iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** VI **Month of publication:** June 2017

DOI:

www.ijraset.com

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Volume 5 Issue VI, June 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Review on Mathematical Modelling and Analysis of Automotive Chassis with Composites Materials Using Fem

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Abstract: ***The automotive chassis serves as a frame work for supporting the body and different parts of the automobile. Also, it has to withstand the shock, twist, vibration and other stresses caused due to sudden braking, acceleration, shocking road condition, centrifugal force while cornering and forces induced by its components. The chassis acts as the backbone of a heavy vehicle which carries the maximum load for all designed operating conditions.***
In current work we will study the i-section of the automotive chassis with various composite materials and compare the strength and weight to the existing material using fem method. This study will perform the static analysis using ansys software and cad modelling will be done in nx 8.5.
Kew words: Automotive Chassis, Fem, Ansys, E-Glass/Epoxy, Carbon/Epoxy Composites.

I. INTRODUCTION

The chassis is considered to be one of the significant structures of an automobile. It is the frame which holds both the car body and the power train. Various mechanical parts like the engine and the drive train, the axle assemblies including the wheels, the suspension parts, the brakes, the steering components, etc., are bolted onto the chassis. The chassis provides the strength needed for supporting the different vehicular components as well as the payload and helps to keep the automobile rigid and stiff. Consequently, the chassis is also an important component of the overall safety system. Furthermore, it ensures low levels of noise, vibrations and harshness throughout the automobile. Chassis should be rigid enough to withstand the shock, twist, vibration and other stresses. Along the strength, an important consideration is chassis design is to have adequate bending and torsional stiffness for better handling characteristics. So, strength and stiffness are two important criteria for the design of chassis. The load carrying structure is the chassis, so the chassis has to be so designed that it has to withstand the loads that are coming over it.

Finite element analysis is most widely used analysis technique due to its ease of use and good comparable results. By providing suitable boundary conditions on can do the analysis like static, modal and harmonic analysis In this paper Modal analysis is done to determine the natural vibrating frequency of the chassis frame by using steel-52, carbon fiber and E-glass epoxy Fiber and maximum deformation also coming out at particular natural frequency . After that Harmonic analysis of chassis frame is done in harmonic analysis the natural frequency at which at which maximum deformation is incur at chassis frame is taken as input and corresponding von misses stress is extract . On the basis of modal analysis and harmonic analysis a comparison is done of all the three material's which is been used in this comparative study. Many composite laminates have excellent fatigue strength to weight ratios and fatigue damage tolerances, hence it is considered as a major class of structural material and are either used or being considered as a replacement for metal in many weight-critical components in various industries. Composite materials with high damping capacity can be beneficial in many automotive applications where noise, vibration, and hardness are a critical issue for passenger comfort. The relevant information of an existing heavy vehicle chassis of EICHER is considered for design and analysis with different cross sections and for different combination of composites like Carbon/Epoxy and S-glass /Epoxy. The model of steel and polymeric composite heavy vehicle chassis was created in Pro-E and analysed with ANSYS for same load conditions. The best one is selected among the various combinations of composites and conventional steel chassis in terms of deflections and stresses. In the era of globalization and tough competition the use of heavy vehicles is increasing for the transportation works, considerable attention has been focused on designing of the heavy vehicles. Thus it is very much necessary for the designers to provide not only equipment of maximum reliability but also of minimum weight and cost, keeping design safe under all loading conditions by careful

stress analysis of the vehicles. Heavy Commercial Vehicles or alternatively Multi Axle Vehicles having gross vehicle weight upwards of 16.2 tons. Being a life line of the economy, these vehicles are an integral part of the commercial activity of any country and these vehicles are usually deployed in the long haul distance and in transportation of materials at the ports as also in the extraction of natural resources like Iron or Coal etc. In Modern vehicle, it is expected to fulfill the following functions:

i. Provide mounting points for the suspensions, the steering mechanism, the engine and gearbox, the final drive, the fuel tank and the seating for the occupants;

ii. Provide rigidity for accurate handling;

iii. Protect the occupants against external impact. While fulfilling these functions, the chassis should be light enough to reduce inertia and offer satisfactory performance. It should also be tough enough to resist fatigue loads that are produced due to interaction between the driver, engine, power transmission and road conditions.

II. LITERATURE

A. *Salvi Gauri Sanjay, Kulkarni Abhijeet, Gandhi Pratik Pradeep, Baskar P(2014),*

Chassis is the foremost component of an automobile that acts as the frame to support the vehicle body. Hence the frame ought to be very rigid and robust enough to resist shocks vibrations and stresses acting on a moving vehicle. Steel in its numerous forms is commonly used material for producing chassis and overtime aluminum has acquired its use. However, 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. 2. Archit Tomar & Dheer Singh(2016), In the case of vehicle the term frame means the part of automobile that holds all the important components all these components constitute together to from chassis. The chassis frame has to be robust enough to resist various forces due to undulation in surface of road or any other reason. Forces act on chassis frame like shock, twist vibration and also due to heavy weight of chassis fame add extra stress. Along with strength the most important in frame designing is to have sufficient bending stiffness. Natural frequency and also played most important role in chassis frame the excitation frequency and chassis frame frequency never match otherwise it create resonance and damage will incur in chassis frame. Now a day's lightweight material gained popularity worldwide due their high strength and less weight. This paper present the static structural analysis is done using FEA method, modal analysis of a chassis frame is done do determine natural frequency and corresponding Vibration mode shapes, and also design modification done to optimize weight of chassis frame to perform this work the chassis frame designed in CATIAV5R19 and analysis is done in ANSYS14.5 .Material used for chassis frame is steel 52 and carbon epoxy composite material. 3. A. Airale, M. Carello, A. Scattina (2011), Weight reduction and high mechanics performance are one of the challenges of the automotive industries future. A particular and interesting field is the application of carbon fibres in combination with structural foams. These allow to realize creative shapes for the car body but also strength and tough elements for the chassis, according to the necessity to combine style with design and engineering aspects. Nowadays, the problem of carbon fibre technology is the cost of production and the recyclability, so the major applications are in the racing field. One interesting application is the body of the prototype called IDRA, a low consumption vehicle which participated in the European Shell Eco-marathon. The chassis is a structural frame made with structural foam, the body is a part of the chassis and it is made of carbon fibre. The result is a well made car body integrated with all the sub-systems: steering, brakes, wheels, cockpit, electric wiring, controls, fuel cell, electric motor and transmission. The different design and production steps, from the concept phase and structural analysis made by means of finite element techniques to the production and the assembling of the monologue, are discussed.

III. OBJECTIVE OF THE STUDY

In earlier study different sections like C, I and box type is analysed with steel material and different loading condition is also taken in many cases. Based on the previous results it was inferred that steel with 'I' section has superior strength to withstand high load and induced low deformation and stress distribution when compared to other cross section.

In present study our main objective is to reduce chassis weight by replacing the rigid solid chassis with I-section chassis and also replacing conventional materials with composite materials Carbon fiber and E-glass epoxy. Numerical simulation techniques provides a great leverage in design optimization for weight reduction, better material utilization, shorter design cycles and elimination of major part of prototype testing. In this study the chassis frame will be modelled in CAD software and the further

analysis in ANSYS by using the composite material like Carbon fiber and E-Glass Epoxy.

IV. PROBLEM FORMULATION

Structural Analysis of Heavy Vehicle Chassis Dimensions of PCHVC (polymeric composite heavy vehicle chassis) are taken as that of the conventional SHVC (steel heavy vehicle chassis). Width of the chassis is 80mm and the properties of PCHVC vary with directions of fiber, a 3-D model of chassis is needed for analysis. The loading conditions are assumed to be static. The element has six degrees of freedom at each node translations in the nodal x, y, and z directions and rotations about the nodal x, y, and z-axes. The finite element analysis is carried out on

Table 1 Specifications of heavy vehicle chassis.

Parameters	Value
Material of the chassis	Steel 52
Chemical composition	0.20% C, 0.50% Si, 0.9% Mn, 0.03% P and 0.025% S
Side bar of the chassis	200 mm × 76 mm × 6 mm
Cross bar of the chassis	180 mm × 75 mm × 4 mm
Front overhang (a)	935 mm
Wheel base (b)	3800 mm
Rear overhang (c)	1620 mm
Young's modulus E	2×10^5 N/mm^2
Poisson ratio	0.3
Radius of gyration R	100 mm

V. PROPOSED METHODOLOGY

CAD Modelling: Creation of CAD Model by using CAD modelling tools for creating the geometry of the part/assembly of which we want to perform FEA.CAD model may be 2D or 3d.

Meshing: Meshing is a critical operation in FEM. In this operation, the CAD geometry is discretized into large numbers of small Element and nodes. The arrangement of nodes and element in space in a proper manner is called mesh. The analysis accuracy and duration depends on the mesh size and orientations. With the increase in mesh size (increasing no. of element) the FEM analysis speed decrease but the accuracy increase.

Basic steps of work

Pre-processing of the CAD geometry

A. Validation of the paper
B. Comparison of cases
C. 3D CAD modelling in UG-NX
D. Numerical modelling or discritization is to be done in Ansys
E. Defining the boundary condition
F. Model selection for the validation of the processes

VI. PROPOSED RESULTS

First, the Existing material is used in chassis design to facilitate comparison in terms of mass savings. Following are the proposed results which help to compare the different type of composites.

A. Stress
B. Deflection
C. Comparison of the static load, stress and deflection to the existing chassis at same dimensions.

In the present study we are going to validate the conventional results of steel chassis by FEM software in term of above given criteria.

VII. CONCLUSION

Automotive Chassis structural design and analysis has been the focus of a number of previous works. The review of some of the previously conducted work related to vehicle structural design, analysis and optimization using Ansys software is surveyed. From FEM Simulation Results we will analyze that I section of chassis frame with different composites and compare with the basis of strength using FEM method.

REFERENCES

[1] Salvi Gauri Sanjay, Kulkarni Abhijeet, Gandhi Pratik Pradeep, Baskar P – "Finite Element Analysis of Fire Truck Chassis for Steel and Carbon Fiber Materials" Salvi Gauri Sanjay et al Int. Journal of Engineering Research and Applications www.ijera.com ISSN : 2248-9622, Vol. 4, Issue 7(Version 2), July 2014, pp.69-7

[2] Archit Tomar1 & Dheer Singh – "Static Analysis, Modal Analysis and Design Modification in Chassis Frame to Optimize Weight by Using Composite Material" International Journal of Mechanical Engineering (IJME) ISSN(P): 2319-2240 ; ISSN(E): 2319-2259 Vol. 5, Issue 1, Dec – Jan 2016, 101-108 © IASE

[3] Airale, M. Carello, A. Scattina – "Carbon fiber monocoque for a hydrogen prototype for low consumption challenge" Volume - 42,Issue, 5 May2011 Pages 386-39

[4] Divyesh N. Chaudhari , Prof. Vinod M. Makwana, Prof. Dharmeet J. Patel – "A Review Paper on Strength and Rigidity analysis of Heavy Vehicle Chassis for different frame cross section by analytically and FEA under various loading condition" International Journal of Advance Research in Engineering, Science & Technology(IJAREST), ISSN(O):2393-9877, ISSN(P): 2394-2444, Volume 2,Issue 12, December-2015, Impact Factor: 2.12

[5] Singarajan Nagammal Vijayan1 and Sathiavelu Sendhilkumar – "Structural Analysis of Automotive Chassis Considering Cross-Section and Material" Int. J. Mech. Eng. Autom. Volume 2, Number 8, 2015, pp. 370-376 Received: June 28, 2015; Published: August 25, 201

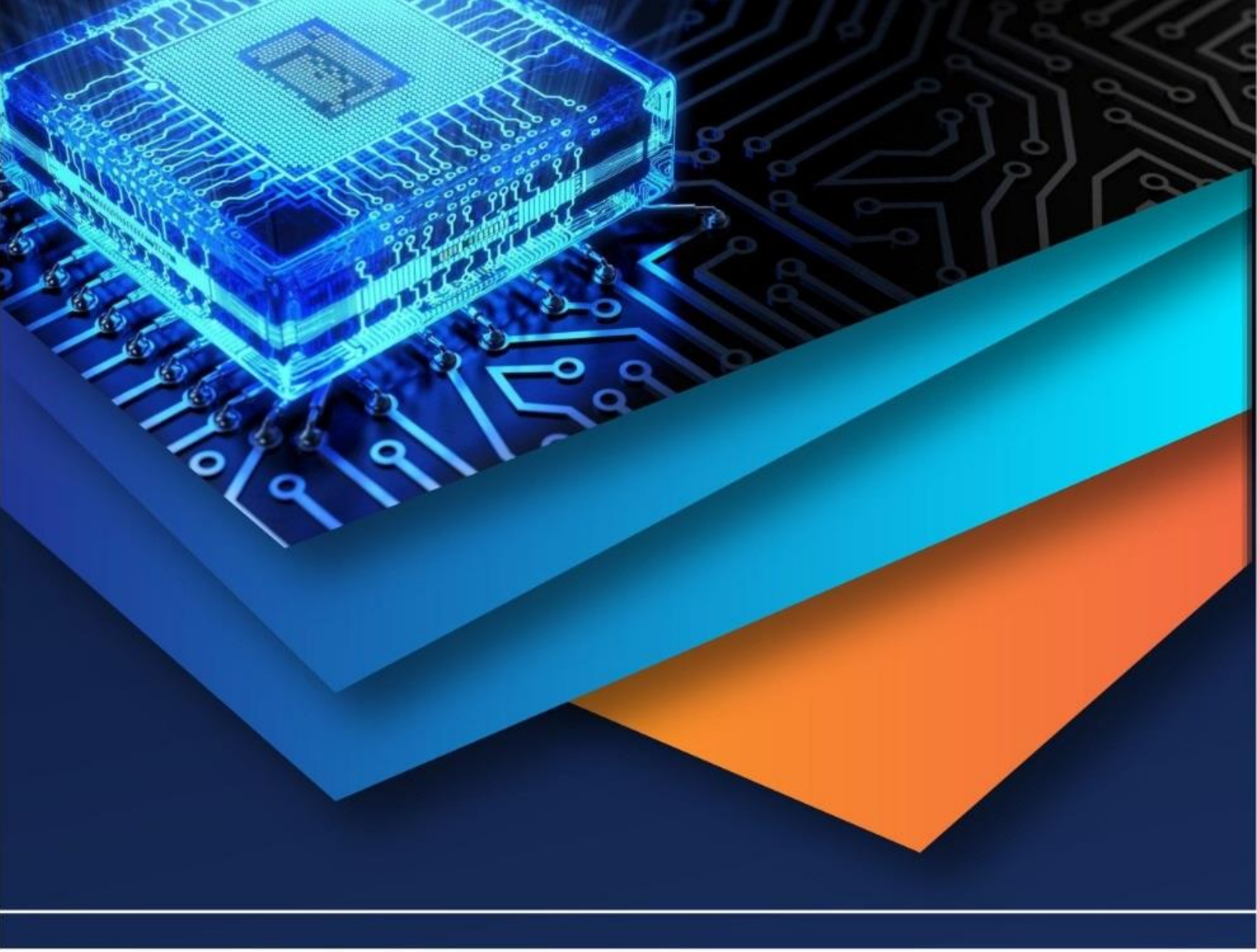
[6] Vijayan S N, S Karthik, K Maharaja – "Finite Element Analysis of Automotive Chassis with Various Cross-Section" ISBN 978-81-929866-6-1, VOL 02 Website icssccet.org email icssccet@asdf.res.in Received 25 – February – 2016 Accepted 10 - March – 2016 Article ID ICSSCCET037 eaid ICSSCCET.2016.03

[7] .Archit Tomar1 & Dheer Singh – "Modelling and Analysis of a Chassis Frame by Using Carbon Fiber and E-Glass Epoxy as Composite Material: A Comparative Study" International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395 -0056, Volume: 03 Issue: 04 | April-2016, p-ISSN: 2395-007

[8] Vijayan.S.N, S.Sendhilkumar, M.Prakash – "Effect of Cross-Sections Considering Material and Design Aspects in Automotive Chassis" IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684,p-ISSN: 2320-334X, Volume 12, Issue 5 Ver. I (Sep. - Oct. 2015), PP 86-9

[9] Seelam Sreekanth Reddy, G.Amarnath – "Modeling and Analysis of Automobile Chassis Using Honeycomb Sandwich Structure" International journal & magazine of engineering, technology, management and research ISSN 2348-4845, vol-3 (2016), Issue no-11 (November

[10] Jagbhooshan Patel; Veerendra Kumar – "Finite Element Analysis of Mono Composite Leaf Spring: A Review:" International Journal of Engineering Sciences & Research Technology (IJESRT) (Vol.3, No. 5), 30-05-2014



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