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Impact Force Analysis and Design of Go-Kart

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ABSTRACT - This paper covers all the designing and analysis of the final Go-kart chassis design. It also covers the material used and the reason of using the material in the Go-kart chassis. And it has further been planned to the simple design procedure and enhance driver comfort and safety, and to increase the performance of the vehicle. The aim to design and develop of chassis for Go-Kart vehicle in accordance with the international F9 Go-Kart Championship.

Key Words: Impact force, deformation, BHN, CATIA-V5, ANSYS FEA.

I. INTRODUCTION

Go-Kart is a small four-wheel vehicle, this vehicle generally used for racing purpose and improving driving skill. They are generally powered by four stroke IC engine and Electric motor. Present design is initiated by considering all possible alternatives for a modelling and simulation with the help of CATIA (CAD Software) after carrying a number of simulations, the design was finalized on the basis of analysis result which is subjected on ANSYS FEA software. The design process of vehicle based on various engineering aspects depending upon the availability, cost and other such factor.

So, the design process focuses on following objectives:

1. Safety and Ergonomics
2. Cost of components
3. Drive Quality
4. Market Availability
5. Safe Engineering Practices

The design objective set out to be achieved were three simple goals applied to every component of the vehicle durability, light weight and high performance.

II. DESIGN OF KART

The following design methodology was used in design:

- Requirements
- Design Calculations and analysis
- Considerations
- Testing
- Acceptance

Based on the overall design objectives of durability, performance, and light- weight design, the component is evaluated by the design team and must meet all of the criteria to become an overall part of successful design. Alternatives were also considered during each process and testing commenced once the chosen design met the design objective.

III. MATERIAL SELECTION

AISI 4130 was chosen for the chassis with 1-inch external diameter and 2 mm thickness because of its high bending strength and roll stiffness. A good strength material is important in a chassis because the chassis needs to absorb as much energy as possible to prevent the chassis material from fracturing at the time of high impact. AISI 4130 has been chosen for the chassis because it has structural properties that provide a low weight to strength ratio.

TABLE III.1 The material properties are given below in tabular form:

Sr. No.	PROPERTIES	VALUES
1	Brinell Hardness	200-300
2	Density	7.8g/cm^3
3	Young's Modulus (Tensile)	210GPa
4	Poisson's ratio	0.29
5	Specific heat Capacity	450J/Kg-K
6	Strength to weight ratio	72 to 130 KN-m/kg
7	Tensile strength ultimate	560-1040MPa
8	Tensile strength Yield	440-980MPa
9	Ultimate Resilience	94-130MJ/m

TABLE III.2 The chemical composition of material is as follows:

Iron (Fe)	97.30 to 98.2%
Chromium (Cr)	00.80 to 1.1%
Manganese (Mn)	00.40 to 0.6%
Carbon (C)	00.28 to 0.33%
Silicon (Si)	00.15 to 0.35%
Molybdenum (Mo)	00.15 to 0.25%
Sulphur (S)	00.00 to 0.040%
Phosphorus (P)	00.00 to 0.035%

The above material properties satisfy the technical requirements which is used to be framed.

IV. FRAME DESIGN AND ANALYSIS

The frame is designed to meet the technical requirements of competition the objective of the chassis is to encapsulate all components of the kart, including a driver, efficiently and safely. Principal aspects of the chassis focused on during the design and implementation included driver safety, drive train integration, and structural weight, and operator ergonomic. The number one priority in the chassis design was driver safety. By the competition rules and Finite Element Analysis (FEA), the design assured.

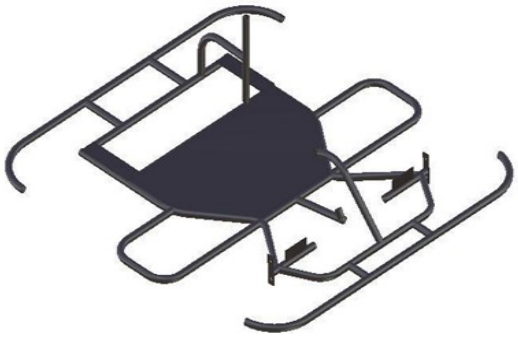


Fig:1

V. IMPACT CALCULATION

A. IMPACT FORCE DETERMINATION BY SPEED LIMIT

According to the constraints in the rulebook, the maximum speed of the car is assumed to be 60km/hr. or roughly around 16.66 m/s. For a perfectly inelastic collision, the impact force is as calculated from Eqn. (1).

Weight of the go kart (M) = 160kg

Initial velocity before impact (Vi) = 16.672m/s or 60km/hr

Final velocity after impact (Vf) = 0 Impact time = 0.4sec

From work energy, principal Work done = change in kinetic energy

$$W_{net} = \frac{MV_f^2}{2} - \frac{MV_i^2}{2} \quad \ldots\ldots(1)$$

$$W_{net} = -\frac{MV_i^2}{2}$$

Negative sign indicates the direction of impact force. So, neglecting the negative sign

$$W_{net} = \frac{MV_i^2}{2} \quad \ldots\ldots(2)$$

$$= \frac{160 \times 16.672^2}{2}$$

$$= 22236.44 \text{ Nm}$$

Work done = Impact force $\times$ displacement

$$W_{net} = F \times d \ldots\ldots(3)$$

$$\text{impact force} = \frac{W_{net}}{d}$$

by displacement equation:

$$d = \frac{1}{2}(v+u)t \quad \ldots\ldots(4)$$

Where, d = distance, v = final velocity, u = initial velocity, t = time

$$v = 0$$

$$d = \frac{ut}{2}$$

$$d = \frac{16.672 \times 0.4}{2}$$

$$= 3.33 \text{ m} \approx 3 \text{ m}$$

$$\text{impact force} = \frac{W_{net}}{d}$$

$$= \frac{22236.44}{3}$$

$$= 7412.12 \text{ N}$$

Therefore, Impact Force by Speed Limit (F_1) = 7412 N

B. IMPACT FORCE DETERMINATION BY ACCELERATION LIMIT

The "Motor Insurance Repair Centre" has analyzed that the Go Kart will see a maximum of 5G"s of force during front impact.

FORCE = 5G

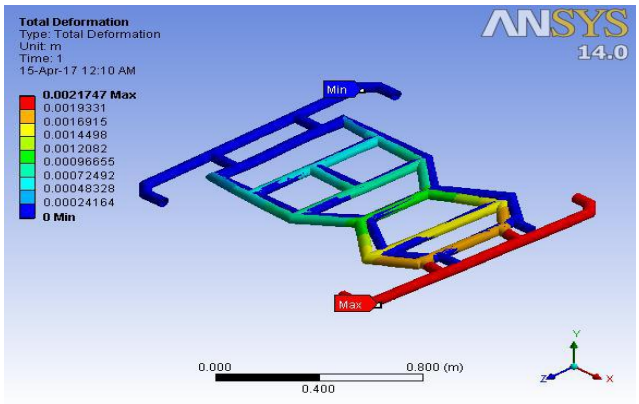
5G = 7840N (5*160*9.81=7840N)

F2 = 7800N

Therefore, Impact Force by Acceleration Limit (F2) ≈ 7800 N These two values of F1 and F2 are practically comparable.

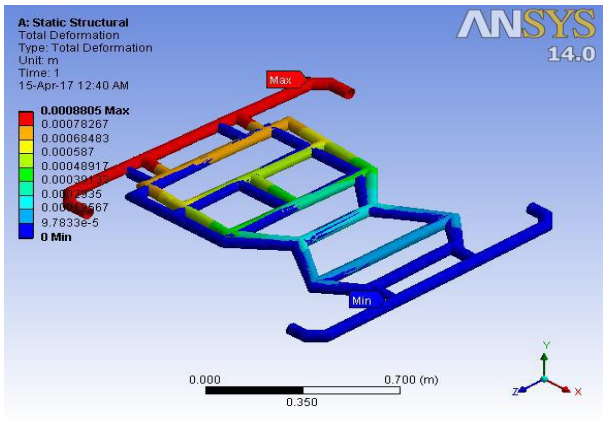
a) FRONT IMPACT ANALYSIS

For the front impact test the front nodes are applied with the load. The rear is completely constrained. Impact force is 5G = 7840N and maximum deformation is 0.0021m.



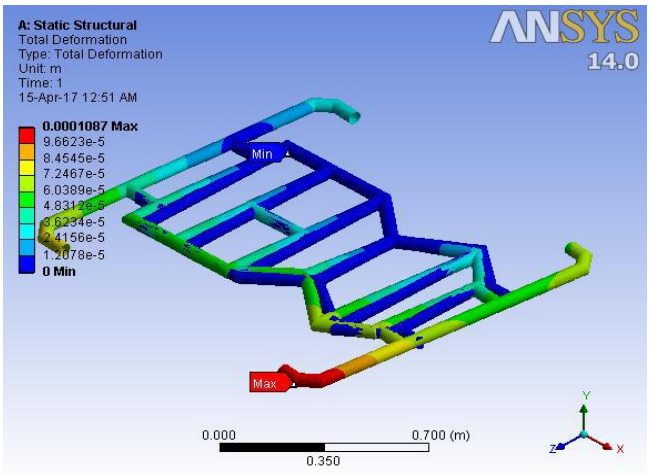
b) REAR IMPACT ANALYSIS

The rear impact load is same as the front impact considering and is applied to the nodes with the front completely constrained this time. And 2G force is applied and maximum deformation is 0.0088m.



c) SIDE IMPACT ANALYSIS

For the side impact, the preset load is used for font impact and rear impact test. In this the load is applied along the side face of the frame and the other side wheels are constrained referring to the frame. Force is applied 1G=1570N and maximum deformation is 0.00010m



C. DIFFERENT VIEWS OF THE VEHICLE

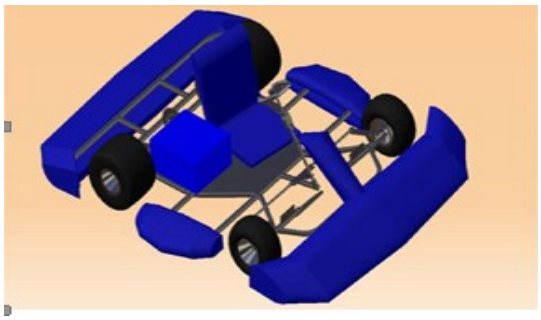
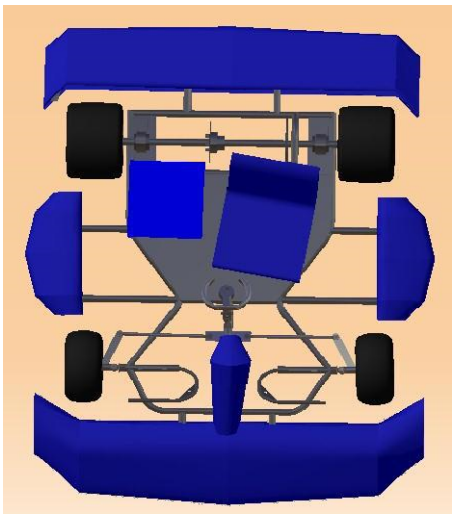


Fig -2 Isometric View of the vehicle



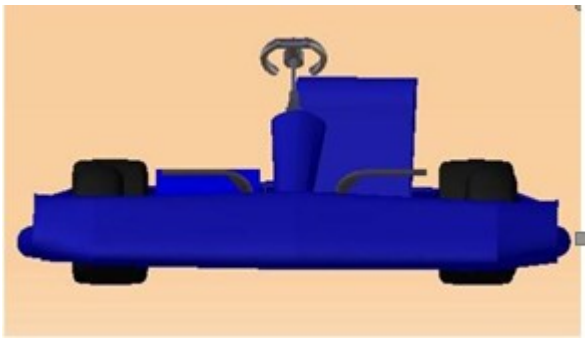


Fig-4 Front view of vehicle

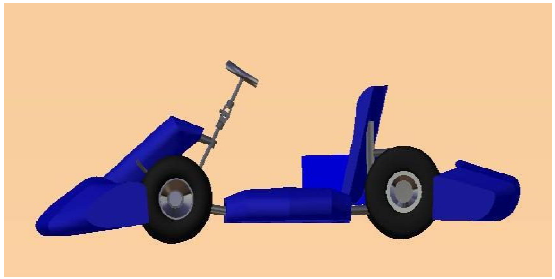


Fig-5 Side view of vehicle

TABLE 5.1 DESIGN PARAMETERS

Length	53 inch
Width	50 inch
Height	32 inch
Wheel base	31 inch
Track width	38 inch
Weight of vehicles	60 kg
Ground clearance	2 inch

CONCLUSION

There are several factors to be considered that are common to all engineering vehicles. The chosen design is the safest & the most reliable go kart for racing vehicle. All the parameters like Reliability, safety, Cost, Performance, ergonomics, dimensions & material were also taken in consideration on the same time.

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REFRENCES

[1]. Saheb S. H. et.al. “DESIGN REPORT OF A GO KART VEHICLE “[2016] IJEAST Vol. 1, Issue 9, ISSN No. 2455-2143, Pages 95-102

[2]. Pattanshetti V.S, “DESIGN AND ANALYSIS OF GO KART CHASSIS”[2016] IJMIT Vol. 4, Issue 1, pp: (150-164),

[3]. Gaikwad R.L, et.al“DESIGN OF GO-KARTVEHICLESYSTEMS”[2016] ICETEMR, ISBN:978-81 932074-7-5.

[4]. Hajare K, et.al, “A Review Paper On Design And Analysis Of A Go-Kart Chassis”[2016], IJETMAS, Volume 4, ISSUE 2, ISSN 2349-4476,

[5]. Nilawar A, et.al, “DESIGN OF GO-KART”, Maharashtra,India, IJFEAT, ISSN: 2321-8134.

[6]. Yadav G, et.al, “GO KART DESIGNING AND ANALYSIS”[2014], JIAATS-JCME, Vol-15, ISSN-3347-4482

[7]. Deepak Raina et.al. “Design and Development for Roll Cage of All-Terrain Vehicle” [2015] IJTRE Vol 2, Issue 7, ISSN 2347-4718.