Design and Static Analysis of Chassis used in Go-Kart

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***Abstract*— This work aims to design the Go-Kart chassis by keeping in mind the rules imposed by Go– Kart Design Challenge 2017. Theoretical calculations are to be carried out which have to be realize through several analyses. These results during front impact analysis, the chassis should meet the required factor of safety. In order to enhance factor of safety the computer aided design model was altered marginally such that it meets the safety requirements. An innovative method of design optimization has been discussed, without significant increase in the overall kerb weight of the chassis. The design and fabrication of go kart many people are trying to build with in a cost of 1lakh and we had also taken up the challenge to make a go-kart within a budget of 70K.This is a dream for which we are working with a hope of making it true. So it is sure that this project will have a high demand in the industry.**

Keywords—Auto-CAD ; CATIA ; Chassis ; Braking system

I. INTRODUCTION

The Go-Kart is a vehicle which is simple, lightweight and compact and easy to operate. The go-kart is specially designed for racing and has very low ground clearance when compared to other vehicles. The common parts of go-kart are engine, wheels, steering, tyres, axle and chassis. No suspension can be mounted to go-kart due to its low ground. The design consists of all possible alternatives for the System and modeling them in CAD software like CATIA, Solid works etc. And subjected to analysis using Ansys software. Based on analysis result, the model was modified and re-tested and a final design was frozen. The design process of the vehicle is iterative and is based on various engineering and reverse engineering processes depending upon the availability, cost and
other such factors.

Das [1], design and fabrication of a go-kart vehicle with improved suspension and dynamics. This project is based on the redesign and analysis of the chassis and suspension systems of terrain vehicle made in 2010 into a low ground clearance Go-kart. The project aimed to perform static and dynamic analysis from theoretical knowledge and analytical methods using ansys and solid works. Design and fabrication of the Go-kart focuses on developing a simple, lightweight and easily operated vehicle. Aspects of ergonomics, safety, ease of manufacture, and reliability are incorporated into the design specifications. Sharma et al. [2] Proposed Design And Fabrication Of Environment Friendly Kart. In this paper they replaced internal combustion engine with a battery power and a motor. The various systems of the single passenger Eco-kart were designed and fabricated e.g. chassis, brakes, steering, and drive train. Further, adequacy and performance of each designed component and system was checked by ANSYS simulation. To insure safety of the passenger as well as factor of safety is about 6.2 and 3.2 respectively.

Kalita et al. [3] explained the design and analysis of go-kart chassis. This paper is aimed to model and perform the dynamic analysis of the go-kart chassis which is of constructed with circular beams. The go-kart chassis is different from ordinary car chassis. The chassis is designed in such a way that it requires less materials and ability to withstand loads applied on it. Strength and light weight are the basic consideration for choosing the chassis material. AISI 1018 is the suitable material to be used for the go-kart chassis which is a medium carbon. Nath et al. [4] described the design and fabrication of go-kart. Main motto of us is to design a Go-kart using 2-stroke petrol engine. The maximum speed range of this will be of 40 km. Material used for the construction of frame is mild-steel. Maximum weight which can be placed on this will be of 150-200 kilograms. The designing of this go-kart will be in the form of F3 racing car. Drum brake is placed to the rear wheel. Main purpose of this is for racing and used as re-creation purpose. Pitman arm steering mechanism is used. Alpesh et al. [5]. Described the design and analysis of hybrid go-kart. Since last 2-3 decades the average temperature of earth increased by 3-40C because of the greenhouse effect. Due to increase in the fuel prices and continuously depletion of natural recourses for the fuels causes fuel crises in the modern society. Due to which demand of development of newly energy efficient vehicles increases. The hybrid technology fulfills this requirement by incorporating various combinations of bio-fuels and also by combinations of highly efficient electric drive systems. Along with the same it reduces the emission and cut the fuel cost. This project illustrates an implementation of hybrid technology on a small scale. Project aims at improving the mileage of the car using simple mild parallel hybrid

technology with combination of electric motor drive and the petrol engine drive. We have used the straight open kart chassis design. The results show that alone a petrol engine gives best 25Km/lit, alone an electric motor gives 12kms on full battery charge. The combination of above two gives 40Kms.

The present work explains the design and static analysis of the chassis used in Go-kart. Initially the modelling of the chassis is performed on the Solid works software. Later the model is imported in to Ansys workbench for static analysis. The static analysis is performed to identify the deformation and stress distribution in the chassis.

II. DESIGN OF CHASSIS

A. *chassis*

Chassis is a French term and was initially used to denote the frame or main structure of a vehicle. Chassis is sub-divided into the running gear and the power plant. The running gear includes the frame, steering system, brakes, wheels and the tyres. Hence chassis is Skelton of a vehicle so it should have adequate strength to protect the driver in the event of an impact.

B. *Frame*

Frame is the part of the chassis on which remaining parts are mounted. It is rigid structure consisting of two longitudinal members known as side members and are braced by number of cross members. It can hold all the major components together. On one end can accommodate engine assembly along with clutch and gearbox to form a complete power assembly. Frame is narrow at front for short turning radius and wide at rear to provide enough space for other mountings. The flowchart of the proposed work is shown in Fig. 1.

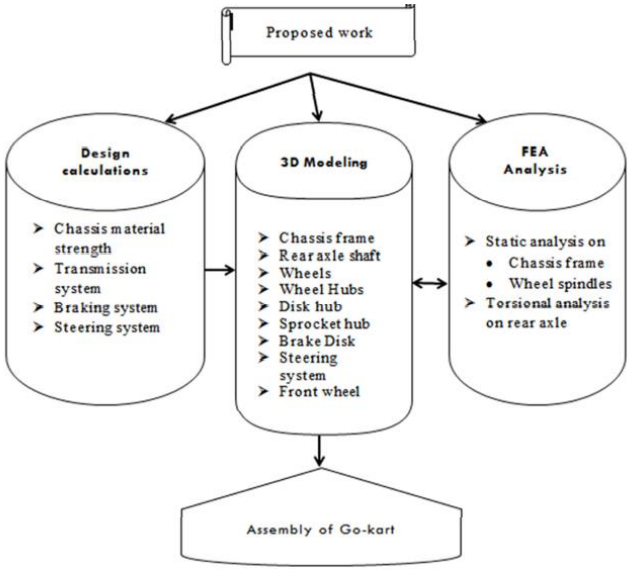

Fig. 1 Flowchart of proposed work

C. *Design calculations*

The design calculations are shown below for different components used in the stirling engine.

Outer diameter: 35.4 mm
Thickness: 3.38mm
Bending strength = σ×I/Y
σ = Yield strength = 415 MPa.
Y = Distance from neutral axis to extreme fiber
= (415 x 106 x π x (0.03544-0.02874)) = 1022.193 N-m
64 x 0.0177
Bending stiffness = $E \times I$
E = Young's Modulus = 200GPa.
I = Second moment of area for the structural cross section
= (200 x 109 x π (0.03544-0.02874)) 64
= 8756.64 N-m^2
Fig. 2 shows the dimensions of the chassis.

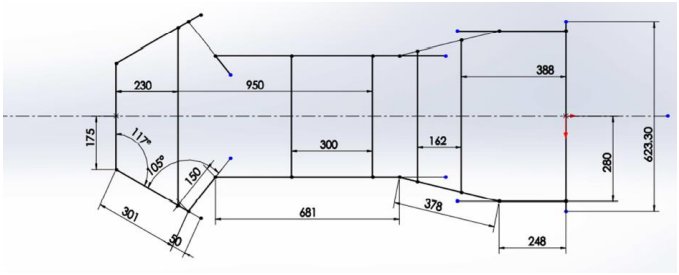

Fig. 2 Dimensions of chassis

III. RESULTS AND DISCUSSION

D. *Solids works model*

The modeling of chassis is carried using SOLIDWORKS software; the Fig. 3 shows the 3D model of Go-kart chassis frame.

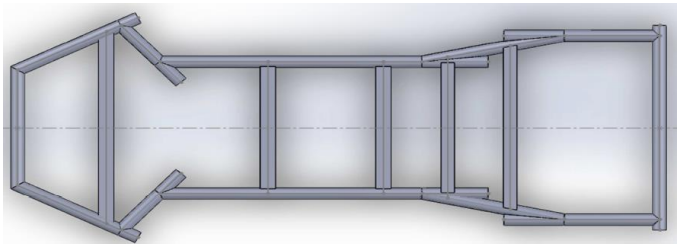

Fig. 3 Solid model of chassis

E. *Finite elemnt analsysis*

(i) Static load influence on chassis

The three dimensional model is further imported in to ANSYS Workbench to perform the static analysis of the chassis. The following analysis has been made by assuming the driver weight is 80kg and Engine weight of 20kg. and the results of analysis is shown in the following the Fig. 4 to Fig. 6.

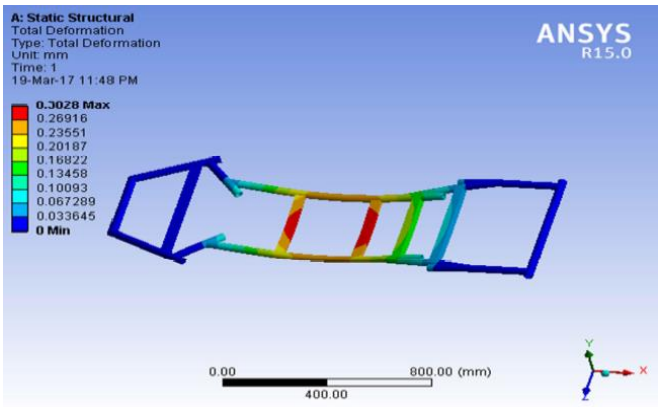

Fig. 4 Total deformation

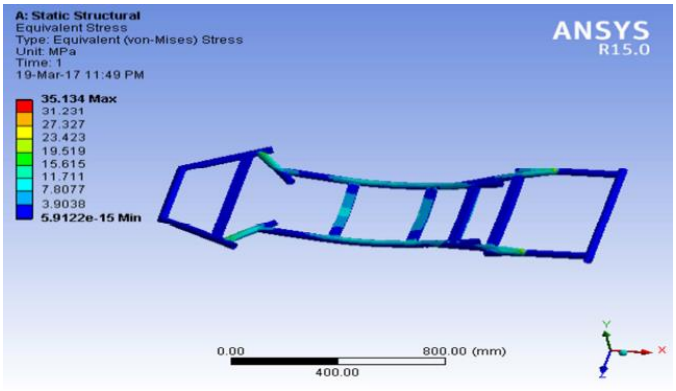

Fig. 5 Total stress

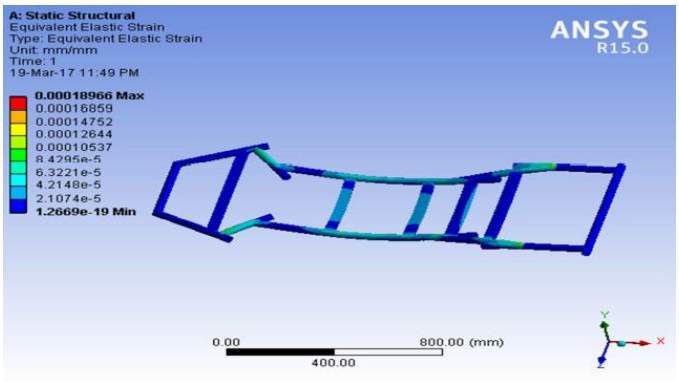

Fig. 6 Total strain

(ii) Front impact analysis

The following analysis is made by applying load conditions by assuming that the vehicle is hitting an obstacle while moving with a speed of 60kmph. Whose mass is 200kg including driver weight. The results of analysis are shown in the following the Fig. 7 to Fig. 9.

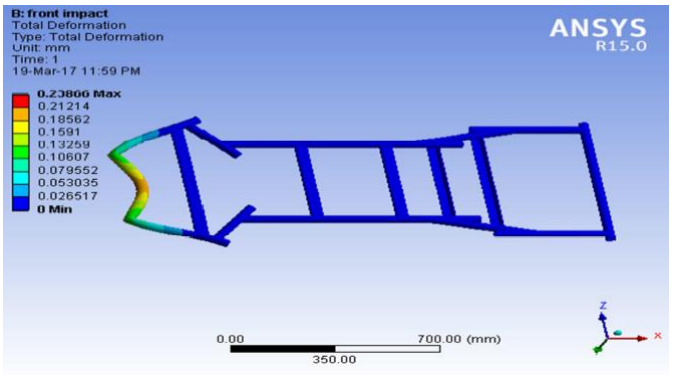

Fig. 7 Total deformation

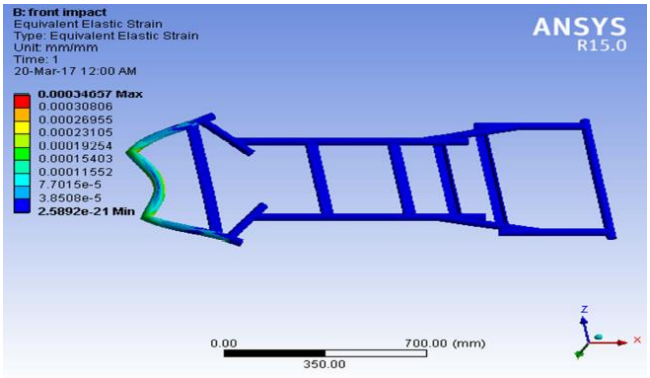

Fig. 8 Total strain

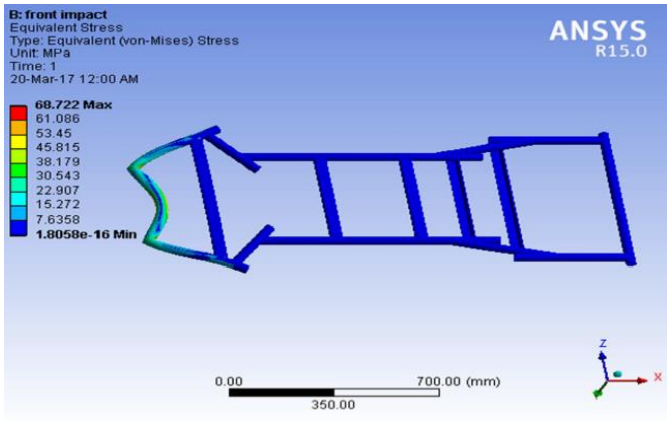

Fig. 9 Total stress

(iii) Rear impact analysis

The rear impact analysis is made by assuming that a mass of 200kg vehicle committed an accident from rear of our vehicle with a speed of 60kmph. The results of analysis are shown in the following the Fig. 10 to Fig. 12.

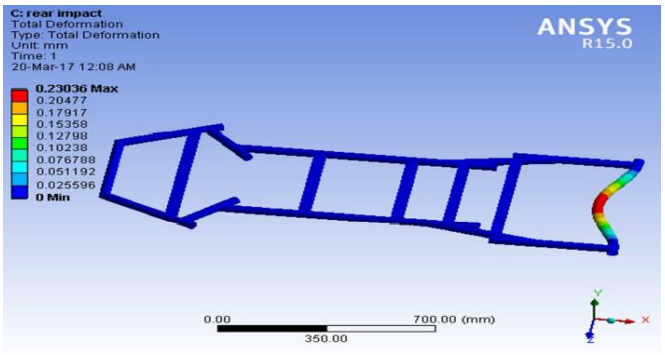

Fig. 10 Total deformation

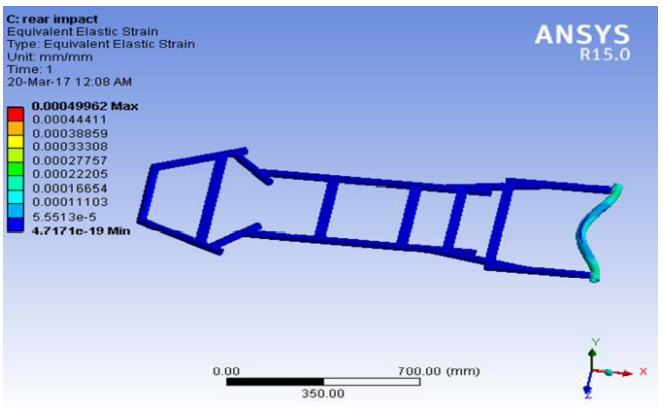

Fig. 11 Total strain

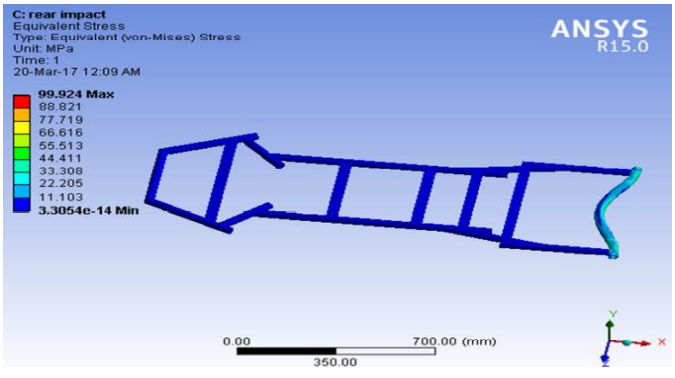

Fig. 12 Total stress

From the above analysis, reports of chassis frame shows that the developed stress are under safe conditions and the obtained results are shown in the Table I.

TABLE 1. STATIC ANALYSIS OF THE CHASSIS

Load Particulars	Minimum stress, MPa	Maximum stress, MPa	Maximum deformation, mm
Static load	5.9122×10^{-15}	35.134	0.3028
Front impact	1.8058×10^{-13}	68.722	0.2386
Rear Impact	3.3054×10^{-15}	99.924	0.2033

IV. CONCLUSIONS AND FUTURE SCOPE

The present work explains about the design of a Go-kart vehicle chassis, giving special attention to satisfy the design conditions of rule book of Seiger pro Karting champion ship 2017 using basic automobile principles. The modeling of Chassis is carried out using SOLIDWORKS-16 modeling software's. The models compatibility has analyzed using finite element techniques to prove its effectiveness and withstand ability under various loads in ANSYS 15.0 threw different approaches such as real world crash statistics and crash testing like front and rear impact on frame of Go-kart chassis structure, stress developed in the chassis of vehicle and also analyzed. Finally, the results of the present study shown the evolved stress and deflection of the models due to the action of various conditions of load are under safe.

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