International Engineering Research Journal

Analysis of HCV Chassis using FEA

Nikhil Tidke[1], D. H. Burande[2]

[1]PG Student, Mechanical Engineering, Sinhgad College of Engineering, Pune 41.
[2] Associate Professor, Mechanical Engineering, Sinhgad College of Engineering, Pune 41

Abstract

The Automobile industry plays a vital part in economy of modern emerging and industrialized states. The Chassis is an important factor in designing of the truck. The topmost purpose of chassis is to support payload and component placed on it. The objective of this project to seek out best material and most fitted cross-section for an Eicher E2 Truck Chassis with the limitations of most shear stress, consistent stress and bending of the chassis under extreme load conditions. In present, the ladder chassis that are used for creating buses and trucks are C and that I cross section sort, that area unit product of steel alloy (austenitic). In Asian Country variety of passenger travel within the bus isn't uniform, excess passenger's area unit movement within the buses daily as a result of that there are unit forever prospects of being failure/fracture within the chassis/frame. Chassis with superior cross section strength cross section is essential to attenuate the failure together with matter of safety of design. Within the current work, we have taken higher strength because the main issue, that the magnitudes of an existing vehicle chassis of Eicher E2 (Model No. 11.10) Truck is taken for analysis with materials specifically ASTM A710 steel, ASTM A302 steel and Metal alloy 6063-T6 subjected to constant load. Vehicle chassis are modelled by considering two different cross-sections specifically C and Rectangular Box (Hollow) sort cross sections. Using Catia modelling of the chassis is done and Using Ansys analysis is done.

Keywords:*Automotive ladder chassis, Material optimization, FEA, Cross-section Optimization, Ansys.*

1. Introduction

The ON-Road vehicles have changes drastically in the modern world based on the design and the functions. So, in the short span of time the market demands the higher and faster transportation. These heavy loads carrying vehicles gives the advantage of faster and heavy transportation in short span of time. It's the frame which holds each the automotive body and the gear train. Numerous mechanical components just like the engine and the drive train, the shaft assemblies together with the wheels, the suspension components, the brakes, the steering elements, etc., are assembled on the chassis.

A Vehicle without a body is called Chassis, it is also called carrying unit as it is core mounting used for all the element including the body. The chassis is consisting of the Side members which is attached with the series of the cross members. Chassis is design in such a way to increase the stiffness features. As the weight of the chassis increases the fuel efficiency of the vehicle decreases and the cost of the material cost also increases.

The chassis provides strength required for supporting the various transport elements additionally because the payload and helps to stay the auto rigid and stiff. Accordingly, the chassis is the crucial section of the over-all protection system. It safeguards Vibrations, Harshness and the low-level noise throughout the auto. The Automotive Chassis should be rigid enough to resist against the vibrations, shocks, twists and the various stresses. On the strength, a crucial thought is chassis styleis to possess adequate torsional stiffness and bending stiffness.

Chassis provides correct inflexibility for exact vehicle handling. It also protects the occupants against external impact. So, to fulfill the above functions the chassis should be of light weight. With the light weight, it should be tough enough to resist against fatigue loads which are produced because of power transmission and road situations.

Ananda raj (2012) has done analysis on the LCV Chassis using Finite Element Method and simulated failure during testing. Opti struct is usedand simulation. During the work, they presented local rigorousness to decrease the magnitude of the stress. The improved chassis stress values were minimized by 46%.

M. Ravichandra,(2012) Studied the alternate material for chassis. They acquired and analyzed E-glass/Epoxy, Carbon/Epoxy, E-glass/Epoxy and S-glass/Epoxy as chassis material in several cross sections like I, Box Section & C. TATA 2515 Chassis was taken for study. Ansys and Pro-E Software were used. the Carbon/Epoxy I section chassis has extra stiffness, strength and low weight.

Madhu Ps (2014) has done static, modal analysis on Structural chassis frame. The structural chassis frame molded using Pro-E, the preprocessing has done with Hyper mesh and postprocessing has done with HyperView. Ansys is used for the Modal Analysis. Result shows that Von Mises stress below yield strength of the material, design satisfies and deflection is about 5.648 mm. (2)

Vishal Francis (2014) has done Structural Analysis on Ladder chassis frame of Jeep. Software used are Catia v5 and Ansys. The Shear Stresses Generated was less than the permissible value so the design was safe for all the three materials used i.e. Mild Sheet Steel, Aluminum Alloy, Titanium Alloy. The Shear Stress was found more in Mild Sheet Steel and low in Aluminum Alloy. In Aluminum Alloy Von Mises Stress found minimum & Titanium Alloy found Maximum under the given boundary conditions. (3)

Navnath V palde (2016) has done analysis on car chassis & design changes for Static & Dynamic Characteristics. The chassis has been made by Pro-E & Analysis done by Ansys and Radioss. In the study, it is observed that there is improvement in Natural Frequency by 28.33 % & the equivalent stress reduced by 63.95 %. Torsional Stiffness increased by 56.20%.(4)

In Asian Country variety of passenger travel within the bus isn't uniform, excess passenger's area unit movement within the buses daily because of that there are unit forever prospects of being failure/fracture within the chassis/frame. To reduce the failures with factor of safety in design high strength cross section of the chassis is must require. Chassis with superior cross section strength is essential to attenuate the failure together with matter of safety of design. The problem to be deal with for this thesis effort is to Design and Analyze using appropriate CAE software for ladder chassis. Generally, C cross section category of chassis is used in buses and I cross section category in heavy trucks where more strength is essential. we have used Rectangular Box category cross section for creation of ladder chassis by producing it which is used in trucks. It will give best strength among all above three.

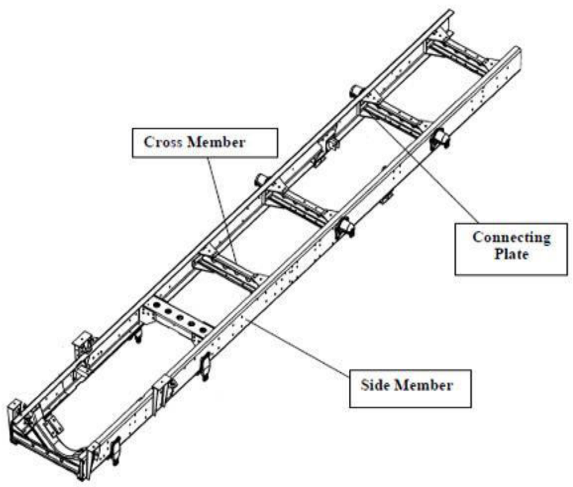

Fig.1 Parts of Chassis

2. Specification of material

Table.1 Properties of materials

property	ASTM A710	ASTM A302	Aluminum alloy6063-T6
Poisons ratio	205	210	69
Yield strength	450	340	220
Shear modulus	0.29	0.33	0.32
Youngs modulus	80	78	26
Mass density	7.85	7.79	2.8
Ultimate tensile strength	515	590	250

3. Theoretical analysis

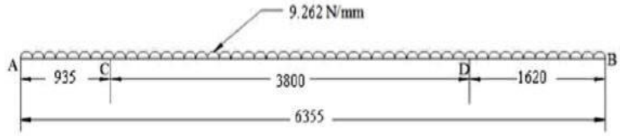

Fig 2 Chassis as simply supported beam

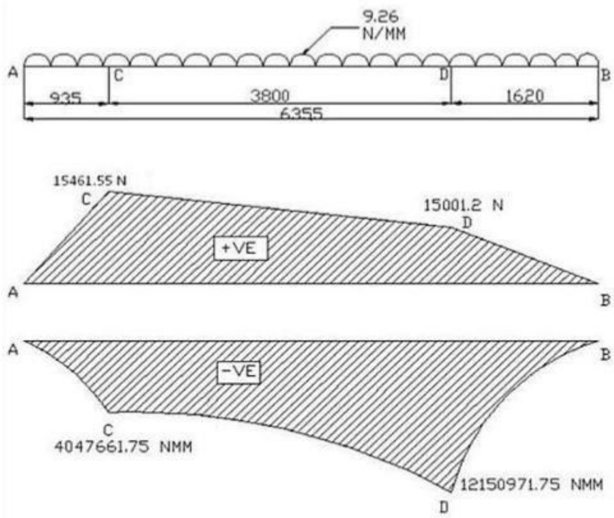

Fig 3 loading diagram SFD & BMD

4. Chassis Design

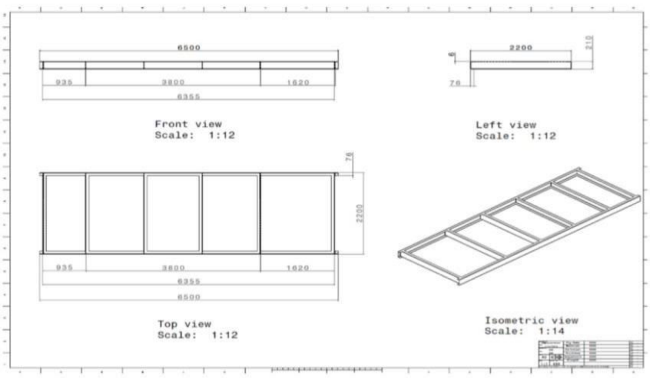

Fig.4 2d Model

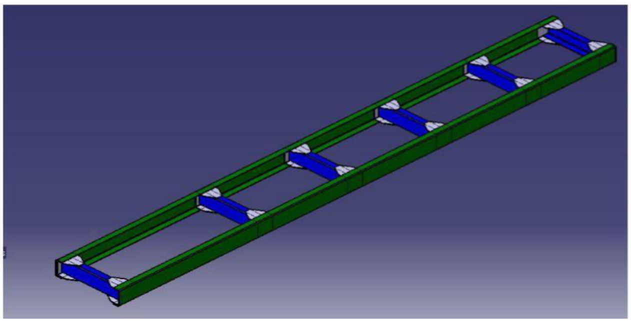

Fig.5 3d model on Catia

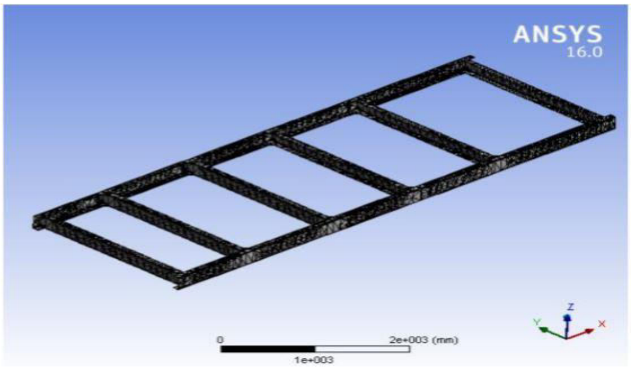

Fig.6 Meshed Model

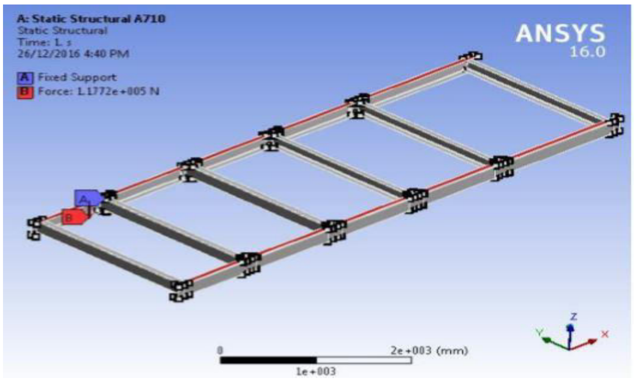

Fig.7 Boundary Conditions

5. Analysis for C Cross-Section of the Chassis

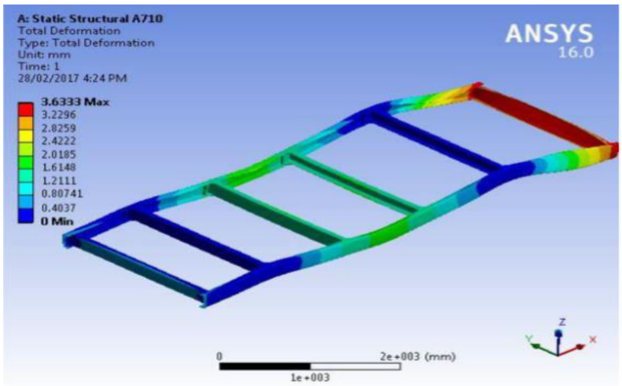

Fig.8 **Deformation** ASTM A710 Steel for C cross section

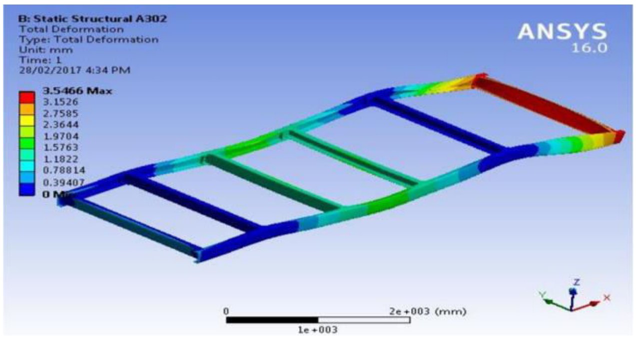

Fig.9 Deformation ASTM A302 for C Cross Section

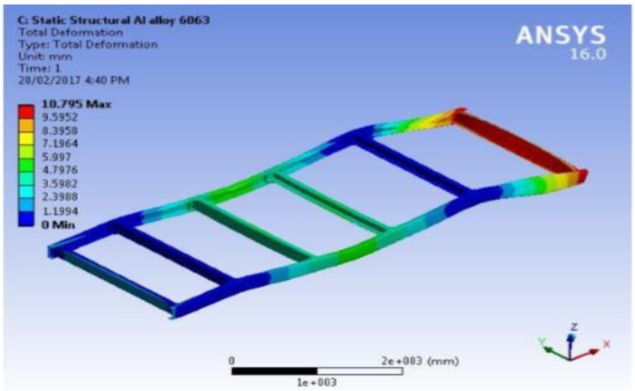

Fig.10 Deformation Al Alloy 6063 for C-CS

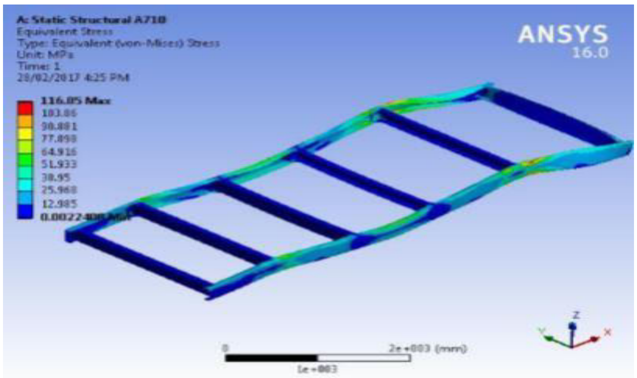

Fig. 11 Von-Mises Stress ASTM A710 for C-CS

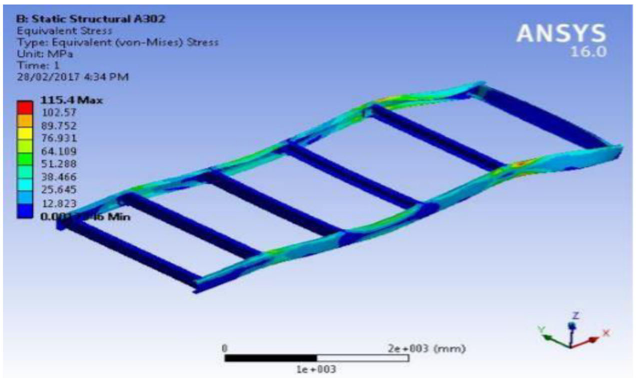

Fig.12 Von-Mises Stress ASTM A302 for C-CS

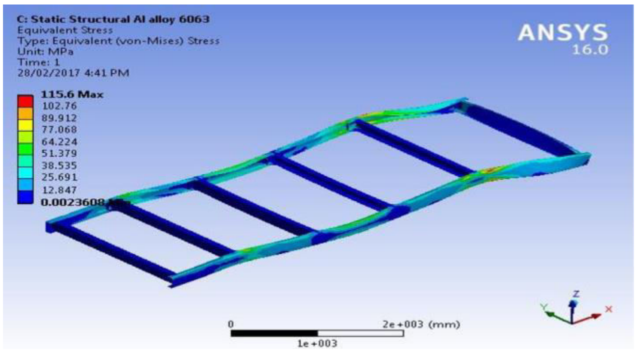

Fig.13 Von-Mises Stress Al Alloy 6063 for C-CS

6. Analysis for Rectangular Cross-Section

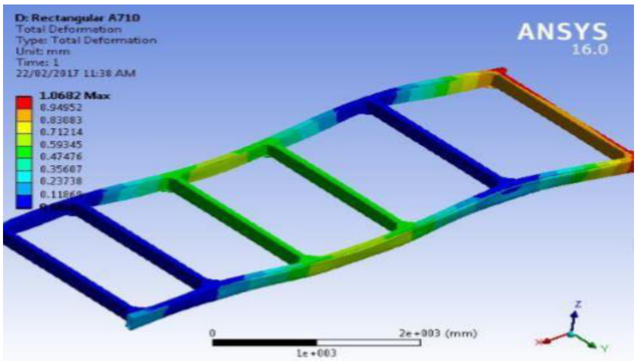

Fig.14 Deformation ASTM A710

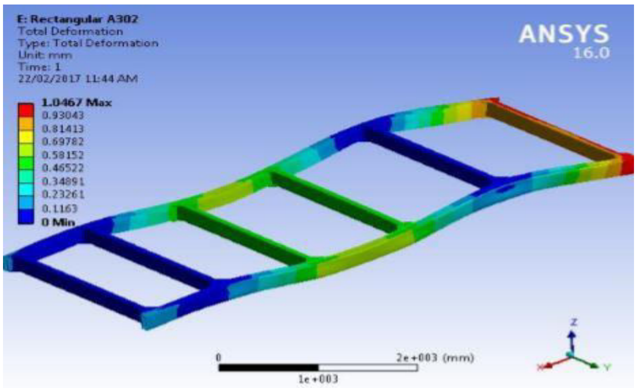

Fig.15 Deformation ASTM A310

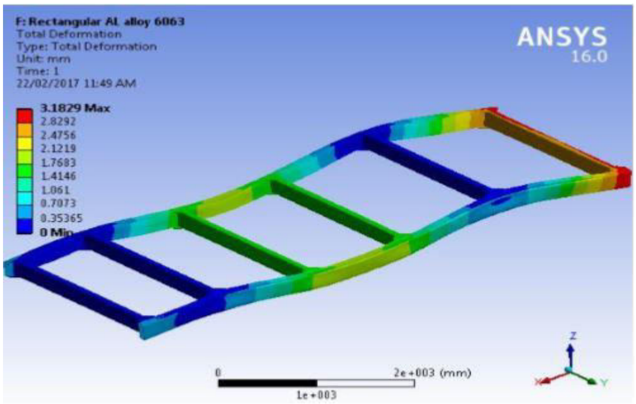

Fig.16 Deformation Al Alloy 6063

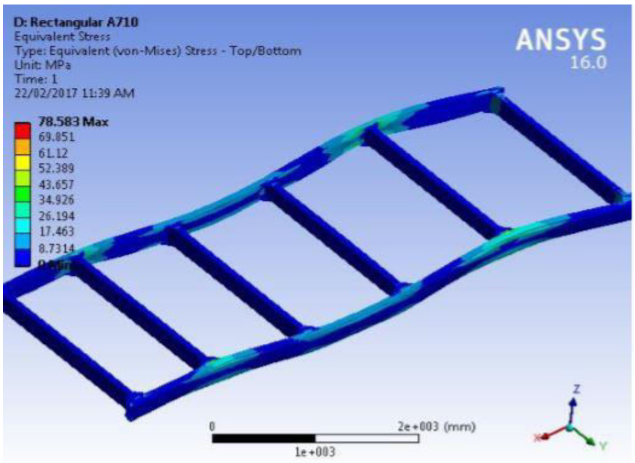

Fig.17 Von-Mises Stress ASTM A710

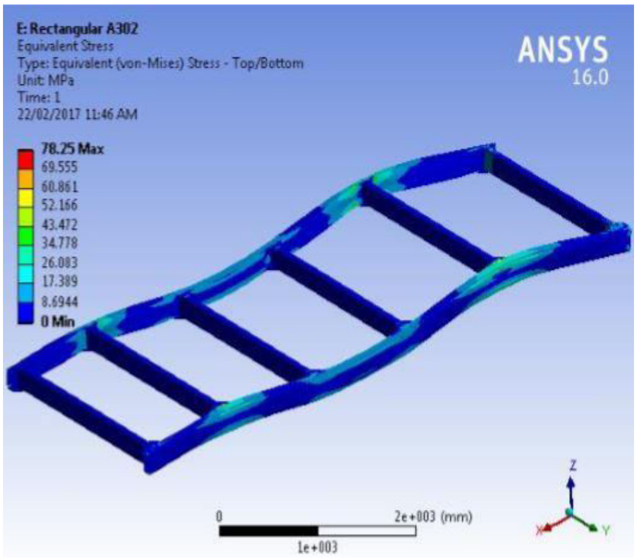

Fig.18 Von-Mises Stress ASTM A302

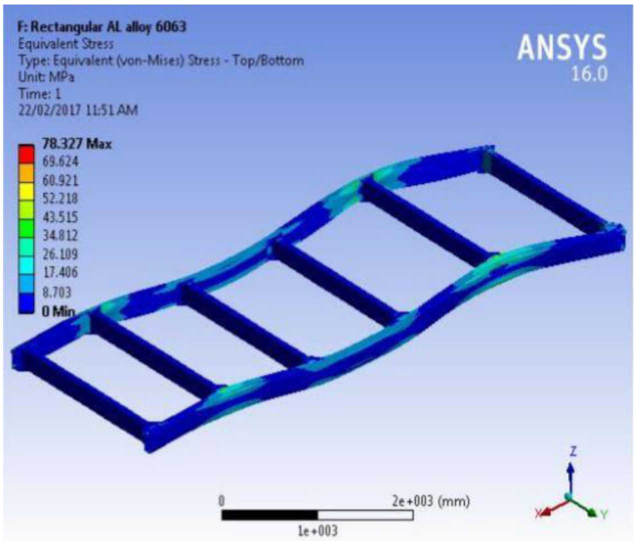

Fig. 19 Von-Mises Stress Al Alloy 6063

7. Result and Discussion

Table. 2 FEA Result

	Cross-Section

parameter	Rectangular Box			C Cross Secton		
	A710	A302	Al Alloy	A710	A302	Al Alloy
Directional deformation	0.0645	0.06823	0.2198	0.85	0.82	2.36
Equielastic strain	5.22 e-4	5.15 e-4	1.44 e-3	5.78 e-4	5.49 e-4	1.70 e-3
Eq.vonmises stress	77.79	77.9	77.85	115	114	114
Max Principle stress	84.98	85.5	85.2	115	120	118
Max shear stress	42.34	42.7	42.66	65.7	64.1	64.6
Total Deformation	1.06	1.04	3.18	3.62	3.56	10.8

Table 3. Optimization of Material

Material	Density Kg/m3	Mass of cross section (KG)	
		Rectangular Box	C Cross Section
ASTM A710	7850	435.65	991.06
ASTM A302	7790	434.306	987.45
AL Alloy	2800	155.44	353.22

From the results, it is observed that the Rectangular Cross Section is having more strength than C Cross Section type Ladder Chassis. The Rectangular Box Cross Section Chassis is having least deflection and least Von Mises Stress and Maximum Shear Stress respectively for Aluminum Alloy 6063- T6 in both type of Chassis of different Cross Section.

Conclusions:

In the present work, the ladder type chassis frame of Eicher E2 model was analyzed using ANSYS 16 Software. The theoretical and numerical analysis is done through using the essential concepts of strength of materials. After analysis, it is observed that the Rectangular box section have additional strength than C cross section. The Rectangular box section have low deflection, lowest stress and deformation value. Based on analysis following conclusion can be obtained.

- **a)** The part is safe under all the loading conditions
- **b)** Al alloy 6063 chassis should be preferred for low loading conditions C cross sections due to low density and weight.
- **c)** ASTM 302 chassis should be preferred for normal loading C Cross Sections due to low stress and deformation values.
- **d)** ASTM 302 chassis should be preferred for heavy loading conditions rectangular cross section due low deformation values and stress.

References

[1] S S Sane, GhanshyamJadhav and Ananda raj H. Stress Analysis of light commercial vehicle chassis by FEM (2012) HTC 08

[2] Madhu Ps and Venugopal T R. Static Analysis, Design Modification and Modal analysis of Structural Chassis Frame's (2014) IJERA 2248-9622

[3]Vishal Francis. Structural Analysis of ladder chassis frame for Jeep using Ansys. (2014) 2249–6645

[4] Mr. Navnath, Design Improvement and Analysis of Car Chassis for Static and Dynamic Characteristics. (2015) IERJ 238-244

[5] Nor, MohdAzizi, Stress analysis of a low loader chassis. Procedia Engineering 41 (2012) 995-1001.

(6)Kurdi, Ojo, Roslan, Stress analysis of heavy duty truck chassis using finite element method. 2nd RCVET 2008.

(7)Veloso, V.,et al. Failure investigation and stress analysis of a longitudinal stringer of an automobile chassis. Engineering Failure Analysis 16.5 (2009) 1696-1702.