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Simulation and Anlysis of Automotive Chassis

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ABSTRACT—Theterm "chassis" refers to the Truck fundamental framework. It is also known as the carrying unit because the body and all other units are attached on it. The chassis is subjected to a variety of loads, including inertia loads, static loads, over loads, etc. In addition, it must endure the forces produced by abrupt braking and accelerating. The stress analysis of chassis using finite element analysis software programs like ANSYS, HyperWorks, etc. has been reviewed in this study. As designers work to remove extra weight from the current vehicle design, weight reduction is taking on more significance. The numerous methods for reducing the weight of the chassis are reviewed.

Keywords—CHASSIS, ANSYS, NX CAD.

I. INTRODUCTION

ATruck chassis is a major component in a vehicle system. This work involves static and dynamics analysis to determine the key characteristics of a truck chassis. The static characteristics include identifying location of high stress area and determining the torsion stiffness of the chassis. The dynamic characteristics of truck chassis such as the natural frequency and mode shape were determined by using finite element (FE) method. Experimental modal analysis was carried out to validate the FE models. Modal updating of the truck chassis model was done by adjusting the selective properties such as mass density and Poisson's ratio. Predicted natural frequency and mode shape were validated against the experimental results. Finally, the modification of the updated FE truck chassis model was proposed to reduce the vibration, improve the strength and optimize the weight of the truck chassis. The major area of concern in the truck chassis was structural resonance at 52 Hz, experienced during the torsional and bending modes. Modifications to shift natural frequencies were proposed by increasing the thickness of the chassis center section by 2 mm and additional stiffener members located at the center of the base plate with a thickness of 10 mm. The overall modifications resulted in the natural frequency shifted by 13 % higher than the original value, increased the torsion stiffness by 25 % and reduced the total deflection by 16 %. The overall weight of the new truck chassis was increased by7%.

II. LITERATURE REVIEW

VijaykumarV.Patel

Patel have used structural analysis analysis to study the Eicher E2's ladder chassis frame. In this study, the chassis was envisioned as a straightforwardly supported beam with an overhang. Software from Ansys and Pro-E were used in this project. The analytical evaluation of chassis was also a part of the investigation. When the results of the software analysis and the analytical calculations were compared, it was discovered that the displacement was 5.92 percent higher and the stress value produced from the software analysis was 10% higher.

KutayYilmazcoban

Yasar Kahraman used the Finite Element method to analyse and improve the thickness of a medium tonnage truck chassis. The main goal of this project was to decrease material utilisation in order to lower material costs. They evaluated the findings of stress and displacement after analysing three different types of thickness material for the chassis. According to a study, 4 mm of thickness is secure enough to support a 15 tonne load.

V.Veloso

Examined the vehicle's longitudinal stringer failure. During the durability test, failure was seen at the car suspension's fixation points close to the bumpers. The component was fractured as a result of an initial crack that grew over time. They

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looked into six different sorts of reinforcement to address this issue. Using hyper mesh software to assess all six forms of reinforcement techniques, it was determined that the sixth type of reinforcement produced the best outcomes. Based on software results, laboratory tests were performed, and no failures were found. They reduced the number of laboratory tests used and got better findings faster by using the software analysis. Consequently, the majority of testing expenses are cut.

John George

Illuminated about the cyclic test of a chassis model compare with monotonic test. The plasticity or plastic deformation resulting of stress concentration on the critical area of the chassis. The system studied and experienced about the plastic deformation. The software used Hypermesh and ANSYS.

Shivakumar MM

Detailed discussion about the modal analysis for the prediction of dynamic characteristic of truck chassis such as mode shape and frequency response, stress and deformation. These are the important output results for design of chassis. The maximum distortion energy theory applied and determine the criterion for failure. The factor of safety assumed to be 2.0 and allowable stress is less than the yield stress. The fatigue failure behaviour is a most important parameter hence the fatigue life of excited shear force and bending moment diagram of a chassis.

VARIOUS LOAD ACTING ON FRAME

- Short duration load – crossing broken patch
- Momentary duration load – taking a curve
- Impact load – collision of the vehicle
- Inertia load – while applying brakes
- Static load – due to chassis parts
- Over load – Beyond design capacity.

SCOPE OF STUDY

There are three scope of study for this dissertation of finite element analysis of Chassis. There are:

Modeling the 3D of chassis with using SOLIDWORK software. Structural and thermal analysis carried on by using Finite element software ANSYS. Results are discussed for Structural Steel and Magnesium alloy.

OBJECTIVES

The following are the objectives of the study
•To study basic principle of working of chassis.
• To investigate the problems occurs in the chassis.
• To prepare 3D CAD model of chassis geometry .
• To perform Finite element analysis of chassis geometry with natural boundary conditions.
• To suggests the remedial actions, new material, and different shapes for chassis geometry to solve the failures

GEOMETRICAL PARAMETERS OF CHASSIS

Maximum engine Torque : 685 Nm @ 1400 rpm

Performance of Vehicle:
• Gross Vehicle Weight (GVW): 25000kg.
• Gross Combined Weight (GVW + Payload): 26200kg.
• Maximum Gear speed: 78 km/hr.
• Frame: Ladder type heavy duty frame, Depth285mm, width-65mm, frame width-884mm.
• Weights (kg):
• Max. permissible GVW = 25000 Max.
• permissible FAW = 6000 Max.
• permissible RAW = 19000
• Side bar of the chassis are made from "C" Channels with116mm x25mm x5 mm
• Front Overhang (a) = 740 mm
• Rear Overhang (c) = 1400 mm
• Wheel Base (b) = 6670 mm
• Material of the chassis is St 52 E = 2.10 x 105 N /
Total load acting on chassis= Capacity of the Chassis + Weight of body and engine = (25000+600+400+200)*9.81 = 257022N Chassis has two beams.
load acting on beam is half of the Load acting on the single frame = 257022 / 2 = 128511N /
Beam Moment of inertia around the x-x axis = 1266840 mm^4
Section of modulus about X-X axis = 21842.06897 mm^3 stress produced on the beam= 3297.422 N/mm^2

PROBLEM DEFINITION

This project is mainly carried out with the intention of selecting the suitable material of the chassis.The chassis, it is modeled in Pro/Engineer software packages. Structural and thermal analysis iscarried out in ANSYS software determining stress, deformation and elastic strain are formed due topressure on the chassis.

SOLID WORKS

Typically, we begin with a sketch, create a base feature, and then add more features to the model. (One can also begin with an imported surface or solid geometry). We are free to refine our design by adding, changing, or reordering features. Associatively between parts, assemblies, and drawings assures that changes made to one view are automatically made to all other views. We can generate drawings or assemblies at any time in the design process. The Solid Works software lets us customize functionality to suit our needs.

MATERIAL PROPERTY
STRUCTURAL STEEL

Structural Steel

Fatigue Data at zero mean stress comes from 1998 ASME BPV Code, Section 8, Div 2, Table 5-110.1

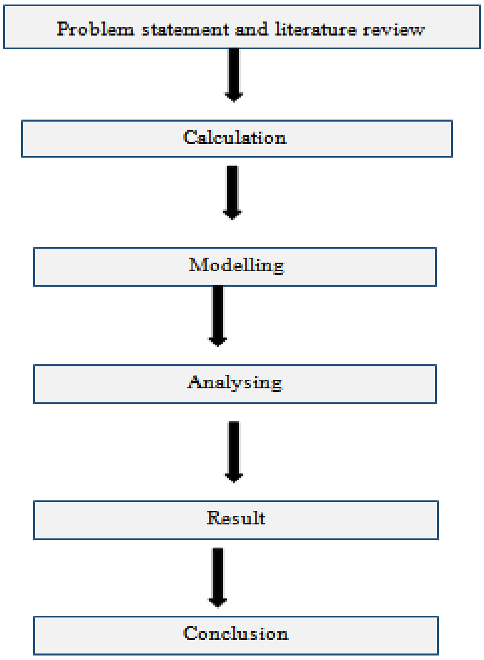
Density	7850 kg/m³
Structural	
Isotropic Elasticity	
Derive from	Young's Modulus and Poisson's Ratio
Young's Modulus	2e+11 Pa
Poisson's Ratio	0.3
Bulk Modulus	1.6667e+11 Pa
Shear Modulus	7.6923e+10 Pa
Isotropic Secant Coefficient of Thermal Expansion	1.2e-05 1/°C
Compressive Ultimate Strength	0 Pa
Compressive Yield Strength	2.5e+08 Pa

MAGNESIUM ALLOY

Magnesium Alloy

Density	1800 kg/m³
Structural	
Isotropic Elasticity	
Derive from	Young's Modulus and Poisson's Ratio
Young's Modulus	4.5e+10 Pa
Poisson's Ratio	0.35
Bulk Modulus	5e+10 Pa
Shear Modulus	1.6667e+10 Pa
Isotropic Secant Coefficient of Thermal Expansion	2.6e-05 1/°C
Compressive Ultimate Strength	0 Pa
Compressive Yield Strength	1.93e+08 Pa
Tensile Ultimate Strength	2.55e+08 Pa
Tensile Yield Strength	1.93e+08 Pa

III. METHODOLOGY



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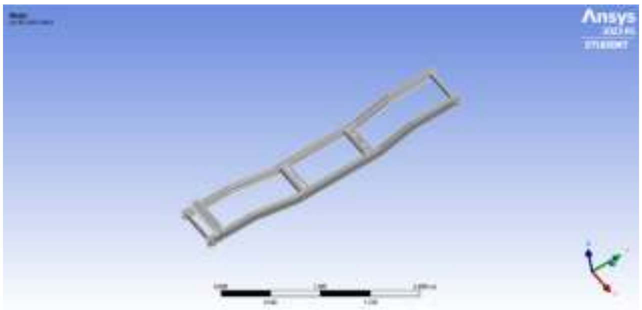
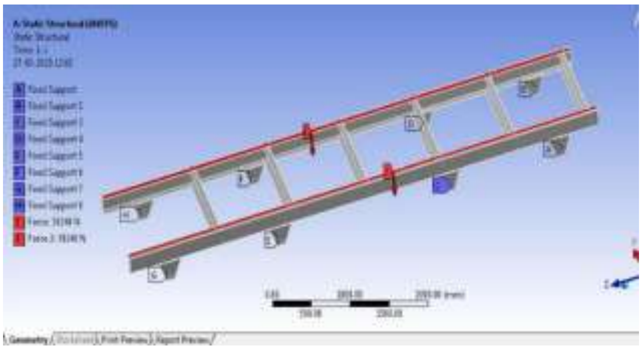
ANALYSINGMODEL:

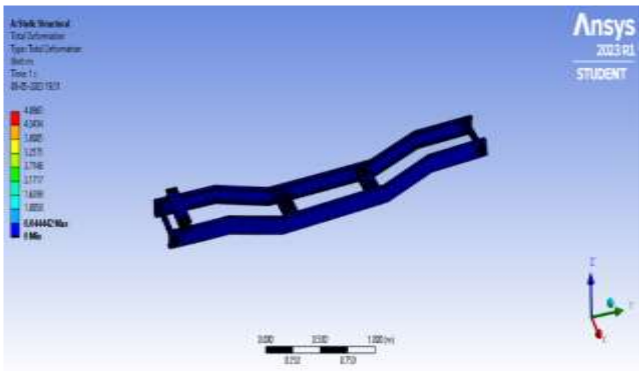


FORCE AND LOADS ACTING:

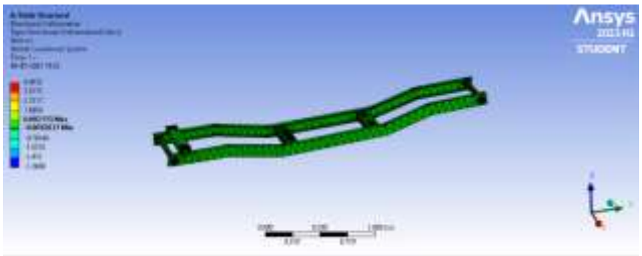


MESHED COMPONENT:

DEFORMATION:

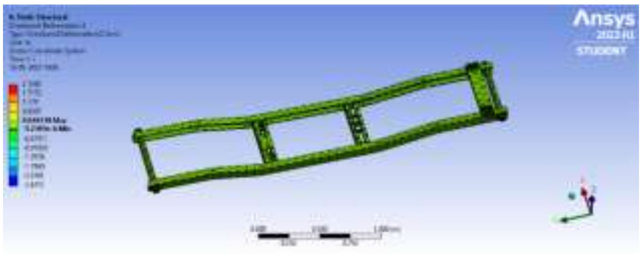


DEFORMATION IN X-AXIX

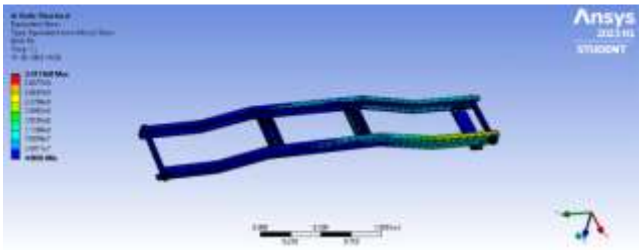


DEFORMATION IN Y-AXIX

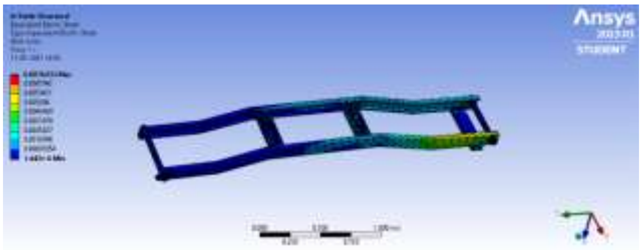
DEFORMATION IN Z-AXIX



EQUIVALENT STRESS



EQUIVALENT ELASTIC STRAIN



IV. RESULT

RESULT	STRUCTURAL STEEL	MAGNESIUM ALLOY
Total Deformation(mm)	4.8253	4.8863
Equivalent von-mises stress (MPa)	3.207e8	3.417e8
Equivalent von-mises elastic stain (MPa)	0.00723225	0.0076433
Deformation in X-Axix	3.2414	4.4332
Deformation in Y-Axix	2.2617	3.3966
Deformation in Z-Axix	3.2636	2.1565

V. CONCLUSION

The Model enquiry and stationary mechanical study were carried out on the truck's Tata 407 staircase. From the above results for steel and carbon fiber the maximum shear stress, maximum equal stress and displacement is equal to that of steel. The weight of the product in the automobile industry is a major factor for design and the stress values of carbon fiber are within acceptable limits. Carbon fiber is therefore suitable as a chassis material for vehicles due to its high strength and light weight. For the same load-carrying capacity, carbon fibers are better than steel for building ladder frames, as this reduces the chassis frame by 80% and increases the rigidity of the chassis frame. To conclude, by prodigious FEM software we can optimize the frame weight and conclude that it is suitable for chassis construction .

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