# Design and Analysis of Automobile Chassis by using Alternative Materials

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**ABSTRACT:** The Chassis is the most integral part of the vehicle. It is the frame of the chassis on which the entire body of the vehicle is built. The entire external load of the vehicle including its self-weight is on the chassis. Thus, this chassis design and its analysis forms the most important part of the vehicle manufacturing. This paper deals with the structural analysis of a light duty automobile chassis which is replaced an existing material (Grey Cast Iron) by ASTM A710, AISI 4130 steel and Al6063. Material properties are applied on an automobile chassis and analysed under maximum load conditions. An automobile chassis is modelled in Solid Works with the appropriate dimensions. Analysis for the different materials is done in ANSYS based on the model.

## I.INTRODUCTION

The chassis of an automobile provide mounting points for the components like engine, driveline, suspension system and wheels. The main functions of the chassis are to support the chassis components and the body to withstand static and dynamic loads without excessive deflection or distortion. The frame must be rigid enough to support or carry all the loads and forces that the vehicle is subjected to in operation. A frame must also be flexible enough to handle shock loads and the twists, bends, sway and sag that it encounters under different road or load conditions. The frame should be able to flex under different situations, while being able to return to its original shape when loads or forces are removed. From the comparison it has been found that Eicherhas lowest height of frame section and Eicher 11.10 has maximum load body length (length of Frame). So this frame is having greatest possibility of bending among all, thus this frame has been considered for the case study. The chassis frame is made of two side members joined with a series of cross members. These cross members provide better handling of the vehicle, prevents deflection and gives torsional strength to resist twisting of the chassis. Forthe analysis of the chassis frame appropriate model of the chassis is developed and analysed by the Finite Element Method (FEM).

### Chassis frame and body

Introduction of Chassis Frame: Chassis is a French term and was initially used to denote the frame parts or Basic Structure of the vehicle. It is the back bone of the vehicle. A vehicle without body is called Chassis. The components of the vehicle like Power plant, Transmission System, Axles, Wheels and Tires, Suspension, Controlling Systems like Braking, Steering etc., and also electrical system parts are mounted on the Chassis frame. It is the main mounting for all the components including the body. So it is also called as Carrying Unit.

**Chassis body**

In most passenger cars through the middle of the 20th century, a pressed-steel frame the vehicle's chassis formed a skeleton on which the engine, wheels, axle assemblies, transmission, steering mechanism, brakes, and suspension members were mounted. The body was flexibly bolted to the chassis during a manufacturing process typically referred to as body-on-frame construction. This process is used today for heavy-duty vehicles, such as trucks, which benefit from having a strong central frame, subjected to the forces involved in such activities as carrying freight, including the absorption of the movements of the engine and axle that is allowed by the combination of body and frame.

In modern passenger-car designs, the chassis frame and the body are combined into a single structural element. In this arrangement, called unit-body

construction, the steel body shell is reinforced with braces that make it rigid enough to resist the forces that are applied to it. Separate frames or partial "stub" frames have been used for some cars to achieve better noise-isolation characteristics. The heavier-gauge steel present in modern component designs also tends to absorb energy during impacts and limit intrusion in accidents.

An automotive Chassis plays important role in the suspension system as handling becomes much easier when one drive quality one. Suspension system take charge when driving on bad road, causing the stress on the entire chassis of a vehicle and causes same stress on the suspension system when accelerated. This is to say, chassis bear up forces and make a fast drive. The added engine to

the chassis also add serious weight to a vehicle chassis butthe good news is there is enough strength to carry it.

Breaking system as one of the essential part in an automobile. It is also mounted to the chassis frame, the chassis have the ability of resist the sudden braking of the vehicles. On a heavy load vehicle, great force is also needed to immediately stop the vehicle. This is why an automobile chassis are design according to the force bearing capacity.

**Functions of the Chassis Frame**

- To carry load of the passengers or goods carried in the body.
- To support the load of the body, engine, gear box etc.
- To withstand the forces caused due to the sudden brakingor acceleration
- To withstand the stresses caused due to the bad road condition.
- To withstand centrifugal force while cornering

**TYPES OF FRAME**

- Conventional frame
- Semi integral frame
- Integral frame

**Conventional frame**

It is non load carrying frame. The loads of the vehicle are transferred to the suspensions by the frame. This suspension in the main skeleton of the vehicle which is supported on the axles through springs. The body is made of flexible material like wood and isolated frame by inserting rubber mountings in between. The frame is madeof channel section or tubular section of box section. Example: This type of frame is used for trucks.

**Conventional Chassis**

**Semi integral frame**

In this case the rubber mountings used in conventional frame between frame and suspension are replaced by more stiff mountings. Because of this some of the vehicle load is shared by the frame also. This type of frame is heavier in construction. Example Popular in European and American car.

**Semi-integral chassis**

**Integral Frame**

In this type of construction, there is no frame. It is also called unitized frame body construction. In this case, the body shell and underbody are welded into single unit. The underbody is made of floor plates and channel and box sections welded into single unit. This assembly replaces the frame. This decreases the overall weight compared to conventional separate frame and body construction.

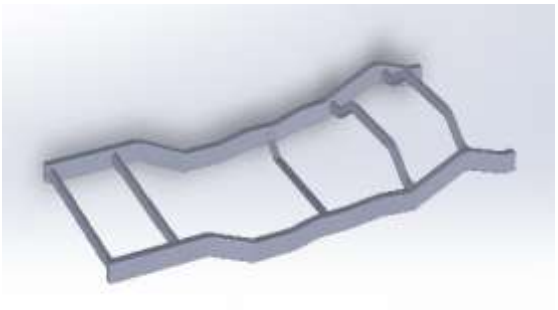
## II. PROBLEM IDENTIFICATION

Automobiles that use gasoline or diesel fuels affect the environment and the country economy specially the developing country like Ethiopia. So, it is necessary to build green and light vehicle. We can solve this problem by reducing the size and the weight of automobile by using light weight material such as aluminium, composite like metal metrics composite and polymer composites. When the vehicle number increases, the usage of petrol (fuel) also increases. At the same time, the emission from the vehicles increases the air pollution. Reducing the weight of the vehicle

which can reduce the usage of petrol. If the chassis is designed in an optimal material usage then it will save the amount of material consumed for single time also the reduction in fuel cost will also be economical for customer.

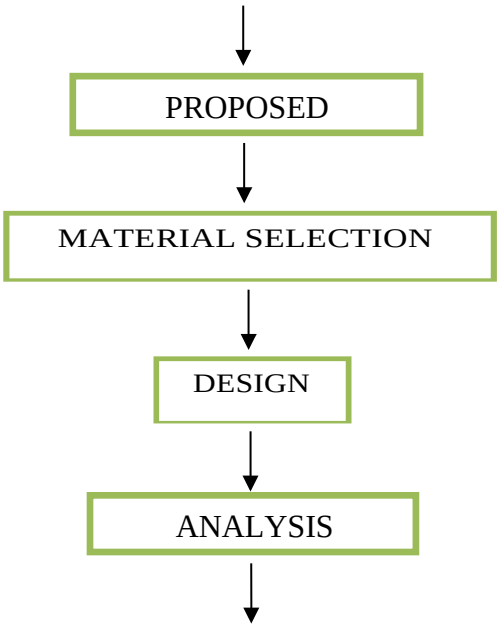
## III. DESIGN

Design is the plan or specification of the object which also shows the model in three-dimensional view. Solid works is used to design the product model. Some of the major tools used for designing the project are extrude, sketch, mirror, bend, boss, swept boss



**Chassis model**

## IV.RESULT AND ANALYSIS

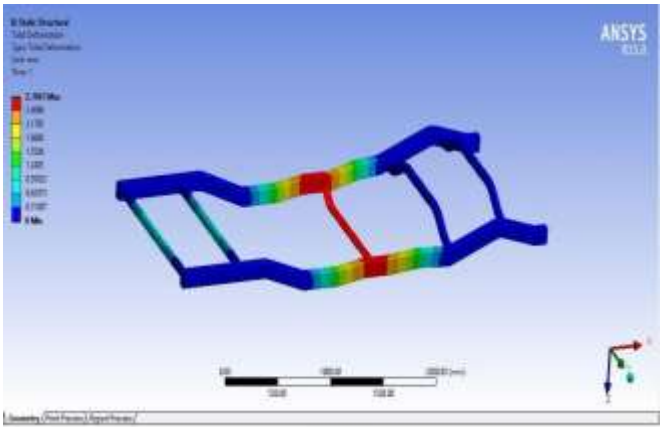



RESULT & CONCLUSION

EXISTING

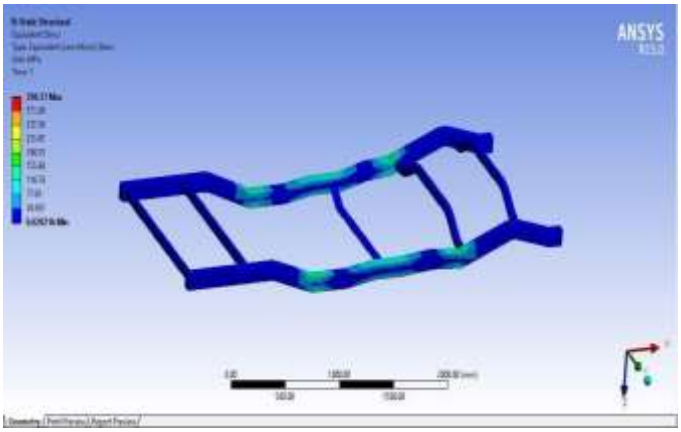
**GREY CAST IRON MATERIAL**

**Total Deformation of Grey Cast Iron**



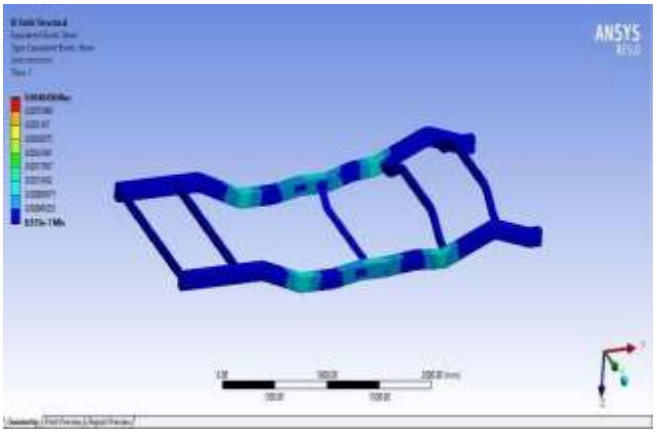

**Total Deformation of Grey Cast Iron**

**Stress of Grey Cast Iron**




**Stress of Grey Cast Iron**

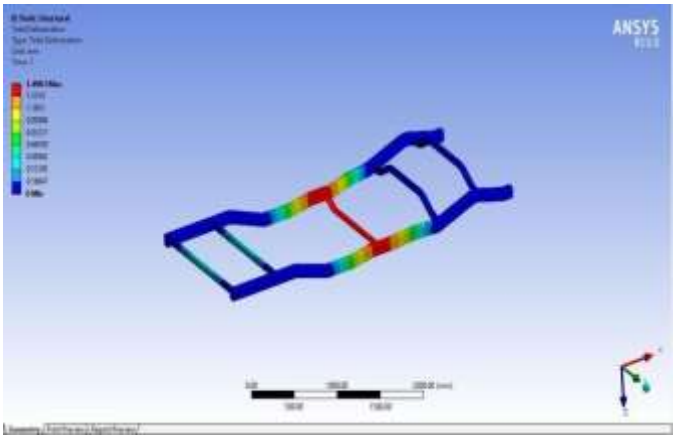
**Strain of Grey Cast Iron**




**Strain of Grey Cast Iron**

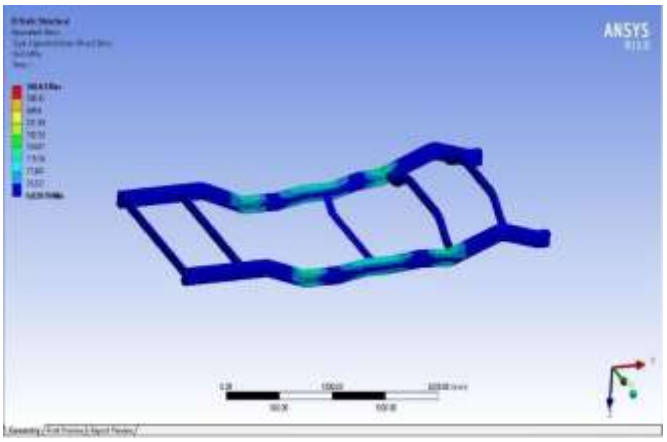
**AISI 4130 STEEL MATERIAL**

**Total Deformation of AISI 4130 Steel**



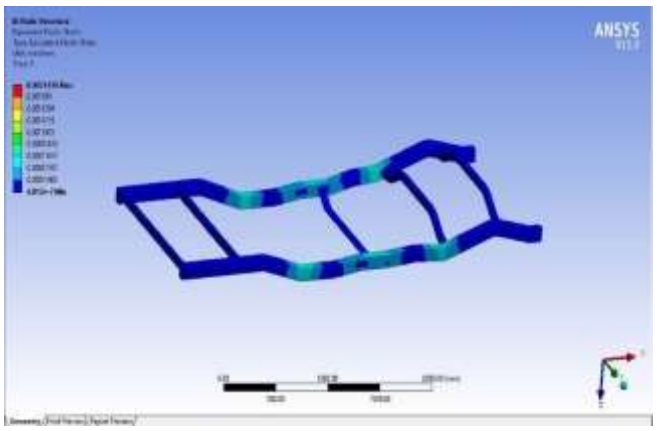

**Total Deformation of AISI 4130 Steel**

**Stress of AISI 4130 Steel**




**Stress of AISI 4130 Steel**

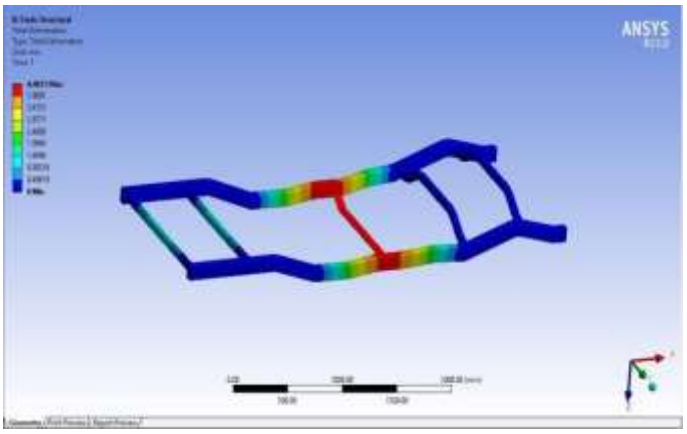
**Strain of AISI 4130 Steel**




**Strain of AISI 4130 Steel**

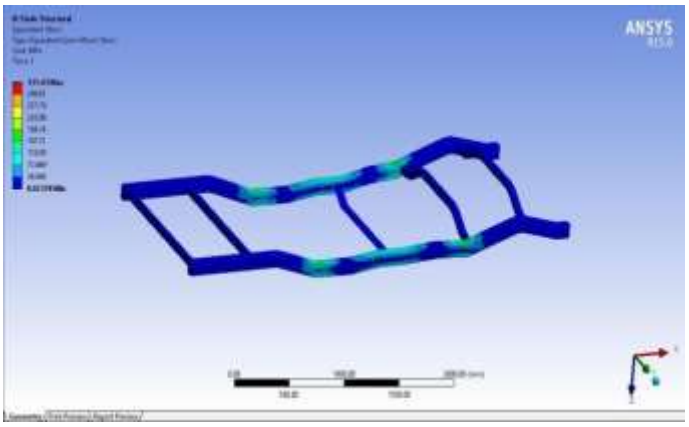
**AL 6063 ALLOY MATERIAL**

**Total Deformation of Al 6063**



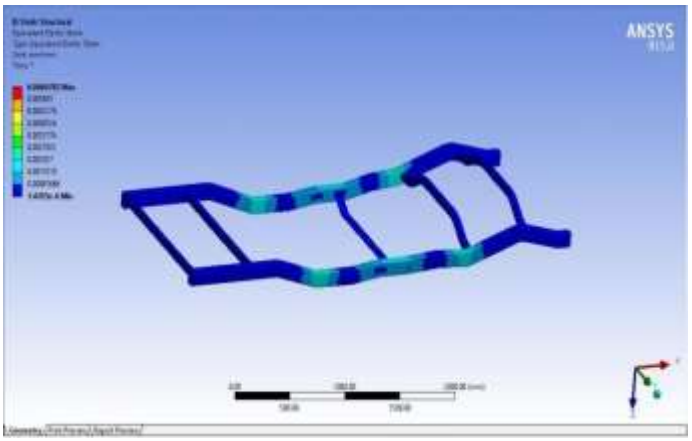

**Total Deformation of Al 6063**

**Stress of Al 6063**




**Stress of Al 6063**

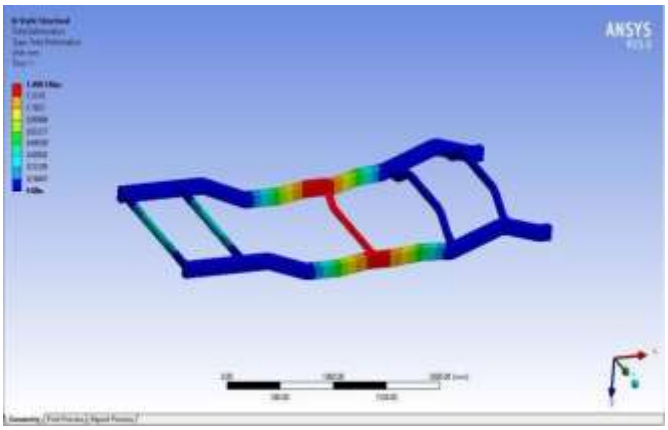
**Strain of Al 6063**




**Strain of Al 6063**

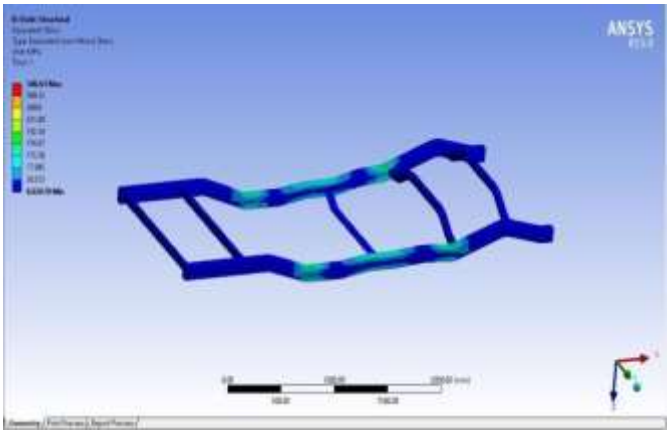
**ASTM A710 STEEL**

**Total Deformation of ASTM A710 Steel**



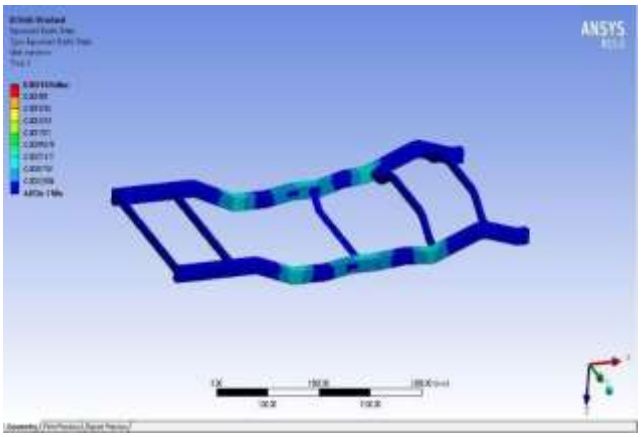

**Total Deformation of ASTM A710 Steel**

**Stress of ASTM A710 Steel**



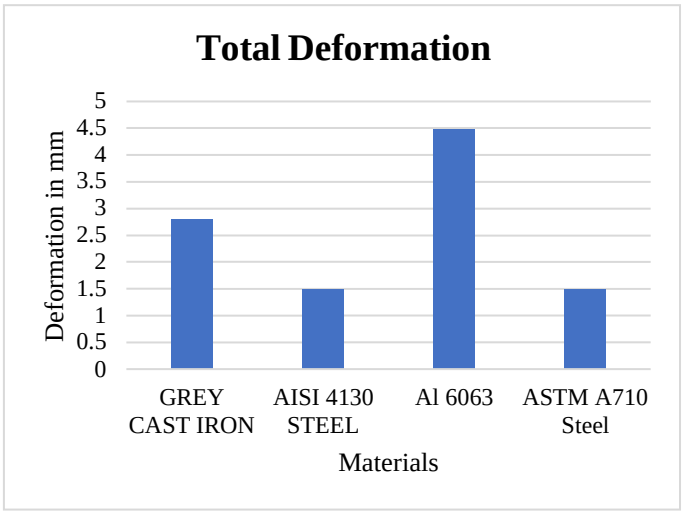

**Stress of ASTM A710 Steel**

**Strain of ASTM A710 Steel**

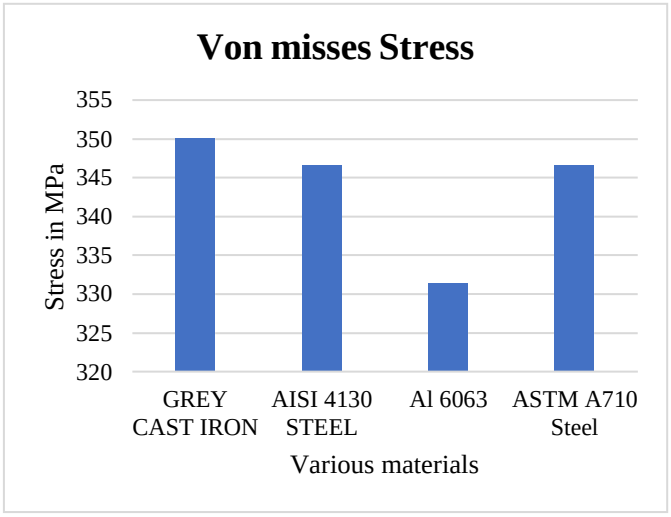



**Strain of ASTM A710 Steel**

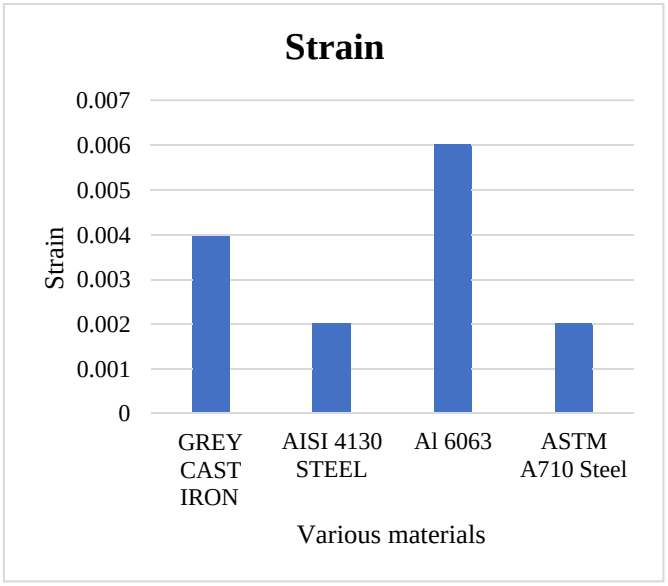
## V. GRAPH




**Total deformation for various materials**




**Von misses Stress for various materials**




**Strain for various materials**

## VI. CONCLUSION

The static structural analysis of chassis was carried out. In the present work, chassis frame was analysed using ANSYS software. From the results, it is observed that AISI 4130 STEEL and ASTM A710 Steel materials are having more strength than grey cast iron and Al 6063 material Chassis. The AISI 4130 STEEL and ASTM A710 Steel materials are having least deformation i.e., 1.49 mm and least strain value i.e., 0.0021 respectively. Based on the analysis results of the present work, the following conclusions can be drawn. Part is safe under the given loading condition. To improve performance, chassis material has been changed. From the result, AISI 4130 Steel and ASTM A710 Steel are having less deformation and strain when compared with grey cast iron and Al 6063. These materials are highly suitable for automobile chassis manufacturing.

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