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DESIGN AND ANALYSIS OF GO-KART CHASSIS

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ABSTRACT

A Go-Kart is a small four wheeled vehicles without suspension or differential. It is a light powered vehicle which is generally used for racing. This paper is aimed to model and perform the dynamic analysis of the go-kart chassis which is of constructed with circular beams. Modelling and analysis are performed in SOLIDWORKS and ANSYS respectively. The go-kart chassis is different from ordinary car chassis. The chassis is designed in such a way that it requires less materials and ability to withstand loads applied on it. Strength and light weight are the basic consideration for choosing the chassis material. AISI 1018 is the suitable material to be used for the go-kart chassis which is a medium carbon steel having high tensile strength, high machinability and offers good balance of toughness and ductility.

KEYWORDS: Chassis, Go-Kart, AISI 1080.

INTRODUCTION

The Go-Kart is a vehicle which is simple, lightweight and compact and easy to operate. The go-kart is specially designed for racing and has very low ground clearance when compared to other vehicles. The common parts of go-kart are engine, wheels, steering, tyres, axle and chassis. No suspension can be mounted to go-kart due to its low ground clearance.

Go-Kart is a great outlet for those interested in racing because of its simplicity, cost and safer way to race. The tracks go-kart is similar to F1 racing track. A go-kart is powered by 125cc engine in most of the countries. In some countries, go-karts can be licensed for use on public roads. Typically, there are some restrictions, e.g. in the European Union a go-kart on the road needs head light (high/low beam), tail lights, a horn, indicators and a maximum of 20 HP.

CHASSIS OF GO-KART

The chassis of go-kart is a skeleton frame made up of hollow pipes and other materials of different cross sections. The chassis of go-kart must be stable with high torsional rigidity, as well as it should have relatively high degree of flexibility as there is no suspension. So that it can give enough strength to withstand with grub load as well as with other accessories. The chassis is designed by taking ergonomics as main factor. The chassis is designed in such a way that it should ride safe and the load that applies does not change the structural strength of the chassis. The chassis is the backbone of the kart as it has to be flexible so that it must be equal enough to the suspension. Chassis construction is normally of a tubular construction, typically GI with different grades. In this kart, we use AISI 1080 material. The chassis supports the power unit, power train, the running system etc. The design of chassis was done in CATIA V5 software.

The chassis has the ability to carry and support the power train, power unit, running system, etc. the go-kart chassis has been classified into different types such as open, caged, straight, and offset.

- Open karts do not have chassis.
- Caged kart chassis surrounds the driver and have a roll cage which is mostly used in dirt tracks.

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- Straight chassis is the commonly used and driver sits at the centre. This kind is used in sprint racing.

Table:

Table 1. Chassis Dimensions

PARAMETERS	VALUE
Vehicle length	1568mm
Vehicle width	1388mm
Roll cage material	AISI 1018
Tube dimensions	OD- 25.4mm ID- 21.4mm

Open chassis has been used for this go-kart and also for analysis process.

MATERIAL AND METHODOLOGY

The carbon content in the steel is very important to determine the hardness, strength, machining and weldability characteristics. Material selection for chassis plays a vital role in building up of entire vehicle in providing reliability, safety and endurance. The steel which has carbon increases the hardness of the material. Aluminium alloy is expensive than steel, in that case steel is the most preferable material for fabricating the chassis.

MATERIAL USED AND ITS COMPOSITION

The chassis material is considered depending upon the various factors such as maximum load capacity, absorption force capacity, strength, rigidity. The material selected for the chassis building is AISI 1018. AISI 1018 is a mild/low carbon steel

Tables:

Table 2. Composition Of AISI 1018

COMPOSITION	AISI 1018
Iron (Fe)	98.8 to 99.25%
Manganese (Mn)	0.6 to 0.9%
Carbon ©	0.15 to 0.2%
Sulfur (S)	0 to 0.050%
Phosphorus (P)	0 to 0.040%

Table 3. Properties Of AISI 1018

PROPERTIES	AISI 1018
Density	7.9 g/cm^3
Elastic (Young's, Tensile) Modulus	210 *GPa*

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Elongation at Break	16 to 27 *%*
Poisson's Ratio	0.3
Tensile Strength: Ultimate (UTS)	430 to 470 *MPa*
Bulk Modulus	159 GPa
Yield strength	264 MPa
Thermal conductivity	51.9 W/m-k

MODELING OF CHASSIS

The modeling of the chassis is done in SOLIDWORKS software, designed according to the requirements. Then the design is imported into the ANSYS for further analysis.

Figure:

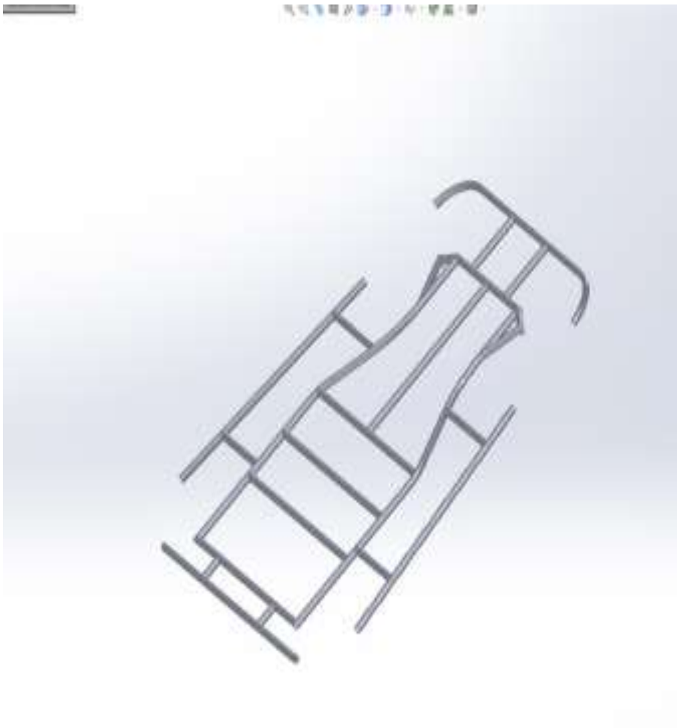

Fig.1 Design of chassis in SOLIDWORKS

MESHING OF CHASSIS MODEL

The meshing is the most important tool for analysis and one can expect drastic changes when the results of mesh are obtained. The chassis is spilt into finite pieces very finely so that each element is analyzed very critically.

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Figure:

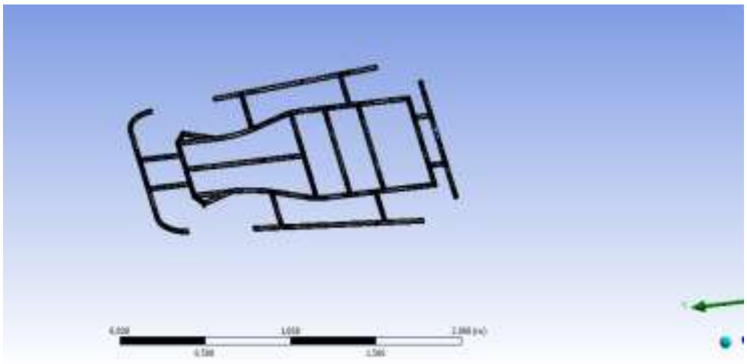

Fig.2 Meshing of chassis

Tables:

Table 3. Meshing Properties

State	Meshed
Graphics Properties	
Visible	Yes
Transparency	1
Definition	
Suppressed	No
Stiffness Behavior	Flexible
Coordinate System	Default Coordinate System
Reference Temperature	By Environment
Material	
Assignment	Structural Steel
Nonlinear Effects	Yes
Thermal Strain Effects	Yes
Bounding Box	
Length X	1.6285 m
Length Y	1.7787 m
Length Z	3.935e-002 m
Properties	
Volume	2.4947e-003 m³
Mass	19.583 kg
Centroid X	-3.9499e-004 m
Centroid Y	1.6734e-002 m
Centroid Z	1.1431e-005 m
Moment of Inertia Ip1	5.7358 kg·m²
Moment of Inertia Ip2	3.4675 kg·m²
Moment of Inertia Ip3	9.1998 kg·m²
Statistics	
Nodes	85643
Elements	44939
Mesh Metric	None

Table 4. Geometry Of The Chassis

Object Name	*Geometry*
State	Fully Defined
Definition	
Type	SOLIDWORKS
Length Unit	Millimeters
Element Control	Program Controlled
Display Style	Body Color
Bounding Box	
Length X	1.6285 m
Length Y	1.7787 m
Length Z	3.935e-002 m
Properties	
Volume	2.4947e-003 m³
Mass	19.583 kg
Scale Factor Value	1
Statistics	
Bodies	1
Active Bodies	1
Nodes	85643
Elements	44939

ANALYSIS OF CHASSIS

The analysis of the chassis designed in SOLIDWORKS is analyzed using ANSYS software. With help of analysis, one can know the strength of the design and the load carrying capacity, stresses induced in the structure, torsional rigidity and also overall dynamic loads applied. Different loads are applied on each side of the chassis i.e on the front bumper, rear bumper and side bumper.

Figures:

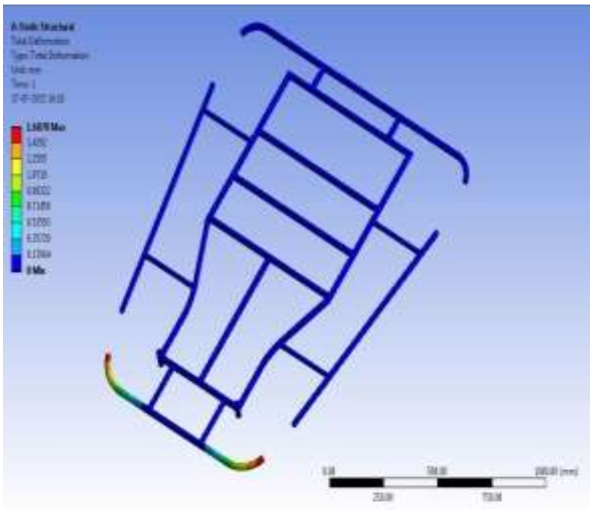

Fig.3 Front load displacement in ANSYS

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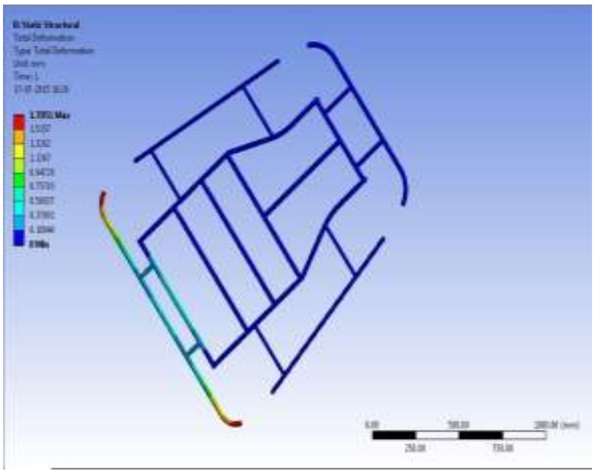

Fig.4 Rear load displacement in ANSYS

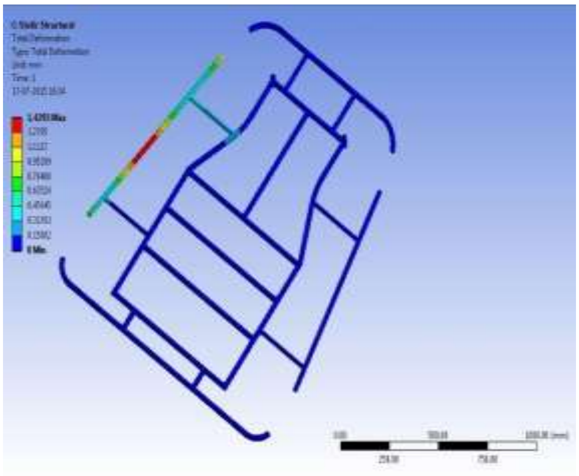

Fig.5 Side load displacement in ANSYS

Torsional load is also applied on the bumpers to test its rigidity level using ANSYS.

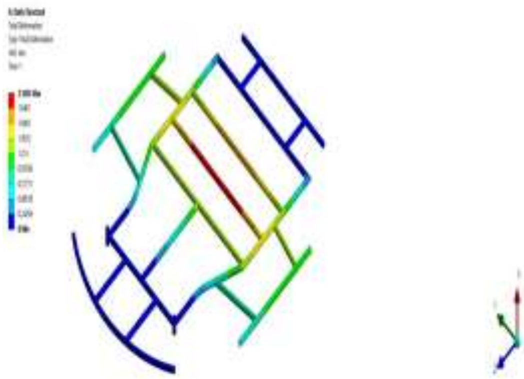

Fig.6 Torsional load displacement in ANSYS

Von mises stress is applied at front, rear and side bumpers to predict the yield of chassis under any load conditions.

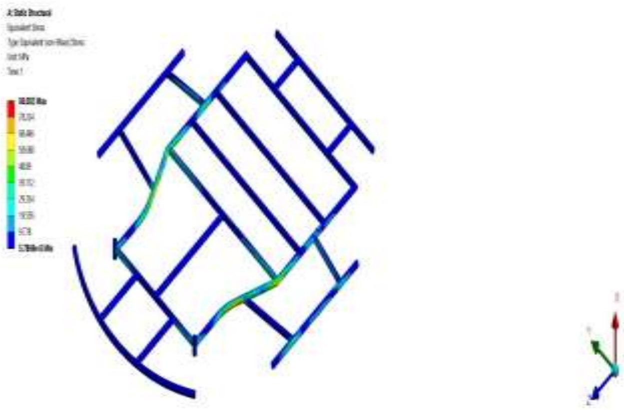

Fig.7 Torsional load von mises stress in ANSYS

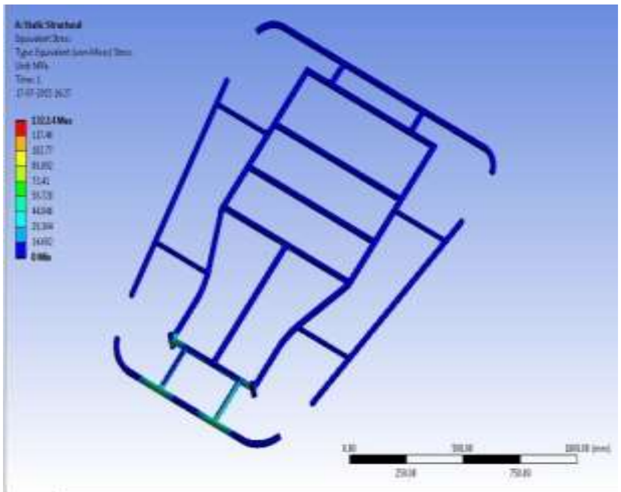

Fig.8 Front load von mises stress in ANSYS

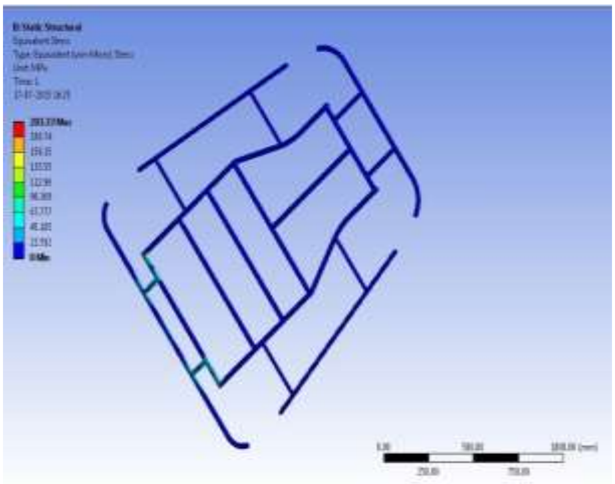

Fig.9 Rear load von mises stress in ANSYS

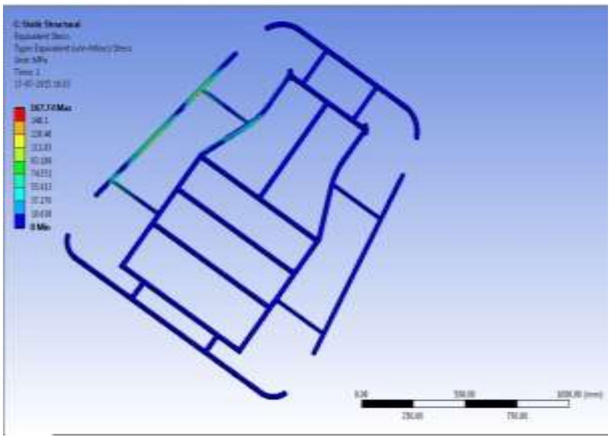

Fig.10 Side load von mises stress in ANSYS

CONCLUSION

The designing of the chassis for Go-Kart helps in identifying the strength and weakness of the build and design. With the help of the analyses, it will be easy to modify the chassis to rectify the weak points and to strengthen it with slight modifications. It will be able to carry all the components such as power train, power unit, wheels, tyres and also it must have the capacity to carry a human weighing more than 70kg. On adding all the weights, it crosses more than 120kgs.

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