# AN APPORACH IN DEVELOPING DESIGN OF HEAVY CHASIS UNDER OPTIMAL LOAD CONDITIONS WITH DIFFERENT COMPOSITE MATERIALS

**ANGIREKULA RAJASEKHAR**
Student M.Tech
Department of Mechanical Engineering
Indira Institute of Technology and Science
angirekularajasekhar@gmail.com

**V. PURUSHOTHAM**
M.Tech Assoc. Professor
Department of Mechanical Engineering
Indira Institute of Technology and Science
Purushotham.m.tech@gmail.com

## ABSTRACT

*The chassis forms the main structure of the modern automobile. A big quantity of designs in pressed-metallic frame shape a skeleton on which the engine, wheels, axle assemblies, transmission, guidance mechanism, brakes, and suspension participants are installed. During the producing technique the body is flexibly bolted to the chassis.*
*For motors, chassis consists of an meeting of all the critical elements of a truck (with out the frame) to be geared up for operation on the road.*
*In our project, the modeling of chassis by using **CREO** software, by taking the data from the previous journal paper for six wheeler chassis. Present used material for chassis is steel. The main aim is to replace the chassis material steel with differentALLOY STEEL materials. By using steel, the weight of the chassis is more compared with **TITANIUM BORIDE, EN 24&SS 304**and, since its density is more. Crash analysis, Structural and modal analysis is done on the chassis model.*
*Crash analysis to determine the stress, deformation and strain when applying sudden load on the component. Static analysis to determine the deformation, equivalent stress and strain to finding the strength of the component when component is in rest position. Modal analysis to determine the deformation and frequency of chassis.*
*3D modeling in CREO and analysis in ANSYS software*

## 1.0 INTRODUCTION TO CHASSIS

The chassis forms the main structure of the modern automobile. A large variety of designs in pressed-steel frame form a skeleton on which the engine, wheels, axle assemblies, transmission, steerage mechanism, brakes, and suspension participants are established. During the manufacturing manner the frame is flexibly bolted to the chassis.

This aggregate of the body and body plays sort of capabilities. It absorbs the reactions from the actions of the engine and axle, receives there movement forces of the wheels in acceleration and braking, absorbs aerodynamic wind forces and street shocks thru the suspension, and absorbs the foremost power of effect inside the occasion of an accident.

**Types of Chassis Frames:**

There are three types of frames
1. Conventional frame
2. Integral frame
3. Semi-integral frame

Design Goals

Chassis and Body Structure

The car layout starts up with conceptual research to outline size, quantity and region of un-pushed and pressure axles, form of suspension, engine energy, transmission, tire length and axle reduction ratio, cab size and auxiliary equipment. The selected configuration must be appropriate for the considered transportation responsibilities and have to match the existing manufacturing line. Either new automobile type is generated or a positive improvement over current sorts needs to be done. Because of the fierce competition, and advanced generation in engineering, manufacturing and provider and strenuous work is needed to be successful. Having defined the general configuration of a vehicle, allow us to now attention the primary structural additives.

**The Functions of the Chassis frame**

1. To carryall the stationary hundreds attached to it and loads of passenger and cargo carried in it .
2. To resist torsional vibration as a result of the movement of the vehicle

3. To withstand the centrifugal pressure resulting from cornering of the vehicle
four. To manipulate the vibration as a result of the jogging of the automobile
five. To face up to bending stresses due to rise and fall of the the front and rear axles.

## 2.0 LITERATURE REVIEW

**Design & analysis of automobile chassis by A.harikumar, v.deepanjali,** The objective of paper is to find out best material and maximum suitable pass-phase for an Eicher E2 TATA Truck ladder chassis with the constraints of maximum shear strain, equivalent stress and deflection of the chassis below maximum load situation. In present the Ladder chassis that are makes use of for making buses and vehicles are C and I cross section type, that are manufactured from Steel alloy (Austenitic). In the present paintings, we have taken higher energy as the primary problem, so the scale of an existing vehicle chassis of a TATA Eicher E2 (Model no.Eleven.10) Truck is taken for analysis with substances namely EN 24 Steel, ASTM A302 Alloy Steel and Aluminum Alloy 6063-T6 subjected to the identical load.

**Design and analysis of chassis frame of TATA 2516TC by R. L. PATEL1, K.R.Gawande2, D.B. Morabiya3** Automotive chassis is an critical a part of an vehicle. The chassis serves as a frame paintings for supporting the body and different components of the car. Also, it must be rigid sufficient to face up to the shock, twist, vibration and different stresses. Along with electricity, an essential attention in chassis layout is to have good enough bending and torsional stiffness for better managing characteristics. So, strength and stiffness are two critical criteria for the layout of the chassis. This report is the paintings carried out closer to the analysis of the automotive chassis with constraints of stiffness, electricity and herbal frequency.

**Design and analysis of chassis frame by 1anurag, 1amrendra kumarsingh, 1akash tripathi, 1aditya prataptiwari, 1nitish upadhyay, 2 shyambiharilal** Truck chassis is the structural backbone of any automobile. The fundamental characteristic of the truck chassis is to hold the goods and payload positioned upon it. The chassis body has to endure the stresses evolved and deformation happens in it and that should be within a restrict. This paper offers the take a look at of the pressure developed in chassis in addition to deformation of chassis frame. The pressure and deformation has been calculated for the chassis body and the evaluation has been carried out for the validation on the chassis body. The model of the chassis has been evolved in Creo (Pro-E) 2.0 and static structural analysis has been achieved in ANSYS WORKBENCH 15.0.

## 3.0 DESIGN CALCULATIONS FOR CHASSIS FRAME

Material and Geometry of Eicher E2 (Model No.11.10) Truck
Side bar of the chassis are made from "C" Channels with 210mm x 76 mm x 6 mm
Material of the chassis is EN 24 Steel

| | |
|---|---|
| Front Overhang (a) | = 935 mm |
| Rear Overhang (c) | = 1620 mm |
| Wheel Base (b) | = 3800 mm |
| Modulus of Elasticity, E | = 2.10 x 105 N / mm2 |
| Poisson Ratio | = 0.28 |
| Capacity of Truck | = 8 tons = 8000kg = 78480 N |
| Capacity of Truck with 1.25% | = 98100 N |
| Weight of the body and engine | = 2 ton = 2000 kg = 19620 N |
| Total load acting on chassis | = Capacity of the Chassis + Weight of body and engine = 98100 + 19620 = 117720 N |

Chassis has two beams. So load acting on each beam is half of the Total load acting on the chassis.

Load acting on the single frame = 117720/2 = 58860 N / Beam

***Calculation for Reaction*** Beam is simply clamp with shock absorber and leaf spring. So, beam is considered as a simply supported beam supported at *C* and *D* with uniform distributed load.

Load acting on the entire span of the beam = 58860 N
Length of the beam = 6355 mm
Uniformly Distributed Load = 58860 / 6355 = 9.26 N/mm

For getting the load at reaction *C* and *D*, taking the moment about *C* and we get the reaction load generate at the support *D*. Calculation of the moment are as under.

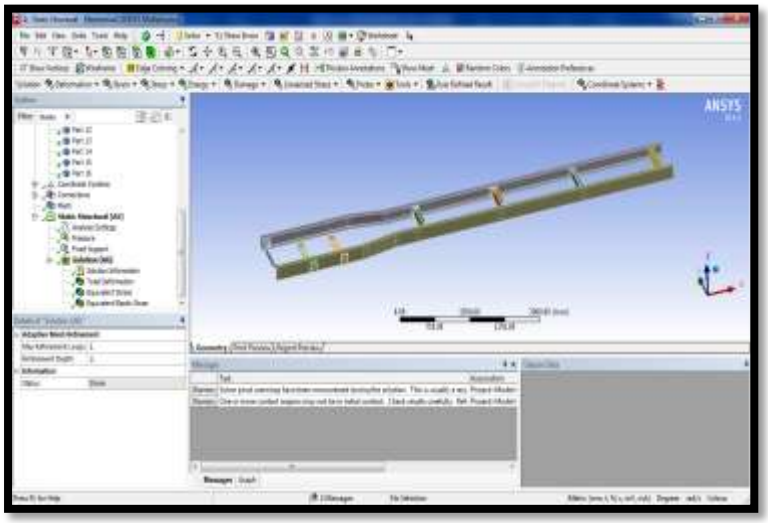
Moment about C:

9.26×935×935/2 = (9.26×3800×3800/2) - (Rd×3800) + (9.26×1620×4610)
Rd = 34727.65 N
Total load acting on the beam = 9.26 × 6355 = 58847.3 N
Rc + Rd = 58847.3
Rc = 24119.65 N

## 4.0 STATIC ANALYSIS OF CHASSIS

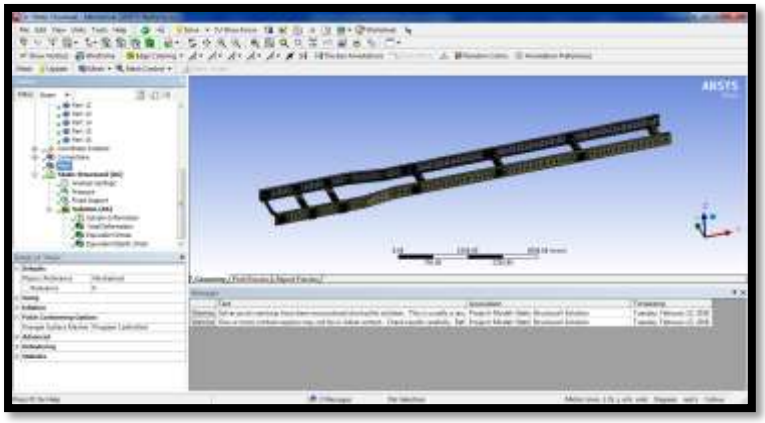
## FINITE ELEMENT ANALYSIS OF CHASIS USING ANSYS WORKBENCH

The model of chassis is saved in IGES format which can be directly imported into ANSYS workbench. The model imported to ANSYS workbench



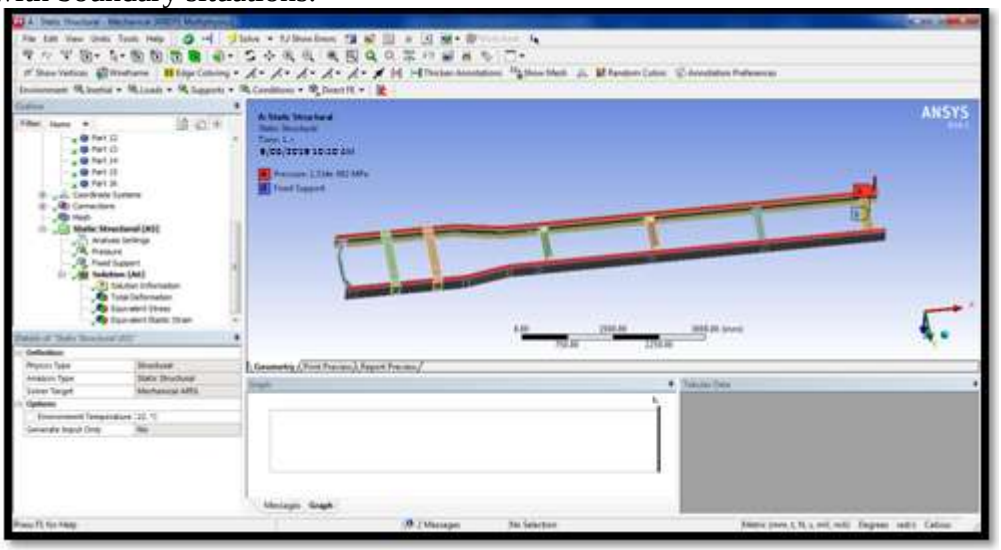

### Meshing and Boundary Conditions

The meshing is done on the model with 3504 number of nodes and 10282 numbers of tetrahedral elements.



**Loads acting on the chassis**

The truck chassis model is loaded by using static forces from the truck frame and cargo. For this model, the maximum loaded weight of truck plus frame is 10,000 kg. The load is assumed as a uniform disbursed acquired from the maximum loaded weight divided by using the entire duration of chassis frame. The finite element version of the chassis, implemented with boundary situations.



**SPECIFICATION OF MATERIAL**

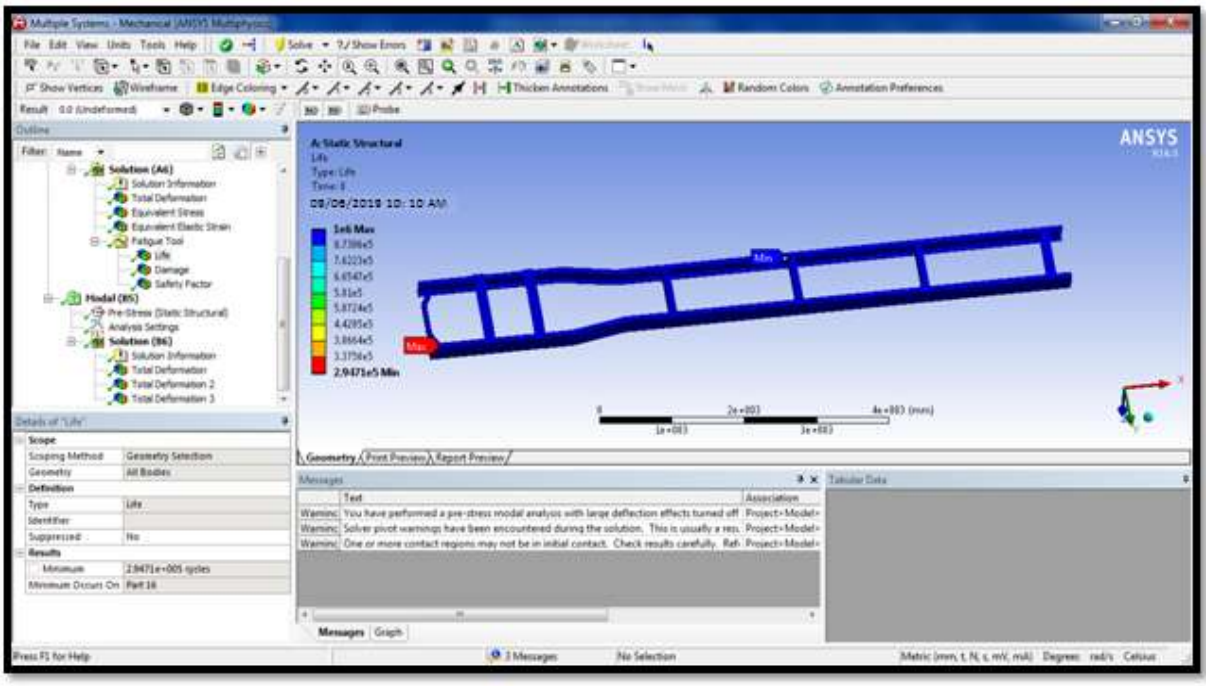
| Properties | EN 24 | SS 304 | TITANIUM BORIDE | STEEL ST 37 |
|---|---|---|---|---|
| Density(g/cm$^3$) | 7.85 | 7.79 | 7.89 | 7.8 |
| Young's modulus (MPa) | 80000 | 78000 | 190000 | 20000 |
| Poisson's ratio | 0.29 | 0.33 | 0.29 | 0.29 |

**FATIGUE ANALYSIS OF CHASSIS**

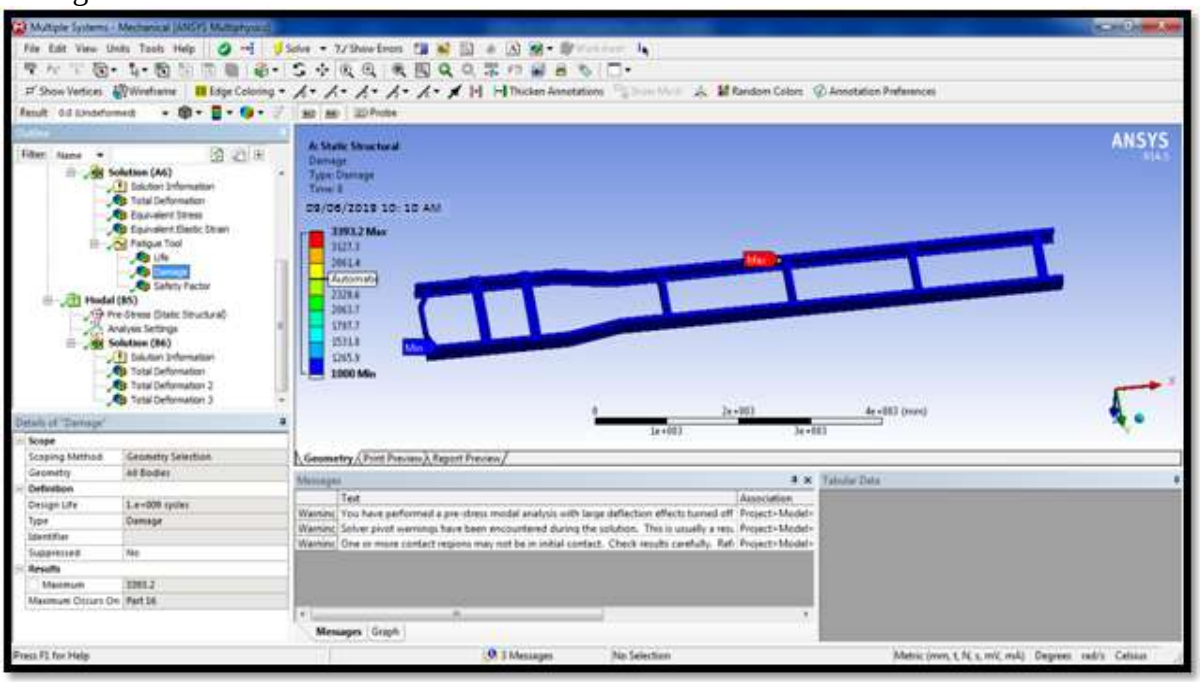
**Fatigue** Is the weakening of a cloth because of time and again applied hundreds. It is the progressive and localized structural harm that takes place while a cloth is subjected to cyclic

loading. The nominal most stress values that motive such damage may be a great deal less than the electricity of the fabric generally quoted as the remaining tensile strain limit, or the yield strain restriction.

Life




Damage

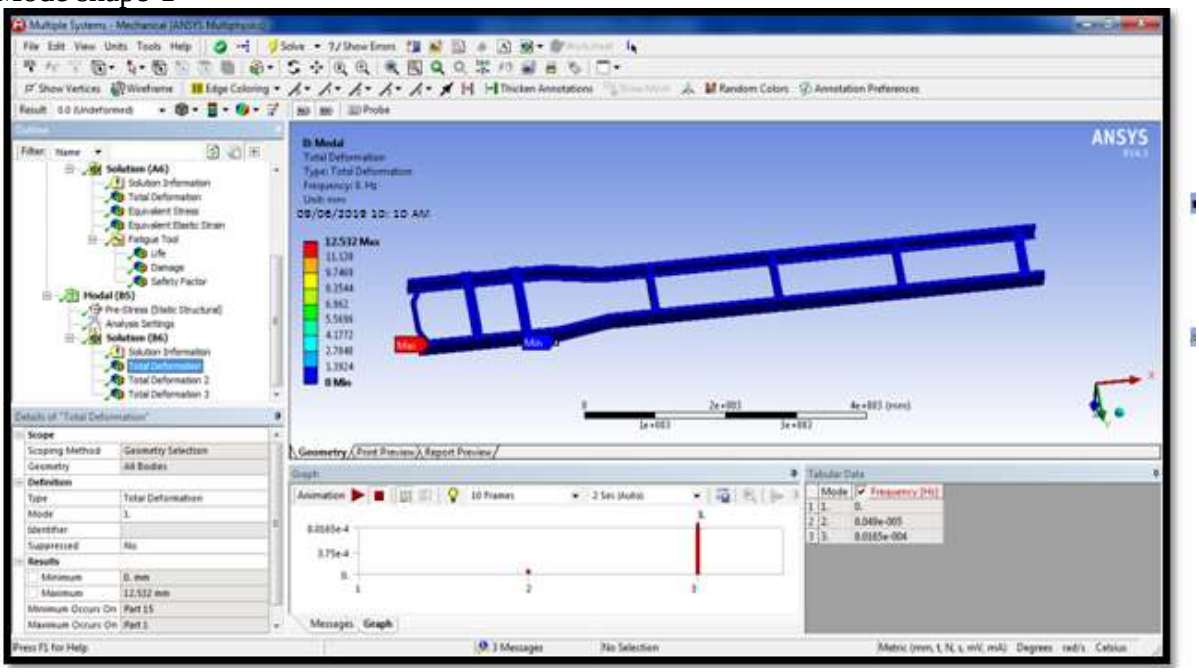



Safety factor

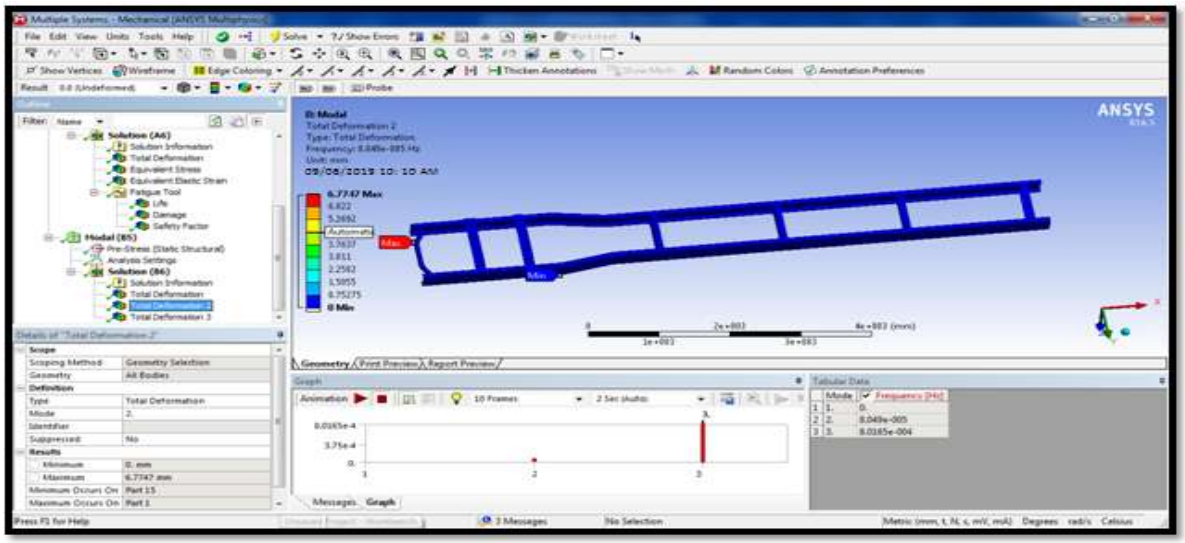

**Modal analysis of chassis**

Modal evaluation to decide the vibration traits (herbal frequencies and mode shapes) of a structure or a gadget thing at the same time as it's miles being designed. It also can be a place to begin for any other, extra targeted, dynamic evaluation, which include a brief dynamic evaluation, a harmonic response evaluation, or a spectrum evaluation.

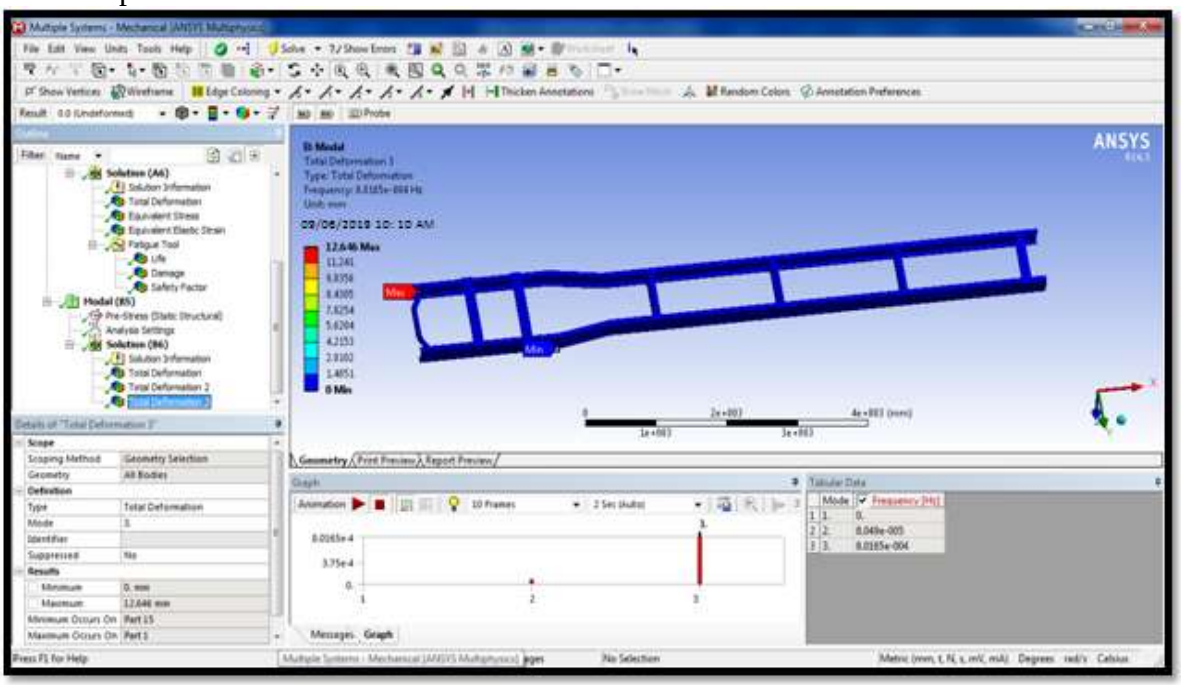
Mode shape-1




Mode shape-2




Mode shape-3




**STATIC ANALYSIS RESULTS TABLE**

| Material | Deformation(mm) | Stress (MPa) | Strain |
|---|---|---|---|
| **EN 24** | **0.019704** | **1.0658** | **0.000013565** |
| **SS 304** | **0.019801** | **1.0552** | **0.000013754** |
| **TITANIUM BORIDE** | **0.0082963** | **1.06588** | **0.0000057118** |

## CONCLUSION

Present used cloth for chassis is metal. The major purpose is to update the chassis cloth steel with exceptional ALLOY STEEL substances. By the use of metallic, the weight of the chassis is greater in comparison with TITANIUM BORIDE, EN 24&SS 304and, because its density is extra. Crash analysis, Structural and modal analysis is achieved on the chassis model. Crash analysis to determine the pressure, deformation and stress whilst making use

of sudden load at the issue. Static evaluation to determine the deformation, equal strain and strain to locating the electricity of the aspect when component is in rest role. Modal analysis to determine the deformation and frequency of chassis.

The layout and static structural analysis of steel alloy chassis has been performed. Comparison has been made between c-phase and rectangular phase chassis having same substances and identical load wearing ability. The pressure and displacements have been calculated using theoretically in addition to the use of ANSYS for steel alloy (TITANIUM BORIDE, EN 24&SS 304) chassis. A comparative study has been made between c segment and square phase with recognize to power and weight.

From the above outcomes the square segment chassis having less strain whilst we compare the c-segment chassis and having less strain SS 304 metallic.

**FUTURE SCOPE OF WORK**

- Analysis may be achieved on chassis via converting the fiber orientation of composite fabric.
- It may be obtained by means of doing the analysis with steel matrix composite chassis.

**REFERENCES**

*[1] Abhishek Singh, et al, "Structural Analysis of Ladder Chassis for Higher Strength", International Journal of Emerging Technology and Advanced Engineering, ISSN: 2250-2459, Volume 4, Issue 2, February 2014.*

*[2] Patel Vijaykumar, et al, "Structural Analysis of Automotive Chassis Frame and Design Modification for Weight Reduction", International Journal of Engineering Research & Technology, ISSN: 2278-0181, Volume 1, Issue 3, May 2012.*

*[3] Vishal Francis, et al, "Structural Analysis of Ladder Chassis Frame for Jeep Using Ansys", International Journal of Modern Engineering Research, ISSN: 2249-6645, Volume 4, Issue 4, April 2014.*

*[4] Monika S.Agarwal, et al, "Finite Element Analysis of Truck Chassis", International Journal of Engineering Sciences & Research, ISSN: 2277-9655, December 2013.*

*[5] Vijaykumar V. Patel and R.I. Patel, "structural analysis of ladder chassis frame" , ISSN 2231 2581, Mechanical department, Government engineering college, Gujrat.*

*[6] SairamKotari and V. Gopinath , "Static and dynamic analysis on tatra chassis", vol 2, ISSN: 2249-6645 department of mechanical engineering, QIS college of engineering, Andhra Pradesh.*

*[7] Introduction to chassis design, by Keith J. Wakeham, Memorial University of Newfoundland And Labrador.*

*[8] Chetan J. Choudhury and akashlodhi, "Static load analysis of TATA-407 chassis" -an approach , ISSN 2231-5063,Mechanical department, K.D.K. college of engineering , Maharashtra.*

*[9] PSG Design Data Book for Standard Data-M/s Kalaikathir Achchagam, Coimbatore2004*