Design and Assembly of open wheel car (Go-kart).

Bhatta Faisal Y.[1], Patel Hussain M.[2], Masi Akbarali J.[3], Solanki Ghanshyamsinh N.[4]
Mr. Sanket T Ghandhi.[5]

[1]*U.G. Student, Mechanical Engineering Department, SCET, Himmatanagar, Gujarat, India*
[2] *U.G. Student, Mechanical Engineering Department, SCET, Himmatanagar, Gujarat, India*
[3] *U.G. Student, Mechanical Engineering Department, SCET, Himmatanagar, Gujarat, India*
[4] *U.G. Student, Mechanical Engineering Department, SCET, Himmatanagar, Gujarat, India*
[5] *Assistant Professor, Mechanical Engineering Department, SCET, Himmatanagar, Gujarat, India*

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. 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 lightweight are the basic consideration for choosing the chassis material. ST 52 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, ST 52, Strength, Analysis.*

1. INTRODUCTION

A go-kart, also written as go-cart (often referred to as simply a kart), is a type of open-wheel car. Go-karts come in all shapes and forms, from motorless models to high-powered racing machines. Some, such as Superkarts, are able to beat racing cars or motorcycles on long circuits.Gravity racers, usually referred to as Soap Box Derby carts, are the simplest type of go-karts. They are propelled by gravity, with some races taking place down a single hill.Many recreational karts can be powered by four-stroke engines or electric motors, while racing karts use a two-stroke or, rarely, higher powered four-stroke engines. Most of them are single seater but some recreational models can accommodate a passenger.In some countries, go-karts can be licensed for use on public roads often referred to as street tracks. 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 and indicators, and their power must not exceed 20hp (15 kW).

1.1 OVERVIEW OF GO-KART

1. CHASSIS

The chassis is made of steel tube and the main condition of a good cart chassis is the chassis need to be lightweight and able to flex and twist. Therefore, before making a chassis we need a lot of thought went into its design and the factors influenced in order to handle properly either on the straight or a corner. Many of us will think that the structure of a car is more complicated compare to a go-cart. In fact, it is perhaps a more difficult to explain than an equivalent car. Both vehicles have many parts and principles in common but there two major differences, which account for a large divergence in design and in setting up. These differences are the karts lack of differential, and also its lack of any suspension components. Thus, the cart chassis is playing an important role to work as a suspension component. That is why a cart chassis need to be flexible enough not to break or give way on a turn. The stiffness of the chassis enables different handling characteristics for different circumstances. Typically, for dry conditions a stiffer chassis is preferable, while in wet or other poor traction conditions, a more flexible chassis may work better. Best chassis allow for stiffening bars at the rear, front and side to be added or removed according to race conditions.

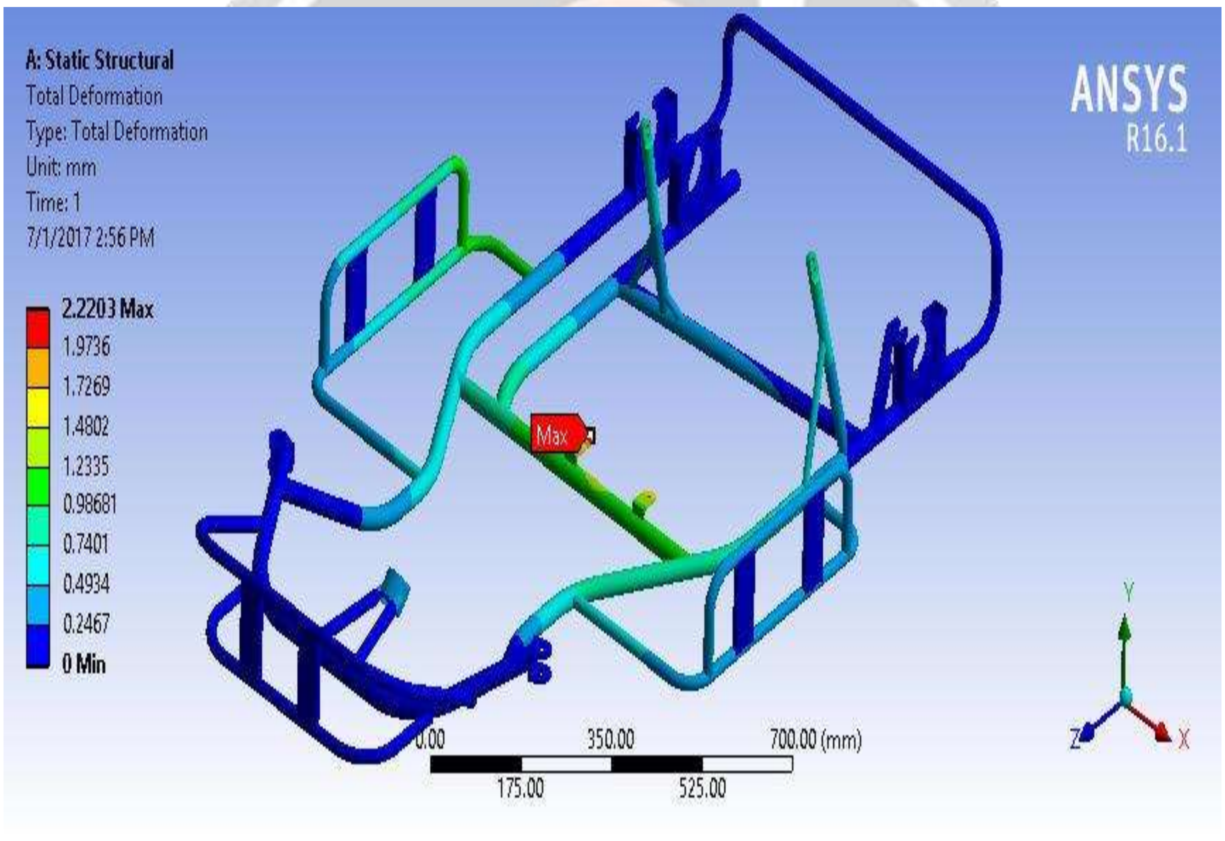
2. DESIGN

We used st52 material for our framework, which is a composition of mild carbon steel. The outer diameter of the frame is 30mm, which has thickness of 3mm.

The properties of the st52 material is as per follows:

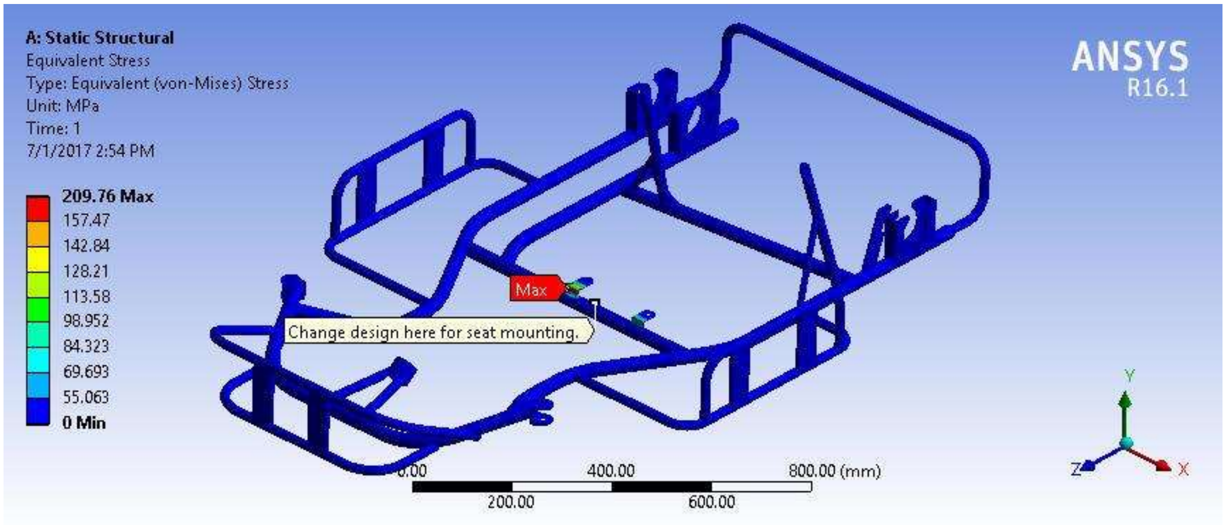
Yield Strength	420 Mpa
Tensile Strength	580 Mpa
Elongation	10 %

Image: -1 Maximum deformation



The image establishes the analysis of maximum deformation. We applied the point load of sub systems on the chassis at different points. After the Fea the report says that it will not deform from any edges, surfaces or any bandings.

Image: - 2. Max. Stress



The figure shows the analysis of frame for the maximum stress parameter. As we can see in picture that there is not any kind of problems after applying the stress on different points. As per the above simulation reports it shows no deformation will occur from any points.

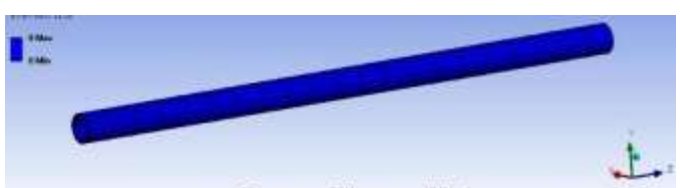
Front stub axle: -

Image: - 3. Analysis results

The figure shows the FEA reports for the front stub axle. The report shows the results of analysis as a **maximum deformation of 0.1761mm and maximum stress of 19.548MPa.**

Rear Axle: -

Image: - 4. Rear Axle Analysis.



The figure shows the FEA repot for the rear axel. The report shows the results of analysis as a **maximum deformation of 1.7mm and maximum stress of 48.57MPa.**

Factor of Safety: -

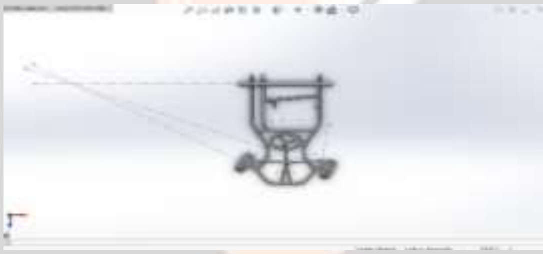
Component	Factor of safety (assumption)
Frame	2.0
Front Stub Axle	2.03
Rear Axle	1.77

Table: FOS

3. DESIGN CALCULATION

Steering Calculations: -

Simplicity and safety were the main design specifications for the vehicle's steering system. While designing the steering system the constraints that we possessed were centre alignment of steering system, track width, human effort at the steering wheel and the desired response of the steering system. A Pivot Pin steering a+ low cost. Very less play due to limited number of joints. We are also introduced the multi sensitive steering system. This system has a tendency to increase or decrease the sensitivity of our steering by means of multiport pivot plate, by changing the position of tie rod from port one by one. This system provides the driver simplicity and directional control over vehicle according to condition.



The formulae's used for steering calculation are:

R = d/2+Lcosec (A/2+B/2)

Where,

R = the turning radius,

L = the length of the car,

A = the angle of the inside angle of the wheel

B = the angle of the outside wheel

d = the width of the car.

Ackerman Angle

$$= \tan^{-1}\left(\frac{0.5 * \text{trackwidth}}{\text{wheel base}}\right)$$

$= \tan^{-1}(\frac{0.5 * 683.01}{1104.9})$

$= \tan^{-1}(0.6504)$

= 21.9 deg

To achieve the correct steering mechanism the inside angle A should be 28.92deg and outside angle B should be 22.14deg so we can achieve the max effort for steering.

For correct steering mechanism it is must to follow the following formula:-

$$\cot B - \cot A = \frac{Track\ width}{\text{Wheel Base}}$$

$$\cot 22.14 - \cot 28.9 = \frac{684.01}{1104.91}$$

L.H.S. = $\cot 22.14 - \cot 28.9$

= 0.6504

R.H.S. = 684.01/1104.91

= 0.65

Due to L.H.S. = R.H.S. we can say that it follows the correct steering mechanism formula.

This gave a turning radius of 4.8 m. In this geometry when a car taking a relative wide turns, the point where axle lines intersect is the point about which the car is turning.

The final values are as per following table:-

Inner turning Angle	28.9 deg
Outer turning Angle	22.14 deg
Turning Radius	4.8 m
Ackerman Angle	21.9 deg

Table 1

Brake system Calculations: -

Objectives: -

The purpose of the brakes is to stop the car safely and effectively. In order to achieve maximum performance from the braking system, the brakes have been designed to lock up rear wheels, while minimizing the cost and weight.

As we know that the total kinetic energy of a vehicle at the time of breaking is converted into heat due to the friction of caliper pad on rotor disc.

Kinetic energy,

$E = ½ mv^2$

$=1/2 * 140 * (22.22)^2 m/s^2$

$=34560 kgm/s^2$

Where,

m = mass of vehicle

= 140 kg

v = speed of vehicle

= 22.22 m/s^2

Deceleration of the vehicle is not exceed the value of friction between road and tires which is about μ = 0.4. Therefore, the deceleration of the vehicle is 0.6g or 5.88 m/s^2.

Stopping distance of the vehicle is calculated by Newton's law of motion formula,

$v^2 – u^2 = 2*a*s$

Thus, $v^2 – u^2 / 2*dec = s$

Thus, $12.5^2 / 2*19.3= s$

Thus, s = 4m

Where v = final velocity,

u = initial velocity,

a = acceleration,

s = stopping distance

The stopping distance is 4m achieved by us.

Stopping time:

v - u = at

t = u/a

t = 12.5 /

t = 3.125 sec

the stopping time is 3.125 sec.

Braking force on tyre

= Total mass of vehicle * dec

= 140 * 19.3

= 2730 N

Braking torque

= braking force * effective radius

= 2730 * 7.16

= 381 N.m

Force applied by driver on brake pedal is assumed as 125 N and the pedal ratio is 5:1.

The area of the piston of the master cylinder is 706.5 mm^2

Fluid line pressure generated

= Pedal force* pedal ratio / master cylinder area

= 125 * 4/0.0031

=$1.93 * 10^5$ Nm^2

Weight transfer at 40-km/h speed,

=(Weight on rear axle * height of cg / wheel base)

= (77* 9.81*1.24*220) / (25.4* 43.5) = 186.5 N

Dynamic weight on rear Axle

= (77*9.81) + 186.5

= 941.87 N

Dynamic weight on front Axle

= (63*9.81) – 186.5

= 431.53 N

Braking Force at disc

= μ * 2 * force exerted by pads

= 0.4 * 2 * 136.74

= 107.92 N

Disc outer diameter	220 mm
Thickness of disc	34 mm
Brake Pedal Force	125 N
Pedal Ratio	4:1
Co. of Friction	0.4
Brake line pressure	$1.093*10^5$
Brake Torque	381 Nm
Stopping Time	3.125 sec
Stopping distance	4m

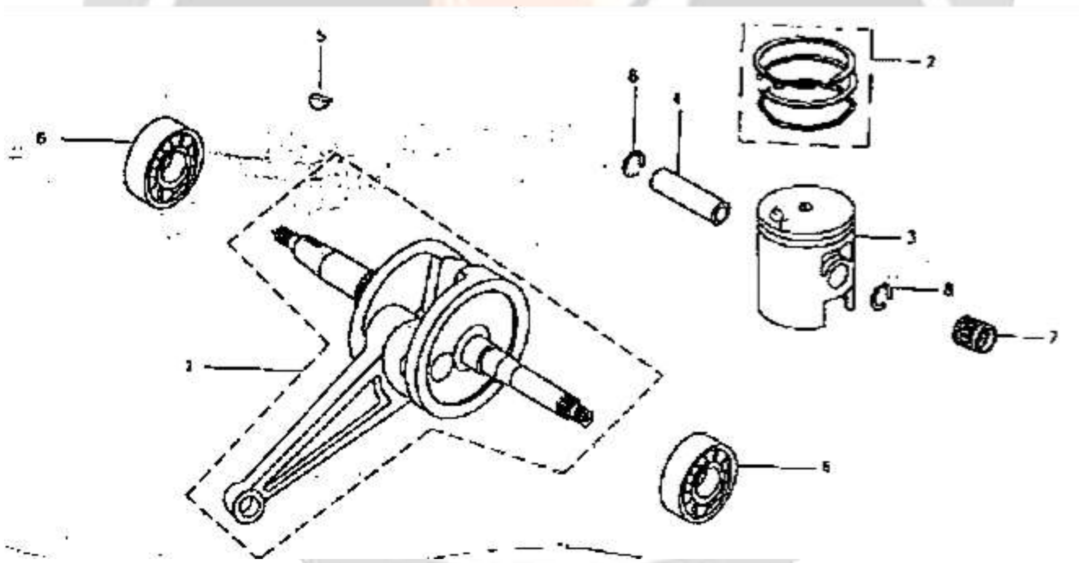
Transmission: -

The following figure shows that the sprocket ratios for the driving and driven ratio for transmission calculation of automatic centrifugal clutch transmission with use of chain and sprocket to transmit power.

As per the image of table for sprocket ratios show that the 6 is the perfect value for the better performance as per the consideration of torque and speed. As we go horizontally downward side the acceleration will increase And speed will decrease as per that if we talk about vertically when we move left side acceleration will increase and speed will decrease.

Drawings of Engine: -

FIG - ROTAX 125cc Engine



1. Crankshaft Components 4. Piston Pin 7. Bearing Connect Rod End

2. Piston Rings 5. Woodruff Key 8. Piston Clip Pin

3. Piston 6. Ball Bearing

Fabrication: -

Chassis: -

First of all, the chassis is constructed. The GI pipe is taken as per dimensions and bends in required places using bending machine. Then the pipes are welded rigid

Axle: -

The required shaft is taken as per the dimensions and turned on the lathe.

Sprocket: -

The sprocket is welded on the axle at required place.

Brake: -

The brake is also placed in the axle in the left side. The boredom is connected to it and is connected to left pedal in front of kart.

Accelerator: -

The accelerator pedal is placed is the right side of the front of the kart and is connected to the engine.

Engine: -

The engine is mounted in the chassis and the chain is connected to the sprocket and engine.

Fuel tank: -

The fuel tank is placed in the upper position of the engine level using clamps and bolts.

Muffler: -

The two pipes are taken as per the dimension and join together. Then 3 ‘ V ‘ Shaped cuts are made in large cylinder and 3 washers are placed inside it and the ‘ V ‘ cuts are re welded and grinded. The inlet end of muffler is bolted to the exhaust of engine and also a rubber bush is placed to support the muffler.

Rear wheels and tyres: -

The 2 wheels are connected to the both ends of the axle and bolted together. Then the assembly is connected to the chassis using 2 bushed bearing.

Steering: -

The steering spindle and steering are made as per the dimensions and bolted together. This is connected to the plate and link mechanism. This mechanism is connected to the 2 front wheels.

Seat: -

First the seat is mounted on seat stand using bolts and the seat is bolted on the chassis.

Electric start: -

The battery is placed under the seat and connected to the starting motor using wires. And the switch is placed in the steering spindle stand.

Painting: -

The painting is done to increase the appearance to the kart. The chassis, steering and steering spindle, wheels, seat, muffler, engine cover etcare painted using different colors. The pedals are also painted.

4. CONCLUSION

The 125cc, 2 stroke, 4 wheeled racing car, Go-Kart, we finally made one under 2.5 to 3 lac. We made it for our final year project and also for racing purpose, which held, at national and international level. Our kart is capable of running at a speed of 80 to 95 km/hr. and also it contains disc brake, which help to stop instantly rather than drum brake. The material we used is ST 52 which is best for weight carrying upto 100kg, we have completed this project under 2years, hence every detail in this report file is certified with our real work and our kart is capable to run at races.The project report is prepared in such a manner that every layman can understand the details pertaining to the project. The report is prepared in simple language and described well. The report give adequate idea and design guide line for making suitable report is expected to prove valuable to the successor students of mechanical engineering to know the essentials of a project and projectreport.The matter discussed in the early pages just give a broad outline of small-scale industries. We have, tried to cover all the aspects concerned with our project.

5. ACKNOWLEDGEMENT

Our Heartfelt Thanks are due to Mr. Sanket T Ghandhi, Ass. Prof. in Mechanical Engineering Department and Head of Mechanical Engg. Department, Samarth college of Engg. And Technology, Himmatangar. For providing support and giving precise and helpful guidance.

6. REFERENCES

[1]Automobile Engineering R. B. Gupta

[2]Automobile Engineering Kripal Singh

[3]Industrial Engineering and Management O. P. Khanna

[4]Automotive Technology H. M. Sethi

[5]Thermal Engineering M. ZakriaBaig

[6]Auto CAR Magazine, February 2004 issue

[7]Anjul Chauhan, LalitNaagar, Sparsh Chawla, Design And Analysis Of A Go-Kart, International Journal of Aerospace and Mechanical Engineering Volume 3 – No.5, September 2016, 29

[8]Sandeep Ramini, Mohan Rentala, SnehaGulab Mane B.Tech (Mechanical Engineering), Design and Structural Analysis of a Go-Kart Vehicle Chassis, International Journal & magazine of engineering, technology and management research , Volume 2 – No.10, October 2015 ,1373

[9] Machine Design by R.S. khurmi