IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

DESIGN, ANALYSIS AND FABRICATION OF GO-KART VEHICLE

Prof. Sachin Jadhav1, Mr. Shubham Yadav2, Mr. Omkar Kumbhar3, Mr. Pushpak Patil4,

Mr. Sopan Vyavhare5, Mr. Mahesh Yadgire6,

1Professor 2,3,4,5&6 Student,
Department of Mechanical Engineering,
ISB&M College of Engineering, Pune, India

Abstract:

A Go-kart is a small four wheeled vehicle. Go-kart, by definition, has no suspension and no differential. They are usually raced on scaled down tracks, but are sometimes driven as entertainment or as a hobby by non-professionals.

Our goal is to design and fabricate an eco-friendly go-kart that offers exceptional performance, driver comfort, and safety. The primary focus is on creating a lightweight kart that delivers impressive performance. Adherence to the rulebook of Edgeline Championship is mandatory and significantly influences our objectives.

The go-kart, which is propelled by a rear- wheel internal combustion engine without suspension or differential, has been designed in accordance with standard principles. All critical factors and design parameters have been taken into account, resulting in a thoroughly failure-analysed and ergonomically optimized go-kart.

Comprehensive calculations have been conducted for each component, followed by 3D modelling and simulation using professional software tools.

The analysis was carried out with different iterations and finally the optimum design of each part of the Go kart was done so as to obtain the optimum result.

INTRODUCTION

Go-Kart is four wheeled racing car that can be used by any one and can be made by professional and non-professional personal so. Driver in Go-Kart may or may not be professional. They denote Formula1 car in manners of speed but it is less costly. They are widely used for racing in America and now increasing its popularity in India because of cost effectiveness and racing thrill. Go- kart is simple, light weight and easy to operate. Most of go-kart used simple mechanical principles to manufacture its body. As the popularity is

increasing new participants are introducing themselves in competition. Each team has to the go through many positive and negative aspects throughout the designing process to achieve the exact solutions.

OBJECTIVE:

1.Improve lap times: Set a goal to reduce your lap times with each session, focusing on smooth driving and mastering each corner.

2.Master race craft: Learn the art of overtaking, defending, and navigating traffic efficiently to become a more competitive racer.

3.Enhance driving skills: Work on fundamentals like braking, acceleration, and cornering techniques to become a more proficient driver.

4.Learn track layout: Memorize the track layout and optimal racing lines to maximize speed and minimize lap times.

5.Stay consistent: Aim for consistent lap times throughout a race to maintain momentum and competitiveness.

6.Understand kart setup: Experiment with different kart setups such as tire pressures, alignment, and chassis adjustments to find the optimal configuration for your driving style and track conditions.

7.Race craft strategy: Develop strategic race craft skills such as pit stop timing, fuel management, and race strategy to gain a competitive edge over opponents.

8.Safety awareness: Prioritize safety by following track rules, wearing proper safety gear, and being aware of other drivers on the track to minimize the risk of accidents.

PROBLEM STATEMENT:

The go-kart is a vehicle that is small, quick, light, and simple to drive. Since the go-kart is designed for flat-track racing, it has a very poor ground clearance relative to most cars, but it does not have suspension. Engine, steering, suspension, tires, and bumpers are the elements of a go-kart. A go engine kart is either a two-stroke or a four-stroke engine. The word "eco-kart" refers to a car that uses electric motors instead of an engine. Go-karting is a form of open-wheel motorsport that involves lightweight, open-wheeled vehicles with four wheels. To feel the excitement, the chassis is independent of the suspension. Because of its ease, low cost, and safer way of racing, go-karting is a perfect outlet for those involved in racing. It is possible to have an indoor or outdoor track. The go-kart tracks are much smoother than the F1 tracks. Go-karting experience will better introduce the driver to the actual racing environment, allowing them to participate as professional motor racer in various competitions. This project is intended to design and fabricate a low-weight go-kart. To reduce the weight of this vehicle, the main effort in this project is to select material. Hence, by choosing an appropriate material for its fabrication, one can reduce the overall weight of this vehicle.

SCOPE

1.It is used in racing.

2. Outdoor karts are also typically used for traditional kart racing, but these are more robust as mainly comprising of four-stroke engines.

3. Indoor karts are used in warehouses and factories, and typically, these are smaller in size than outdoor karts.

4. It offers opportunities for entertainment, skill development, tea building, and even career progression in motorsports.

5. Go-karts vary in design and purpose, catering to diverse audiences from children to adults, amateurs to professionals.

6.They are used in indoor and outdoor tracks, amusement parks, and training facilities, making them versatile vehicles for various purposes.

7.Additionally, go-karting serves as a stepping stone for aspiring race drivers, providing a platform to hone driving skills, learn racecraft, and gain experience before advancing to higher levels of motorsport.

METHODOLOGY:

DECISION MAKING PROCESS

The team initiated the process with brainstorming, followed by a comprehensive review of considerations. This was seamlessly followed by stages of designing, design analysis, fabrication, assembly, and documentation, all meticulously aligned with the specifications outlined in the Go-kart rulebook.

Our design methodology involved a thorough exploration of all conceivable alternatives for each system, which were then modelled in CATIA V5 R21. Subsequently, the model underwent iterative modifications and retesting, reflecting a dynamic engineering process that hinges on factors such as availability and cost.

The design objectives we pursued cantered around three fundamental goals, each systematically applied to every vehicle component: durability, lightweight construction, and high performance. These objectives were achieved through meticulous design optimization, which concurrently contributed to cost reduction. In this manner, our vision for the kart's form and function crystallized.

Working

The working of a go-kart vehicle involves several key components and their interactions to propel the vehicle forward and control its movement.

1. **Engine:** The engine is the heart of the go-kart. It generates power by burning fuel (usually gasoline) in a combustion chamber. The energy produced from this combustion is converted into rotational motion, which drives the go-kart forward.

2. **Transmission**: In most go-karts, power from the engine is transmitted to the wheels through a transmission system. This system typically includes a centrifugal clutch, which engages as engine RPM increases, and a chain or belt drive that transfers power to the rear axle.

3. **Throttle Control:** The throttle controls the amount of fuel and air mixture entering the engine, thus regulating engine speed and power output. When the driver presses the throttle pedal, it opens the throttle valve, allowing more fuel and air into the engine, which increases RPM and accelerates the go-kart.

4. **Steering System:** The steering system allows the driver to control the direction of the go-kart. It consists of a steering wheel connected to a steering column, which is linked to the front wheels via tie rods. When the driver turns the steering wheel, it rotates the front wheels accordingly, causing the go-kart to turn left or right.

5. **Braking System:** Brakes are essential for slowing down and stopping the go-kart. Most go-karts are equipped with disc brakes on the rear axle, operated by a foot pedal. When the driver presses the brake pedal, hydraulic pressure is applied to the brake callipers, which squeeze the brake discs, creating friction and slowing down the go-kart.

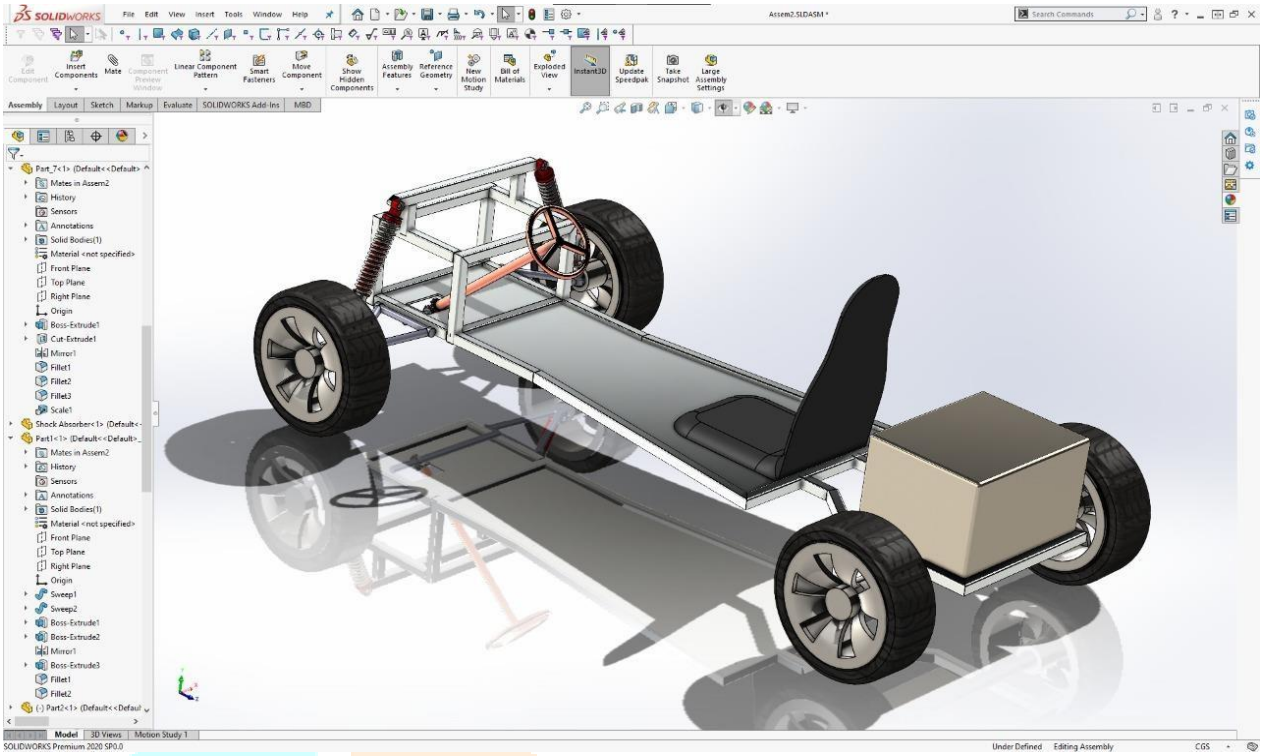
6. **Wheels and Tires**: The wheels and tires provide traction and support for the go-kart. Pneumatic tires are commonly used, as they offer good grip and shock absorption. The size and type of tires depend on the intended use of the go-kart, whether it's for racing, off-roading, or recreational purposes.

7. **Chassis:** The chassis serves as the structural backbone of the go-kart, providing support and rigidity while also protecting the driver. It's typically made of steel tubing or aluminium and includes components like roll bars and seat mounts for safety.

8. **Driver Controls**: The driver interacts with the go-kart through various controls, including the throttle pedal for acceleration, brake pedal for braking, and steering wheel for steering. The driver also wears safety equipment like a helmet, gloves, and racing suit for protection.

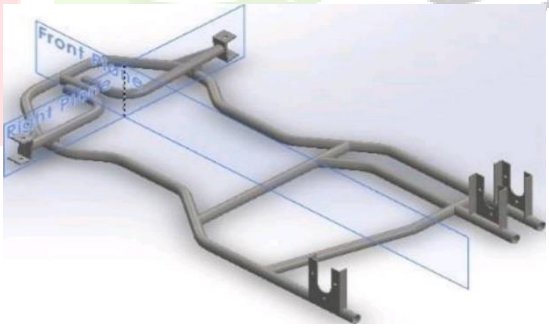
Overall, the working of a go-kart involves the coordinated operation of its engine, transmission, steering, braking, and other systems to propel the vehicle forward and enable the driver to control its movement effectively.

Model & Design

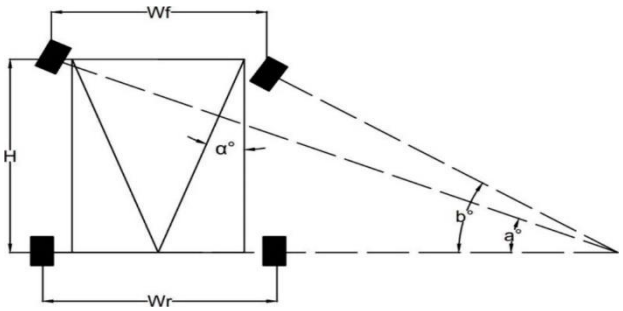


1. CHASSIS

The chassis design we chose for our go kart is one of the most unconventional design, because this chassis is constructed on single floor. This allows the outer frame to be on the same level comprising of many bends on the same tube to solve the most troublesome problem in manufacturing of a chassis. The single piece frame gives the chassis very high strength and rigidity as it doesn't involve welded joints. This frame reduces the bending forces developed on the chassis since the frame is straight. It is better than the conventional chassis where the front axle is raised from ground leading to weaker front part of chassis.



CALCULATION :



Ackerman's angles

H =1.08m = 1080mm

W_r =1.17m = 1 170mm

Wf = 1.05m = 1050mm

R = 2.085m = 2085mm

. **Ackerman's angle:**

Tan (Wr/2)/H a-tan -I (0.585/1.08) a-28.440

Outer angle: Tan (a) $=H/(R+(W_r/2))$ $=1.08/(2.085+0.585)$

a =22 0

Inner angle:

Tan (b) $=H/(R-(W_r/2))$ $=1.08/(2.085+0.585)$ b-35.750

Inner turning radius: Rm,n =H/sin(b)

=1.08/sin(35.75 ˚)

=1.848m

Outer turning radius:

R max = H/sin(aO)

Rmax = 1 .08/sin(22 0)

= 2.883m

Maximum steering effort(E):

E = Vertical load on tyres/Steering ratio

Weight ratio =Front side weight/Rear side weight

As the engine is mounted at rear end of the chassis, the ratio should be 40:60

Mass of the vehicle (including driver) =175kg

Weight of the vehicle =175x9.81 = 1716.75N

TRANSMISSION SYSTEM

Abbreviations used:

Static torque in N-m

Rolling torque in N-m

Co efficient of rolling friction • w - Weight of kart (including driver) in kg

Radius of wheel in inches

Fluctuating torque in N-m

m- Mass of vehicle (including driver) in kg

a- Acceleration in m/s2

r Perpendicular distance in Meters

D Diameter of wheel in inches

N Average speed in rpm

SF Shear force in newton(N)

BM Bending moment in N-m

- Allowable stress in MPa

FOS Factor of safety

Maximum bending moment

Cm Fatigue factor for bending

Braking torque in N-m

do Outer diameter of shaft in mm

Fatigue factor for torsion

Gear ratio

T - Output torque at sprocket in N-m

sprocket

engine - Torque at engine in N-m

N out - Output speed in rpm

N engine Engine speed at maximum torque in rpm

Vehicle velocity in m/s

F shaft - Maximum force in rear axle in Newton(N)

0rsprocket- Radius of sprocket in Meter(m)

T shaft - Maximum torque on rear axle in N-m

R shaft - Radius of shaft in Meter(m)

T Wheel - Maximum torque on rear wheel in N-m

R wheel - Radius of wheel in Meter(m)

CONCLUSION:

To achieve the set goals, we used the finite element for the evaluation, creation and modification of the best vehicle design. The prior aim of the team was to build a go kart with minimum cost without compromising the safety and performance of the vehicle. The final result is a desired Go Kart design meeting all the above factors.

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