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"DESIGN AND ANALYSIS OF A GO-KART CHASSIS"

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ABSTRACT

Team Sagar Seals designed and fabricated a high-performance go-kart for national-level competitions, focusing on lightweight construction, safety, durability, and cost efficiency. The project involved concept development, benchmarking, and setting performance targets. A mild steel tubular chassis was designed and validated using Finite Element Analysis (FEA) under impact, braking, and torsional load conditions. Key subsystems, including steering, braking, transmission, and ergonomics, were optimized for handling and driver comfort. A single-cylinder IC engine was integrated with a carefully designed drivetrain. Precision fabrication and extensive testing confirmed reliable performance, stability, efficient braking, and consistent power delivery

Key Words: FEA, Go Kart, Chassis, mild steel.

I. INTRODUCTION

Go-kart is a small, four-wheeled, single-seater racing vehicle powered by a compact engine. It originated in the 1950s when Art Ingles, known as the "Father of Karting," built the first kart in California in 1956. Since then, karting has grown rapidly across the United States and Europe. A typical go-kart has no suspension and no differential, and is raced on small, scaled-down tracks. Karting is widely considered the most affordable and safest entry point into motorsports, allowing children and adults—starting from the age of 8—to learn racing skills. It is popular both as a hobby and as a competitive sport. Go-karts are simple, cost-effective, and provide a safe racing experience. Most karts use engines around 125cc, and in some countries, certain models can be licensed for road use with added safety features like headlights, indicators, and tail lamps. The following report details the design and analysis of a student-designed go-kart vehicle, we used CAD software (SolidWorks and Ansys Workbench) research parts and items to make Because of this method cost and complexity manufacturing will comes down and the product can be tested on the components itself. To achieve the necessary results without wasting any time and effort CAD Software Chosen (among them as CAD Software) alternative. The reasons behind this long history of race car weight reduction, there is a need for designing and analyzing the race car to make it a race-worthy one, and this makes the variables that will be examined afterwards as design variables, English proper guidance in the right way with correct components. These components then have to undergo mechanical forces and analyzed virtually which will feel in real world and predict its wear out life, strain, and stress induced without actual testing. This CAD procedure significantly reduces manufacturing costs and time. Karting is commonly perceived as the stepping stone to the higher and more expensive ranks of motor sports. Kart racing is generally accepted as the most economic form of motor sport available. As a free-time activity, it can be performed by almost anybody and permitting licensed racing for anyone from the age of 8 onwards. Kart racing is usually used as a low-cost and relatively safe way to introduce drivers to motor racing. Many people associate it with young drivers, but

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adults are also very active in karting. Go-Kart is a great outlet for those interested in racing because of its simplicity, cost and safer way to race. The tracks go-kart is similar to F1 racing track. A go-kart is powered by 125cc engine in most of the countries. In some countries, go-karts can be licensed for use on public roads. Typically, there are some restrictions, e.g. in the European Union a go-kart on the road needs head light (high/low beam), tail lights, a horn, indicators and a maximum of 20 HP.

II. Literature Review

The literature review provides insights into various approaches adopted by researchers for go-kart chassis design, analysis, and manufacturing. Previous studies emphasize the importance of achieving a balance between safety, durability, performance, and cost-effectiveness. Simranjeet Singh et al. focused on a rigid and reliable chassis using triangulation principles to enhance driver safety and structural strength. Shaik Himam Saheb et al. highlighted the design of a torsion-free and easily manufacturable frame. Dr. D. Ravikanth et al. demonstrated the feasibility of developing a low-cost go-kart suitable for the Indian market.Review of available literature suggests that the carburizing process has shown a larger impact to enhance the tribological response of the steel substrates. Carburization technique has helped to improve the corrosion resistance of ferritic steel and ferritic-martensitic steel. The technique has improved the different steel grades for their wear and hardness responses. In view of the application limits of the investigated steels, the carburization, if carbon potential is increased to 1.1 could influence the wear resistance of the substrate.

Several researchers, including Koustubh Hajare et al., Virendra S. Pattanshetti et al., and Kartik Kelkar et al., performed static and finite element analyses using software such as SOLIDWORKS, ANSYS, CATIA, and HyperWorks to evaluate stress distribution, deformation, and crashworthiness. Ujjal Kalita et al. prioritized driver safety through impact testing and the use of AISI 1018 tubular chassis with strategically placed gussets. D. Raghunandan et al. emphasized lightweight construction while maintaining structural strength through dynamic analysis. Harish Harsurkar et al. focused on weight reduction and conducted front, rear, side impact, and torsional analyses.

III. Methodology

The methodology adopted for the Design and Analysis of a Go-Kart Chassis involves defining the design requirements based on safety, strength, rigidity, and weight considerations. A detailed literature review was conducted to understand existing chassis designs and analysis techniques. The chassis material and dimensions were selected according to performance and manufacturing requirements. A 3D model of the chassis was developed using SolidWorks, followed by structural analysis in ANSYS Workbench. Various loading conditions, including front impact, rear impact, side impact, and torsional loads, were applied to evaluate stress, deformation, and factor of safety. Based on the analysis results, necessary design modifications were made to optimize the chassis. The final design was validated to ensure adequate strength, stability, and safety for go-kart operation.

IV. Experimentation

The experimental work is the most crucial and decisive phase of the Go-Kart project, as it validates the theoretical calculations, simulation outcomes, and fabrication precision. It bridges the gap between design and real-world performance, ensuring that all vehicle subsystems perform efficiently under actual conditions. This chapter outlines the detailed experimental testing conducted on the fabricated Go-Kart to assess its performance, handling, safety, and endurance parameters. The testing was performed in two stages static testing and dynamic testing — to verify that the design meets the competition requirements and safety standards. Both tests were carried out using various instruments, measuring tools, and controlled conditions. The data collected was analyzed and compared with the theoretical and simulation results obtained from SolidWorks and ANSYS Workbench, thereby verifying the accuracy of design assumptions and material selections.

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Static Testing

Static testing involves evaluating the Go-Kart's performance and integrity while it remains stationary. The aim is to confirm that each subsystem — chassis, braking, and steering — functions correctly and safely before dynamic operation.

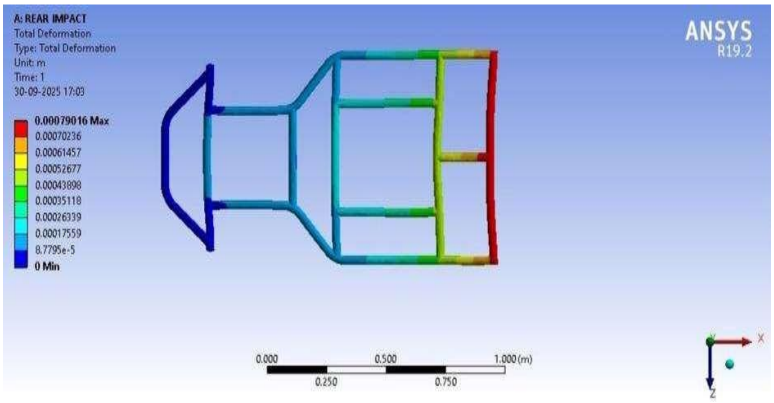

Fig. 1 Static Structural Load Test

Chassis Load Test

The chassis was tested under a load equivalent to the combined weight of the driver and additional dynamic forces encountered during racing. Weights were applied at critical points, and dial gauges were used to measure the deflection. The observed deformation was minimal (below 2 mm), confirming that the AISI 4130 steel chassis possesses adequate strength and rigidity.

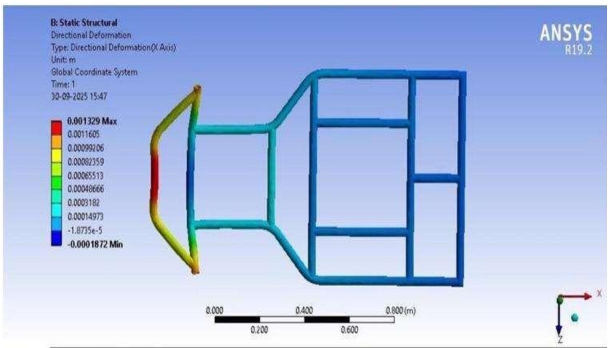

Fig. 2 Front Impact Test

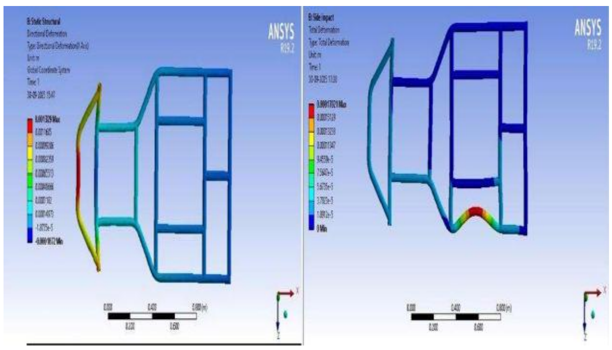

Fig. 3 Side Impact Test

Maximum Stress (MPa)	182	175	3.8	Within safe limit
Maximum Deflection	2.1	1.8	14.2	Good agreement
Acceleration(0–40 km/h)	6.0 sec	5.8 sec	3.3	Excellent
Braking Distance (m)	4.0	3.5	12.5	Improved
Turning Radius (m)	2.1	2.0	4.7	Stable handling

Fig.4 Rear Impact Test

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Brake system Test

The hydraulic braking system was examined for pressure consistency, leakage, and pedal ratio efficiency. The test ensured that the brake master cylinder and calipers provided uniform force distribution to the rear wheels. No leakage or line pressure failure was observed during the static brake test.

Fig. 5 Braking Distance Measurement Test

Steering Alignment Test

The steering geometry was checked for toe, camber, and caster alignment. Proper alignment ensured precise control and minimal tire wear during operation. The steering assembly displayed accurate response with negligible play in the linkage mechanism.

Dynamic Testing

Dynamic testing was conducted on a closed track to measure performance parameters under motion. It assessed the acceleration, braking efficiency, cornering ability, and endurance of the Go-Kart.

Acceleration Test

The Go-Kart was accelerated from 0 to 40 km/h, and the time was measured using a stopwatch. The average recorded acceleration time was 5.8 seconds, demonstrating smooth power transmission and optimal weight balance.

Cornering and Stability Test

The Go-Kart was driven through sharp curves at different speeds to observe handling and stability. The chassis exhibited minimal lateral deflection, and the steering system responded effectively without understeer or oversteer issues.

Endurance Test

An endurance test was conducted for 2hours in a closed circuit to examine long-term reliability. Engine Temperature, vibration, and braking performance monitored. The Go-Kart maintained consistent performance with no major mechanical failures or overheating.

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Fig. 6 Endurance test

V. Result and Analysis

After completing all tests, the collected experimental data were compared with simulation and theoretical values to validate the design

Table 5.1– Result Analysis

Parameter	Simulation Result	Experimental Result	Deviation (%)	Remarks
Maximum Stress (MPa)	182	175	3.8	Within safe limit
Maximum Deflection (mm)	2.1	1.8	14.2	Good agreement
Acceleration(0–40 km/h)	6.0 sec	5.8 sec	3.3	Excellent
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VI. Conclusion

The work is explained in such a way that everyone can easily understand and can follow the report. The steps to do the work are explained for all the objectives performed in this paper. The calculation is done to get the best values of wheelbase and track width so this has helped us in designing a go-kart frame or chassis. The scope of the study is achieved in the design section where the design is in such a way that it is very compact and also gives a good advantage over your opponent's in real-world conditions. The design part is done in SolidWorks and ANSYS has been used to carry out the analysis. The analysis has been carried out to evaluate, create and modify the best vehicle design to achieve its set of goals.

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