Structural Analysis of A Car Chassis By Using E-Glass Epoxy and Kevlar Composites

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Abstract- *The present usage of composite materials in car manufacturing industries is limited to the parts of the car body. This project aims in focusing the usage of composites to car chassis also, utilizing their capability in increasing the efficiency of the automobiles. The usage of these smart materials reflects the increase in efficiency of the system in terms of availability and strength.*

In this paper an attempt is made for checking the scope of composites in manufacturing Monocoque chassis of cars for better efficiency and safety, it is also helps us for indeed saving our earth from global warming.

In this paper design a base part of Monocoque chassis is modeled in Catia v5 software, and the structural analysis is done by using Ansys14.5 work bench. The composites of E-glass epoxy and Kevlar materials are used for chassis of three different models.

Keywords- automobiles, E-glass epoxy, Kevlar materials, Monocoque chassis, scope of composites, three different models.

I. INTRODUCTION

Vehicle frame

A vehicle frame, also known as its chassis, is the main supporting structure of a motor vehicle to which all other Components are attached, comparable to the skeleton of an organism.

Until the 1930s, virtually every (motor) vehicle had a structural frame, separate from the car's body. This construction design is known as body-on-frame. Since then, nearly all passenger cars have received uni-body construction, meaning their chassis and bodywork has been integrated into one another. The last UK mass-produced car with a separate chassis was the Triumph Herald, which was discontinued in 1971. However, nearly all trucks, buses and pickups continue to use a separate frame as their chassis.

Functions:

The main functions of a frame in motor vehicles are:

1. To support the vehicle's mechanical components and body
2. To deal with static and dynamic loads, without undue deflection or distortion.

These include:

- Weight of the body, passengers, and cargo loads.
- Vertical and torsion twisting transmitted by going over uneven surfaces.
- Transverse lateral forces caused by road conditions, side wind, and steering the vehicle.
- Torque from the engine and transmission.
- Longitudinal tensile forces from starting and acceleration, as well as compression from braking.
- Sudden impacts from collisions.

II. LITERATURE REVIEW

M. Ravi Chandra, S.SreenivasuluSyed, Altaf Hussain [1] this paper describes design and analysis of heavy vehicle chassis. Weight reduction is now the main issue in automobile industries. In the present work, the dimensions of an existing heavy vehicle chassis of a TATA 2515EX vehicle is taken for modeling and analysis of a heavy vehicle chassis with three different composite materials subjected to the same pressure as that of a steel chassis., he explains the various types of automobile chassis and performs the modeling and structural analysis in three different heavy vehicle chassis by the changing various materials. For validation the design is done by applying the vertical loads acting on the horizontal different cross sections.

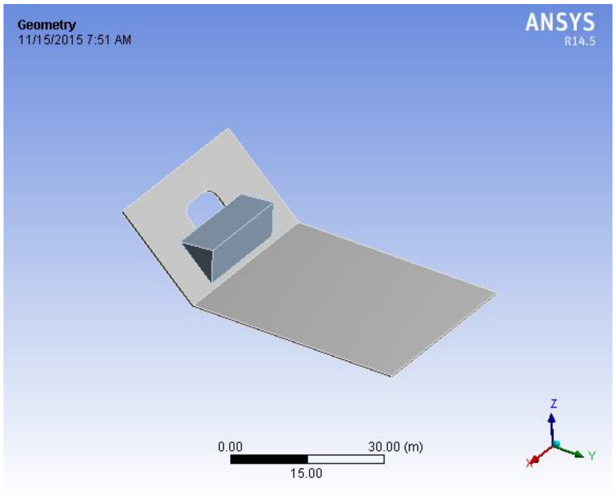
Carl Anderson Eurenius [2] the main goal is to achieve a guide of how to design the perfect chassis. This is done by identifying the area’s most vital to chassis performance and exploring these by studies and analyses. How it works and why the chassis of the cars are relevant to study is provided. A brief summary of chassis design aspects is included in order make sure the reader understands the methods and results of this report. Therefore, a static model is developed to investigate the effects of chassis rigidity, material options are researched on, aerodynamic properties are explored, performance simulations are conducted and guidelines for composite chassis design and manufacturing are established. The most important key performance indicators were found to be weight, torsional stiffness and the torsional stiffness to weight ratio.

Sairam Kotari, V.Gopinath [3] describes the analysis of chassis frame for improving its payload by adding stiffener and c channel at maximum stress region of chassis frame. The FEM analysis has been carried out with various alternatives. The results illuminate the new creative ways for optimum frame design which makes it more sustainable for structural concerns. This paper analyzed the backbone frame for both dynamic and static load condition with the stress deflection bending moment on the tetra chassis frame. The finite element analysis over ansys is performed by considering the load cases and boundary conditions for the stress analysis of the chassis.

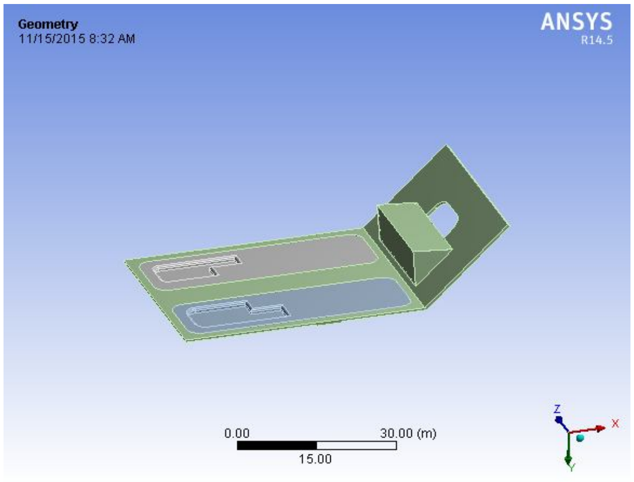
Salvi Gauri Sanjay, Kulkarni Abhijeet, Gandhi Pratik Pradeep, Baskar.P [4]
In this study traditional materials are replaced with ultra light weight carbon fiber Materials. High strength and low weight of carbon fibers makes it ideal for manufacturing automotive chassis. This paper depicts the modal and static structural analysis of TATA 407 fire truck chassis frame for steel as well as carbon fibers. From the analyzed results, stress, strain and total deformation values were compared for both the materials. Since it is easy to analyze structural systems by finite element method, the chassis is modified using PRO-E and the Finite Element Analysis is performed on ANSYS workbench.

III. ANALYSIS

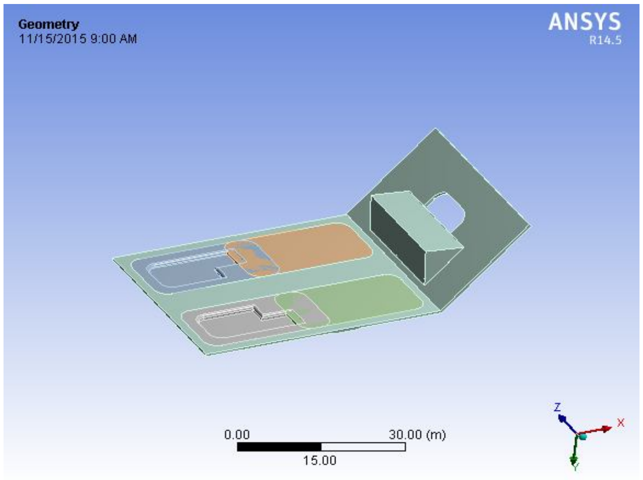
IMPORT MODEL 1



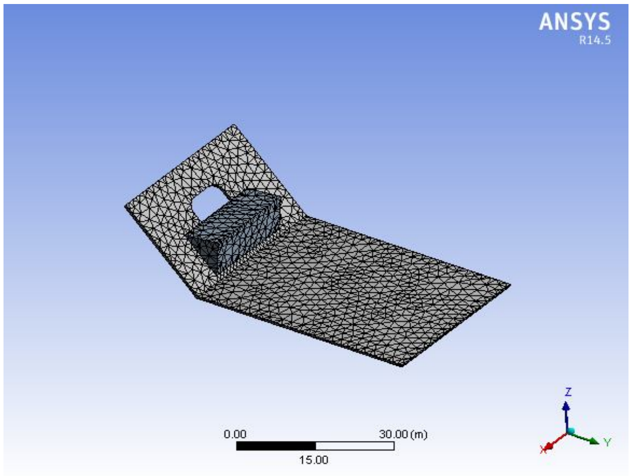
IMPORTE MODEL 2



IMPORT MODEL 3



MESHING MODEL 1



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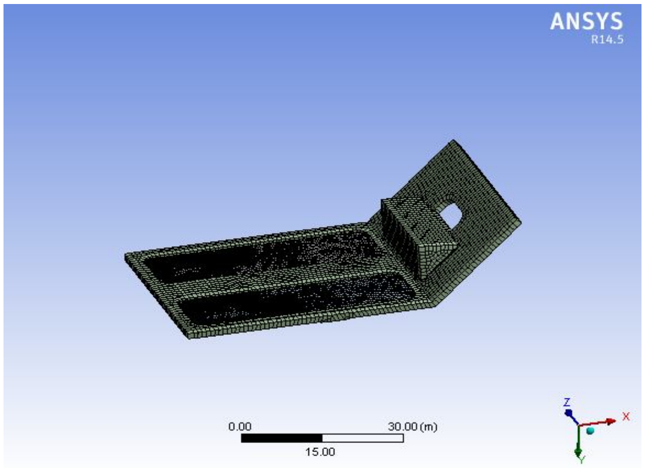

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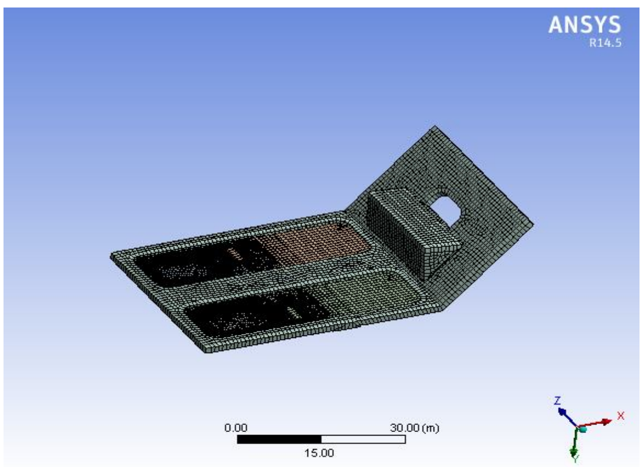
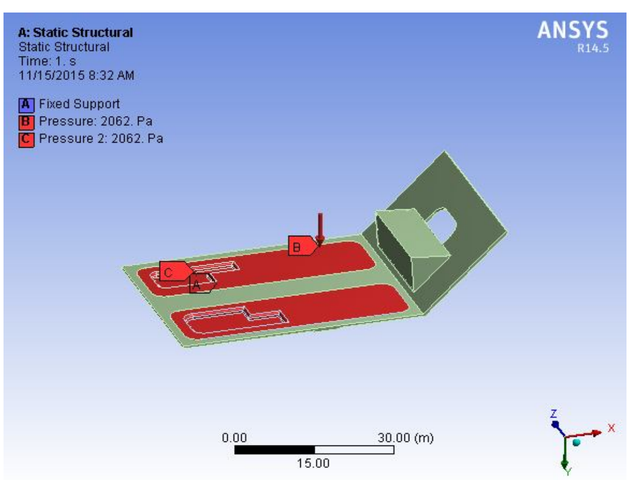
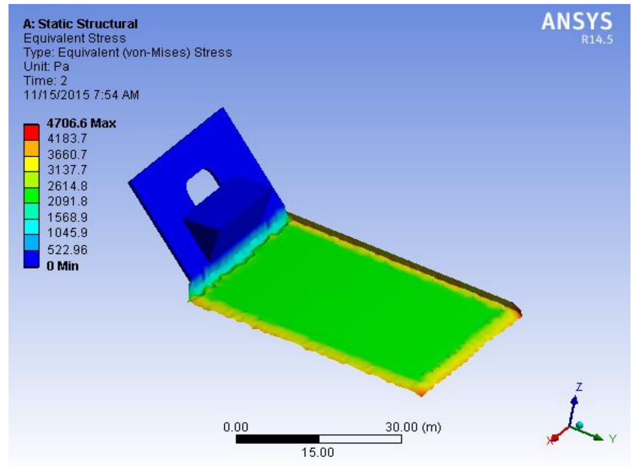


IMPORTED MODEL WITH E-GLASS EPOXY

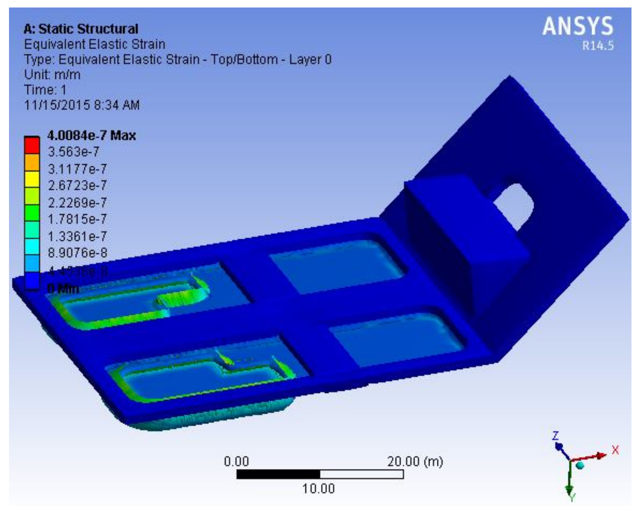
FORCES



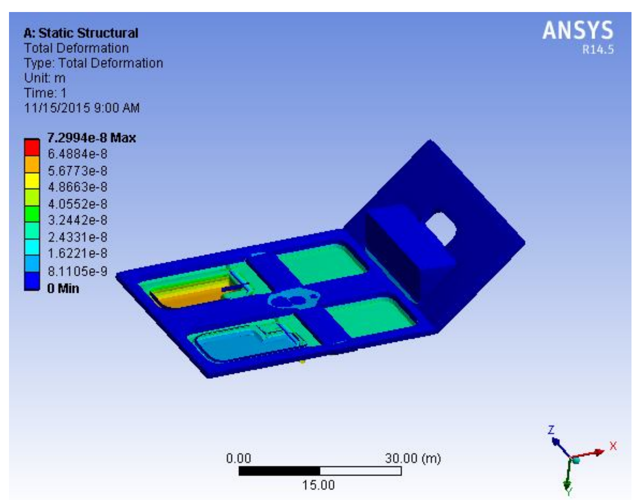
STRESS



STRAIN

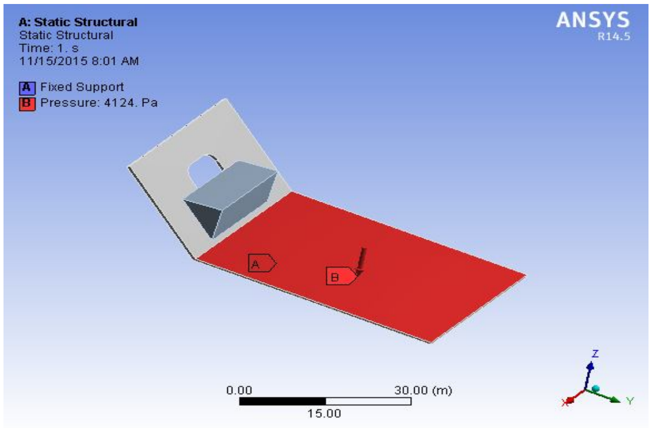


TOTAL DEFORMATION

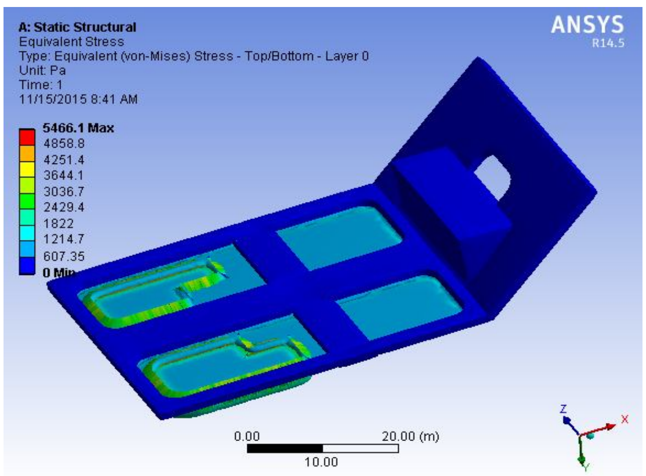


IMPORTED MODEL WITH KEVLAR MATERIAL

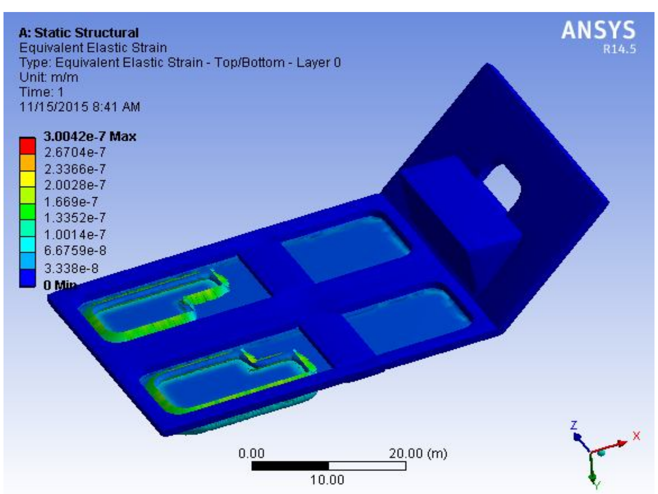
FORCES



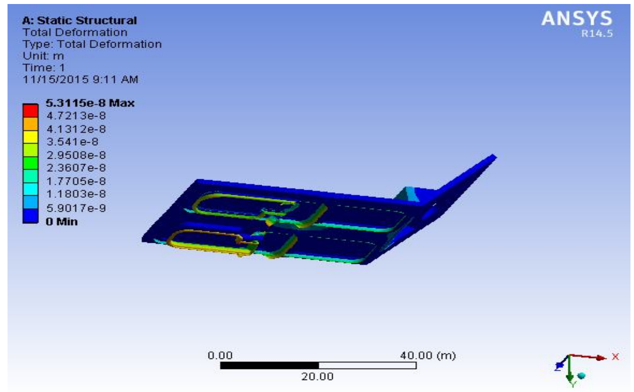
STRESS



STRAIN

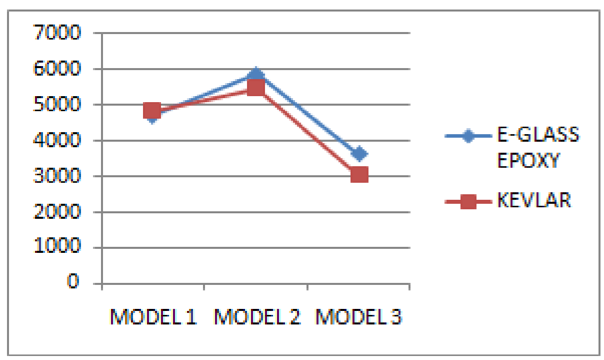


TOTAL DEFORMATION

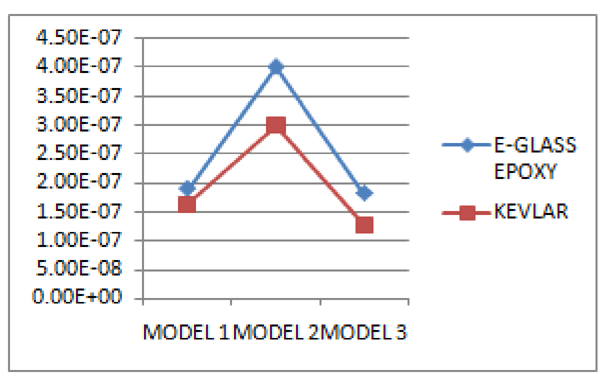


IV. RESULTS AND GRAPHS

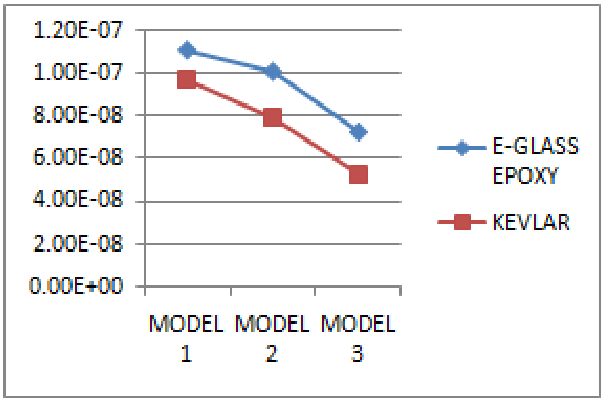
		STRESS	STRAIN	DEFORMATION
MODEL 1	E GLASS EPOXY	4706.6	1.90E-07	1.11E-07
	KEVLAR	4854.7	1.64E-07	9.74E-08
MODEL 2	E GLASS EPOXY	5861.5	4.01E-07	1.01E-07
	KEVLAR	5466.1	3.00E-07	7.97E-08
MODEL 3	E GLASS EPOXY	3620.9	1.82E-07	7.30E-08
	KEVLAR	3047.4	1.28E-07	5.31E-08



GRAPH 1.1 SHOWS STRESS VALUES OF E-GLASS EPOXY, KEVLAR MATERIAL



GRAPH 1.2 SHOWS STRAIN VALUES OF E GLASS EPOXY, KEVLAR MATERIAL



GRAPH 1.3 SHOWS DEFORMATION VALUES OF E GLASS EPOXY, KEVLAR MATERIAL

V. CONCLUSION

The present usage of composite materials in car manufacturing industries is limited to the parts of the car body. This project aims in focusing the usage of composites to car chassis also, utilizing their capability in increasing the efficiency of the automobiles. The usage of these smart materials reflects the increase in efficiency of the system in terms of availability and strength.

By the comparison of static analysis report of three different car chassis models with E-glass and Kevlar materials. It is conclude that from the model 3 KEVELAR is the better material when compared with the values of stress, strain and total deformation.

Hence by the comparison of the all the results obtained it is conclude that model 3 with Kevlar material is the best material which is having best output with better life.

REFERENCES

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[3] Sairam Kotari and V. Gopinath, “Static and dynamic analysis on tetra chassis”

[4] Salvi Gauri Sanjay, Kulkarni Abhijeet, Gandhi Pratik Pradeep, Baskar.P Finite Element Analysis of Fire Truck Chassis for Steel and Carbon Fiber Materials

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[2] Engineering composite materials Bryan Harris.

[3] The Composite Material Research Requirements of the Rail Industry Prepared by New Rail.