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DESIGN & MANUFACTURING OF FORMULA 9 CAR

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Abstract: *There are many motor sports in the world. Bikes, Cars, Formula one are examples of them. The drivers in these fields are very professionals attitudes and capable of accurate driving. They can drive it very fast. But there are also automobile sports which for newest drivers need professional experience as drivers and need to drive great speed. The vehicles used are also very cheap. Such a motor sport is Go-Karting. They resemble to the formula cars but it is not as fast as F1 and also cost is very low. The drivers in go-karting are also not professionals. Even children can also drive it. Go-karts have 4 wheels and a small engine. They are widely used in racing in United State and also they are getting popular worldwide in India. Our primary objective is to design a safe and functional vehicle based on a rigid and torsion-free frame, well mounted power train and to understand the finer aspects of vehicle design with motive of fabricating prototype vehicle that could be manufactured while strictly adhering to the competition rules. The secondary objective is to enhance driver's comfort and safety, and to increase the performance and manoeuvrability of the vehicle. To achieve our goal the team has been divided into core groups of major subsystem like steering, braking, engine and power train, frame design and ergonomics which were later integrated into our final design.*

This paper content on explaining the design aspects and engineering aspects of making a Go Kart vehicle .This report explains objectives, assumptions and calculations made in designing a Go Kart vehicle. The design is such that the Kart is easy to fabricate in every possible aspect.

I. Introduction:

Formula nine (Go-kart) is a simple four-wheeled, small engine, single Seated racing car. A Go-kart Vehicle is a by definition, has no suspension system and no differential system. They are usually raced on special prepared scaled down tracks, but they are non-professionals sometimes driven as entertainment or as a hobby. Karting is mostly perceived as the stepping-stone to the higher & more expensive rank of motor sports. Kart vehicle racing is generally accepted as the economically form of motor sport available.

We have followed the strategy of designing parts to assembly for the whole vehicle for which we have drawn a layout of components physically so that we can do the best optimization possible by minimizing the errors. After ending up with the calculations we found Solid works most feasible out of all other CAD software is known to our team. Analysis of subsystems in done in ANSYS.

A. Go-karts in india:

Home of go-karts in India. Many engineers and public take part in the vehicle racing and is getting more popular nowdays. Go-karts events organized in India in 2003 by MRF, which has a 250 cubic capacity two-stroke engine vehicle, which produce 15 brake horsepower, which costs nearby 3 lakhs. Indus motors are also offer to Go-karts for 1 lakhs to 3 lakhs. There are racing tracks in Nagpur for go-karting vehicle, which is known as the home-town of go-karts in India. Many people take part in the racing and is getting popular.

B. Parts of a go – kart :

In a Go-Kart, there are mainly six parts. They are

1. Chassis,
2 .Engine,
3. Steering,
4. Transmission
5. Tiers
6. Brake, and
7. Electric Starter.

C. Systems used in a go – kart:

Like every automobile, go-karts also have various systems. Mainly there are 4 systems in this kart. Lubrication system, Ignition system and Cooling system Fuel system,. Engines. Generally, there are two main types of cooling system. Water cooling and air-cooling. In two stroke petrol engine, water-cooling system is fitted for cooling of engine.

II. OUR WORK HAS BEEN DIVIDED INTO FOLLOWING GROUPS:

- Frame
- Fuel management system
- Fairing
- Drive train
- Engine
- Driver seating
- Steering system
- Braking system
- Electrical system

III. Plan of their Work:

Firstly, we made design of the chassis in solid works for reference after that we have limitation for the dimension of our car. So for that we made drawing on mate for our reference. After this we design steering system for the vehicle. Then we design transmission system which gives us better performance for the Race. At last we design braking system.

Our manufacturing plan will follow as above first we are going to make prototype of vehicle. For the proper design of chassis. After the prototype we will give our steering
& braking parts for machining. So whole manufacturing process will be complete in 2 months after designing phase.

A. Materials/ Tools Required:

Material & Tools For chassis manufacturing

- Carbon steel tubes grade st-52
- Outer diameter 30mm
- Thickness 3mm
- Bending machine
- Hand grinder
- Radial cutter
- Welding machine

B. Material & Tools For Steering system Manufacturing

- EN 9
- cutting machine
- Welding machine
- Hand grinding machine

C. Tools required for assembling of Subsystems

- Ring spanners
- Fix spanners
- T-spanners
- Screwdrivers
- Allen keys
- Pliers
- Hammers

D. Engine mounting materials

- Aluminium Alloy
- Vertical milling machine

IV. Material selection:

As the vehicle needs to be light in weight and simultaneously should have good effective strength, an alloy of carbon steel was found most compatible for our design. we had many options for the chassis material like aluminium and carbon fiber.
But weldebility of aluminium is not so well and carbon fiber is too costly, lack of knowledge for using carbon fiber so we selected best compatible material ST 52

- Material : ST52
- Outer diameter of pipe : 30 mm
- Thickness of pipe : 3 mm
- Yield strength : 420 Mpa
- Tensile strength : 580 Mpa

V. STEERING SYSTEM DESIGN:

Centre steer steering system is used for quick turning action of the vehicle, This steering system eliminates free play of steering wheel and .Steering system of the vehicle is designed on Ackerman's principle. The best set of turning angles for vehicle giving maximum turning are mentioned below.

Simplicity and safety were the design specifications for the vehicle's steering system. While designing and making the steering system assembly the constraints that we possessed were center alignment of whole steering system, track width, human effort at the steering wheel and the proper function of the steering system.
A Pivot Pin steering and low cost. Low play due to limited number of joints. We are also have the multi sensitive whole steering system.

This system has a tendency 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 directional control over vehicle according to condition and driver simplicity.

- Inner Turning Angle: 29 degree
- Outer Turning Angle: 23 degree
- Steering Wheel Turning Angle: 82 degree

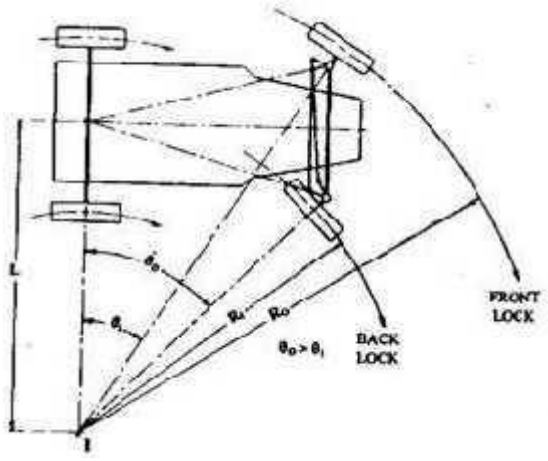


Fig.1. CORRECT STEERING MECHANISM BY ACKERMAN'S PRINCIPLE

VI. BRAKING SYTEM DESIGN:

As being a high speed vehicle hydraulic disc brake was the only best option possible for the vehicle to be reliable. Mechanical disc brakes are complicated for our vehicle setting up the linkage during racing Is time consuming. then pneumatic brakes need a cylinder for the storage of the air & it can increase the weight of the vehicle. so we found that the hydraulic brakes are the most compatible for our kart.

We are going to use O.E.M disc brake & calliper for the braking system it fulfil all the design criteria of our car. because it is O.E.M part there is no need of analysis. Master cylinder is also an O.E.M part from OTK.

It is single piston cylinder assembly. The application of the brakes system is to slow down or stop the car safely and effectively. In order to achieve maximum brake performance from the braking system, the brakes have been designed to lock up rear wheels and also while minimizing the cost and weight.

A. Braking system components:

- Disc: Rear disc Bajaj Pulsar 220 OD 215 mm
- Master Cylinder: OTK single piston cylinder assembly
- Brake pedal force: 125 N
- Pedal ratio: 4:1
- Co of friction: 0.4
- Brake line pressure: 1.093*10^5
- Brake torque: 385 Nm

VII.ENGINE & TRANSMISSION:

We are restricted to use only 125cc engine in our vehicle. There were many options for the ready Engines 125cc criteria. But we choose professional karting engine of Rotax. Rotax max Junior was the best option for our vehicle.

Engine specifications:

Rotax Max Junior Single Cylinder Displacement: 125cc Cooling type: water cooled Max torque: 19 Nm @8500 rpm Max power: 23 hp @8500 rpm

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 table shows we get best torque output and acceleration for the combination of 13 teeth on driving
- sprocket and 78 teeth on driven sprocket which gives us the drive ratio of 6 units.
- As we move horizontally downward side the acceleration will increase and torque will decrease as per the vertical column the combination of driven sprocket applies the same proportionality of torque and acceleration
- Driving sprocket: 13 teeth
- Driven sprocket: 78 teeth

We are using chain drive which is automatic transmission for the better performance of the kart. In Manual transmission we get more torque then the Automatic transmission. But here road surface is flat so we don't need more torque. We get required acceleration in Automatic transmission.

We had also option for the continuously Variable Transmission But it increases the weight of vehicle & complication also. Any of our team member don't have the proper knowledge for the tuning of cvt. So chain drive is best option for us.

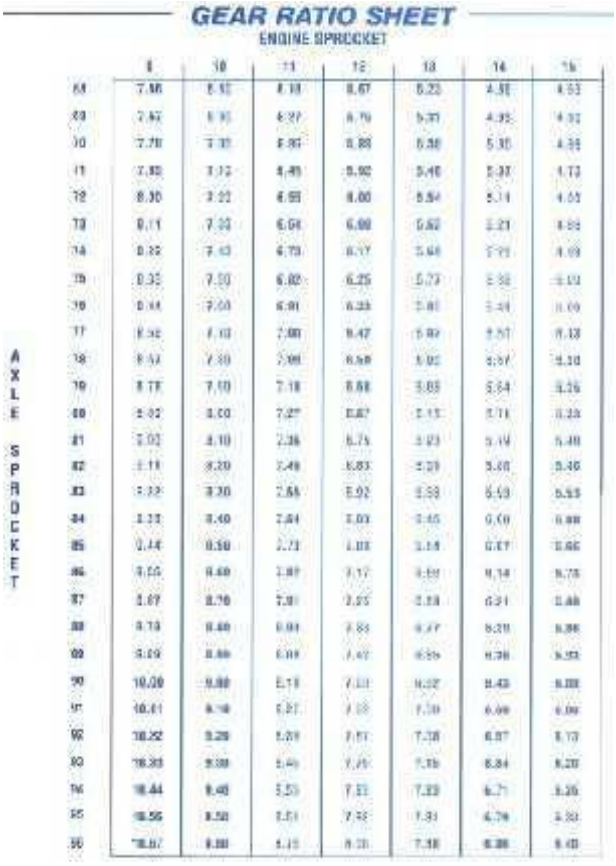


Fig.2. Gear ratio sheet

VIII. Implementation:

A. Centrifugal clutch:

A clutch is a machine member used to connect the driving shaft to a driven shaft, so that the driven shaft may be started or stopped at will, without stopping the driving shaft. A clutch provides an interruptible 0connection between two shafts. The centrifugal clutch is usually used into motor pulley. It consists of number of shoe on the inside of a rim of pulley. The outer surface of pulley is covered with friction material. These shoes which can move radial in guides are held against the boss on the driving shaft by means of springs. The spring exert are inward force which assumed to be constant. The weight shoes when revolving cause it to exert a radial out ward force (centrifugal force).

The magnitude of centrifugal force depended on speed at which shoes is revolving. A little consideration s how that when centrifugal force is less than the spring force, the shoes remain same position as when driving shaft was stationary, but when centrifugal force is equal to spring force, spring is floating. When centrifugal force exceeds the spring force, the shoe moves outward and comes in contact with driven member and press against it. The force with which the shoe press against the driven member is the difference of the centrifugal and spring force.

B. Safety:

Roll cage feature were first implemented by keeping on mind the safety requirement of the event. The first primary safety standard focused on during design was maintaining the proper clearance of the driver's body rest to the other rigid parts like engine compartment, firewall structure, and panel bracing of the vehicle.

Once the basic requirements fulfilled the other safety design were implemented. The chassis was designed to give occupant extra space to operate the vehicle easily. The place of the fire extinguisher is designed in the easily accessible point.

C. Snapshots:

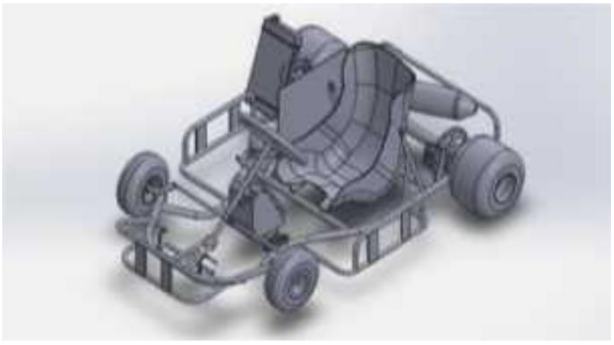


fig.3. Isometric view of kart

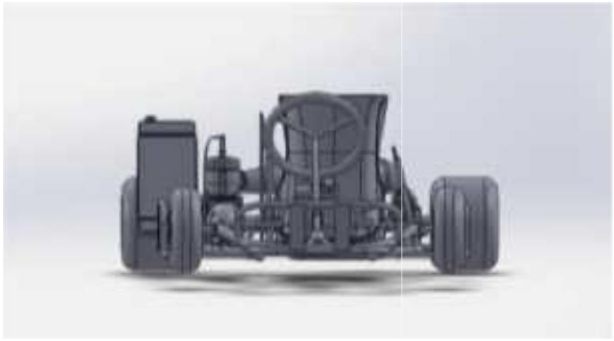


fig.4. Front view of kart

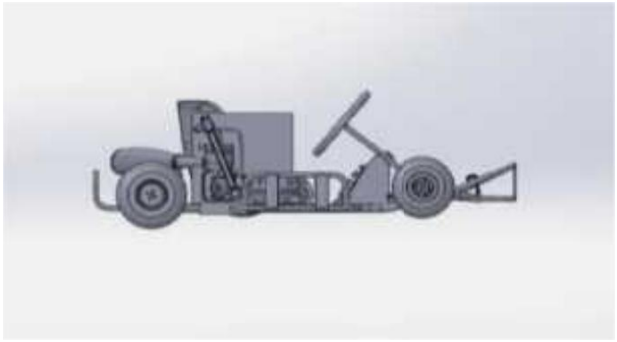


fig.5. R.H.S view of kart

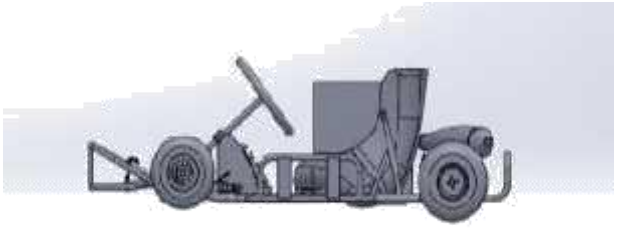


fig.6. L.H.S view of kart

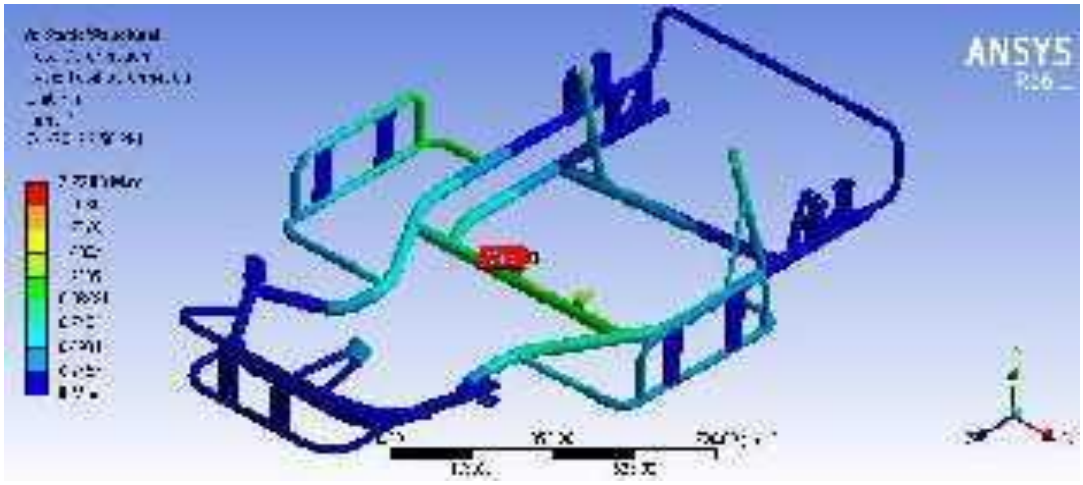
The properties of the ST 52 material is as per follows:

Yield strength	420 Mpa
Tensile strength	580 Mpa
Elongation	10 %

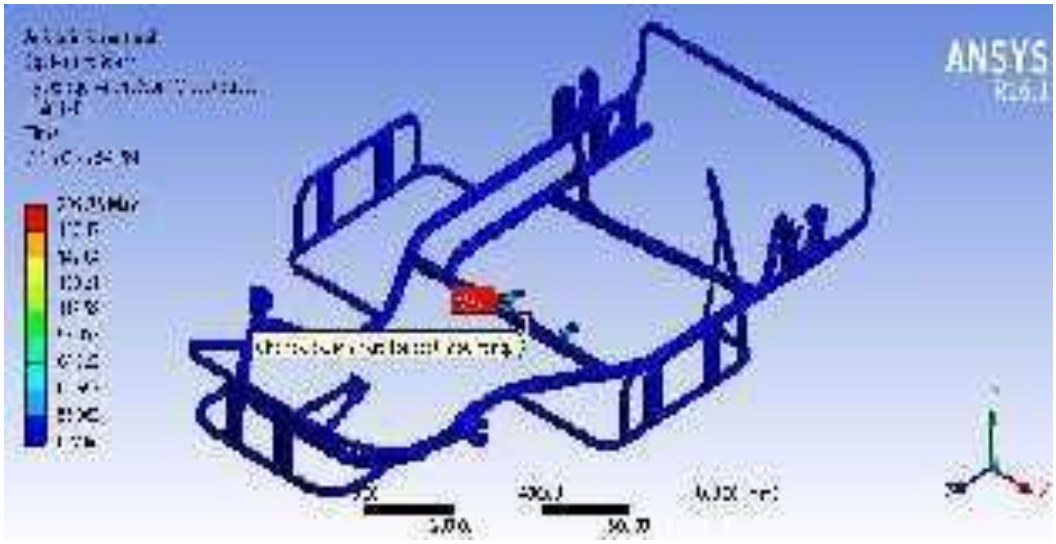
Factor Of Safety:

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

Maximum Deformation:



Maximum stress:



REFERENCES:

1. http://www.instructables.com/id/How-to-Make-a-Go-Kart/
2. V. B. Bhandari " Design of Machine Elements" McGraw Hill Education India Pvt. Ltd., vol. 3
3. Race car vehicle dynamics
4. Tune to win
5. Nalecz A. G. and Bindemann A C, "Analysis of the 1988 dynamic response of four wheel
6. Steering vehicles at high speed." International journal of vehicle
a. Design, Vol 9, No 2, pp. 179-202.
7. Callister, W.1 D. (2006). Materials Science and Engineering: An introduction. John Wiley & Sons Inc

