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Impact & Analysis of Go-Kart Chassis.

• Abstract

In the present study, the chassis of Go-Kart is designed and simulated for different impact tests like front impact test, rear impact test and side impact test for four materials. First chassis is designed in CAD Software, simulates an ANSYS Workbench. This paper represents the designing and failure criterion according to the von-Mises stress for four different materials. The objective of the present investigation aims to get perfect material for the designed chassis and enhance the value of the factor of safety for low ground clearance Go-Kart. For the safety point of view of the driver, present analysis is carried out for a range of force values for all three impact tests. For present analysis, reliability, strength of material, ease of manufacture, energy absorption ability and structural rigidity are main considerations.

• Introduction

A GO-KART is a 4- non-aligned wheel vehicle without suspension that is mainly used in sports for racing purpose & for recreation .GO-KART were invented in 1950 after the war period by airmen as a way to pass spare time. Arts ingles is known as the father of karting. For motor racing, kart racing is a relatively safe game for them. According to the international karting commission -Federation International Automobile (CIK-FIA), GO-KART is a land vehicle with or without bodywork with non-aligned wheels in contact with the ground, two which control the steering while the other two transmit the power. The chassis of a GO-KART consists of a body frame made up of steel pipe that are welded together. There are a lot of sports available to people for their entertainment & motor sports is one of them. Mostly to drive bikes, cars and F-1 one must have professionalism into it .But what if there would be a motor sport where there is no need to have professionalism in driving i.e. GO-KART, which do not need professional drivers & have low speed .The main focus is on producing lower cost and light weight vehicle structure but with better safety efficiency. Various parameters of GO- KART can be altered in order to improve the competitiveness of other motor racing.
There are different sub-parts of the design of GO-KART
1. Chassis Department
2. Steering Department
3. Brakes and Tire Department

Out of these, the chassis department is the important one as the chassis frame –provide the necessary support to the vehicle component placed in it. Hence this frame should be strong enough in order to withstand sudden impacts to make the GO-KART more efficient in terms of its performance. In the present investigation four materials AISI 1018, AISI, 1026, AISI, 1020 and AISI 4130 are used in front, rear and side impact tests.

• CATIA

CATIA is an acronym for Computer **A**ided **T**hree-dimensional **I**nteractive **A**pplication. It is one of the leading 3D software used by organizations in multiple industries ranging from aerospace, automobile to consumer products.

CATIA is a multi-platform 3D software suite developed by Dassault SystÃ¨mes, encompassing CAD, CAM as well as CAE. Dassault is a French engineering giant active in the field of aviation, 3D design, 3D digital mock-ups, and product lifecycle management (PLM) software. CATIA is a solid modelling tool that unites the 3D parametric features with 2D tools and also addresses every design-to-manufacturing process. In addition to creating solid models and assemblies, CATIA also generates orthographic, section, auxiliary, isometric or detailed 2D drawing views. It is also possible to generate model dimensions and create reference dimensions in the drawing views. The bi-directionally associative property of CATIA ensures that the modifications made in the model are reflected in the drawing views and vice-versa.

CAD MODELING

o The entire Space frame was modeled in CATIA V5 R21 software.

o The following are the considerations for the design:

1. Driver Ergonomics: The emphasis of the design is on driver comfort
2. Nodal Geometry: To increase the load transfer path.
3. Mounting points for the integration of Suspension, Transmission, Steering and Brakes.

• Finite Element Analysis and Ansys

• Design of a product that used to be done by tedious hand drawings has been replaced by computer-aided design (CAD) using computer graphics.

• Analysis of a design used to be done by hand. calculations and many of the testings have been replaced by computer simulations using computer aided engineering (CAE) software.

• Ansys is an analysis software.

<u>Need for Analysis :</u>

• To reduce product development cycle time

• To reduce the cost of product Idle time reduction
• Better design and Alternate materials
• To reduce material wastage

Finite element method

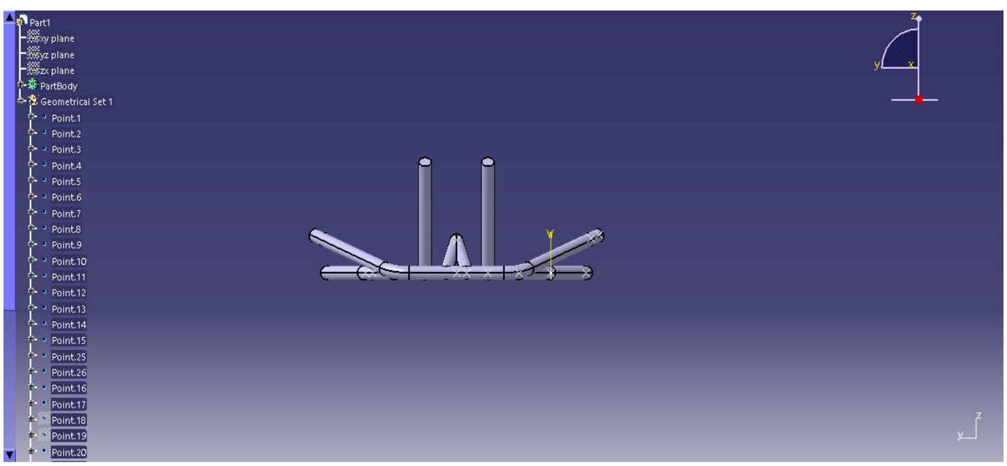
• The finite element method (FEM), or finite element analysis (FEA), is based, dividing a complicated object into smaller and manageable pieces.
• FEA provides a way of virtually testing a product design.
• It helps users understand their designs and implement appropriate design changes early in the product development process.

Finite Element Applications in Engineering

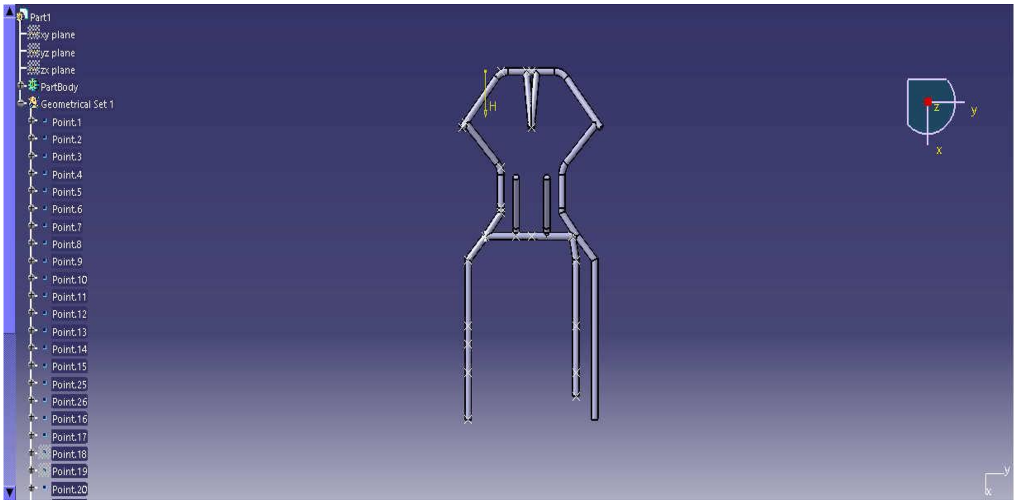
• The FEM can be applied in solving the mathematical models of many engineering problems, from stress analysis of truss and frame structures or complicated machines, to dynamic responses of automobiles, trains, or airplanes under different mechanical, thermal, or electromagnetic loading.
• There are numerous finite element applications in industries, ranging from automotive, aerospace, defense, consumer products, and industrial equipment to energy, transportation and construction, as shown by some examples in Table

Modelling of Go-kart chassis using catia

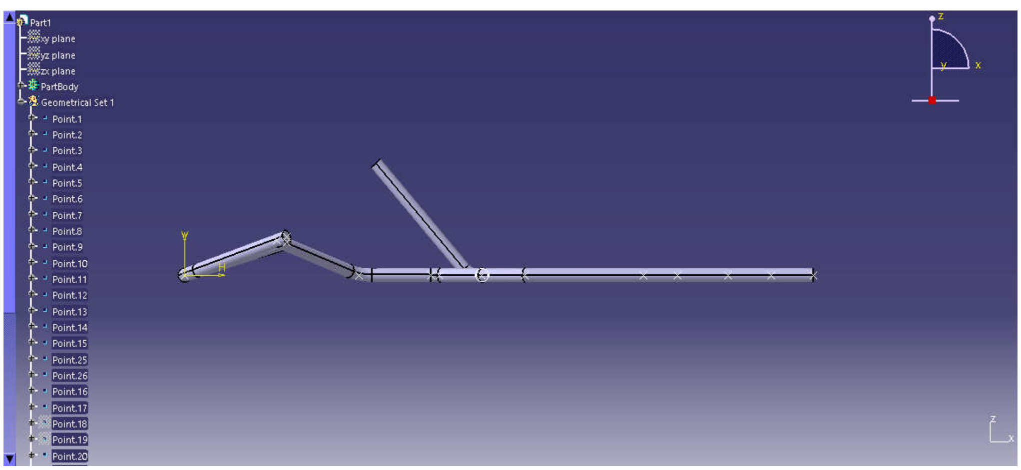
Front View:



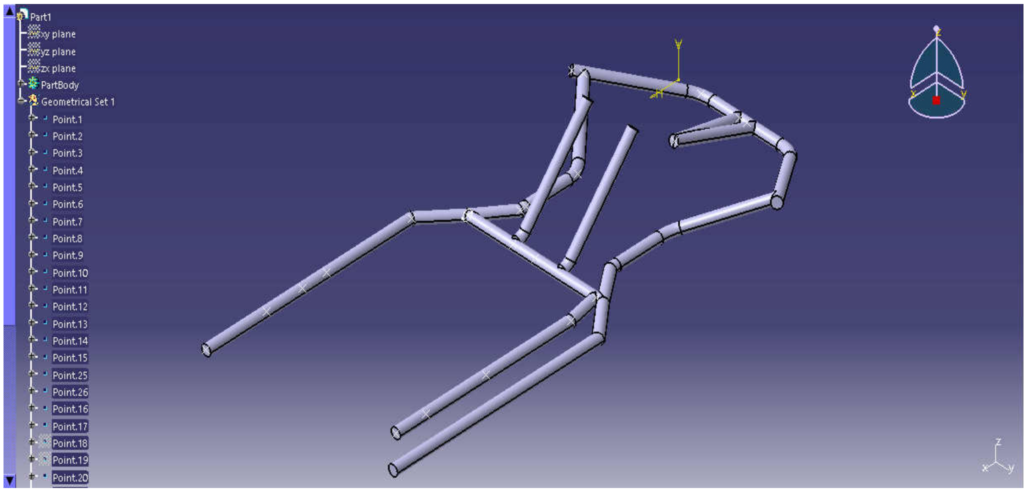
Top View:



Side View:



Isometric View:



Structural analysis of Go-Kart chassis

• Materials and Method

The chassis of GO- KART is designed in CAD software with the help of finite element method deformation and induced von-Mises stress is calculated for which ANSYS Workbench is used. Elastic properties are used. Elastic properties of used materials are given in the following table and the design of chassis is given with complete dimensions.

Material Properties:

Property	AISI 1018	AISI 1026	AISI 4130	AISI 1020
Young;s Modulus(GPa)	200	200	210	205
Poission's ratio	0.29	0.3	0.3	0.29
Tensile Strength, Yield (MPa)	370	415	435	297.74
Density (Kg/m^3)	7850	7858	7850	7870

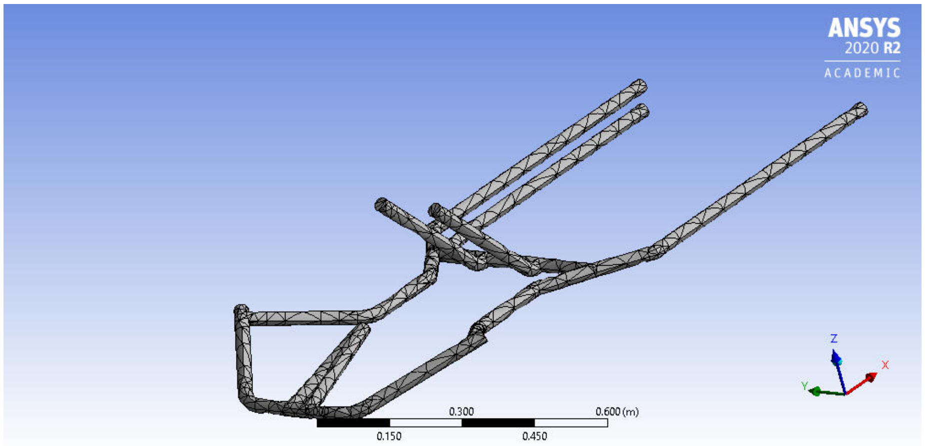


Fig.1. Meshed model of Go-Kart Chassis ANSYS Workbench

Front Impact Test:

Impact was calculated for an optimum speed of 80 kmph. The impact test force is calculated by the change in momentum in the unit interval of time (1 second). Hypothetically, the kart is given a velocity of 80 Kmph and stops in one second. This gives an impact force on the frame. The analysis based on the mass of the vehicle 180 kg

The force 4000 N is applied to calculate front impact, back impact and side impact conditions.

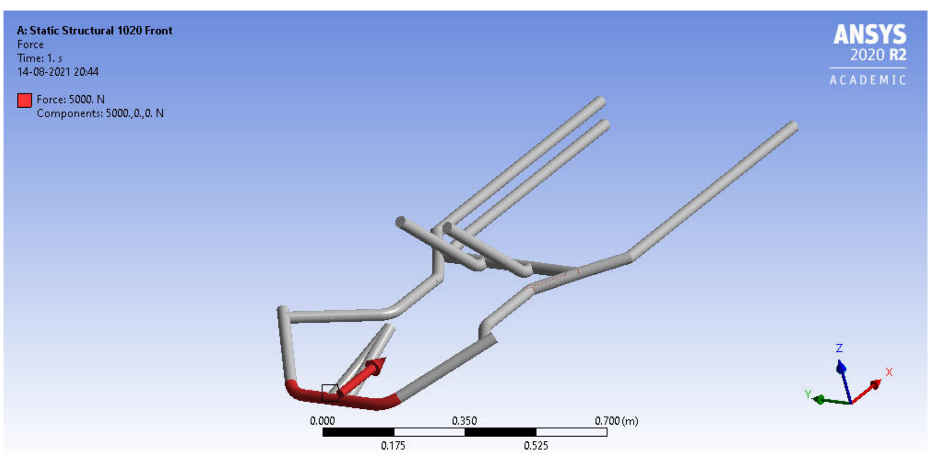
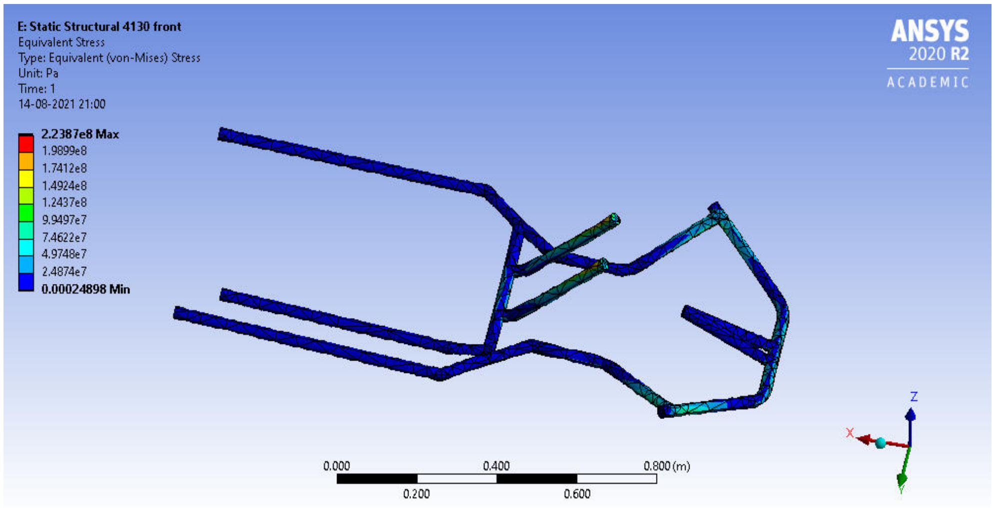
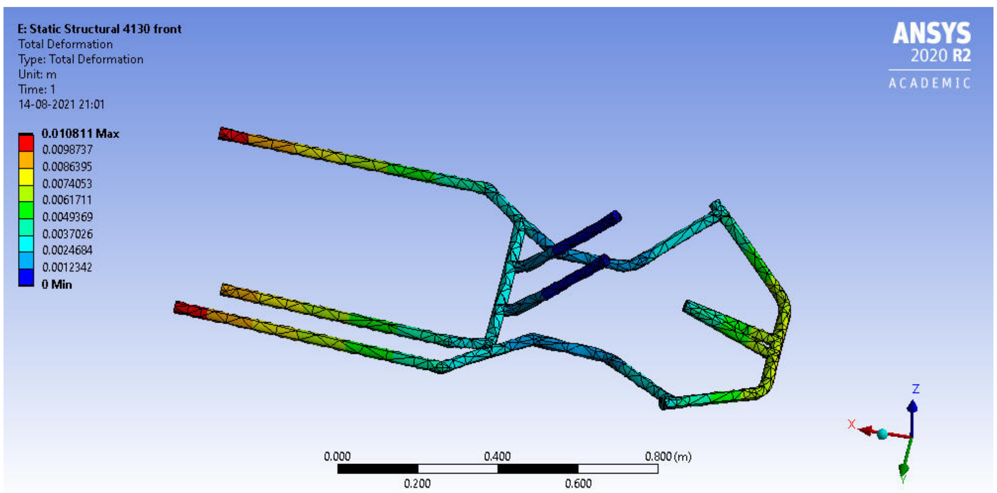


Fig.2. Front Impact loading condition in ANSYS Workbench

Material AISI 4130:



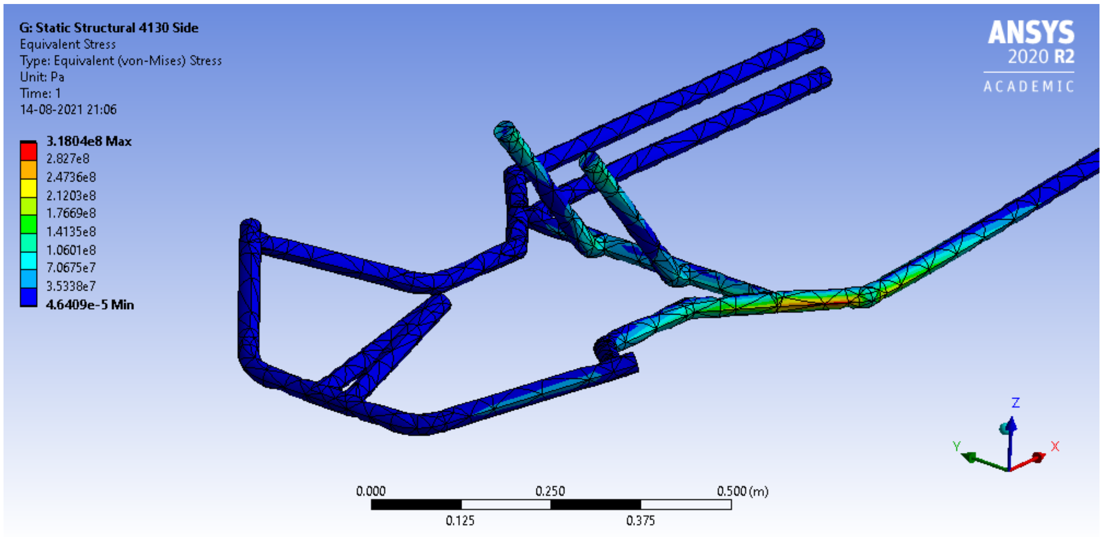


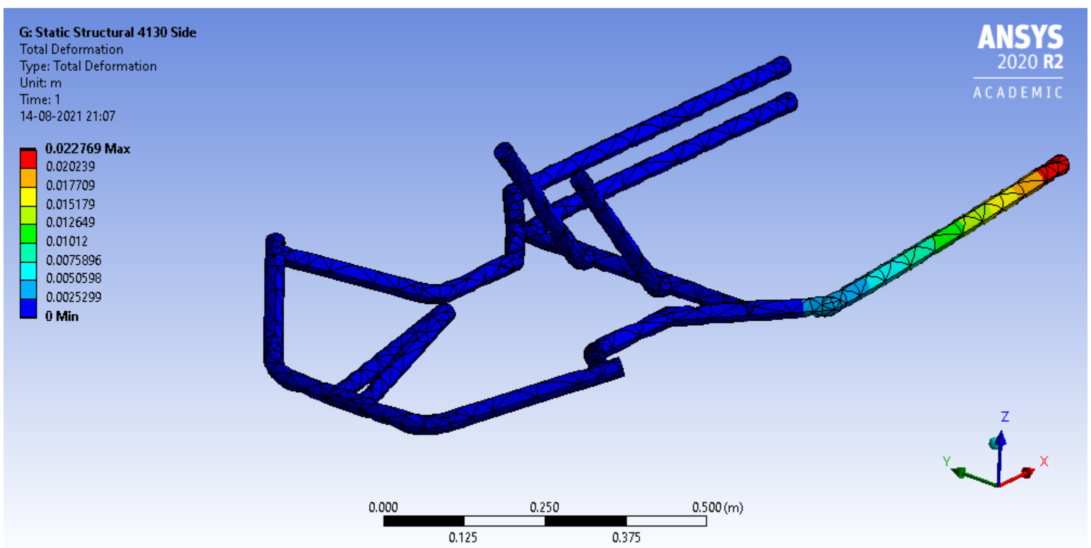
Side Impact Test:

Impact was calculated for an optimum speed of 80 kmph. The impact test force is calculated by the change in momentum in the unit interval of time (1 second). Hypothetically, the kart is given a velocity of 80 Kmph and stops in one second. This gives an impact force on the frame. The analysis based on the mass of the vehicle 180 kg

The force 4000 N is applied to calculate front impact, back impact and side impact conditions.

Material AISI 4130:



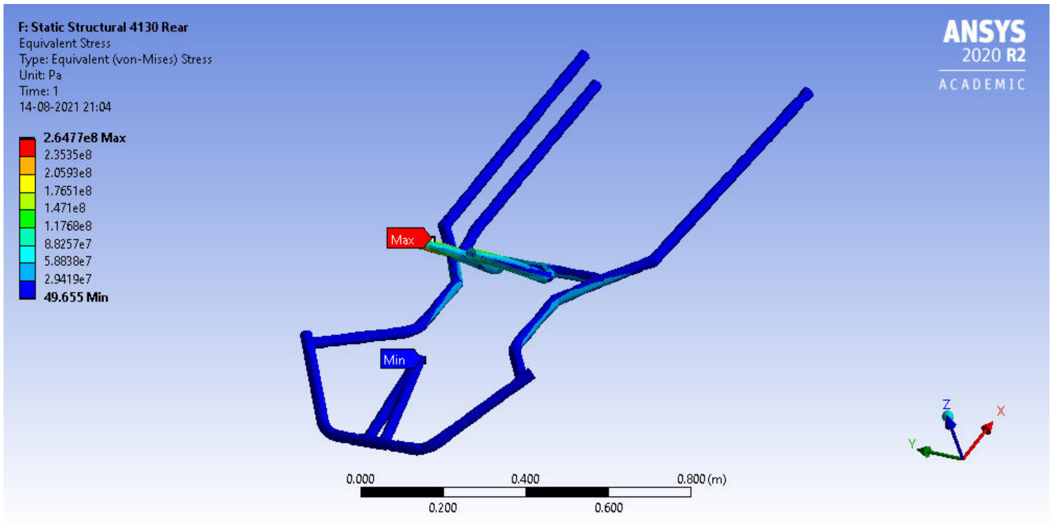


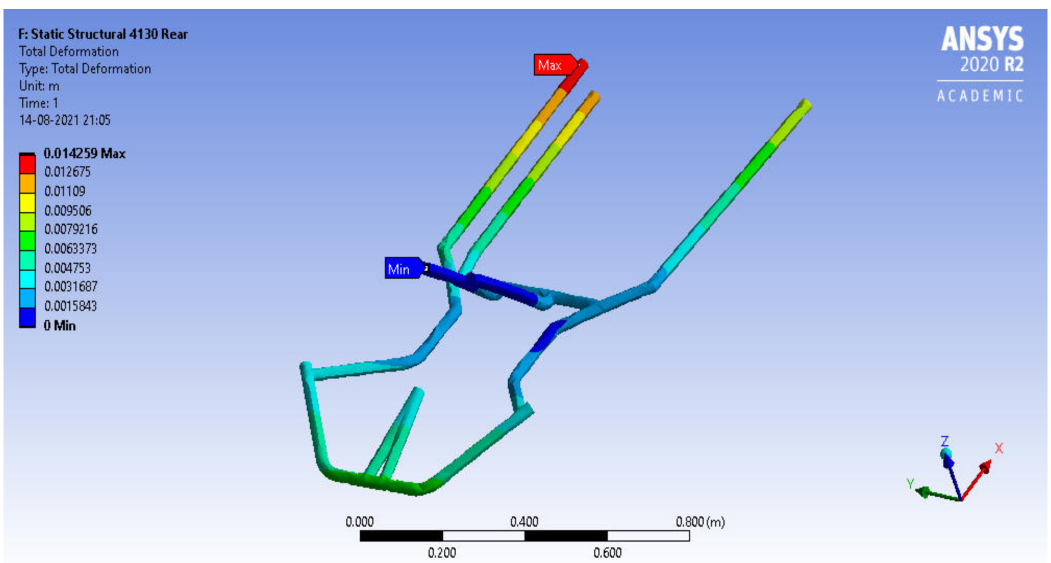
Rear Impact Test:

Impact was calculated for an optimum speed of 80 kmph. The impact test force is calculated by the change in momentum in the unit interval of time (1 second). Hypothetically, the kart is given a velocity of 80 Kmph and stops in one second. This gives an impact force on the frame. The analysis based on the mass of the vehicle 180 kg

The force 4000 N is applied to calculate front impact, back impact and side impact conditions.

Material AISI 4130:





Results and Conclusion:

• Front Impact Results

Properties	AISI 1018	AISI 1026	AISI 4130	AISI 1020
Equivalent Stress (MPa)	180.36	180.2	180.2	187.8
Yield Stress (MPa)	370	415	435	297.74
Factor of Safety	2.05	2.30	2.41	1.58

• Side Impact Results

Properties	AISI 1018	AISI 1026	AISI 4130	AISI 1020
Equivalent Stress (MPa)	150.3	150.44	150.44	151
Yield Stress (MPa)	370	415	435	297.74
Factor of Safety	2.46	2.75	2.89	1.96

• Rear Impact Results

Properties	AISI 1018	AISI 1026	AISI 4130	AISI 1020
Equivalent Stress (MPa)	216.99	216.99	216.99	216.99
Yield Stress (MPa)	370	415	435	297.74
Factor of Safety	1.70	1.91	2	1.37

CONCLUSION

• After performing the Front impact, side impact and rear impact analyses and making the necessary changes, the following design was finalized.
• It is cleared from the present investigation. AISI 4130 is a more efficient material as it gives a sale result for the 4000 N loading criterion.