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Design & Fabrication of Utility Go-Kart

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A B S T R A C T

This thesis deals with the design and fabrication of Go-kart chassis. The objective of this thesis is to design and fabricate a go-kart chassis of the go-kart. The main problem is the cost for current go-kart chassis is too costly so the project is decide to fabricate with a lower cost. The scopes identified chassis design should bear load of <200kg and the go-kart chassis must with floor dimension of chassis is 900mm x1493mm. There are many steps taken to design and fabricate this chassis. The first stage is did some literature review about the existing go-kart and go-kart chassis. Mostly current model of go-kart chassis is made from tabular pipe. Hence, this project is to modify the current model of go-kart chassis into a model that is easier to design, build and modify. Follow up with some designing and sketching. During this phase design had been sketched to be as the design concepts. The structural three dimensional solid modelling of go-kart chassis was developed by using Catia V5 engineering drawing software. After done with the design and sketch, conceptual process is done. Design is lightweighted and easier to design, build and modify. Some modification is done on design where, the go-kart chassis is more space saving and the design has provided protection to the users to prevent the user from accident while driving of the go-kart. Next stage after finalize the design, the project is continued with fabrication process. The fabrication process also undergoes many steps such as material marking, cutting, drilling, welding, grinding and finalizing the go-kart chassis by painting to make a go-kart chassis more interested. Thus, by finishing this project, the objective of the project achieved. Finally, the conclusion about this project and the recommendations for the future plan has been sattached together with this thesis.

INTRODUCTION

Project Background

Go-kart was born from United States in 1950s, where the engine mainly from discarded lawn engine. Go-kart is racing miniature, skeleton frame, and rear engine automobiles called karts. Go-kart was a non popular sport previously, but today it has become one of the most popular sports by multiple group age. Now days, racing go-karts are considered as one of the most economic activity where a large number of people can participate. We regularly hear about motorsports racing such as formula one, NASCAR, rally art and many more. Those motorsport activities are out of reach of the average people because of strict regulations and high cost. But apparently, go-kart motorsport gives chances to public to get involved in legal racing with no restricted age and low budget needed. Seven times formula one World Champion; Michael Schumacher started his involvement in motorsports with karting. He joined go-kart motorsports at his hometown, Germany and won first go-kart championship when he was 19 years old. All go-karts look alike, but the fact is go-kart have its own classes such as sprint kart, road racing kart, indoor karting

and speedway karting. In 2 addition, with small engine and skeleton frame go-karts speed can reach up to 100 miles per hours and stand a weight up to 210 pounds. In figure 1.1 and figure 1.2 show the different between old version go-kart and now day go-kart.

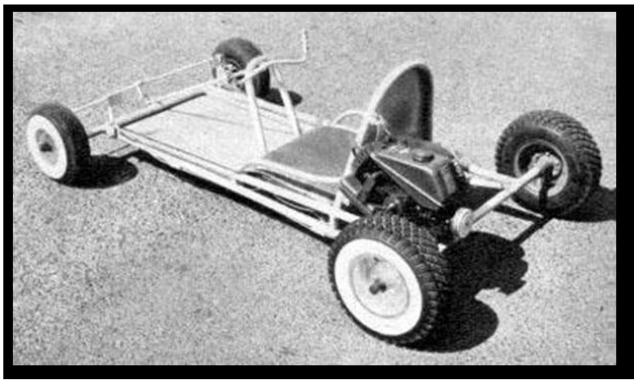

Fig. 1.1: Old Version Go-kart

Fig.1.2: Go-kart

The development in karting has been expanded rapidly together with advanced technology. As this motorsport become popular among citizens, those go-karts manufactures started to do more research and development to improve the go-kart in terms of the chassis design, speed, braking system and transmission system. Today is go-kart frames are made from lighter iron, chromoly and others which is more durable and it can absorb more vibration even if it has no suspension. Designers, engineers and others have involved directly towards new achievement in

improving all aspects in the go-kart. The usage of advance technology in manufacturing is widely utilized to invent a better go-kart.

Literature Review

A chassis of Go-Kart mainly consists of an internal framework that supports a man-made object in its construction and use. An example of a chassis is the under part of a motor vehicle, consisting of the frame (on which the body is mounted). If the running gear such as wheels and transmission, and sometimes even the driver's seat, are included then the assembly is described as a rolling chassis. The chassis of Go-Kart takes a load of the operator, engine, brake system, fuel system and steering mechanism, so chassis should have adequate strength to protect the operator in the event of an impact. The driver cabin must have the capacity to resist all the forces exerted upon it. This can be achieved either by using high strength material or better cross sections against the applied load .But the most feasible way to balance the dry mass of chassis with the optimum number of longitudinal and lateral members. The chassis must be constructed of steel tubing with minimum dimensional and strength requirements dictated by ASME (AMERICAN SOCIETY OF MECHANICAL ENGINEERS).

American Art Ingels is generally accepted to be the father of karting. A veteran hot rodder and a race car builder at Kurtis Kraft, he built the first kart in Southern California in 1956.[2] Instantly popular, Karting rapidly spread to other countries,[3] and currently has a large following in Europe.

The first kart manufacturer was an American company, Go Kart Manufacturing Co. (1958). In 1959, McCulloch was the first company to produce engines for karts. Its first engine, the McCulloch MC-10,[4] was an adapted chainsaw two-stroke engine. Later, in the 1960s, motorcycle engines were also adapted for kart use, before dedicated manufacturers, especially in Italy (IAME), started to build engines for the sport.

Racing go karts have evolved over the past 50 years to become one of the most competitive forms of motor racing in the United States. Kart racing has been a "stepping stone" for many drivers working their way up the professional ladder in NASCAR, Formula 1 and the Indy Racing League. Drivers like Tony Stewart, Danica Patrick, Michael Schumacher and Sarah Fisher each got his or her start in this less expensive but adrenaline pumping form of motorsports racing. As a recreational activity, karting can appeal to just about anyone. From age 5 to 75, racing go karts have become popular all over the world with people looking for an exciting way of having fun. In fact, many amusement parks have added rental racing go karts (called concession karts) that use detuned 4-stroke go-cart engines for a milder experience.

Most karting historians give credit to Californian Art Ingels as the first person to build a racing go kart, originally called a go-cart. It did not take long for this fad to catch on and go-cart tracks started to pop up all across America. By the late 1950s, an American company modified a 2-stroke chainsaw motor and the McCulloch MC-10 became the first motor manufactured specifically for go-cart racing. Today, engines used in kart racing are generally split into two classifications: 2-stroke or 4-stroke motors. The majority of 2-stroke kart racing engines is now manufactured in Italy, the European home to large karting companies like IAME, Birel, Tony Kart & CRG. Racing engines have become very sophisticated with some capable of 20,000 rpm. On the other hand, the 4-stroke motors

used in kart racing and recreational karting have mostly been adapted from the standard lawnmower engine. The 4-stroke kart racing engine provides an affordable alternative to the more powerful 2-stroke motor

The actual design of a kart chassis depends upon the type of recreational karting or kart racing event. Racing Go Kart chassis for sprint tracks (a scaled-down road course with left and right corners) are built square. On the other hand, drivers that prefer oval-track kart racing have the option of running an offset racing go kart chassis for an on-track performance advantage when you only have to turn left. Karters who participate in "Enduro" racing in the United States can opt for sprint-kart chassis or the more popular class of laydown kart chassis with an overall height that is much lower to the ground. Some speedway kart racing and oval track events offer classes for a caged racing go kart with a full rollover bar providing the racing go kart driver with additional protection, seat belts and fire extinguisher. Concession karts and bumper karts have a protective bumper surrounding the entire racing go kart.

Components of Go Kart

Chassis

The chassis are made up of mild steel square rods & there is no suspension, therefore chassis must be flexible enough to work as a suspension and stiff enough not to break on a turn. Open karts have no roll cage.

- Caged karts have a roll cage surrounding to the driver;and they are mostly used on dirt tracks.
- In straight chassis the driver sits in the center. Straight chassis generally are used for sprint racing.
- In offset chassis the driver sits on the left side.

The stiffness of the chassis enables the different handling characteristics for the different circumstances. Basically, for dry conditions a stiffer chassis is preferable, while in the wet conditions, a more flexible chassis may be work better..

Braking is achieved by the disc brake mounted on the rear axle. Front disc brakes generally are used in most shifter kart classes and are increasingly popular in other classes too; however, certain classes do not allow them.

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Fig: Kart Chassis

Engine:

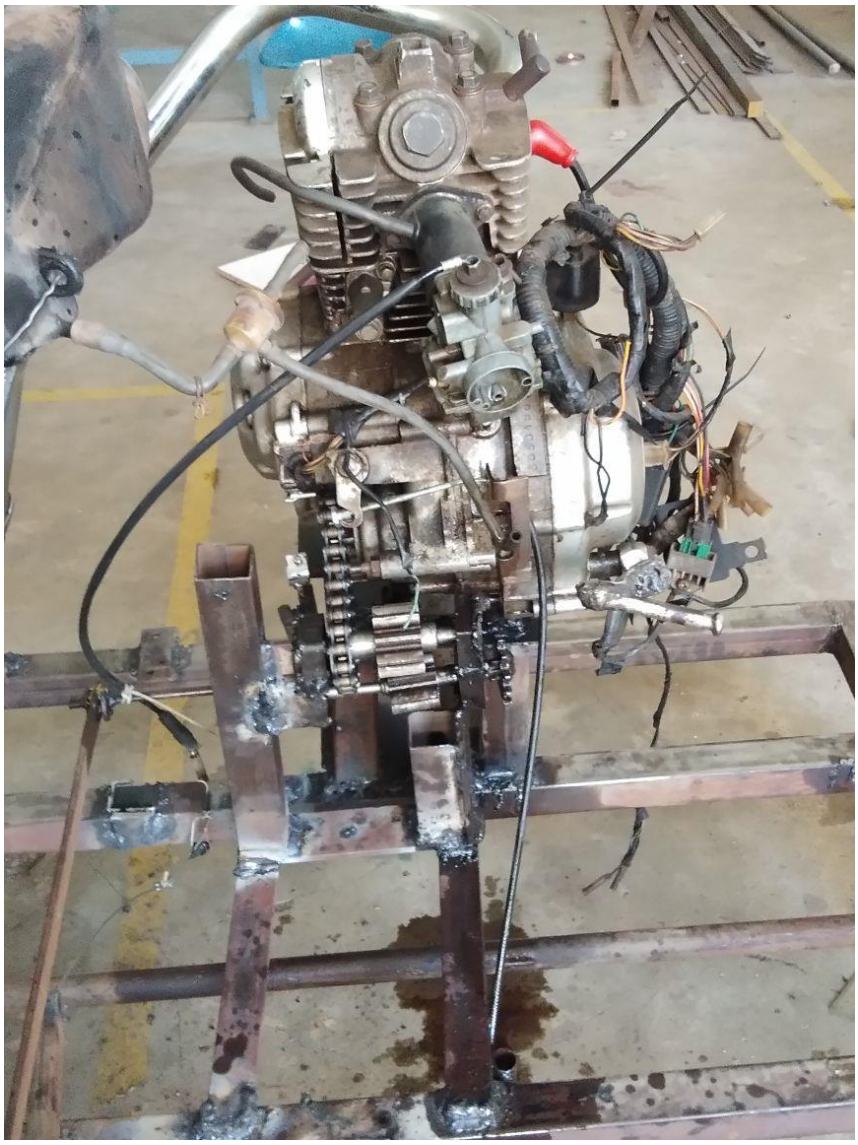

Fig: Kart Engine

- Amusement park go-karts can be powered by 4-stroke engines or electric motors, while racing karts use small 2-stroke or 4-stroke engines.

- 4-stroke engines can be the standard air-cooled industrial based engines, sometimes with small modifications, developing from about the 5 to 20 hp. Briggs & Stratton, Tecumseh, Kohler, Robin, and Honda are the manufacturers of such engines. They are adequate for racing and the fun kart applications. There are also more powerful four-stroke engines available from the manufacturers like Yamaha, TKM, Wankel engine offering from 15 hp up to 48 hp. They run to and around 11,000 rpm, and are manufactured specifically for karting. Those are used in some National Championship classes like the two-strokes.
- 2-stroke kart engines are developed and built by dedicated manufacturers like WTP, Comer, IAME (Parilla, Komet, Woltjer), TM, Vortex, Titan, REFO, TKM, PRD, Yamaha and Rotax are manufacturers are of such engines. These can develop from about 8 hp for a single-cylinder 60 cc unit to over 90 hp for a twin 250 cc.

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Transmission

Karts do not have a differential, the lack of the differential means that one rear tire must slide while cornering; this is achieved by designing the chassis so that the inside rear tire lifts up slightly when the kart turns the corner. This allows the tire to lose some of its grip and slide off the ground completely.Power is fully transmitted from the engine to the rear axle by a chain. Both engine and axle sprockets are removable.

Tires

Wheels and tires are the much smaller than those which used on a normal car. Rims are made up of composite materials. Tires can support cornering forces in excess of (20 m/s²), depending on chassis, engine, and motor setup. Some car tire manufacturers, such as bridgestone, dunlop, and maxxis make tires for the karts. There are also specific kart tire manufacturers, which include MG, MOJO, Vega, Hoosier and Burris.Similar to other motorsports, kart tires have different types for the use appropriate to track conditions:

METHODOLOGY

CAD Modeling

The go-kart will be modeled using CAD software when the go-kart design and its specifications will finalized. The CAD model may need to be remodel if the results of the FEA do not meet with the predetermined requirements. In this phase, all the required detailed engineering drawings for the manufacturing prototype of the go-kart are prepared.

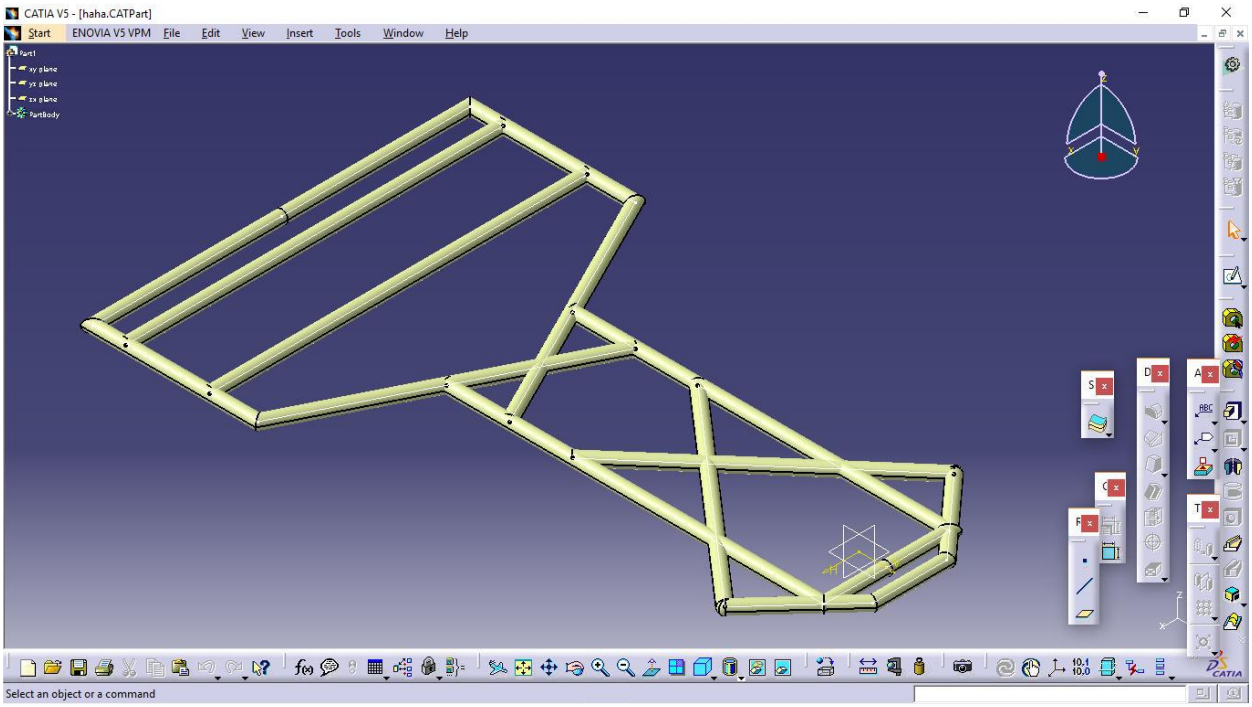

Fig. Cad Modeling

Finite element analysis

The finite element analysis (FEA) used numerical methods that can be applied to approximate solution for an engineering problem .The approximate solution is obtained by the idealized a product model by splitting it into as many small discrete pieces .This dividing process is generally known as mesh generation. Each of the generated elements has the exact equations that define how it reacts to certain load. Hence, the accuracy of the solution can be increased by refining the mesh generation.

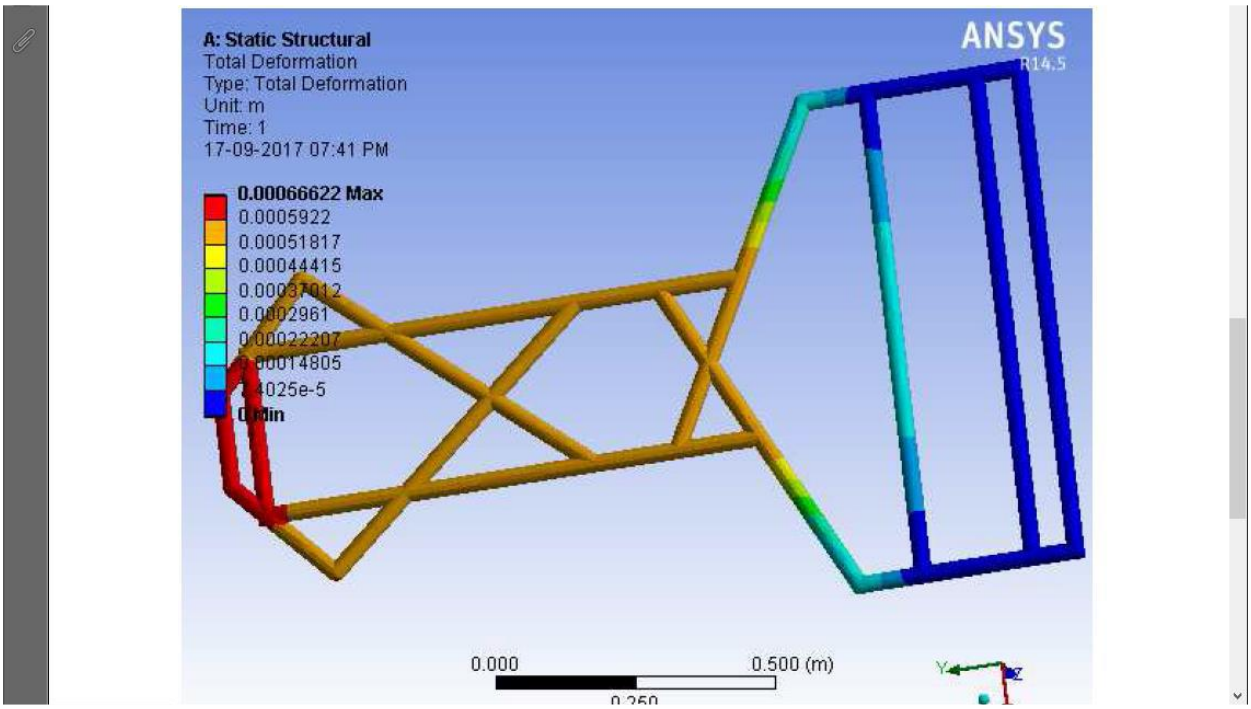

Fig. Finite Element Analysis

Prototyping

This is the last phase of this project where the prototype of the go-kart has been constructed based on finalized detailed of engineering drawings.

Result And Discussion

The key to good chassis design is that the further mass is away from the neutral axis the more ridged chassis will be. This one sentence is basis of automotive chassis design**.** This study attempted to analize stress on the chassis design using finite element analysis . This is important because the simulation data are useful for further design improvement and subsequently leads to the cost effectiveness.

The table below show all the results of analysis done on the chassis of Go-kart successfully :-

Analysis	Result
Vertical Loading	Safe
Front Impact	Safe
Reae Impact	Safe
Side Impact	Safe
Four Sided Impact	Safe
Vibrational (nodal)	Studied
Torsional	Studied

Table: Result And Discussion

Fig. 9.1 Chassis

Fig. 9.2 Chassis with Wheels mounted on it

Fig. 9.3 Complete Fabricated Chassis

Fig. 9.4 Back View of Complete Chassis

Fig. 9.5 Final Go- Kart

Conclusion:

Static analysis using the finite element method was successfully carried out to determine maximum deflection and its location on the chassis structure. The results of the analysis has revealed that the location of the maximum deflection agrees well with the theoretical maximum location of simple beam. This study found out that there is discrepancy between that of theoretical (2-D) and numerical (3-D CATIA V5) results.

Future Scope:

As of now, The Go-Karts are only used for recreational purposes in India, But there are Automobile manufactures which produce high performance Go-Karts which are street legal. For example, Ariel Atom manufactured by the Ariel Motor Company and KTM X-Bow manufactured by the KTM. So in the future, Go-Karts can be used as a people's mover, which are safer and gives high comfort to user.

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