FABRICATION OF HYBRID AIR ATV REAR SUSPENSION SYSTEM

MOHD IZZAT BIN ZULKAFLI

Report submitted in partial fulfillment of the requirements for the award of Diploma in Mechanical Engineering

Faculty of Mechanical Engineering

UNIVERSITI MALAYSIA PAHANG

JUNE 2013

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

This chapter is written to explain 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 explain the overall procedure and how time is being distributed for this project.

1.2 PROJECT BACKGROUND

Suspension is the term given to the system of springs, shock absorbers and linkages that connects a vehicle to its wheels and allows relative motion between the two. Suspension systems serve a dual purpose, contributing to the vehicle's road holding/handling and braking for good active safety and driving pleasure, and keeping vehicle occupants comfortable and reasonably well isolated from road noise, bumps, and vibrations, etc. (Reza N. Jazar (2008).Vehicle Dynamics: Theory and Applications. Spring. p.455. Retrieved 2012-06-24.)

These goals are generally at odds, so the tuning of suspensions involves finding the right compromise. It is important for the suspension to keep the road wheel in contact with the road surface as much as possible, because all the road or ground forces acting on the vehicle do so through the contact patches of the tires. The suspension also protects the vehicle itself and any cargo or luggage from damage and wear. The design of front and rear suspension of a car may be different.

For the history based on the suspension system, Leaf springs have been around since the early Egyptians. Ancient military engineers used leaf springs in the form of bows to power their siege engines, with little success at first. The use of leaf springs in catapults was later refined and made to work years later. Springs were not only made of metal, a sturdy tree branch could be used as a spring, such as with a bow.

In a Horse drawn vehicle, By the early 19th century, most British horse carriages were equipped with springs; wooden springs in the case of light one-horse vehicles to avoid taxation, and steel springs in larger vehicles. These were made of low-carbon steel and usually took the form of multiple layer leaf springs. (Peter Chamberlain and Hilary Doyle, Encyclopedia of German Tanks of World War Two, 1978, 1999)

The British steel springs were not well suited for use on America's rough roads of the time, and could even cause coaches to collapse if cornered too fast. In the 1820s, the Abbot Downing Company of Concord, New Hampshire re-discovered the antique system whereby the bodies of stage coaches were supported on leather straps called "thorough braces", which gave a swinging motion instead of the jolting up and down of a spring suspension. (http://en.wikipedia.org/wiki/Suspension_(vehicle)

Automobiles were initially developed as self-propelled versions of horse drawn vehicles. However, horse drawn vehicles had been designed for relatively slow speeds and their suspension was not well suited to the higher speeds permitted by the internal combustion engine.

In 1901 Mors of Paris first fitted an automobile with shock absorbers. With the advantage of a dampened suspension system on his 'Mors Machine', Henri Fournier won the prestigious Paris-to-Berlin race on the 20th of June 1901. Fournier's superior time was 11 hrs 46 min 10 sec, while the best competitor was Léonce Girardot in a Panhard with a time of 12 hrs 15 min 40 sec.

In 1920, Leyland Motors used torsion bars in a suspension system. In 1922, independent front suspension was pioneered on the Lancia Lambda and became more common in mass market cars from 1932. (Jain, K.K.; R.B. Asthana. Automobile Engineering. London: Tata McGraw-Hill. pp. 293–294)

1.3 PROBLEM STATEMENT

Fabrication can be done on a normal swing arm to support absorber and the chassis of the ATV. But, it is exactly difficult to fabricate the prototype as same as the design.

Therefore it is necessary to solve the problems of fabrication to ensure the fabricated prototype is as close as possible to the design and that a high quality rear suspension is fabricated so that it can give high comfort to the rider.

1.4 PROJECT OBJECTIVES

There are two main objectives to achieve in this project which is to reverse engineering of independent rear suspension unit for ATV motorcycle and to fabricate the working prototype of rear suspension unit for ATV motorcycle.

1.5 PROJECT SCOPE

In order to achieve the objective ,there are scopes of project which is to design the suitable suspension for ATV motorcycle. Otherwise, to fabricate the rear suspension using provide materials and machine and do some literature review.

1.6 FLOW CHART

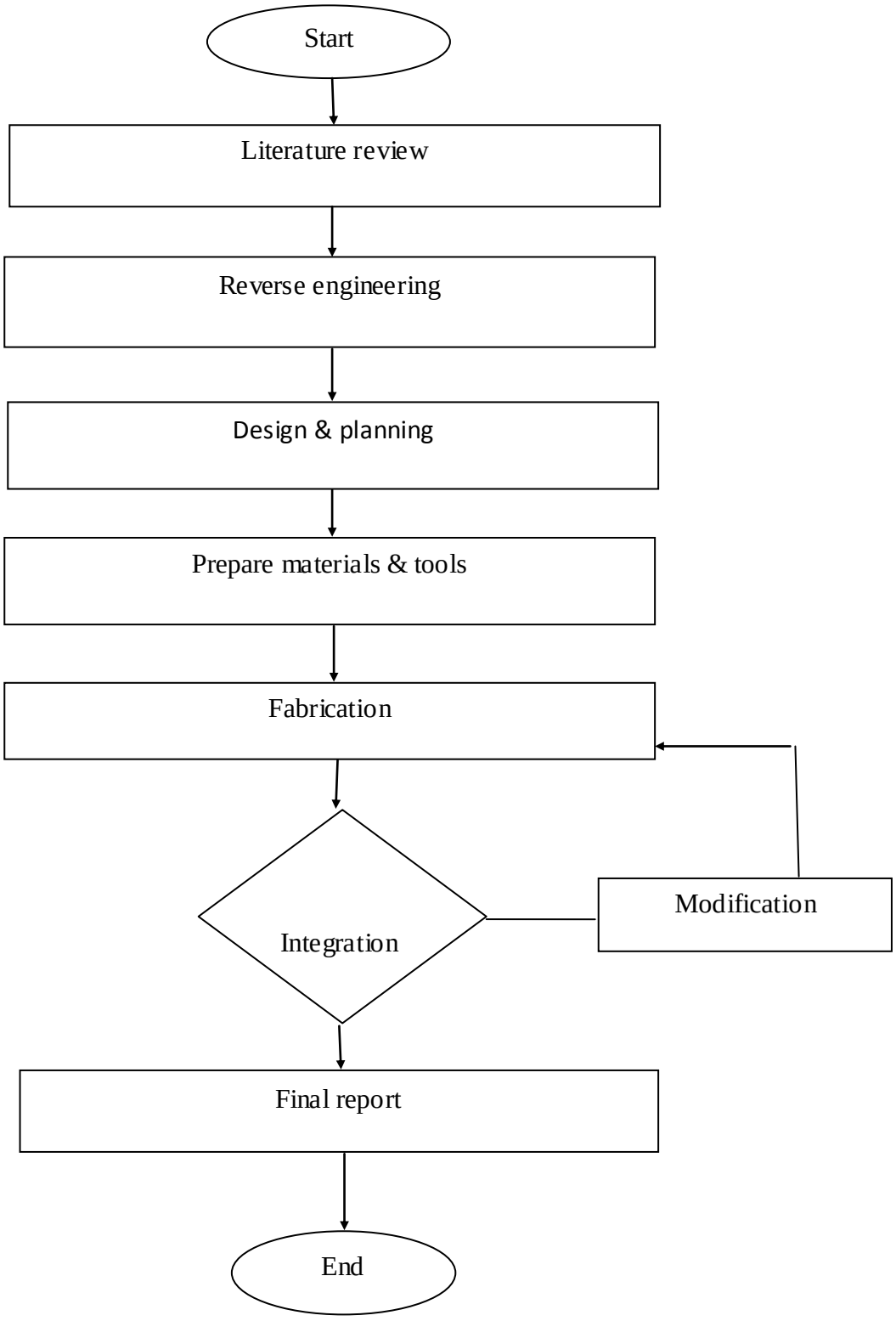


Figure 1.1 : Flow chart

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter explains about literature review would be done, which include the theory about rear suspension system. Usually the rear suspension system is build because of customer need towards the comfortable when drive or cycling. The manufacturer always do some research to make a suspension like rear or front more improve or better than before. They use many technologies to create a modern suspension. The first stage in achieving a good rear suspension that will provide the greatest percentage of power efficiency is to go right back to basics of the rear suspension system. (www.monroe.com/en-US/support/.../Suspension-System-Fundamentals/

The rear suspension system is back part of the vehicle especially ATV that including the springs, shock absorber, struts, control arms and spindle. The primary function of the suspension is to provide vertical compliance so the wheels can follow the uneven road, isolating the chassis from roughness in the road. Otherwise, it also maintain the wheels in the proper steer and camber attitudes to the road surface and also

react to control forces produces by the tires. Furthermore ,it also resist roll of the chassis and keep the tires in contact with the road with minimal load variations.

There are main categories of rear suspension system like independent and non-independent.

2.2 TYPES OF THE SUSPENSION SYTEM.

There are two types of the suspension system on the vehicle like car ,ATV and etc. the first types is independent suspension system and the second types is non-independent suspension system. This two types of rear suspension will be discuss on the next chapter .

2.2.1 Independent suspension system

Independent suspension is a broad term for any automobile suspension system that allows each wheel on the same axle to move vertically independently of each other. This is contrasted with a beam axle, live axle or de Dion axle system in which the wheels are linked – movement on one side affects the wheel on the other side. Note that "independent" refers to the motion or path of movement of the wheels/suspension. It is common for the left and right sides of the suspension to be connected with anti-roll bars or other such mechanisms. The anti-roll bar ties the left and right suspension spring rates together but does not tie their motion together.(https://en.wikipedia.org/wiki/Independent_suspension).

Most modern vehicles have independent front suspension . Many vehicles also have an independent rear suspension . Independent rear suspension , has the rear wheels independently sprung. A fully independent suspension has

an independent suspension on all wheels. Some early independent systems used swing axles, but modern systems use Chapman or Mac Pherson struts, trailing arms, multilink, or wishbones.

Independent suspension typically offers better ride quality and handling characteristics, due to lower un sprung weight and the ability of each wheel to address the road undisturbed by activities of the other wheel on the vehicle. Independent suspension requires additional engineering effort and expense in development versus a beam or live axle arrangement. A very complex independent rear suspension solution can also result in higher manufacturing costs.

The key reason for lower un sprung weight relative to a live axle design is that, for driven wheels, the differential unit does not form part of the un sprung elements of the suspension system. Instead it is either bolted directly to the vehicle's chassis or more commonly to a sub frame. The figure above is show the independent suspension system works. (http://en.wikipedia.org/wiki/Suspension_(vehicle)

Figure 2.1: Independent suspension

Source : H & H trikes inc. (1999)

2.2.2 Advantage of the independent suspension system

This system provides many advantages over other suspension systems. For example, in solid axle suspension systems, when one wheel hits a bump, the wheel across from it is affected as well as the one that hit the bump. This will compromise traction, smoothness of the ride, and could also cause a dangerous wheel shimmy when moving at high speeds. According to "Car Suspension Bible" with independent suspension systems, only the wheel that hits the bump would be affected. This offers many advantages such as greater ride comfort, better traction, and safer, more stable vehicles on and off the road .

2.2.3 Disadvantage of the independent suspension system.

The disadvantage of the independent suspension system, weight is take place on the vehicle. Otherwise, the independent suspension system also have complicated pieces of equipment .Furthermore, it also quite expensive that another types of suspension system.

Figure 2.2: the independent suspension system

Source : H & H trikes inc.(1999)

2.2.4 Non independent suspension system

The suspension arms or axles connect the wheels and tires to the frame and allow the tires and wheels to move up and down depends on surface. Otherwise , Solid axles are strong and, relatively inexpensive and A car with solid axles will usually have a harsher ride than a car with an independent suspension.

Overall, non-independent suspensions are less adept than independent varieties at isolating vehicle occupants from bumps and dips in the road. This is because a jolt on one side travels through the shared axle and affects the opposite wheel and, often, the chassis as well.

Non-independent suspensions should not be considered substandard in all cases, however. For example, Jeep uses non-independent axles in both the rear and front of its Wrangler because it affords an advantage in some off road situations. Most sport utility vehicles designed for true off road use employ a non-independent rear suspension.

Reference :(http://en.wikipedia.org/wiki/Suspension_(vehicle))

2.2.5 Advantage of non independent suspension system

For the non independent suspension system , there is a advantages like the left and right wheels bounce mutually implicated ,the tire angle changes in the amount of small tire wear. Otherwise ,the decrease of the body height is not easy to change the angle of the wheel ,so that steering feeling is consistent and in non independent suspension system also have a simple structure ,low manufacturing cost ,and easy maintenance. Furthermore ,it also take up less

space ,can reduce the height of the car floor. In addition ,left and right wheels bounce mutually implicated, and reduce ride comfort and control stability. Simple structure design freedom ,manipulation of the stability is poor and suspension system is shortcomings.

2.2.6 Disadvantage of non independent suspension system

In non independent suspension system ,there is disadvantage of this system that independent didn't have like less adept than independent suspension system. Otherwise, this type of suspension system is not suitable for ATV because of harsher ride when drive at rough surface.

2.3 SPRINGS

ATV use metal coil springs usually made of steel attached to the outside of the damper. They have specific performance characteristics that determine by the spring wire diameter, coil diameter, pitch, and material quality. Springs are designed to absorb the impacts and bumps as the ATV is ridden. There are three different types of coil springs used on ATV suspension systems: single, dual, and progressive rate.

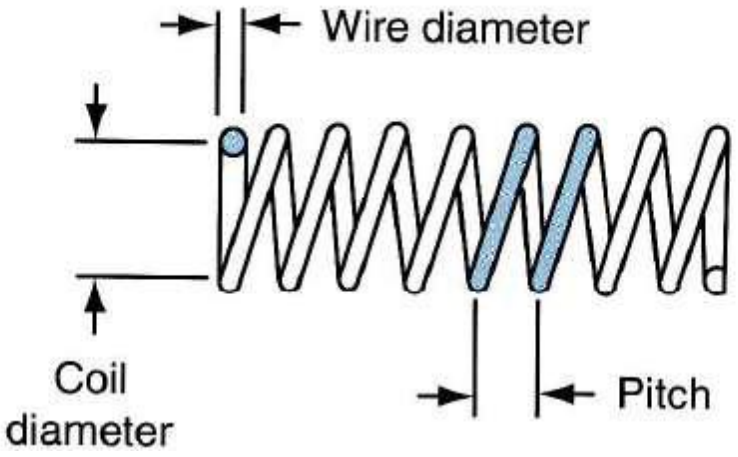


Figure 2.3 : specific performance characteristics of springs

Source : Ed Abdo ,modern motorcycle & ATV technology(1985)

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

The methodology had been done right after the motivation and objectives of the project were identified. This methodology functioned as guidance in order to complete the project given. The completed structure of methodology had been illustrated and planned as guideline to achieve the objectives of the project.

3.2 SKETCHING

There were 3 sketches including a reference. The entire concepts are screened and after the screening process, the best sketching is converted or apply into the solid work drawings. This sketches were made based on the ideal concept and as followed:

3.2.1 Concept 1

This is the basic design of the rear suspension system unit for ATV. This design is need about one materials and three part to combined to make a rear suspension system.

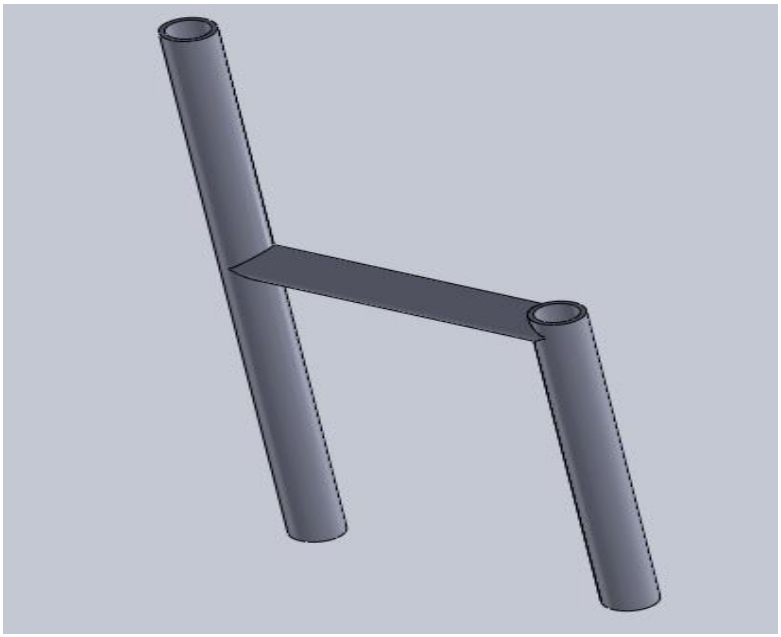


Figure 3.1: Concept 1

Table 3.1: Advantages and disadvantages of concept 1

Advantages	**Disadvantages**
Simple design	This concept is not strong enough to be placed into the chassis of the ATV
Didn't use many materials	Easy to fracture
Not complicated to make it	

Table 3.1 shows the advantages and disadvantages of the design concept 1 .This design is the simplest design than another two . It also easy to construct and didn't use many materials so that the cost can be reduce. But , this concept design have more problem because it is not strong enough to be placed into the chassis of the ATV as the force that imposed at the ATV is huge. Otherwise, the design also easy to fracture due to the large force that imposed on the suspension.

3.2.2 Concept 2

This design is improved to make more stable and strong . This design also more wider that design 1 that suitable to place the tire and the absorber . This design is used one materials and 4 junction as can see below:

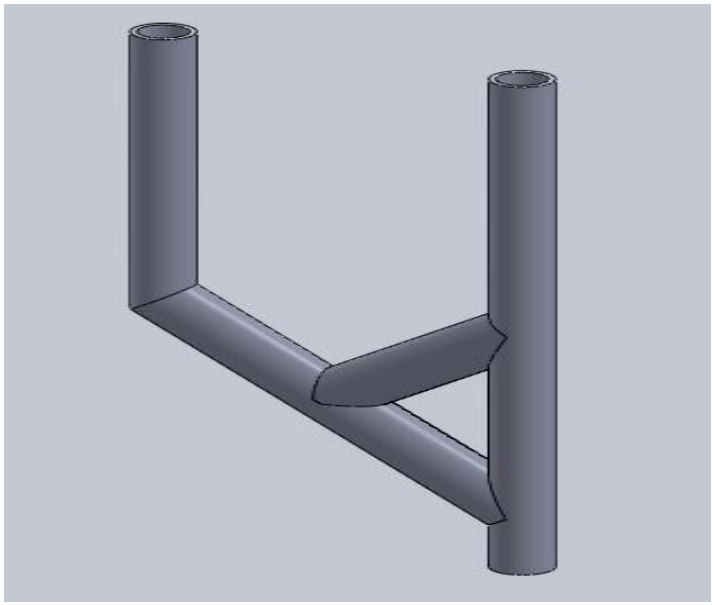


Figure 3.2: Concept 2

Table 3.2: Advantages and Disadvantages of concept 2

Advantages	**Disadvantages**
strong	Complicated
Attractive	Also not enough to strong sustain the chassis of ATV
	Difficult to assemble

Table 3.2 shows the advantage and disadvantage of the design concept 2 .This design is more strong than design concept 1. This is because , it has be added of one part to be joint into main structure. Furthermore, this design is attractive and more beautiful than concept 1. But , it has many disadvantage like more complicated to be build .Otherwise ,it also has not strong to sustain the chassis of the ATV. Furthermore, it also more difficult to be assemble than design 1.

3.2.3 Concept 3

This design is completed and suitable than concept one and two. This is because, the design can sustain more force than other concept.

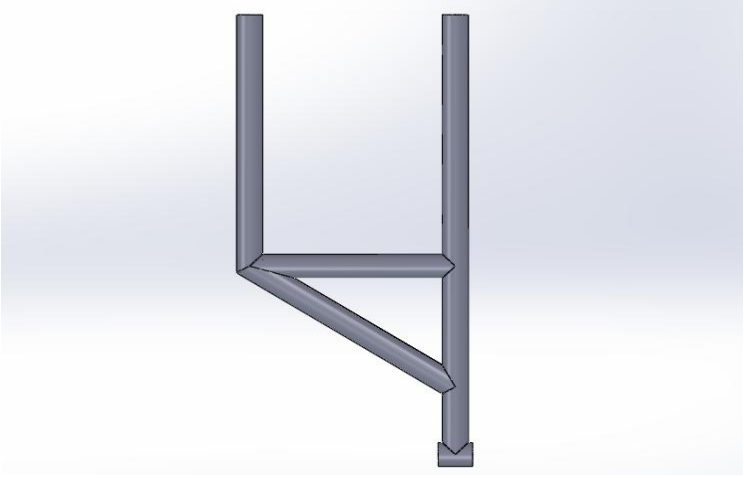


Figure 3.3: Concept 3

Table 3.3: Advantage and disadvantage of concept 3

Advantages	**Disadvantages**
strong	Difficult to made
attractive	
Provide protection	

Table 3.3 shows the advantage and disadvantage of the design concept 3. This design has been improved. This design is strong that can sustain the weight of the ATV. A large force can be imposed to this design .Otherwise , the design is more attractive and provide protection because of the design is too strong. But, it is difficult to made or assemble because it need accuracy that made it more strong than others.

3.3 CONCEPT SELECTION AND COMPARISON

Concept selection and comparison are made to select the best concept among all entire concepts given. The design must follow up the problem that was consider .The 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 total score was chosen to be developed and fabricated. The three given concept is the best among all the concept generate.

From the data show that the symbol positive (+) is means by the types of selection is in good and the last is symbol (-) show it is weak condition. The result can be obtained that shows in the table below:

Table 3.4: Design comparison for three proposed design

Selection criteria	Concept 1	Concept 2	Concept 3
Attractive	_	+	+
Strength and durability	_	_	+
Easy to fabricate	+	_	_
Easier to design	+	_	+
Cost production	+	_	_
Provide protection	_	_	+
Total (+)	3	1	4
Total (-)	3	5	2
Total score	0	-4	2
Rank	2	3	1

3.4 FINAL CONCEPT SELECTION

From concept of selection table, the advantages and disadvantages of the design can be outlined .Criteria of the rear suspension system to be fabricate are very important things to be considered before fabrication process . Six criteria are been chosen to be consider. According to the table study of the concept selection shows that each concept has their advantages and disadvantage.

From the table 3.4 , it was shown that the concept 3 has been selected as the concept to be fabricated. It is score the highest marks in design comparison and proves to be able to fabricate .Compared to the another design , it has the same advantage with concept 1 easier to design and with concept 2 is attractiveness.

As conclusion , the best concept that will be selected is design concept 3 that to be a fabricate the rear suspension structure in final year project.

3.5 SOLIDWORKS DESIGN

The sketch of concept 3 is converted into 3D drawing by using Solid Works 2012 software. The design is made part by part and by using this software. The Figure 3.5 below show the final design that draws in solid works software.

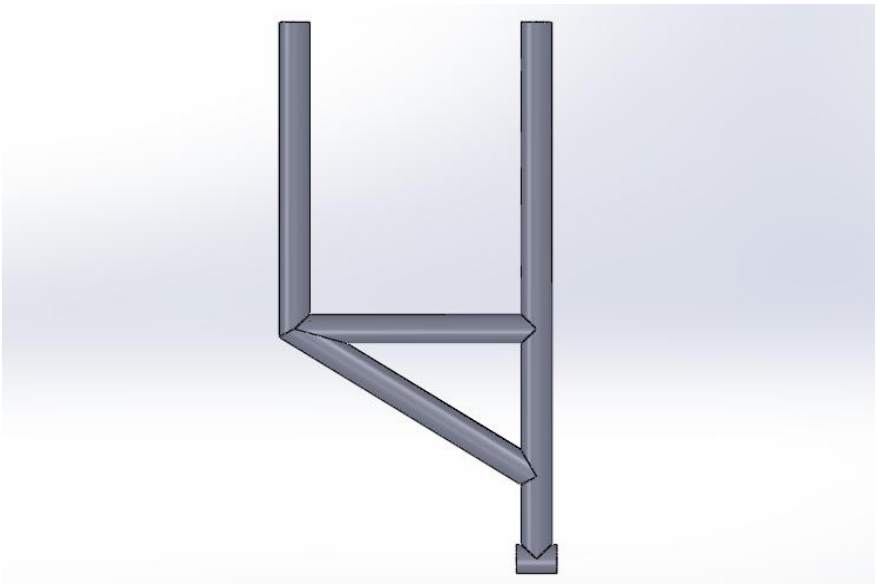


Figure 3.4: Final design (combined)

3.6 SELECTED MATERIALS.

For this final year project ,the (stainless steel) round hollow section would be selected and to be used for the most of the part to make a rear suspension structure. This materials must have available to complete the whole of the rear suspension structure Besides that, the materials was chosen because it is the easiest material to find and get it. Otherwise, this materials is enough strong and though to do a hard work like a ATV chassis and suspension.

3.7 FABRICATION PROCESS

In this chapter ,it would explain about the fabrication process that is done to build the rear suspension structure. All the fabrication process will be explain thoroughly. The fabrication processes are made in Fakulti Kejuruteraan Mekanikal. The project is fabricated based on the design made earlier and using various fabricating methods. The method used to fabricate the product such as, cutting, grinding, and more other methods.

3.8 PROCESS INVOLVE

a. Selecting or collecting materials

Firstly, the material used is collected at Solar House store. There are various types of materials there and then we selected the stainless steel round hollow section. The other materials were bought from hardware nearby.

Figure 3.5: Collecting materials

b. Measuring and marking

Before start the fabricating process, the materials that we selected must be measured and mark according to the dimension in solid work design or in the bill of materials. The Figure 3.6 shows the measuring tape that is used to measure the materials used for the project. The fabrication process is start with measuring and marking the materials into the dimension needed according the design. The measuring and marking process is done by using measuring tape and steel marker.

Figure 3.6: Measuring tape

c. Cutting process

After the materials are measure and marked, the cutting process will be done. The material is cut based on the mark on the material earlier. The tool were used in this process such as grinder to cut the stainless steel round hollow section. In the Figure 3.7 shows the grinder to cut the materials .This tool is easy to use than other tool like floor cutting disc machine.

Figure 3.7: Cutting process

c. Notching process

Notching is a process that involves the cutting of various types of metal stock at an angle. Notching are done to create a vertical cut in a tube or sheet stock. Notching is used in many different metals applications. A notch is cut inward from the edge of the material, and is always cut at a measured angle that is calculated in accordance with the application that requires the notching. The vertical cut that is made in the stock is also made perpendicular to the edge of the material. The most common application that notching are used for in tube stock is welding.

There are many types notching process like tube notching ,end notching and side notching (offset notching). In this project, I usually used are tube notching as the materials are round. To make a tube notching ,the tools that used is also grinder that use cut off points. The Figure 3.8 show the material that has been made by notching process.

Figure 3.8: Tube notching process

e. Welding process

Welding is a fabrication or sculptural that joints material ,usually metals or thermoplastics ,by causing coalescence. In Figure 3.9, shows the example of the welding that must do to joint the part of materials to make a rear suspension structure. After making a tube notching of the material, the fabrication process continues by assembling all the parts by using the welding process. The welding that used for this fabrication is gas metal arc welding (GMAW).

Figure 3.9: GMAW(gas metal arc welding).

f. Grinding process

Figure 3.10 show the grinder point to make a finishing .After made a welding process, the next steps is grinding to dispose the over limited and melted welding parts. This is the one ways to make a rear suspension structure looks clean and attractive.

Figure 3.10: Grinder point finishing.

3.9 SAFETY PRECAUTIONS IN WELDING OPERATION

3.9.1 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 cautions must be taking serious and should be exercised when using any types of welding equipment. Injury can result from fire, explosions, electric shocks 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:

a. Make sure before using welding machine equipment requested permission from who is in charge the lab

.

b. Do not weld the materials with wooden floors, unless the floors are protected from hot metal by means of fire resistance fabric, sand, or other fireproof materials and must be sure that hot sparks of metal will not fall on the operator or an any welding equipment components.

c. Remove all the flammable materials such as cotton ,oil, gasoline etc from the vicinity of welding.

d. Make sure before welding or cutting ,warm those in close promixity who are not protected to wear proper clothing or goggles.

e. Remove any assembled part from the component that being welded that may become warped or otherwise damaged by the welding process.

f. 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.

3.9.2 Personal protective equipment

During the welding the rear suspension structure the gas metal 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.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 FINAL PRODUCT

4.1.1 Overview of product

Figure 4.1 show the rear suspension structure of the final year project. This is the result of all fabrication process that discuss at chapter 3.

Figure 4.1: Rear suspension system

In the Figure 4.1, the rear suspension framework is finish. But, it is not finish at combining the absorber and the springs. The materials stainless steel round hollow section is the best idea to make a rear suspension because the lightweight and not become a rust in the future. This material is easy to modify and build. Besides that, if we use this material, it provided a protection to the users as the factor of safety in the analysis is bigger. Otherwise, the design concept is made in strongest condition.

Figure 4.2: Angle part of the rear suspension

In the Figure 4.2 above, the angle part of the rear suspension are 45 degree, 90 degree and 30 degree. To get the angle that accurate, we can use a angle bar and a protector. This is made because to get a rear suspension to become a strong one. The length of the hollow stainless steel that use are 370 mm, 300 mm and 700 mm to make this parts.

4.1.2 Overview of notching process

a. Angle notching

Figure 4.3 : Angle Notching

In Figure 4.2, this is angle notching to make the rear suspension. In this part, we must cut the end of the hollow stainless steel about 10mm at the bottom and 5mm at the top to make the hollow stainless steel inclined about 45 degree. To joint the 2 hollow stainless steel to become perfect or didn't have a strange space, we must do a notching and then make a finishing using grinding point finishing. A perfect notching can make easier to weld the hollow stainless steel.

b. Straight or perpendicular notching

Figure 4.4: Perpendicular notching

This type of notching is easier than angle notching that show in the Figure 4.2. In the Figure 4.3 above, we can cut the left and right of the hollow stainless steel with same depth. The depth is about 10mm and it can joint perfectly with the other hollow stainless steel. To get a more perfect, use a grinder to make a finishing.

4.2 DEFECT

Figure 4.5 shows the defect of the rear suspension .

Figure4.5: Defect of the rear suspension

Basically, this rear suspension system has a defect that actually can be seen in Figure 4.5 .There are many defects can be happened while the fabrication process is done. The defect can happened due to the human error or machine and tool error like zero error. One of the defect that can be detected is depth to make a notching process. This defect can make difficult to weld the hollow stainless steel.

4.3 PROBLEM ENCOUNTER

There progress of making the product also faces some problems during its time. The problems can occur because of the limited number tools or time and more.

a. Materials problem

The problem happen when the material that early suggested, needs to be changed. It is because the material needed for the project is not located in faculty store. So the material is change to the suitable material which is in the store. But not the materials are in the lab, so student has to wait until the material has reach in faculty store

b. Fabrication problem

There are also problem that occur in fabrication process. The problem caused by the limitation of the tool, type of tool in the lab and how to use machines. At the beginning of this project, student must know how to use all machines involve in this project. The problems occur when student is hard to find person in charge of the lab. Some of the student doesn't know where the PIC for a lab while doing their work.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

In conclusion, the overall project is achieved. The objectives of designing and fabricating the rear suspension model was reached to the objective. The best design is selected and then make some fabricating within the time limit given. The designing process has more required study to expert in solid work drawing. Otherwise, the fabrication process also required many skills that have been learned in previous mechanical laboratory such as, material measuring, marking, cutting, drilling, welding , and grinding.

The fabrication process provided 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.

5.2 RECOMMENDATION AND IMPROVEMENT

The project should be plan earlier to ensure that the project is reach the objective. The materials also must reach early to make a project run smoothly. Otherwise, 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 rear suspension 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 rear suspension also must be welded properly so that the go-kart chassis is stable and more durable.

REFERENCES

E.R. Teoh, M. Campbell / Journal of Safety Research 41 (2010) 507–512, Science Direct

P.E. Uys and M. Thoresson, 2007. Suspension settings for optimal ride comfort of off-road vehicles travelling on roads with different roughness and speeds. Journal of Terramechanics, 44: 163-175.

Wilson, Hugo (1995). "The A-Z of Motorcycles". The Encyclopedia of the Motorcycle (in UK English). London: Dorling Kindersley. p. 100. ISBN 0-7513-0206-6.

Peter Chamberlain and Hilary Doyle, Encyclopedia of German Tanks of World War Two, 1978, 1999

Jain, K.K.; R.B. Asthana. Automobile Engineering. London: Tata McGraw-Hill. pp. 293–294

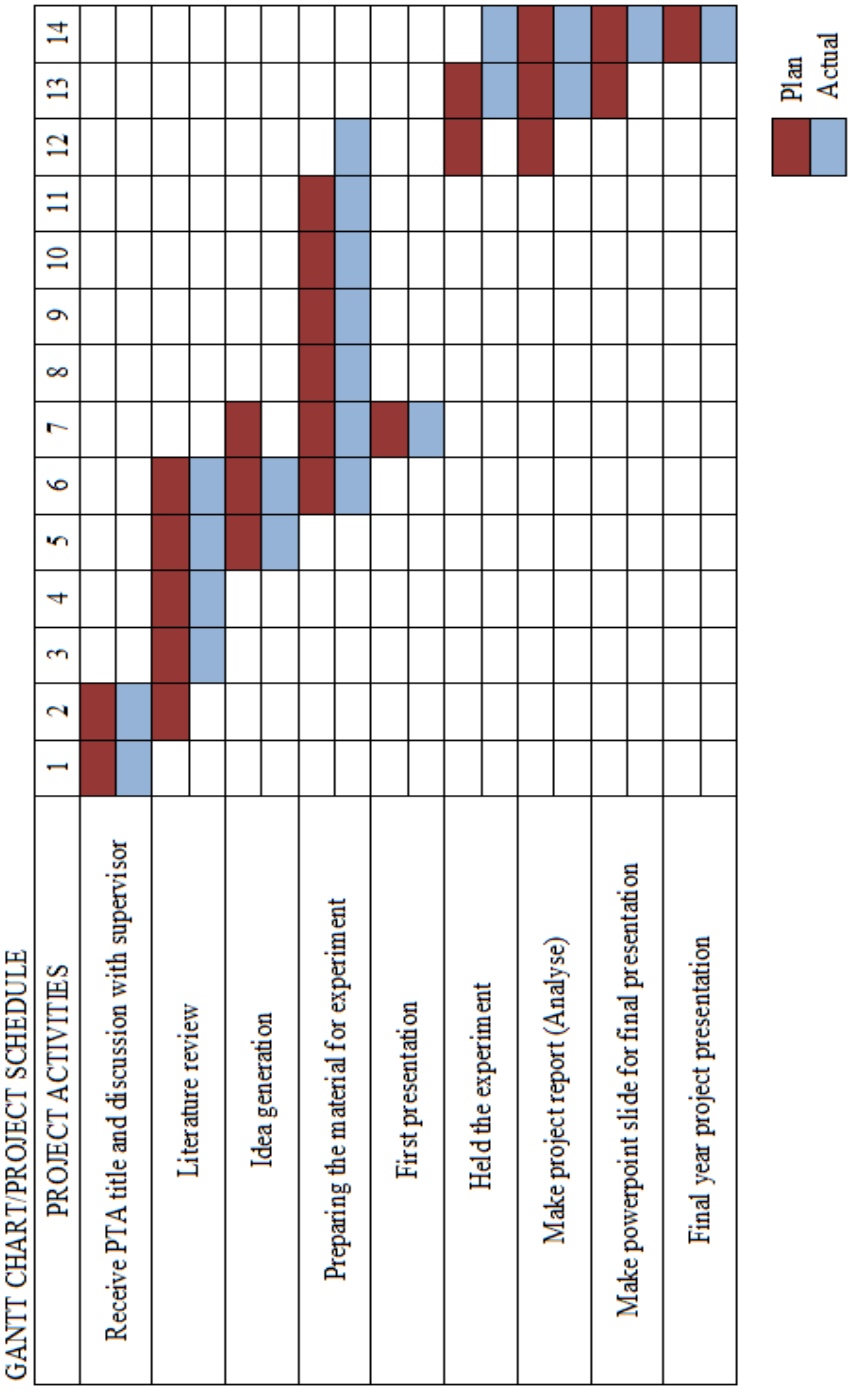
Reza N. Jazar (2008).Vehicle Dynamics: Theory and Applications. Spring. p.455. Retrieved 2012-06-24.

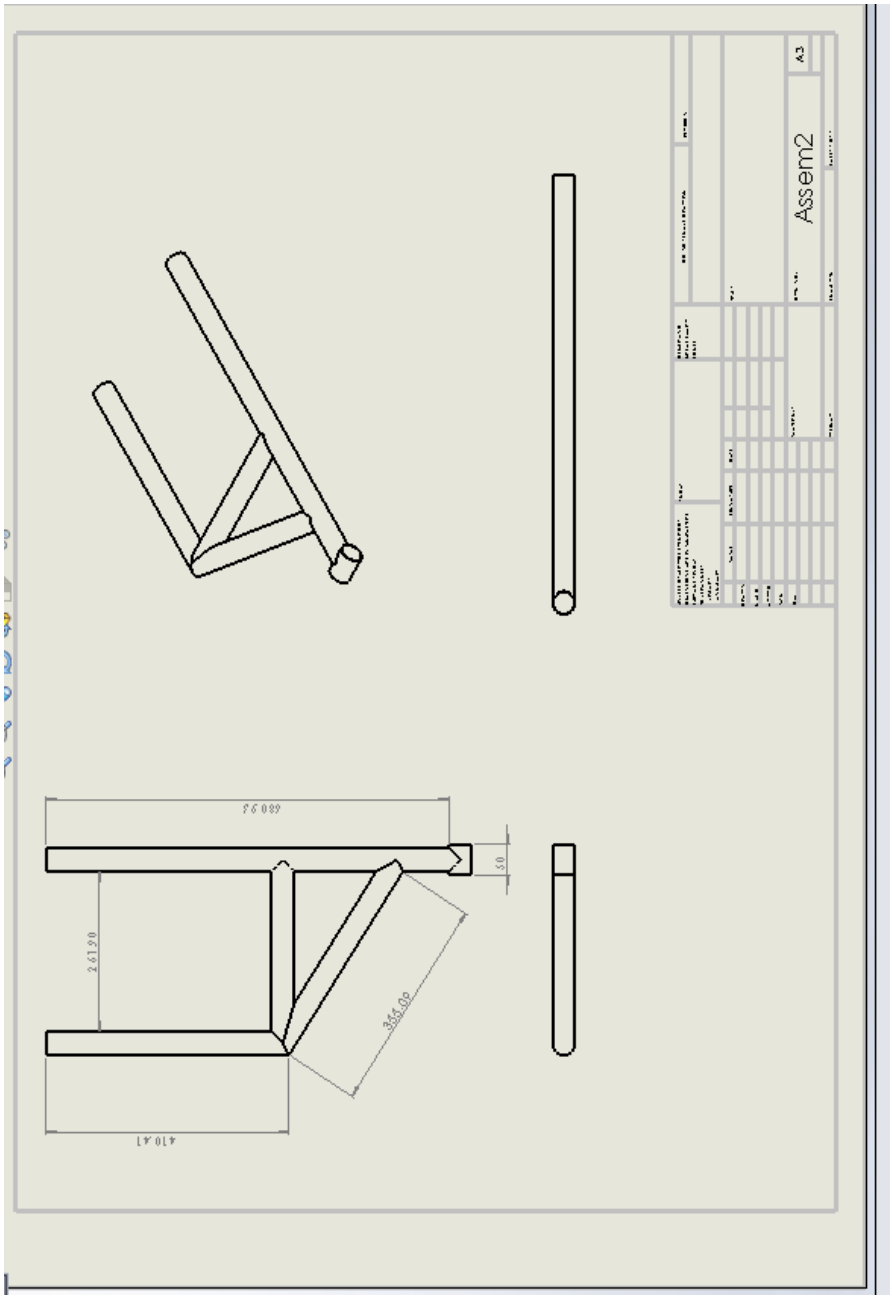
http://en.wikipedia.org/wiki/Suspension_(vehicle).

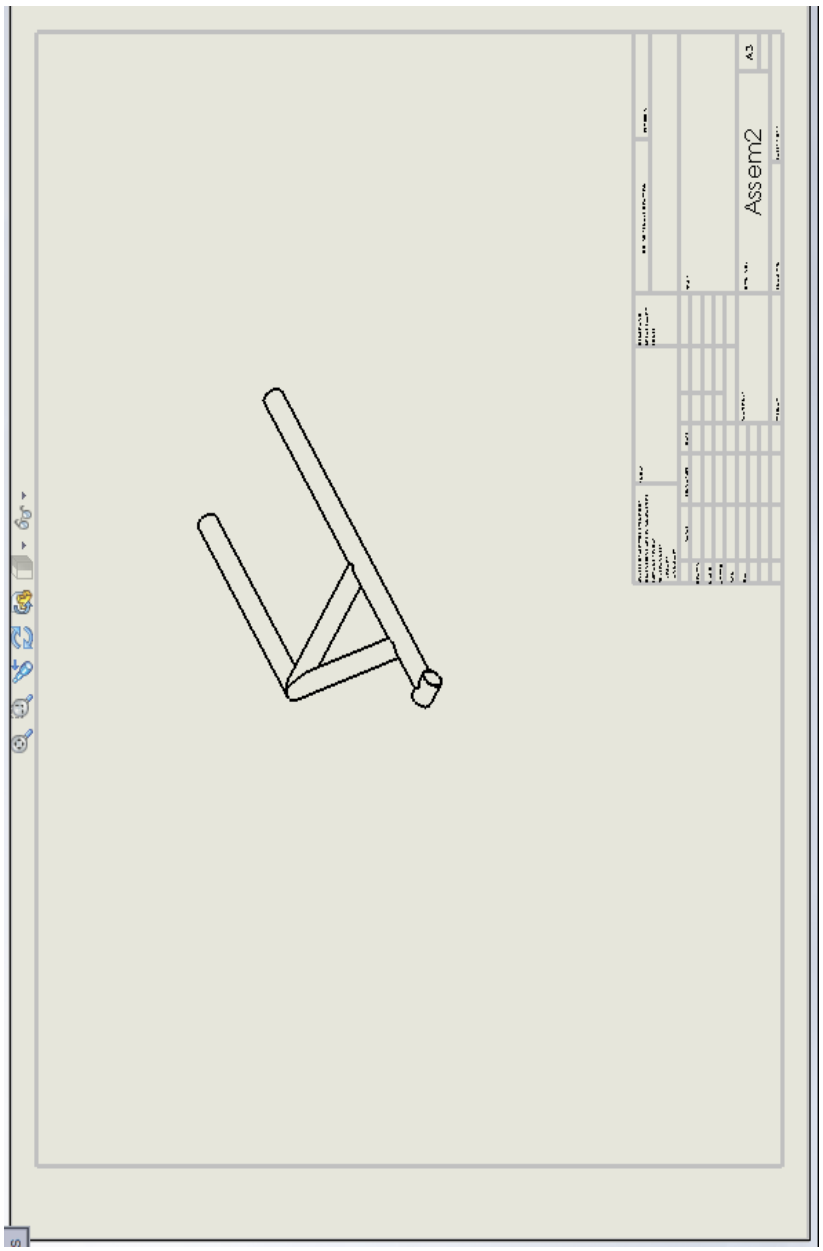
http://performance-suspension.eibach.com/powersport/products/atv.(1990)

https://en.wikipedia.org/wiki/Independent_suspension

APPENDICES


GANTT CHART/PROJECT SCHEDULE
PROJECT ACTIVITIES
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Receive PTA title and discussion with supervisor
Literature review
Idea generation
Preparing the material for experiment
First presentation
Held the experiment
Make project report (Analyse)
Make powerpoint slide for final presentation
Final year project presentation
Plan
Actual


Assem2
A3
680.93
50
261.90
365.08
410.41


Assem2
A3

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project and in my opinion, this project is adequate in terms of scope and quality for the award of the Diploma of Mechanical Engineering.

Signature : _____

Name : GAN LEONG MING

Position : LECTURER

Date : 24 JUNE 2013

STUDENT'S DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of other degree.

Signature : _____

Name : MOHD IZZAT BIN ZULKAFLI

Id Number : MB11011

Date : 24 JUNE 2013

DEDICATION

I specially dedicate to my beloved parents
(Zulkafli Bin Zakaria &Roslina Binti Mustapha), my siblings,
My supervisor (Dr Gan Leong Ming) and those who have guided
And motivated me for this project

ACKNOWLEDGEMENTS

Alhamdulillah first of all, the deepest sense of gratitude to the god ,who guide and gave me the strength and ability to complete this final year project and also thanks I brace upon him.

I would like to take this opportunity to express my gratitude and sincere appreciation to all those who gave me the possibility to complete this report. I am very grateful to my supervisor Dr Gan Leong Ming for his patience, trust and supporting for guide me finished this project. I also sincerely thanks for the time spent and correcting of my mistakes.

I would like to acknowledge to all the staffs in mechanical laboratory whom gave me permission to use the necessary tools in the laboratory and guide me the machine's operating system. Also thanks to kak zarina senior of the project as she helps a lot to finish my project.

I will also like to express my deepest appreciation to my parents whom always support me and motivate me to complete this final year project.

My sincere appreciation also extends to all my colleagues ,housemate , and friends whom had provided assistance at various occasions by support and give ideas for my final project.

Finally to individuals who has involved neither directly nor indirectly in succession of this thesis or project .Indeed I could never adequately express my indebtedness to all of them. Hope all of them stay continue support me and give confidence in my efforts in the future Very thankfully of all of them.

ABSTRACT

This thesis deals with the fabrication of Hybrid Air ATV rear suspension. The objectives are to reverse engineering of independent rear suspension unit for ATV motorcycle and to fabricate the working prototype of rear suspension unit for ATV motorcycle. The scope identified are design a suitable suspension for ATV motorcycle and fabricate the rear suspension using a provide materials and machine. There are many steps taken to fabricate this ATV motorcycle. The first stage of these steps is do some Literature review about suspension unit. The second steps is planning the suspension unit to combine the chassis body . The design of suspension unit are provided by senior of project .Next stage is do some work like welding ,cutting , drilling, and marking. Thus ,finishing this project ,the objectives of the project is achieved. Finally ,the conclusion about this project and the recommendation for the future plan also attached together with this thesis.

ABSTRAK

Tesis ini membincangkan pembuatan suspensi belakang udara hybrid untuk ATV . Objektif projek ini adalah untuk menterbalikkan kejuruteraan unit bebas suspensi belakang untuk motosikal ATV dan untuk mereka prototaip unit suspensi belakang untuk motosikal ATV. Skop yang dikenalpasti adalah reka bentuk suspensi yang sesuai untuk motosikal ATV. Terdapat banyak langkah-langkah yang diambil untuk mereka motosikal ATV. Peringkat pertama adalah melakukan beberapa kajian Kesusasteraan tentang unit penggantungan. Langkah yang kedua adalah perancangan unit penggantungan untuk menggabungkan badan casis. Reka bentuk unit penggantungan disediakan oleh kanan projek. Peringkat Seterusnya membuat kerja-kerja seperti kimpalan, memotong, penggerudian, dan penandaan. Oleh itu, menyelesaikan projek ini, objektif projek tercapai. Akhir sekali, kesimpulan mengenai projek ini dan cadangan untuk rancangan masa depan juga dilampirkan bersama-sama dengan tesis ini.

TABLE OF CONTENT

CHAPTER 2 LITERATURE REVIEW

CHAPTER 3 METHODOLOGY

LIST OF TABLES

TABLE OF FIGURE

LIST OF ABBREVIATIONS

ATV	All Terrain Vehicle