CCET JOURNAL OF SCIENCE AND ENGINEERING EDUCATION

ISSN(Print):2582-0680 ;ISSN(Online):2455-5061 *Vol. –6, Page-34-39 Year-2022*

IMPACT FORCE ANALYSIS ON GO-KART CHASSIS

Prajwal Dhebe*, Aniruddha Deshmukh*, Riyaj Bagwan*, Shivshankar Bhavre*, Prof. S. B. Hankare**

**U.G. student, JSPM NTC, Pune, India*

***, Assistant Professor, JSPM NTC, Pune, India.* *srinivcas.indore@gmail.com*

Abstract

This paper is aimed to model and perform the dynamic analysis of the go-kart chassis which is of constructed with circular beams. This report focuses on briefing the sole ideology behind the development of compact and light- weight kart chassis while doing all the acting force analysis.

Index Terms: *Go-kart, Finite Element Analysis, Vehicle dynamics, SOLIDWORKS.*

1. INTRODUCTION

This project is aimed to be model and perform the dynamic analysis of the go-kart chassis which is constructed with the circular cross section beams. Modelling and analysis are performed on SOLIDWORKS software. The chassis is designed in such a way that it requires less pipes and ability to withstand optimum loads applied on it. They are usually raced on almost any plain tracks with no pits and speed breakers. This is considered as the first vehicle for starting a career in racing field. A driver could easily prepare for racing through this vehicle, wheel-to-wheel racing for high speed, precision control, impulsive racing skills and spontaneous decision-making skills. These vehicles, now called as "Go-Karts" had grown into a billion dollars industry in the USA and most of the developed countries in the world. They are made, sold, and used exclusively as recreational racers. However, these vehicles are not designed for transportation and are considered illegal in most places to drive them on the road. The objective of the design is to optimize the working and performance of go-kart considering various factors.

2. SCOPE:

As Karting is a racing sport, the evolvement in EVs have brought a huge demand in E-Karting. E-Kart events are being held around the globe and it's too trending. European countries lead the other countries in terms of karting.

3.METHODOLOGY:

Design methodology is proposed for this type of system that combines multibody simulation and finite elements.

- This model includes both designed parts and other commercial parts.
- Creation of iterative model using tools.
- Checking of dimensions for fulfilling regulations.
- FEA analysis using Ansys.
    - Calculation and optimization process.
    - Set of results including stresses strains.
    - Another iterative model.

Analysis using Ansys by considering new feature i.e. stiffness of structure and flexibility of chassis.

4. DESIGN:

Chassis is the backbone of any Kart. Chassis is the load bearing framework of an artificial object. Therefore, material used for chassis should have high tensile and yield Strength

Ladder frame, Backbone chassis, Monocoque, Tubular chassis, this are some types of classified chassis.

Tubular chassis is most commonly used type of construction and we to have worked on making this type of construction.

5. MATERIAL SELECTION:

The chassis of E-kart must be stable, with high torsional rigidity, as well as have relatively high degree of flexibility as there is no suspension. Keeping the frame as light as possible was top priority because when power is limited weight plays an important role in vehicle performance.

The main component of the frame is divided into two major parts: First the front block (cockpit) for steering and seat positions etc. and second rear block (Motor compartment) for transmission and brake assembly. Chassis construction is of a tubular construction, typically mild steel with different grades. In this kart, we had used AISI-4130 having low weight and high strength having same dimensions.

6. DESIGN OF CHASSIS:

After material selection further next step in the process is design of chassis or kart. Kart is to be designed in such a way that it should perform optimum in every racing condition. Designing the chassis was a trial-and-error process, we designed many chassis with iteration and changing the component and reducing the unnecessary bulks from the chassis to reduce weight cause weight would a deciding factor at some point of the race. After cancelling out we came up with best four options as a design for our chassis.

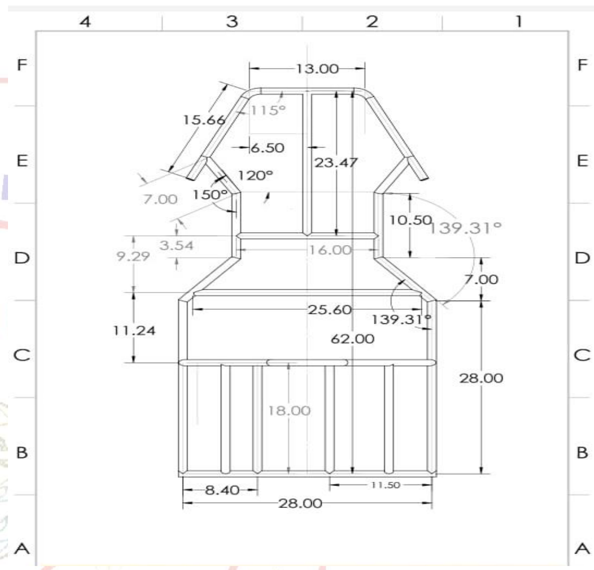

Fig 1: Dimension of kart

Table 1: Material Comparison

Parameters	AISI 1018	AISI 4130	AISI 1020
Carbon %	0.28% -0.33%	0.15% - 0.20%	0.17%-0.23%
Ultimate Tensile Strength	560 MPa	440 MPa	420 MPa
Ultimate Yield Strength	460 MPa	370 MPa	350 MPa
Modulus of Elasticity	210 GPa	205 GPa	186 GPa
Hardness, Brinell	217	126	111
Density	7.85 g/cc	7.87 g/cc	7.87 g/cc

7. ANSYS REPORT:

In order to analyses the effect of impact which might cause in case of accidents, we have to consider all the forces which are involved. These forces can be calculated based on the speed of the vehicle and the percentage deformation can be estimated. This analysis is important as we can determine, and redesign based on the failure which occur during the analysis. The deformation which is considered in mm must be negligible and the equivalent stress generated during the impact must be lesser than the yield strength of the material. Based on this the FOS can be calculated as a ratio of the yield strength to stress noted from analysis.

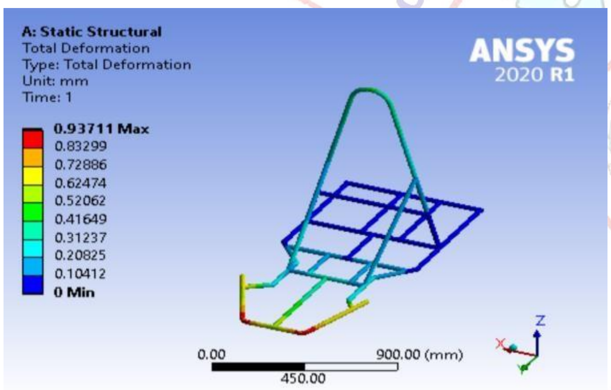

Fig 2: Front Impact Analysis

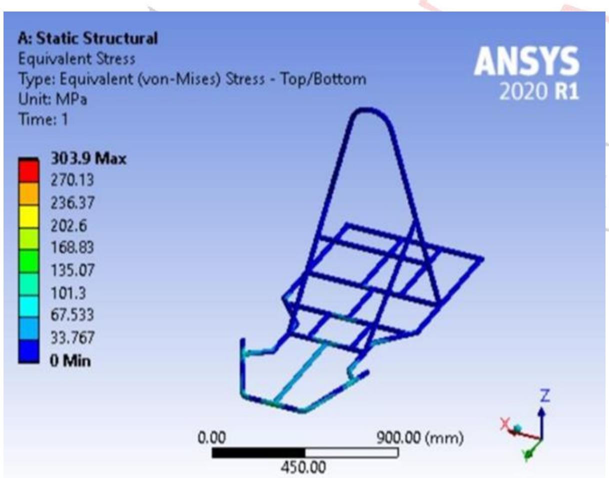

Fig 3: Front Equivalent Stress

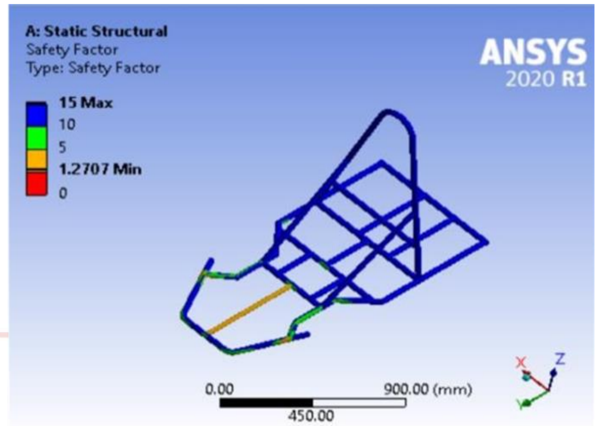

Fig 4: Front Safety Factor

Table 2: Result table for Chassis Analysis

Factor	Front Impact	Rear Impact	Side Impact
Total Deformation (mm)	0.93711	0.6646	0.20778
Equivalent Stress (N/mm2)	303.9	213.58	96.52
Factor O Safety	1.2707	1.1747	1.415

8. DYNAMIC EFFECTS OF WEIGHT DISTRIBUTION:

Brake is a device used for slowing, stopping controlling the vehicle. Brakes are designed to stop the vehicle by converting the kinetic energy of the vehicle to heat energy.

8.1 Objective:

For maximum performance from the braking system, the brakes are designed to lock the rear wheels while minimizing cost and weight.

CCET JOURNAL OF SCIENCE AND ENGINEERING EDUCATION
ISSN(Print):2582-0680;ISSN(Online):2455-5061 *Vol. – 6, Page-34-39, Year-2022*

9. CENTER OF GRAVITY:

Angle of incline depends upon the height of block added. Hence, by changing height of block the COG might change as well, as the Angle of incline will change. Similarly, due to higher incline angle, there will be higher shift in weight towards either side while the Kart is in inclined position. Considering this parameter height of COG has been calculated under multiple conditions where the height of block changes for every calculation. Average of these values has been considered as the Height of Centre of Gravity.

Co-ordinates of COG by calculation(with respect to reference point): (x ,y,z)≡(0,30,4.52)

Co-ordinates of COG by Alternate Method (with respect to reference point): (x,y,z)≡(0,28.55,4.67)

As observed from the study conducted, the deviation between the values by calculation and alternate method is less than 5%.

10. FINAL DESIGN

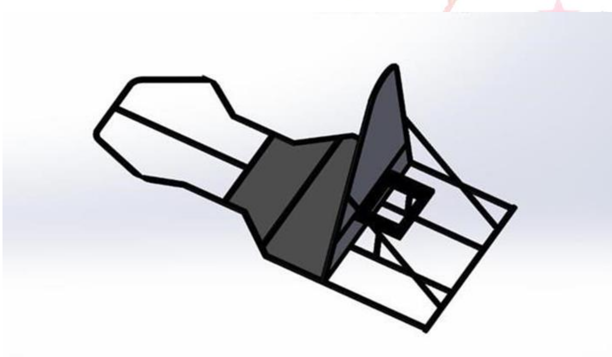

Fig 5: 3D Model of Go-Kart Chassis

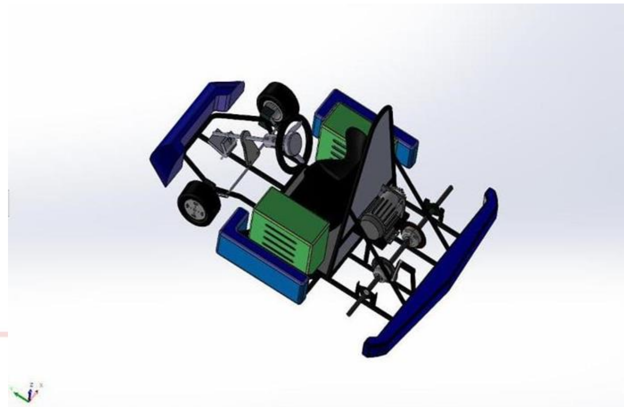

Fig 6: 3D Model of Go-Kart

Fig 7: Kart Assembly

11. CONCLUSION

•It is cleared from the present investigation, no material withstands with 10g, 16g loading criterion in front impact test for a deigned chassis. AISI 4130 is more efficient material as it gives safe result for 4g, 6g and 8g loading criterion.

All materials are giving safe design for side impact test but again AISI 4130 is more efficient material.

The static structural analysis of GO-KART CHASSIS was done with two different materials i.e., structural steel and grey cast iron and the values of total deformation, equivalent stress, maximum principal stress, and shear stress was found for the load of 600N. It was found that it is less than yield strength values which are 250 for steel and 200 for grey cast iron which means it's safe for the driver in the Kart.

Finite element analysis system is used to evaluate, create,and modify the best vehicle design to achieve its set goals. The main goal was to simplify the overall design to make it more light weight without sacrificing performance and durability. The result is a lighter, faster, and more agile vehicle that improves go kart design.

- Future scope
- Centre of Gravity and its effect on Go-kart.
- Calculating Centre of Gravity
- Methods to calculate Centre of gravity.
- Dynamic effects and Relation between COG and Impact.
- Graphical Representation.
- Weight Distribution calculations and effects on Braking, Steering and Dynamics

12. REFERENCES

1. Joseph Katz, "Race Car Aerodynamics-Designing for Speed”.
2. Simon McBeath, Gordon Murray, "Competition Car Down force-A Practical Handbook".
3. Caroline M.L., Sankar R., Indirani R.M., Vasudevan S., "Growth, optical, thermal and dielectric studies of an amino acid organic nonlinear optical material: l-Alanine", Materials Chemistry and Physics, ISSN : 0254-0584, 114(1) (2009) pp. 490-494.
4. Forbes Aird , "Racer's Encyclopedia of Metals, Fibers & Materials".
5. Parvez Hussain S. D, C. N. Veeramani, B. Amala Priya Shalini, R. Karthika, “An Innovative Energy Efficient Automobile Design, "International Journal of Innovative Science and Modern Engineering (IJISME).ISSN: 2319-6386, Volume-2 Issue-10, September 2014.
6. U.S. Department of Energy, Transportation Energy Data Book Edition 2004. July 2006 (visited 15/2/2009).
7. Caroline M.L., Vasudevan S., "Growth and characterization of bis thiourea cadmium iodide: A semiorganic single crystal", Materials Chemistry and Physics, ISSN : 0254-0584, 113(Feb-3) (2009) pp. 670-674
8. Mes Paolino, Alexander Jadczak, Eric Leknes and Tarek Tantawy, "The S-90 Go-Kart - Optimal Design Report, NSF Projects. Ashford.
9. Caroline, M.L., Vasudevan, S., "Growth and characterization of an organic nonlinear optical material: l-alanine alaninium nitrate", Materials Letters, ISSN : 0167-577X, 62(15) (2008) pp.2245-2248.
10. Dave Agler, "Humar Power- HPV Design Considerations", The Technical Journal of the IHPVA Volume 4, No. 4, fall 1985.
11. Sciences, ISSN : 1682-4474, 9(5) (2009) pp. 240-244.
12. Arumugam, S., Ramareddy, S., "Simulation comparison of class D/ Class E inverter fed induction heating", Journal of Electrical Engineering, ISSN : 1335-3632, 12(2) (2012) pp. 71-76.
13. Ayush Gandhi and Harsh Kansal, “Troubleshooting and Its Solutions in Designing of a Smart Go Kart”, IJRMET Vol. 4,

Issue: 2, spl- 2 May - October 2014 ISSN: 2249-5762 (Online).

14. Go kart front suspension plans (Dec 2014), Powered by Reliable Pharmacy Network 2006-2015.
15. Alpesh V. Mehta, Nikunj Padhiar, Mr.Jaydip Mndapara, "Design and Analysis of Hybrid Go-Kart", International Journal of Advanced Engineering Technology (IJAET) Vol. Fig 1: Dimension of kartII- Issue I-January-March 2011, ISSN: 0976- 3945 (Online).
16. Anbuselvi S., Chellaram C., Jonesh S., Jayanthi L., Edward J.K.P., "Bioactive potential of coral associated gastropod, Trochus tentorium of Gulf of Mannar, Southeastern India", Journal of Medical Sciences, ISSN : 1682-4474, 9(5) (2009) pp. 240-244.
17. Hemank Dabhade, "Design and Fabrication of Super kart Hd-250", International Journal of Recent Trends in Engineering, Vol. 1, No. 5, May 2009.
18. G.Ayyapan, Chemo Informatics QSAR Analysis of Nitro aromatic Compounds Toxicity, International Journal of Innovative Research in Science, Engineering and Technology, ISSN: 2319-8753, pp 372-375, Vol. 2, Issue 2, February 2013.
19. G.Mathubala , Dr.T.Jayadoss, Evaluation of Non-Conventional Fertilizers On The Growth Response of Zinnia Seedlings ,International Journal of Innovative Research in Science, Engineering and Technology, ISSN: 2319-8753, pp 8360-8376 , Vol. 3, Issue 1, January 2014.
20. G.Mathubala , S.Rosy Christy , Hazardous Materials - Restriction, International Journal of Innovative Research in Science, Engineering and Technology, ISSN: 2319-8753 , pp 4398-4400 , Vol. 2, Issue 9, September 2013.
21. G.Mathubala, Dr.V.Krishnasamy , kinetics of oxidation of Schiff base by chloramine –t catalyzed by mixture of os (viii) and ru (iii) – effect of osmium tetra oxide and ruthenium chloride , International Journal of Innovative Research in Science, Engineering and Technology , ISSN: 2319-8753 , pp 2756-2762, Vol. 2, Issue 7, July 2013 .