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DESIGN AND FABRICATION OF PEDAL OPERATED THREE WHEEL GO KART

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Abstract: This paper's primary goal is to provide a thorough design calculation and analysis of the go-kart vehicle parts. A go kart is a three-wheel vehicle in which both of the rear tyres rotate at the same speed because it lacks a differential and suspension. The goal of this research is to model and analyse go-kart vehicle components using design calculations and part simulations. Impact analysis was carried out in the front, rear, and lateral directions with SOLIDWORKS 2016 for modelling and analysis, and ANSYS WORKBENCH 16.2 for simulation. Next, we looked at the deformation of the chassis and the flexural rigidity of the structure. After comparing the outcomes of two distinct materials, the qualities with the finished design are finished. The design stresses and deformation results of several car part components, include[Ping the disc brake's temperature analysis and the stub axle and stub arm of the steering system, are presented in this study. The design is adjusted in accordance with the findings of thesetests.

Keywords— Simulation, Design calculation, modelling

1. INTRODUCTION

1.1 Project Definition

A vehicle that is lightweight, fast, easy to manoeuvre, and compact is the go-kart. The go-kart lacks suspension but has extremely little ground clearance compared to most cars because it is made for flat-track racing. The components of a go-kart are the tyres, bumpers, steering, suspension, and engine. An engine in a goengine kart can be two or four strokes long. An "eco-kart" is a vehicle that is propelled by electric motors rather than an engine. Lightweight, four-wheeled open-wheel vehicles are used in go-karting, an open-wheel racing. The chassis is not dependent on the suspension to experience the thrill. Go-karting is the ideal hobby for individuals who enjoy racing due to its simplicity, affordability, and safer mode of competition. The goal of this project is to design and build a go-kart that is lightweight. The primary focus of this project is material selection in an effort to lighten the vehicle. Hence, one can lower the overall weight of this vehicle by selecting the proper material for its construction.

1.2 OBJECTIVE

Our idea is to create a reasonably priced, user-friendly, and secure drift trike.

1.2.1 Project Definition

The following are the project's primary goals:
1. Choosing an appropriate material for the design.
2. Software design for the Go-Kart.
3. Vehicle analysis using analytic software
4. Manufacturing of Go-Karts

1.3 Problem Statement

The primary drawback of the current go-kart design is its reliance on traditional internal combustion engines, which is compounded by problems with compatibility, weight, durability, and speed. We understand that we cannot rely solely on non renewable power sources and that resources like petrol and diesel are finite. A heavyweight kart restricts speed and airflow, and the internal combustion engine pollutes the environment. A race

season in motorsports produces about 256,000 CO2-equivalent tonnes of carbon dioxide because of the incredibly strong internal combustion engines used in Formula One, which is often regarded as the sport's pinnacle.

As you can see, there are a lot of greenhouse gases emitted into the atmosphere, which is a big problem because it contributes to global warming. a significant problem. The best defence against this is to use batteries to power the cars without necessarily compromising speed. In the motor sports business, noise pollution is a major problem because of the fast-revving engines. When you are standing next to a Formula 1 car, the noise level is 140 dB. Again, hearing loss starts at 85 dB, which is quite dangerous. Compared to typical internal combustion karts, electric go-karts are quieter and more environmentally friendly. In the past, the primary worry about electric go-karts was their short range, which meant they would have less power and, thus, less speed than internal combustion engines. However, with the recent advancements in motor technology and battery technology, this worry can now be disregarded.

1.3.1 Classification

There are four types of car chassis: offset, caged, straight, and open. Straight chassis karts have the driver seated in the centre, while open karts lack a roll cage. Caged karts are primarily utilised on dirt tracks. Sprint racing uses straight chassis, while offset chassis place the driver on the left side of the vehicle. For speedway racing with only left turns, offset chassis are utilised.

1.3.2 Specialization

Hollow rectangular shafts are being used in place of hollow tubular shafts.

This replacement serves the following purposes: - It weighs the same as a tubular shaft of the same length; it improves appearance; it is easier to mount; and most importantly, it has been discovered that hollow rectangular shafts experience higher bending stresses than tubular shafts.

1.3.3 Steering System

Making sure the wheels are pointed in the appropriate directions is the fundamental goal of steering. Usually, a system of links, rods, pivots, and gears accomplishes this. The idea of caster angle is one of the basic ones; every wheel has a pivot point ahead of it, which causes the steering to tend to self-center in thedirection of movement.

Many contemporary automobiles include rack and pinion steering systems, in which the pinion gear is turned by the steering wheel, and the rack—a linear gear meshing with the pinion—is moved by the pinion. This results in the conversion of circular motion into linear motion along the car's transverse axis, or side to side motion. The swivel pin ball joints that, using tie rods and a short lever arm known as the steering arm, replaced the previously employed kingpins of the stub axle of the steered wheels. The benefits of the rack and pinion design include direct steering "feel" and a high degree of feedback. Its inability to be adjusted means that the only remedy available when it starts to wear and develop lash is replacement.

The recirculating ball system, still present in trucks and utility vehicles, is frequently used in older designs. In this version of the worm and sector design, a big screw known as the "worm gear" is rotated by the steering column, and it meshes with a gear's sector to cause the gear to revolve around its axis as the worm gear is turned.

2. LITERATURE SURVEY

2.1 Project Background

The Go-Kart is an easy-to-use, lightweight, compact, and basic vehicle. The go-kart has relatively limited ground clearance and is designed exclusively for racing, unlike other types of cars. The most frequent parts of a go- kart are the engine, wheels, suspension, steering, tyres, and frame. The go-poor kart has too little ground clearance for a suspension to be installed. (CHAUHAN, 2016) Go-karts are primarily used for racing; therefore, in order to maximise acceleration, the vehicle's weight must be decreased. As a result, the cars have high torque and low acceleration. However, in order to accelerate a vehicle during a race, the driver must always use a lighter vehicle. Go-karts are an excellent option for individuals who want to drive

because of their affordability, simplicity, and safety features.

2.2 Previous Work

Go-karts with a 125cc four-stroke motor that produces 15 horsepower and costs roughly three lakhs were introduced to India by MRF in 2003. Indus Motors also sells go-karts for between one and three lakhs. Considered the go-kart capital of India, Nagpur, has go- karting racing circuits. The race is drawing a sizable field of competitors and is growing in popularity. International go-karts perform even better than Indian go-karts. Two versions are available: a 160cc 4-stroke single-engine kart with a top speed of approximately 40 mph and an outdoor twin- engine 320cc 4-stroke kart with a top speed of 70 mph. The karting courses in the United States, where there are hundreds of them, are far more advanced than those in India. (Quazi, 2018) Running in a race Go-kart racing has grown to be one of the most competitive motorsports in the US during the past 50 years. Many drivers who aspired to work in Formula One or NASCAR found success in kart racing; all of them started in this less expensive but intense form of motorsports competition. Almost anyone can enjoy karting as a recreational activity.

3. METHODOLOGY

3.1 System Design

3.1.1 Design Constraints

Following are the design constraints in the design of go kart

3.1.2 Weight Considerations

In the design of go karts, the weight has always remained an integral element because increased weight is directly linked to a decrease in acceleration of this go karts, mainly used as a racing cars.

3.1.3 Compact Design

The next most daunting challenge is designing a go kart in a very compact and unfriendly manner.

3.1.4 Ergonomics

This factor is very significant in designer is concerned about the drive's comfort. It will be easy and simple for the driver to drive and have a comfortable environment for the driver in designing go-kart while remaining with in the range of allowable weight.

3.1.5 Environmental Considerations

Here the main concern is to avoid the negative impact on the environment, and for this use of high-quality quality fuel and proper combustion in the engine is to be managed while the designing the go-kart.

3.2 Design Methodology

The way a project proceeds and how the idea is ultimately realised as a product is how the design approach is commonly understood. Typically, this is displayed as a flow chart to provide a visual representation of the concept. This flowchart illustrates the ideation and execution phases of the project. In the end, the project is distinguished by its effective designtechnique.

Figure 3.1: Flow chart showing design methodology of go-kart

Idea: We looked at a variety of ways to make the go-kart lighter in order to build a lightweight vehicle

Review of the literature: In this area of the process, we have reviewed past projects that have used various approaches to lower the vehicle's weight; but, in the end, we have chosen a lightweight material.

Design: For this section, we used grade 304 stainless steel, which is a lightweight material. The remainder of the project is designed in accordance with the go-kart's standard designs. This product's substance is the only

thing that differs.

Analysis: We will examine and test prototype one in this section of the project. We're going to end now. In creating a go-kart out of the material we chose. Project Analysis: Lastly, we will analyse the project's costs to see how various expenses were handled during the project's design.

3.3 Working Principle

a) A completely novel kind of mobility is the three-wheel drift trike. The back wheels begin to rotate as soon as we, the operator, start the engine, transferring power to them via a chain.

b) The vehicle has handle bars up front that are used to turn the vehicle, regulate acceleration, and apply and remove brake force. According to Indian norms, the gear change lever is similarly located on the left side of the car, making it easier to transfer gears thanks to the gear rod that connects to the engine.

c) The front fork's footrest contributes to the comfortable and exciting ride quality. Since the frame is a hard, weightless structure, in order for it to support large loads and spur acceleration.

d) Because the frame isn't covered with sheet metal, it won't resist the air at faster speeds, allowing for the creation of a more aerodynamic shape. For the rider, a stiff and weightless plastic seat is provided. Because there is no sheet metal covering the car, the engine cools more quickly.

4. COMPONENTS

A steel bar, sometimes called a tone bar, slide bar, guitar slide, bottleneck, or simply "steel," is a smooth, hard object that is pressed up against the strings to play steel guitar. The name "steel guitar" comes from this practice. The gadget can be worn around the player's finger or it can be a solid bar that is held in the hand. The steel guitarist uses one of these objects pressed against the strings with one hand, while plucking the strings with the other, to gain the ability to play a smooth glissando and a deep vibrato that are not possible when playing a traditional guitar.

4.1. Mild Steel Rectangular Bar

The solid bar is usually employed in what is known as the "hawaiian-style" playing method, which is when the instrument is supported horizontally and played on the player's lap (across the knees). Although it is utilised in a variety of musical genres, American country music is frequently linked to it.

Figure 4.1 Mild Steel Rectangular Bar

In blues and rock music, the tubular type is usually utilised when the guitar is held in the customary position, which is flat against the body. Then, it's referred to as a "slide" and the guitar technique as "slide guitar."

4.2. One Inch Square Tube

Square and rectangular hollow steel sections are also referred to as box sections or tube steel. Sometimes, circular hollow steel pipe (hss) is falsely identified as steel pipe, yet true steel pipe has different dimensions and classifications than hss. Square tubes are typically utilised for structural and maintenance needs. Sign posts, railings and building construction are a few instances of applications. Their wall thickness and external measurements are used to measure them. Depending on its size and wall thickness, square steel tube, a welded structural grade tubing, is available in type A513 or A500grade B.

Figure 4.2 One Inch Square tube

Hss are frequently employed in welded steel frames, particularly in rectangular sections, where members are subjected to numerous directions of loading. Due to their homogeneous strength characteristics and uniform geometry along two or more cross- sectional axes, square and circular hollow steel slabs are particularly effective forms for this multiple-axis loading. They are therefore excellent options for columns. They also withstand twisting rather well.

4.3 Cycle Pedal

The portion of a bicycle that the rider presses with their foot to move the machine forward is called the pedal. It acts as a link between the pedalist's foot or shoe and the crank, enabling the leg to rotate the bottom bracket spindle and move the wheels of the bicycle forward. The typical components of a pedal are a spindle that threads into the crank's end and a body that can revolve freely on bearings in relation to the spindle and the foot rest.

Originally, pedals were fastened directly to the driving wheel, which was often the front wheel, using cranks. The modern safety bicycle was created when the pedals were fastened to a crank that turned a sprocket, transferring power to the powered

Figure 4.3 Cycle Pedal

4.4 Cycle Crank

The part of a bicycle's drivetrain that transforms the rider's legs into rotational motion to drive the chain or belt, which in turn drives the rear wheel, is called the crankset (in the US, chainset in the UK). The parts of it are one or more sprockets, also known as chainrings or chainwheels, that are fastened to the arms, cranks, or crankarms, which are where the pedals are attached. The pedals attach it to the rider, the bottom bracket secures it to the bicycle frame, and the chain connects it to the rear sprocket, cassette, or freewheel.

Figure 4.4 Cycle Crank

4.5 Free Wheel

A freewheel, also known as an overrunning clutch, is a gearbox component that, in mechanical or automotive engineering, disconnects the driveshaft from the driven shaft when the driven shaft spins more quickly than the driveshaft. Occasionally, an overdrive is wrongly referred to as a freewheel, but this is unrelated.

Most bicycles have a situation where the driven shaft spins faster than the driveshaft when the rider stops pedalling. Without a freewheel, the back wheel of a fixed-gear bicycle turns the pedals.

Similar circumstances can occur in a car with a manual gearbox driving downhill or in any scenario when the driver closes the throttle by taking their foot off the gas pedal: the engine is driven by the wheels, sometimes at a higher rpm. In an engine with two strokes, this can be catastrophic—since many two-stroke engines rely on an oil/fuel mixture for lubrication, a fuel deficit will deprive the engine's cylinders

of oil, which might quickly lead to piston seizing and severe damage. For this reason, Saab kept the freewheel technology from its two-stroke models in the early Saab 99 and 96 v4, which improved fuel economy.

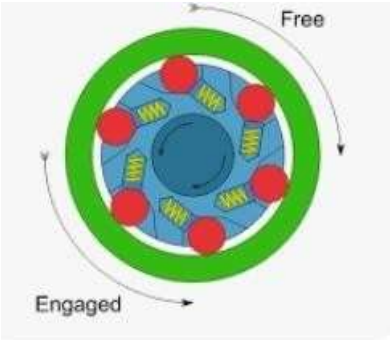

Figure 4.5 Free Wheel

4.6 Cycle Wheel

A bicycle wheel is a wheel made specifically for a bicycle, usually a wire wheel. Especially in the case of ready-made, "off the shelf" performance-oriented wheels, a pair is frequently referred to as a wheelset. Typically, bicycle wheels are made to slide into the frame and fork via dropouts and accommodate bicycle tyres. The original bicycle wheels had a wooden hub, a fixed steel axle with bearings housed in the fork ends, wooden spokes and an iron tyre that was shrink-fitted. These features were inspired by the traditions of carriage building. A metal hub, wire tension spokes and a metal or carbon fibre rim that houses a pneumatic rubber tyre are the common components of a modern wheel.

Figure 4.6 Cycle Wheel

4.6 Chain

A bicycle chain is a roller chain that propels a bicycle by transferring force from the pedals to the drive wheel. The majority of bicycle chains are composed of alloy or plain carbon steel, but some are nickel-plated for aesthetic reasons or to stop rust.

Figure 4.6 Chain

The block chain, skip-link chain, and simpson lever chain were among the outdated chain designs that were formerly seen on bicycles. The initial chains had a straightforward, bushing-less design. Compared to modern chains, these featured a little bit higher friction and mechanical efficiency losses, as well as intrinsic dependability issues. The nevoigt brothers of the German diamant bicycle firm created the roller chain, which employs bushings, in 1898 with these constraints in mind.

4.8 Acrylic Shift

A clear film or sheet composed of acrylic resins. Cast polymerization or extrusion are used to create thermoplastic acrylic sheets, which were first marketed as "organic glass" in 1931. Plexiglas, Perspex, and Lucite are a few examples of well-known brand names. Acrylic sheets have outstanding clarity, resistance to outside weather, and are lightweight, durable, and colourless. Acrylic is stronger and less brittle than glass, but it is also more prone to scratches and UV radiation. Acrylic has a special quality that allows light to flow around corners. Safety glass, aircraft canopies, windows, skylights, instrument dials, tail light lenses, lighting fixtures, optical lenses, storage and display cases, and bulletproof glass are among the many applications for acrylic sheets. Additional varieties of transparent plastic glazing encompass polycarbonate sheets, such as Lexan®. Also see glazing comparsion

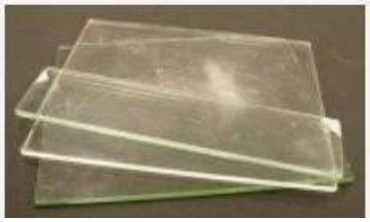

Figure 4.8 Acrylic Sheet

4.9 Cycle Suspension

The system—or systems—used to suspend the rider and bicycle to protect them from the uneven ground is known as bicycle suspension. Though it's also frequently seen on hybrid bikes, bicycle suspension is mainly utilised on mountain bikes.
There are several approaches to bicycle suspension, as well as any combination of them:
• Suspension saddle, suspension seatpost, suspension rear suspension, and suspension stem (now rare).
Due to the continued trend of short stems, which restrict the size of the suspension and the "slacker" head tube angle for stability, suspension stems are becoming unusual. Bicycles with front-only suspension are called hardtails, and those having front- and rear-wheel suspension are called dual or full suspension bikes.

Figure 4.9 Cycle Suspension

Rigid bicycles are those without suspension. It is rare to see a bicycle with only rear suspension, even though the Brompton folding bicycle has one.

4.10 Handle Bar

Bicycle steering is controlled by a handlebar. It is comparable to a tiller for cars and boats since it is typically attached to the fork by a stem that is mechanically connected to a pivoting front wheel. In addition to steering, handlebars frequently carry a portion of the rider's weight depending on how they position themselves. They also offer a practical mounting location for various accessories such bells, cyclocomputers, brake and shift levers, and shifters.
Bar ends are extensions that are usually attached to the ends of handlebars that are straight in cycling. They allow the rider to change their grip and posture while riding by extending away from the handlebars. When getting down of the saddle, they are really useful because they increase leverage.

Figure 4.10 Handle Bar

Bar ends can also make riding more comfortable for the rider by offering multiple locations to rest hands during a lengthy ride and by keeping the hands in a neutral position (palms inward), which slightly lessens the strain on the muscles.

4.11 6202 Ball Bearing

High rotational speeds are made possible by the exceptional versatility, low friction, and low noise and vibration reduction of single row deep groove ball bearings. Compared to many other bearing types, they are easy to mount, can support radial and axial loads in both directions, and require less maintenance.
• Robust, adaptable, and basic design;
• Minimal friction
• Capable of operating at high speeds; • Able to support axial and radial stresses in both directions; • Low maintenance requirements
Ball bearings come in a variety of standard designs, each with a different performance trade-off. Numerous materials, such as ceramic (silicon nitride, si3n4), stainless steel, and chrome steel, can be used to make them. A ball bearing with metal races and ceramic balls is called a hybrid ball bearing.

Figure 4.11 6202 Ball Bearing

4.12 Bearing Bush

When earthed material is present, a bushing needs to be built to withstand the electrical field strength generated in the insulation. Leakage channels within the insulation may form when the electrical field's strength rises. If the energy of the leakage path outweighs the dielectric strength of the insulation, it may penetrate the insulation and allow the electrical energy to transfer to the nearest earthed substance producing burning and arcing.
A standard bushing design has an insulated conductor, with the exception of the terminal ends, that is typically made of copper or aluminium, though it can also occasionally be made of another conductive material.

Figure 4.12 Bearing Bush

The installation location and the electrical service function of the bushing will dictate the type of insulation to be used. Insulated bushings can be installed either indoors or outdoors. A bushing's ability to function properly over an extended period of time depends heavily on the insulation's ability to maintain its effectiveness in terms of both composition and design.

5. ADAVANTAGES AND APPLICATIONS

5.1 Advantages

The technology can be triggered in an emergency, allowing the driver to take the car to a safe location if it breaks down in the middle of the race.
• The kart requires no human effort and may be driven in reverse.

5.2 Applications

The go-kart's applications are as follows:
1. Racing makes advantage of it.
2. Traditional kart racing also commonly uses outside karts, but these are more durable since they primarily have four-stroke motors.
3. Usually smaller than outside karts, indoor karts are utilised in factories and warehouses.

6. PROJECT ANALYSIS

Lifelong education Working on our project gave us the opportunity to learn a wide range of topics, including software, hardware, time management, and project management. Working as a team taught us how to prioritise jobs, manage our time well, and have effective team dynamics. This section will detail the multitude of talents we have acquired since working on this project.

6.2. Software Skills

Through this assignment, we were able to get practical experience using programmes like Solidworks, Microsoft Word, and Microsoft PowerPoint. We used Solidworks software to create the kart, which helped us hone our talents with this designing programme. Additionally, while writing the report and creating the presentation, we learnt how to use Word and PowerPoint.

6.3 Hardware Skills

We gained knowledge about assembling the planned elements to construct the kart during our project. Additionally, we have practical experience using the welding expertise. Moreover, before beginning the project's manufacture phase, I understood the

importance of completing accurate calculations. A tiny discrepancy in the calculations can have a significant impact onthe project's fabrication.

6.4 Management Skills

We gained knowledge of time management during project work, including how to effectively meet deadlines while carrying out the project. In addition, I gained a lot of knowledge and abilities from finishing the project, including how to assign tasks, work well with others, and guide the group towardssuccess.

7. CONCLUSION

In summary, the goal of this project was to construct a go-kart using an optimised conceptual design that would increase the vehicle's stability. The goal of the go-design karts and construction is to provide a straightforward, lightweight, and simple-to- use vehicle. Considerations for dependability, safety, and ergonomics were addressed in the design specifications. To increase vehicle performance, increase strength and rigidity, and lower manufacturing costs and complexity, all major components were examined. The go- kart's design followed standard go-kart calculations, but we chose to use lighter 304 grade stainless steel instead of heavier materials in order to lighten the vehicle. Furthermore, the 110 cc engine utilised in this concept is lightweight enough to be included in the construction of a vehicle.

8. FUTURE RECOMMENDATIONS

Many suggestions can make the project better. The ideas listed below can be applied to help this project proceed:

1. Since fibres are the lightest and can withstand relatively high stresses, manufacturers ought to switch to using themto make go-karts.
2. The second concept involves refining the go-kart's design to eliminate unnecessary components and further reduce its weight.
3. The third suggestion is to decrease its ground clearance and lower its bottom in order to increase its grip.
4.

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