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"DESIGN AND MANUFACTURING OF A GO-KART"

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ABSTRACT

This report presents the design, analysis, fabrication, and testing of a high-performance go-kart developed by Team Sagar Seals for national-level racing competitions. The objective was to build a lightweight, durable, and safe vehicle while meeting competition regulations and cost constraints. The chassis was designed using seamless mild steel tubes and validated through Finite Element Analysis (FEA) under various loading conditions to ensure structural integrity and optimum weight distribution. Key subsystems, including steering, braking, power transmission, and ergonomics, were optimized to enhance vehicle performance, handling, and driver comfort. A single-cylinder internal combustion engine was integrated with a carefully designed drivetrain for efficient power delivery. Following fabrication, the go-kart underwent extensive testing, including braking, acceleration, and endurance evaluations. The results demonstrated reliable structural performance, stable handling, effective braking, and consistent power output, confirming the success of the design and manufacturing process.

Key Words: *Gokart, Design ,manufacturing*

I. INTRODUCTION

A go-kart is a small, four-wheeled, single-seater racing vehicle powered by a compact engine. It was first developed by Art Ingels in California in 1956 and has since become one of the most popular forms of motorsport worldwide.
A typical go-kart has no suspension or differential and is raced on dedicated karting tracks. Karting is considered one of the most affordable and safest entry points into motorsports, allowing participants from the age of 8 to develop racing skills. It is popular as both a recreational activity and a competitive sport.

Most go-karts are powered by engines of around 125 cc. In some countries, specially modified karts can be licensed for road use with safety features such as headlights, indicators, tail lamps, and a horn.

This report presents the design and analysis of a student-designed go-kart using SolidWorks and ANSYS Workbench. CAD modeling and simulation were used to design, analyze, and validate various components before fabrication. The virtual analysis helped predict stress, strain, deformation, and component life under operating conditions, reducing manufacturing cost, development time, and material wastage.

The objective of this project is to design a lightweight, safe, and cost-effective go-kart while ensuring structural strength and reliable performance through engineering analysis and optimization.

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II. LITERATURE REVIEW

Several researchers have contributed to the development and analysis of go-karts by focusing on chassis design, structural safety, performance optimization, and cost-effective manufacturing. Previous studies emphasize that a go-kart chassis must provide high rigidity, durability, and driver safety while maintaining a lightweight structure. The principle of triangulation has been widely adopted to improve chassis strength and torsional stiffness. Researchers have also highlighted the importance of selecting suitable materials such as AISI 1018 and mild steel due to their favorable strength-to-weight ratio, weldability, and affordability.

With the advancement of Computer-Aided Design (CAD) and Computer-Aided Engineering (CAE) tools, software such as SolidWorks, CATIA, ANSYS, and HyperWorks has been extensively used for chassis modelling and structural analysis. Various investigations have been conducted to evaluate stress distribution, deformation, factor of safety, and energy absorption characteristics under front impact, side impact, rear impact, and torsional loading conditions. These analyses enable designers to identify critical stress regions and optimize the frame before fabrication, thereby reducing development costs and improving vehicle reliability.

Several studies have also focused on achieving a balance between performance and manufacturability. Researchers have designed torsion-resistant frames that are easy to fabricate while ensuring adequate strength and safety. In addition, efforts have been made to develop low-cost go-karts to promote motorsports by making them more affordable without compromising structural integrity or performance. Vehicle components have been analyzed and optimized for weight reduction, enhanced safety, and improved handling characteristics.

The reviewed literature demonstrates that successful go-kart development depends on effective chassis design, appropriate material selection, detailed structural analysis, and costefficient manufacturing practices. These findings provide a strong foundation for designing a lightweight, safe, and high-performance go-kart capable of meeting competitive racing requirements.

III. METHODOLOGY

The development of the go-kart was carried out through a systematic engineering design process consisting of planning, design, analysis, fabrication, and testing stages. The methodology began with a detailed study of competition regulations, literature review, and benchmarking of existing go-kart designs to establish performance targets and design constraints.

Based on the identified requirements, a conceptual vehicle layout was developed, considering factors such as chassis dimensions, weight distribution, driver ergonomics, steering geometry, braking efficiency, and powertrain configuration. The chassis was designed using AISI 1018 steel tubular members and modeled using SolidWorks CAD software. Critical vehicle subsystems, including the steering system, braking system, transmission system, rear axle, fuel system, and exhaust system, were designed and integrated into the overall vehicle architecture.

Structural validation of the chassis was performed using ANSYS Workbench. Finite Element Analysis (FEA) was conducted under various loading conditions, including front impact, side impact, rear impact, and torsional loading, to evaluate stress distribution, deformation, and structural safety. Vehicle dynamics calculations such as center of gravity determination, load transfer analysis, stability factor evaluation, steering geometry calculations, and braking performance assessment were also carried out to optimize vehicle handling and stability.

The powertrain was designed around a Bajaj Pulsar 150 cc single-cylinder engine. Gear ratio selection, sprocket design, chain drive calculations, and rear axle design were performed to ensure efficient power transmission and desired acceleration characteristics. Steering parameters including Ackermann percentage, camber angle, caster angle, kingpin inclination, and scrub radius were optimized to achieve responsive handling and improved cornering performance.

Following the design and analysis phase, the chassis and associated components were fabricated using cutting, machining, and TIG welding processes. Dimensional inspections were conducted to ensure manufacturing accuracy and proper assembly of all subsystems. The completed go-kart was then subjected to performance testing, including braking tests, acceleration trials, steering evaluation, and endurance assessment. The results obtained from testing were compared with design objectives to validate the vehicle's safety, reliability, and performance.

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The overall methodology ensured a structured and efficient approach to the design and development of a lightweight, safe, and high-performance go-kart suitable for competitive racing applications.

IV. EXPERIMENTAL SETUP

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.

1. 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.

2. 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

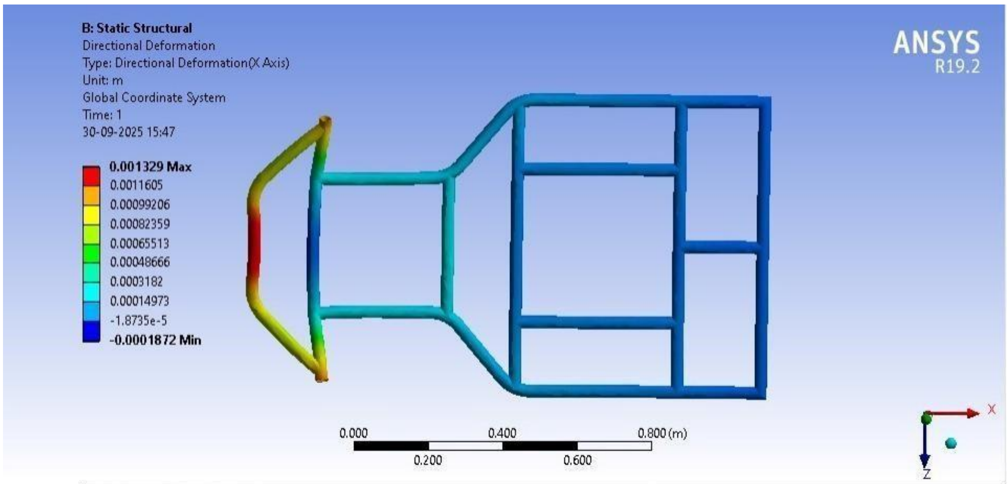

Figure.1 Static Structural Load Test

3. 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.

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4. **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

5. **Braking Test**
   To measure braking efficiency, the kart was driven at **30 km/h** and the stopping distance was recorded.
   The average stopping distance was **3.5 meters**, con firming efficient hydraulic braking performance with excellent grip.

Figure.2: Braking Distance Measurement Test

6. **Endurance Test**

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

Figure.3 Endurance test

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V. RESULT ANALYSIS

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

Table 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
Braking Distance (m)	4.0	3.5	12.5	Improved
Turning Radius (m)	2.1	2.0	4.7	Stable handling

The small deviation values indicate high accuracy in fabrication and close correlation between simulated and actual results.

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