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STATIC STRUCTURAL ANALYSIS OF TRUCK CHASSIS

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ABSTRACT

Automobile chassis is one of the major elements of road motor vehicles. Normally automobile is divided into two parts they are Body and Chassis. Thus this chassis design and analysis form the most important stage of vehicle manufacturing. It is a basic structure of a vehicle. Chassis is the integral part of the vehicle it bears the entire load of the vehicle including its self-weight. A weight of chassis is one of the major influencing factors & it must be strong enough to resist shocks, twist, vibrations and stresses [1]. In designing of chassis frame maximum stress and maximum deflections are the important factors. Static analysis of chassis is carried out by finite element method and we obtain the results like stress & deformation. The most suitable method for analysis is the finite element method [2]. A three-dimensional chassis model is created in Creo 5.0 imposed in ANSYS 18.2. Finite element analysis truck chassis was carried out using ANSYS & its static behavior was studied taking 3 different types of materials like Steel, Aluminum alloy, Carbon steels

KEYWORDS: *Ansys, Automotive Vehicles, Creo 5.0, Finite Element Analysis, Twisting*

Article History

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INTRODUCTION

Chassis is a French word that was initially used to represent the basic structure of the vehicle. Chassis is an integral part like a skeleton. It connects the various mechanical parts like Engine, Steering, Axle assemblies, Transmission system, Brakes, and Tyres. The chassis frame plays a crucial role in the automobile. All the components weight acts on the chassis frame, thus it is subjected to static, dynamic [3], and cyclic loading on the road. So, the chassis must be rigid enough to resist the loads.

The chassis consists of side members attached with a series of cross members to complete the ladder-like structure. FEM with required boundary conditions is used to find the critical regions in the chassis frame. Static structural is used to find the critical regions, based on the results obtained the design modifications, the rigidity of the system was analyzed and their resonance [5] could be avoided.

Various Loads Acting On the Frame

- Short time Load – While crossing a broken patch.
- Momentum duration Load – While taking a curve.

- Impact (from certain height) Loads – Due to the collision of the vehicle. .
- Steady Loads – Loads due to chassis parts.
- Other Loads – Beyond Design capacity.

DIMENSIONS

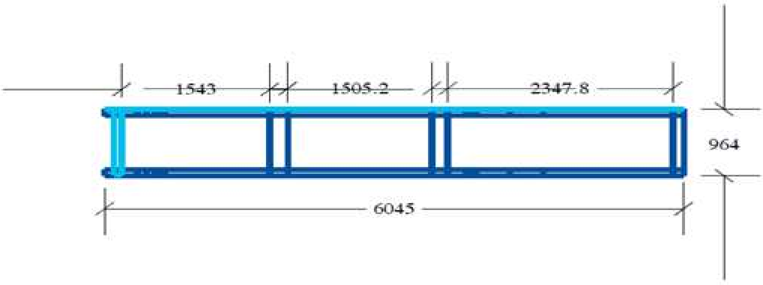

Figure 1

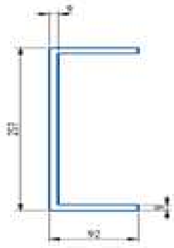

Figure 2

SPECIFICATIONS

Overall length = 6045 mm

Width = 964 mm

Dimensions of the side members = 257 x 92 x 9 mm^3

Type of side member = Rectangular box section type

Type of cross section = Rectangular

Total number of cross sections = 3

Gross vehicle weight = 5 tons

Neglecting unsprang weight

Total weight of the vehicle body including engine, cabin and the load body = 1850 kg

The passengers weight = Average weight x number of Passengers = 75 x 2

= 150 kg

Vehicle payable load [6] = 3000 kg

Gross vehicle weight = 1850 + 3000 +150

= 5 tons

= 5000 kg = 5000 x 9.81

= 49050 N.

PROPERTIES OF MATERIALS

Table 1

Material	Young's Modulus (Mpa)	Poisson's Ratio	Density (Kg /M^3)
Carbon Steel (AISI 12L14)	200 x 10^3	0.29	7861
Carbon / Epoxy	250 x 10^3	0.2	1800
Titanium alloy	115 x 10^3	0.35	4560

Loading Conditions

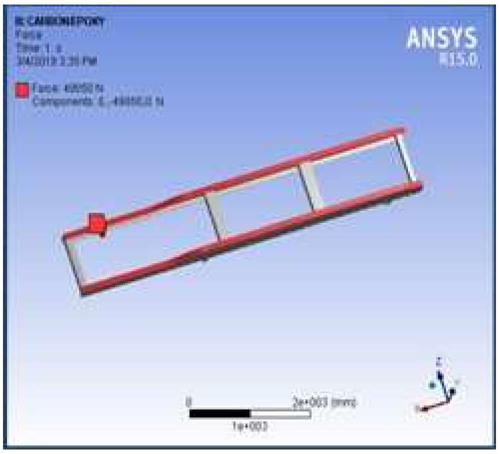

Figure 3 (a)

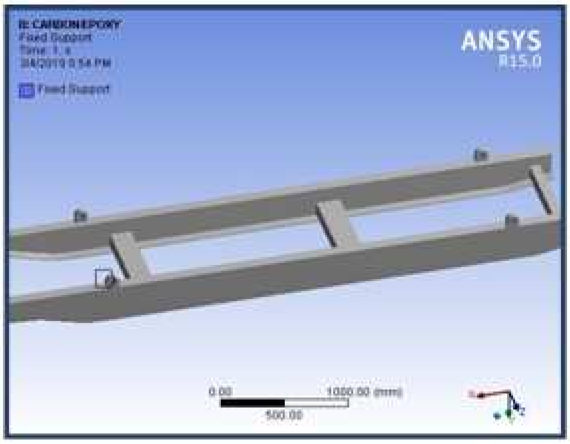

Figure 3 (b)

The load will be applied on the beam of chassis after fixing the supports of the chassis. While selecting fixed support must analyze where the stress [7] will be maximum. The load 49050 N is applied. It is shown in figure 3 (a) and 3 (b).

RESULTS

CARBON STEEL

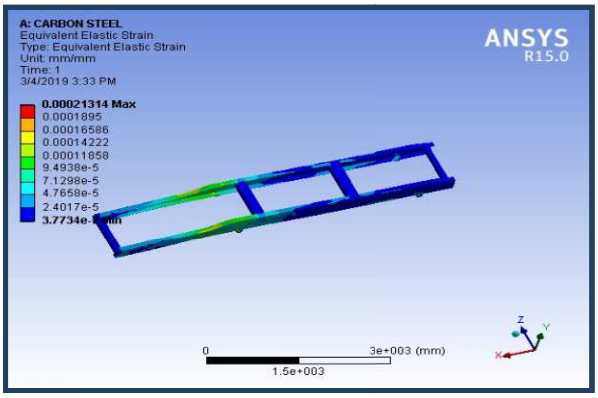

Figure 4 (a)

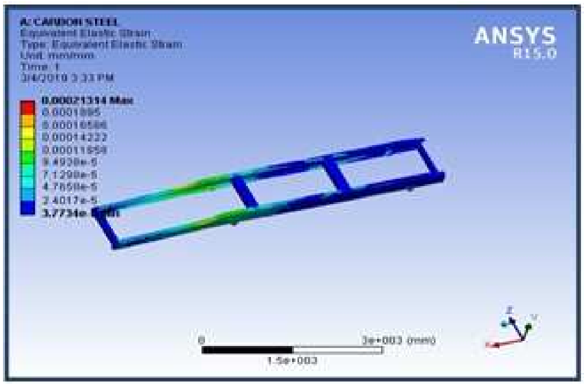

Figure 4 (b)

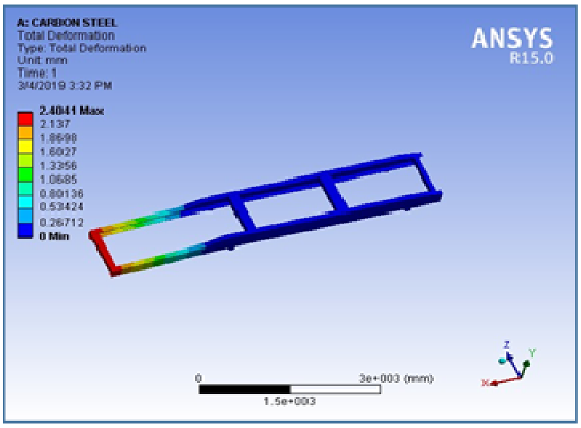

Figure 4 (c)

The load is applied on the Carbon Steel chassis to find the maximum stress, strain, and deformation. Basically, Carbon steel has high strength, hardness, and moderate ductility. Carbon steel deforms more at the front end that is 2.404 mm and stress value is 34.754 MPa. The strain is comparatively low with a value of 0.000213 mm. These are shown in figure 4(a), 4(b) and 4(c).

CARBON/ EPOXY

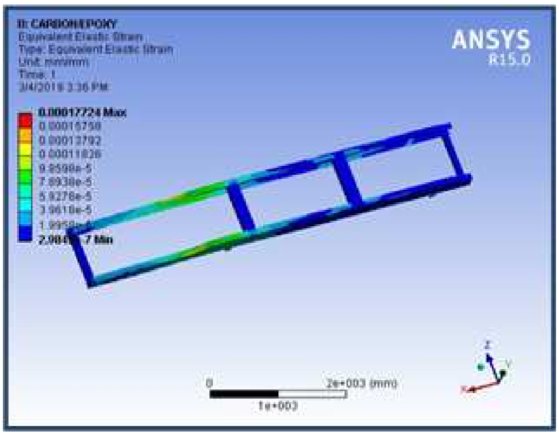

Figure 5 (a)

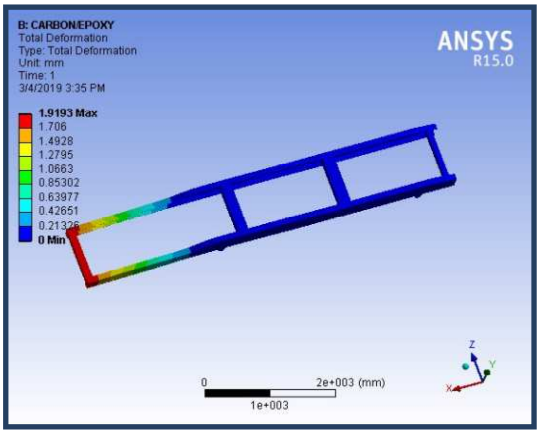

Figure 5 (b)

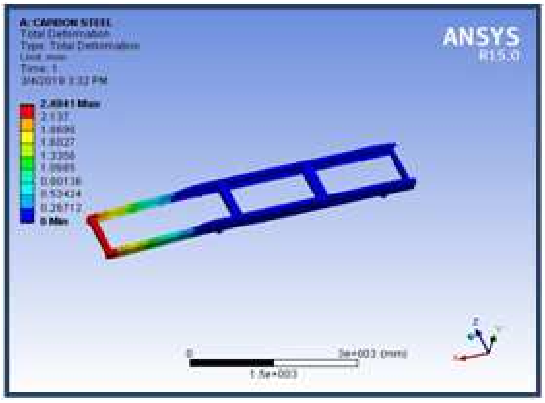

Figure 5(c)

The load is applied on the Carbon / Epoxy[4] chassis to find the maximum stress, strain, and deformation. Basically Carbon / Epoxy has high strength, hardness, and moderate ductility. Carbon steel deforms more at the front end that is 1.9193 mm and stress value is 35.693 MPa. The strain is comparatively low with a value of 0.00017724 mm. These are shown in figure 5(a), 5(b) and 5(c).

TITANIUM

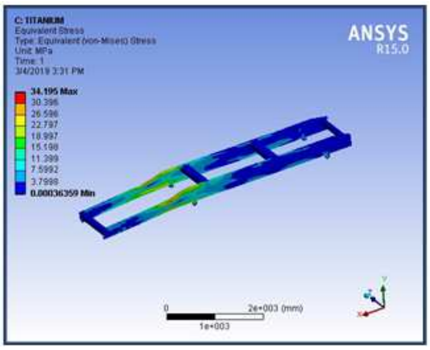

Figure 6 (a)

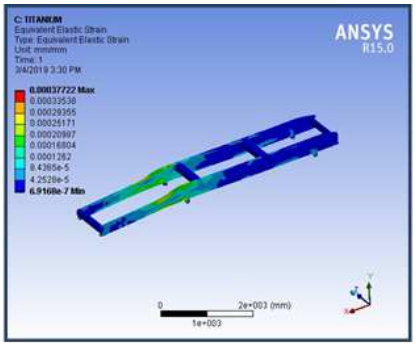

Figure 6 (b)

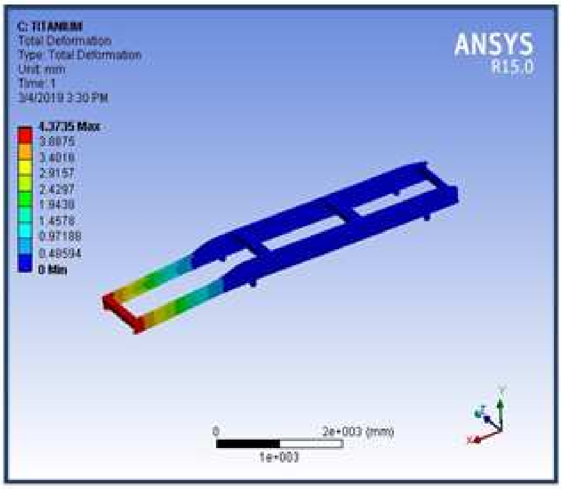

Figure 6 (c)

The load is applied on the Titanium alloy chassis to find the maximum stress, strain, and deformation. Basically, Titanium alloy has high strength [8], hardness, and moderate ductility. Carbon steel deforms more at the front end that is 4.3735 mm and stress value is 34.195 MPa. The strain is comparatively low with a value of 0.00037722 mm. These are shown in figure 6(a), 6(b) and 6(c).

CONCLUSIONS

- To study the different characteristics of chassis, experimental and finite element methods stand out as the most accurate and widely used methods.
- In our present works, the design of the truck chassis was found to have good structural strength and integrity.
- Epoxy/Carbon was found out to be the best material for designing the chassis among all the three materials used with a maximum deformation of 1.9193, Equivalent stress of 35.693 MPa and strain value is 0.0001772.

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