# 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 CREO PARAMETRIC 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.

Keyword : Chassis, Go-Kart, AISI 1018, Creo Parametric 3.0, ANSYS 14.5.

### 1. 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.

#### 2. 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 CREO parametric 3.0.

The chassis has the ability to carry and support the power train, power unit, running system, etc. the gokart 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

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

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Table:

Table 1. C	Table 1. Chassis Dimensions				
PARAMETRES	VALUES				
Vehicle length	42 inch				
Vehicle width	38 inch				
Roll cage material	AISI 1018				
Tube dimensions	OD=26.4				
	ID=21.4				

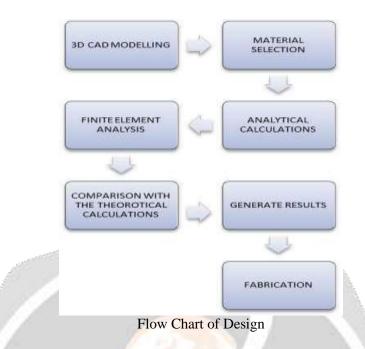
# **DESIGN METHODOLOGY**

Design of any component is consists of three major principles:

1. optimization 2.safety 3.comfort

The primary objective of the roll cage is to provide a 3-dimensional protected space around the driver that will keep the driver safe. Its secondary objectives are to provide reliable mounting locations for components, be appealing, low in cost, and low in weight. These objectives were met by choosing a roll cage material that has good strength and also weighs less giving us an advantage in weight reduction.

A low cost roll cage was provided through material selection and incorporating more continuous members with bends rather than a collection of members welded together to reduce manufacturing costs. The modeling of the roll cage structure is done by using catia v-5 software. This design is checked by Finite Element Analysis. We have focused on every point of roll cage to improve the performance of vehicle without failure of roll cage. We began the task of designing by conducting extensive research of go kart roll cage through finite element analysis.



3-D modeling was done using creo parametric 3.0 software as shown in Fig.3

# **3. MATERIAL 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. Aluminum 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:

COMPOSITION	AISI 1018
Iron	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 2.	Composition	of AISI 1018
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### Table 3. Properties of AISI 10 1018

PROPERTIES	AISI 1018
	11010
Density	7.9 g/cm3
Density	1.5 greins
Elastic (Young's,	210 GPa
	210 01 0
Tensile) Modulus	
rensite) modulus	

### Finite Element Analysis (FEA):

Finite element analysis (FEA) is a computerized method for predicting how a product reacts to real-world forces, vibration, and other physical effects. Finite element analysis shows whether a product will break, wear out, or work the way it was designed. Here we divide the roll cage into small sizes known as element and collective elements on the model form a mesh.

The computer analyses the elements and shows us a collective result. The computer solves by the computational method provided. The material and structure of roll cage was finalized and then FEA was performed on it. It is tested whether the roll cage will be able to withstand torsion, impact.

The analysis was done in ANSYS 14.5 software

Following tests were performed on the roll cage. (i) Front impact (ii) Side impact (iii) Rear impact (iv) Torsion analysis (v) Modal analysis

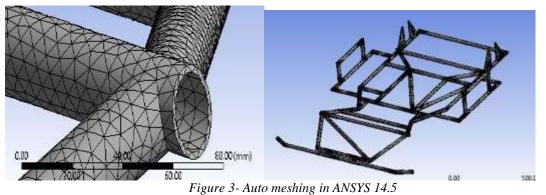
#### Meshing :

Meshing is probably the most important part in any of the computer simulations, because it can show drastic changes in results.

Auto meshing has been done in ANSYS 14.5 software. Following data has been found after meshing of chassis -

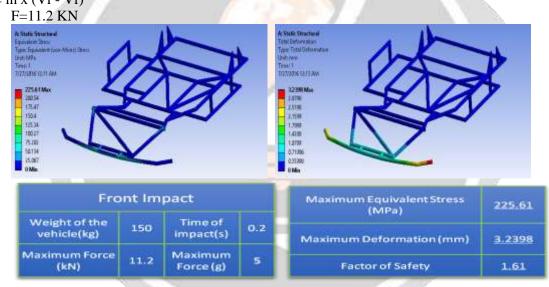
No. of Nodes = 353049

No. of Elements = 176790



1. Front Impact

For the front impact, engine and driver load was given at respective points. The kingpin mounting points and rear wheels position kept fixed. Front impact was calculated for an optimum speed of 60 kmph. From impulse momentum equation, 5g force has been calculated. The loads were applied only at front end of the chassis because application of forces at one end, while constraining the other, results in a more conservative approach of analysis. Time of impact considered is 0.2 seconds as per industrial standards. F x t = m x (Vi - Vf)

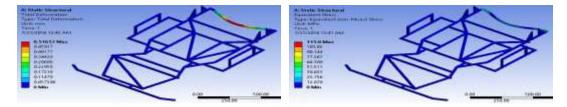


### 2. Rear Impact

Considering the worst case collision for rear impact, force is calculated as similar to front impact for speed of 60 kmph. The value of 5g force has been calculated. Load was applied at rear end of the chassis while constraining front end and king pin mounting points. Time of impact considered is 0.2 seconds as per industrial standards.

F x t = m x (Vi-Vf)

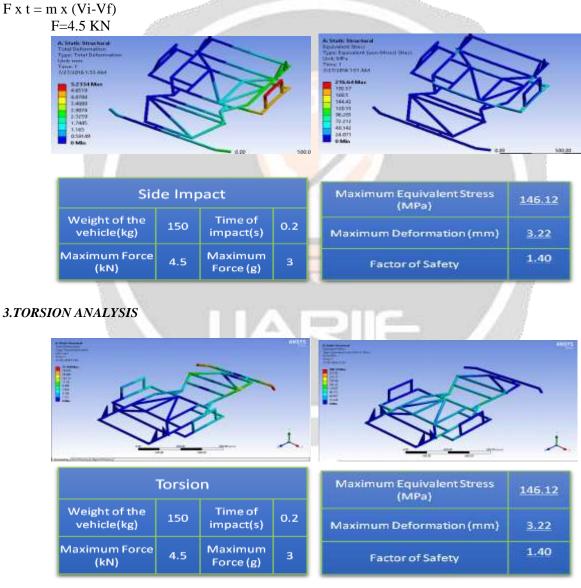
F=11.2 KN



F	Rear In	npact		Maximum Equivalent Stress (MPa)	115.9
Weight of the vehicle(kg)	150	Time of impact(s)	0.2	Maximum Deformation (mm)	0,516
Maximum Force (kN)	11.2	Maximum Force (g)	5	Factor of Safety	3.14

#### **3.**Side Impact

The most probable condition of an impact from the side would be with the vehicle already in motion. So it was assumed that neither the vehicle would be a fixed object. For the side impact the velocity of vehicle is taken 30 kmph and time of impact considered is 0.2 seconds as per industrial standards. Impact force was applied by constraining left side of chassis and applying load equivalent to 2.5g force on the right side.



## **5.** Conclusion:

Result concluded that the AISI 1018 material is more economic and gives better performance. It is also suitable for large scale production. Static analysis using finite element method was successfully carried out on chassis CAD model to determine equivalent stresses, maximum deformations, Factor of Safety and its location on chassis model. The Factor of safety calculated is found to be greater than 1. Hence the chassis design is safe.

# 6. References:

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