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Survey on Design and Analysis of Swift Car Chassis by Using Glass Fiber Material

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Abstract: The automotive chassis is considered to be one of the significant structures of an automobile. It is usually made up of steel frame, which holds the body and motor of an automotive vehicle. More precisely, automobile chassis is a skeletal frame on which various mechanical parts like engine, tires, axle assemblies, brakes, steering etc, are mounted. It provides strength and flexibility to vehicle. In the present work an attempt is made to replace the chassis frame made up of steel with a composite material like E-Glass Epoxy. At first the chassis frame is modelled by considering c-cross section in CATIA V5 software and then it is imported to ANSYS13.0. The analysis is done on E Glass Epoxy subjected to similar conditions as that of chassis made up of steel. The results are then estimated to finalise the best among two materials.

KEYWORDS: Chassis frame, E-Glass Epoxy, CATIA, ANSYS

I. INTRODUCTION

A chassis consist of an internal frame work that supports a man-made object in its construction and use. It is analogous to an animal skeleton. An example of a chassis is the under part of a motor vehicle, consisting of the frame on which the body is mounted. If the running year such as wheels and transmission, and sometimes even the driver seat, are included then the assembly is described as a rolling chassis. In the case of vehicles, the term rolling chassis means the frame plus the “running gear” like engine, transmission, drive shaft, differential and suspension.

A body sometimes referred to as “coach work” which is usually not necessary or integrity of the structure is built on the chassis to complete the vehicle. For commercial vehicles, a rolling chassis consist of an assembly of all the essential parts of a truck without the body to be ready for operation on the road. The design of a pleasure car chassis will be different than one for commercial vehicle manufacturers sell “chassis only”, “cowl and chassis”, as well as chassis cab versions that can be outfitted with specialized bodies. This includes motor home, fire engines, ambulances, box trucks etc.

For design and construction of lightweight transportation systems such as satellites, aircraft, high-speed trains and fast ferries, structural weight saving is one of the major considerations. To meet this requirement, sandwich construction is frequently used instead of increasing material thickness. This type of construction consists of thin two facing layers separated by a core material. Potential materials for sandwich facings are aluminium alloys, high tensile steels, titanium and composites depending on the specific mission requirement. Several types of core shapes and core material have been applied to the construction of sandwich structures. Among them, the honeycomb core that consists of very thin foils in the form of hexagonal cells perpendicular to the facings is the most popular. A sandwich construction provides excellent structural efficiency, i.e., with high ratio of strength to weight. Other advantages offered by sandwich construction are elimination of welding, superior insulating qualities and design versatility. Even if the concept of sandwich construction is not very new, it has primarily been adopted for non-strength part of structures in the last decade. This is because there are a variety of problem areas to be overcome when the sandwich construction is applied to design of dynamically loaded structures. To enhance the attractiveness of sandwich construction, it is thus essential to better understand the local strength characteristics of individual sandwich panel/beam members.

For configuration and development of lightweight transportation frameworks, for example, satellites, and airship, rapid prepares and quick ships, basic weight sparing is one of the real contemplations. To meet this necessity, sandwich development is as often as possible utilized as opposed to expanding material thickness. This sort of development comprises of slim two confronting layers isolated by a center material. Potential materials for sandwich facings are Aluminium amalgams, high pliable steels, titanium and composites relying upon the particular mission prerequisite. A

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few sorts of center shapes and center material have been connected to the development of sandwich structures. Among them, the honeycomb center that comprises of slender foils as hexagonal cells opposite to the facings is the most mainstream. A sandwich development gives great basic effectiveness, i.e., with high proportion of quality to weight. Different favorable circumstances offered by sandwich development are end of welding, unrivaled protecting qualities and outline adaptability. Regardless of the fact that the idea of sandwich development is not new, it has fundamentally been embraced for non-quality piece of structures in the most recent decade. This is on the grounds that there is an assortment of issue zones to be overcome when the sandwich development is connected to plan of progressively stacked structures. To upgrade the allure of sandwich development, it is in this way key to better comprehend the nearby quality attributes of individual sandwich board/shaft individuals. The point of the present study is to examine the quality attributes of Gglassfibre boards made of stainless steel and polypropylene material among others.

In addressing potential environmental problems and minimizing the waste material going to landfill, solving the problem related to recycling glass fibre reinforced plastic (GFRP) is important. The wide use in various sectors makes reliable waste volumes difficult to obtain, but it has been estimated that the annual production in Europe of glass fibre reinforced plastics products are 1.2 million tons1 and due to its considerable potential in various sectors, the volumes are expected to increase in all European countries. Technical characteristics, such as the material being corrosion resistant, easy to use and form in the manufacturing process, and light and easy to handle compared to metals, favour and motivate the use of glass fibre reinforced plastic. The project has mainly focused on the recycling of blades from wind turbines. This type of composite material typically consists of 70 wt.-% glass fibres and roughly 30 wt.-% of a thermosetting plastic. The energy content in such composites material is obviously very low and recycling by incineration is not an ideal solution. GFRPs are therefore often disposed of to landfill. However, the EU directive on the landfill of waste, 1999/31/EC, prohibits the landfilling of materials that contain more than 10 % organic materials. Since scrap composites must not be disposed of to landfill it is of paramount importance to develop methods to recycle scrap composites. It is also likely that the cost for landfill will continue increase in future. Thus, there are both economic and environmental incentives to develop new methods. The increasing amount of worn out products, such as wind turbine mills, boats or car parts containing composites motivates this project in finding a recycling solution through pyrolysis. GFRPs were recycled by means of microwave pyrolysis. This will result in an inorganic fraction mainly consisting a glass, pyrolysis oil and gas. The oil fraction was analysed with bomb calorimetry and by GC-MS. The oil largely consists of aromatic compounds such as styrene and toluene. The calorific energy content of the oil was 36 MJ/kg which is slightly lower than a petroleum based oils. The recovered glass fibres were characterised. Test showed that the fibres retained much of its tensile strength after the pyrolysis. However, virgin glass fibres a coated with a sizing. The purpose of the sizing is to increase the adhesion between the fibre and the plastic matrix. Test showed that the sizing was degraded after the pyrolysis. The recovered fibres were used to prepare new composites. Several methods were evaluated and both thermoplastic and thermoset composites were evaluated. Preparing thermoplastic composites from polypropylene (PP) and the recovered glass fibres were studied in detail. PP is often sold blended with chalk and sometimes with virgin glass fibres. Tests showed that the prepared composites had mechanical properties which were better than the commercial reference with chalk but not as good as the commercial reference with virgin glass fibres.

II. LITERATURE SURVEY

1 Swami K.I. et al.
The Automotive chassis is considered as the backbone of the vehicle. An important consideration in chassis design is to have adequate bending stiffness for better handling characteristics. So, strength and stiffness are two important criteria for the design of the chassis. This paper related with work performed towards the static structural analysis of the truck chassis. Structural systems like the chassis can be easily analyzed using the finite element techniques. So a proper finite element model of the chassis is to be developed. The chassis is modeled in ANSYS. Analysis is done using the same software".

2 Pankaj Saini and Ashish
Goel stated that the comparative analysis between the conventional steel leaf spring and composite material like polymer reinforced with glass fiber i:e Carbon epoxy, E-glass based epoxy and Graphite epoxy used for designing leaf spring. They done the modeling in the Auto-CAD 2012 software and ANSYS 9.0 used for analysis. the static analysis results shows that maximum displacement of conventional steel leaf is 10.16 mm and that for E-glass based epoxy is 15 mm for Graphite epoxy is 15.75 mm and for carbon/epoxy 16.21 mm the values of stress forconventional steel leaf is 67 N/mm and 163.22 Mpa, 663.68 Mpa, and 300 Mpa, for composite material resp. Out of that graphite epoxy has more stress the conventional material steel leaf so E-glass based epoxy leaf spring can be replaced from stress and

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strain point of view". "Design and Analysis of Composite Drive Shaft using ANSYS and Genetic Algorithm". This study deals with the review of optimization of drive shaft using the Genetic Algorithm and ANSYS. Here the replacement of the conventional steel is done by the composite materials of glass fiber of carbon fiber and optimization is done for further selection of most effective material Genetic algorithm technique is used. Substitution of composite material over the conventional steel material for drive shaft has increasing the advantages of design due to its high specific stiffness and strength".

3 N.V.Dhandapani, G Mohan kumar, K.K.Debnath
Have used Finite element methods to study the effect of various stress distribution using Ansys software. To investigate the field failure of 100Ton dumper they introduced gussets in failure area. After modification the chassis structure was validated by linear static analysis and found that the modified chassis was safe".

4 KutayYilmazcoban, Yasar Kahraman
have studied and optimized the thickness of a middle tonnage truck chassis by using Finite Element technique. The main objective of this work was to reduce the material usage through that gaining reduction in material cost. They had analyzed three types of thickness material to chassis and compared the results by stress and displacement. Study reveals that the 4mm thickness is safe enough to carry 15ton Load".

5 Jim Kindngerhas
Mentioned about lightweight structural cores. His paper describes brief about glass fiber material, cell configuration, application of glass fiber material. He also mentioned about manufacturing methods for glass fiber material, adhesive bonding and expansion, corrugation and adhesive bonding, corrugation and brazes welding, and extrusion. He mentioned cell configuration like hexagonal reinforced hexagonal, over expanded (ox), square, flex core, double flex-core spirally wrapped (tube core), cross core, circular with its specific applications. Most glass fibers are anisotropic that is properties are directional .it is also includes selection parameter about the core such as material, size, density, and mechanical properties. Hexagonal shape of unit cell is most popular as it is most efficient in structural efficiency so honeybees also preferred that shape. If you draw hexagon you will observe the angle between two adjacent sides are 1200.if you stretch this sides away from each other you will find different shapes of core. To understand this we have to first focus how to define different direction regarding unit cell.

6 C. W. Schwingshackl, G. S. Aglietti, and P. R. Cunningham [2]
Examined several available analytic and experimental methods to determine the orthotropic material properties of glass fiber structure. Fifteen published sets of simple equations for the material properties were reviewed and their values calculated for a specific glass fiber core. The same core was tested with ASTM standard methods and the agreement between the theoretical material properties and the experimental results was considered. To reduce the time and cost for the experimental determination, a simple technique for measuring the main dynamic material properties of glass fiber is introduced. A good agreement was found between the major theoretical out-of-plane material properties of glass fiber, the experimental ASTM methods, and the presented dynamic in this paper mainly focus is on calculation of orthotropic properties of glass fiber properties. The production process and the resulting geometry of the lightweight sandwich core create a highly orthotropic material with significantly different characteristics from the isotropic base material. The nine required core material properties are the two in-plane Young's moduli Ex ,Ey, the out-of-plane Young's modulus Ez, the in-plane shear modulus Gxy, the out of- plane shear moduli Gxz,Gyz, and the three Poisson ratios xy,xz,yz.

7 Harish R, Ramesh. S Sharma[3]
found out the effect of the core height on the fundamental natural frequency of glass fiber sandwich panels by both experimentally and by finite element method. Experimental modal testing was conducted on specimen by using traditional "strike method" for three boundary conditions viz. c-f-ff, c-f-c-f. The modal characteristics of specimens are obtained by studying its impulse response. Specimens are subjected to impulse through a hard tipped hammer which is provided with a force transducer and the response are measured through the accelerometer. Computer aided FFT analyser is used to extract the modal parameters with the aid of software by using the input obtained from accelerometer and hard tipped hammer. This paper explains sandwich theory in which only hexagon glass fiber core is equalized and orthotropic material properties are calculated. By using these material properties numerical simulation is carried .it is proved that increase in core height increase natural frequency of sandwich panel. Table no.2.1 shows list of formulae to equalize the glass fiber core.

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8 Sourabha S. Havaldar, Ramesh S. Sharma, Arul Prakash, M. D.
In this paper vacuum bag moulding technique is used for preparation of glass fiber panel and detailed process with figure is explained. it is low cost method as far as research is concern to made panel .Now variation of cell size shows that as cell size increase the natural frequency of panel decreases.

9 Antony Mohan Bangaru
have done remarkable work in investigation effect of parameter cell size on vibrational characteristic .They manufactured FRP glass fiber sandwich panel with varying size from 8mm to 20mm maintaining face thickness constant at around 1mm with two different condition C-F-F-F and C-F-C-F. The traditional strike hammer method is used has been used vibration characteristic. Each specimen has been subjected to impulses through a hard tipped hammer which is provided with a force transducer and the response has been measured through the accelerometer. The impulse and the response are processed through a computer aided FFT Analysing test system in order to extract the modal parameters with the aid of software. Finite Element modelling has been done treating the facing as an orthotropic laminate and Core as orthotropic with different elastic constants as recommended in the literature. The results are presented which show that the theoretical model can accurately predict the fundamental frequency and how glass fibers with different cell size will perform under dynamic loads.

10 DimitriosGarinis, MirkoDinulović, BoškoRašuo
have performed modal analysison modified Gazelle helicopter blade. The construction of the blade is fully compositewith the glass fiber core. The approach to determining structure mode shapes andnatural frequencies is presented. Modified blade consists of core material, 3Dunidirectional composite spar and thin carbon composite face sheets as blade skin. Todetermine the stiffness of the glass fiber core, the equivalent mass approach was used.Several methods of Eigen value extraction have been investigated in order to find optimalmethod which can be used in dynamic analysis of composite structures containingglass fiber cores. Among all extraction methods investigated, it was found that combinedLanczos method is most effective in terms of accuracy.CPU time for Eigen valueextraction in composite structures with glass fiber core having large number of degreesof freedom. Strain energies for first four mode shapes of modified helicopter blade havebeen calculated using numerical approach and results are presented.

III. PROPOSED SYSTEM

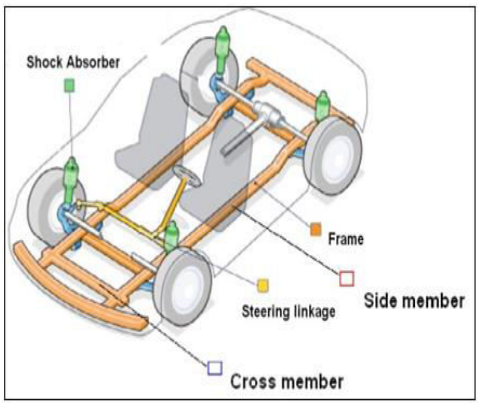

Fig1 Proposed System Chassis Layout

Automotive chassis is a skeletal frame on which various mechanical parts like engine, tires, axle assemblies, brakes, steering etc. are bolted. The chassis is considered to be the most significant component of an automobile. It is the most crucial element that gives strength and stability to the vehicle under different conditions. Automobile frames provide strength and flexibility to the automobile. The backbone of any automobile, it is the supporting frame to which the body of an engine, axle assemblies are affixed. Tie bars, that are essential parts of automotive frames, are fasteners that bind different auto parts together. Automotive chassis is considered to be one of the significant structures of an automobile. It is usually made of a steel frame, which holds the body and motor of an automotive vehicle. More precisely, automotive chassis or automobile chassis is a skeletal frame on which various mechanical parts like engine, tires, axle assemblies; brakes, steering etc. are bolted. At the time of manufacturing, the body of a vehicle is flexibly molded according to the structure of chassis. Automobile chassis is usually made of light sheet metal or composite plastics. It provides strength needed for supporting vehicular components and payload placed upon it. Automotive

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chassis or automobile chassis helps keep an automobile rigid, stiff and unbending. Auto chassis ensures low levels of noise, vibrations and harshness throughout the automobile.

IV. CONCLUSION

The goal of this study is to investigate the use of Glass Fiber as an alternative to the present automobile chassis. And will be tested under standard boundary conditions to determine its stress and deformation.

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