FABRICATION OF AIR-HYBRID ALL TERRAIN VEHICLES FRONT SUSPENSION SYSTEM

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CHAPTER 1

INTRODUCTION

1.1 Background

Front suspension system in a vehicle helps absorb hardness in the road. It is very important to all terrain vehicles because of the road condition it travels. Thus, the fabricating process of all terrain vehicle front suspension system must be very careful to ensure the suspension system works well. It is also to ensure the driver's safety and comfort of riding the all terrain vehicles.

This project is to fabricate front suspension system of an air-hybrid all terrain vehicle's front suspension system according to the design given.

1.2 Problem statement

In the progress of fabricating the front suspension system of the Air-hybrid ATV suspension system, it is important to understand Engineering drawing and transform the 3D drawing into a real life product. However, it is difficult to fabricate the product as ideal as the drawing.

Fabricating the Air-hybrid ATV front suspension system involve choosing suitable method to fabricate the product as similar as the design but it is difficult is to make sure the actual product is the same as design. Thus, it is necessary to refine the design according the fabrication process.

1.3 Objectives

The main objectives of this project are:

i. To reverse engineering of double wishbone front suspension unit for ATV motorcycle
ii. To fabricate the working prototype of front suspension unit for ATV motorcycle

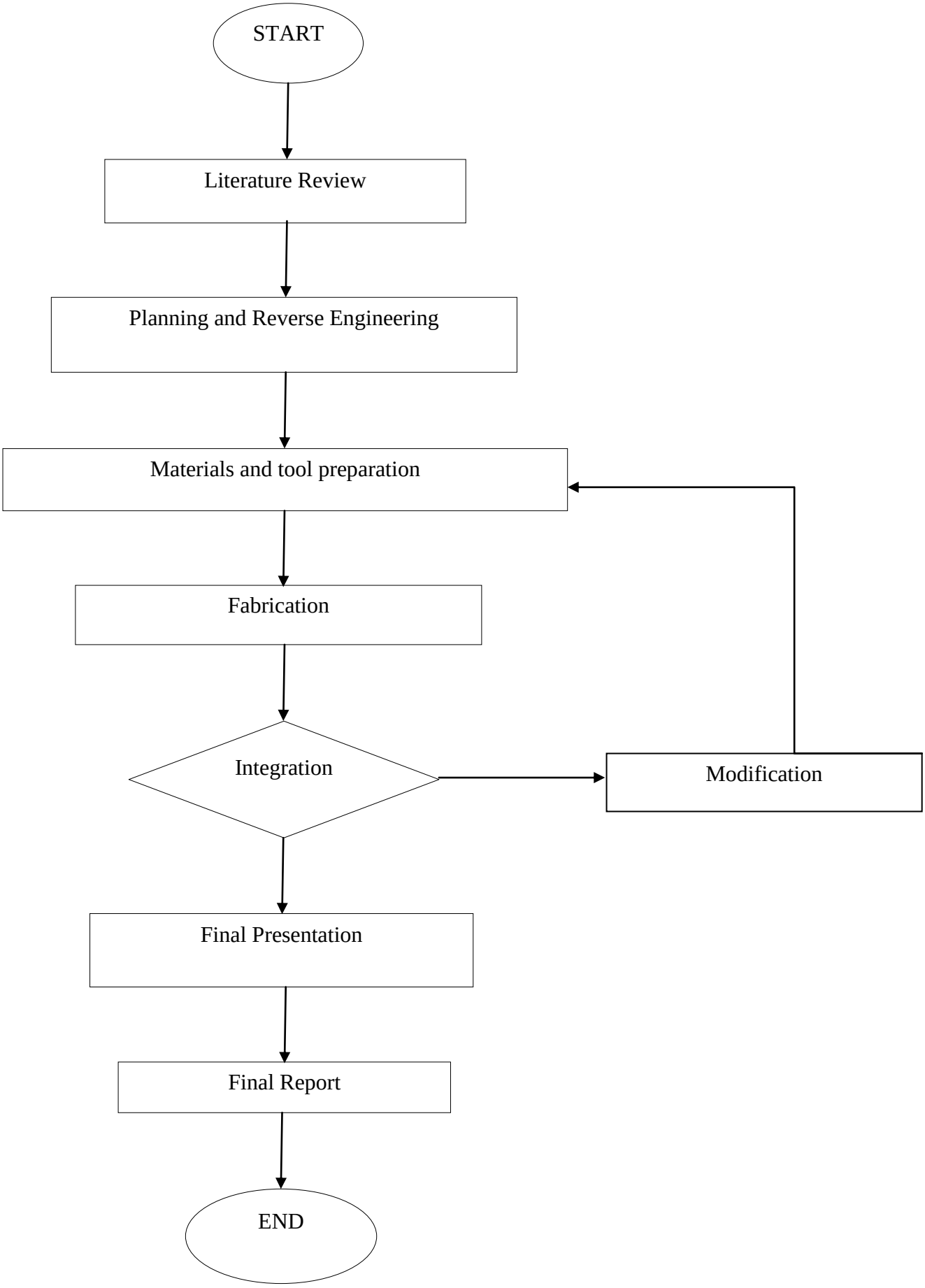
1.4 Scopes

The scopes of this project are:

i. Literature review on the selected work scopes
ii. Measurement and reverse engineering of the existing model in 3D format
iii. Preparation of materials and tools
iv. fabrication of working prototype based on the refined design
v. System integration and operational verification
vi. Final report preparation

1.5 Flow chart

A flowchart is a type of diagram that represents an algorithm or process, showing the steps as boxes of various kinds, and their order by connecting them with arrows. This diagrammatic are presentation solution to a given problem. Process operations are represented in these boxes, and arrows; rather, they are implied by the sequencing of operations. Flowcharts are used in analyzing, designing, documenting or managing a process or program in various fields. Below is the flow chart of this project- Fabricating ATV front suspension system.


START
Literature Review
Planning and Reverse Engineering
Materials and tool preparation
Fabrication
Integration
Modification
Final Presentation
Final Report
END

CHAPTER 2

LITERATURE REVIEW

2.1 All-Terrain Vehicle

An all-terrain vehicle is defined as a motorized off-highway vehicle designed to travel on four low-pressure tires, having a seat designed to be straddled by the operator and handlebars for steering control. ATVs are subdivided into two types as designated by the manufacturer. Type 1 ATVs are intended by the manufacturer for use by a single operator and no passenger. Type 2 ATVs are intended by the manufacturer for use by an operator and a passenger, and are equipped with a designated seating position behind the operator (Jeff Savage, 2004).

2.1.1 Historical Perspective

The table (Table1.1) below shows the history of ATVs. It records the types of the ATVs build by different manufacturer on different year. This also shows the trends of ATVs.

Table 1.1: History of ATVs

1970	Honda introduces the first all-terrain vehicle, the three-wheeled US90 with a 7hp engine, for US$595.
1979	Yamaha introduces its first ATV, the YT125.
1981	Honda introduces the ATC250R, the first high-performance two-stroke three-wheeler adapted
1982	Suzuki introduces its first ATVs, including the first four-wheeled ATV, the QuadRunner LT125. It has an odometer, five forward speeds, plus reverse. Honda begins to sell the first ATV designed specifically for utility use, the ATC 200E 'Big Red' three-wheeler.
1984	Yamaha and Honda begin selling four-wheeled ATVs.
1985	Suzuki introduces the first high-performance, two-stroke four-wheeler, the QuadRacer LT250. Polaris Industries becomes the first North American company to enter the ATV business, introducing snowmobile technology such as automatic transmissions to replace manual gearboxes and floorboards rather than footpegs. Kawasaki offers its first four-wheeled ATV.
1986	Honda introduces the most successful racing quad in history, the FourTrax 250R two-stroke. The company also debuts the first four-wheel-drive quad, the FourTrax 350 4x4.
1988	ATV manufacturers agree to stop selling three-wheeled models after the U.S. government raised safety concerns. The industry also launches safety programs to train riders. Honda introduces the FourTrax 300 and FourTrax 300 4x4, which become the most

	versatile, most popular ATVs in history selling more than 530,000 units over the next 12 years.
1992	The last holdout in the high-performance 250cc two-stroke four-wheeler class, the Suzuki QuadRacer, disappears from the showroom floors.
1996	The first Arctic Cat ATVs go on sale.
1998	Bombardier of Valcourt, Que. begins selling ATVs.
Late 1990s to early 2000s	A resurgence of high-performance ATV models return to showroom floors with all-new premium 4-stroke models from virtually every ATV manufacturer.
2001	Polaris offers a 683cc engine, the largest ever so far in an ATV, on its Sportsman model. It sells for US$7,399.
2006	Bombardier introduces the fuel-injected 800cc Outlander, a V-twin-powered machine that features class-leading horsepower and torque.
2008	The displacement wars continue with Arctic Cat taking top honors for the year with their new ThunderCat 1000, twin-cylinder four-stroke sport/utility model

2.1.2 Types of ATVs

ATVs come in many different shapes and sizes. The different types of ATVs are designed and manufactured for different uses including racing, pit-vehicles, recreation, hunting, ranching, military, emergency services and industrial. Just about anything you can think of.

While the most common type of ATV is of the four-wheeled variety, there are also ATVs that come with three, six or even eight wheels. And there are some eco-friendly ATVs hitting the market that run on batteries like the Model One EUV from Barefoot Motors (Edward Abdo, 2012).

Figure 2.1: Earth Utility Vehicle (EUV) Model One Electric Quad by Barefoot Motors

Source: Edward Abdo (2012)

Utility ATVs

Utility ATVs (Figure 2.2) are the most popular type of ATV. This type of ATV typically has short travel suspension, a big motor and more accessories designed for working or hunting.

Utility ATVs are used in industries such as agriculture and ranching where repair work, feeding and other tasks are done. They are also very popular with hunters who traverse rugged terrain, often carrying heavy cargo. Electric ATVs are becoming popular with hunters because they can move more quietly.

You see a lot of Utility ATVs being ridden at recreation spots like desert OHV areas and on private property. Some are bought with every intention of being used as a tool but often see just as much recreation time, which isn't a bad thing (Edward Abdo 2012).

Figure 2.2: 2012 BRP Outlander 800r EFI 4×4 Utility ATV

Source: Edward Abdo (2012)

Sport ATVs

Sport ATVs (Figure 2.3) are the second most popular type of ATV in the USA. Ranging in size from 250cc on up to 700cc, these All Terrain Vehicles are lightweight, have lots of suspension to handle jumps, bumps and turns. These quads can be highly modified and enhanced with literally thousands of accessories to alter style and performance based on numerous criteria.

Sport ATVs are much quicker than their utility based brethren and extra care goes in to designing them to be as light as possible with very forgiving suspension and responsive engines. Sport quads are used in sanctioned racing because of their speed and suspension advantages over other different types of ATVs (Edward Abdo 2012).

Figure 2.3: Honda TRX 700XX IRS Sport ATV

Source: Edward Abdo (2012)

Side by Sides ATVs

Side by Side ATVs (Figure 2.4) are sometimes referred to as SxS or Rhino's. They're like golf carts, only with suspension equal to that of sport quads, with larger, more powerful motors. SxS, with their ability to carry passengers and cargo, their light weight, extreme suspension and short wheel-base, are able to take you and your friends to places you might not have thought possible.

SxS are becoming the most popular of the different types of ATVs in small rural communities. Some towns allow them to be registered on-highway use. They are used as "pit vehicles" at races and other events to provide more versatility in transportation and mobility. Fire and Rescue or military often get them highly modified for specific applications (Edward Abdo, 2012).

Figure 2.4: BRP Can-Am® Maverick™ 1000R

Source: Edward Abdo (2012)

Children's ATVs

Children’s ATVs (Figure 2.5) are smaller than the other different types of ATVs. They usually come between 50cc and 110cc, and in some cases go up to 125cc. They offer little or no suspension, little power and an automatic transmission or no gears at all.

Youth ATVs are geared towards riders with little or no previous riding experience. Children’s ATVs are usually limited to weights that do not exceed around 100 to 150 lbs depending on the make and model (Edward, Abdo 2012).

Figure 2.5: Electric ATV for children

Source: Edward Abdo (2012)

2.2 Suspension system

A suspension system is the system consists of springs, shock absorber and linkages that connect a vehicle to its wheels to allow the vehicle to pass through any road conditions. Suspension system also serves a dual purpose which is contributing to vehicle's handling and braking. Most of the vehicles suspensions nowadays are passive type which is generally consists of mass, spring and damper. However, both comfort and stability characteristics cannot achieve at the same time, increasing one, decreasing another. Thus, due to the different characteristic of the vehicles, different type of vehicles uses different type of suspension system (Don Knowles, 1994).

Front suspension system

There are two types of front suspension in general use: the independent system & the solid axle system. Independent suspension usually operates through heavy-duty coil springs or torsion bars and direct, doubles acting shock absorbers. In solid axle construction, the axle beam and wheel assemblies are connected to the car by leaf springs and direct or in-direct shock absorber (Don Knowles, 1994).

2.2.1 Historical perspective

Horse drawn vehicles

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 (Ttti, K K Jain R B Asthana, Bhopal, Jain & Asthana, 2002).

Automobiles

a. 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.
b. In 1920, Leyland Motors used torsion bars in a suspension system.
c. In 1922, independent front suspension was pioneered on the Lancia Lambda and became more common in mass market cars from 1932.

2.2.2 Type of front suspension system

Dependent suspension system

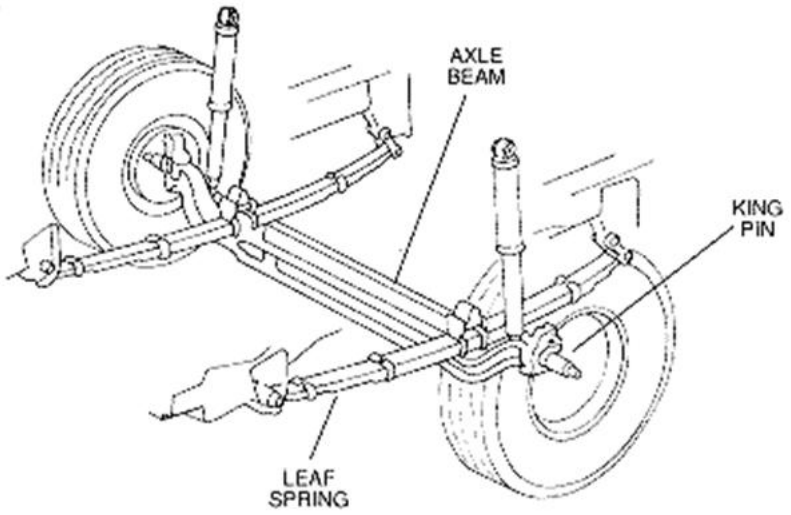


Figure 2.6: Dependent suspension system

Source: Don Knowles (1994)

The dependent front suspension (Figure 2.6) uses a solid axle. This design consists of one steel or aluminum beam extending the width of the vehicle. This beam is held in place by leaf springs (Don Knowles, 1994).

a. Load carrying ability.
b. Use only on heavy trucks and off-road vehicles.

Independent suspension system

Twin I-beam suspension system

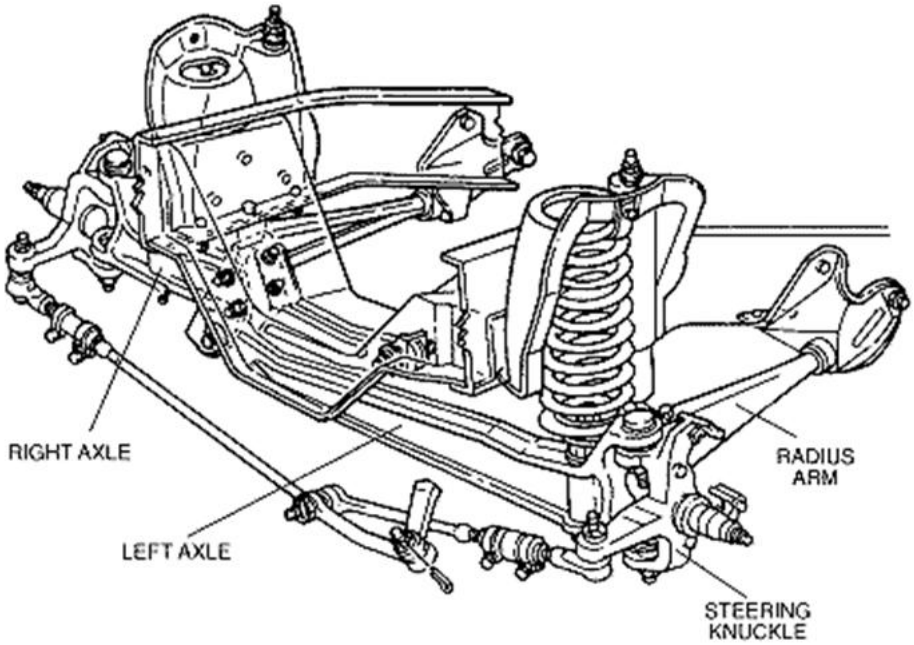


Figure 2.7: Twin I-beam suspension system

Source: Don Knowles (1994)

The twin I-beam (Figure 2.7) is one type of independent front suspension. Although it is similar to the solid axle in many ways, it was designed to improve ride and handling (Don Knowles, 1994).

a. Load carrying ability
b. Used to picked up
c. Used on van and four-wheel drive

Double wishbone suspension system

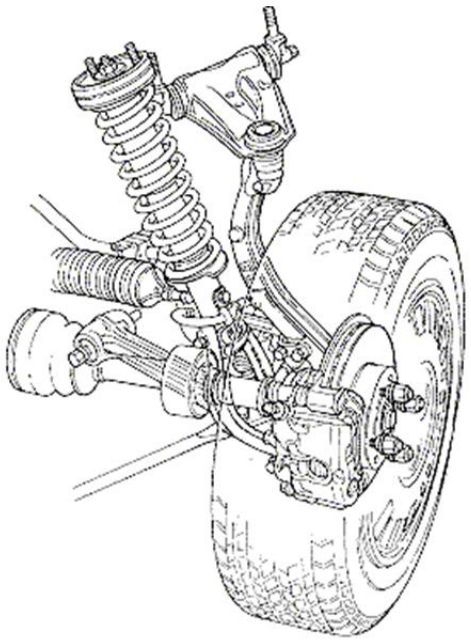


Figure 2.8: Double wishbone suspension system

Source: Don Knowles (1994)

The double wishbone (Figure 2.8) is another type of strut suspension that is becoming more common. It combines the space saving benefits of a strut suspension system with the ability of the parallel arm suspension to ride low to the ground. This allows for a more aerodynamic hood line (Don Knowles, 1994).

a. very common on sports cars and racing car
b. provide least camber change at bump and rebound condition

2.2.3 Double Wishbone Suspension System

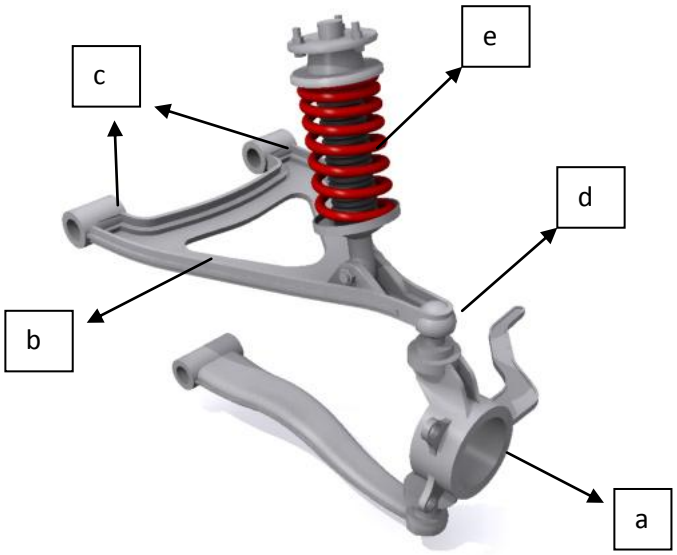


Figure 2.9: Double wishbone suspension system CAD drawing

Source: Ttti, K K Jain R B Asthana, Bhopal, Jain & Asthana (2002)

Part and function of double-A arm suspension system

The double wishbone (Figure 2.9) suspension system are used on both front and rear wheels. It is named because the control arm resembles the shapes of wishbone. This type of suspension system uses two control arms of unequal length that are not parallel to one another. The shorter one locates at top while the longer 1 locate at bottom. This causes the wheel to tilt inward when the spring is compressed, which allows the tread width of the front tires to remain constant (Ttti, K K Jain R B Asthana, Bhopal, Jain & Asthana, 2002).

Double wishbone suspension system (Figure 2.9) usually consists of five important parts. Which are :

a. Knuckles
b. Control arms
c. Joint
d. Ball joint
e. Spring and dampers

Knuckles

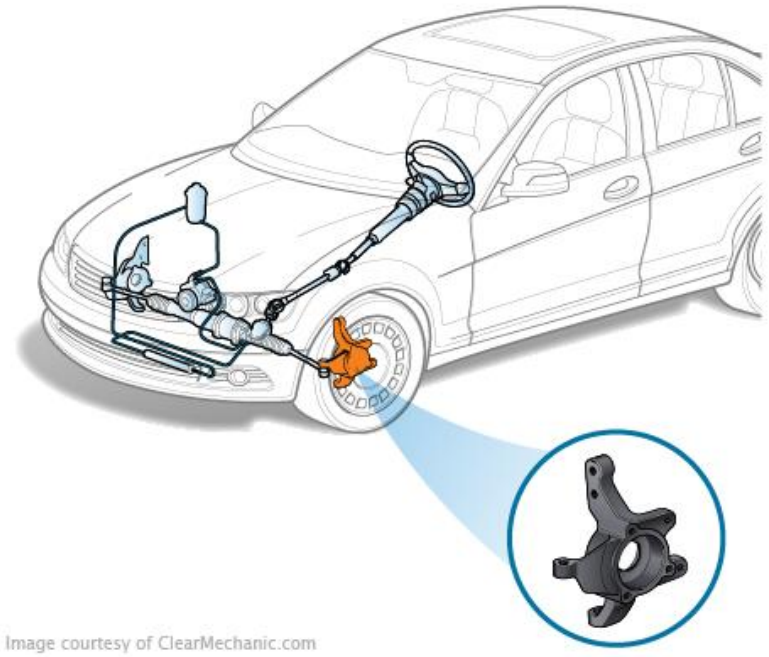


Figure 2.10: Knuckles

Source: Edward Abdo (2012)

A suspension knuckle (Figure 2.10) attaches the upper and lower suspension components to the wheel support assembly and is the mounting point for the wheel spindle or hub. It is called a “steering knuckle” if it is used in a location requiring the wheel to turn, where the knuckle rotates on the lower ball joint, allowing the wheels to turn left or right (Edward Abdo, 2012).

Control arm

Figure 2.11: Control Arm

Source: Edward Abdo (2012)

Control arm (Figure 2.11) are used to allow the spring to deflect. They are called A-arms if they are A-shaped. They also named wishbone. A-arms connected to the wheel mount with ball joint bearings allow limited rotation about all three axes. This allows the wheels of the car to turn when given steering input (Edward Abdo, 2012).

Joint

Figure 2.12: Joint

Source: Edward Abdo (2012)

Joint (Figure 2.12) are the part which connect the chasis with the A-arms. The chassis of the car is connected to the suspension system at the four points at the ends of the two wishbones. This connection uses cylindrical thrust bearings to allow rotation about the X axis only (Edward Abdo, 2012).

Ball joint

Figure 2.13: Ball joint

Source: Edward Abdo (2012)

Ball joint (Figure 2.13) are used to attached the control arm to the knuckles. A ball joint allow motion in two direction, moving with the same up-and-down motion as the bushings on the other end of control arm. A ball joint also allows the knuckles to pivot for steering (Edward Abdo, 2012).

Spring and damper

Figure 2.14: Spring and damper

Source: Edward Abdo (2012)

The spring (Figure 2.14) is what actually supports the weight of the car and will determine how the car's weight transfers under braking, acceleration and cornering. While dampers (Figure 2.14) control the movement of spring. They absorb the vibration and damping cause by the uneven situation of the road (Edward Abdo, 2012).

CHAPTER 3

METHODOLOGY

3.1 Planning and reverse engineering

A briefing is given by the person in charge of the air-hybrid ATV to introduce the job scope. Some design of the part of the suspension system are given. Planning for the work progress is important to work more systematically and more efficient.

Reverse engineering is done by study on double A-arm suspension system and the design given by the person in charge. The suspension system should attach on the chassis of the air-hybrid ATV to ensure that the suspension system could function. Thus, we measured and decide the location of the suspension system. The design of the double A-arm is modified based on the result.

3.2 Materials and tool preparation

For the front suspension system, most of the part is customize for the ATV chassis. So, it is important to prepare the material needed. Some simple calculation is done to estimate the amount of materials needed the type of material. Solid stainless steel bar is prepared for the brackets, hollow round stainless steel is prepared for the A-arms, and solid round mild steel is prepared for shaft and joints. Some part of the suspension system which is too complicated to be fabricated is bought and standby for assembly. This includes the absorber and bearings.

Based on the planning, tools are prepared based on the type of fabrication use. The tools prepared include angle grinder, welding machine, lathe machine, bench saw, milling machine and sand blast machine. The preparation made is to ensure that the fabrication process goes well and smoothly.

3.3 Fabrication

In fabricating the double wishbone suspension system, various type of fabrication method is used to fabricate the parts of the suspension system. This includes cutting and grinding, lathing, welding, cutting solid metals, drilling and sand blasting.

Cutting and Grinding

Angle grinder (Figure 3.1) is used to cut hollow round stainless steel for the A- arms. The hollow steel is cut according the dimension of the design before it is weld together as a A-arms. The brackets (Figure 3.2 and Figure 3.3) are cut from stainless steel bar by using angle grinder. Notching is done so that it can fit the round steel hollow.

It is also used to grind off the chips result by cutting. The excess weld also grinds by using angle grinder.

Figure 3.1: Angle Grinder

Figure 3.2: Brackets that are grinded and ready to drill

Figure 3.3: Cutting stainless steel bar

Lathing

A lathe (Figure 3.4) is a machine tool which rotates the work piece on its axis to perform various operation such as sanding, knurling, drilling, or deformation, facing, turning, with tools that are applied to the work piece to create an object which has symmetry about an axis of rotation.

Lathe machine is use to lathe the shaft (Figure 3.6 and Figure 3.8), the joint tie-road stud is lathe from round solid mild steel (Figure 3.5) and shorten the length of the screw(Figure 3.7). The joint is also drill by using lathe machine. Tie road stud is also drill to allow insertion of the screw.

Figure 3.4: Lathe machine

Figure 3.5: Solid mild steel for tie-rod stud

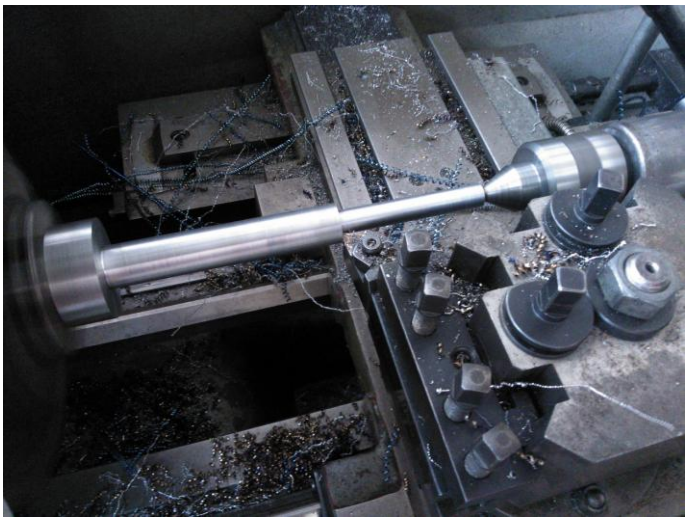


Figure 3.6: Lathing shaft

Figure 3.7: Screw and tie road stud after lathing

Figure 3.8: Shaft

Welding

Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the work pieces and adding a filler material to form a pool of molten material (the weld pool) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. This is in contrast with soldering and brazing, which involve melting a lower-melting-point material between the work pieces to form a bond between them, without melting the work pieces.

MIG Welding machine (Figure 3.9) is used to weld some of the part of the suspension system. The hollow round stainless steel which is cut according dimension is weld together to become a A-arm (Figure3.12). The tie-road stud and joint are weld on the A-arms (Figure 3.10 and Figure 3.11). The screw is weld into the tie-road stud. Brackets are weld to the chassis to allow the attachment of the suspension system.

Figure 3.9: Welding Machine

Figure 3.10: Welding tie-road stud on A-arms

Figure 3.11: Welding tie-road stud on A-arms

Figure 3.12: A-arm

Cutting solid metal

Bend saw (Figure 3.13) is a saw that powered by electric power. It is used to cut through hard material, most often metals. The cut is made by placing the toothed edge against the material with a circular motion driving by an electric motor. It is usually used to cut solid metals. Coolant is used to remove the chip and heat produced by the saw.

Bend saw is used to cut solid round mild steel (figure 3.14) for shaft, tie road stud and joint. The solid stainless steel bar is also cut by using bench saw for brackets.

Figure 3.13: Bend saw

Figure 3.14: Solid round mild steel

Drilling

Milling is the machining process of using rotary cutters to remove material from a workpiece advancing in a direction at an angle with the axis of the tool. It can also used for drilling holes on the work piece.

Milling machine (Figure 3.15) is used to drill hole on brackets. It is also used to drill holes on knuckles (Figure 3.16) for assembly of brakes and other component.

Figure 3.15: Milling machine

Figure 3.16: Drilling knuckles

Sand blasting

Sandblasting is a general term used to describe the act of propelling very fine bits of material at high-velocity to clean or etch a surface. Sand used to be the most commonly used material. Due to the dangers of inhaling dust during the process, sandblasting is carefully controlled, using an alternate air supply, protective wear, and proper ventilation.

Sand blast machine (Figure 3.17) is used to remove rust on the knuckles. Figure 3.18 shows the process of sand blasting the knuckles and Figure 3.19 shows the knuckles before sand blasting. It is necessary to remove the rust to ensure the quality and appearance of the suspension system.

Figure 3.17: Sand Blasting Machine

Figure 3.18: Blasting Knuckles

Figure 3.19: Knuckles before sand blasting

3.4 Integration

The double wishbone front suspension system is integrated to the chassis, brakes, and tires of the air-hybrid ATV (Figure 3.20 and Figure 3.21) by using new bolt and nut. Modification is done to make sure all the suspension system works well with other parts of the ATV.

Figure 3.20: Assembly knuckles ,bearing and shaft with the tire

Figure 3.21: Assemble the suspension system

CHAPTER 4

RESULT AND DISCUSSION

The parts fabricated are able to assembly with the parts bought direct from the market. All the parts are able to be assembled and integrated with other parts of the ATV such as tires and brakes.

4.1 Overview of the parts fabricated

The parts of the suspension system are done by using suitable fabrication method and machines. The design is drawn by using Solidwork software with given dimension. The part is then fabricated from suitable materials by following the dimension and design. Tie rod stud (Figure 4.1) is lathe and centre drill to fit into the A-arms (Figure 4.2). The brackets (Figure 4.3) are cut from stainless steel bar and notching by using angle grinder. Knuckles (Figure 4.4) are drill for the brakes to install.

Figure 4.1: Tie-rod stud and screw

Figure 4.2: A-arms

Figure 4.3: Brackets

Figure 4.4: Knuckles

4.2 Overview of the parts bought from market

These are some part of the suspension bought from the market. This is because they are to complicated to be fabricate. These part are also drawn using Solidwork software to ensure that they are able to assemble with the part fabricated. These components include brakes (Figure 4.5), bearing (Figure 4.6) and spring and dampers (Figure 4.7).

Figure 4.5: Brakes

Figure 4.6: Bearing

Figure 4.7: Spring and dampers

4.3 Overview of the product assembly

After the fabrication, all the part of the suspension system is ready. Figure 4.8 show the parts of the suspension system. These include those fabricated and bought from market. The entire component is then install together and become a suspension system as shown in Figure 4.9.

Figure 4.8: Parts of the suspension system

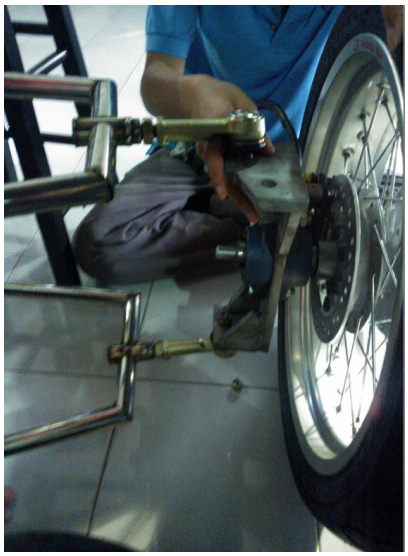


Figure 4.9: Assembly of the suspension system

4.4 Fabricating Suspension system

Suitable type of machine is used to fabricate the parts in this project. The part of the product is fabricated according the dimension of solidwork drawing. It required high accuracy to achieve the dimension of the drawing. The dimension is always modified if it cannot fit to other part of the suspension system. All the parts are then assemble in to a suspension system. It is assemble to the tires for integration.

Double wishbone suspension is an independent suspension design using two wishbone-shaped arms to locate the wheel. Each wishbone or arm has two mounting points to the chassis and one joint at the knuckle. The shock absorber and spring mount to the wishbones to control vertical movement. Double wishbone designs allow us to carefully control the motion of the wheel. In this project there is two absorber used for each side of the suspension.

Double wishbone suspension is suitable for the air-hybrid ATV which allows tuning the suspension system according the effect of each joint. The double absorber is also allowed the ATV to carry heavy load and provide necessary damping force to ensure the safety and comfort for the driver.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

In conclusion, the objectives of this project are achieved. The first objective is to reverse engineering of double wishbone front suspension unit for ATV motorcycle. Researches are done based on the double wishbone suspension system, and the suspension system is fabricated according the chassis design of the air-hybrid ATV. The suspension system uses a double absorber to provide sufficient support and damping force for the air-hybrid ATV.

The second objective is to fabricate the working prototype of front suspension unit for ATV motorcycle. This allows students to understand the procedure to fabricate a suspension system. Besides, the fabrication process required many skills that have been learnt in previous mechanical laboratory such as material measuring, marking, cutting, drilling, welding and grinding. There is also some machine which are not learn in the mechanical laboratory is also used such as sandblasting machine. The fabrication process allows students to gain a lot of experience operating the machines and decide suitable machine to fabricate each part of the product. It was a challenge for students to complete the project and prepared to face further challenges to become a professional.

5.2 Problem faced during the project

During the progress of fabricating the air-hybrid ATV front suspension system, many obstacles were faced. First, don't have enough knowledge about the air-hybrid ATV and suspension system. This knowledge is not in the syllabus of my two years study. Therefore, library and internet have become the tools to achieve the knowledge. Next consulting supervisor and senior to understand the scope. During fabrication, using wrong tools is also one of the problems faced. In the progress of drilling stainless steel bar for the bracket, high speed steel tools are not able to drill through the stainless steel. After asking the lab assistant, carbide cutting tools is used to drill stainless steel bar. Another major problem is not able to install the suspension system onto the air-hybrid ATV because the chassis is not able to be done. This result was not able to integrate the suspension to the chassis. After discuss with supervisor, suspension system is installed on the tire to show how the suspension system looks like and function.

5.3 Recommendation

There are some recommendations related to the project. The chassis should be done earlier before the fabrication of the suspension system. The position of the suspension system should be decided before fabricating the suspension system.

Before doing any machining process, the understanding of tools and material is important. This is to ensure that user not to break the tools and damage the product hence allows the fabricating progress more smoothly and well and not damaging the tool and work piece.

Lastly, based on the product, the material use for the A-arms should be solid round stainless steel instead of hollow. This allows the A-arms to overcome grater force from the overall body of ATV.

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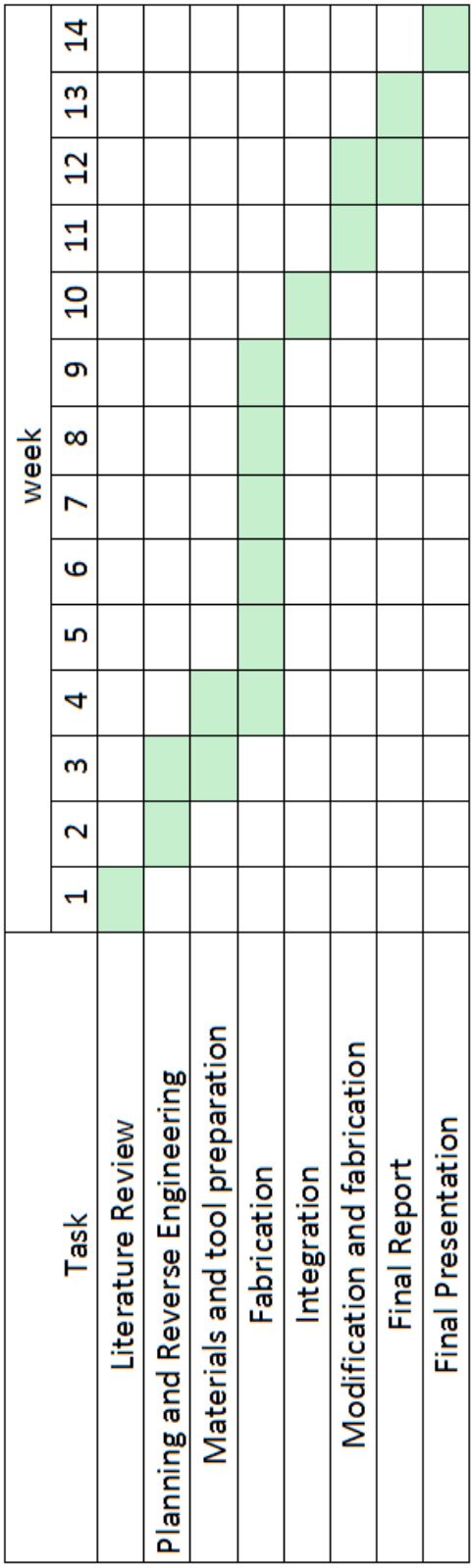
APPENDIX A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Literature Review
Planning and Reverse Engineering
Materials and tool preparation
Fabrication
Integration
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Final Report
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Title : FABRICATION OF AIR-HYBRID ATVs FRONT SUSPENSION SYSTEM

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ABSTRACT

This thesis is about fabricating of Hybrid-air ATV front suspension system. It consists of spring shock absorber and linkage to support the vehicles. Suspension system plays an important role in vehicles. It is to ensure the safety and riding comfort of the passengers during their journey. It is also providing sufficient damping force to overcome the damping of vehicle due to the road condition. The process of fabricating the suspension system is one of the crucial part which will affect the quality and function of the suspension system. The suspension system used for the Air-hybrid ATV suspension system is double wishbone suspension system. The reverse engineering is done to design and fabricate the suspension system. The project is to fabricate the part based of the design given. Most of the part of the suspension system is design to fit the chassis of the Air-hybrid ATV. Thus, the part must follow exactly the dimension of the drawing else they could not fit each other. Part of the suspension system also need to be fitted to the part brought from market and the chassis of the Air-hybrid ATV chassis. Thus, the design refinements are needed to ensure that all the parts of the suspensions system can integrate to each part. It is impossible to fabricate the product as same as the engineering drawing. Therefore, by refining the design, the product can be done as close as the design given. Material preparation and methods chosen for fabricating the part of suspension system will also decide the quality and functionality of the suspension system. Fabricating suspension system of the Air-hybrid ATV suspension system is not easy, but by doing well progress planning and using the right method, the suspension system could be fabricated as close as the design to ensure the quality of the suspension system.

ABSTRAK

Tesis ini adalah mengenai pembuatan Hybrid udara ATV sistem suspensi hadapan. Ia terdiri daripada spring penyerap kejutan dan rangkaian untuk menyokong kenderaan. Sistem suspensi memainkan peranan yang penting di dalam kenderaan. Ia adalah untuk memastikan keselamatan dan keselesaan menunggang penumpang dalam perjalanan mereka. Ia juga menyediakan daya redaman yang mencukupi untuk mengatasi redaman kenderaan kerana keadaan jalan raya. Proses reka sistem penggantungan itu adalah salah satu bahagian penting yang akan memberi kesan kepada kualiti dan fungsi sistem penggantungan. Sistem penggantungan digunakan untuk udara hibrid ATV sistem penggantungan dua tulang garpu sistem penggantungan. Kejuruteraan terbalik dilakukan untuk reka bentuk dan sistem penggantungan. Projek ini adalah untuk membuat bahagian berdasarkan reka bentuk yang diberikan. Kebanyakan bahagian daripada sistem penggantungan itu adalah reka bentuk untuk memenuhi casis ATV Air-hibrid. Oleh itu, bahagian yang mesti ikut betul-betul dimensi lukisan lain. Kalau tidak, bahagian tersebut tidak dapat memenuhi antara satu sama lain. Sebahagian daripada sistem penggantungan itu juga perlu dipasang ke bahagian yang dibawa dari pasaran dan casis Udara hibrid ATV casis. Oleh itu, reka bentuk perbaikan yang diperlukan untuk memastikan bahawa semua bahagian-bahagian sistem penggantungan yang boleh mengintegrasikan ke setiap bahagian. Ia adalah mustahil untuk membuat produk sebagai sama seperti lukisan kejuruteraan. Oleh itu, dengan menyelitikan reka bentuk, produk boleh dilakukan sehampir reka bentuk yang diberikan. Penyediaan bahan dan kaedah yang dipilih untuk memasang bahagian sistem penggantungan juga akan menentukan kualiti dan fungsi sistem penggantungan. Memasang sistem penggantungan udara hibrid ATV sistem penggantungan adalah tidak mudah, tetapi dengan cara yang betul dan juga perancangan serta menggunakan kaedah yang betul, sistem suspensi boleh dibuat sehampir reka bentuk untuk memastikan kualiti sistem penggantungan.

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