Performance Characteristics Analysis Of Chasis Using Finite Element Method

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Abstract- *The Chasis is the most integral part of the vehicle. It is the frame of the chasis on which the entire body of the vehicle is built. The entire external load of the vehicle including its self-weight is on the chasis. Thus this chasis design and its analysis forms the most important part of the vehicle manufacturing. To design a chasis of the vehicle which gives the most appropriate desired results is the most tedious task. The chasis has the most complex design and it also doesn't have a proper loading pattern and thus its design and analysis is complex. Thus the most accurate and widely used method of analysis, which is the numerical method of analysis using ANSYS package is used.*

I. INTRODUCTION

The vehicles are the back bone of a country's economy. In developing countries like India almost most of the transportation works goes by the road. The reason being that the Railways takes longer time in transportation than the roadways. Thus the business in India runs on road. Also India is one of the largest consumers of vehicle in the world. There are number of Indian as well as foreign automobile manufacturers who depend on this sector. For transportation and travels the vehicles are preferred even today than any other means.

II. LITERATURE REVIEW

Today the load and volume of the materials transported by the heavy trucks are dramatically increasing day by day. This becomes the reason why the chasis of the vehicle must be stronger enough and designed properly based on all the behavioral characteristics of the chasis under various loading conditions, so that the chasis would be able to transmit the lateral and vertical loads during the vehicle movement. The aspects which are taken into consideration during designing and analysis of the chasis are material selection, strength, weight, stiffness and components requirements. The weight and the payload are the two factors which are considered during the design and analysis of the chasis. The manufacturers of todays are more towards developing a chasis which could carry more payload than it usually does. The chasis has to not only carry the vehicle's own load like cabin, engine, transmission system but also the body of the vehicle including the passengers and their payloads.

III. THREE DIMENSIONAL CAD MODELS

The Three Dimensional CAD models of the chasis are designed based on the requirements and all design aspects using the CATIA V5 R20. Few important components of the chasis are mentioned below:

- Side bars
- Cross members
- Brackets
- End member
- Rivets.

This model is analyzed in the ANSYS software using three different materials mentioned below:

- Structural steel
- Aluminium alloy and
- Titanium alloy

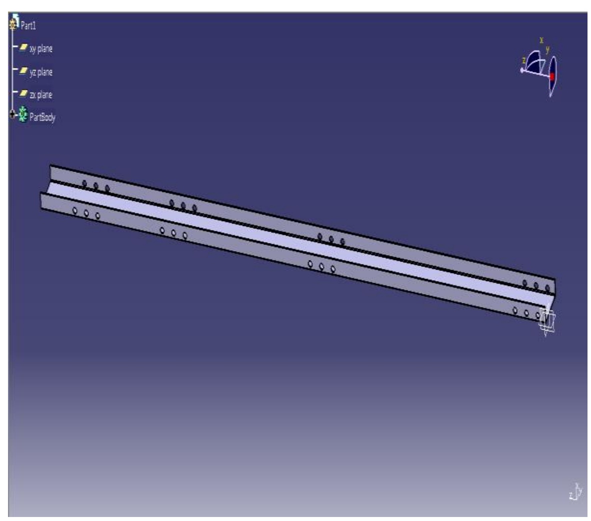

Fig.1 Model of Side Bar.

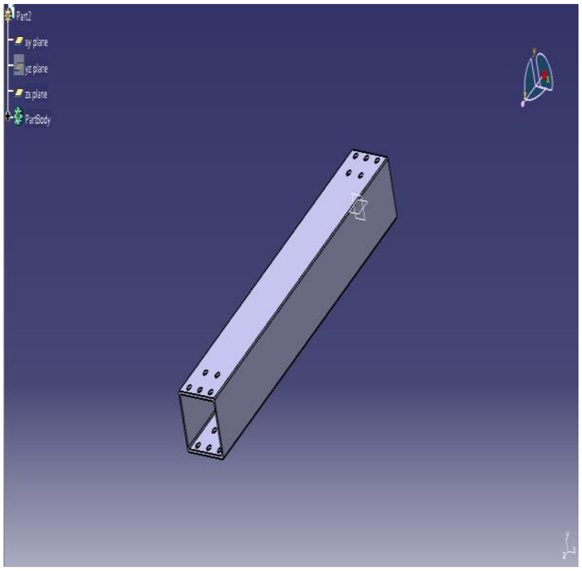

Fig.2 Model of Cross Member.

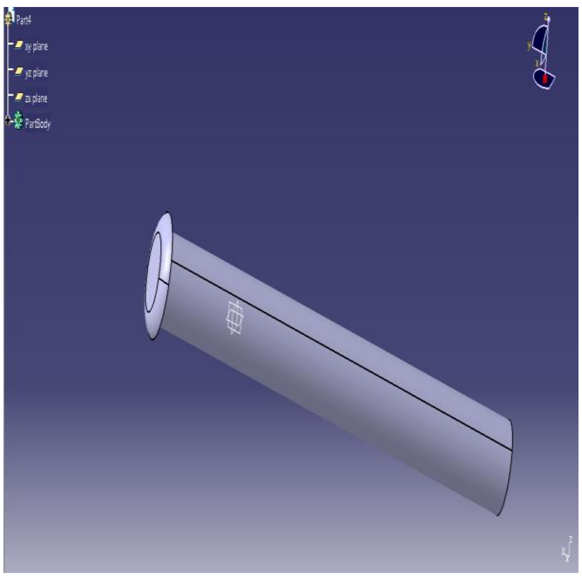

Fig.3 Model of Rivet.

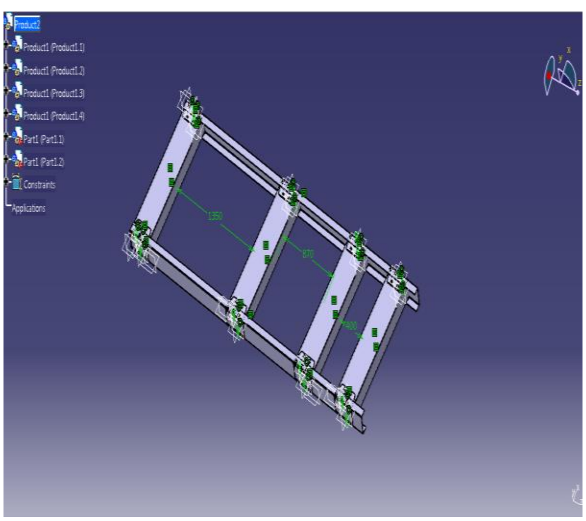

Fig.4Chasis Assembly.

IV. MESHING

The designed chasis frame is imported in the Analyzing software ANSYS. Then the model is meshed. The Fig.4 shows the imported model and Fig.5 shows the meshed image of the model.

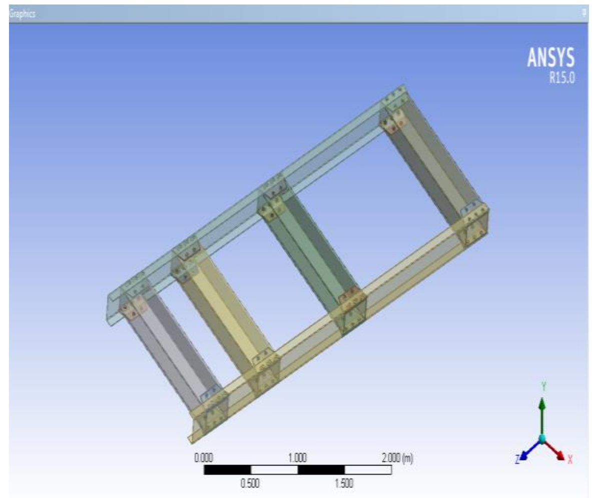

Fig.5 Imported Model.

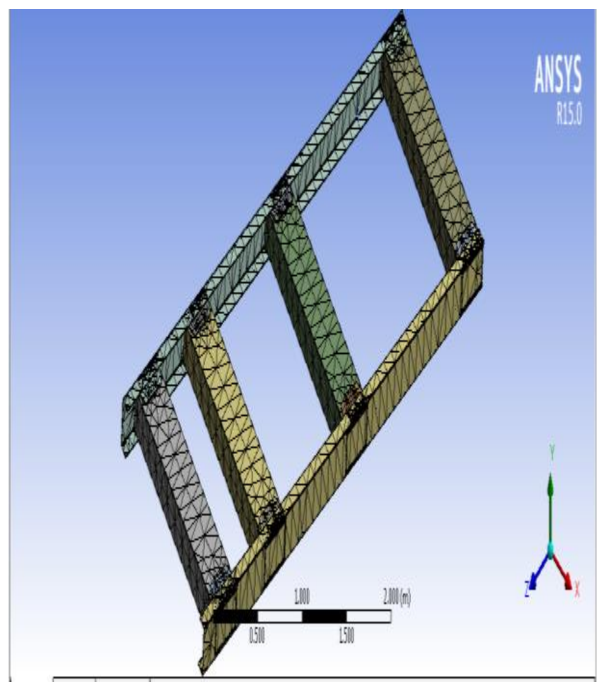

Fig.6 Meshed Model.

V. MODEL CALCULATIONS:

VI. LOADING CONDITIONS

The model is analyzed for both Tortion and Bending design aspects. The application of loads on the chasis for both the conditions are shown in the figures below.

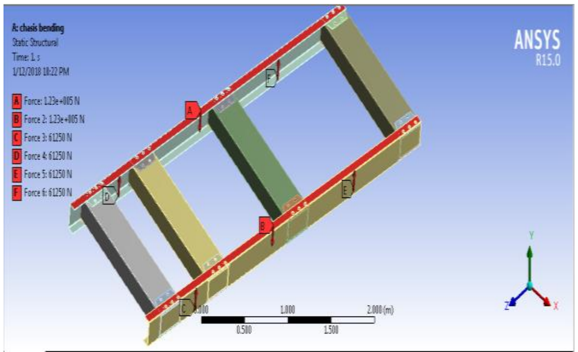

Fig.7 Loads for Bending.

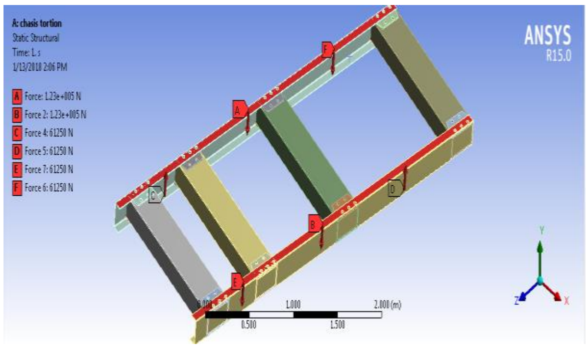

Fig.8 Loads for Tortion.

VII. COMPARISION OF ANALYSIS OF CHASIS OF DIFFERENT MATERIALS

The chasis is analyzed for the three different materials as mentioned above for the following design aspects mentioned below:

- Total Deformation
- Equivalent Elastic Strain
- Maximum Principal Elastic Strain
- Equivalent Stress
- Maximum Principal Stress
- Shear Stress

7.1 TOTAL DEFORMATION:

The Total Deformationvalues of the analyzed chasis is shown in the figures below. This analysis also shows that structural steel is better than the other two types of materials.

BENDING:

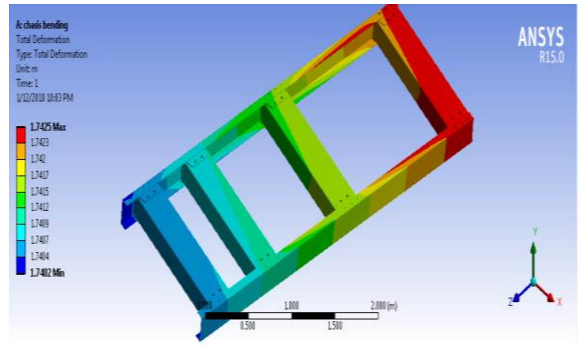

Fig.9 Total Deformation of Structural Steel.

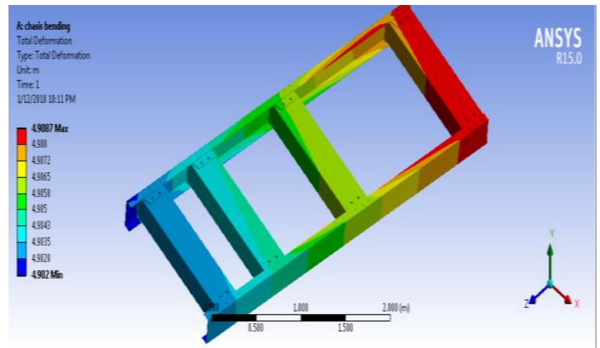

Fig.10 Total Deformation of Aluminium Alloy.

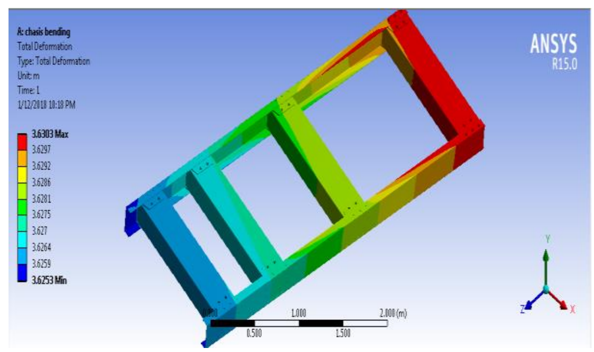

Fig.11 Total Deformation of Titanium Alloy.

TORTION:

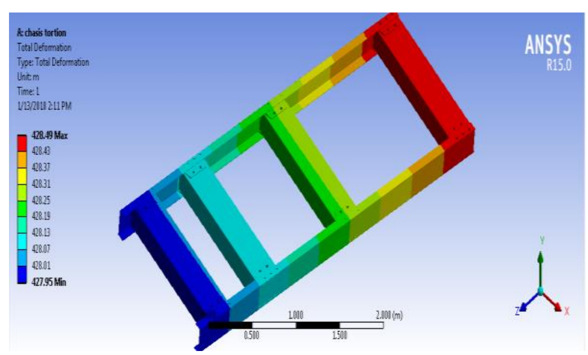

Fig.12 Total Deformation of Structural Steel.

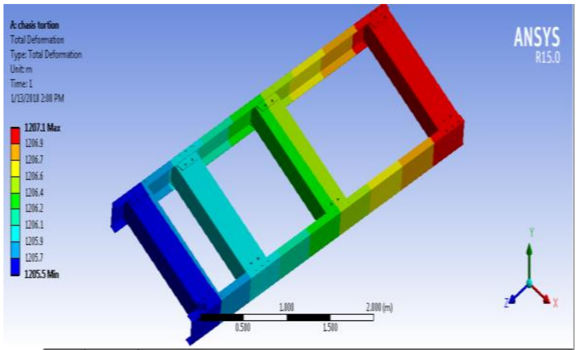

Fig.13 Total Deformation of Aluminium Alloy.

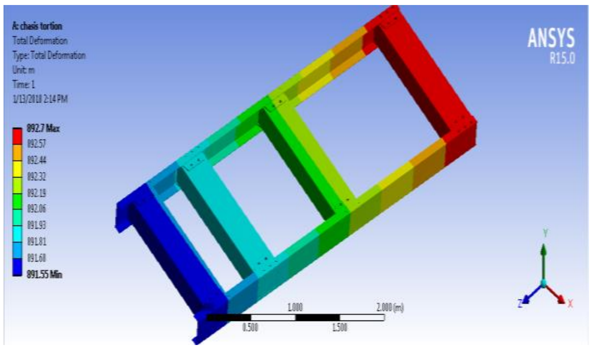

Fig.14 Total Deformation of Titanium Alloy.

7.2 EQUIVALENT ELASTIC STRAIN:

The Equivalent Elastic Strainvalues of the analyzed chasis is shown in the figures below. This analysis also shows that structural steel is better than the other two types of materials.

BENDING:

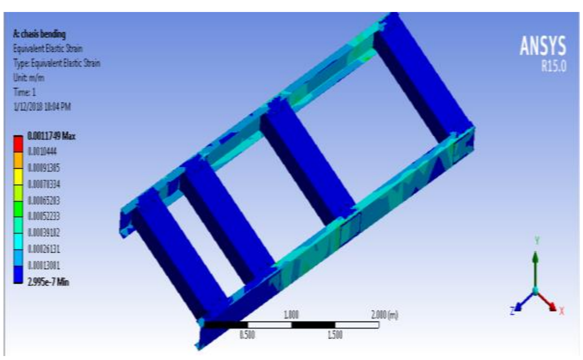

Fig.15 Equivalent Elastic Strain of Structural Steel.

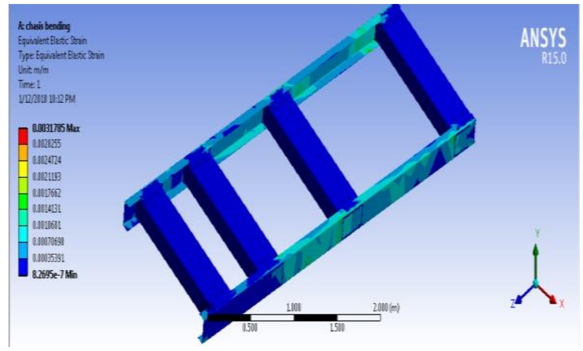

Fig.16 Equivalent Elastic Strain of Aluminium Alloy.

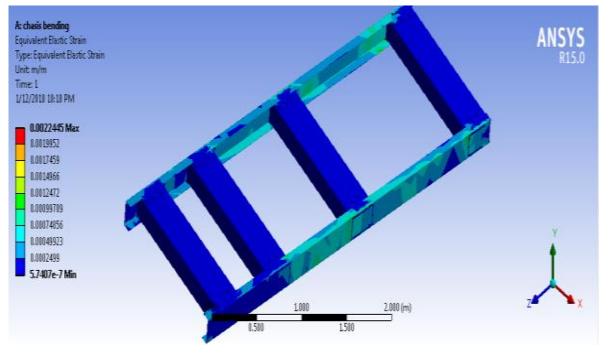

Fig.17 Equivalent Elastic Strain of Titanium Alloy.

TORTION:

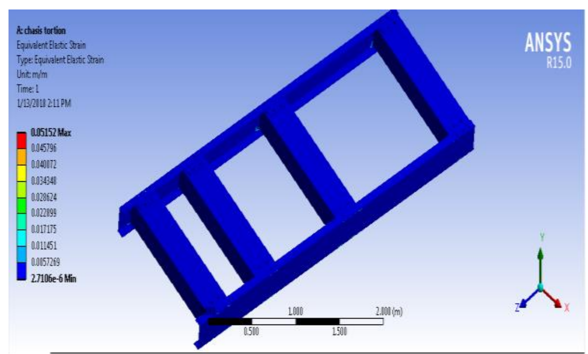

Fig.18 Equivalent Elastic Strain of Structural Steel.

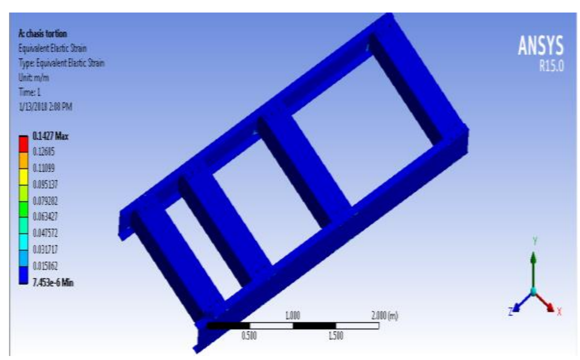

Fig.19 Equivalent Elastic Strain of Aluminium Alloy.

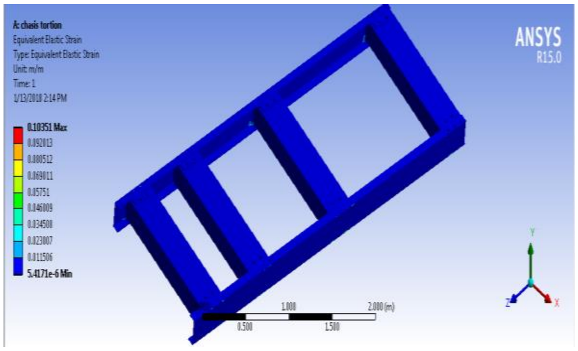

Fig.20 Equivalent Elastic Strain of Titanium Alloy.

7.3 MAXIMUM PRINCIPAL ELASTIC STRAIN:

The Maximum Principal Elastic Strainvalues of the analyzed chasis is shown in the figures below. This analysis also shows that structural steel is better than the other two types of materials.

BENDING:

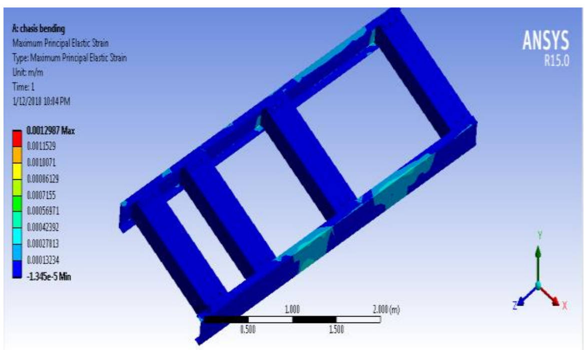

Fig.21 Maximum Principal Elastic Strain of Structural Steel

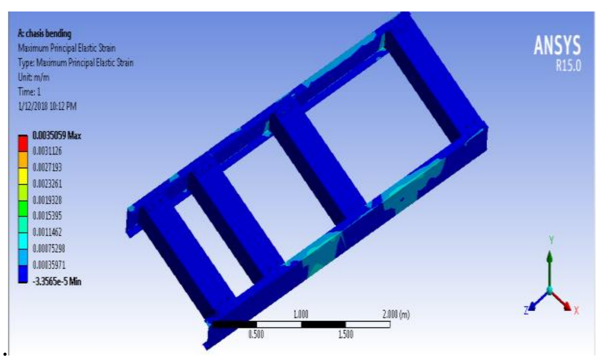

Fig.22 Maximum Principal Elastic Strain of Aluminium Alloy.

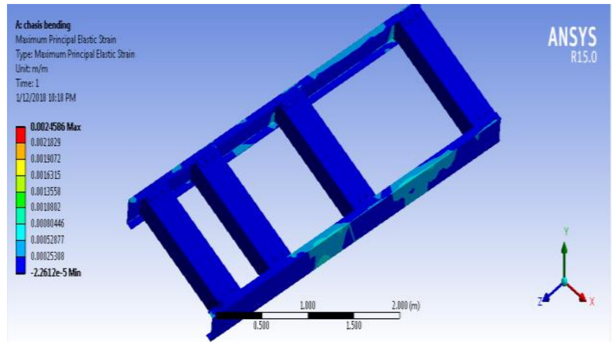

Fig.23 Maximum Principal Elastic Strain of Titanium Alloy.

TORTION:

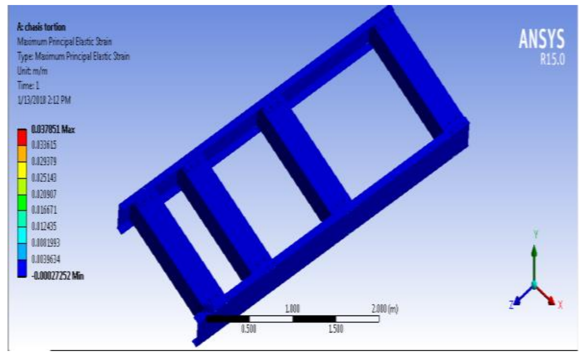

Fig.24 Maximum Principal Elastic Strain of Structural Steel.

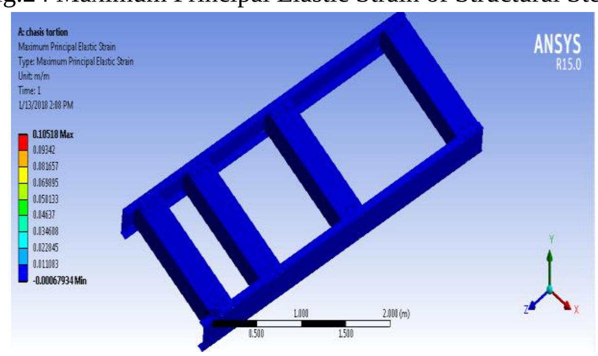

Fig.25 Maximum Principal Elastic Strain of Aluminium Alloy.

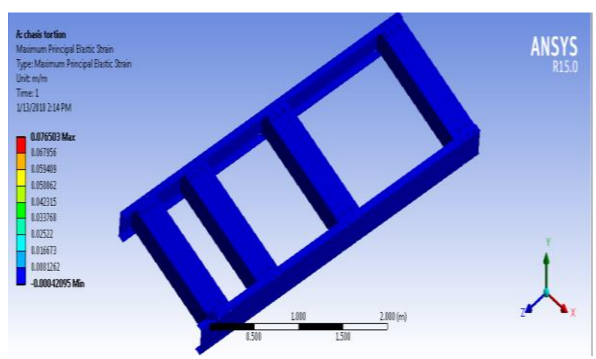

Fig.26 Maximum Principal Elastic Strain of Titanium Alloy.

7.4 EQUIVALENT STRESS:

The Equivalent Stress values of the analyzed chasis is shown in the figures below. This analysis also shows that structural steel is better than the other two types of materials.

BENDING:

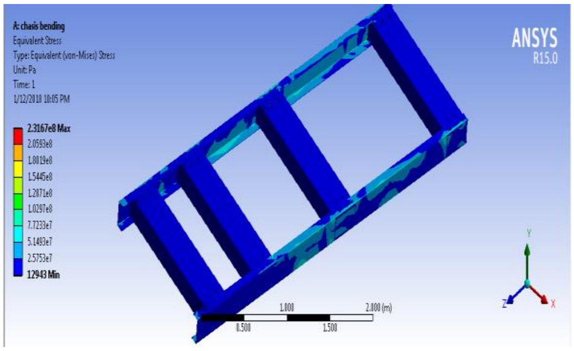

Fig.27Equivalent Stress of Structural Steel.

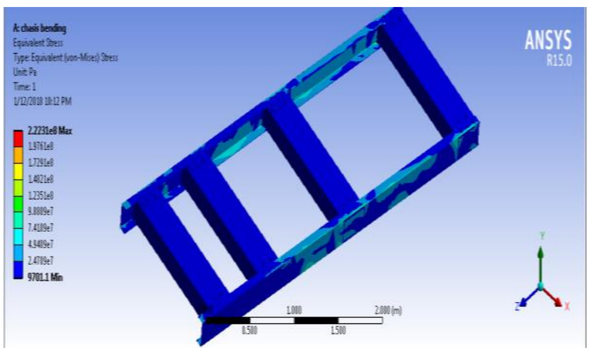

Fig.28Equivalent Stress of Aluminium Alloy.

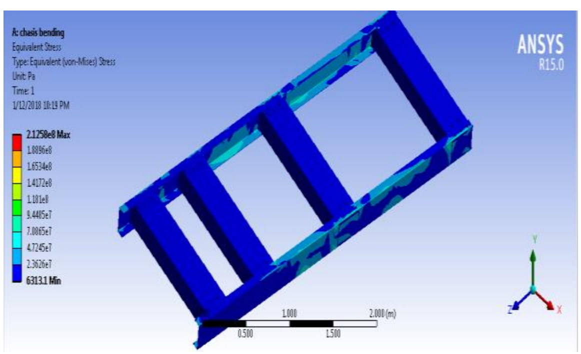

Fig.29Equivalent Stress of Titanium Alloy.

TORTION:

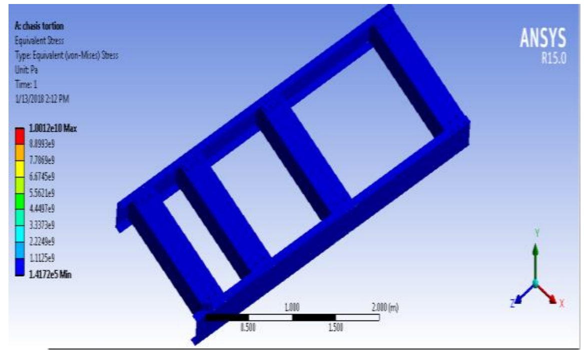

Fig.30Equivalent Stress of Structural Steel.

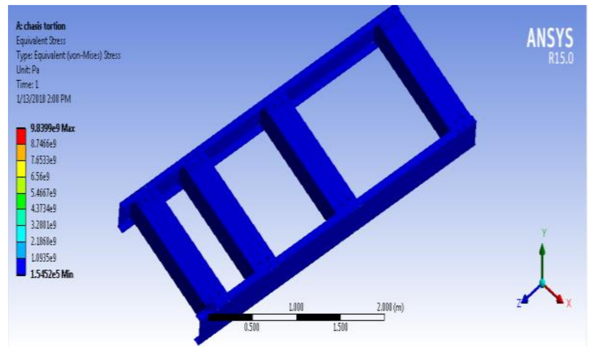

Fig.31Equivalent Stress of Aluminium Alloy.

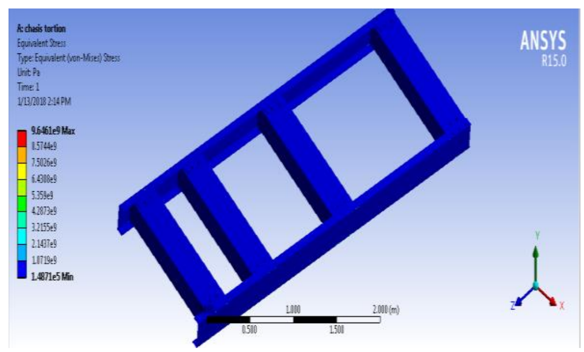

Fig.32Equivalent Stress of Titanium Alloy.

7.5 MAXIMUM PRINCIPAL STRESS:

The Maximum Principal Stressvalues of the analyzed chasis is shown in the figures below. This analysis also shows that structural steel is better than the other two types of materials.

BENDING:

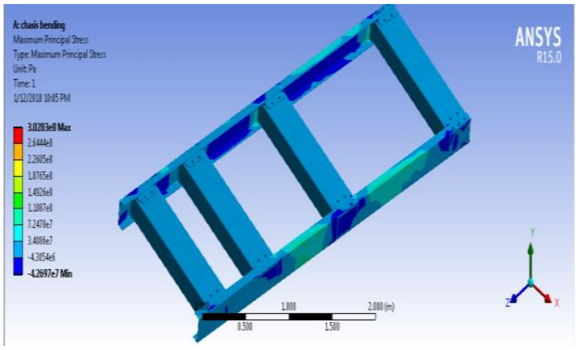

Fig.33Maximum Principal Stressof Structural Steel.

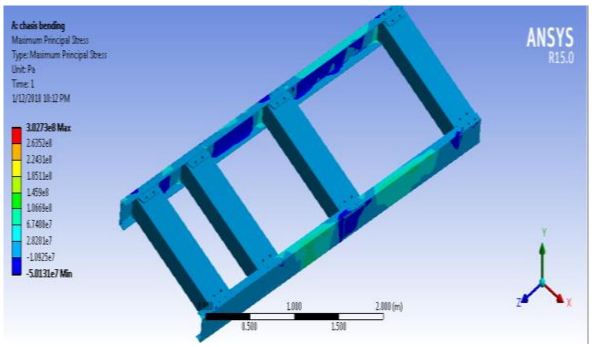

Fig.34Maximum Principal Stress of Aluminium Alloy.

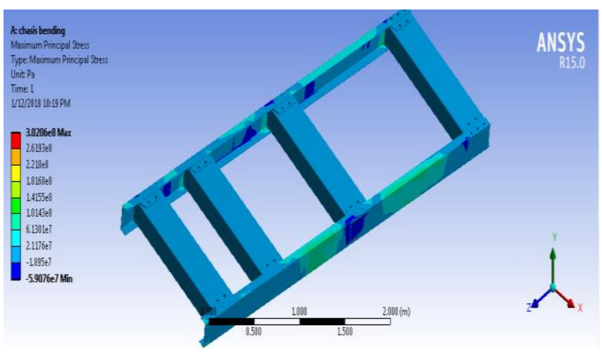

Fig.34Maximum Principal Stress of Titanium Alloy.

TORTION:

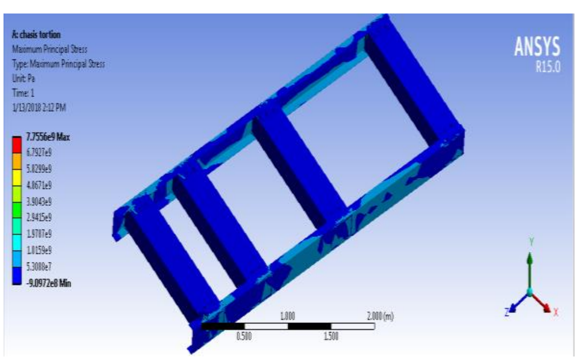

Fig.35Maximum Principal Stress of Structural Steel.

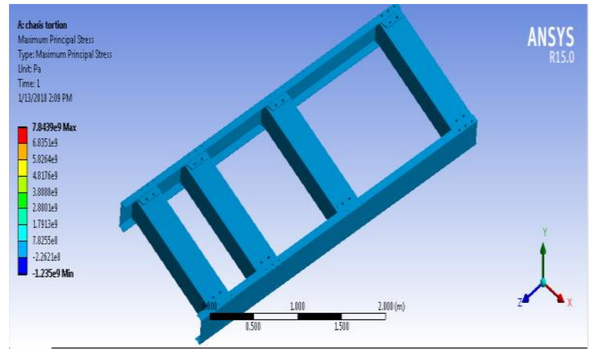

Fig.36Maximum Principal Stress of Aluminium Alloy.

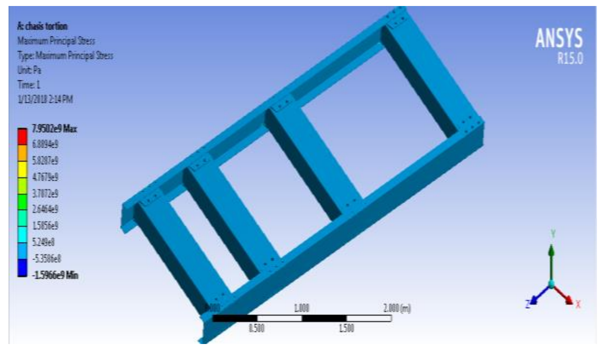

Fig.37Maximum Principal Stress of Titanium Alloy.

7.6SHEAR STRESS:

The Shear Stressvalues of the analyzed chasis is shown in the figures below. This analysis also shows that structural steel is better than the other two types of materials.

BENDING:

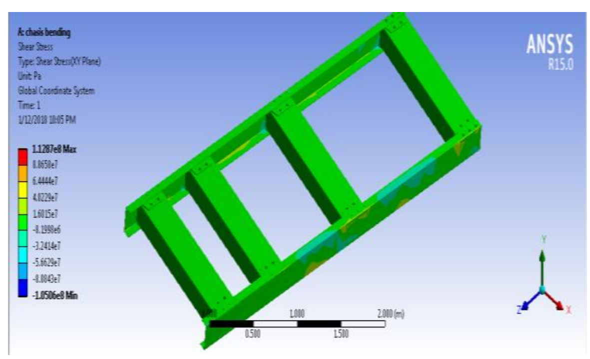

Fig.38 Shear Stress of Structural Steel.

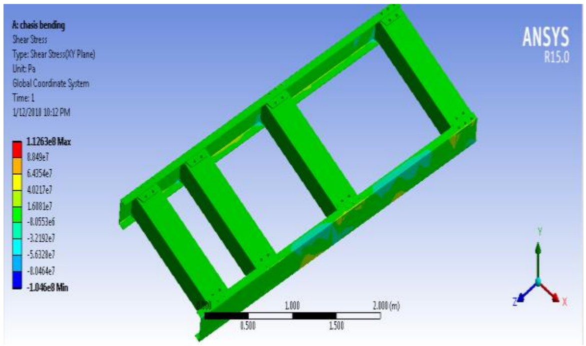

Fig.39Shear Stress of Aluminium Alloy.

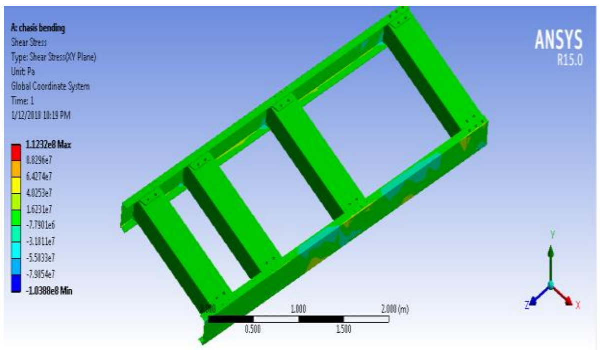

Fig.40Shear Stress of Titanium Alloy.

TORTION:

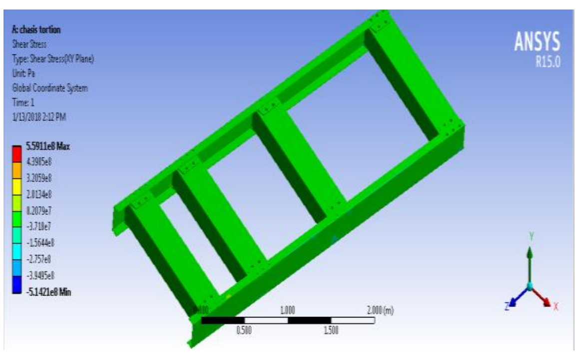

Fig.41 Shear Stressof Structural Steel.

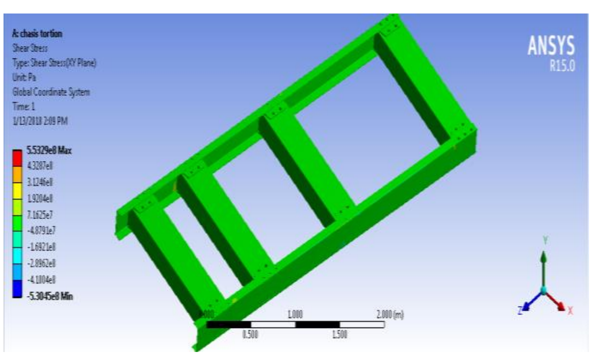

Fig.42 Shear Stress of Aluminium Alloy.

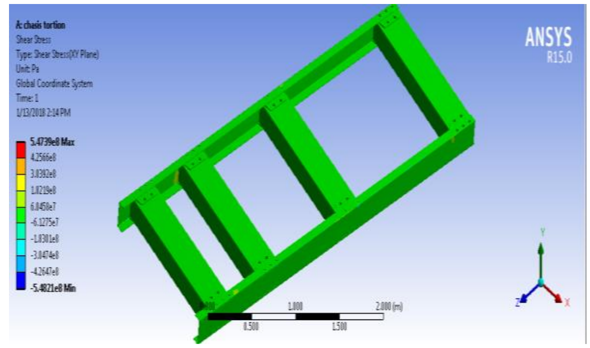

Fig.43 Shear Stress of Titanium Alloy.

VIII. RESULTS AND DISCUSSION

All the design aspects are analyzed carefully based on the required parameters. The analysis clearly suggest that the Structural Steel material is the best material for the chasis manufacturing based on the particular design, when compared with Aluminium Alloy and Titanium Alloy. In future better design with better composite material can deal even better with this requirement.

S.NO	PROPERTIES	STRUCTURAL STEEL		ALUMINIUM ALLOY		TITANIUM ALLOY	
		BENDING	TORTION	BENDING	TORTION	BENDING	TORTION
1.	TOTAL DEFORMATION (m)	1.7423	428.49	4.9087	1207.1	3.6303	892.7
2.	EQUIVALENT ELASTIC STRAIN (m/m)	0.0011749	0.05152	0.0031785	0.1427	0.0022445	0.10351
3.	MAXIMUM PRINCIPAL ELASTIC STRAIN (m/m)	0.0012987	0.037851	0.0035059	0.10518	0.0024586	0.076503
4.	EQUIVALENT STRESS (Pa)	2.3167e8	1.0012e10	2.2231e8	9.8399e9	2.1258e8	9.6461e9
5.	MAXIMUM PRINCIPAL STRESS (Pa)	3.0283e8	7.7556e9	3.0273e8	7.8439e9	3.0206e8	7.9502e9
6.	SHEAR STRESS (Pa)	1.1287e8	5.5911e8	1.1263e8	5.5329e8	1.1232e8	5.4739e8

IX. CONCLUSION

The chasis structural design and optimization of the same has been the key area of focus in the recent times. Various literature reviews regarding in this issue has been studied and implied in this research. The stress analysis and fatigue analysis are the main analysis carried out on the chasis using ANSYS software. This is particularly done for the identification of the weak points and the life of the chasis. Further even more research has to be continued to carry out in the near future for the better enhancement of the chasis structure and design.

X. ACKNOWLEDGEMENT

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