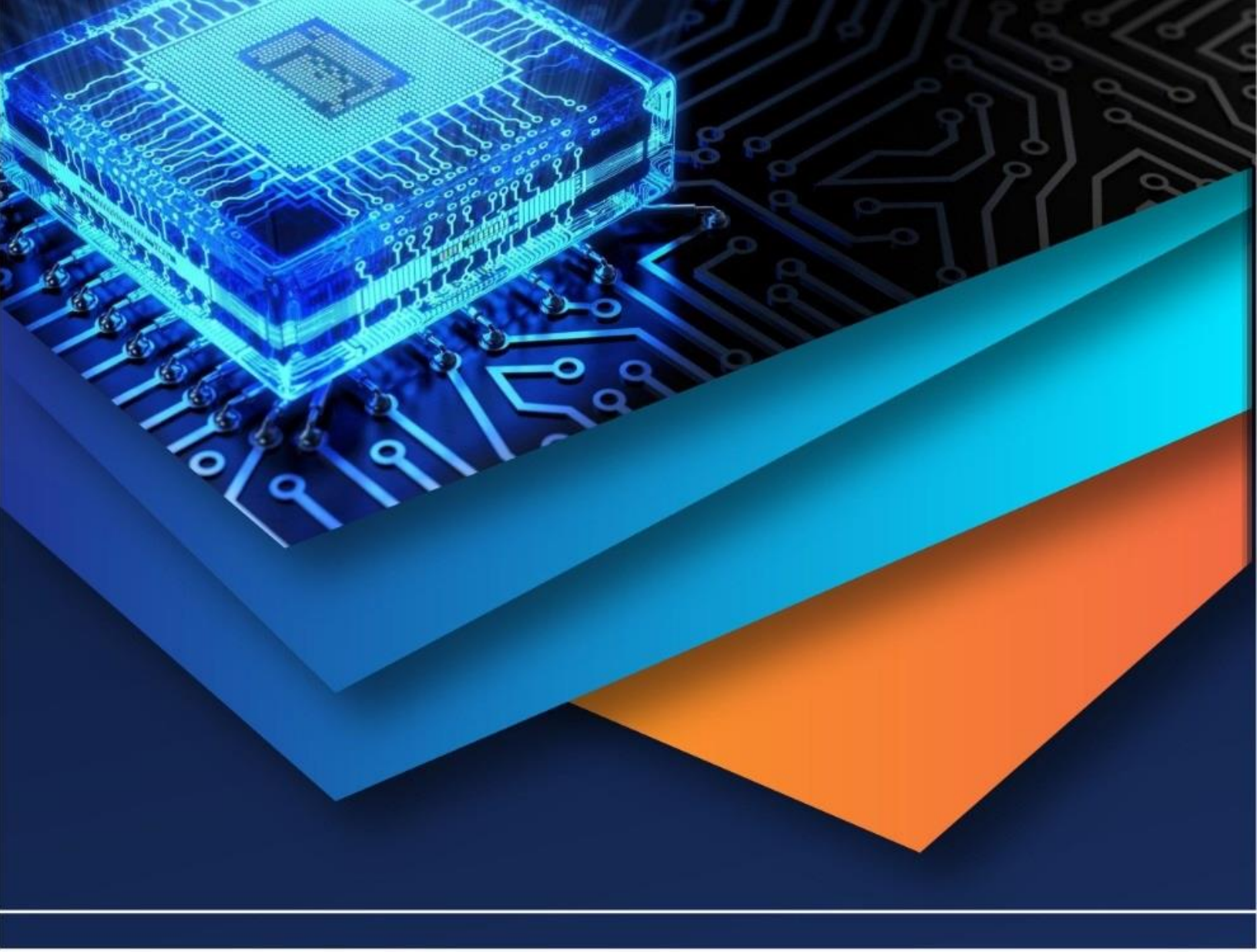
Material	Force reaction (N)
Plastic	1920.4
Glass fiber	30955

A. Scope

Glass fiber means composite material possess several advantages and can be used in many applications. Its properties like high strength, flexibility and high stiffness can be used for construction of lightweight, fuel-efficient vehicle structures.
Applying composite material in other automotive interiors, for example bonnet, dashboard etc is beneficial.

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