UNIVERSITI MALAYSIA PAHANG ◆

BORANG PENGESAHAN STATUS TESIS

JUDUL: DESIGN AND FABRICATION OF GO-KART CHASSIS

SESI PENGAJIAN: 2012/2013

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CHAPTER 1

INTRODUCTION

1.0 Introduction

This chapter it will explains about the project background, project objective, project scope and the project flow that been conducted. Besides that, it also consists of flow chart and Gantt chart of the project which explains the overall procedure and how time is being distributed for this project.

1.1 Project Background

Go-kart or karting was born from United States in 1950s, where the engine mainly from discarded lawn engine. Go-kart is a driving and racing miniature, skeleton frame, and rear engine automobiles called karts (DiNozzi. B, 1999). Go-kart is 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 (McCauley. J, 2008). 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

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.

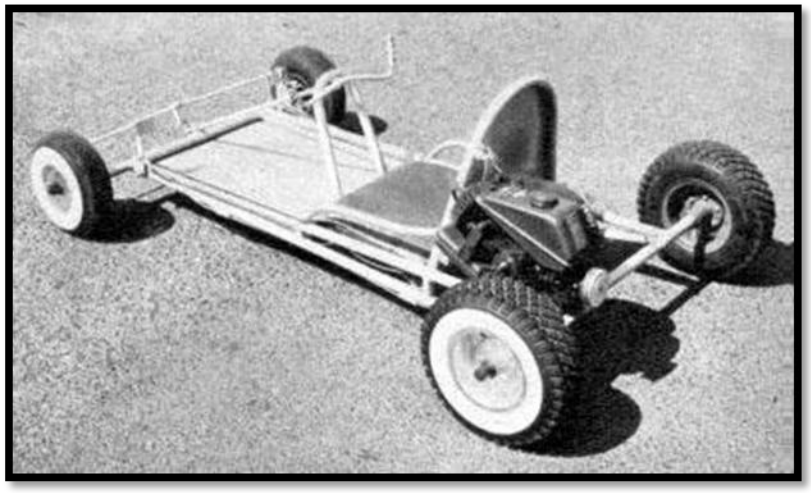


Figure 1.1: Old Version Go-kart

(www.rc-trucks.org)

Figure 1.2: Go-kart

(www.tornadoDriver.com)

The development in karting has 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.

1.2 Problem Statement

The problem statement of this project is:

(i) To improve the skill and knowledge of Mechanical engineering student in designing and importance of project developing go-kart.

(ii) The cost for current go-kart chassis is too expensive.

1.3 Objective

The objectives of the project are as follow:

(i) To design a go-kart chassis.

(ii) To fabricate a go-kart chassis.

1.4 Scope of Project

The scopes of project are as follow:

(i) Create conceptual design by using solid works.

(ii) Chassis design should bear load of 150kg.

(iii) The go-kart chassis with floor dimension of chassis is 1400mmx830mm.

1.5 Project Planning

Figure 1.3 is the flow chart of the whole Final Year Project. To start this project, an appointment with the supervisor is done to understand about the project title given and manage the schedule of weekly meeting. The meeting with supervisor was set up on Wednesday every week.

Problems are then indentified and objective and scopes of the project is then fixed. Designing phase starts off by sketching few designs and models of go-kart chassis by using manual sketch on A4 papers. Then, analyses the designs and choose an appropriate design to finalize. Next, propose the design to the supervisor. After that, convert the design to the three dimensional drawing using Solid Works software.

The preparation of mid-presentation of the project is next. Before presenting, the supervisor will see through the presentation slides and comment on corrections to be made. Then, the presentation on the knowledge attained and instilled in the design phase is presented to the three panels of judges.

Following up, is the survey for the materials is needed. The modification is done on the design so as the model chassis will operate better. Once receive the materials, start the fabrication of the go-kart chassis. Fabrication starts with the measuring of the materials and follow up by cutting of the materials, welding the parts together, grinding to get finishing the project and lastly painting the go-kart chassis.

After that, the final report writing and presentation will be the last task to be accomplished before semester break. The supervisor will review the final presentation and revise the mistakes to be amended. The final presentation then again will be presented to three panels. A draft report would then be submitted to the supervisor to be point out the flaws. Corrections are done and the real final report is handed over as completion of the final year project.

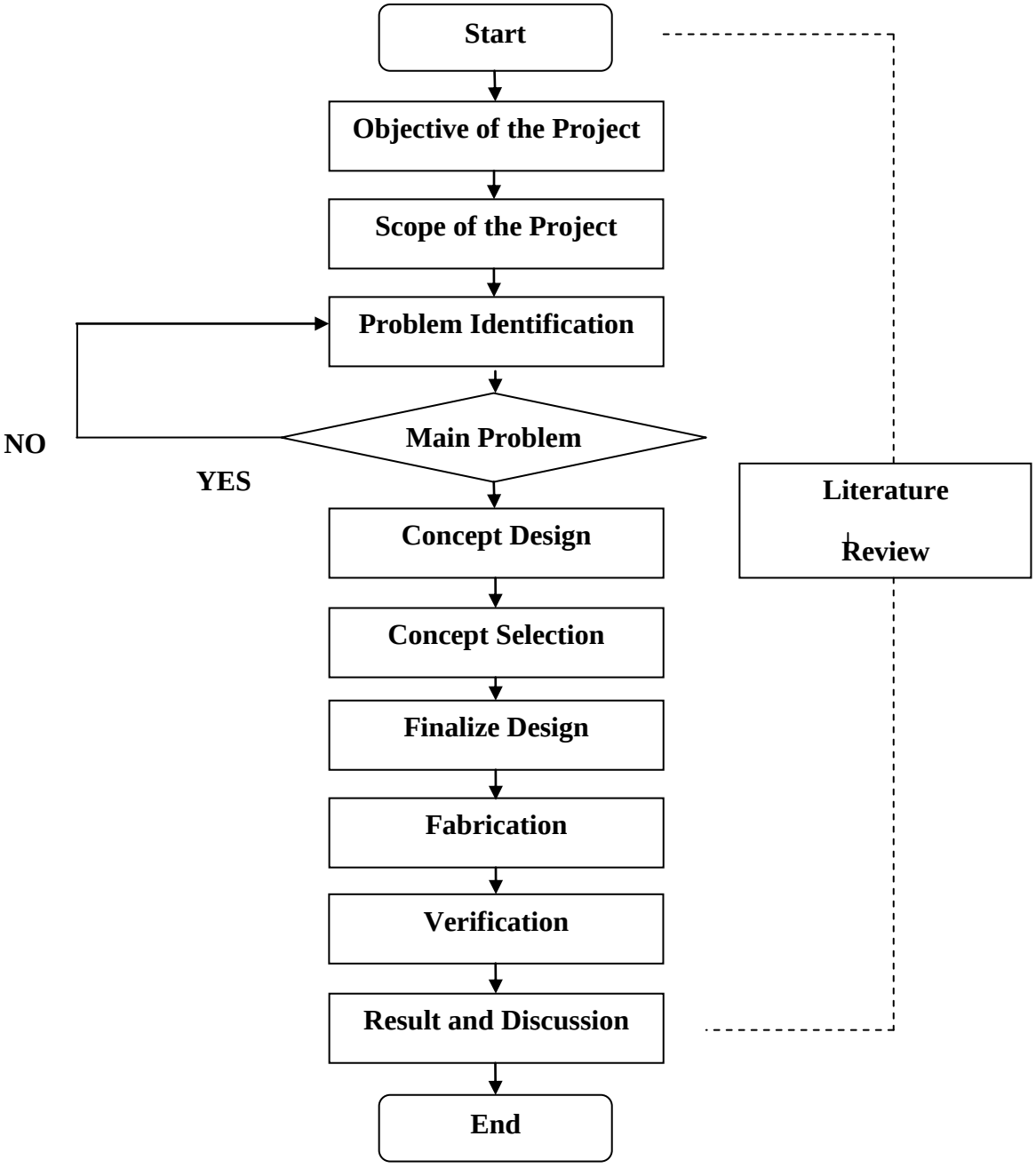


Figure 1.3: Project Flow Chart

Gantt chart of this project is shown in figure 1.4. Gantt chart would show the planning and the actual progress of the final project. It will show the difference between the planning of the project and the actual progress of it thus allowing a comparison to be made between two.

As shown in the Gantt chart, the time used for concept design was longer than expected. This was because of the incompatibility of the laptop to design the chassis. The laptop could not afford to install the suggested, Catia and the design process has to be done using Solid Works. Besides that, the go-kart chassis dimension must fixed with other team members tasks so it took a longer time to create a new concept that can be fixed with other member teams.

The time used for literature review was also shorter. This was because more focus has to be given to conceptual design and fabrication process that were delayed due to causes that cannot be prevented.

The fabrication of the go-kart chassis also took longer time than expected because of the limited choices of material that faculty has. The fabrication process of the go-kart chassis also took a longer time because the facilities provided at the workshop is not enough to be done at the appointed time for example cutting machine problems and anything that the problems that can contribute to this factor.

Other than that, the preparation for final report also started late. It was due to uncertainties that are caused by the delay of the fabrication process. This is because the presentation of most of the chapters for the final report has to base on the fabricated product.

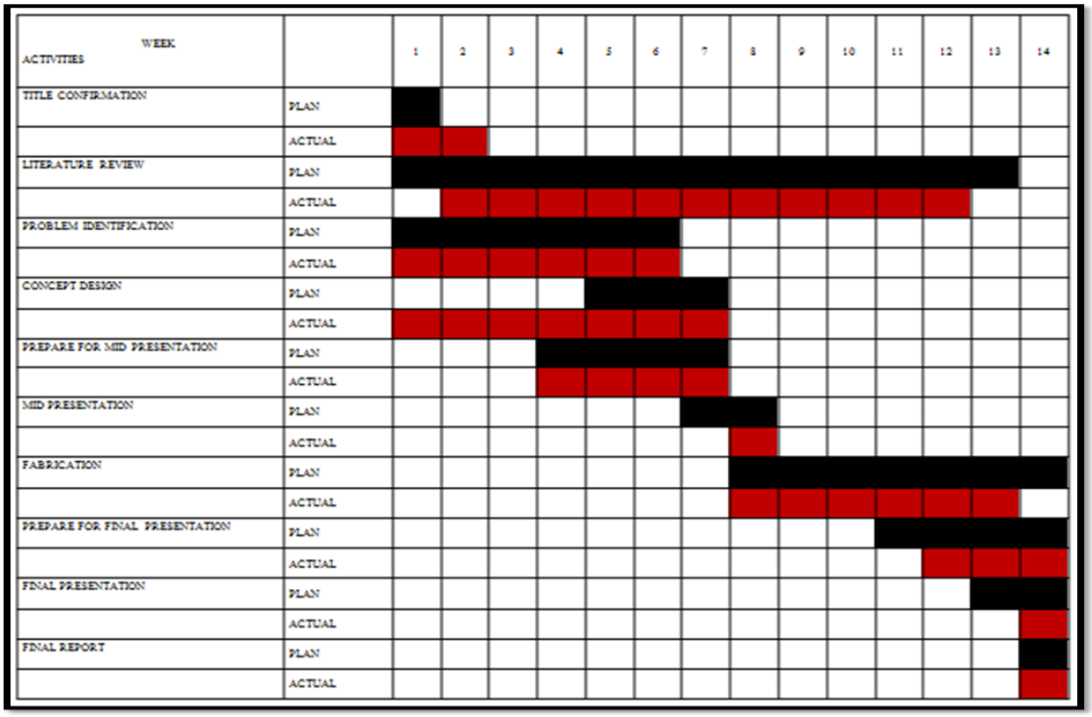


Figure 1.4: Gant Chart

1.6 Thesis Outline

In Chapter 1 it would explain about problem identifications, objectives, scopes, flow chart and Gantt chart. In this chapter also contain planned the direction of my final year project.

In Chapter 2 it will go through the literature review of the go-kart chassis. This chapter will discuss about reviewing study about the Go-kart chassis and the theory about chassis.

In Chapter 3 it will explain about the Design Concept and Selection of the project. This chapter will discuss more about the concept that I have come out with and the selection of project to fabricate the go-kart chassis.

In Chapter 4 would go through the fabrication process of the selected design, the tools and machine that were used for fabrication would also be discussed.

In Chapter 5 would then go detail on the final product that has been fabricate. The fabricated product would explain the go-kart chassis and it would also be shown. The result and discussion of the project would also be done in this chapter.

In Chapter 6 it contains the conclusion about the project. This chapter would conclude the project and give some recommendation on future similar projects.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

In this chapter explains about literature review would be done, which include the theory about go-kart chassis. Usually a go-kart or owner who wants to improve the handling of the vehicle will purchase the latest in wheels, tires and other optional equipment, but end up finding that those things in fact handles worse. The first stage in achieving a good handling kart that will provide the greatest percentage of power efficiency is to go right back to basics.

The chassis is the framework of any vehicle. The suspension, steering, and drive train components such as engine, transmission, and final drive components are mounted to the chassis. The chassis would have to be strong and rigid platform to support the suspension components (James D. Halderman). Furthermore, the constructions of today are vehicles require the use of many different materials. Chassis of go-kart is not much different from normal car chassis; in fact it is much less complicated. The different in size and weight make go-kart chassis much easier to design and construct.

2.1 Chassis Design

A typical dictionary definition of chassis usually includes terms such as framework on which body or working parts of a vehicle, radio or television are built. There are three basic design used today: frame, unit body, and space frame construction.

2.1.1 Frame Construction

The frame construction usually consists of channel-shaped steel beams welded and fastened together. The frame (chassis) of vehicle will supports all the running gear mounted on it, it also including the engine, transmission, rear axle assembly (if rear wheel drive), and all the suspension components.

The type of frame construction that is referred to as full frame, is so complete that most karts can usually be driven without the body. Terms and label of different kind of frame are as follows:

i. Ladder Frame

This type of frame is common for the type of perimeter frame where the transversely (lateral) connected members are straight across. Figure 2.1 shown as ladder frame sample where viewed with the body removed. The frame resembled a ladder viewed from top.

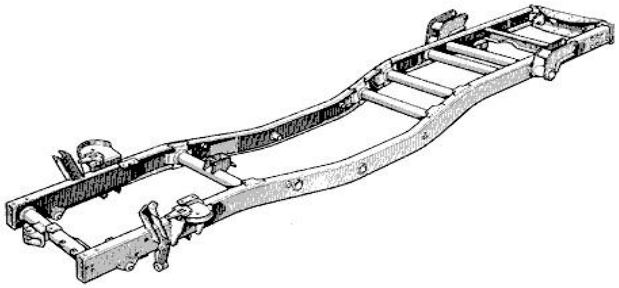


Figure 2.1: Ladder frame of common vehicle.
(Source from *Automotive Chassis System*)

ii. Perimeter Frame

This type of frame consists of welded or riveted frame members around the entire perimeter of the body as shown in Figure 2.2. The frame members will provide support underneath the sides as well as for the suspension and suspension components.

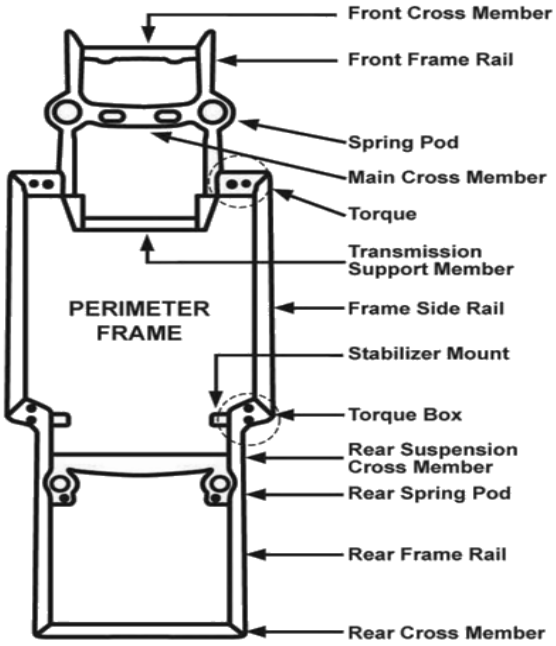


Figure 2.2: Perimeter frame of common vehicle.
(Source from *Automotive Chassis System*)

iii. Stub-Type Frame

Stub-type frame shown in Figure 2.3 is a partial frame often used on unit-body vehicle, a type of vehicle construction, first used by the Budd Company of Troy, Michigan, that does not use a separate frame. The body is built strong enough to support the engine and the power train, as well as the suspension and steering system. The outside body panels are part of the structure to support the power train and suspension components. It is also called cradle.

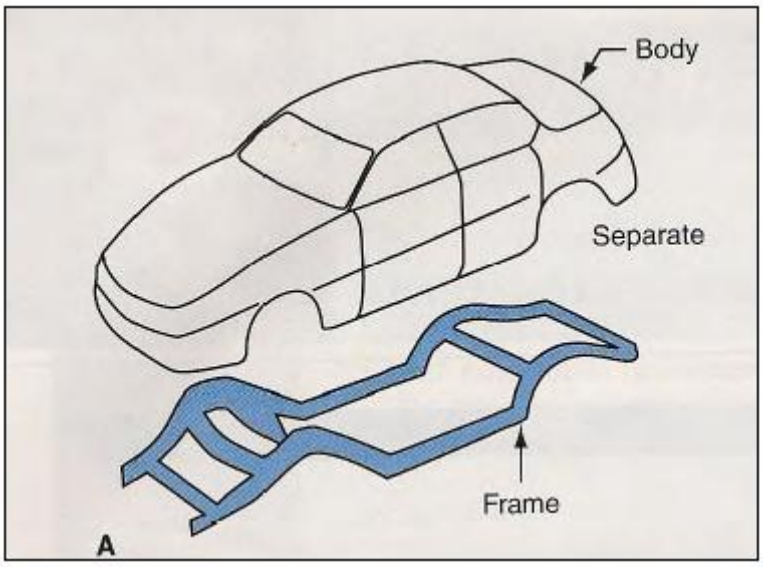


Figure 2.3: Stub-Type Frame of common vehicle.

2.1.2 Unit-Body Construction

The Unit-Body Construction is sometimes referred as unibody that is designed in such a way that the body is combined with the structure of the frame. The body itself also supports the engine and driveline components, as well as the suspension and steering components. The body is composed of many individual stamped steel panels welded together.

The strength of this type of construction lines is in the shape of the assembly. The arrangement of parts to be jointed or formed not only provides sufficient strength to withstand high stress but also the stability of the vehicle during any performances. The typical vehicle uses 300 separate and different stamped steel panes that are spot-welded to form a vehicle`s body.

2.1.3 Space Frame Construction

A space frame construction is a type of vehicle construction that uses the structure of the body to support the engine and drivetrain as well as the steering and the suspension. The outside body panels are non-structural it consists of formed sheet steel used to construct a framework for the entire vehicle. The vehicle using this type of framework is drivable without the body. It would only uses plastic or steel panel to cover the steel framework.

2.2 Platform

The platform of any vehicle is it basic of the shape and size. The various vehicle of different can make a share with same platform and therefore many of the same drivetrain and suspension and also the steering components.

The platform of a unit-body vehicle must includes all major sheet-metal components that form the load-bearing structure of vehicle, which include the front suspension and the engine supporting sections. The area separating the engine compartment from the passenger`s seat is variously called bulkhead, cowl panel, dash panel, or firewall. The height and location of this bulkhead panel to large degree to determine the shape of the rest of the vehicle.

The other components of the vehicle platform design that affect handling and ride are the track and the wheelbase of the vehicle the track of a vehicle is distance between the wheels, as viewed from the front or rear. A wide-track vehicle is a vehicle with a wide wheel stance this can increases the stability of the vehicle especially when cornering. The cornering is most important want to create a vehicle because it can make the vehicle ability to turn right or left. The wheelbase of the vehicle is the distance between the centre of the rear wheel, as viewed from the side. The vehicle with a long wheelbase tends is to ride smoother than vehicle with a short wheelbase.

2.3 The Chassis Materials

Most of the automotive components and parts are made of by cast iron, such as brake drums and rotors, spindle, engine blocks, and many other components including fasteners. There are many different types of steel that can be uses to make a chassis but it must require with different strengths and characteristic from the material that uses. The amount of carbon in steel is the most important point in determining the strength, hardness, and machining characteristics.

2.3.1 Galvanized Steel

The Galvanized steel it is steel with zinc coating that which could be protect the steel from corrosion (rust). Besides that, another type of rust-resistance steel includes zincrometal, which is a two-coat bake-on the system that using chromium zinc and oxide.

2.3.2 High-Strength Steel

The high-strength steel (HSS) has been introduced widely since the mid 1970s, as many car and light truck parts that have been built with it. Application of HSS is commonly in the sill area under the doors where high strength that is required, yet lightweight is needed. Other applications in vehicles are in bumper supports and impact beams in doors.

High-strength steel (HSS) is also very hard but the heating causes it to lose much of its strength. High-strength is low-carbon alloy steel that which consists of various amounts of carbon, silicon, phosphorus, nitrogen, and manganese. The body repair technicians should always follow manufacturers recommended procedures to avoid weakening the structure of the body.

2.3.3 Alloy Steel

The Alloy steels are iron-carbon steels that contain significant additional alloying elements. Alloy steels have superior mechanical properties to plain carbon steels. Common alloying elements that are added include Chromium, Manganese, Molybdenum, Nickel and Vanadium. The percentage of alloying elements added can influence mechanical properties to increase strength, hardness, hot hardness, wear resistance, fatigue resistance and toughness. Stainless Steel is the generic name for a number of different high alloy steels used primarily for their resistance to corrosion. The one key element they all share is that they must a minimum of 12% chromium. Although other elements, particularly Nickel and Molybdenum are added to improve corrosion resistance.

Chrome Molybdenum SAE4130 is a high alloy steel which contains Silicon, Chromium and Molybdenum. These alloying elements give the steel superior strength compared to other common steels. The alloying elements also provide a protective barrier within the steel to increase the corrosive resistance. Another advantage of chrome molybdenum steel is that it's weldability is very good. The disadvantages of chrome molybdenum steel is that it is brittle therefore can become fatigued when exposed to fluctuating loads. Chrome Molybdenum is also very expensive and hard to find a supplier.

2.4 Basic Go-Kart Chassis Theories

Basically chassis is considered as a framework to support the load act on the body, engine and other parts which make up the vehicle. Chassis holds the whole vehicle support and rigidity. Normally, chassis will include a pair of longitudinally extending channels and multiple transverse cross members that connecting the channels. The transverse members will have a reduced cross section area in order to allow for a longitudinally extending storage space. The chassis require containing the various components for the race car as well as being based around a driver’s cockpit. The safety condition of the chassis is a major aspect in the design, and should be

considered in all stages. `It is the responsibility of each karter to determine his own requirements. It is also the karter responsibility to stay within the spirit and intent of the rules of the organization in which he will be participating.' (Brian Martin, Go-Kart- Chassis Setup, 2000).

The setting up a good go-kart chassis requires not only the knowledge of the basic theories it that also from past of the experiences. Theories will help beginners in setting their first go-kart experiences would help the further to improve it. Generally, the chassis types consist of backbone, ladder, space frame and monocoque. Different types of chassis design will produce the different performance of the chassis.

2.5 Criteria of Good Chassis

To build and fabricated the go-kart chassis the criteria of chassis is very important to study because the go-kart chassis must be in a good condition and also must support or bear the load from broke. Any good chassis must do several things that are contains:

(i) Be structurally sound in the every way over the expected life of the vehicle and beyond. This means nothing ever breaks under normal conditions.
(ii) Maintain the suspension mounting locations so that handling is safe and consistent under high cornering and bump loads.
(iii) Support the body panels and other passenger components so that everything feels solid and has long reliable life.

In the real world, few chassis designs will not meet the criteria of Major structural failures, even in kit cars, are rare. Most kit designers, even if they're not engineers, will overbuild naturally. The penalties for being wrong here are too great. The trouble is, some think that having a "strong" (no structural failures) chassis is enough. Structural stiffness is the basis of what we feel at the seat of our pants. It defines how a car handles, body integrity, and the overall feel of the car. Chassis stiffness separates a great car to drive from what is merely good (ERA Chassis,

2000). Different basic chassis designs each have their own strengths and weaknesses. Every chassis is a compromise between weight, components size, vehicle intent, and ultimate cost. And even within a basic design method, strength and stiffness can vary significantly, depending on the details. There is no such thing as the ultimate method of construction for every car, because each car presents a different set of problems (ERA Chassis, 2000).

CHAPTER 3

DESIGN CONCEPT AND SELECTION

3.0 Introduction

In this chapter it would explain three design concepts that will to do go-kart chassis on the scopes specified. In this chapter also shows the advantages and disadvantages of the designs that are also explained in order to select the best design concept from three designs to be fabricated. It also contains the three design compared using selection criteria that are considered to be important in a go-kart chassis. The selected design would be explained part by part and lastly the bill of material would be generated.

3.1 Design

The design of go-kart chassis must be compliance to several aspects. The aspects that must be considered in designing the mechanical part of the system is operating mechanism, cost, ease of design, and weight of karts components .Finally, the design of the system should be easy to fabricate and assemble in accordance with drawing design.

3.1.1 Design 1

Figure 3.1 shows the isometric view of design 1. The go-kart chassis design has more complex concept because the concept design is made from tubular pipes. It is many part of component in this design. The design by using solid work software is also take a long time to finish it. The material used for the design is by using tubular pipes for the whole of body frame. Figure 3.2 show the front view that is shows the steering support it material is not using tubular pipe but by using steel tube. Full drawing of design 1 would be shown in Appendix A.

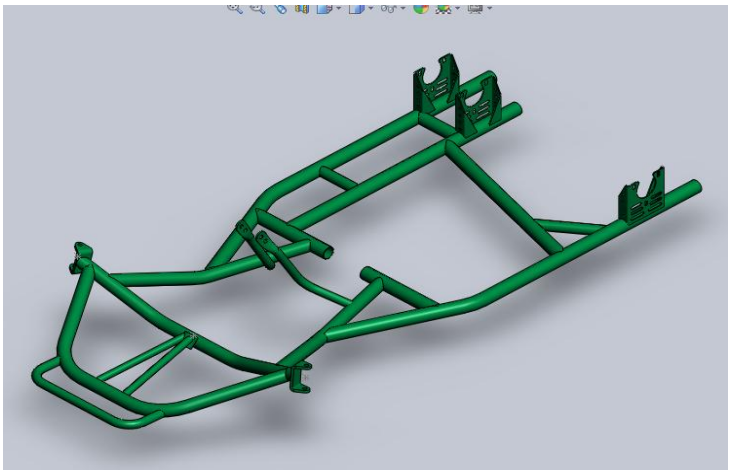


Figure 3.1: Design 1(Isometric)

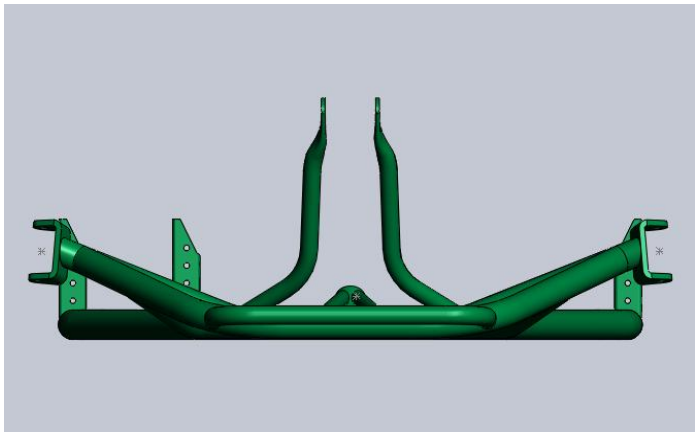


Figure 3.2: Design 1 (Front view)

Table 3.1: Advantages and Disadvantages of Design 1

Advantages	**Disadvantages**
Strong smaller for the sport cars	Very complex due to their triangulated tubular pipes format.
More Suited for heavy duty usage	Construction of chassis is expensive and requires maximum time consuming to be built.
Inherently good crash protection.	Difficult to assembly another part of components.
Provide maximum and minimum deflection do to the support from pipes	Heavyweight
More Attractive	

Table 3.1 shows the advantages and disadvantages of Design 1. It is suitable to use in motorsports because the chassis design is strong smaller for the sport car. Besides that, the chassis of the go-kart suitable for heavy duty such as towing and off-roading and can be more durable. It is also inherently good crash protection and it can reduce low possibility of accident because the go-kart chassis is provide maximum and minimum deflection do to the support from pipes and it is economical in sense that it more attractive to be fabricated. Even though so, the problems is the go-kart chassis is very complex due their triangulated tubular pipes format and it will able to influence the process to fabricate the go-kart chassis because it take a long time to finish it. Besides that, the cost to construction the chassis is too expensive and it requires maximum time consuming to be built and also difficult to assembly with another part of components and the go-kart chassis is heavyweight.

3.1.2 Design 2

Figure 3.3 shows the isometric view of design 2. The design concept is made from square hollow bar and it mostly easier to design and to join the all part of the go-kart chassis during fabricated however the go-kart chassis is not attractive compare between to the design 1.Figure 3.4 show the near view of design, in that figure it have side-bone and backbone to prevent the users from fall during drive the go-kart but it still not provide the complete safety to users because it just only to support the chassis from broke. Full drawing of design 2 would show in Appendix A.

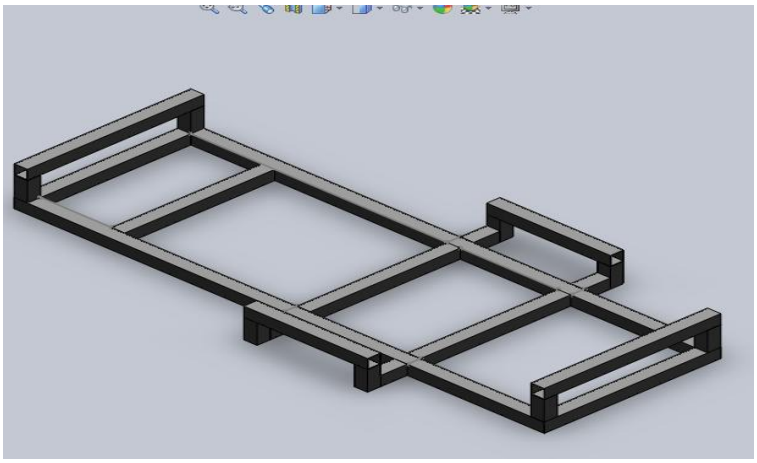


Figure 3.3: Design 2 (Isometric)

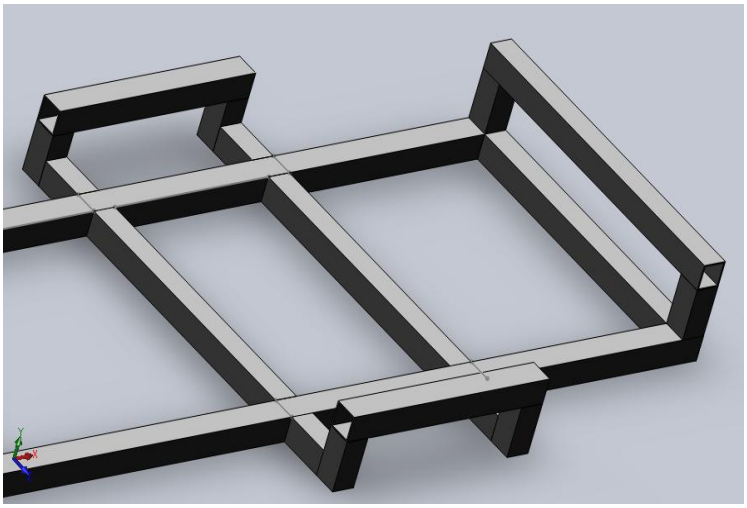


Figure 3.4: Design 2 (Near)

Table 3.2: Advantages and Disadvantages of Design 2

Advantages	**Disadvantages**
Most Space Saving.	Unattractive.
Easy to be made by hand thus cheap for low-volume production.	Not strong enough
Easier to design, build and modify.	Not provide protection.
Lightweight.	
Reduce cost and time to build and modify.	

Table 3.2 shows the advantages and disadvantages of Design 2. The concepts design it most space saving between the designs 1 because it is easy to make by hand thus the cheap for low-volume production. Besides that, it easier to design, build and modify because it not very complex design. In additional, the go-kart chassis is reduce cost and time to build and modify the chassis also in lightweight. However, the design is not attractive because the design is too simple. It is also not strong enough and maybe can cause accident to users because the probability to break is higher. The design also not provides protection against side impact or offset crash.

3.1.3 Design 3

Figure 3.5 shows isometric view of concept 3. This is a concept similar to concept 2 but it is more attractive compare to the concept 2 design. The material is also use similar with concept 2 that is use square hollow bar because the square hollow bar is lightweight and easier to make and assembly and this is aspect important things that must be consider. The design concept is made by using the solid work software. As shown in figure 3.6, this design shows the steering support and the front axle and it must drill to make hole that to support the tires. The side of the chassis is also similar to the concept 2 and the function is same. Full drawing of design 3 would be shown in Appendix A.

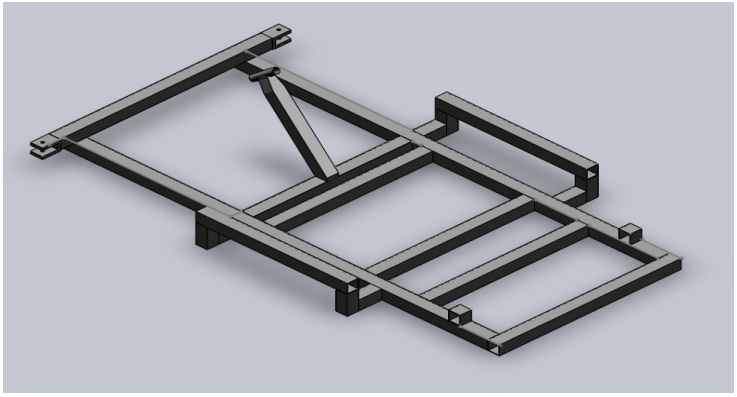


Figure 3.5: Design 3 (Isometric)

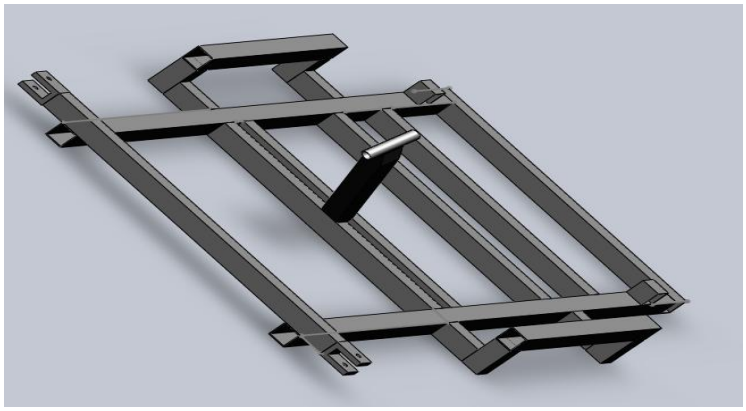


Figure 3.6: Design 3 (Near)

Table 3.3: Advantages and Disadvantages of Design 3

Advantages	**Disadvantages**
Lightweight	Unattractive.
Easier to design, build and modify.	Cannot suit for heavy duty users.
The material is easier to find and low cost production	
More space saving	
Easier to handle when drive	
Provide protection	

Table 3.3 shows the advantages and disadvantages of Design 3. This design is almost the same as design 2 but it is contain more advantages from compare design 1. The concept design is still lightweight. It is also easier to design, modify and build because the chassis design is not complex and can reduce time during fabricated. Besides that, the design has provided protection to the users because the design has a side bone to prevent the user from fall during drive the go-kart. It is also give more space saving in this design. The most important things are the material is easier to find and low cost production during fabricated the project. However, the design is still unattractive to the user but it still attractive compares the design 2. It design cannot suit for heavy duty user or in sport car but it still safe to homemade self go-kart chassis.

3.2 Design Comparison

Table 3.4 is shown the design comparison for the three design concept. The design must follow up the problem that was considered. The concept variants were list to know that which design can be the best for the final design according the important criteria. The design that has the highest total score was chosen to be developed and fabricated.

From the data show that the symbol positive, (+) that means the types of selection criteria is in good, the symbol of zero, (0) is show that is in moderate and the symbol of the negative, (-) that show in weak condition. The result can be obtained that show in the table below:

Table 3.4: Design Comparison for three Proposed Designs

Selection Criteria	**Concepts Variants**		
	Concept 1	**Concept 2**	**Concept 3**
Attractive	(+)	(-)	(0)
Strength and durable	(+)	(-)	(0)
Reduce time to fabricated	(-)	(+)	(+)
Easier to design, modify and build	(-)	(+)	(+)
Low cost production	(-)	(+)	(0)
Space saving	(-)	(0)	(+)
Provide protection	(+)	(-)	(0)

Pluses	3	3	3
Zero	0	1	4
Minuses	4	3	0
Net	**-1**	**0**	**3**
Rank	**3**	**2**	**1**
Continues	**No**	**No**	**Yes**

3.3 Final Concept Selection

From concept of selection table, the advantages and disadvantages of the design can be outlined. Criteria of the go-kart chassis to be fabrication are very important thing to be considered before fabrication process. Seven criteria are been chosen to be consider. According to the table study of the concept selection shows that each concept has their advantages. From the table 3.4, it was shown that concept 3 was selected as the concept to be fabricated. It is score the highest marks in design comparison and proves to be able to be fabricated in the time frame given. Compared to the other designs, it has advantages same with concept 2 that is reduce time to fabricated and easier to design, modify and build but it have more space saving than the concept 2. It is also in average condition at four concept variants and totally not has minuses criteria compare to other concept. As conclusion the best concept that will be selected is concept 3 to be a design go-kart chassis in our final year project.

3.4 Final concept Drawing

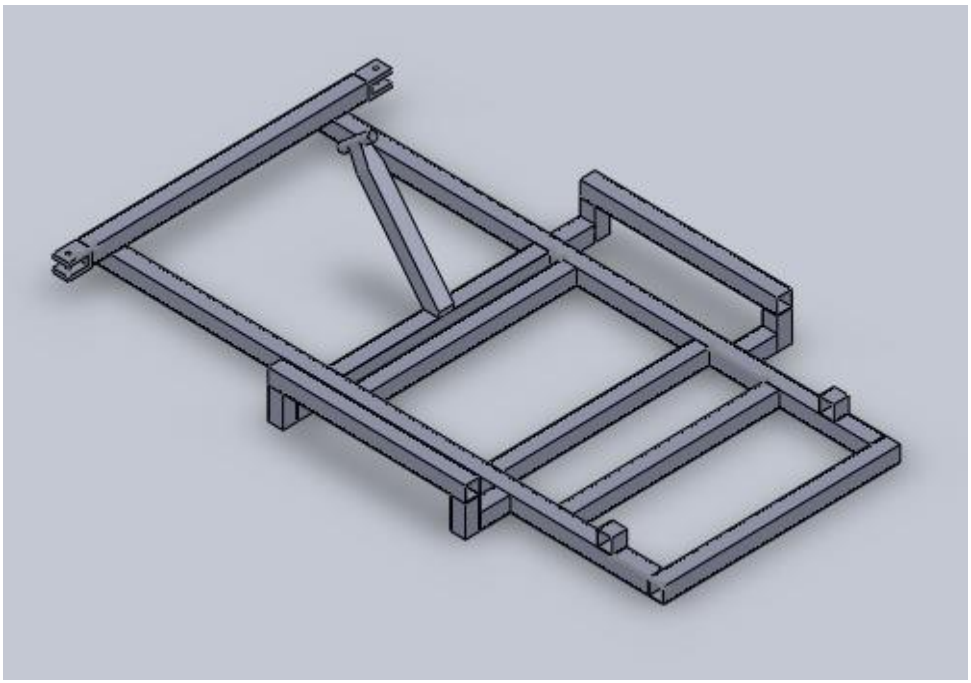


Figure 3.7: 3D Full Drawing

2D full drawing would be shown in Appendix A.

3.5 Part Design Description

The three dimensional drawings include part drawings of the selected design and the usage of each part. Figure 3.8 shows isometric view of the main frame structure of the selected design. The all of the body use square hole bar as the material selected. The base of the different than the other design is frame is easier to assembly and not more complicated. The function of the body is to support another part component of the go-kart.

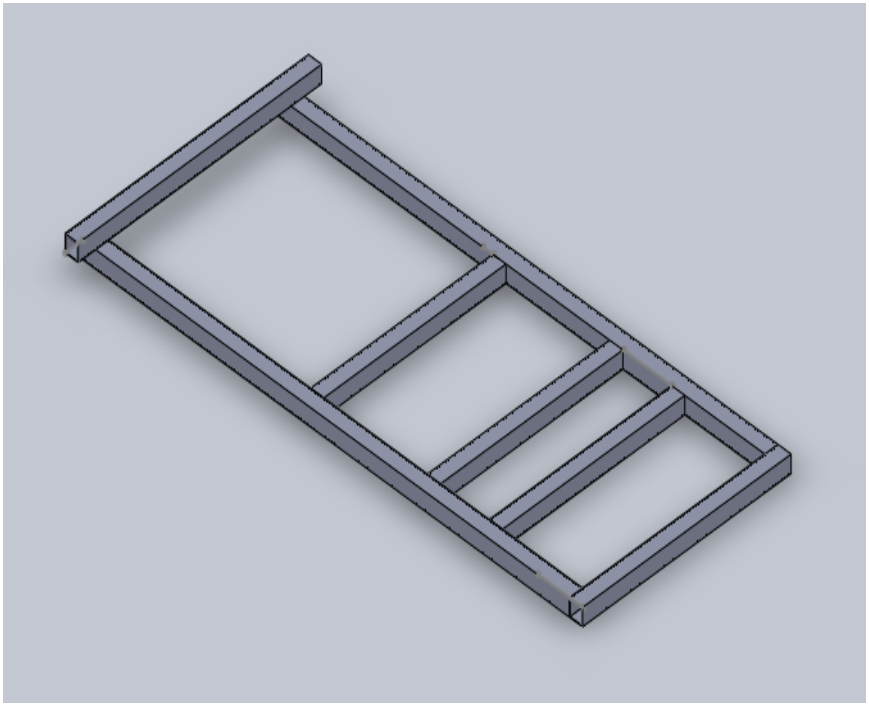


Figure 3.8: Main Frame (Isometric)

Figure 3.9 shows the front axle (tyre holder). This is the part that connected with tyre and the spindle of the steering column so the tyre can turn right or left when the steering is function. The material used for the front axle is steel bar.

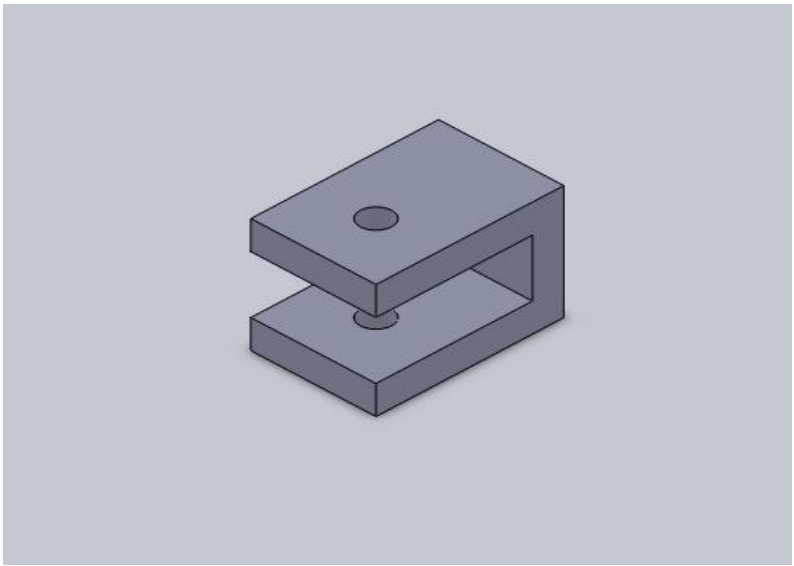


Figure 3.9: Front axle / Tyre holder (Isometric)

Figure 3.10 shows the isometric view that is the steering holder. The function of steering holder it is the part that holds on to the steering column and it was connected to the body frame. Figure 3.11 shows the near view of the steering support. This shows that the part will support the steering column and it will connect to the steering holder.

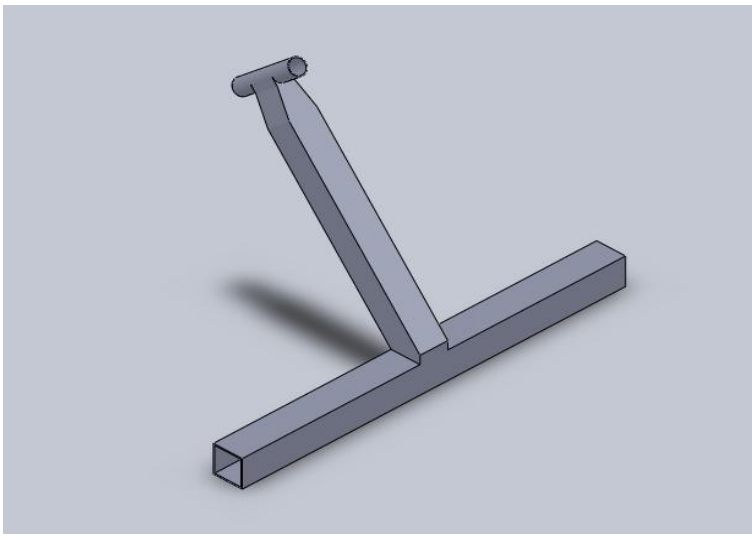


Figure 3.10: Steering Holder (Isometric)

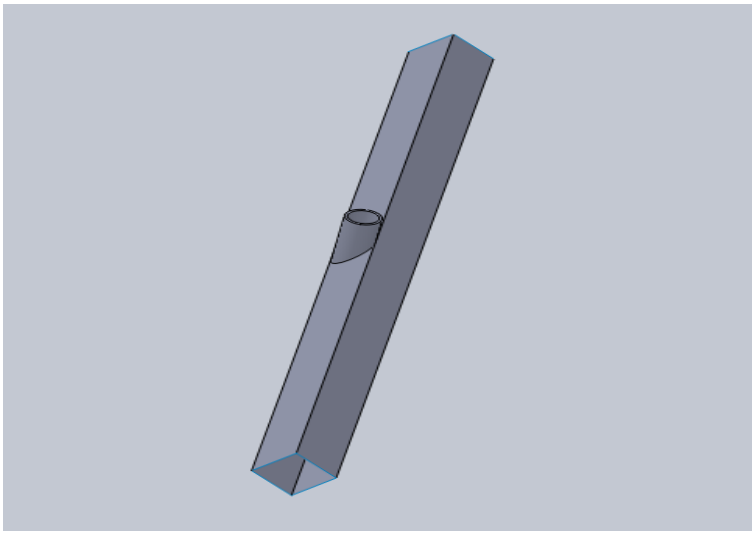


Figure 3.11: Steering support (Near)

Figure 3.12 shows the isometric view of the side body support. It is connected into the main frame at the side chassis frame to support the body. It function is to give the main frame of chassis strength and more durable from broke. Most important things, it prevent the users fall when during drive the go-kart chassis after finish fabricate.

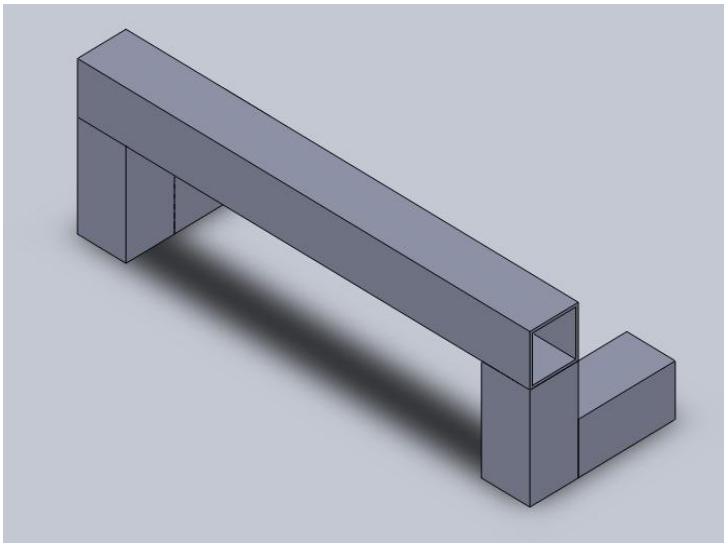


Figure 3.12: Side body support (Isometric)

3.6 Final Design Analysis on the Frame

Figure 3.13 shows the deformation scale of the frame chassis go-kart. Based on the analysis that has been done using solid works simulation express, the material that is hollow square beam alloy steel is very suitable to fabricate the main part of the go-kart chassis. The static displacement (-Res disp-) shown that there are less red part in the material when the main part of the go-kart chassis is applied with the weight of load that is 150kg that is 1500N. The red part means that the material will be break. The deformation occurs shown by deformation scale in go-kart chassis is not critical that is 1.343e-6mm. This project can be continued because the deformation occurs is too small. In figure 3.14 show the equation of Solid work simulation express.

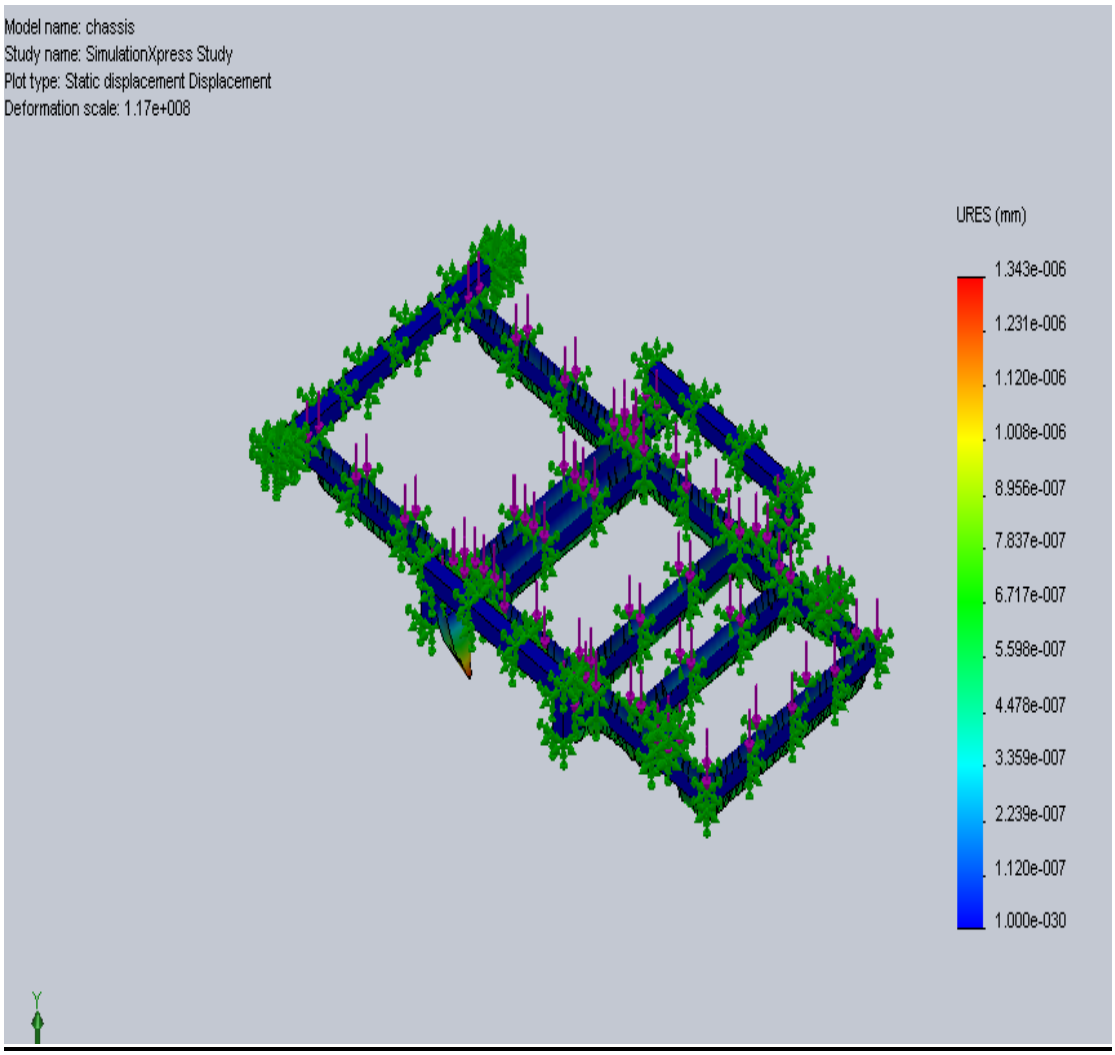
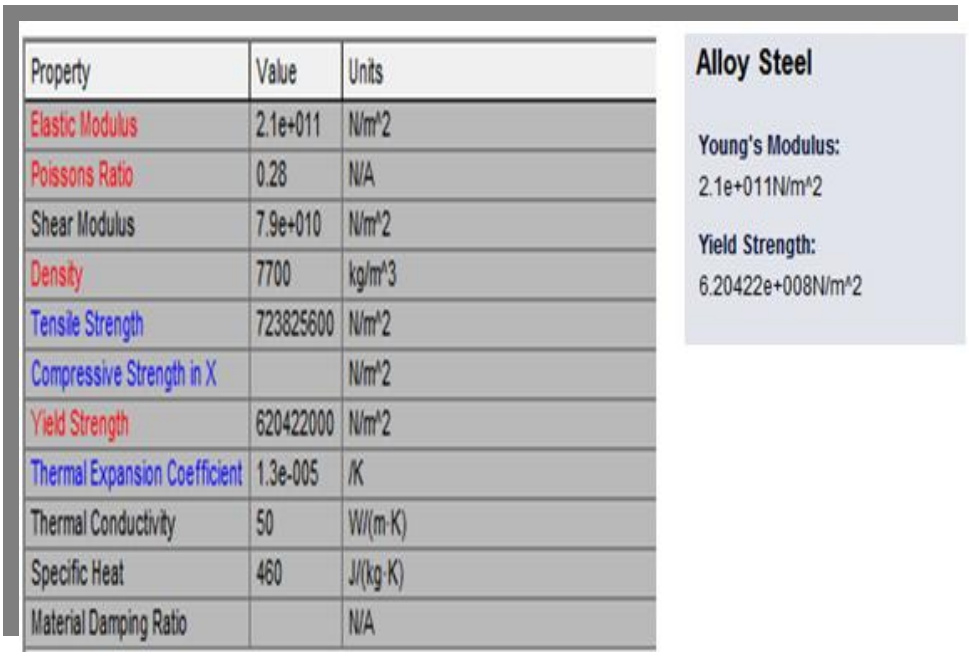


Figure 3.13: Deformation Scale of the Frame



Property	Value	Units
Elastic Modulus	2.1e+011	N/m^2
Poissons Ratio	0.28	N/A
Shear Modulus	7.9e+010	N/m^2
Density	7700	kg/m^3
Tensile Strength	723825600	N/m^2
Compressive Strength in X		N/m^2
Yield Strength	620422000	N/m^2
Thermal Expansion Coefficient	1.3e-005	/K
Thermal Conductivity	50	W/(m·K)
Specific Heat	460	J/(kg·K)
Material Damping Ratio		N/A

Figure 3.14: The equation shows in Solid Work Simulation Express

3.7 Selected Materials

For this final year project, the square hollow bar (alloy steel) would be selected and to be used for the most of the parts to make a body chassis frame. There are only part that would be using the circle hollow bar would be to support the steering column and the steel bar would be use to make and build the front axle to support the tires of go-kart. This all material must have available to complete the whole of the chassis frame. Besides that, the all of the material was chosen because it is the easiest material to find in our mechanical lab store. The use of square hollow bar as the main material compare tubular pipes it would save a lot of cost as buying materials from outside shop would not necessary. The bill of the material would be shown in Appendix B.

CHAPTER 4

FABRICATION PROCESS

4.0 Introduction

In this chapter would explain about the fabrication process that is done to build the go-kart chassis. Fabrication steps including measuring, cutting, welding, grinding, drilling and painting would be explained thoroughly to show the steps of fabricating the go-kart chassis.

4.1 Fabrication Process

The fabrication process is the process to make or built the part or model of the project. This process needs to follow the exact dimension according to the drawing design. In making the design become a real product or model, several processes have been used to fabricate the go-kart chassis, there are seven phases that have must be done to finish go-kart chassis which are:-

i. Measuring :Measure the material (Measuring Tape)
ii. Marking : Required part that has been marked. (Steel Marker)
iii. Cutting : Cut the material (Floor Cutting Disc Machine)
iv. Welding : Assemble the parts of the system. (SMAW)
v. Drilling : Drill to make the hole. (Hand Drill/Drilling Machine)
vi. Grinding : To remove the over melt welding parts. (Grinder Machine)
vii. Painting : Paint the material (Black paint)

All the machines are shown in Appendix C.

4.2 Fabrication Process Steps

4.2.1 Measuring and Marking

Before start the fabricating, it must measure and mark the parts from the raw material according to the dimension in the bill of material. The figure 4.1 shows the measuring tape that used to measure the material used for the project. The fabrication processes start with measuring and marking the materials into the dimension needed according to the design. The measuring and marking process is done by using steel ruler, measuring tape, L-shape ruler and steel marker.

Figure 4.1: Measuring Tape

4.2.2 Cutting

Cutting is the separation of a physical object, or a portion of a physical object, into two or more portions, through the application of an acutely directed force. In Figure 4.2 shows the floor cutting disc machine used for material cutting. After measuring and marking process has been done, the materials will be cut according to the marked by using Floor cutting disc machine.

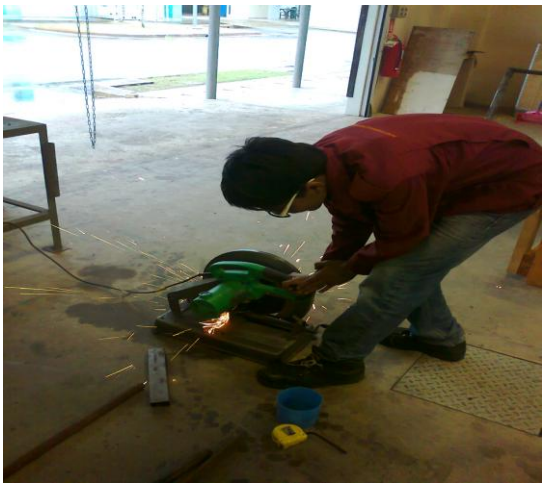


Figure 4.2: Cuts Materials using Floor Cutting Disc Machine

4.2.3 Welding

Welding is a fabrication or sculptural that joins materials, usually metals or thermoplastics, by causing coalescence. In Figure 4.3 shows the welding process that must do to join the part of material to make a go-kart chassis. After cutting the material, the fabrication process continues by assembling all the parts by using welding process. The welding that used for this fabrication is shielded metal arc welding (SMAW). Safety tools and wears for welding is shown in Appendix D.

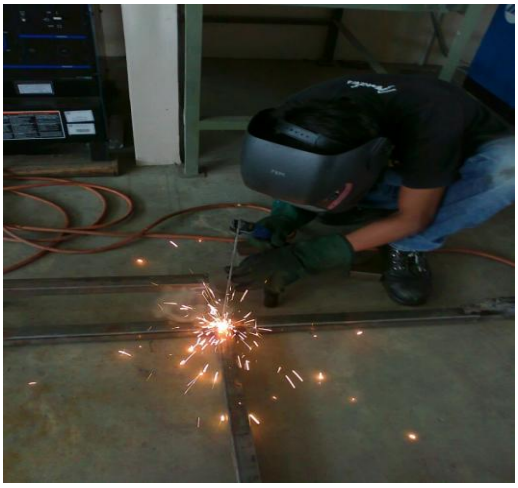


Figure 4.3: Weld the part of go-kart chassis

4.2.4 Drilling

Drilling is the process that to make a hole. In Figure 4.4 shows the use of drilling machine and hand drill to drill the work piece. After finish welding the part of go-kart chassis process is continued with drilling process to make the holes at the go-kart chassis that will combine with another part of components into go-kart chassis.

Figure 4.4: The process of drill in go-kart chassis

4.2.5 Grinding

Figure 4.5 shows the grinding process using the Bosch grinder. After finished welding, the next step is grinding to dispose the over limited and melted welding parts. This is one of the ways to make the go-kart chassis looks clean and attractive.

Figure 4.5: Grind the part of go-kart chassis

4.2.6 Painting

In Figure 4.6 shows the painting of the go-kart chassis. After finalizing the prototype of go-kart chassis, prototype would be painted. This is one of the ways to avoid the go-kart chassis from corrosion. Besides that, the go-kart chassis will also look more attractive and interesting.

Figure 4.6: Paint the Go-kart chassis

4.3 Safety Precautions in Welding Operation

4.3.1 General

In the process of handling welding equipment, safety is very important things before starting a job because it can prevent injury to personnel. The extreme caution must be taking serious and should be exercised when using any types of welding equipment. Injury can result from fire, explosions, electric shock, or harmful agents. Both the general and specific safety precautions listed below must be strictly observed and guideline when using welding or cut the metals:

i. Make sure before using welding machine equipment requested permission from the person who in charge.
ii. Do not weld the material with wooden floors, unless the floors are protected from hot metal by means of fire resistance fabric, sand, or other fireproof material and must be sure that hot sparks of hot metal will not fall on the operator or on any welding equipment components.
iii. Remove all the flammable material such as cotton, oil, gasoline, etc from the vicinity of welding.
iv. Make sure before welding or cutting, warm those in close proximity who are not protected to wear proper clothing or goggles.
v. Remove any assembled part from the component that being welded that may become warped or otherwise damaged by the welding process.
vi. Make sure do not leave a hot rejected electrode stubs, steel scrap, or tools on the floor or around the welding equipment because the accident and fire may be occur.

4.3.2 Personal Protective Equipment

During in welding the go-kart chassis the electric arc is very powerful source of light and including visible the protective clothing and equipment must be worn during all the welding operations and the operators must use safety goggles to protect the eye from heat and flying fragments of hot metals. Safety tool and wear for welding is shown in Appendix D.

CHAPTER 5

RESULT AND DISCUSSION

5.0 Introduction

Chapter 5 would discuss solely about the final product which has been fabricated. Each and every part that has been fabricated would be explained and showed in this chapter. Other than that, the actual testing of the product would also be done in this chapter whereby the go-kart chassis will be tested by install the all the component of the go-kart.

5.1 Final Product

Figure 5.1 shows the final product of the final year project. This was done on time using tools in welding lab as shown in appendix A.

Figure 5.1: Final Product

5.2 Finished product.

5.2.1 Main Frame of the Go-kart Chassis

Figure 5.2 shows the main frame of the go-kart chassis. This part was done using a 1400mmx830mm square hollow bar welded to all of the part to make a frame of go-kart chassis. This frame of go-kart chassis is important as the base for the support all the component of go-kart. The go-kart chassis is accurately follows the dimension and there was no faced during to make it by following the design.

Figure 5.2: Main Frame of go-kart chassis

5.3 Result

Figure 5.3 shows the result of installer the go-kart compartment into the go-kart chassis. The go-kart chassis shows that it will support the entire compartment. The material that is use square hollow bar because the square hollow bar is lightweight and easier to make it and assembly all the components and this is aspect important things that must be consider. The go-kart chassis is in good condition because it is strength and durable enough to hold the entire compartment. The figure

5.4 shows that the all of the component can installer into the go-kart chassis. This result shows that the go-kart chassis is done and successfully installed.

Figure 5.3: The go-kart chassis has been successfully installed.

Figure 5.4: The go-kart chassis support the entire compartment.

5.4 Discussion

The go-kart chassis was successfully operated. The use of square hollow bar was the best idea to make a go-kart chassis. The project has been done and successfully. The go-kart chassis is still lightweight that has we considered. It is also easier to design, modify and build because the chassis design is not complex and it has reduced time during fabricated. Besides that, the go-kart chassis has provided protection to the users because the go-kart chassis has a side bone to prevent the user from fall during drive the go-kart. It is also give more space saving in our project. However, the design is still unattractive to the user but the most important the go-kart chassis can fix all the components and it is easier to make it. It go-kart chassis is cannot suit for heavy duty user or in sport car but it still safe to homemade self go-kart chassis. As conclusion it is the best concept that will be selected to be a design go-kart chassis in our final year project

CHAPTER 6

CONCLUSION AND RECOMMENDATION

6.0 Introduction

In this chapter, a summary is established to conclude the whole final year project. However there were problems faced during the course of this project. The measures taken to rectify these problems have been identified and applied. There will be recommendations for future project of the same kind to improve it so that a more complete understanding and enhanced application steps can be attained.

6.1 Problems faced during the project

During the design and fabrication process of the go-kart chassis, many obstacles were faced. Firstly was the lack of knowledge in the go-kart chassis. The lack of exposure in this field caused a problem as the information of the go-kart chassis was hard to attain either from the internet or the library because least of the sources knowledge about go-kart chassis.

The next problem faced was choosing the software to draw the design of the go-kart chassis. A choice between Catia and Solid Work has to be made. The lack of knowledge in both the software delayed much of the progress of the project as well. Besides that, least knowledge to uses this software also the main factor problem that to be faced before design the go-kart chassis

The problem was also faced while attaining the material for fabrication the go-kart chassis. Advices are given to use materials from mechanical lab store but the

materials found have different dimensions than the wanted ones. This leads to the change of design and more work in cutting the materials into shape that we wanted. Besides that, the material provided not enough to complete our final year project.

The last problem encountered was having problem of the design working in the actual state. The problem is the machine like floor cutting disc machine and the grinder machine could not be used because we must get permission from the instructor before used it. Besides that, the machine is cannot work properly because the disc cutter is in out of limit so this can affected to finish the go-kart chassis project. The fabrication process of the go-kart chassis also took a longer time because the facilities provided at the workshop is not enough to be done at the appointed time for example cutting machine problems and anything that the problems that can contribute to this factor

6.2 Conclusion

In conclusion, the project objectives were achieved. The objective of designing and fabricating the go-kart chassis model was reached. The best design was chosen and fabricated within the time limit given. The fabrication process required many skills that have been learnt in previous mechanical laboratory such as material measuring, marking, cutting, drilling, welding and grinding. The fabrication process provides the experience to develop the skills and the ways to operate the machines to complete the project. Besides that, problem solving skills during the designing and fabrication process was also learnt. It acts as a motivator in facing the challenges as a professional engineer in this globalised era.

6.3 Recommendations and Improvements

Recommendations to similar projects in the future are as follows. First of all would be early determination of the design software to be used in designing the product as installation and learning how to use new software at the later stage proved to be troublesome. Other than that, the future project also can be improved by improving the material selection to fabricate the project. Materials that suit the

design has to be attained rather than selecting low cost and readily available material with inapplicable dimensions. The material also must strength and durable so that the go-kart chassis is in good condition and durable to the heavy duty kart and it can bear more loads. Finally, the future project also must be improved by design and fabricating, the drawing design must be updated and more interesting from the last design. The each part of the go-kart chassis also must be welded properly so that the go-kart chassis is stable and more durable.

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http://gokartsusa.com/race-kart-history-information.aspx
http://www.ehow.com/about_6284649_history-go_kart-racing.html

Literature review for current design of go-kart (online).
http://www.ceet.niu.edu/orgs/projman/Web%20Xtreme/gokart3-pics.htm
http://sell.lulusoso.com/selling-leads/804001/solor-go-cart-E-Go-Kart-.html
http://www.tornadoDriver.com

Examples of used tools and fasteners, fabrication process. (online).
http://www.toolstation.com/shop/Hand+Tools/Engineering+Tools/Engineers+Scriber/d10/sd190/p76054
http://en.wikipedia.org/wiki/Tape_measure
http://www.chinafastener.com/suppliers/Self-clinching-screws-c157/

APPENDIX A

DRAWING

D1A shows 3D drawing for design 1 in isometric view.

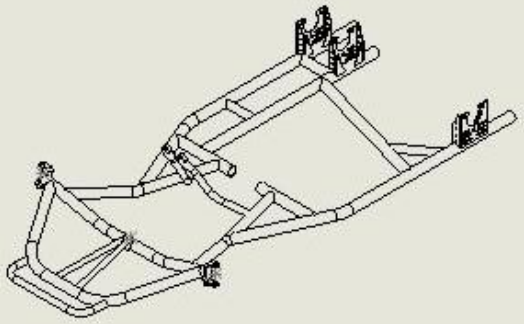
D1B shows 2D drawing for design 1 in autographic view.

D2A shows 3D drawing for design 2 in isometric view.

D2B shows 2D drawing for design 2 in autographic view.

D3A shows 3D drawing for design 3 in isometric view.

D3B shows 2D drawing for design 3 on autographic view.



	NAME	DATE
DRAWN	MUHAMMAD ASYAM BIN RAMADHAN	
CHECKED	DR MUHAMMAD FAIRUZ BIN RAMLAN	
ENG APPR		
MFG APPR		
Q A		
COMMENTS:		

TITLE:

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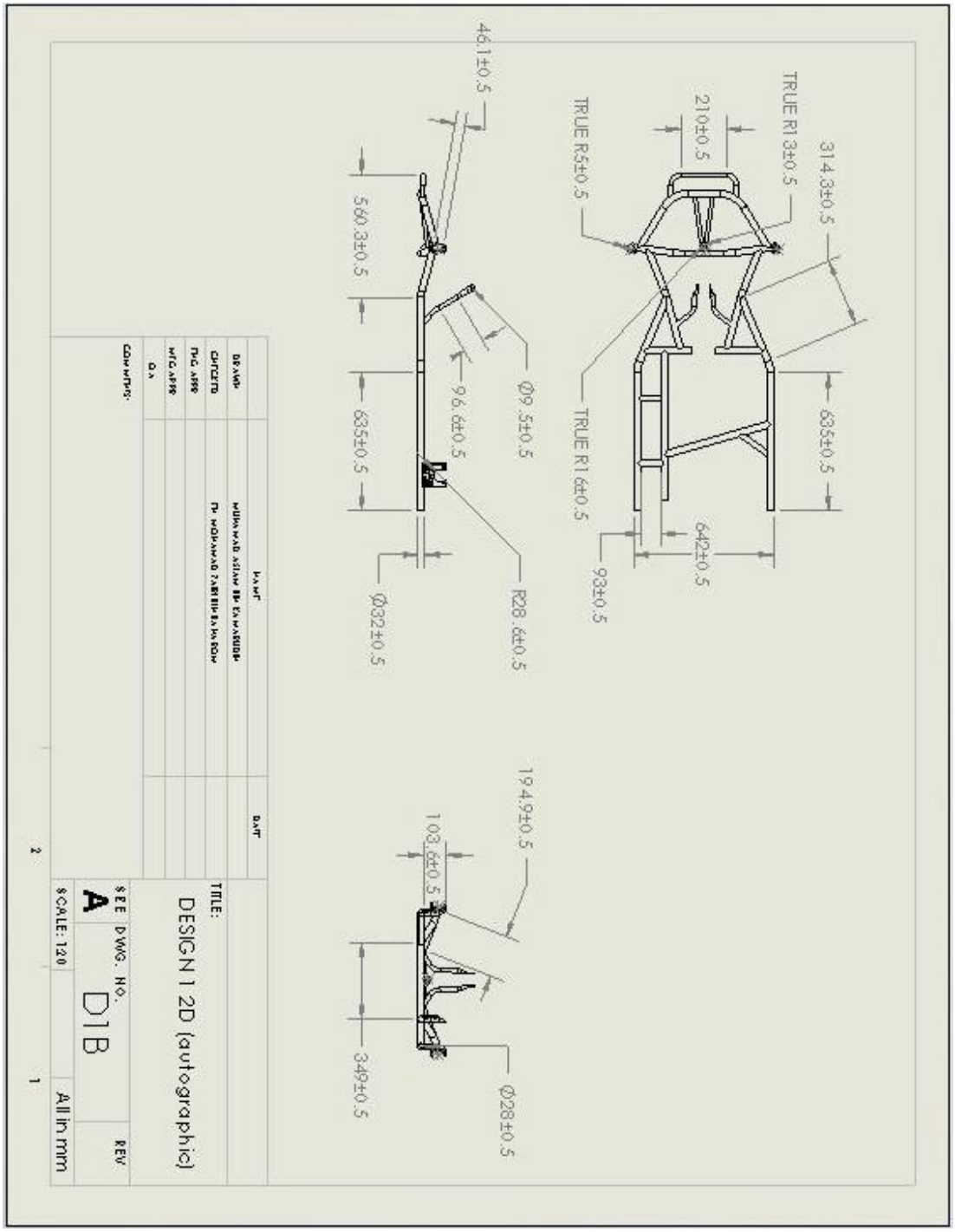
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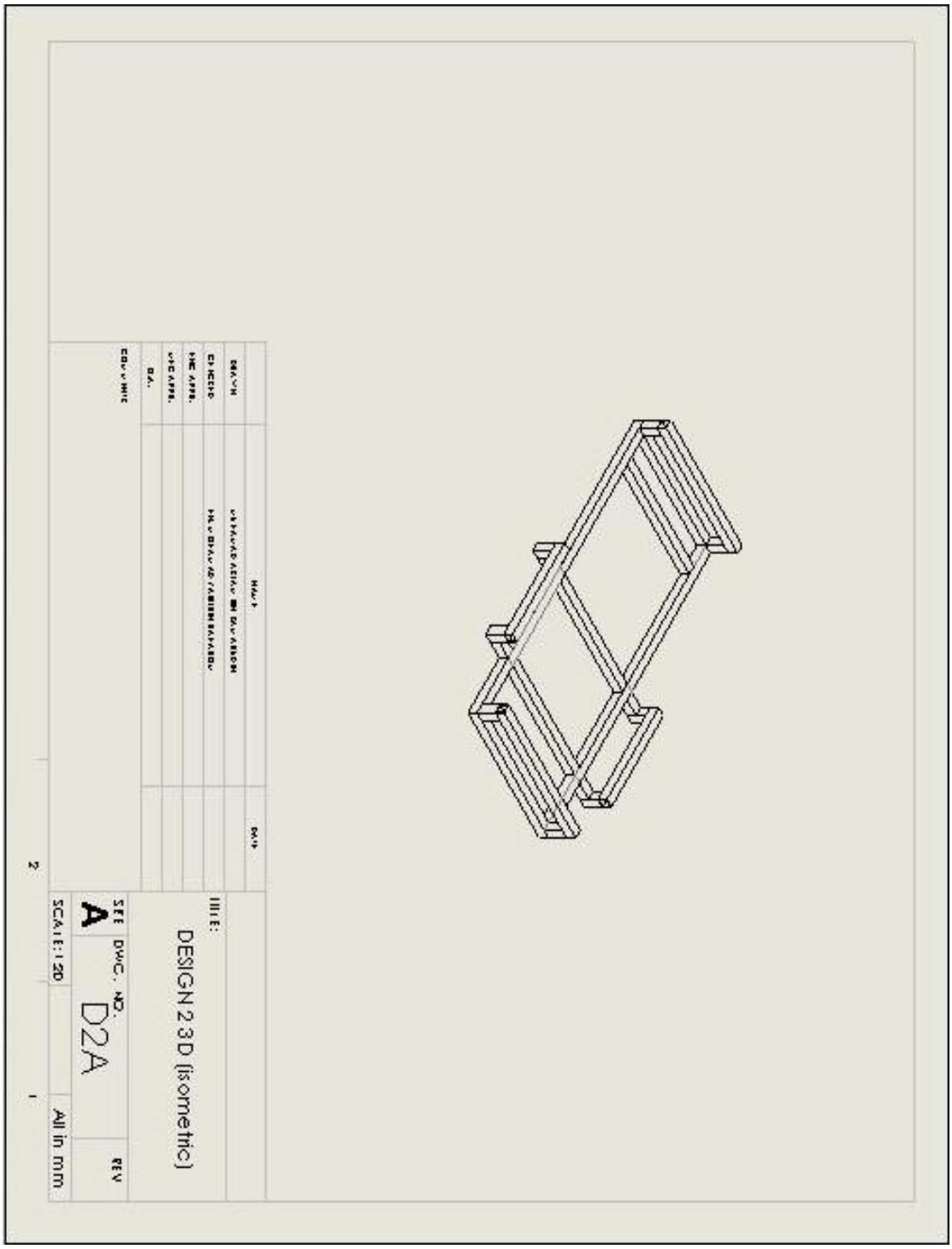
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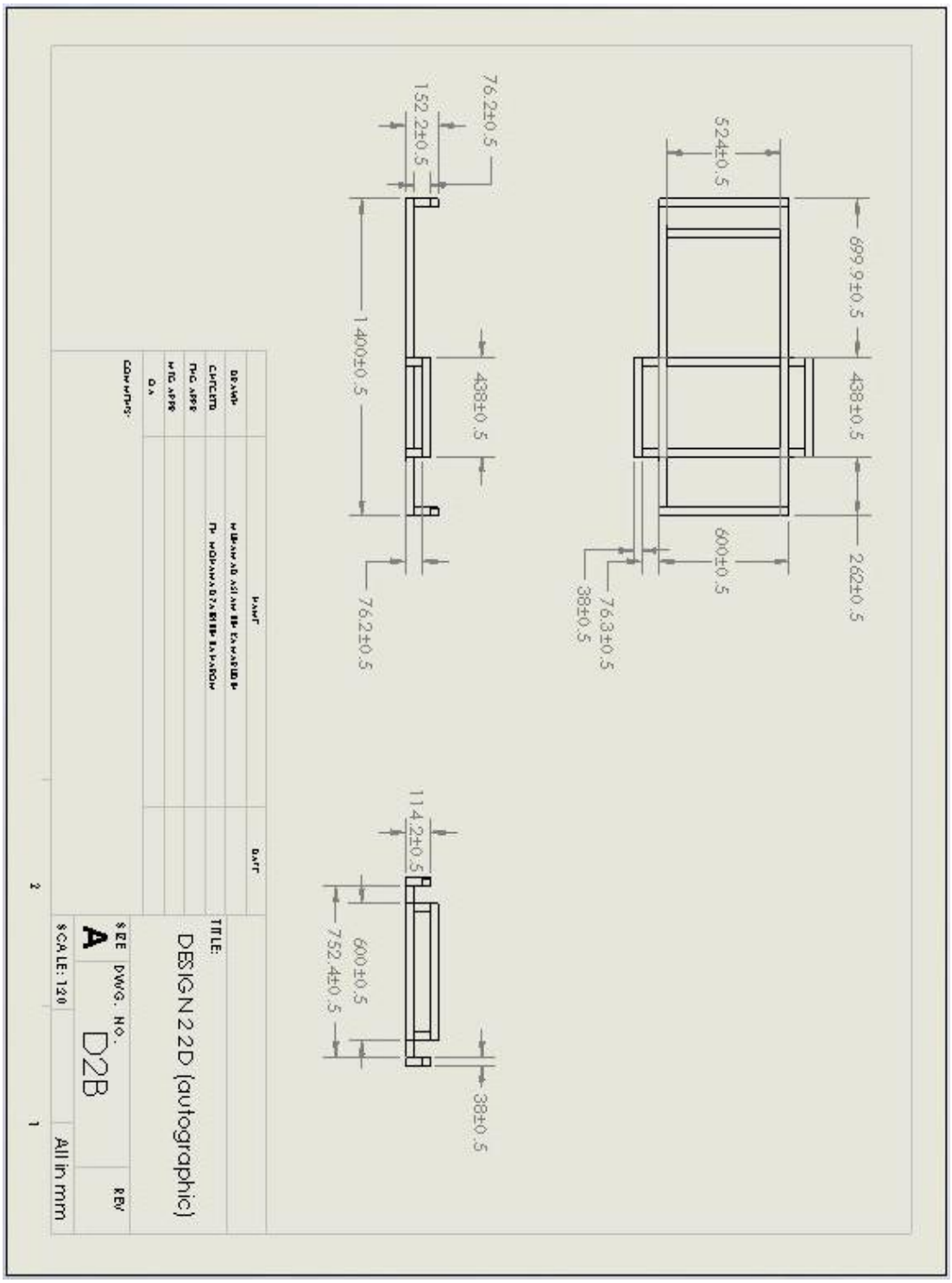
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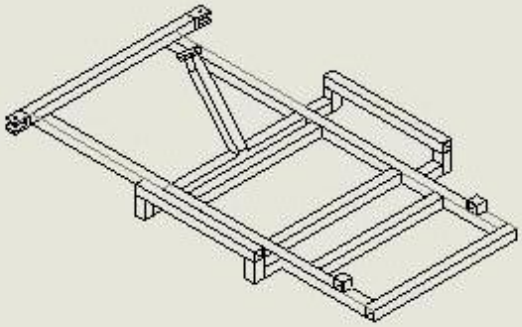

	NAME	DATE
DRAWN	MUHAMAD ASIAM BIN KAMARUDIN	
CHECKED	DR MOHAMAD TARMIZI BAHARUM	
ENG APPR		
MFG APPR		
Q.A		
COMMENTS:		

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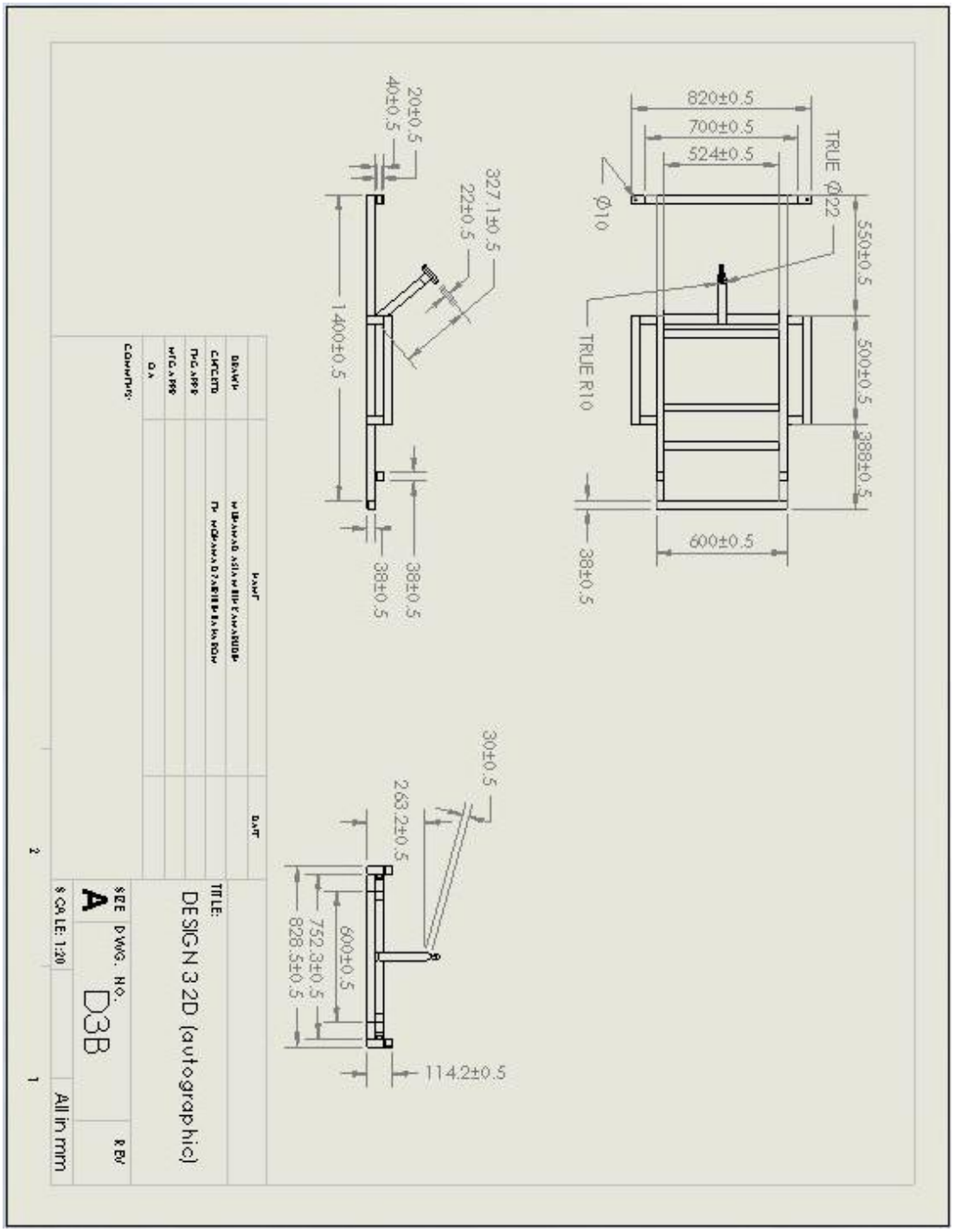
2 1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MFG APPR.
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D3B
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All in mm
2
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APPENDIX B

BILL OF MATERIALS

No.	Size(mm^3)	Material	Numbers of item needed
1	40x60x40	steel bar	2
2	38x38x76	square hollow bar	8
3	38x38x500	square hollow bar	2
4	38x38x38	square hollow bar	2
5	38x38x700	square hollow bar	1
6	38x38x1400	square hollow bar	2
7	38x38x600	square hollow bar	1
8	38x38x524	square hollow bar	4
9	Ø 20 x 100	circle hollow bar	1

APPENDIX C

Figures of Machines

Floor Cutting Disc Machine

Drilling machine

Welding Machine

Grinding machine

APPENDIX D

Figures of Safety Tools / Wears

Welding shield

Gloves

Apron

DESIGN AND FABRICATION OF GO-KART CHASSIS

MUHAMAD ASLAM BIN KAMARUDIN

UNIVERSITI MALAYSIA PAHANG

DECEMBER 2012

DESIGN AND FABRICATION OF GO-KART CHASSIS

MUHAMAD ASLAM BIN KAMARUDIN

A report submitted in partial fulfilment of the requirements for the award of

Diploma of Mechanical Engineering

Faculty of Mechanical Engineering

UNIVERSITI MALAYSIA PAHANG

DECEMBER 2012

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project and in our opinion this project is satisfactory in terms of scope and quality for the award of the Diploma of Mechanical Engineering

Signature :

Name of Supervisor : MR. MOHAMAD ZAIRI BIN BAHAROM

Position : LECTURER

Date : DECEMBER 2012

STUDENT'S DECLARATION

I hereby declare that the work in this thesis entitled "Design and Fabrication of Go-Kart Chassis" is my own research except as cited in the references. The thesis has not been accepted for any diploma and is not concurrently submitted in candidature of any other diploma.

Signature :

Name : MUHAMAD ASLAM BIN KAMARUDIN

ID Number : MB10048

Date : DECEMBER 2012

Specially dedicated to

My beloved family and those who have

Encourage and always be with me during hard times

And inspired me throughout my journey of learning

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ABSTRACT

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 an electric go kart. The main problem is the cost for current go-kart chassis is too expensive so the project is decide to fabricate with a lower cost. The scopes identified chassis design should bear load of 150kg and the go-kart chassis must with floor dimension of chassis is 1400mmx830mm. 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 tubular 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, three designs had been sketch to be as the design concepts. The structural three-dimensional solid modelling of go-kart chassis was developed by using Solid Works engineering drawing software. As for each design have their advantages and disadvantages. After done with design and sketch, conceptual process is done and design 3 has been chosen because this design is more advantageous than other two designs. Design 3 is lightweight and easier to design, build and modify. Some modification is done on design 3 where, the go-kart chassis is more space saving and the design has provided protection to the users to prevent the user from fall during drive 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 is achieved. Finally, the conclusion about this project and the recommendations for the future plan also attached together with this thesis.

ABSTRAK

Tesis ini membentangkan perkembangan mereka bentuk dan menghasilkan rangka badan go-kart. Objektif tesis ini ialah mereka bentuk dan menghasilkan rangka badan go-kart untuk go-kart elektrik. Masalah utama yang dihadapi adalah kos go-kart semasa adalah terlalu mahal dan dengan projek ini ia dapat memutuskan untuk menghasilkan reka bentuk kos yang lebih rendah. . Projek ini perlu merangkumi skop-skop berikut, reka bentuk rangka badan go-kart dapat menampung beban 150kg dan rangka badan go-kart mesti berlandaskan dimensi lantai rangka badan 1400mmx830mm. Terdapat beberapa langkah-langkah yang telah diambil untuk mereka bentuk dan menghasilkan rangka badan go-kart. Peringkat pertama adalah melakukan beberapa kajian mengenai go-kart sedia ada dan rangka badan go-kart. Kebanyakan model semasa rangka badan go-kart diperbuat daripada paip tiub. Oleh itu, projek ini adalah untuk mengubah suai model semasa rangka badan go-kart ke dalam bentuk model yang lebih mudah untuk mereka bentuk, membina dan mengubah suai. Sesulan dengan beberapa bentuk dan lakaran. Semasa fasa ini, tiga reka bentuk telah dilakarkn untuk menjadi sebagai konsep reka bentuk. Lukisan struktur tiga dimensi bentuk rangka badan go-kart ini telah direka dengan menggunakan peisian lukisan kejuruteraan yang dinamakan "*Solid Works".* Setiap rekaan mempunyai kelebihan dan kekurangan masing-masing. Selesai dengan fasa mereka dan melakar rekaan ini iaitu rekaan ini lebih ringan dan rekaan ini lebih mudah untuk mereka bentuk, membina, dan mengubah suai berbanding dua reka bentuk yang lain. Sedikit pengubahsuaian dilakukan ke atas rekaan 3, rangka badan go-kart lebih jimat dari segi ruang dan reka bentuk mempunyai keselamatan kepada pengguna untuk mengelakkan pengguna terjatuh ketika memandu go-kart. Selepas menghasilkan lakaran reka bentuk langkah seterusnya diteruskan dengan proses penghasilan. Proses penghasilan ini telah menjalani banyak proses tertentu seperti mengukur, menanda, memotong bahan mentah, membuat lubang, mencantum bahagian-bahagian tertentu, mengikir bahagian-bahagian yang terlebih semasa dicantumkan dan akhirnya mencatkan rangka badan go-kart supaya lebih menarik. Dengan menyiapkan projek ini, objektif projek ini tercapai. Akhir sekali, terdapat juga kesimpulan mengenai projek ini dan perkara-perkara yang boleh diperbaiki dalam projek ini di masa hadapan dalam tesis ini.

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LIST OF SYMBOLS

kg	Kilogram
mm	Millimeter
m	Meter
%	Percent
+	Positive
-	Negative
N	Newton
Ø	Diameter

LIST OF ABBREVIATIONS

HSS	High-Strength Steel
SMAW	Shielded Metal Arc Welding
UMP	Universiti Malaysia Pahang

LIST OF APPENDIXES