FABRICATION OF THE GO-KART

Submitted in partial fulfilment of the requirements
Of the degree of

BACHELOR OF TECHNOLOGY
IN
MECHANICAL ENGINEERING

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CERTIFICATE

This is to certify that the Research work titled **FABRICATION OF THE GOKART** that is being submitted by **MUKESH KUMAR, RITIK ANAND, ABHASH KUMAR JHA, ABHISHEK KUMAR** is in partial fulfilment of the requirements for the award of **Bachelor of Technology**, is a record of bonafide work done under my guidance. The contents of this research work, in full or in parts, have neither been taken from any other source nor have been submitted to any other Institute or University for award of any degree or diploma.

Supervisor

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Approval Sheet

This thesis/dissertation/project report entitled **Fabrication of The Go-Kart** by **Mukesh Kumar, Ritik Anand, Abhash Kumar Jha** and **Abhishek Kumar** is approved for the degree of bachelor of technology in mechanical engineering.

Examiners

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I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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ABSTRACT

An electric kart is a small, four wheeled, open vehicle but unlike a go-kart which is powered by an internal combustion engine, electric kart is run by a motor which is powered by battery. Right from design considerations, the fabrication is to be done by modifying and assembling various components. FMEA (Failure Mode and Effects Analysis) is a quality management tool that identifies the critical components of a product followed by investigating different failure modes and their subsequent effects on the whole product. This paper implements FMEA technique on an electric-kart by identifying various failure modes and their effects on the kart

Aerodynamics of cars is a crucial research topic that can't be neglected because it plays a pivotal role in stability, handling and fuel efficiency. Aerodynamic is the sub-field of Fluid dynamics in which we analyse the forces on the body of the vehicle caused by flow of air all around the body when the vehicle is in motion. In this project our main goal is to obtain analytical and practical solutions of the flow field so that we can minimize the Drag on the vehicle and able to get the Lift as per the need. We have done all our CFD analysis on ANSYS Fluent.

After all the Analysis, on the basis of our results we have modified our existing design and fixed the final one. After all these analysis and optimization our kart gives the best possible Ride and Handling feel to the drive

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List of abbreviations

1. IC : Internal Combustion

2. GKDC : Go- Kart Design Challenge

3. AISI : American Iron Steel Institute

4. S.A.E : Society of Automotive Engineers

5. C.A.D. : Computer Aided Drafting

10. CIK– FIA : International Karting Commission–Federation International Automobile

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1

Introduction

1.1 Project background

A go-kart is open 4-wheel mini vehicle which is used in motorsports activities. Go Kart is preferred hobby of Engineers because of very basic Automobile involved in it. The go kart is powered by small engines with few 100 cubic capacities of displacement or battery powered motor. Generally, the rear axle is rigid without differential. Sometimes differential can also be used. The chassis is fabricated using round or rectangular steel pipes. According to International Karting Commission –Federation International Automobile (CIK– FIA), go- kart may be a land vehicle with or without bodywork, with four non-aligned wheels in touch with the ground, two of which control the steering while the opposite two transmit the power.

Go Kart is very basic version of Formula vehicle; it should be optimized in every aspect to deliver maximum feel of racing. Its dynamics should be optimized and well calibrated.

In this paper the problem of evaluation of vehicle dynamic forces & aerodynamic drag forces in a competition go kart is addressed.

1.2 Research purpose and meaning

Engineering involved in a vehicle plays the most important role in safety of the passenger or Motorsports driver. Competition go kart optimization requires a deep knowledge of physical phenomena involved. In the last decade several efforts were dedicated to ascertain advanced design and setup procedures useful for the support of manufacturers and teams.

In Vehicle dynamics we consider all the forces that affect the ride and handling feel to the driver.

The dynamic behaviour of vehicles can be analysed in several different ways. This can be as straightforward as a simple spring mass system, through a three-degree of freedom (DoF) bicycle model, to a large degree of complexity using a multi-body system simulation package such as MSC ADAMS or Modelica. As computers have gotten faster, and software user interfaces have improved, commercial packages like CarSim became widely utilized in industry for rapidly evaluating many test conditions much faster than real time. Vehicle models are often simulated with advanced controller designs provided as software within the loop (SIL) with controller design software like Simulink, or with physical hardware within the loop (HIL).

2
Literature review

2.1 Introduction

E go-kart is a national level competition in India that focuses on designing and fabricating a compact electric kart i.e., the source of power for the vehicle is supplied by a motor, run by the battery. The electric kart is powered by the battery run motor. As the environment is polluted by the petrol run vehicles, there is a vital need to find alternatives and an electric kart is one of the best possible alternatives.
We researched various journals for the calculations and for the various assumptions of the Go kart. We got practical exposure during our field study and we got basic clarity on design and fabrication.

2.2 Reviews

Aritra Nath review One of the elemental concepts is that of caster angle each wheel is steered with a pivot point before the wheel this makes the steering tends to self-centring towards the direction of Travel. The front Stub Axle and King pin is one complete piece, however there is a left and right piece. Smooth recovery while the vehicle is popping, the drive must hold the wheel firmly. After the turn is completed, however, recovery – that's, the return of the wheels to the straight-ahead position – should occur smoothly because the driving force relaxes the force with which he's turning the wheel
Source: IJIRSET. (Vol-4, issue-9, Sep 2015)
Observation
• Positive Caster Is recommended
• we observe that Stub Axle is best for Electric go-karts.
• Use direct linkage Steering System.
• Steering should be designed by considering drivers safety and comfort of

Govardhan Reddy Review As per the Ackermann geometry the front tires will rotate about the mean point as a result the entire force will act on the outer front tire on a corner. Thus, the cornering traction will be primarily governed by the outer tire.
Source IJEAST. (Vol-1, issue-9, 2016)

Observation
• Among Anti-Ackermann, Parallel and Ackermann Geometry, Ackermann geometry is best for racing vehicle

Muhammad Bin Zulfiky Review In this chaotic era is the first record of the disk brake. Dr. F.W. Lanchester patented a design for a disc brake in 1902 in England. It was incorporated into the Lanchester car produced between 1906 through 1914. These early disk brakes weren't as effective at stopping because the contemporary drum brakes of that point and were soon forgotten. Another important development occurred within the 1920's when drum brakes were used for all four wheels rather than one brake to halt only the rear axle and wheels such as on the Ford model T. incorporate disk brakes in lower priced non-high-performance cars until the late 1960's.
A recent "Ducati" concept show bike uses brake disks of selenium, developed by the Russian aerospace industry, which claim to possess the friction coefficient of forged iron with the light weight of carbon fibre.

Source Faculty of Mechanical Engineering University Malaysia Pahang
NOVEMBER 2007
Observation
● Using Motorcycle brake is cost efficient in Go-kart. ● It's easy to fit and maintain.
● Taking reference from above research we are using TVS Apache RTR 160.
● Disc brakes were used on the rear axle because it has „linearity" and high torque transmitting capacity in small volume.
Mr. Virendra's. Pattanshetti Review The amount of carbon in steel is important to determine the hardness, strength and machining characteristics. To get desired strength, endurance, safety and reliability of the vehicle, proper material selection for frame is important factor. Various grades of steel or aluminium alloys are preferred material for chassis. Carbon is the main component of steel which increases the hardness of material of chassis. Mainly steel is used to constructs the chassis as aluminium alloys are expensive than steel.

Source International Journal of Mechanical and Industrial Technology ISSN 2348-7593 (Online) Vol. 4, Issue 1, pp: (150-164), Month: April 2016
September 2016
Observation

- Optimization, safety and comfort are parameters for material selection.
- Taking reference from above research we selected AISI 4130 Alloy Steel (Chromoly) for good strength and light weight.

Marco Evangelos Review numerical modelling has been con ducted by means of the CFD solver Fluent. The reference geometry was first presented by the TVK research team (Bertolino, 2003). Basic concepts for CFD modelling of a go kart was described in the study published by (Baudille, 2003).

The detailed geometric model of the vehicle complete of the driver has been adopted for the developing of a very fine surface mesh suitable to capture local flow field gradients. Fluid domain includes the go kart, the ground and the external boundary of the virtual wind tunnel.

Source **Paper** no. F2006SC16 - F2006SC17 Manieri Gianluca, Urbinati Marco University of Rome

Observation

- For Simulation in software ANSYS Fluent is used.
- Very fine mesh is required for better results.
- Drag co-efficient goes up to 0.8.

Boran Pikula Reviews As the manufacturers of the motor vehicles generally use their own wind tunnels to test the real vehicle's performances, especially in the final stage of vehicle design, though the development of prototype starts from defining external aerodynamics of the vehicle model using experimental research and numerical simulation. Today, there are a number of different commercial software designed for the numerical simulation of the external aerodynamics, that show the different air flow images around and especially behind the vehicle depending on the different turbulence models. Therefore, the improvement of prototype implies the testing of the vehicle model in the wind tunnel in order to reach the optimal numerical model for the air flow simulation around the vehicle.

Source Conference Paper: DEMI 2011

Observation

- We can do the wind tunnel for real cars but it’s the final stage so we do it on a prototype.
- The other way is to do the aero simulation of a cad model in various software's.

Nick Owen et al A review carried out by Potkanowicz and Mendel has shown that the influence of stress and strains exerted on race drivers is not well understood or known about the combined effect. While trainers and sports scientists try to simulate the race car and race event environment with their training regimens (e.g. hot yoga, loaded steering wheel resistance training, reaction testing, and training), without quantifiable data of the driver’s experience, these regimens do not take full advantage of the training principle of specificity. Providing quantifiable data through additional research will help to validate the driver as an athlete. In uncovering this information, the scientific community has an opportunity to contribute to racing becoming that much safer, that much more competitive, and that much more comprehensive for the driver, the team, and the sport

Source Procedia Engineering 112 (2015) 344 – 348
Observation

- It is important to ensure the driver safety and comfort in the Go-kart.
- To reduce fatigue we use padded seat.
- Taking reference from above research we found that hot yoga and reaction testing and training helps to reduce the driver's fatigue.

Oliver Lodge and Archibald Low In 1894, the first example of wirelessly controlling at a distance was during a demonstration by the British physicist Oliver Lodge. In 1898, at an exhibition at Madison Square Garden, Nikola Tesla demonstrated a small unmanned boat that used a coherer based radio control. In 1917, Archibald Low as head of the RFC Experimental Works, was the first person to use radio control successfully on an aircraft.
Radio control was further developed during World War II, primarily by the Germans who used it in a number of missile projects**.**

Source In 1898, Tesla demonstrated a radio-controlled boat (U.S. Patent 613,809 — Method of an Apparatus for Controlling Mechanism of Moving Vehicle or Vehicles)
Observations

- To operate machines at some distance.
- To ensure safety of people and driver.
- To operate vehicle wirelessly and without internet in all direction using radio control.

3
Specification of the kart

- Power- 3000watt
- Power Source-Lithium Ion Battery
- Acceleration- 1.93meter/sec^2[0-60KMPH within 50 M]
- Top Speed- 60km/hour(theoretical)
- Drive- RWD [No Gear]
- Chassis- Chromoly Steel (AISI 4130)
- Brake-Single Disk Brake
- Bodyworks- 1. Carbon Fibre (driver seat, steering) 2. Fiberglass(bumpers)
- Track width- 1053mm
- Wheelbase- 1274mm
- Roll Hoop Height- 35inch
- Rear Axle- EN8
- Arduino Based Kill Switch
- Light Weight-110kg (without driver)

4
Design Methodology

- Design of any component is consisting of three major principles:
- Design Optimization
- Go-Kart Safety
- Driver's Comfort

The main objective of the kart chassis is to provide a 3-dimensional protected space around the driver that will insure the driver's safety. Designing secondary objectives involves the designing of the body of the kart in designing software. It consists designing of the frame, rear roll hoop, frontal lateral cross member, fore af bracing, side impact members, lateral diagonal bracing, under seat member, followed by the assembly of steering, braking systems, wheels and tires and the seat. Cost optimization on chassis is done through material selection and by using more continuous members with bends rather than a collection of members welded together to reduce manufacturing costs. The modelling of the roll cage structure is done by using Solidworks software. This design is checked by FEA.We have not only reconsidered on every point of chassis to improve the efficiency of vehicle but also insured that chassis should not fail. Beginning designing process was done by conducting extensive research of go kart roll cage through finite element analysis Rectangular/circular tubes are to be used for the primary and secondary members of the frame.

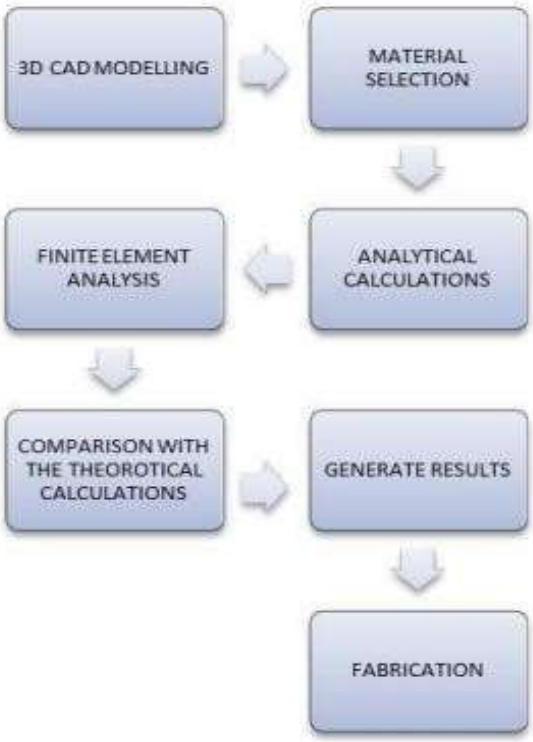

Fig 4.1 : Flow chart of design

4.1 Modelling

3-D modelling was done using Solidworks software as shown in Fig.4.2

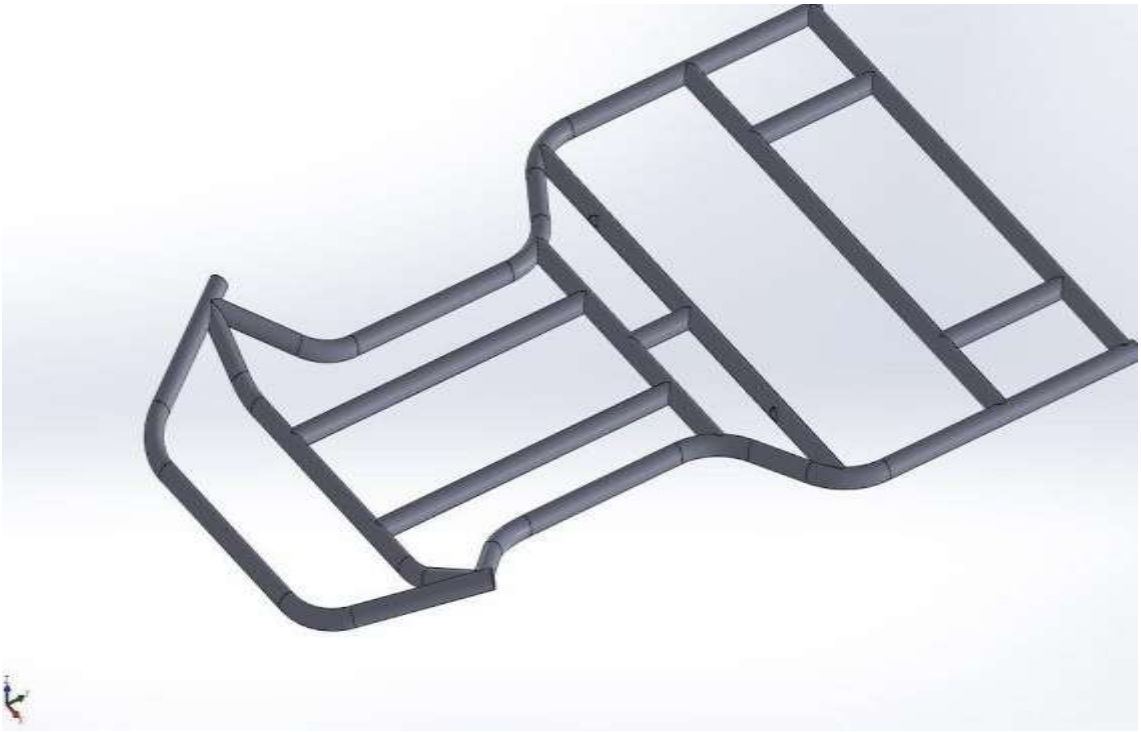

Fig 4.2: 3D-model of chassis in Solidworks

4.2 Material Selection

The selection of material was a challenging task for us as it had many constraints of weight, weldability, structural resilience towards different types of forces, torsional rigidity, factor of safety under application of various loads and also market availability with cost effective constraints. The basic intention behind selecting different sort of materials and finalizing one material for the frame, chassis and the other parts is to get the best and safest results in Publish Journals case of driver's safety and real time load bearing capability.

Table 4.1: Properties of material used

properties	AISI 4130	AISI 1020	AISI 1018
Tensile strength	**560 MPa**	394 MPa	440MPa
Yield strength	**460 MPa**	294 MPa	650-880 MPa
Modulus of elasticity	**190-210GPa**	190- 210 GPa	205GPa
Shear modulus	**80 GPa**	80 GPa	80GPa
Hardness	**217**	111	126
Cost	**360/piece**	400/piece	330/piece

4.3 Finite Element Analysis

FEA is a simulation technique for analysing the various parameters like deformation, stress, vibration and other physical effects occurring on the structure on application of forces on it. In this work Solidworks is used for the modelling as well as performing the different test.

1. Front impact 2. Rear Impact 3. Side Impact

Front Impact

For impact test, mass of kart is taken 110kg

the acceleration is considered to be 2g (ideal condition for testing the front impact force).

F = ma Where F = impact force & m = mass of vehicle, a=2g

F = 110 x 2x 9.8 =2156 Newton

Max displacement=0.29412mm

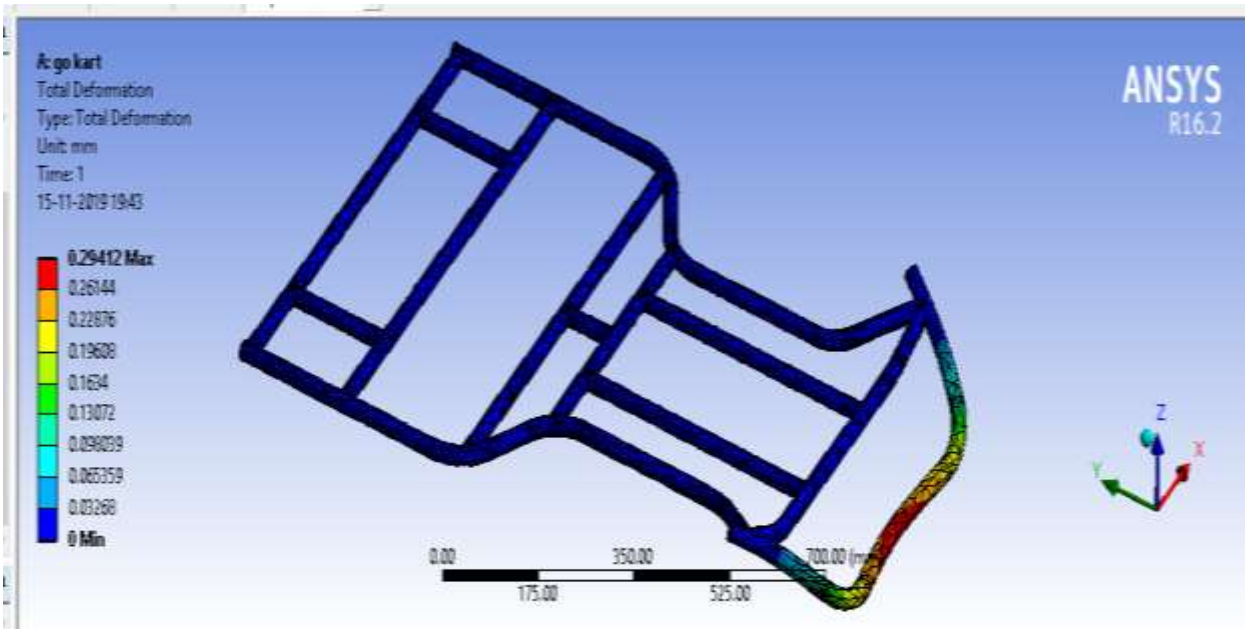

Fig 4.3: Frontal Impact (Deformation)

Rear Impact

The rear impact load is same as the front impact and the force is acting upon the nodes with the front completely constrained this time. The displacement and stress values are well within the permissible levels.

The acceleration is considered to be 2g(ideal for impact analysis).

Rear impact F=2156N.

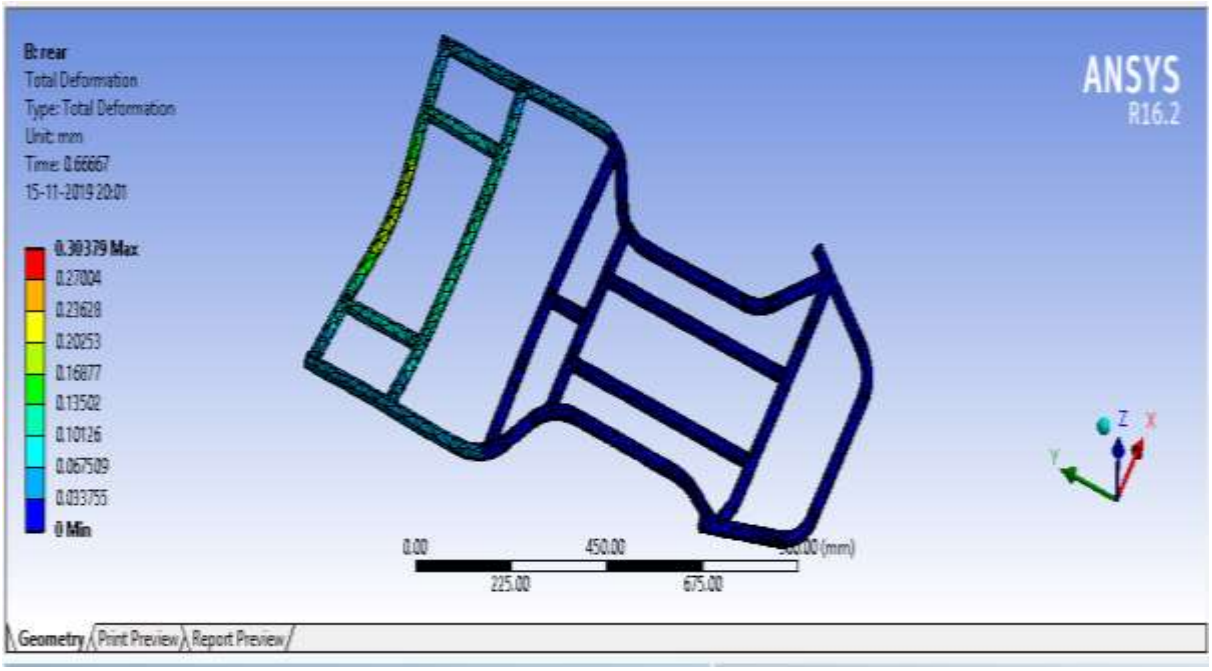

Fig 4.4: Rear Impact (Deformation)

Side Impact

Same Calculated present load is used for side impact, front impact and rear impact test.
For side impact force also, the acceleration is considered to be 2g. (ideal condition)
Side impact =2156 N

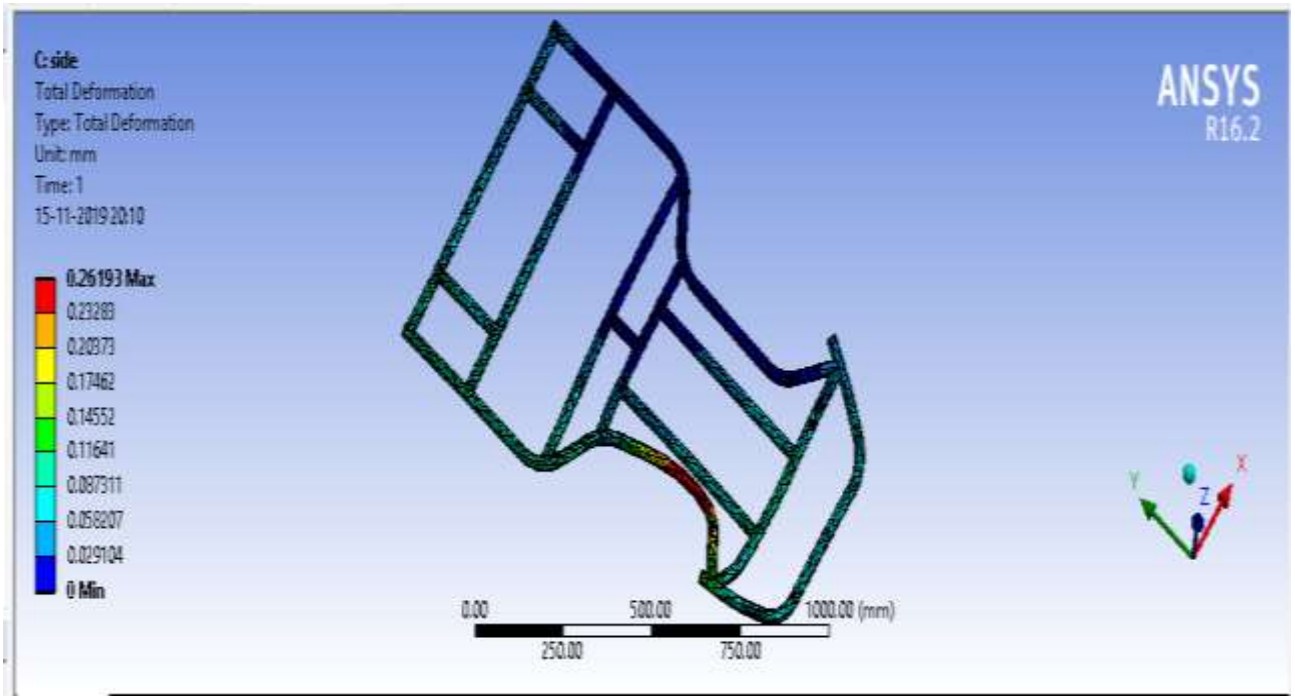

Fig 4.5: Side Impact (Deformation)

5
Fabrication

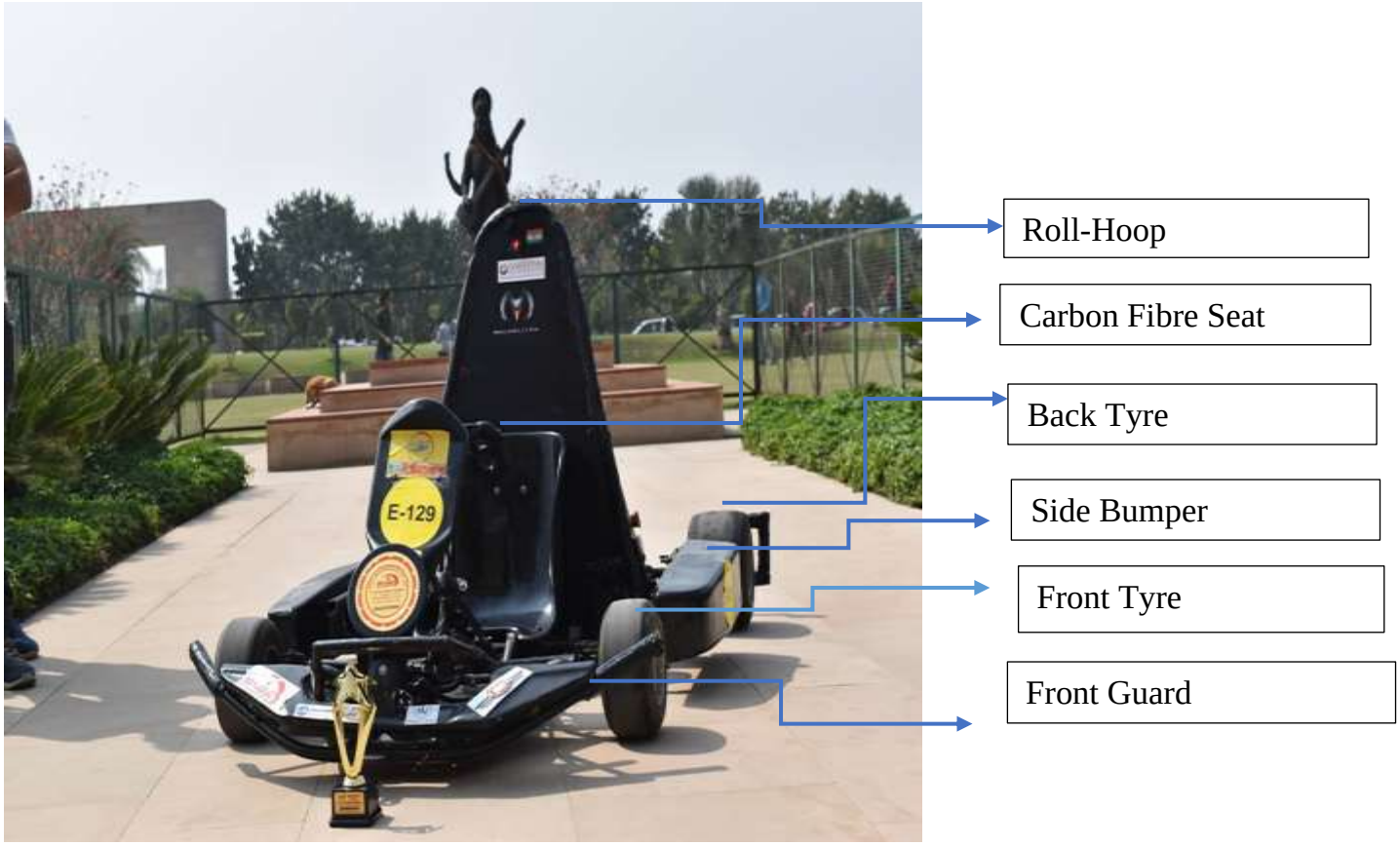

Fig.5.1 Go-Kart Nomenclature

5.1 Body Fabrication work

In this kart we have used two types of fibre 1) Carbon Fibre ii) Glass Fibre

1. We used Carbon Fibre For Driver Seat For Below Mention Properties
2. The fibres are extremely stiff, strong and light
3. The properties of a carbon fibre part are close to that of steel and the weight is close to that of plastic, thus the strength to weight ratio as well as stiffness to weight ratio of a carbon fibre part is much higher than either steel or plastic
4. High tensile strength, high temperature tolerance
5. Low thermal expansion
6. They are relatively expensive when compared with similar fibres, such as glass fibres or plastic fibres

6

Failure Modes and Effects Analysis (FMEA)

6.1 FMEA Objective

American society of quality states that "Failure modes and effects analysis" is a step-by-step approach for identifying all possible failures in a design, a manufacturing or assembly process, or a product or service. Failure modes is defined as the ways or modes in which something might fail. Effect analysis is the analysis of consequences of failures. Failures are given priority on the basis of risk of their consequences. Therefore, FMEA ensures a systematic approach and gives aid in evaluating, tracking and updating the product or the system.

FMEA has the following types-

(a) Functional- which is based on a functional breakdown of a system and potential failure modes are found out & general mitigations are proposed to limit the consequence of failures.
(b) Design- analysis of products prior to production are to be done &
(c) Process-analysis of manufacturing assembly process is to be covered.

Sl. No.	COMPONENT	FAILURE MODE	FAILURE CAUSE	FAILURE SHORT TERM EFFECT	FAILURE LONG TERM EFFECT	PREVENTIVE MEASURES
1	Chassis	Appropriate material type is not chosen	Proper welding is not done, Analysis of material is not done	Over vibration in the vehicle	Can lead to collapse of the vehicle, driver's safety compromised	Simulation in ansys can prevent this failure
2	Frame	Disengagement and bending of roll-cage members.	Broken weld, Ground interference, Strength loss, Collision force	Failing of frame, vibrational shocks, structure loss	Driver's safety is compromised	No immediate action can be taken, High FOS(factor of safety) material should be selected
3	Battery	Short circuit	Improper insulation of wires and their connections, high charging rates, High temperature	Will not start the engine	Performance will reduce	Battery should be purchased from reputed manufacturer, wire connections should also be checked

4	Motor	Rotor and stator faults, Winding rupture	Heating, High current from battery, Short circuit in Connection, Lubrication of drive gear	Abnormal starting, RPM decreases	Repair cost may increase, Damages can happen	Cooling, Connection should be checked, Lubrication should be done
5	Motor Controller	Short circuit in any component, Failure in any component.	Faulty connections, failure in transistor	Motor doesn't start	RPM variations	Electrical components and connections should be checked properly
6	Transmission	Improper material type , improper gear meshing	Disengagement of teeth, Chain breaking	Leads to unsatisfied performance , leads to high amplitude vibrations	Operability is reduced, decrease in speed	Drive and driven shafts should be holding the chain are parallel to each other , proper greasing of the chain , proper bearing type
7	Steering system	Steering ratio varies, tie rod alignment, steering geometry	Improper designing and mounting	Improper stability, more tire wear, chance for collision	Steering failure, driver's safety compromised	Steering calculations, proper lubrication between rack and pinion
8	Brake	Long pedal travel, poor braking, brake pulling	Low fluid level in master cylinder, Leaking master cylinder pipe line	Speed reduced, Insufficient braking	Driver's safety compromised	Oil level checking, Bleeding screw should be tight, Leakage should be checked, Master cylinder should always be filled
9	Tires	Improper seating with steering links, tires subjected to high wear and tear	Less importance to fasteners (bolts and Nuts),low quality tires	May lose control of the vehicle, skidding especially on wet roads, affects the vehicle speed performance	Reduce steering control, chances of accident	Good quality tires should be purchased, Wheel alignment should be proper, Tire should be used according to condition of road

10	Driver Seat	Disengagement from lower frame, Structural failure	Seat frame welding not done properly	Loose balance	Driver's safety compromised	Welding should be very proper, High FOS(factor of safety) material should be used
11	Bumper	Structural failure.	External impact load exceeds the yielding limit of the material.	Chances of getting hurt	Kart can be damaged, Repair cost increases	Clamp/rivet should be properly with FLC(frontal lateral cross member), High FOS (factor of safety) material should be selected
12	Rear axle	Improper machining, improper mounting	Inadequate results from 3D designing, less knowledge on the type of bearing to be used	Break down, transmission loss	Chances of accident	Roundness should be checked, proper mounting, diagnosis
13	Throttle Pedal	Disengagement from fore aft bracing, Signal sent by throttle pedal to motor is hindered.	Wiring between pedal and motor controller is halted, excessive pedal effort from drive	Speed of the motor shaft is decreased	Repair cost may increase	Wiring should be checked thoroughly with proper insulation.
14	Kill Switch	Electrical failure.	Short circuit, wiring problems, In improper insulation, vibrational shocks.	Vehicle becomes inoperable.	Chances of accident	Proper installation should be done, Wiring should be checked frequently
15	Battery working	Short circuit	Insufficient connection, BMS (battery management system), Temperature	No supply for current	Chances of short circuit, Even fir can be caused	Cooling, Charging the battery, BMS customization

6.2 Mass Distribution

Front: Rear = 1:2
Vehicle Mass = 110 kg
Driver Mass = 60kg
Riding Gears Mass = 5kg Fire
Extinguisher Mass = 5kg

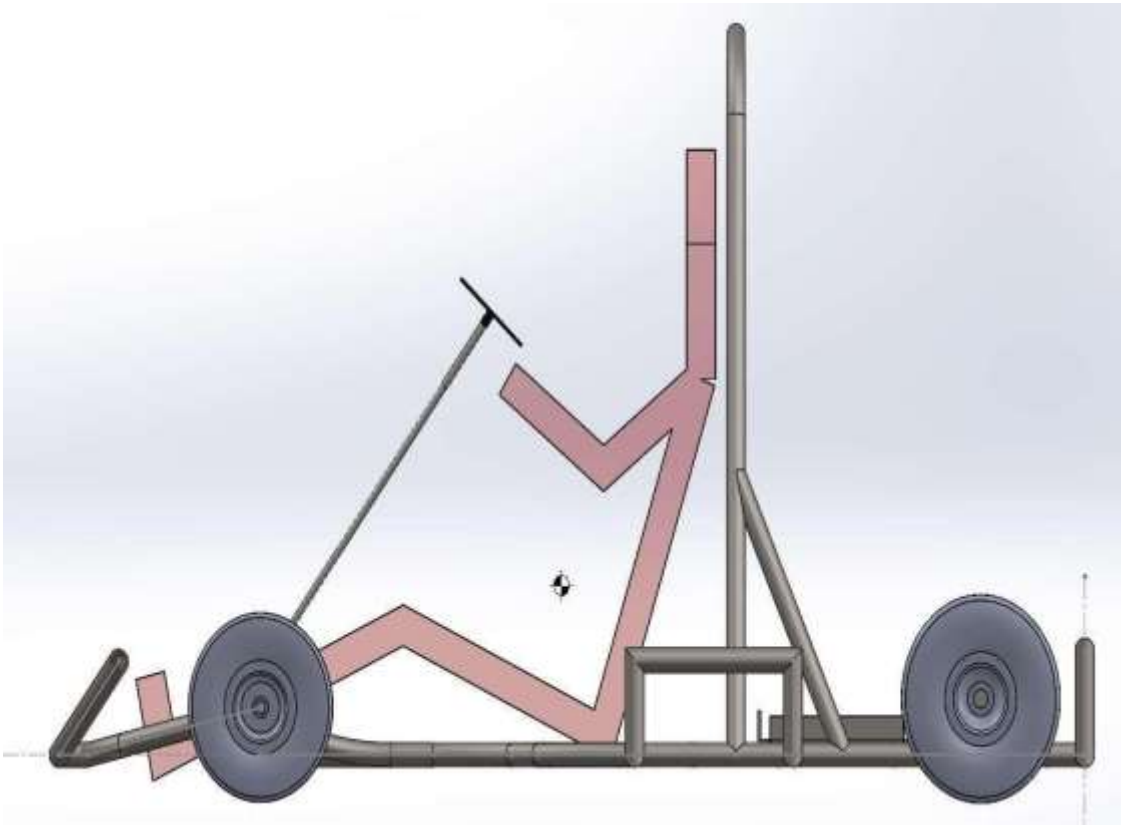

Fig 6.3: Position of Centre of Mass of Frame Only

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7
Remote Control Assembly

7.1 COMPONENTS

- TRANSMITTER
- RECEIVER
- RELAY

7.1.1 TRANSMITTER

A transmitter is an electronic device used to produce radio waves in order to transmit or send data with the aid of an antenna. The transmitter itself generates a radio frequency alternating current, which is applied to the antenna. When excited by this alternating current, the antenna radiates radio waves.

7.1.2 RECEIVER

A radio frequency module is a small electronic device used to transmit and/or receive radio signals between two devices. In an embedded system it is often desirable to communicate with another device wirelessly. This wireless communication may be accomplished through optical communication or through radio-frequency (RF) communication. For many applications the medium of choice is RF since it does not require line of sight.

Fig 7.1 Remote and Transmitter

8

Future Scope

The racing is very important in the day to day life because it improves our driving Skill and Vehicle capability. Most of the accidents caused in today's world is due to over speeding of the vehicles and also due to the bad choice of materials as far as the chassis is concerned. So, here we have considered all the necessary safety precautions while designing the Vehicle. Most go-Kart we found in the small events are not optimized as per the Racing Standards. Access to wider sources of innovation is also vital to motorsport, where suppliers can learn from and incorporate new ideas and developments. What's more, there are many sectors yet to be approached with even more untapped sources of innovation. Road racing with sports cars translates competing in extreme conditions to commuting in extreme conditions. Rain, low visibility in night time, sun glares in day time, adverse road conditions, and how we approach these conditions are critical to ensuring a safe driving experience.

Sports car competition acts as a real-life test bed for innovation and development beyond just speed. The conditions experienced at the highest form of competition are often the same conditions we experience driving to work, and the connection is being made constantly to improve our commute.

9
Problem Description

9.1 Problem description

- The existing go-kart design used today has multiple disadvantages like compatibility, heavy weight, speed durability and most important thing is they use conventional IC engines.
- We know resources like petrol, diesels are limited, and we can’t depend on conventional non-renewable power sources.
- IC engine produces air &sound pollution.
- Heavy weight kart causes speed issue

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10. **Nick Owen et al** Procedia Engineering 112 (2015) 344 – 348
11. **S.S rattan (Theory of machines)**

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