Structural Analysis of Eicher 11.10 Chassis Frame

Chintada.Vinnod babu[#1], Chiranjeeva Rao.Seela[*2], Vykunta Rao.Matta[#3]

Assistant professor & Mechanical Engineering & GMRIT,Rajam,India

Abstract— *automotive chassis is an important part of an automobile. The chassis serves as a frame work for supporting the body and different parts of the automobile. The chassis frame has to withstand the stresses developed within a limit. Along with strength, an important consideration in chassis design is to have adequate bending stiffness for better handling characteristics. So, strength and stiffness are two important criteria for the design of the chassis. This paper is related with work performed towards the static structural analysis of the truck chassis in which study of the stresses developed and deformation of chassis frame of EICHER 11.10 has been done by considering three different materials like St52, Ni-Cr Steel and CFRP in each case. The chassis is modeled in PRO-E and finite element analysis has been done in ANSYS.*

Keywords – *ANSYS, Automotive chassis, strength and stiffness, stresses, structural analysis*

1. INTRODUCTION

Chassis usually denotes the basic frame that decides the overall shape of the vehicle. It is aimed at holding important components of the vehicle. The components of the vehicle like Transmission System, Axles, Wheels and Tyres, Suspension, Controlling Systems like Braking, Steering etc., are mounted on the Chassis frame.

Here the chassis type of Eicher 11.10 is of ladder frame is considered .It consists of two longitudinal members of C- cross section and seven transverse members called cross members of C- cross section. The chassis has been modelled in PRO-E using the most of the actual dimensions. Finite element analysis was done using Ansys 12.0

2. PROBLEM SPECIFICATION

The aim of the present work is to design and analysis of conventional chassis made from steel (st52) and also the chassis made of two different materials like Ni-Cr steel and composite material like CFRP. The chassis model is created in Pro-E and is imported to ANSYS 12.0 for analysis by applying normal load conditions. After analysis a comparison has to made between existing conventional steel chassis (st52) and Cr-Ni steel and CFRP chassis in terms of deflection and stresses in order to choose the best one

3. MODELLING AND STATIC ANALYSIS OF CHASSIS FRAME

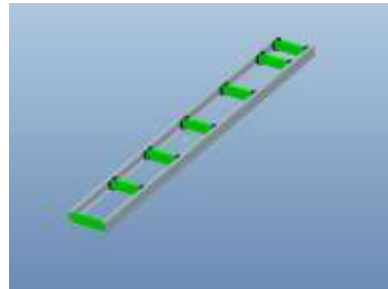3.1. *Modelling* : The chassis frame model is created in Pro-E

Fig 3 .1 : Model of EICHER 11.10 chassis frame in Pro-E
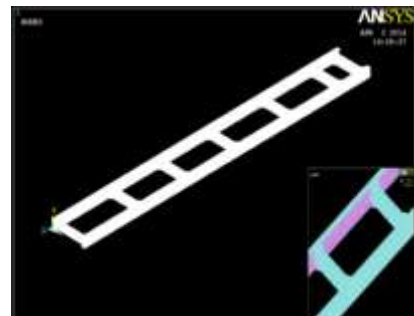

Fig 3 .2 : Mesh Model of EICHER 11.10 chassis frame

3.2. *Analysis:* The chassis frame model created in Pro-E is imported to Ansys. In the analysis, the following boundary conditions, elements and the materials properties are considered.

3.2.1.Elements Considered: Part of analysis two types of elements are considered, one is shell 63 and shell 99.Shell63 is four nodded element having six degree of freedom at each node.Shell99 is used in layered configuration and it is eight nodded element and having six degrees of freedom at each node

3.2.2 Material Properties: Material properties considered for analysis are listed in the table 3.1

TABLE 3.1 **:** Mechanical properties of materials

Material properties	St-52	Ni-Cr Steel	CFRP
Young's modulus (N / mm²)	E = 2.10x10⁵	E=2.02x10⁵	Ex=15.5x10³ Ey=17.5x10³ Ez= 9.4x10³

Density (Kg / mm^3)	7850	8249	1500
Poisson's ratio	0.3	0.3	Vxy=0.14 Vyz=0.38 Vxz=0.408

3.2.3 *Boundary conditions:* Four boundary conditions are considered for the analysis of the model. The 1st and 2nd boundary conditions are applied on the front portion of the chassis and the 3rd and 4th boundary conditions are applied on the rear side of the chassis. The regions where the boundary conditions are the points where the leaf springs are fixed on the axle

3.2.4*Loading Condition of Chassis Frame:* The main static forces acting on the truck chassis are because of the self-weight of the truck body and the external load. For this model, the capacity of the truck is 8000kg and weight of the body and engine is 2000kg finally total load acting on chassis is 10,000 kg. The load is assumed as a uniform distributed obtained from the maximum loaded weight divided by the total length of chassis frame. The magnitude of force on the upper side of chassis is 117720 N which is carried by two side bars so load on one side bar is 58860 N
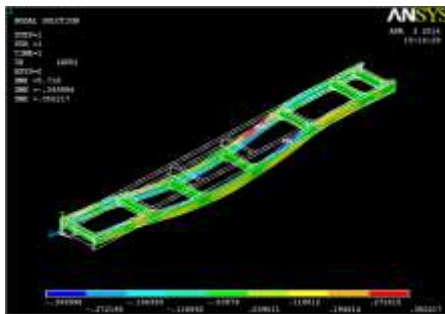
4. *RESULTS:*

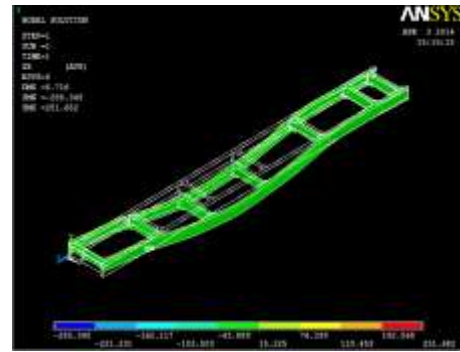**Fig 4.1**: Deformation in St52 chassis frame

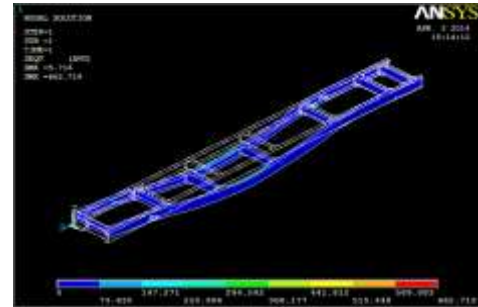**Fig 4.2**: Variation of stresses in St-52 chassis frame

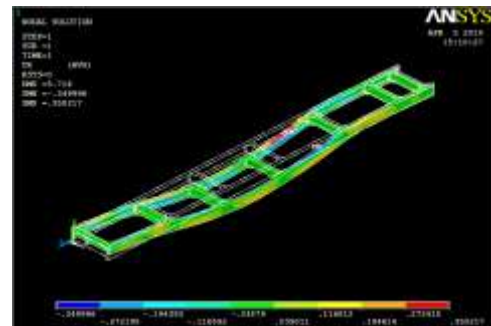
Fig 4.3: Von mises stress in St 52

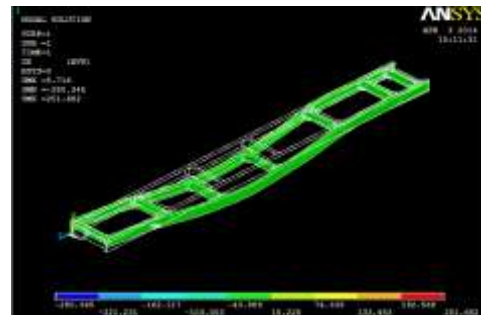**Fig 4.4**: Deformation in Ni-Cr steel chassis frame

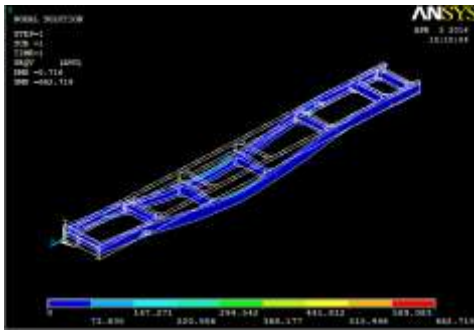**Fig 4.5**: Variation of stresses in Ni-Cr chassis frame

Fig 4. 6: Von mises stress in Ni-Cr Chassis frame

5.   DISCUSSIONS

Comparisons of results shown in following tables

TABLE 5.1 : Comparison of displacement

Displacement in mm	St52	Ni-Cr	CFRP
Max Deflection	5.490	5.716	2.018
X max	0.337	0.350	0.089
X min	-0.336	-0.349	-0.089
Y max	0.349	1.671	0.5238
Y min	-0.480	-6.715	-2.018
Z max	0.349	0.360	0.130
Z min	-0.480	-0.503	-0.176

TABLE 5.2 : Comparison of stresses in X, Yand Z direction

Direction of Stress	St52	Ni-Cr	CFRP
Stress along x direction (N/mm^2)	X max = 253.7 X min = -285.7	X max = 251.682 X min = -280.345	X max = 183.58 X min = -230.245
(N/mm^2)	Y max = 420.22 Y min = -692.42	Y max = 421.266 Y min = -690.642	Y max = 154.363 Y min = -301.36
(N/mm^2)	Z max = 487.92 Z min = -742.95	Z max = 482.77 Z min = -739.48	Z max = 524.5 Z min = -655.18

TABLE 5.3: Comparison of von-mises stress distribution in static analysis

		St-52	Ni-Cr	CFRP
Deflection	(mm)	5.490	5.716	2.018
stress(N/m	m^2)	664.202	662.719	580.404

6. *CONCLUSION*

Finally we conclude that when

1. CFRP is used instead of St52
   a. Deflection is reduced by 63.24% and
   b. Stress was reduced by 12.61%.
2. CFRP is used instead of Ni-Cr
   a. Steel deflection is reduced by 64.70% and
   b. Stress is reduced by 12.40%.

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