FABRICTION OF MOTORIZED DERBY (ATV) KART

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ABSTRACT—A Go Cart also spelled as Go Kart is a four wheeled vehicle designed and meant for racing only (though in some countries it is used for fun personal transportation). It is a small four wheeler run by I.C Engine. It is a miniature of a racing car. Go Cart is not a factory made product; it can be made by Automobile engineers. This report documents the process and methodology to produce a low cost go-kart. Simple but innovative, we have made a simple, self fabricated.

This paper concentrates on explaining the design and engineering aspects of making a Go Kart .This report explains objectives, assumptions and calculations made in designing a Go Kart and to develop a go-kart into an ATV (All terrain vehicle) by modifying the chassis with inclusion of suspension system. The design is chosen such that the Kart is easy to fabricate in every possible aspect.

KEYWORDS—Miniature, Low-cost, Go-kart, ATV, Modification, Suspension

INTRODUCTION:-

Go-kart technology has been widely developed since the introduction of wheels. But, it was not fully implemented in racing activity until the past three hundred years in America. The first go-kart was simply a cart consisting of wheels and handles jointed together as children pushed from behind when learning to walk or a four-wheeler platform where children can sit on it while another push the kart around.

Go-kart was invented in California by Art Ingels and Lou Borelli using 100cc mower engines and strong steel frames. Then, newly designed karts were beginning to gain popularity in Britain around the year 1959-1960. Go-kart has long existed in our world whether used in sport or recreation. By definition of International Karting Commission - Federation International Automobile (CIK-FIA), a kart is defined as a land vehicle with or without a body work, with 4 non-aligned wheels in contact with the ground, two of which control the steering while the other two transmit the power. Its main parts are the chassis (which consists of a body frame work that is made up of a set of bent steel pipes that are welded together) with an engine, four wheels and tyres attached on it.

Go-kart racing is a cheaper and smaller way of automobile racing not forgetting, a lot safer compared to other motor racing sports such as 2 Formula One. Today, go-kart racing is not only practiced by adult hut the younger generation,

Allowing an early start on this sport, as young as the age of 5 or 6 years old would be beneficial as it is the most suitable period for them to gain experience to be a professional driver in the future.

Practicing on go-karting can properly expose the driver to the actual racing environment, training them to be professional motor racer in various competitions such as Formula One, NASCAR, Indy racing, and others.

Nowadays, go-karting is as popular as it has ever been with continued growth every year, and the manufacturers who have stayed with go-kart industries are capable to stabilize and obtain a promising market.

However, the technology in go-karting seems to be stabilizing at a stage even though minor improvement was done on the performance. One of the challenges in improving go-karting would be building more standardized track for the growing number of go-kart's driver. With continuous improvement in go-kart industry whether on go-kart designs, equipments, services such as available tracks, or driving techniques, this sport would surely obtain a very high ranking of popularity in the near future.

LITERATURE REVIEW

According to Graham Smith (2002), Art Ingels who was a veteran hot rod and race car builder at Kurtis Kraft in California, America invented the first ever go-kart in 1956. Initially, karting is a leisure motorsport enjoyed by airmen during the post-war period. The sport is quickly caught on with Go Kart Manufacturing Co. Inc. Being the first company to manufacture and distribute go-karts after two years. In 1959, McCullough also jump in the bandwagon of the industry, by becoming the first company to manufacture go-kart engines.

Although go-kart originated from United States, it has also gain interests from countries all over the worlds especially Europe. For example, according to Tony Kart's company profile in its website from Italy, they have been producing go- kart since 1958 and emerged as one of the main manufacturer to date.

Today, kart racing is governed by CIK-FIA which was founded in 1962 is the current primary international sanctioning body for kart racing. It is also a part of FIA since 2000 which is a governing body for motorsport across the globe. CIK-FIA plays an important role in regulating kart racing related matters such as technical regulations.

OBJECTIVES OF WORK

1. To get knowledge of Go-Kart Chassis Design for beginner in stepwise manner so to avoid unnecessary thing and focuses on competition.
2. Focusing area of analyzing Software to get desirable result.
3. To make use of welding alternative of hydraulic press.
4. Use of welding Principle effectively without increasing weight of chassis and make it simple.
5. Using variety of material to make better chassis for various applications and mostly for racing purpose.
6. Practice Engineering knowledge with budgeting for making Cost effective chassis.

ESSENTIAL ELEMENTS OF ATV KART:-

1. Chassis
2. Body frame
3. Engine
4. Steering mechanism
5. Transmission
6. Ignition system
7. Braking system
8. Suspension
9. Lubrication

10. Tyres

EXPERIMENTAL WORK:-

FABRICATION PART OF WORK HAS BEEN DIVIDED INTO FOLLOWING GROUPS:-

- **Design**

  Designing and modeling of chassis are performed by the use of 3D CAD design software tool "CREO PARAMETRIC" and simulated it by use of "ANSYS WORKBENCH".

Assumptions used in designing of go-kart:

1. Length and width of chassis must be around 70inch and 50inch respectively.
2. Weight of vehicle around 200kg.
3. Engine capacity of 150c.c and BHP of 6.
4. No differential is required.
5. Ground clearance of minimum 4inch.
6. Gear ratio approx. 1: 2.5 to get initial torque.
7. Steering ratio 1:1.

- **Engine installation**

  As an important modification of go-kart into an ATV kart with addition of suspension system. To energize the kart a four stroke twin spark engine was used.

  Engine specifications:-

Type of engine used	Four stroke, s.i engine
Engine capacity	150c.c
Ignition system	Battery ignition, Twin spark plugs
A/F mix. supply	Carburetor
Transmission	Five speed
Max. Velocity of ATV kart	50-60 KMPH
MAX. power	13.80 BHP, (6000 RPM)

- **Transmission system**

  The transmission system is used to transmit power from engine crank shaft to rear wheels. The crank shaft pinion gear is connected to gear wheel of rear axle by using chain drive and centrifugal clutch has been used to avoid direct acceleration after igniting the engine.

- **Steering mechanism**

  Steering is the collection of components, linkages etc. which allows any vehicle (car, motorcycle, bicycle) to follow the desired course. The primary purpose of the steering system is to allow the driver to guide the vehicle.

  Go-karts often use a very direct linkage in the form of a bell-crank (also commonly known as a Pitman arm) attached directly between the steering column and the steering arms, and the use of cable-operated steering linkages.

- **Suspension**

  A suspension is a mechanical or hydraulic device system designed to absorb and damp shock impulses. As a ATV kart implies an all terrain vehicle and moves under different conditions of roads it is as certain that its needed to be installed with proper suspension system.

  So, ATV kart had been installed with rigid axle suspension at rear axle and independent at front.

- **Braking system**

  To retard the kart to its static position a single disc brake is fitted at rear axle rod. It is capable of bringing the kart running at a velocity of 50-60 KMPH to its rest.

- **Tyres**

Unlike vehicles tyres use on normal road to cater for different road conditions, go- kart has specific tyres for dry or wet track so that drivers can have maximum performances and grips from the tyres. Slick and wet tyres are two main types tyres used in karting.Wet tyres has been used for ATV kart, as it needs to move in off road conditions.

CHASSIS MATERIAL DIMENSIONAL SPECIFICATIONS:

Material galvanized iron Square pipe- AISI 1018

Square pipe- 2 inches

Thickness of square pipe- 2mm

Design specifications for chassis:-

- Overall length – 75 inches
- Overall height - 40 inches
- Wheel base – 70 inches
- Wheel track - 43inches
- Ground clearance - 8 inches

Considerations for steering selection:-

- Caster angle – 18 degrees
- Camber angle – 0 degrees
- King pin inclination – 12 degrees
- Combined angle – 10 degrees
- Toe in – 5 mm
- Scrub radius – 9 mm
- Minimum turning radius – 1.26 m
- Maximum turning radius – 2.58 m

STEERING MECHANISM COMPONENTS AND DIMENSIONS:

- Tie rod - 14 inch x 0.5 inch
- King pin – 3 inch x 0.5 inch x 11 mm
- Pit-man arm bolt -10 mm
- Bracket 3.5 inch x 2.5 inch x 0.5 inch x10 mm
- Steering shaft 20 inch x 1 inch
- Steering wheel 10 inch

CALCULATIONS FOR STEERING MECHANISM:

- Inner lock angle (θ) = (total steering wheel rotation * 360) /steering ratio = 50 degrees
- Outer lock angle(ϕ)= cot ϕ – cot θ= w / l- cosθ= 32degrees
- Ackerman angle calculation: Tan α = (sin ϕ – sin θ) / (cos ϕ +cos θ – 2) = 40 degrees
- Ackerman inside angle: Ψ = tan-1 (WB / (WB / tan ϕ – TW)) – ϕ= 14 degrees Ackerman percentage: 2%Ackerman = ((inside angle – outside angle) / (Inside 100% Ackerman)) * 100% = 99.97%
- Turning Radius(R max) Calculation:

  R min = length of wheel base / tan θ = 1.26m

  R max 2= [R min + Wheel track width] 2 +Length of wheel base 2] = 2.58 m

Calculations for braking system:

1. Gross weight of the vehicle
W = weight of the vehicle (with load conditions) in kgs * 9.81= 120*9.81=1177.01 N

2. brakes / area of master cylinders (as pedal ratio is 4:1)
(Assume the normal force applied on the pedal: 300n) =pedal ratio *force on the pedal / area of master cylinder

= 4*300/(π/4)*(0.01)2= 15.28mpa

3. Clamping force (CF): Cf= brake line pressure *(area of caliper piston*2) = 15.28*((π / 4) * (25.4 * 10-3) 2 * 2)
= 16384.625N

4. Rotating force:
RF = CF* number of caliper pistons * coefficient friction of brake pads

=16384.625N *0.3*2=9830.35N

5. Braking torque (tn) = rotating force* effective disc radius =9830.35*0.09
=884.346N-m(torque available at the two tires of the rear shaft)

6. Braking force=(braking torque /tire radius)*0.8 =5614.877N.

7. Deceleration: f=-ma(-ve sign indicates force in opposite direction) a=-B.f/m=5614.87/120 =-46.57m/s

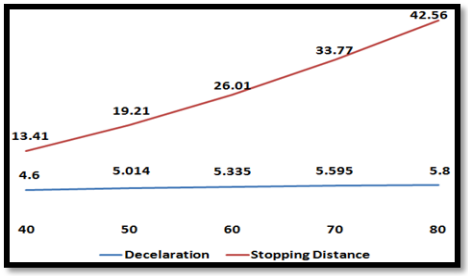
8. Stopping distance: $v^2 – u^2 = 2*a*ds$ (v=0,u=12.5m/s) Stopping Distance =2.237meters

RESULTS ANALYSIS

Brake is an important part of any vehicle as brakes are used to stop the vehicle. To bring the vehicle in motion to the rest position brakes are used as per international standards for go-kart only hydraulic disc brake is to be apply. Go-kart having single rear axle which is used to transmit the power from engine to the wheel disc brake is directly mounted on the axle so that when the brakes are applied brakes will be applied immediately and vehicle will come to rest position in less time and in less distance. In the Present work the summary of Results obtained.

Velocity (km/hr)	40	50	60	70	80
Stopping distance (m)	13.41	19.21	26.01	33.77	42.56
Deceleration (m/s^2)	4.60	5.014	5.335	5.595	5.800
Stopping time (Seconds)	2.41	2.76	3.12	3.47	3.83

Output parameters of braking system



Deceleration and Stopping distance vs. Speed of vehicle

As shown in above graph of deceleration, stopping distance vs. speed of vehicle as the speed of vehicle increases deceleration increases considerably also stopping distance is increasing respectively. This indicates that stopping distance and decelerations are in directly proportion of the speed of vehicle.

LIMITATIONS:

Variety of fuels that can be used is limited to very fine quality gaseous and liquid fuel

Fuel used is very costly like gasoline or diesel

Engine emissions are generally high compared to external combustion engine

Engine is not suitable to run the vehicle with high speed

In case of reciprocating internal combustion noise is generated due to detonation of fuel

CONCLUSION:

With self-design and assembling the prior aim is to build a perfect go-kart by using less cost and without compromising the safety and performance of vehicle. In chassis the stress will generate in designing which plays an important role. Creo-parametric and ANSYS is used to evaluate, create and modify the best vehicle design to

achieve its set goals. The main goal is to simplify the design to make a light weight and safety purpose vehicle then it will improve in the speed of go-kart.

FUTURE SCOPE:

In future go-kart will develop by many ways such as 4-stroke engine. Alternative fuels like bio fuels which are cheaply cost will be used in place of petrol. Solar energy can be produce by solar panels will be apply in go-kart, then it will be convert into E-Kart. By the help of solar energy, the planet can be preventing from pollution. Development in aerodynamic shape will increase the go-kart speed.

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