DESIGN AND STATIC ANALYSIS OF GO-KART CHASSIS: A Review

[1] Mr. Chetan Vikram Rakhonde, [2]Dr. Fahim Rahim Sheikh
P.G Research Scholar[1], Assistant Professor2
Department of Mechanical Engineering,
Pankaj Laddhad Institute of Technology & Management Studies, Buldana (MH), India
cvrakhonde1992@gmail.com[1], fahimsheikh786@gmail.com[2]

ABSTRACT

A go-kart is a miniature four-wheel drive vehicle that lacks a differential and suspension. The car is typically utilized for racing and has a light engine. Modeling and dynamic analysis of a go-kart chassis made of circular beams is the goal of this work. Not many people drive them professionally; most of the time, they're driven for fun or as a pastime on smaller tracks. 'The general public views carting as a stepping stone to the more exclusive and costly levels of motorsports. The consensus among motorsports experts is that kart racing is the most cost-effective option. Most people who are new to motor racing start with kart racing since it is a low-cost and safe method to get their feet wet. Adults are just as active as youthful drivers when it comes to karting. If you want to be a serious racer, karting is where you should start. It can assist the driver hone their reflexes, control of the vehicle, and decision-making abilities, all of which are necessary for high-speed wheel-to-wheel racing. Over time, it gained popularity and other nations began to follow suit. The Indian go-karting scene is about to explode. Nagpur has a go-kart track that is ready to go, and Chennai is also attempting to build one. On a smaller scale, Indian companies are now making go-karts. However, the design and technical components of a go-kart must be reduced in price in order for them to become popular. The report details the goals, assumptions, and computations that went into creating a go-kart.

INTRODUCTION

The American go-kart is a basic, four-wheeled, single-seated racing vehicle with a modest motor. The original creators were pilots looking for a pastime activity in the 1950s, during the post-war era. Everyone agrees that Art Ingles was the one who started karting. The inaugural kart was constructed by him in 1956 in Southern California. After that, it started doing well in Europe and the United States. You can't have a Gokart without suspension and differential, it's in the definition. Not many people drive them professionally; most of the time, they're driven for fun or as a pastime on smaller tracks. Many people see karting as a stepping stone to more lucrative and elite motorsports. The consensus among motorsports experts is that kart racing is the most cost-effective option. Almost anybody can enjoy it as a pastime, and anyone from the age of can participate in regulated racing. Most people who are new to motor racing start with kart racing since it is a low-cost and safe method to get their feet wet. Adults are just as active as youthful drivers when it comes to karting. If you want to be a serious racer, karting is where you should start. It can assist hone the driver's skills in quick reactions, precise control of the vehicle, and decision-making, all of which are necessary for high-speed wheel-to-wheel racing. Also, like other types of motor racing, it raises awareness of the different characteristics that may be changed to make the kart more competitive. As a first step in the design process, we modeled all potential system configurations in CAD software and ran them through ANSYS for analysis. The model was fine-tuned, retested, and finally refined according to the analytical results. Several technical considerations, including safety and ergonomics, component cost, market availability, and safe engineering practices, inform the vehicle's design process.

DESIGN OBJECTIVES OF CHASSIS

1. Obtain the necessary strength and torsional rigidity while decreasing weight through careful tubing selection; provide comprehensive protection to the driver.
2. Keep production costs down and design for manufacturability in mind to make sure your Go-Kart can compete with others in the market.
3. Make the driver's compartment more spacious by adding more room on the sides.
4. Keep the chassis easy to service by making sure its parts don't get in the way of other parts.
5. Determination of forces operating on the vehicle's chassis under varying loading circumstances.
6. In every respect, including price, drivability, maintenance, ease of use, safety, etc., the product has the potential to be highly efficient.

LITERATURE REVIEW

Yuvraj Shet and Koustubh Hajare (2016) These have drivers that are highly skilled and precise. Their driving skills are top-notch. Still, there are motor sports that don't necessitate top-tier drivers or particularly high speeds. Also, there are fewer automobiles used. Take go-kart racing, for example. Despite looking like Formula One cars, they're far slower and far cheaper. Also, go-kart drivers aren't really experts in their field.

Qamar Ul Hasan Ammar (2015) A miniature four-wheeled vehicle is known as a go-kart. The lack of a suspension and differential is inherent to the go-kart design. A lot of people see carting as a stepping stone to the more lucrative levels of motorsports. Most people agree that kart racing is the most cost-effective motor sport.

Vrushabh U. Joijode and Shubham Kolhe (2016) A four-wheeled vehicle exclusively intended for racing is known as a Go Cart, sometimes spelled Go-Kart. An internal combustion engine powers this little four-wheeler. This is a scale model of a racing vehicle. The steps and procedures needed to build an affordable go-kart are detailed in this article.

Abhishek O. S. and Kiral Lal (2016) The chassis is a crucial part of the kart since it acts as a suspension in the front and provides excellent grip via flex. Without suspension, karts are typically barely larger than the space required to place a driver's seat.

Nikunj and Alpesh V. Mehta (2011) The fiber acts as a structural element, bearing the load, while the matrix phase can only withstand a minimal amount of stress. Not only is the matrix material ductile, but it also prevents surface damage to the individual fibers by shielding them from mechanical abrasion and chemical reactions with the environment.

METHODOLOGY

To ensure the driver's safety, the roll cage primarily serves to create a three-dimensional enclosed environment surrounding the driver. Reliable component mounting locations, aesthetic appeal, affordability, and light weight are its secondary goals. We achieved these goals by selecting a roll cage material that is both strong and lightweight, which gave us an upper hand in terms of weight reduction. To create a roll cage at a reasonable cost, we opted for certain materials and used more continuous members with bends instead of a bunch of welded-together ones. This design is used to model the roll cage construction, which is then verified using Finite Element Analysis. In order to enhance the vehicle's performance without compromising the roll cage, we have paid close attention to every detail of it. Before diving into the design process, we used finite element analysis to learn all we could about go-kart roll cages.

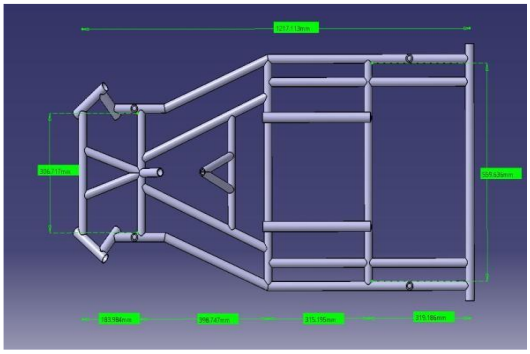

Figure 3.1: Dimensional chassis

Analyzing Finite Element Models Checking the analysis result against the material standard values ensures the frame's structural integrity. The analysis was carried out using the ANSYS software and finite element analysis (FEA). After importing a preexisting chassis design into the computer, finite element analysis was used to determine stresses through the simulation of three distinct induced load instances. Three different types of impacts were modelled: frontal, side, and rear. The deflection was found to be within the allowed limit according to the test results.

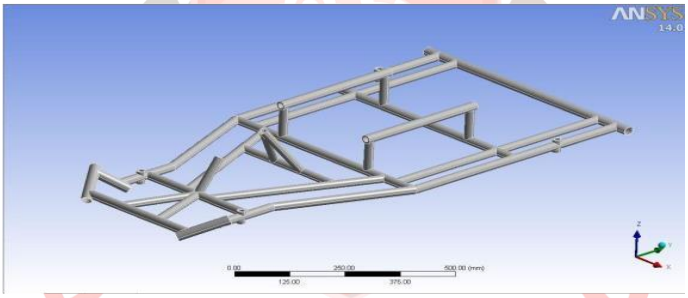

Figure 3.2: Ansys Go-Kart Frame

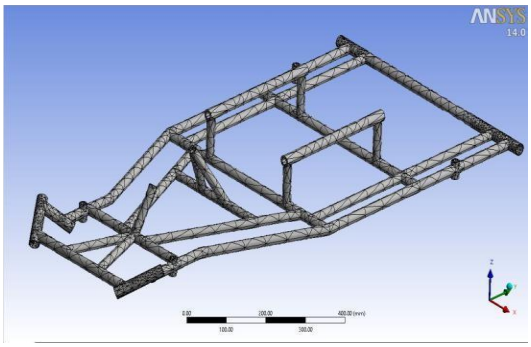

Figure 3.3: Model for meshing

The roll cage is the structural backbone of every vehicle, supporting and attaching the main and secondary components. Due to the lack of suspension, the primary design aspect for a go-kart's roll cage is its flexibility, which serves as suspension when the vehicle is in motion. We surveyed the market and found two materials that met the criteria: AISI 1018 and AISI 1045, both of which have pipe cross-sections and are known for their

excellent strength and flexibility. Although every material has its own set of characteristics that make it suitable for a certain application, we settled on AISI 1018 due to its high strength and pliability under stress.

Properties Material	AISI 1018	AISI 1045	AISI4 130	Aluminium alloy
Modulus of Elasticity (Gpa)	205	200	210	71
Caron Content %	0.15-20	0.20-23	0.28-33	0.20-27
Yield Strength (Mpa)	370	375	435	280
Ultimate Strength (Mpa)	440	400	560	310
Density (kg/m 3)	7.87×10^3	7.70×10^3	7.85×10^3	2770

Table 3. 1: Applied materials and their characteristics

There are four main considerations when choosing a material: price, availability, weight, strength, and weldability. You can find tube in the following common fractional diameters, down to the eighth of an inch: 1, 1, 12, 1, 25, and 1.5. Standard Birmingham Tubing Gauges are the only acceptable wall thickness measurements.

STATIC STRUCTURAL ANALYSIS RESULTS

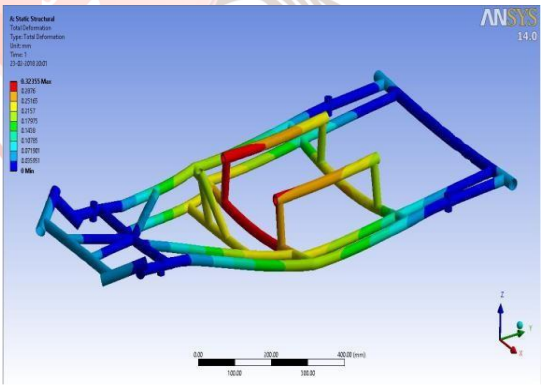

Figure 4.1: The AISI 4130 material's total deformation

When we put 150 kg of stress on the frame made of AISI 4130, as you can see in the image above, it completely deformed. Deformation, stress, and strain are among the several options that appear when we right-click on an ANSYS solution. Additionally, we can acquire the values in a variety of forms. You can see the consequent distortion in the above image, which is selected in these values. Maximum deformation is shown by the color red in these. The dark blue indicates the least amount of distortion. At the base of the sole, where we have applied all of the degrees of freedom, we see the least amount of frame distortion. Additionally, the red area on the top of the sole shows the maximum distortion, which is 0.32353 mm.

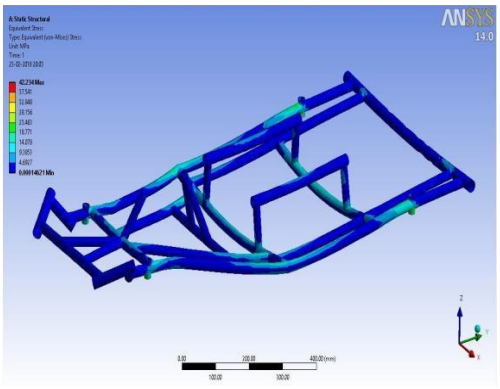

Figure 4.2: Footwear with AISI 4130 Sole Stresses

A picture showing the Von-Mises stresses in an AISI 4130 frame is up there. In common parlance, these stressors are also known as aftermath stresses. The yield point of the material should be less than the stresses experienced by the frame. The strains caused by applying a load of 150 kg are shown in the image above. The corners of the limited base show the highest stresses. The frame's stress value of 42 MPa is less than the material's yield stresses.

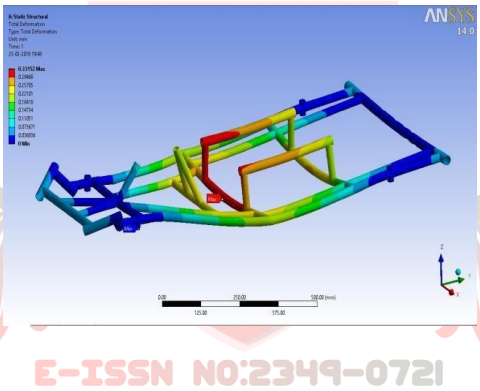

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Figure 4.6: Deformation of AISI 1018 material

The complete frame deformation caused by the AISI 1018 material is shown in the image above. Maximum deformation is shown by the red hue in this figure, while minimum deformation is shown by the dark blue tint. The uppermost edges of the frame showed the most distortion. The upper ends of the frame experienced the least amount of deformation, with a value of 0.33152 mm.

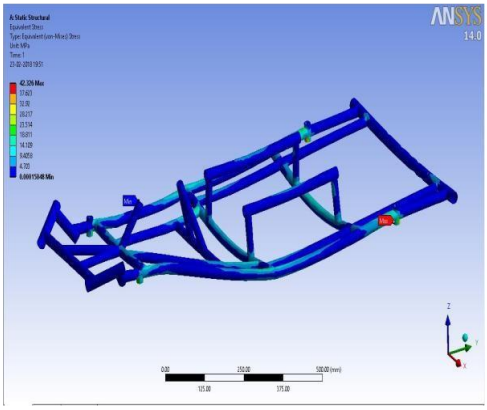

Figure 4.7: Frame stresses in AISI 1018

The aforementioned picture displays the highest stresses that can be found in an AISI 1018 frame. The red hue represents the highest strains and the dark blue color represents the lowest stresses when we put a 150 kg load on the frame. Where the frame is limited at the bottom, you can see the highest strains. However, these numbers fall short of the yield material. You can see the lowest stresses all throughout the picture, while the highest stress is 42.326 MPa.

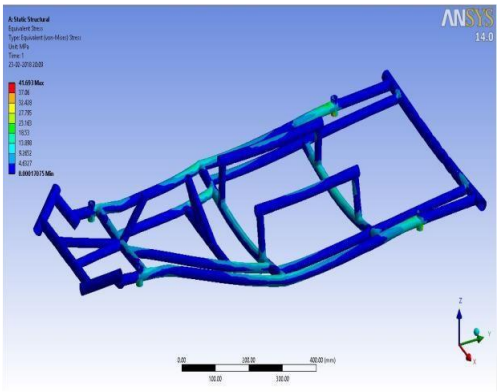

Figure 4.11: Frame stresses that are made of aluminum

We subjected the AISI 1045 frame to a load of approximately 150 kg, as depicted in the next photograph. Similar to other materials, stresses do develop in the confined areas of the frame's corners, however the values of these stresses are far less than those of ordinary materials. We can get a maximum stress value of 42.326 MPa. In the majority of the frame's regions, the strains are little.

CONCLUSION

We were able to effectively conduct static analysis using the finite element approach to calculate the maximum deflection and its position on the chassis structure. Findings from the analysis corroborate the maximum placement of the simple beam, which is consistent with theory. Results from this research show that Low Carbon Steel and Aluminum materials are very similar in value. Therefore, either material can be utilized according to the design and requirements. Each part of the go-kart was meticulously engineered to resist a wide range of potential failures and safety concerns, making it the ideal vehicle for circuit racing. The kart roll cage is designed to be extremely flexible in a small bending action so that it can act as a suspension during turns and other twisting motions, as karts do not employ suspension.

FUTURE SCOPE

Go-Karts are now only enjoyed for leisure in India. However, there are car companies that make street-legal, high-performance go-karts. Take, for instance, the Ariel Atom and the KTM X-Bow, both produced by the Ariel Motor Company. Therefore, Go-Karts can be a people-mover in the future because they are safe and provide a great deal of comfort.

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