

FABRICATION OF AUTOMOTIVE BODY PART
USING CARBON FIBER

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BORANG PENGESAHAN STATUS TESIS

**JUDUL: FABRICATION OF AUTOMOTIVE BODY PART USING
CARBON FIBER**

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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.

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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.

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DEDICATION

**I specially dedicate to my beloved parents,
My supervisor and those who have guided
And motivated me for this project**

ACKNOWLEDGEMENT

In the name of Allah S.W.T the most gracious and merciful, first and foremost, after a year of struggle and hard work, with His will, this thesis is completed. Thanks to Allah for giving me the strength to complete this project and the strength to keep on living. I would like to convey heartiest appreciation to my supervisor, Sir Rosmazi bin Rosli for his consistency, advising and giving ideas throughout this thesis. I appreciate his consistent support from the first day I start doing the thesis.

To my parent, Meor Ruslan bin Mohd Idris, thank you for all the support and sacrifice that both of you gave me. Your sacrifice is too great to be measured and it will be never forgotten. Also to my brothers Muhammad Ishfaq bin Meor Ruslan, Muhammad Luqman Hakeem bin Meor Ruslan and my sisters Shafiqah binti Meor Ruslan, Haziqah binti Meor Ruslan and Nur Aqilah binti Meor Ruslan.

Last but not least, to all people that did not involve directly nor directly in succeeded the thesis, especially to all my beloved friend, that is cannot find appropriate words that could properly describe my appreciation for their devotion, support and faith in my ability to attain my goals. Hopefully, they will continue to support me and thanks for making this possible to happen.

ABSTRACT

This thesis presents the fabrication of automotive part using carbon fiber. In this modern era, carbon fiber became high demand in the market. This is because sports like racing such as sport car racing, motorcycle racing and bicycle racing become famous. So carbon fiber became popular among the racer because carbon fiber is strong, light at once can reduce the part of automotive and increase the speed of vehicle. Beside carbon fiber do not rust and the out layer is interesting. The project has to begin with choosing 4 automotive parts. The selected parts are side mirror, box, motor cycle body part and oil tank cover. These parts consist of different shape which is flat, curve and flat curve. Based on that, the difficulty of fabricate this project can be determined. These parts have designed using SolidWork engineering drawing software for the structural three-dimensional solid modeling. All the step and procedure of fabricate the glass fiber and carbon fiber was listed in this thesis. The problem faced during making this project and the problem solving also have in this thesis. Lastly, for making the product better and perfect the recommendation for the future work was been discussed in this thesis.

ABSTRAK

Tesis ini membentangkan tentang fabrikasi bahagian automotif menggunakan gentian karbon. Dalam era modernisasi ini, gentian karbon semakin mendapat permintaan yang tinggi di pasaran. Ini adalah kerana sukan perlumbaan seperti sukan lumba kereta, lumba motosikal dan lumba basikal menjadi semakin terkenal. Oleh sebab itu, serat karbon menjadi popular dalam kalangan pelumba kerana gentian karbon adalah kuat dan ringan,sekali gus boleh mengurangkan berat bahagian automotif dan meningkatkan kelajuan kenderaan. Selain itu, serat karbon tidak berkarat dan mempunyai lapisan luar yang menarik. Projek ini bermula dengan memilih 4 bahagian automotif. Bahagian-bahagian yang dipilih adalah cermin sisi, kotak, bahagian badan motorsikal dan penutup tangki minyak. Bahagian-bahagian ini terdiri daripada bentuk yang berbeza iaitu rata, lengkung dan lengkung rata. Oleh itu, tahap kesukaran menghasilkan projek ini dapat ditentukan dengan mengikut bentuk bahagian. Bahagian-bahagian ini telah direka menggunakan SolidWork kejuruteraan perisian lukisan untuk pemodelan struktur tiga dimensi . Semua langkah dan prosedur meghasilkan gentian kaca dan gentian karbon telah disenaraikan didalam tesis ini. Masalah yang dihadapi semasa menghasilkan projek ini dan cara penyelesaian masalah juga tersenarai didalam tesis ini. Akhir sekali, untuk menghasilkan produk yang lebih baik dan sempurna, cadangan untuk menghasilkan produk ini pada masa hadapan telah dibincangkan dalam tesis ini.

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LIST OF SYMBOLS

μm	Micrometer
ml	Milliliters
Kg	Kilogram

LIST OF ABBREVIATIONS

K	Thousands individual filaments in a tow
GRP	Glass-reinforced plastic
GFRP	Glass-fiber reinforced plastic
CF	Carbon fiber
VOC's	Volatile Organic Compounds

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

This project title is fabrication of automotive body part using carbon fiber. The material use in this project will reduce the mass of automotive part, increase the acceleration of vehicle and also can stand high impact. This carbon fiber part is produce by 2 layers if E-glass chopped strand using the polyester resin and one layer of 3K carbon fiber using the epoxy resin. The fabrication required student to familiar the procedure and safety on handling fiber glass and carbon fiber and other materials such as resin and other solvent.

1.2 PROBLEM STATEMENT

The common automotive parts in market or factory are typically made out of steel, but aluminium is rapidly gaining popularity with auto companies. Although these materials are tough enough to absorb the high energy from the crash but it's quite heavy to use. Using the fiberglass (glass-fiber reinforced plastic, or GFRP) and carbon fiber are not only increasing the acceleration and reduce the mass of automotive part but it will also provide versatility and freedom of design, strength & durability.

1.3 OBJECTIVE

There are three objectives of this project as follow:

- i. To fabricate automotive component using carbon fiber.
- ii. Reduce the mass of automotive component
- iii. Increase the acceleration of vehicle

The function of this project objective is to determine whether the result of the product is fulfill the objective or not.

1.4 SCOPE

The scope of this project is:

- i. Fabricate the carbon fiber part with good surface finish.
- ii. Reduce the weight of the body part
- iii. One layer of Carbon Fiber with two layer of fiberglass

The function of the scope is to control the fabrication of the product so that the work that performed is under the objective.

1.5 THESIS ORGANIZATION

Chapter review is to briefing the chapter shortly from chapter one until chapter five. This is to make sure that the chapter is under the title that given.

i. Chapter one

In chapter one, there is introduction. Which is include project synopsis, project scope and project objective. Based on this chapter, the title of the project can be determines. Besides that, the objective of this project was listed and to control the objective there is the project scope.

ii. Chapter two

Chapter two consists of literature review. At this chapter, the background of the part and materials that use can determine. Besides that, the type and advantages of the product that use also can be known. The method and type of joining also listed in this chapter.

iii. Chapter three

This chapter is methodology. This chapter consists of the flow chart of the project. How the project is worked and flow also can be known. What the method that use in this project can be determine. Besides that, there is the step or procedure of making the fiber glass and carbon fiber part.

iv. Chapter four

Chapter four is result and discussion. This chapter shows the image of the product that produce in this project. Besides that, there is the discussion which is consists of the problem facing while fabricate this product and the problem solved. In this chapter are more details about how the problem can occurs and how to solving it.

v. Chapter five

Chapter five is conclusion and recommendation which is included of conclusion of this project and the recommendation for future work. The conclusion of this project can be determine. Next, the recommendation of this product to make the product better and perfect have listed in this chapter

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, the importance and application of the composite materials at several sectors will be discussed. This chapter will inquire into the general properties of the components that commonly used to produce polymer composite materials which are fiber glass and carbon fiber. Next, the step and procedure of making a part (fiberglass) and carbon fiber will be covered. Through this chapter, the details of the composite materials can be understood in depth. The roles of build orientation in mechanical properties of the composite materials also can be studied deeply. Hence, the advantages and disadvantages of fiberglass and carbon fiber will be listed so we can choose the suitable materials properly.

2.2 AUTOMOTIVE PART

Automotive parts such as car's body is very important part which is it must strong, hard and rust resistance. Most auto bodies are made of sheet metal (steel) and aluminum in varying mixes, because steel is malleable, it is capable of being shaped into the forms needed to create the chassis and body panels of automobiles. Steel is able to be poured into molds and cooled to create other forms, such as an engine block. And steel is easy to bond together using welding techniques.

The price of steel is low relative to many other metals. Although aluminum and carbon fiber is lighter than steel and has a similar strength-to-weight ratio, it is significantly more expensive and so is only used in high-end automobiles. Steel is plentiful and cheap. But depends on the car, mostly carbon steel, its strong but formable, moderately rust resistant but usually coated with other metals (zinc or chrome) or other materials for rust resistance. Deloreans (brand of car, production officially began in 1981) are made with stainless steel. The metal was brushed instead of painted and stainless (most grades) is very rust resistant. Stainless is more expensive than carbon steel and since it was not painted repairs would be visible so it usually was replaced when damaged.

Sometimes aluminum is used when strength is not critical. Aluminium is rust proof, light weight, lower strength and more expensive than steel. It is also used in high end (lower production numbers) to improve power to weight ratios and to reduce tooling costs as it is easier to form than steel.

2.3 FIBERGLASS

2.3.1 Definition

Fiberglass (also called glass-reinforced plastic, GRP, glass-fiber reinforced plastic, or GFRP) is a fiber reinforced polymer made of a plastic matrix reinforced by fine fibers of glass. Common uses of fiberglass include high performance aircraft (gliders), boats, automobiles, hot tubs, water tanks, roofing, pipes, cladding, casts, surfboards and external door skins.

2.3.2 Characteristic

Fiberglass is a lightweight, extremely strong, and robust material. Although strength properties are somewhat lower than carbon fiber and it is less stiff, the material is typically far less brittle, and the raw materials are much less expensive. Its bulk strength and weight properties are also very favorable when compared to metals, and it can be easily formed using molding processes. Glass is the oldest, and most familiar, performance fiber. Fibers have been manufactured from glass since the 1930s.

2.3.3 Type

As to the raw material glass used to make glass fibers or nonwovens of glass fibers, the following classification is known:

- i. A-glass: With regard to its composition, it is close to window glass. In the Federal Republic of Germany it is mainly used in the manufacture of process equipment.
- ii. C-glass: This kind of glass shows better resistance to chemical impact. Mainly used in the form of surface tissue in the outer layer of laminates used in chemical and water pipes and tanks.
- iii. E-glass: This kind of glass combines the characteristics of C-glass with very good insulation to electricity. Good tensile and compressive strength and stiffness, good electrical properties and relatively low cost, but impact resistance relatively poor. Widely used.
- iv. AE-glass: Alkali resistant glass.

2.4 CARBON FIBER

2.4.1 Definition

Carbon fiber, alternatively graphite fiber, carbon graphite or CF, is a material consisting of fibers about 5–10 μm in diameter and composed mostly of carbon atoms. The carbon atoms are bonded together in crystals that are more or less aligned parallel to the long axis of the fiber. The crystal alignment gives the fiber high strength-to-volume ratio (making it strong for its size). Several thousand carbon fibers are bundled together to form a tow, which may be used by itself or woven into a fabric. Although carbon fiber can be relatively expensive, it has many applications in aerospace and automotive fields, such as Formula One. The compound is also used in sailboats, rowing shells,

modern bicycles, and motorcycles, where its high strength-to-weight ratio and very good rigidity is of importance.

2.4.2 Properties

The properties of carbon fibers, such as high stiffness, high tensile strength, low weight, high chemical resistance, high temperature tolerance and low thermal expansion, make them very popular in aerospace, civil engineering, military, and motorsports, along with other competition sports. Carbon fibers are usually combined with other materials to form a composite. When combined with a plastic resin and wound or molded it forms carbon fiber reinforced plastic (often referred to as carbon fiber) which has a very high strength-to-weight ratio, and is extremely rigid although somewhat brittle. However, carbon fibers are also composed with other materials, such as with graphite to form carbon-carbon composites, which have a very high heat tolerance.

2.4.3 Type

Fibers are bundled in various sizes designated in thousands (K) of fibers. 1K, 3K, 6K, 12K, 24K, 50K and others are common bundle sizes. These fibers are woven into fabric with various weave patterns. 3K fabric is most common. The various types of fiber will have the same "K" designation to indicate the number of fibers in the bundle. These numbers describe the size of the bundle used and have little to do with the quality of the fiber itself. The "K" stands for thousands so there are 3,000 individual filaments in a 3k tow, 6,000 strands in 6k, and so on.

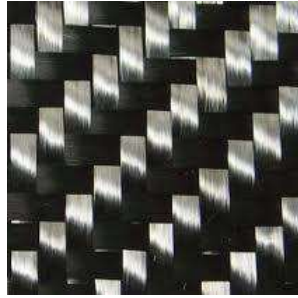


Figure 1.1: 3K

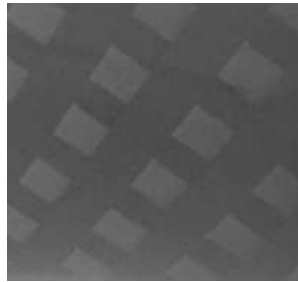


Figure 1.3: 12K

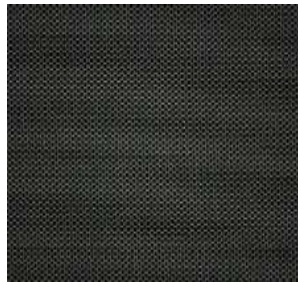


Figure 1.4: 1K

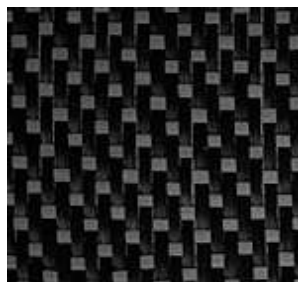


Figure 1.5: 6K

2.5 RESIN

2.5.1 Definition

Resin in the most specific use of the term is a hydrocarbon secretion of many plants, particularly coniferous trees. Resins are valued for their chemical properties and associated uses, such as the production of varnishes, adhesives and food glazing agents. They are also prized as an important source of raw materials for organic synthesis, and as constituents of incense and perfume.

2.5.2 Type and Properties

i) Epoxy resin

The large family of epoxy resins represent some of the highest performance resins of those available at this time. Epoxies generally out-perform most other resin types in terms of mechanical properties and resistance to environmental degradation, which leads to their almost exclusive use in aircraft components. As a laminating resin their increased adhesive properties and resistance to water degradation make these resins ideal for use in applications such as boat building. Here epoxies are widely used as a primary construction material for high-performance boats.

ii) Vinylester resins

Vinylester resins are stronger than polyester resins and cheaper than epoxy resins. Vinylester resins utilize a polyester resin type of cross-linking molecules in the bonding process. Vinylester is a hybrid form of polyester resin which has been

toughened with epoxy molecules within the main molecular structure. Vinylester resins offer better resistance to moisture absorption than polyester resins but its downside is in the use of liquid styrene to thin it out (not good to breath that stuff) and its sensitivity to atmospheric moisture and temperature. Sometimes it won't cure if the atmospheric conditions are not right. It also has difficulty in bonding dissimilar and already-cured materials. It is not unusual for repair patches on vinylester resin canoes to delaminate or peel off.

iii) Polyester resin

Is the cheapest resin available in the marine industry and offers the poorest adhesion, has the highest water absorption, highest shrinkage, and high VOC's. Polyester resin is only compatible with fiberglass fibers and is best suited to building things that are not weight sensitive. It is also not tough and fractures easily. Polyesters tend to end up with micro-cracks and are tough to re-bond and suffer from osmotic blistering when untreated by an epoxy resin barrier to water. This is really cheap and widely used stuff.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

This chapter will discuss about methods and procedure taken order to fabricate of automotive body part using carbon fiber.

Before start on fabrication process,

- 1) Have automotive parts that want to be change to fiberglass part. Automotive parts are consists of 4 which is in different shape. First is box shape which is car accessory, second is curve shape which is side mirror of motorcycle. Third is flat shape which is oil cover car part. Last is curve shape which is body part of motorcycle.
- 2) Prepare the materials that needed. The materials are sellotape, resin, hardener, fiberglass, carbon fiber, brush, scissor, glove, cups, stick, abrasive paper, polish, wax polish, compound.

- 3) Fiberglass. The type of fiberglass is E-glass which is good tensile, compressive strength and stiffness. Good electrical properties, low cost and most common use. The resin that we used is polyester resin which is widely used and low cost.

- 4) Carbon fiber. The type of carbon fiber is 3k and the resin is epoxy resin which is highest performance resin at this time. Epoxies is generally greater capability, very reliable and strong.

3.2 PROJECT FLOW CHART DIAGRAM

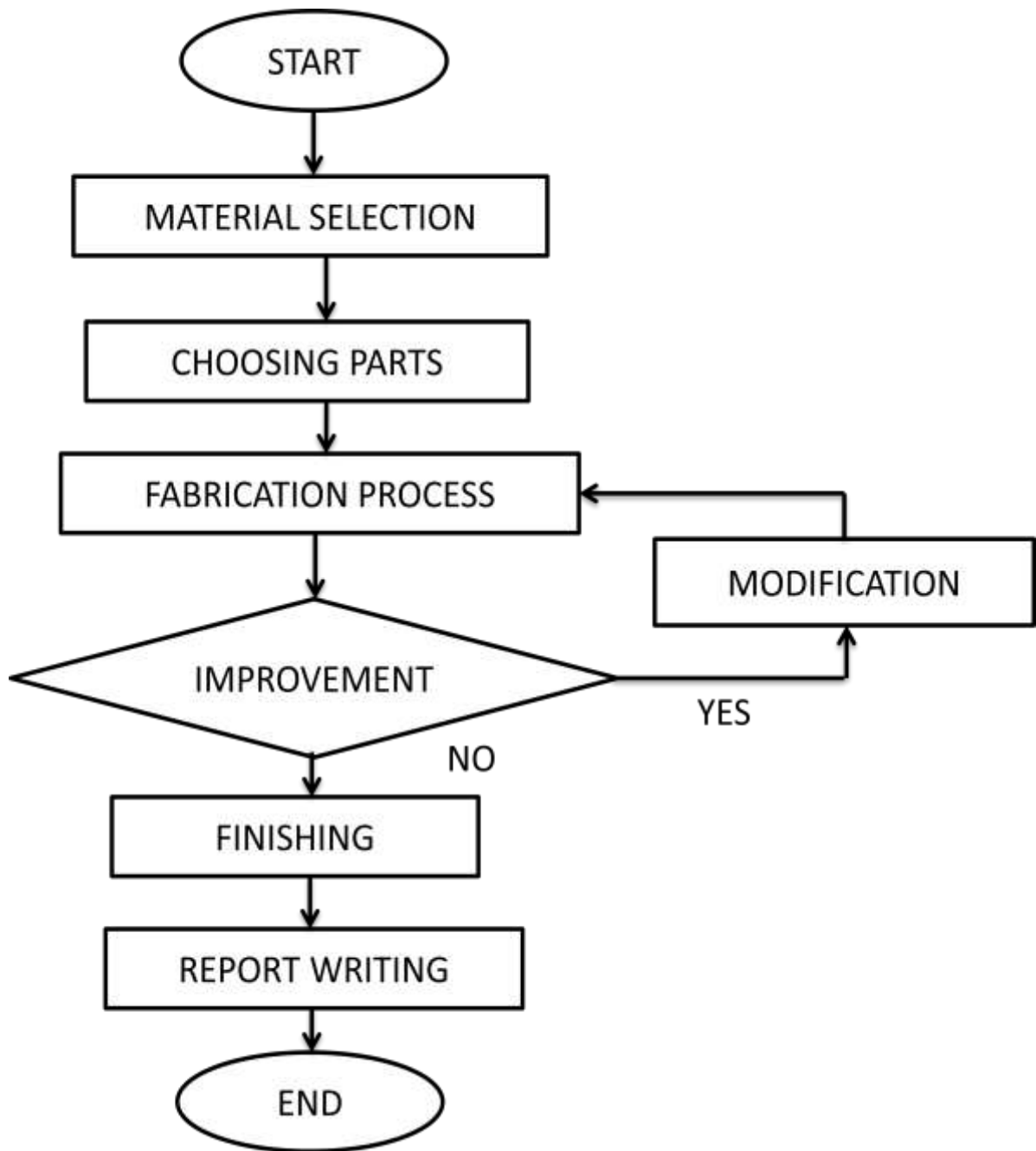


Figure 3.1: Flow chart

3.3 MATERIAL SELECTION

Material that needed for fabrication of glass fiber and carbon fiber are sellotape, resin, hardener, fiberglass, carbon fiber, brush, scissor, glove, cups, stick, abrasive paper, polish, wax polish, compound.



Figure 3.2 : Fiberglass



Figure 3.3 : 2nd polish, 1st polish, compound



Figure 3.4 : The materials

3.4 CHOOSING PARTS

i) Box

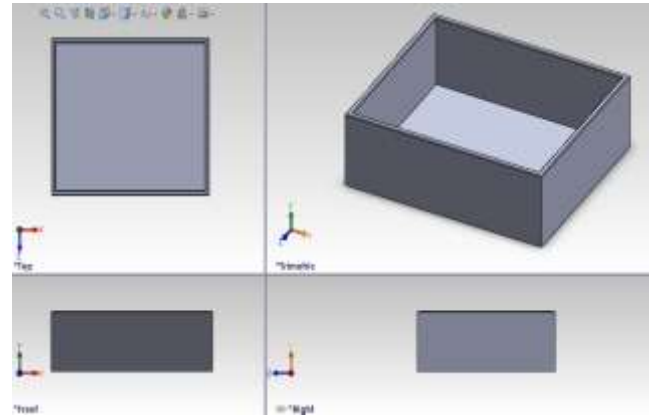


Figure 3.5 : Box and isometric view of box

ii) Side mirror

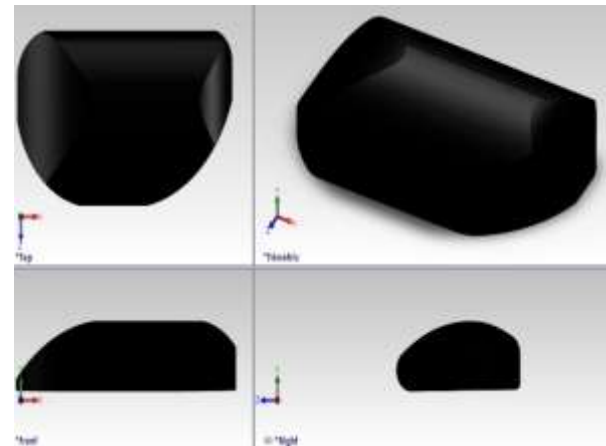


Figure 3.6 : Side mirror and isometric view of side mirror

iii) Motorcycle body part

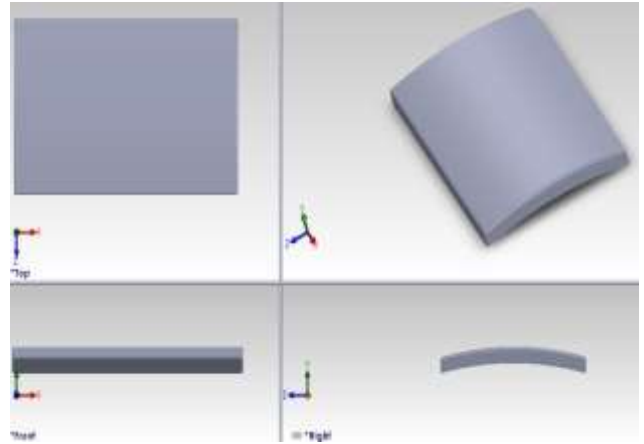


Figure 3.7 : Motorcycle body part and isometric view of motorcycle body part

iv) Oil tank cover

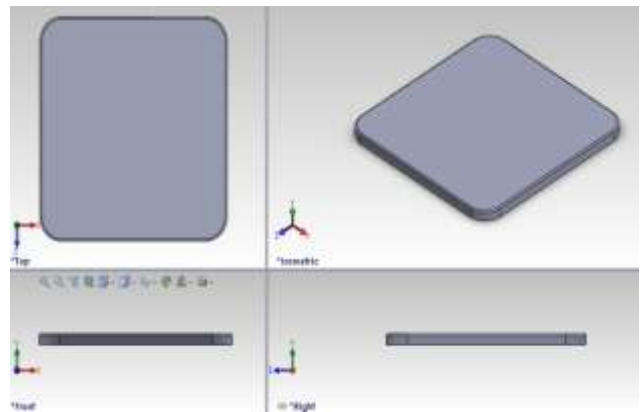


Figure 3.8 : Oil tank cover and isometric view of oil tank cover

3.5 FABRICATION PROCESS

3.5.1 Fabrication of Fiberglass

This is the procedure or step of making a fiberglass part :

- 1) First, rub the automotive part using sand paper before wipe it. This is to make sure that the surface is flat. Beside to make sure that the part is free from foreign object.



Figure 3.9 : Rubbing process

2) Measure and cut the fiberglass according to the size of automotive part.



Figure 3.10 : Cutting process

3) Wrap the surface with sellotape. Sellotape function is to remove the fiberglass part from automotive part. This is another alternative to replace a release mould agent.



Figure 3.11 : Wrapping process

- 4) Apply resin + hardener (2% of hardener). Mix the polyester resin and hardener with 2% of hardener. For example 10ml of resin mix with 0.2ml of hardener



Figure 3.12 : Mixing the resin and hardener



Figure 3.13 : Brushing process

- 5) Apply Fiber glass and Apply resin + hardener. Apply the resin to the glass fiber with ratio of (Resin : glass fiber with ratio 3 : 1) which is mean if 1kg of glass fiber and resin should be 3kg. This step should do it twice because of the two layer of the fiberglass.



Figure 3.14 : Brushing process



Figure 3.15 : Side mirror covered by glass fiber

6) On the next day, cut the excess of fiberglass and remove it. Cut it using the scissor or grinder.



Figure 3.16 : Parts covered by fiberglass



Figure 3.17: Cutting process



Figure 3.18 : Glass fiber parts

3.5.2 Laminate the fiberglass part with carbon fiber

This is shown the procedure or step of laminating the fiberglass with carbon fiber :

- 1) Rub the fiberglass part with sand paper. This is to make sure that the surface is flat. After finish rubbing process then wipe it.



Figure 3.19 : Rubbing process



Figure 3.20: Glass fiber part

- 2) Cut the carbon fiber according to the size of the part. This is the tip of cutting the carbon fiber, pull the 2 strands of the carbon fiber before cut it. This to produce a line, so the cutter can easily cut the carbon fiber straightly.



Figure 3.21 : Cutting process



Figure 3.22 : Line produce

- 3) Wipe the resin that mix with hardener with ratio 2 : 1 on the part. Stir well until 1-2 minutes. Mix the resin with hardener with ratio 2 : 1 which mean if the resin is 20ml and the hardener should be 10ml. Then, stir well and slowly. This is to prevent bubbles from produce.



Figure 3.23 : Stirring process



Figure 3.24 : Brushing process

- 4) Apply the carbon fiber onto the fiberglass part. Lay it carefully because after it stick, it can't be lift up. Hold it gently to prevent the pattern of the carbon fiber from change.



Figure 3.25: Laminating process

- 5) Apply resin + hardener onto the carbon fiber. Brush it one way and slowly. This is to prevent bubbles from produce and pattern of carbon fiber from changes.



Figure 3.26 : Carbon fiber coated by resin mix with hardener

- 6) Next day, cut excess of C.F. Rub use sand paper. Do not give a lot of force while rubbing the carbon, this will make the layer of resin become thin so it will rub the carbon fiber and change the pattern of carbon fiber. Rub it until the surface is flat.



Figure 3.27 : Rubbing process

- 7) Apply compound on the surface. After apply it, wait until 1 to 2 minutes then wipe it. The effect of rubbing will make a scratches then wipe it until the scratches disappear.



Figure 3.28 : Carbon fiber after applying compound

- 8) Apply 1st polish and 2nd polish to the part, wait until 3 to 4 minutes then wipe it. If the surface still has a scratch, repeat the step 7 until the surface look good and shiny.



Figure 3.29 : Carbon fiber after polished

CHAPTER 4

RESULT AND DISCUSSION

4.1 INTRODUCTION

These chapters have result and discussion include the first step until the last step. The step is fabrication of automotive body part using carbon fiber. These chapters divide by important point. The point is result and discussion for this project. In this result have the picture about the true product and their picture include the many view side the carbon fiber part like top view, side view, front view and top side view. These topics also have the details about the problem in fabrication process like have a scratch at the surface, the surface is not too shiny, the carbon fiber do not follow the shape, the pattern of carbon fiber is change, brushing process. Besides that, this chapter also have discussion and the step how to solving the problem.

4.2 RESULT



Figure 4.1 : Carbon fiber of motorcycle body part



Figure 4.2 : Carbon fiber of side mirror



Figure 4.3 : Carbon fiber of oil tank cover



Figure 4.4 : Carbon fiber of box

4.2.1 Problem in Fabrication Process



Figure 4.5 : The surface is not too shiny

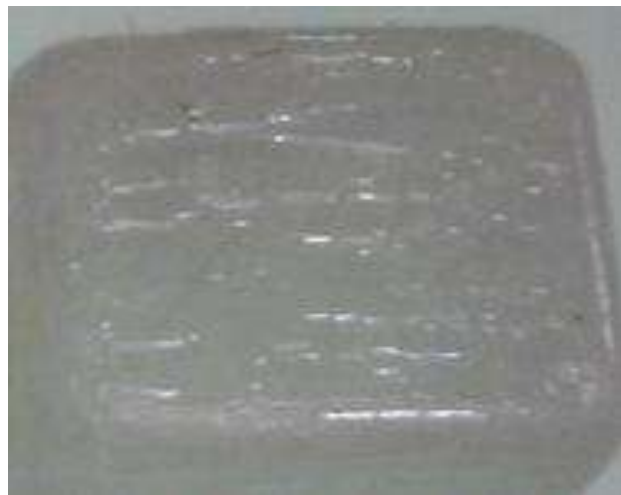


Figure 4.6 : The surface of glass fiber is not flat



Figure 4.7 : Have a scratch on the surface



Figure 4.8 : The pattern of carbon fiber is change



Figure 4.9 : The carbon fiber is not follow the shape of the part

4.3 DISCUSSION

4.3.1 Introduction

These topics is discussion topic which is include the problem solving from the problem that occur in this fabrication of automotive body part using carbon fiber project. In this chapter, the first step is finding out the sources of each problem. After that, analysis or investigate it which one is the real source of the problem. The last thing is after the entire problem is solved, the product must have improvement process to get the better and good quality of the product.

4.3.2 Problem and Solving

The first problem that happened in this project is the surface is not too shiny. This problem is critical, because to get the shiny surface is the priority of customer needs. After analysis the sources of this problem, the real source is because the layer of resin lay on the carbon fiber is thin. Another source is only a time doing the finishing process, which is the wax step include compound, 1st polish and 2nd polish. To get the shiny surface, this should do twice or more.

Beside that, the second problem is the surface of the glass fiber is not flat. This problem can affect the product become not interesting. Because if the surface of glass fiber is not flat, than the surface of carbon fiber also not flat. The source of this problem is using the sellotape. The function of the sellotape in this project is to replace the release mould agent. One of the problems facing while doing this project is cannot find the release mould agent so we use the sellotape to replace it. The effect of using the sellotape is the surface of the product is not flat. To solve this problem, prevent using

the sellotape but use release mould agent. Besides that, you can rub the surface using sand paper.

The third problem is having a scratch on the carbon fiber surface. This problem is very serious because the finishing of the product is low at once cannot fulfill the customer needs. This problem usually happen because of the worker did not carefully when doing some dangerous step such as cutting process. This problem occurs because of gives too much force while doing rubbing step, to flat the layer of resin. If the huge force is exerted while rubbing the layer of the resin is become thin and disappears at once the sand paper is rubbing the carbon fiber. The effect of rubbing the carbon fiber, is the carbon fiber become scratch.

Next is fourth problem, which is the pattern of carbon fiber is change. This problem can causing the finishing of the product is low. This problem happens because of give too much force while brushing the resin onto the carbon fiber. If the big force exerted while brushing, the pattern of the carbon fiber could change. To prevent this problem, doing the brushing step properly which is not gives too much force, brush it parallel and slowly.

The last problem that happen which is problem five is the carbon fiber is not following the shape of glass fiber. This make the product look not interesting. Besides that cannot fulfill the customer needs because of the finishing is low. This problem happen because of laying the resin is not equal. There is a part which is no resin been lay, so the carbon fiber is not stick at the place. Besides that, use the roller brush to make carbon fiber follow the shape.

Finally, after all the problem solved, the next product can be fabricate perfectly without making the same mistake and the product have the good finishing at once can fulfill the customer needs.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

The project involves fabrication of automotive body part using carbon fiber. Basically this fabrication is divided into two stages which is concept review and development, fabrication. This fabrication is divide into two which is fabrication of glass fiber and fabrication of carbon fiber. This carbon fiber is fabricate and produce using all necessary manufacturing process such as grinding (use grinder to cut the fiber glass after fiber glass get hard on the next day). Besides that, use the basic technique of fabrication which is rubbing (use sand paper) to get flat surface, brushing (brush the surface with resin mix with hardener), cutting (use scissor) the glass fiber and carbon fiber, measuring (use tape measure) the fiberglass and carbon fiber based on original part.

Before the fabrication process start, select the part first. Parts that been selected are box, side mirror, motorcycle part and oil tank cover. These part is have different

shape which is flat, curve , flat curve and square shape. Based on that, different shapes include the different aspect and criteria. With that, we have to use different skill of laying and brushing the fiber glass and carbon fiber. Also can conclude which shape is harder to fabricate. The result that shows in this project is the curve surface is harder to fabricate than the flat surface. The more curve of the surface is the more hard to fabricate.

5.2 CONCLUSION

As the conclusion, the carbon fiber part that has been developed is more light than it original weight and has good appearance. In addition, it is suitable to be used for extreme sport or outdoor activity sport because it uses two layers of glass fibers and carbon fiber. The fibers are extremely stiff, strong, and light, and are used in many processes to create excellent building materials so that it can withstand a big force. Besides that, the other advantage of carbon fiber is high chemical resistance, high temperature tolerance and low thermal expansion which is it can stand in chemical. No damage occurs when happen an accident that include of hazard chemical. Besides that, carbon fiber did not having an expansion if the temperature is increase and can stand in high temperature. The finishing of this product is in satisfactory level. This is because no big mistake happened and type of carbon fiber that used is 3K. Which is in survey from the internet shows that the 3K carbon fiber is the most been sold. Customers more choose 3K because of the pattern is more interesting than others. Besides the 3K is more light than others because 3K is only 3,000 individual filaments in a tow. Usually carbon fiber is widely used in sport such as car sport and motor sport. This is because the carbon fiber can reduce the weight of the part at once can increase the acceleration beside carbon fiber is a strong materials. So this carbon fiber has many advantages and also will satisfy market.

5.3 RECOMMENDATION FOR FUTURE WORK

For the recommendation for future work, refer back at topic of discussion. Where at that topic there is the problems and the problem solving. The problem that occurs in this fabrication of automotive body part using carbon fiber project has been list, at once the source of the problems and the method of solving the problem are also listed at that topic. Based on it, study the topic and at once can prevent the same mistake from happen. Before that, before start the fabrication of making the glass fiber part, the mould should make first. The function of mould is to get the actual size based on the original size. From that, the part that produce is the same size of the original part at once can ease the fabrication process. To fabricate the part using the glass fiber, the layer of the glass fiber must be two layers and above. This is because using just one layer of the fiber glass is weak. It is easy to crack and broken. Two layers of fiber glass is strong enough to stand the normal force. The more layers of glass fiber can increase the strong of the product. The carbon fiber that use is 3K which is it is easy to get because 3K is widely used. Next is do not use the same resin which is mix with hardener of glass fiber and carbon fiber. Because the resin of the glass fiber is polyester resin but the resin of the carbon fiber is epoxy resin. Besides that, the ratio of the resin and the hardener for glass fiber and carbon fiber is also different. The ratio of resin mix with hardener for glass fiber is 100 : 2 which is the hardener is 2% of the resin. The ratio of resin mix with hardener for carbon fiber is 2 : 1 which is hardener is a half oh resin. The result of the finishing is also different. The surface finish that will produce for carbon fiber is more shiny and clear than glass fiber. Lastly, after following all the discussion and use the proper method the product that produce is the better and perfect besides good quality and finishing at once can fulfill customer needs and market.

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APPENDIX

GANTT CHART

Project Activities	Week													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Identify the Problem	Planning													
	Actual													
Identify the scope, objective & project background		Planning	Planning											
		Actual	Actual											
Material selection				Planning	Planning	Planning								
				Actual	Actual	Actual	Actual							
Choosing design of automotive parts							Planning	Planning						
							Actual	Actual	Actual					
Material preparation & fabrication process									Planning	Planning	Planning			
									Actual	Actual	Actual	Actual	Actual	
Testing & modification											Planning	Planning		
											Actual	Actual	Actual	
Report writing					Planning	Planning	Planning	Planning	Planning	Planning	Planning	Planning	Planning	Planning
					Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual	Actual
Presentation							Planning							Planning
							Actual							Actual

	Planning
	actual