Design and Fabrication of 125CC High Speed Go-Kart

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Abstract— A Go-Kart is a small, four-wheeled, light vehicle and easy to operate which is meant for racing Purpose but such vehicle does not require professional drivers or enormous speed to drive it. These vehicles are Cheaper in rate compare to F1 or other racing cars. Therefore, Go-Kart is called as a miniature of F1 racing car. This paper highlights the key elements such as Material selection along with its properties, Methodology, Design, and Analysis. The entire design and analysis are performed on 3D-Modelling software's CATIA V5R19 and ANSYS.

Keywords: Professional, Enormous, 3D-Modeling, Miniature.

I. INTRODUCTION

Go-Kart is a racing car which is originated from United States in 1950's. American Art Ingles is considered as a father of karting as he created the first Kart in south California in 1956. Go karting has grasped the large popularity throughout the world and presently has a large popularity in Europe. In 1959, McCullough also jump in the bandwagon of the industry, by becoming the first company to manufacture Go-kart engines. It emerged in India through MRF in year 2003 which was the newest invention in racing Indian market at that time it was little expensive too but after passing few years and development in Go kart it becomes cheaper. A Go kart is a simple, light weight vehicle which is easy to operate and does not require any skilled person to drive it. Even go kart can be drive by small kid more than 10 or 12 years. It contains parts such as Engine, Steering system, Braking system, Axle, tyres and bumpers etc. Such karts are designed to be raced on the flat tracks as a result there is very less ground clearance and hence there is absence of differential as well as suspension system. The engines used in this type of vehicles are generally two stroke or four strokes. With the advancement in the technologies now a days Go karts are also evolved and their IC engines are replaced by Electric Motors which are chargeable and termed as E-Kart or Eco-Kart. It has a great exposure to the persons who are interested in racing because of its cheaper cost, simplicity, thrill experience and safety of driving. As a spare time, movement, it tends to be performed by nearly anyone and allowing authorized dashing for anybody from age of 8 onwards. Karting can be the safe way to introduce drivers in motor racings which help them to developing their skills, gaining precise control over vehicle and developing mind set to think in decision making situation.

The motive of this work is to design safe and workable vehicles which ensure complete safety to driver as well as enhanced strength such as self-confidence, team work spirit, coordination which is a need of any working industry. For designing the 3D-Modelling software's such as CATIA V5R19 and ANSYS are used.

II. METHODOLOGY

Following figure shows the overall methodology adopted during work:

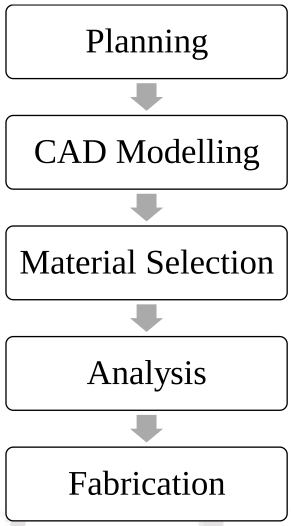

Fig. 1: Overall Methodology

III. MATERIAL SELECTION AND PROPERTIES

Material selection plays a vital role in the complete manufacturing of any model because it contains various constraints such as of weight, various types of forces, torsional rigidity, a factor of safety, density etc. The amount of carbon in steel is important to determine the strength, hardness, and other machining characteristics. The detailed material selection and material properties of key elements of Go kart are as follows:

A. Chassis

We compared different material such as SAE 1018, AISI 1212 and AISI 4130. We found that AISI 4130 was best material which was lighter in weight and comparatively has more strength than other two materials.

AISI 4130 Steel normalized at 870°C (1600°F) pass factor of safety. The following table shows the properties of chassis frame:

Component	Wt. %
C	0.28-0.33
Cr	0.8-1.1
Fe	97.3-98.22
Mn	0.4-0.6
Mo	0.15-0.25
P	Max 0.035
S	Max 0.04
Si	0.15-0.35

Table 1: Chemical Properties of AISI 4130

The mechanical properties of AISI 4130 Steel normalized at 870°C (1600°F):

Tensile strength, Ultimate	670 MPa
Tensile Strength, Yield	435 MPa
Modulus of Elasticity	205 GPa
Density	7.845 g/cc
Bulk Modulus	140 GPa
Machinability	70%
Shear Modulus	80 GPa
Poisson Ratio	0.29

Table 2: Mechanical Properties of AISI 4130

B. Engine

The engine deployed in our Go-Kart is HONDA CB Shine 124 cc. The specifications of our Go-Kart engine are given below:

Specification	Value
Engine Type	Air Cooled, 4 Stroke, SI Engine
Engine Displacement (CC)	124.73 cc
Power (PS@rpm)	10.30 PS @ 7500 rpm
Torque (Nm@rpm)	10.30 Nm @ 5500 rpm
Bore	52.4 mm
Stroke	57.8 mm
Drive Type	Chain Drive
No Of Cylinders	1
Valves (per cylinder)	2
Fuel System	Carburettor
Fuel Type	Petrol
Ignition	Digital CDI (Multi Mapping)
No. of gears	4

Table. 3: Engine Specifications

C. Transmission System

In our Go-Kart transmission system, we have modified the belt drive to chain drive system for transmission. The adaptability of a CVT permits the information shaft to keep up a consistent precise speed. Belt-driven design offers roughly 88% efficiency this is lower than a manual transmission.

Fig. 2: Chain drive

Rear Axle (EN8 Carbon Steel) Diameter	30 mm (SOLID)
Young’s Modulus	210 GPa
Poisson’s Ratio	0.29
Specific Heat	450 J/Kg-K
Density	7.8gm/Cu. cm
Torque	19Nm
CVT To Chain Drive	For Transmission
Sprocket Teethes	41

Table. 4: Transmission System Specifications

D. Steering System

The steering system is controlling framework for the vehicle must be intended to give most extreme control of the vehicle. Straightforwardness and wellbeing were the principle plan details for the vehicle’s guiding framework. The principle objective for guiding framework is to have controlling steering radius of less than or equals to 4m. Alongside controlling the vehicle, the directing framework needs to give great ergonomics and be easy to work. Ackerman steering mechanism has been chosen for such guiding framework since it doesn’t slip during the turning of tyres and it lessens the controlling endeavours. The positive 3-degree caster is given for self-centring of the kart. Mechanical controlling linkage framework has been utilized to make steering easy to fabricate, decline the directing exertion and the amount of directing wheel travel and increment the guiding responsiveness.

Diameter of Spindle	20mm
Diameter of Steering Wheel	280mm
Inner Angle	30 Degree
Outer Angle	25.52 Degree
Turning Radius	3.5m
King Pin Inclination	7 Degree
Tie Rod	14 inch
Toe In –Toe Out	0 Degree

Table. 5: Steering Parameters

E. Braking System

The goal of Braking System is to give dependable and brief deceleration of vehicle. So as to accomplish most extreme execution from the stopping mechanism, the brakes have been intended to bolt up rear wheels, while limiting the expenses and weight. In addition, the driver must have full authority of the vehicle while brakes are activated. According to rule book of Event the vehicle travelling at 40 kmph should stop when you apply the brake. A hydraulic disc brake has been selected as most appropriate way to achieve such requirements. The disc of diameter 170 mm, which is operated by 2 piston caliper hydraulic braking system, has been selected according to vehicle design demands. The disc is mounted on the rear axle. Master cylinder is put front side of the vehicle next to the steering column for easy and better maintenance.

The following table shows the parameters regarding the braking system of Go-kart:

Inner Radius of Disc	130 mm
Outer Radius of Disc	200 mm
Thickness of Disc Plate (Double Plated)	10 mm
Pedal Ratio	4:1
Coefficient of Friction (Between Pads & Disc)	0.4

Brake Pressure (Brake Force / Area of Brake)	6.1 MPA
Braking Torque	3137.63 N-mm
Breaking Force	3260.84 N

Table. 5: Braking Parameters

IV. DESIGN

Designing is a boon of any manufacturing or fabrication and with the advancement in technologies and newly developed software's it has become very easy to design a model and simulate it with applying too much of cost and hence a product can be made available to any consumer in cheaper rate. The essential target is to design a protected and operative vehicle based on a unbending and torsion less frame with an all-around mounted power train and to understand the smaller and smaller aspects of vehicle design structure with the ulterior thought process of creating prototype vehicle that could be produced for purchaser deal, while carefully and strictly adhering to the event rule. The design procedure of the vehicle depends on different engineering aspects such as:

(1) Safety and Ergonomics
(2) Market Availability
(3) Cost of the Components
(4) Safe Engineering Practice

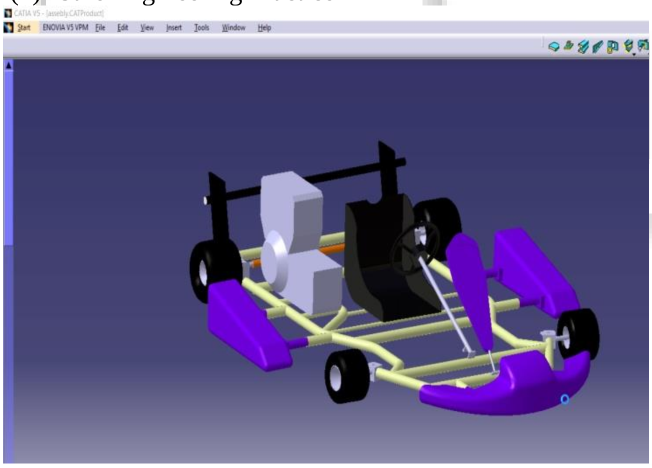

Fig. 3: CATIA Model of Go-Kart

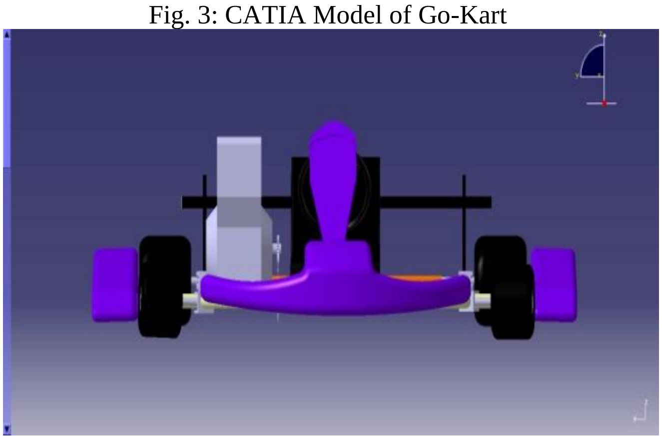

Fig. 4: Front view CATIA Model of Go-Kart

V. ANALYSIS

A. Stub Axle

The AISI 1040 steel has been chosen as a material for the design of stub axle. The Force is equal to load of front tyres, cornering the magnitude of force i.e.1.2g and kingpin movement were employed to respective points while obliging the stud around all the directions. For worst condition, the deformation and stresses are given below:

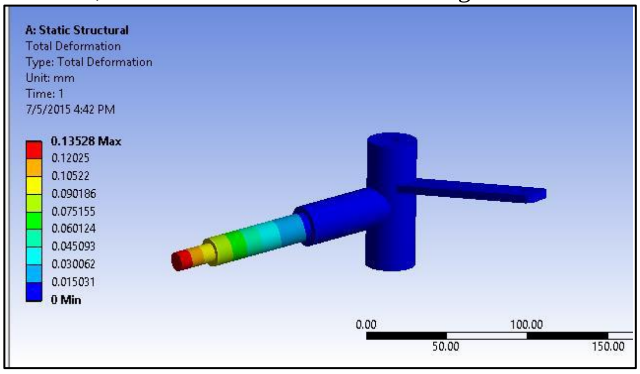

Fig. 5: Deformation

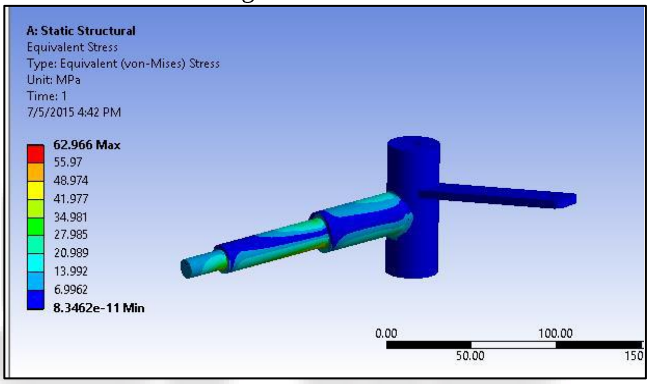

Fig. 6: Equivalent stresses

B. Frame Safety Analysis

Analysis of chassis was done by use of finite element analysis on ANSYS workbench 15 software. To do the analysis of the chassis a 3D design of chassis was made using CATIA V5 software. Stresses were calculated by simulating three different cases as frontal impact, side impact, and rear impact. Different cases of impacts are calculated by the procedure as follows:

As the mass of our Go-kart is 120 kg and gravitational acceleration g = $9.81 m/s^2$. We assume it approximately as $10 m/s^2$.

Calculations:

$F = m \cdot g$

$F = 120 \times 10 = 1200N$

1) Front Impact Analysis

As per standards we use 4G for front impact analysis.

Therefore,

Total force = 4 x F

= 4 x 1200 = 4800 N

Now this force was placed on the frontal part of frame by keeping the rear part fixed in ANSYS. And the stimulated result found was shown in below

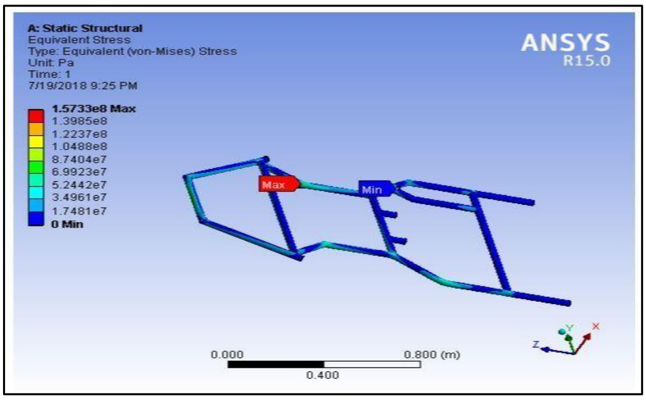

Fig. 7: Front Impact Analysis

2) Side Impact Analysis

As per standards we use 2G for side impact analysis.

Therefore,

Total force = 2 x F

= 2 x 1200

= 2400 N

Now this force was placed on one side of the frame by keeping the other side fixed in ANSYS. And the stimulated result found was shown in below

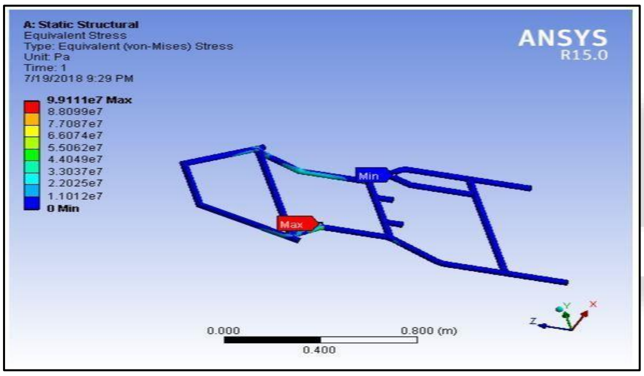

Fig. 8: Side Impact Analysis

3) Rear Impact Analysis

As per standards we use 4G for rear impact analysis.

Therefore,

Total force = 4 x F

= 4 x 1200

= 4800 N

Now this force was placed on rear part of the frame by keeping the frontal part fixed in ANSYS. And the result found was shown in below

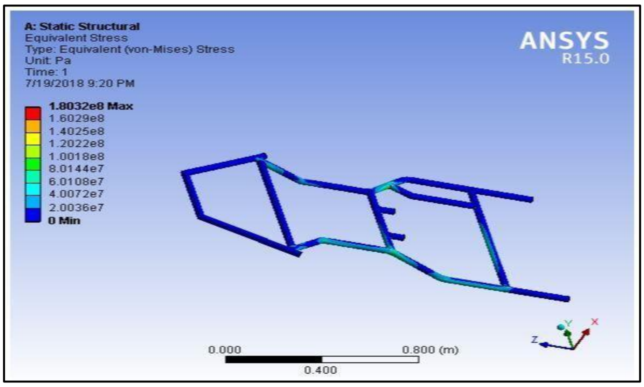

Fig. 9: Rear Impact Analysis

Factors	Front Impact	Side Impact	Rear Impact
Impact Force	4800 N	2400 N	4800 N
Stress Generated	157 MPa	99 MPa	180 MPa
Total Deformation	0.005 m	0.0006 m	0.0022 m
F.O.S	3.56	5.67	3.11

Table. 6: Conclusions of the analysis

VI. Conclusion

All the design modelling is carried successfully in 3D-Modelling software's CATIA and Annoys. At the end it is concluded that the entire analysis meet to specification and all the elements discussed in above paper are used for fabrication of our Go-Kart.

Fig. 10: Developed model of Go-Kart

VII. Future Scope

With the developing technologies Go kart has also been evolved and now being available in the form E-Kart which Eco friendly to nature and many of companies are also working on it so that it will be available for the public mover. Also, Solar Energy can be also used in solar panel to use as E-Kart.

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