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Design and Modification in Go-Kart

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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. In this paper a go-kart has been designed, simulated, fabricated and tested for probable feasibility for undergraduate students to explore different aspect of vehicle and develop their own go-kart. This paper concentrates on explaining the design and engineering aspects of making a Go Kart for student karting championship 2020.

Keywords: Chassis, steering system, Braking system, Innovation, Engine, Transmission.

I. INTRODUCTION

The first kart manufacturer was an American company, Go Kart Manufacturing Co. (1958). In 1959, McCulloch was the first company to produce engines for karts. Its first engine, the McCulloch MC-10, was an adapted chainsaw 2-stroke engine. Later, in the 1960s, motorcycle engines were also adapted for kart use, before dedicated manufacturers, especially in Italy (IAME), started to build engines for the sport.

There are many motor sports in the world. Bike, cars, formula one is examples of them. The drivers in these are very professionals and accurate. They can drive it very fast. But there are also motor sports which do not need professional drivers and need no great speed. The vehicle used are very cheap. Such a motor sport is Go-Karting. They resemble to the formula one cars but it is not faster as f1and also cost is very less. The drivers in go karting is also not professionals. Even children can also drive it. Go-Karts have four wheels and a small engine. They are widely used in racing in US and also, they are getting popular in India.

Fig. Go-Kart

II. LITERATURE REVIEW

Ref. prof. S.R. Satish Kumar and prof. A.R. Santha Kumar: - Trusses are triangular frame works, consisting of essentially axially loaded members which are more efficient in resisting external loads since the cross section is nearly uniformly stressed. They are extensively used, especially to span large gaps.

Trusses are used in roofs of single storey industrial buildings, long span floors and roofs of multi-story buildings, to resist gravity loads. Trusses are also used in walls and horizontal planes of industrial buildings to resist lateral loads and give lateral stability.

III. DESIGN ELEMENTS OF KART

A. Chassis

A chassis is one of the most important components of a vehicle, without which the car would have no structure. It is the canvas in which the final construction of the vehicle is placed upon.

B. Engine

The engine used is a pulsar 150 CC single cylinder SOHC 4 stroke petrol engine, which produces maximum power of 14 PS at 8000 RPM and maximum torque of 13.1 N-m at 7000 RPM. The reason behind opting this engine is because it is a good mix of performance and efficiency.

Engine Capacity	149.8
Engine Type	4 strokes
Type of Cooling	Air cooled
No. of spark plug	2

C. Transmission

The mechanism that transmits the power from the engine crankshaft to the rear wheels. In this vehicle, the power from the engine is transmitted to the sprockets using chain, i.e., this is chain drive. The driver sprocket has 12 teeth and driven sprocket has 30 teeth.
We used Gear box with chain drive type of transmission system, the gear box gives the quick high pickup than any other and, in the racing, kart the requirement of pickup is very high. Chain drive have less power loss than any other type of transmission that's why we used chair box with chain drive transmission system.

D. Steering Mechanism

The mechanical linkage mechanism is used, the linkage mechanism gives high amount of efficiency than other type of steering mechanism in racing. Because of sharp turning and anti-skid, the mechanical linkages are most efficient.

Camber Angle	+7°
Kingpin Angle	7°
Toe in	3°

E. Shaft

It is a rotating element, which is used to transmit power from one place to another place. It supports the rotating elements like gears and flywheels. It must have high torsional rigidity and lateral rigidity.

F. Braking System

We have used a hydraulic disc brake. The reason why we opted hydraulic disc brake over traditional drum braking system is because it is easy to obtain high output force by less applied force. Also, hydraulic brakes have a simpler construction where brake oil is used for transmission of force unlike drum brakes which have a greater number of mechanical linkages, springs. This means more wear and increased maintenance.
For Innovation, a double disc braking system on a single shaft has been installed. This increases the braking capacity of the kart. Also, the discs are installed on opposite side of the shaft and at equal distance from each end hence decreasing the chances of skidding and increases the braking capacity.

Brake Specification	
Rotor	Suzuki Access 125
Master Cylinder	Apache RTR 160
Brake Fluid	DOT 4
Calliper	Pulsar 150

G. Body Works

High strength light weight body work made out of fiber glass. The reason why we used fiberglass over other metals for bodyworks is because fiberglass has excellent strength is to weight ratio. This means high strength with low weight, making the kart lighter and imparting it with high impact resistance.

H. Tyres

Racing slick also known as slick tyres is a type of tyre that has a smooth tread used mostly in auto racing by eliminating any grooves cut into the tread, such tyres provide the largest possible contact to the road, and maximize traction for any given tyre dimension.

Tyre Dimensions	
Front Tyres	4.5 x 10.0
Rear Tyres	7.1 x 11.0

I. Bumper

On any vehicle there are installation for the driver’s safety purpose. There are certain accessories in two wheelers which protect the vehicle after collision such as leg guards and safety foot rest. In four wheelers there are bumpers at front and rear end which protects the vehicle and results in safety purpose. Shock absorber bumper has been installed to lower the impact on chassis. A couple of helical springs has been installed at front bumper so that during collision, the shock could be first absorbed by the springs and less damage will occur on chassis and driver.

IV. DESIGN OF KART

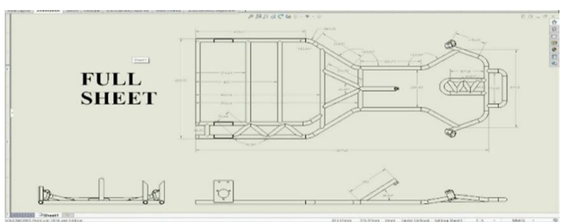
A. Design of Chassis

Chassis Material Specification

Ultimate tensile strength	470 MPa
Yield Tensile Strength	270 MPa
Poisson’s ratio	0.3

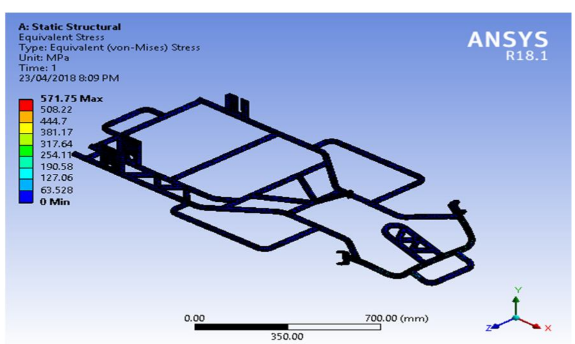
Round tube of dimension = 25.4 mm

Thickness = 2 mm



B. Impact Analysis

1) Front Impact Analysis



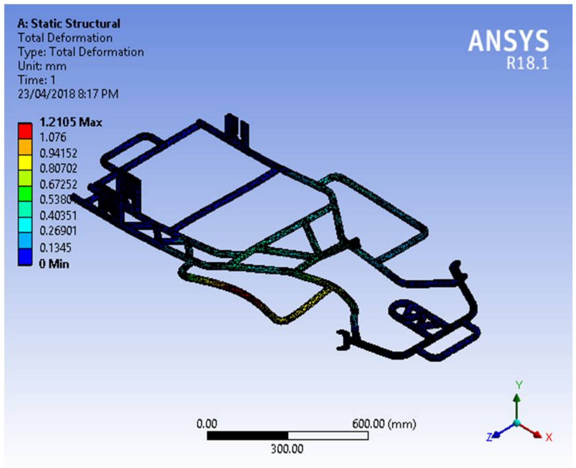
Maximum deformation = 2.5 mm

Maximum strain = 0.0029054 MPa

Maximum stress = 571.75 MPa

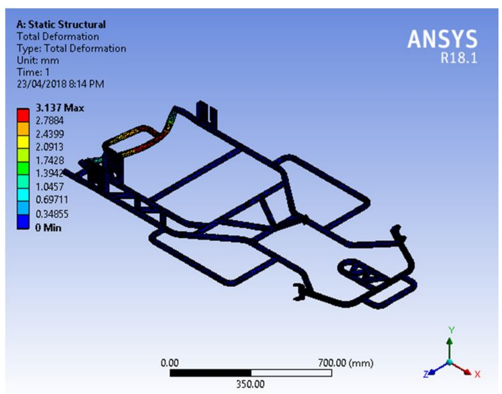
FOS = 1-15

2) Side Impact Analysis



Maximum deformation = 1.2105 mm
Maximum strain = 0.0010311 MPa
Maximum stress = 185.54 MPa
FOS = 1.35-15

3) Rear Impact Analysis



Maximum deformation = 3.317 mm
Maximum strain = 0.0056296 MPa
Maximum stress = 1125.9 MPa
FOS = 1-15

V. BRAKING SYSTEM CALCULATIONS

A. First Case Assuming Slip Occurs

N = (m × g × c)
n = Normal force on each tyre caused by the weight of Go-kart driver (lbf)
m = Total mass
g = constant gravitational acceleration
(32.17405 ft / s^2)
c = weight distribution
front = 0%
rear = 100%
N = 447.53 × 32.174 × 0.1 = 14398.8 lbf

B. Frictional Forces

$F_{(rear)} = \mu \times N_{(rear)}$
F = Frictional force (lbf)
N = Front normal force (lbf)
µ = co-efficient of friction
(assume 0.1 to 0.9) = 0.7
$F_{(rear)} = 0.7 \times 14398.8 = 10079.8$ lbf
Then,
F = m × a
$a = \frac{F(rear)}{m}$
F = Total frictional force (lbf)
m = Total mass (lbm)
a = acceleration (ft / s^2)
$a = \frac{-10079.16}{\frac{447.53}{32.2}} = -725.20\ ft / s^2$
negative sign indicates deacceleration
Now we can calculate the time to stop the vehicle
$t = \frac{u}{a}$
t = time
u = initial velocity (ft / s)
a = acceleration (ft / s^2)
$t = \frac{41}{-725.20} = 0.565$ sec
distance
$d = \frac{v^2}{2a} = \frac{41^2}{2 \times 725.20} = 1.158\ ft$

C. Second Case assuming no slip Occurs

The fluid pressure that was caused by master cylinder can be calculated as follows
$P = \frac{(PF \times R \times \eta)}{A}$

where,
P = Fluid pressure (Psi)
PF = Pedal force (lbf)
R = Pedal lever ratio
η = Pedal efficiency
A = Cross area of master cylinder
Fluid Pressure = $\frac{100 \times 6 \times 0.8}{0.4417}$ = 1086.71 psi
(pound force per square inch)
The normal force acting on front and rear callipers can be found by
N = P × A

Where,
P = Fluid pressure
N = Normal force (lbf)
A = Calliper area $(inch^2)$
$N_{(rear)} = 1086.71 \times 4.81 = 5227.07$ lbf
Once we found the normal force the
Frictional force can be calculated :

$f_{(rear)} = \mu N_{(rear)}$
Co-efficient of friction for our brake pads = 0.4
$force_{(rear)} = 0.4 \times 5227.07 = 2090.82$ (lbf)
Breaking torque = $f_{(Rear)} \times D$
D is the distance from each calliper
To the centre from each moving axle.
$t = 2090.82 \times 0.344$
$t = 719.24$ lbf .ft
Assuming the torque is constant over the entire length of all the axle we can find the force that we are acting on each liver.
$F_{(rear)} = \frac{Torque}{Radius}$
Radius of rear tires
$F_{(rear)} = \frac{719.24}{0.45} = 1598.31$ lbf
Acceleration = $\frac{F(rear)}{mass} = \frac{1598.31}{\frac{447.538}{32.17}} = 114.9\ ft\ /\ s^2$
$t = \frac{u}{a} = \frac{41}{114.9}$
t = 0.356 sec (stopping time)
and
distance = $\frac{V^2}{2 \times a} = \frac{41^2}{2 \times 114.9} = 7.315$ ft

VI. SUMMARY

A. Concept of trusses has been studied while designing and fabricating chassis.
B. SAE 1030 material has been used for building chassis because of its hardness and ductility.
C. Chain drive transmission system has been used due its efficiency and availability.
D. Ackermann steering geometry has been studied for fabricating steering system.
E. A round bar of EN8 material has been used as a shaft material due the higher tensile strength since the transmission as well as braking system will be installed on it.
F. Double discs braking system has been installed for increase braking force and to decrease skidding effect.
G. Fiber body has been used since it is light weight cheaper as compare to other materials which are used for making body work.

VII. OBJECTIVES

A. By using double discs braking system, a better braking force will be achieved which will increase the safety of kart and decrease skidding effect.
B. Shock absorber bumper will decrease the impact on kart hence increasing safety of driver and increasing life of go-kart.
C. Due to the extra weight, go-kart becomes stable and hence a lighter driver will also remain safe.

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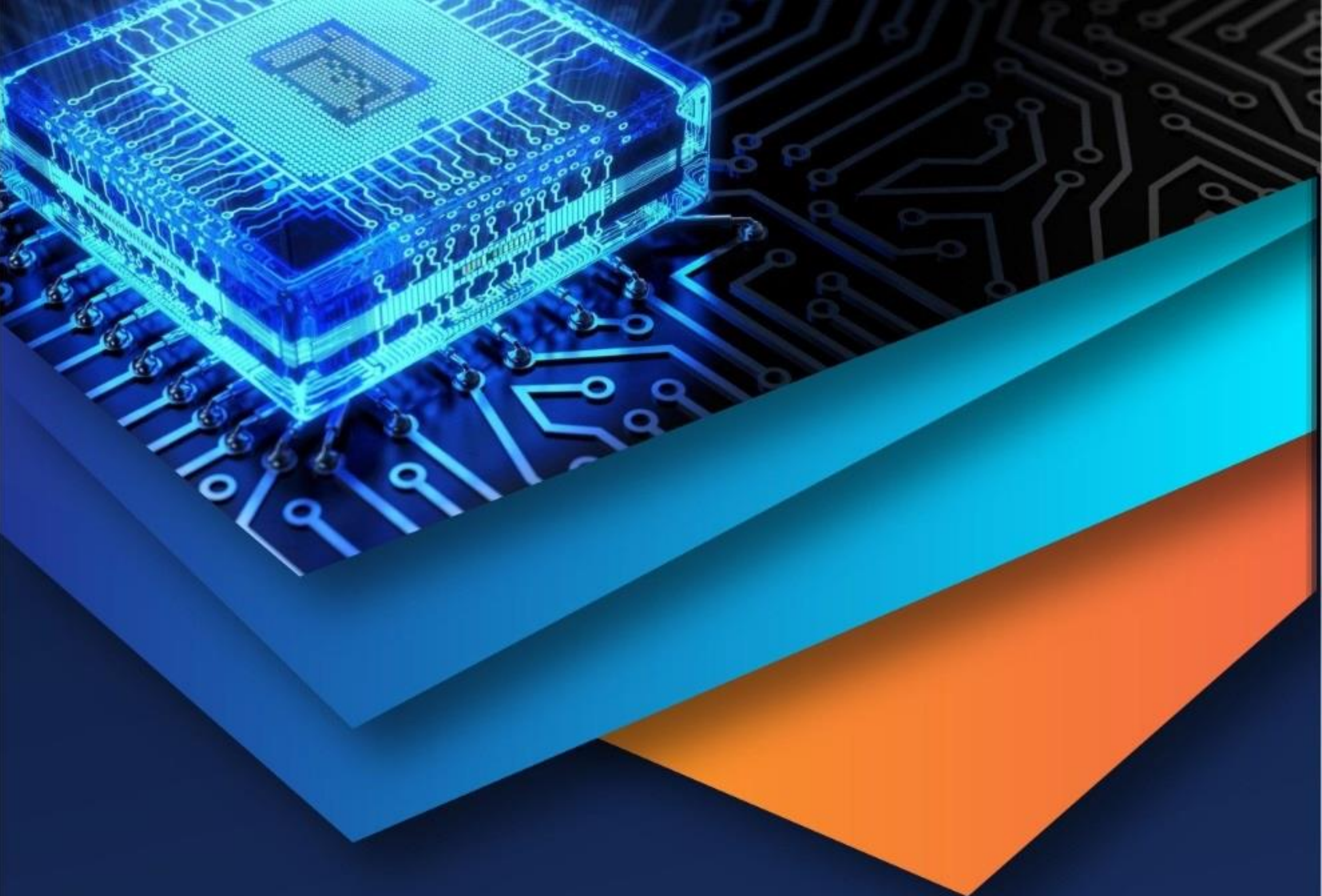

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