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Analysis and Optimiztion of Chassis for E-Vehicle

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Abstract— **Now-a-days most of the researches are being conducted in order to develop, increase performance and reliability in the field of electrical vehicles. As they are efficient, produce no pollution and environment friendly. One of the most important part of any vehicle is chassis. Chassis forms a back bone for the automobile as it carries all the components of the vehicles. As it supports more components it must be capable to withstand heavy loads and impact. The performance of chassis depends upon the material. The material and design of chassis are based upon the load at which it needs to be working without problem. In this project structural analysis of chassis is carried out for two materials namely Aluminium and Steel for 1 ton including four passengers and other components. Based on the analysis the best one is suggested**.

Keywords—E-Vehicle, Chassis, Analysis, ANSYS

I. Introduction

E-Vehicle: Electrical Vehicle. E-Vehicle works functions by plugging the charger into the charging and consumes electricity from the grid. The consumed electricity is then stored into rechargeable batteries that helps in driving the electric motor which helps the vehicle to move. E-Vehicle accelerates faster than conventional IC engine vehicles such that they feel lighter when they drive. Chassis is derived from a French word which means the complete automobiles without body. Chassis is defined as the back-bone for any type of vehicle. It forms the basic frame work of the automobile. It supports all the parts of the automobile attached to it. Chassis is made up of forged steel. All the components related to the automobile are bolted in it. All the systems like power train, transmission system, braking, suspension, etc. are attached and supported by it. It should be strong such that bear load during sudden braking and accidents.

II. Methodology

All the necessary pre-requisites have been selected and modelling is done with SOLIDWORKS 2017 and ANSYS is used for analysis**.**

A. Modelling

First, the main I section beam or rail of the main frame the bending and curvature are all measured and created the main axis of the beam and on that created the I section with dimension and used the SWEEP function to extrude the I section through the axis profile. On that profile, creation of all necessary solid section is carried out on that beam. The chassis is made symmetry to the axis and after completing the whole model precisely, the model after completing all the section mirroring all body about the symmetry axis is done and combining of the both profile by using the feature called COMBINE is selected from INSERT-> FEATURE -> COMBINE which allow the profiled body and mirrored body to combine into single body which allow to stop many error which may occur in

B. Analysis

For analysis ANSYS software is used. Analysis is done for two materials namely aluminium alloy and structural Steel. Finite Element Analysis (FEA) is performed to find the Von Mises stress, strain, total deformation, directional deformation, fatigue life and factor of safety using ANSYS workbench. Three dimension structural chassis is created from the SolidWorks software is imported to the ANSYS software by converting the file SLDPRT to IGS. IGS or IGES are the formats used for ANSYS software. After import this file into ANSYS software first we need to give the Engineering parameter of the material used in the chassis. After that we need to create the mesh on that chassis. We need to give the necessary load condition to the chassis and insert the values. Then, we need to calculate in solution section. After completing this entire step we get the result that we desired.

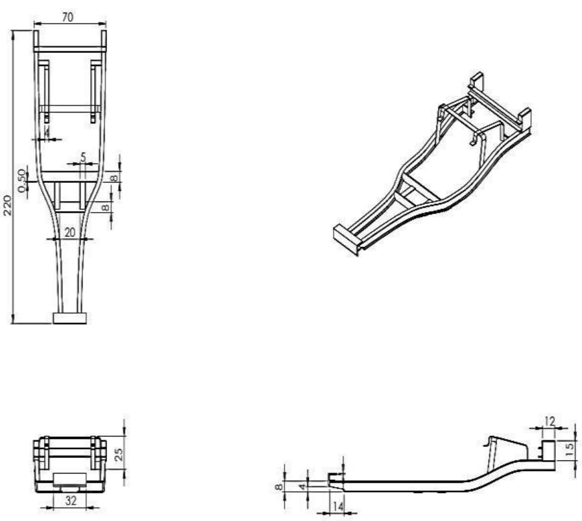
III. Need For The Project

- Inorder to present accurate and reliable data.
- To avoid error in term of statistical and mathematical.
- To conform that the components works within the Factor of Safety.

IV. Objective

- To analyse and optimize the parameters of the chassis.
- To find whether the chassis works according to the permitted Factor of safety.

V. Chassis Model



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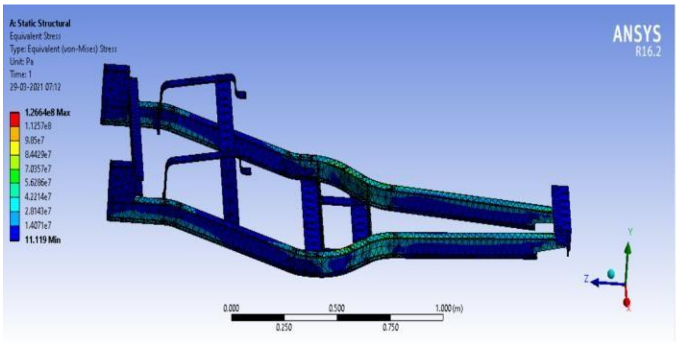
VI. Results & Discussion

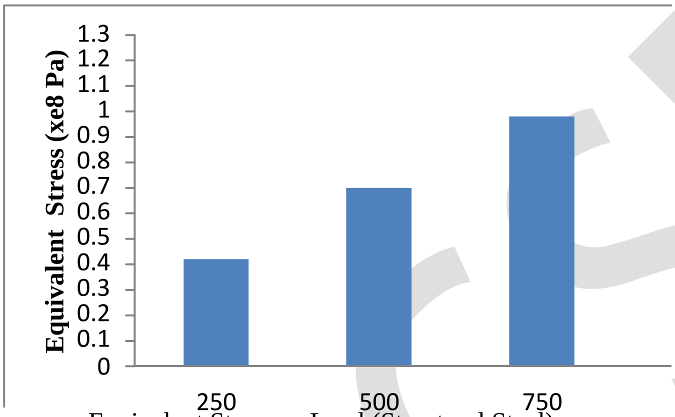
After modelling of computerized design model of chassis we analysed the same and found the result using ANSYS software.

A. Equivalent Stress (Von Mises)

Stress is defined as the internal forces acting inside the body. Stress is a physical quantity. In other words stress is defined as the force acting per unit area. Its unit is N/mm.

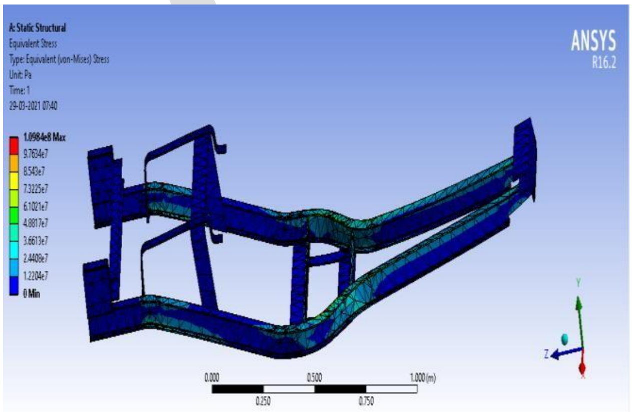


Equivalent Stress (Von Mises) for Structural Steel

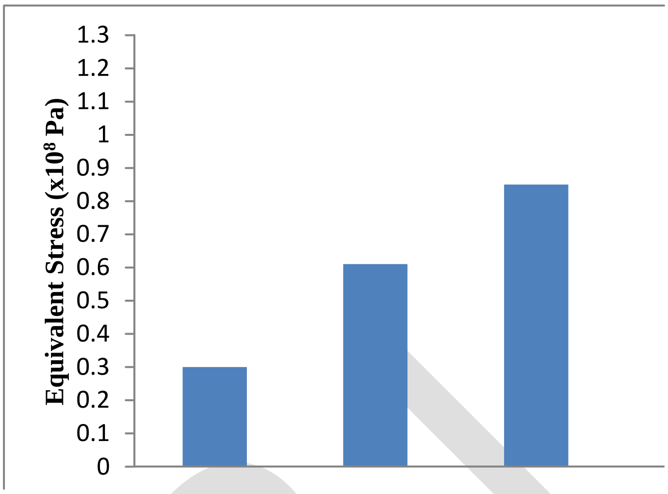


Equivalent Stress vs Load (Structural Steel)

This figure shows on minimum load of 250kg and maximum load 1000kg the chassis experiences stress of about $0.42x10^8$ Pa and $1.26x10^8$ Pa.



Equivalent Stress (Von Mises) for Aluminium



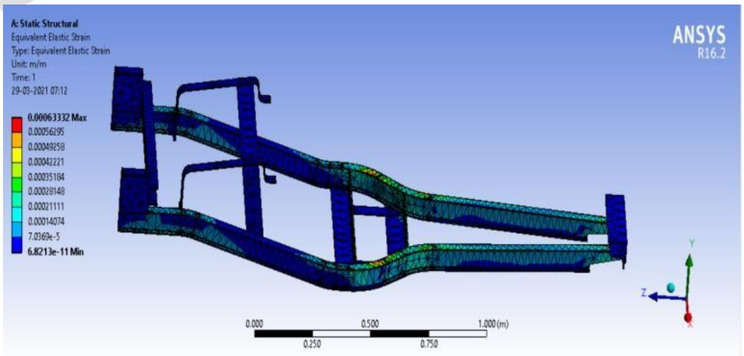
Equivalent Stress vs Load (Aluminium)

This figure shows on minimum load of 250kg and maximum load 1000kg the chassis experiences stress of about $0.4x10^8$ Pa and $1.09x10^8$ Pa.

On comparison of equivalent stress experienced by both structural steel and aluminium with respect to load. It is found that aluminium experiences less stress ($1.09x10^8$ Pa) compared to steel (1.26xe8 m) at maximum load. Therefore, in terms of stress resistance aluminium offers the more.

B. Equivalent Elastic Strain

Stress is caused due to the external forces or loads in the body. It is defined as the relative motion within the body. There are two types of strain elastic and plastic strain. In other words strain is defined as the ratio of the original dimension to change in dimension.



Equivalent Elastic Strain for Structural Steel

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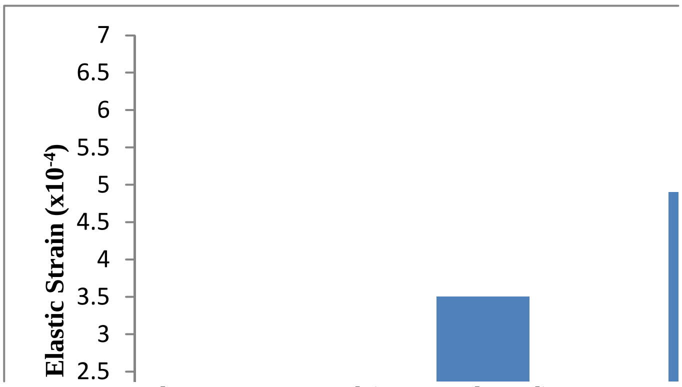
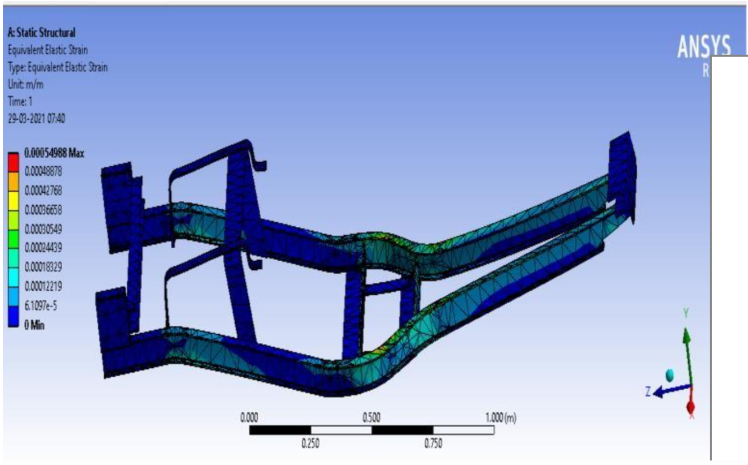
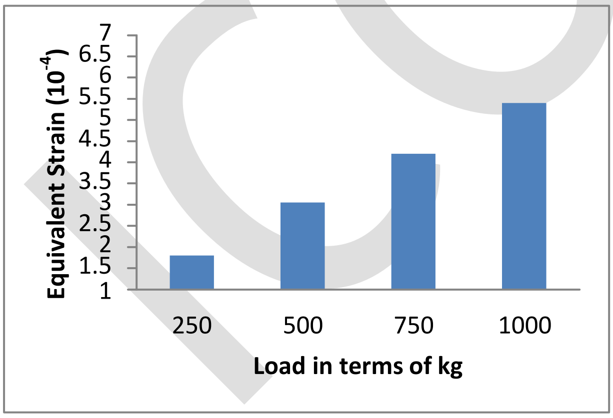


Equivalent Strain vs Load (Structural Steel)

This figure shows on applying load for 250kg the chassis experiences $2.1x10^{-4}$ of equivalent stress and finally for 1000kg the chassis experiences $6.3x10^{-4}$ of equivalent stress.



Equivalent Elastic Strain for Aluminium



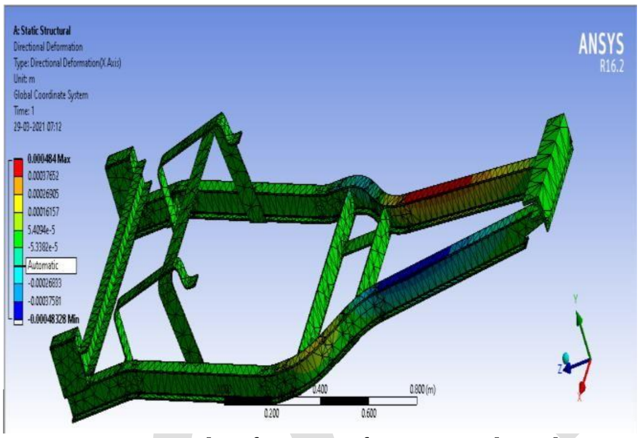
Equivalent Elastic Strain vs Load (Aluminium)

This figure shows on applying load of 250kg the chassis experiences $1.8x10^{-4}$ of equivalent stress and finally for 1000kg the chassis experiences $5.4x10^{8}$ of equivalent stress.

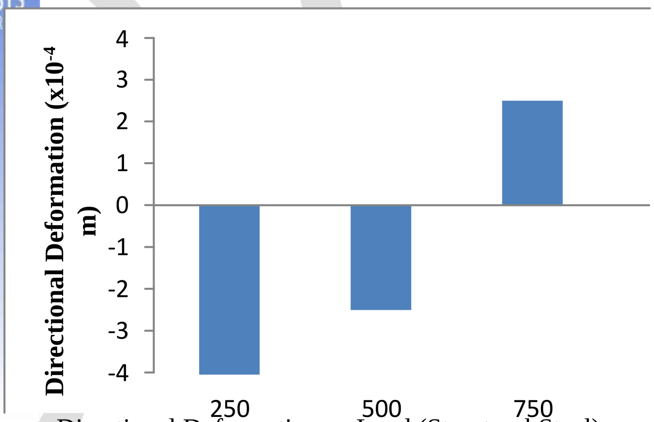
On comparison of Equivalent strain vs Load for both structural steel and aluminium, aluminium offers good resistance towards strain when compared to structural steel at maximum load.

C. Directional Deformation

Directional deformation is defined as the displacement of the system in a particular axis.

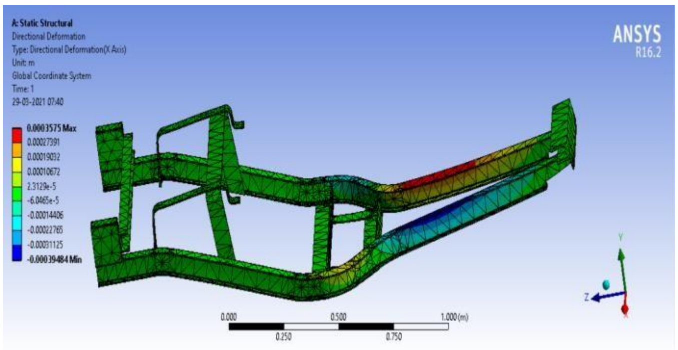


Directional Deformation for Structural Steel



Directional Deformation vs Load (Structural Steel)

This figure represents that by applying load of 250kg and 1000kg the Structural Steel chassis experiences that the minimum and maximum elastic strain of value $-4x10^{-4}$ m and $4x10^{-4}$ m.



Directional Deformation for Aluminium

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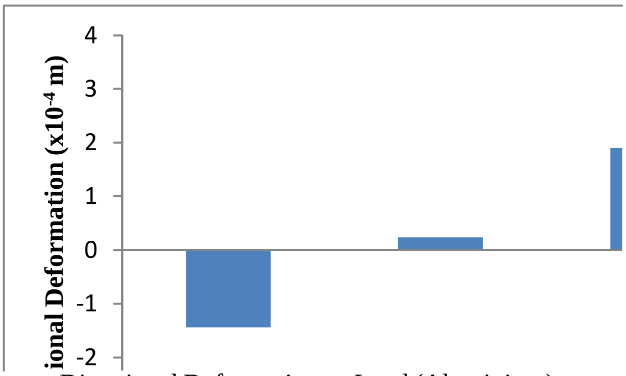


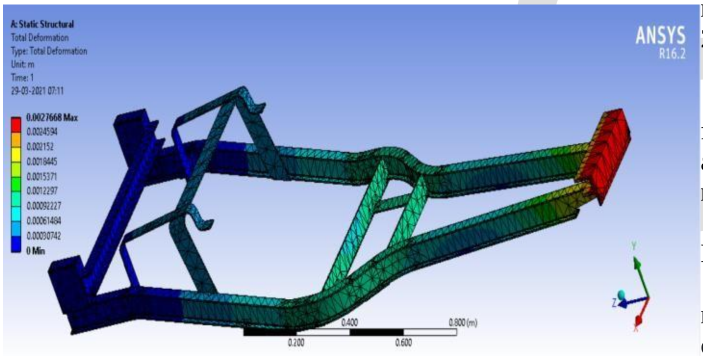
Directional Deformation vs Load (Aluminium)

This figure represents that by applying load of 250kg and 1000kg the aluminium chassis experiences that the minimum and maximum elastic strain of value $-4x10^{-4}$ m and $3.5x10^{-4}$ m.

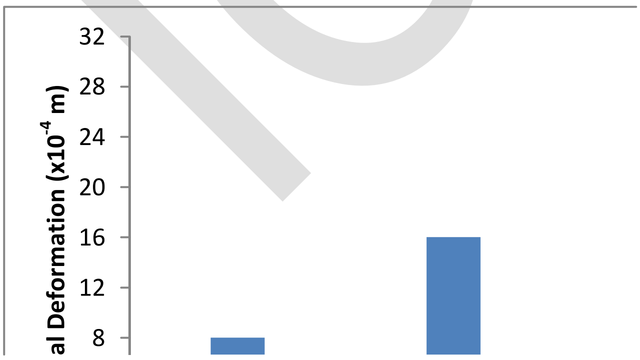
On the analysis of chassis for directional deformation by structural steel and aluminium as material it is found that aluminium exhibit less directional deformation compared to steel for the maximum load.

D. Total Deformation

Total deformation is defined as the vector sum of all directional displacement of a system

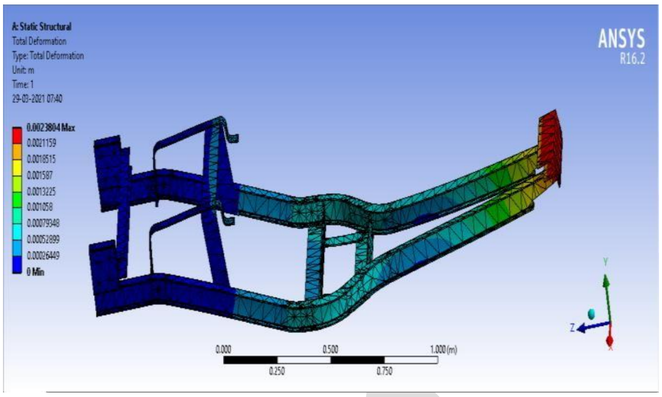


Total Deformation for Structural Steel



Total Deformation vs Load (Structural Steel)

This figure represents that by applying load of 250kg and 1000kg the Structural Steel chassis experiences that the minimum and maximum elastic strain of value $8x10^{-4}$ m and $26x10^{-4}$ m.



Total Deformation for Aluminium

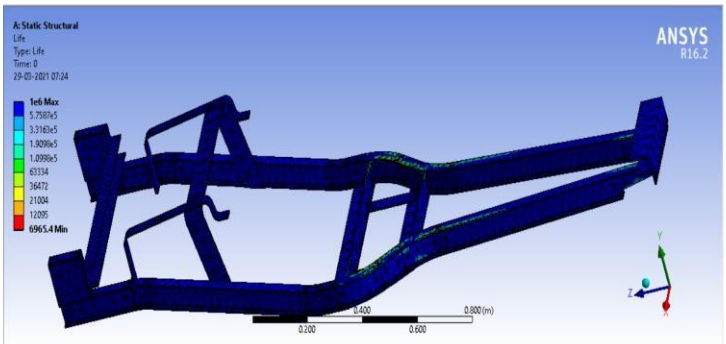
Total Deformation vs Load (Aluminium)

This figure represents that by applying load of 250kg and 1000kg the Structural Steel chassis experiences that the minimum and maximum elastic strain of value $8x10^{-4}$ m and $23x10^{-4}$ m.

On the basis of analysis result there is no big difference for the total deformation between structural steel and aluminium. The difference is about $4x10^{4}$ which is a negligible one.

E. Fatigue Life

Fatigue life is a mechanical and scientific term that relates to how long an object or material will last before completely failing because of concentrated stresses.



Fatigue life for Structural Steel

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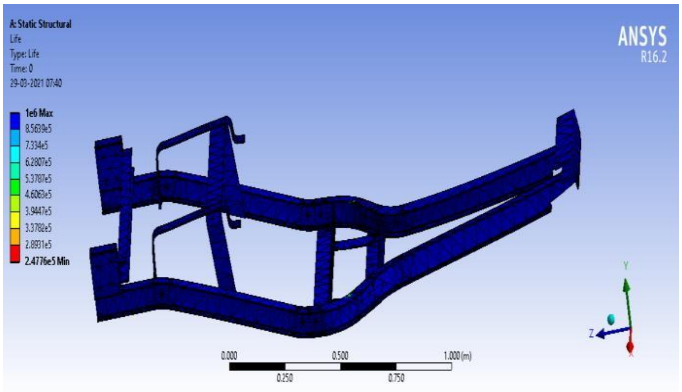


Fatigue life for Aluminium

On comparing the fatigue life, structural steel have more compared to aluminium for the maximum load.

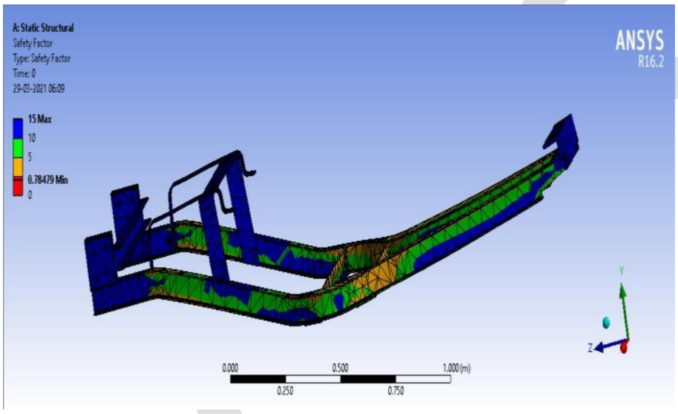
F. Factor of Safety

Factor of Safety usually refers to one of two things:

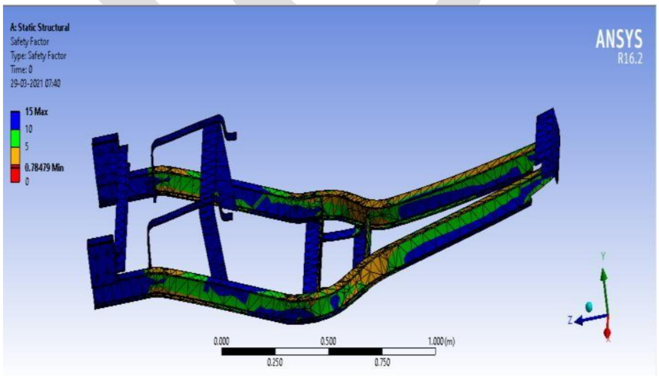
1) The actual load-bearing capacity of a structure or component

2) The required margin of safety for a structure or component according to code, law, or design requirements.

In other words it is defined as the ratio of strength of the material by the stress applied on that material.



Factor of Safety for Structural Steel



Factor of Safety for Aluminium

On the comparison of Factor of Safety for both structural steel and aluminium there is same for the different loads.

VII. Conclusion

Steel chassis are stronger, durable, corrosive resistance, easy to fabricate and construct, has more aesthetic look and efficient. But on comparison with aluminium in terms of stress, strain, etc., aluminium chassis performs well in analysis. So it is recommended to use aluminium for the fabrication of chassis. Also chassis made in aluminium are lighter in weight when compared to steel and the manufacturing cost is also less. The durability of aluminium is more when compared with steel.

VIII. Future Scope

There is more studies are being carried out in the field of chassis. Also more studies are carried out for to solve frequency, vibration, etc. This project is recommend for the consumers to prefer aluminium when compared steel for its specifications and load carrying capacity.

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