DESIGN & FABRICATION OF REAR CAR SPOILER FOR PROTON WIRA MODEL

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ABSTRACT

Idea to fabricated of spoiler is appear after mass production of accessory on market, this problem will make easily to get some information to fabricated or make it and also to installation. For make the sketch, it specification for a spoiler must be have like an aerodynamic flow on the spoiler. Besides that, beautiful and stylist also will be taken for this fabricate.

By using fiberglass as a main material for this project because the fiberglass has their own advantages that it has the higher of strength and it can hardly force until 3 kilogram per time. The fiberglass also becomes the first selection material because it is light compare by using sheet metal. When car is moving speedy on the road, the lift force under the car will increase. It will make instability to the car. With fabricated this spoiler, the driven level of car will be increase and comfortable when this spoiler make stability again. It is because when the car moving speedy, the spoiler will produce the downforce to make neutral from the lift force.

ABSTRAK

Idea pembuatan spoiler ini terhasil setelah terdapatnya lambakan penggunaan aksesori ini dipasaran sekarang, hal ini akan memudah dalam mendapat serba sedikat tentang maklumat mengenai cara pembuatan dan pemasang barang tersebut. Lakaran yang dihasilkan adalah mempunyai spesifikasi pada sesebuah spoiler iaitu membenarkan aliran aerodynamic pada permukaan spoiler ini. Di samping itu juga, aspek kecantikan dan trend terkini juga dititik beratkan.

Penggunaan gentian kaca pada bahan utama untuk pembuatan projek adalah kerana gentian kaca ini mempunyai kelebihannya tersendiri yang mana ia mempunyai daya ketahanan yang tinggi dan mampu menanpung hentakan sehingga 3 kilogam dalam satu masa. Gentian kaca ini juga dijadikan pilihan atas sebab sifatnya yang ringan. Apabila sesebuah kenderaan itu meluncur laju di atas jalan raya, daya apungan pada kenderaan tersebut akan meningkat. Hal ini akan menyebabkan berlakunya kurang kestabilan pada kenderaan tersebut dan pemanduaan akan terjejas. Dengan rekaan spoiler ini, tahap pemanduan pada sesebuah kenderaan akan dapat ditingkatkan apabila spoiler ini akan memberi kestabilan kembali pada kenderaan dengan menghasilkan daya yang berlawanan iaitu daya tekanan ke bawah.

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CHAPTER 1

INTRODUCTION

1.1 Background

By the use of modern technology, many equipments and devices are being developed and brought to reality for human benefit and satisfaction. Among them are the vehicles. These are machines adorned with accessories that were engineered to primarily bring artistic sense and appearance enhancement. Also with the aid of continuously technology evolving, these accessories also work as very functional car items [1].

Spoiler is just one of those impressive creations from human technology. It is machined to bring sporty and cool look in a very trendy manner. However, ultimately, this auto accessory was designed to affect the aerodynamics of vehicle from it's has been mounted to. Particularly, cars that accelerate at top speed benefit from its capacity [2].

A spoiler is an aerodynamic device attached to an automobile whose intended design function is to 'spoil' unfavourable air movement across a body of a vehicle of some kind in motion. This can result in improved vehicle stability by decreasing lift or decreasing drag that may cause unpredictable handling in a car at speed. Spoilers are often fitted to race and high-performance sports cars, although they have become common on passenger vehicles, as well. Some spoilers are added to cars primarily for styling purposes and have either little aerodynamic benefit or even make the aerodynamics worse [2].

A car spoiler also improves the way that air flows over the vehicle. Its abutments and wing like design features do this by disrupting the airflow so that the vehicle can handle better and move faster. The result of affixing a spoiler to a car is that car is has more traction on the road, which can allow it to go faster. Once the installation of a car spoiler is accomplished car becomes more stable and has less lift or decreasing drag that might cause the car to handle in a dangerous or unpredictable way if it is being driven at a high speed. Usually it looks like a big sleek tail a shown in Figure 1.1 that uplifts the rump of the car or like a ledged wing [3].

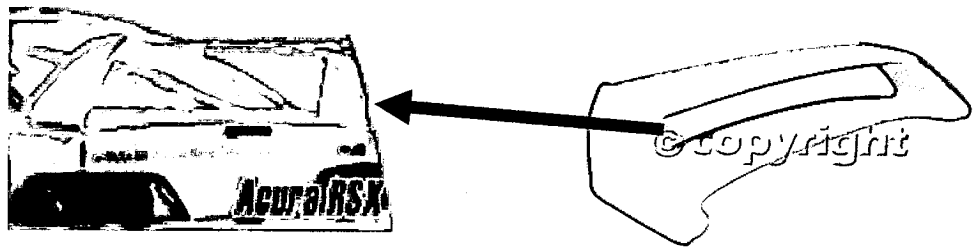

Figure 1.1: Example of spoiler [4]

1.2 Problem statements

Although spoilers are available in variety, most of these are plain styling components that have little or no effect on the aerodynamic properties of the vehicle. Therefore, it is necessary to design spoiler that provided not only style but also for aerodynamic benefits.

1.3 Importance of the project

This project helps the student practice the knowledge and skill that has gathered before in solving problem using academic research. This project also important to train and increase the student's capability to get knowledge, research, data gathering, analysis making and then solve a problem scientifically.

1.4 Objective

- To design a passenger car rear spoiler.
- To fabricate a passenger car rear spoiler.

1.5 Scope

- Passenger car rear spoiler for PROTON wira model
- Fabricated and assembly to real car.
- Material - Fiberglass and aluminium.

1.6 Project outline

This report will cover for five chapters, the first chapter is introduction, second chapter is literature study and the third chapter is methodology. At chapter four will cover for result and discussion, on the last chapter has covered the conclusion and recommendation.

CHAPTER 2

LITERATURE STUDY

2.1 Spoiler types

Spoilers come in variety. The front spoiler or air dam can be found under the front bumper in a car. The rear spoiler also known as wing is positioned on top of vehicle's trunklid to provide a downforce when accelerating at top speeds for better stability shown in Figure 2.1. Another type is window spoiler. There are same other spoilers which are exclusively crafted for pickups, including cab spoilers, tailgate spoilers, truck cap spoiler and tonneau cover spoilers [5].

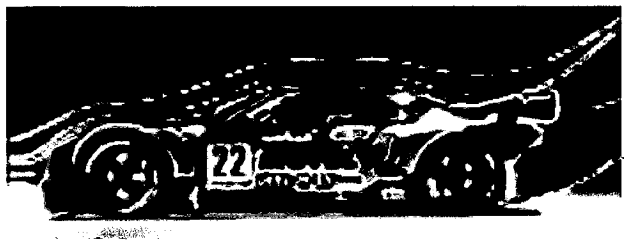

Figure2.1: Aerodynamic of car [6]

There are important things to consider in mounting spoiler onto a vehicle. Different spoilers possess different weights and adding them will affect the performance in varying augmentations, depending on the material that they were made of. Most spoilers are made of the light and sturdy polyurethane material. Other is made from light weight steel or fiberglass [7].

Spoilers are originally installed only on race cars and sports cars to redirect airflow around their bodies. Specifically, spoilers were designed to disrupt airflow going over a vehicle, decreasing the lift naturally generated by the shape of the vehicle and increasing the amount of force pushing the vehicle's tires to the ground, Figure 2.2 shown how airflow through onto a spoiler. As a result, racing vehicles can turn, brake and accelerate more aggressively. Today, spoilers are no longer limited to racing vehicles and sports car [5].

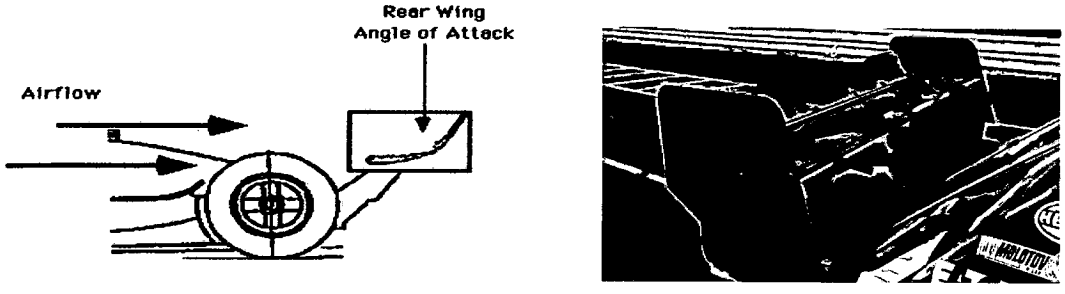

Figure 2.2: Air flow direction [9]

Many cars that fall into the sports-car or sporty-sedan classes come with factory-installed spoilers. Though a few spoilers are actually functional adding to the aerodynamic efficiency and stability of the vehicle at high speeds most are merely cosmetic and designed to add a sleek, sporty look. Some enthusiasts like to exaggerate that look even further by replacing the factory spoiler with a more aggressive looking after-market model. Installing one of these add-ons involves removing the old spoiler and, if there is an integrated high-mount brake-light, doing some electrical re-wiring [5].

Spoilers are available in quite a few styles. Some have top-mounted elements that attach to the rear of the trunk or hatch (Figure2.3-A), and additional pieces that attach to the top section of the rear fender. Others attach only to top surface of the trunk or hatch. The elements themselves come unpainted (Figure2.3-B), so unless you plan to repaint your vehicle, it will be necessary to have the parts painted in advance in a colour that is an exact match with your vehicle [5].

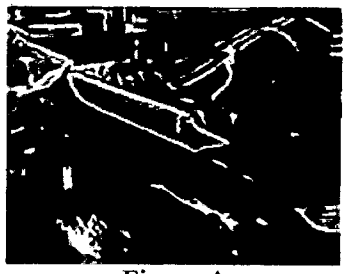

Figure A

Figure B

Figure 2.3: Type of spoiler [5]

2.2 Bernoulli Principles

Aerodynamics is a branch of fluid mechanics that deals with the motion of air and other gaseous fluids, and with the forces acting on bodies in motion relative to such fluids. The motion of an aircraft through the air, the wind forces exerted on a structure, and the operation of a windmill are all examples of aerodynamic action. Figure 2.4 shown how aerodynamic action related to Bernoulli principle that applied to spoiler [10].

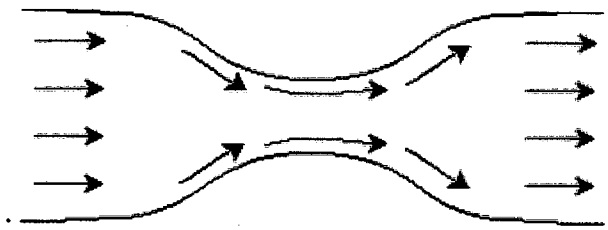

Figure 2.4: Bernoulli principle [10]

Bernoulli's principle is used in aerodynamics to explain the lift of an airplane wing in flight. A wing is so designed that air flows more rapidly over its upper surface than its lower one, leading to a decrease in pressure on the top surface as compared to the bottom. The resulting pressure difference provides the lift that sustains the aircraft in flight. If the wing is turned upside-down, the resultant force is downwards. This explains how performance cars corner at such high speeds. The downforce in Figure 2.5 where the downforce produced pushes the tires into the road giving more grips [10].

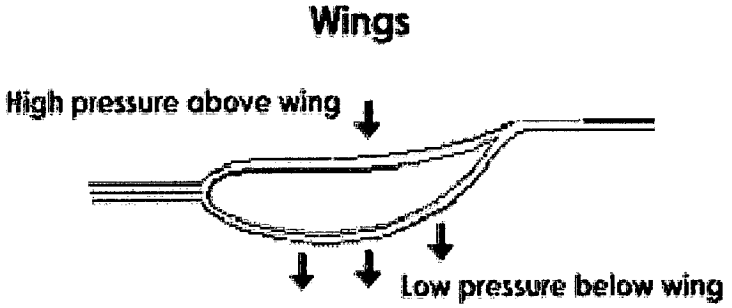

Figure 2.5: Downforce principle [1]

Another important aspect of aerodynamics is the drag, or resistance, acting on solid bodies moving through air. The drag forces exerted by the air flowing over an airplane, for example, must be overcome by the thrust force developed by the engine. These drag forces can be significantly reduced by streamlining the body. For bodies that are not fully streamlined, the drag force increases approximately with the square of the speed as they move rapidly through the air [12].

Spoilers do a few things to reduce the drag profile-a 3-D measure of the laminar (non-turbulent or "flat" air) and turbulent air pressure on the race car which acts as a friction force against the car and increase pitch stability, while also aiding the traction. Spoilers act in similar fashion to create lift and to stabilize air flows at opposite ends of the vehicle example shown on Figure 2.6 [12].

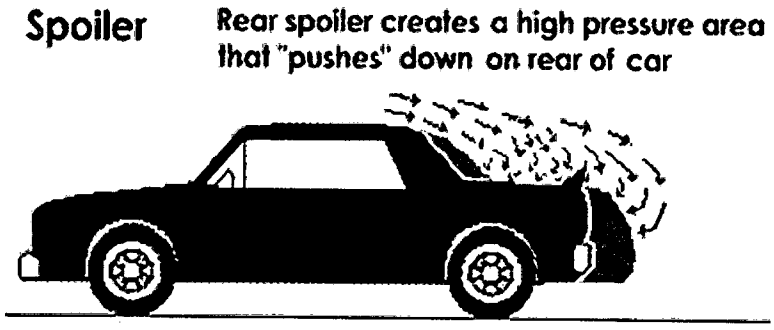

Figure 2.6: The effect of rear spoiler [1]

2.3 Aerodynamics

Aerodynamics has played a major role in car racing since the late 1960s, when introduction of the first inverted wings appeared in some formulas. After that time, improved wing systems like the shape of spoiler (refer Figure 2.7) taken from the aeronautic technology made leaps forward, improving consistently lap times, increasing cornering speeds and vehicle stability. With the introduction of the ground effect a few years later the vehicles used a third element (the under body) to produce downforce like shows on Figure 2.8, and hence improve the performances of the car [12].

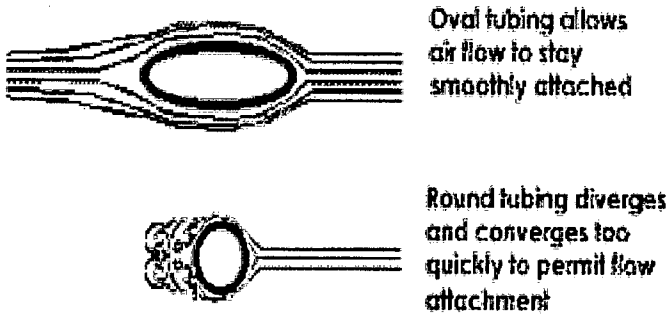

Figure 2.7: Type of airflow [7]

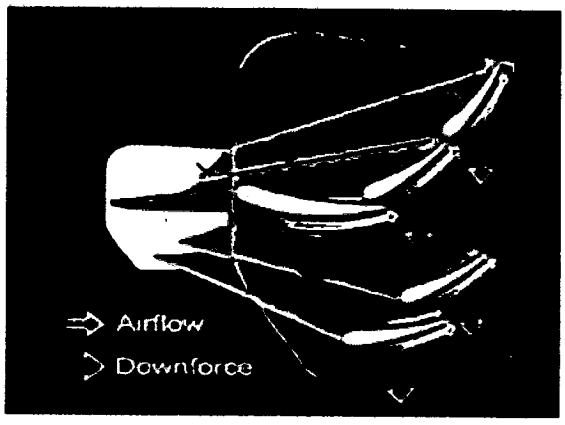

Figure 2.8: Aerodynamic affect [1]

2.4 Material

Commonly used material for fabricated a spoiler are fibreglass and polyester.

2.4.1 Fiberglass

Fiberglass (also called *fibreglass* and *glass fibre*) is material made from extremely fine fibers of glass. It is used as a reinforcing agent for many polymer products; the resulting composite material, properly known as fiber-reinforced polymer (FRP) or glass-reinforced plastic (GRP), is called "fiberglass" in popular usage [8].

2.4.1.1 Formation

Glass fiber is formed when thin strands of silica-based or other formulation glass is extruded into many fibers with small diameters suitable for textile processing. Glass is unlike other polymers in that, even as a fiber, it has little crystalline structure. The properties of the structure of glass in its softened stage are very much like its properties when spun into fiber. One definition of glass is "an inorganic substance in a condition which is continuous with, and analogous to the liquid state of that substance, but which, as a result of a reversible change in viscosity during cooling, has attained so high a degree of viscosity as to be for all practical purposes rigid "[8].

2.4.1.2 Chemistry

The basis of textile grade glass fibers is silica, SiO_2. In its pure form it exists as a polymer, $(SiO_2)_n$. It has no true melting point but softens up to 2000°C, where it starts to degrade. At 1713°C, most of the molecules can move about freely. If the glass is then cooled quickly, they will be unable to form an ordered structure [8].

In the polymer it forms SiO_4 groups which are configured as a tetrahedron with the silicon atom at the center, and four oxygen atoms at the corners. These atoms then form a network bonded at the corners by sharing the oxygen atoms, Figure 2.9 shown the network bond. The vitreous and crystalline states of silica (glass and quartz) have similar energy levels on a molecular basis, also implying that the glassy form is extremely stable. In order to induce crystallization, it must be heated to temperatures above 1200°C for long periods of time [8].

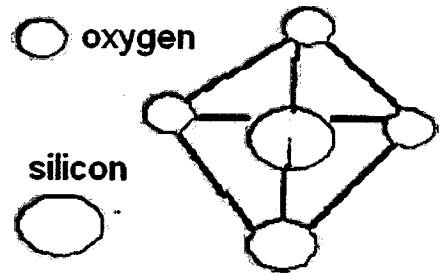

Figure 2.9: Molecular structure of glass [8]

Although pure silica is a perfectly viable glass and glass fiber, it must be worked with at very high temperatures which are a drawback unless its specific chemical properties are needed. It is usual to introduce impurities into the glass in the form of other materials, to lower its working temperature. These materials also impart various other properties to the glass which may be beneficial in different applications [8].

The first type of glass used for fiber was soda-lime glass or A glass. It was not very resistant to alkali. A new type, E-glass was formed that is alkali free (< 2%) and is an alumino-borosilicate glass. This was the first glass formulation used for continuous filament formation. E-glass still makes up most of the fiberglass production in the world. Its particular components may differ slightly in percentage, but must fall within a specific range [8].

The letter E is used because it was originally for electrical applications. S-glass is a high strength formulation for use when tensile strength is the most important property. C-glass was developed to resist attack from chemicals, mostly acids which destroy E-glass. T-glass is a North American variant of C-glass. A-glass is an industry term for cullet glass, often bottles, made into fiber. AR-glass is alkali resistant glass [8].

Most glass fibers have limited solubility in water but it is very dependent on pH. Chloride ions will also attack and dissolve E-glass surfaces. A recent trend in the industry is to reduce or eliminate the boron content in the glass fibers [8].

Since E-glass does not really melt but soften, the softening point is defined as, "the temperature at which a 0.55 – 0.77 mm diameter fiber 9.25 inches long, elongates under its own weight at 1 mm/min when suspended vertically and heated at the rate of 5°C per minute". The strain point is reached when the glass has a viscosity of $10^{14.5}$ poise. The annealing point, which is the temperature where the internal stresses are reduced to an acceptable commercial limit in 15 minutes, is marked by a viscosity of 10^{13} poise [8].

2.4.1.3 Properties

Glass fibers are useful because of their high ratio of surface area to weight. However, the increased surface area makes them much more susceptible to chemical attack. By trapping air within them; blocks of glass fiber make good thermal insulation, with a thermal conductivity of 0.05 W/mK [8].

Glass strengths are usually tested and reported for "virgin" fibers which have just been manufactured. The freshest, thinnest fibers are the strongest and this is thought to be due to the fact that it is easier for thinner fibers to bend. The more the surface is scratched, the less the resulting tenacity is. Because glass has an amorphous structure, its properties are the same along the fiber and across the fiber. Humidity is an important factor in the tensile strength. Moisture is easily adsorbed, and can worsen microscopic cracks and surface defects, and lessen tenacity [8].

In contrast to carbon fiber, glass can undergo more elongation before it breaks. The viscosity of the molten glass is very important for manufacturing success. During drawing (pulling of the glass to reduce fiber circumference) the viscosity should be relatively low. If it is too high the fiber will break during drawing, however if it is too low the glass will form droplets rather than drawing out into fiber [8].

2.4.2 Polyester

Polyester is a category of polymer, or, more specifically condensation polymer, which contain the ester functional group in their main chain. Usually, polyester refers to cloth woven from polyester fiber. Polyester clothing is generally considered to have a "less natural" feeling to it compared to natural fibers [13].

Polyester fibers are often spun together with fiber cotton, producing a cloth with some of the better properties of each. Because there are so many varieties of plastic, and new ones are being developed almost continuously, it is helpful to have knowledge of both general properties of plastics as well as the unique or specific properties of the various families [13].

General properties include:

i. **Light weight:** Most plastics have specific gravities between 1.1 and 1.6, compared with about1.75 for magnesium (the lightest engineering metal).
ii. **Corrosion resistance:** Many plastics perform well in hostile, corrosive environments. Some not notably resistant to acid corrosion.
iii. **Electrical résistance:** Plastics are widely used as insulating materials.
iv. **Low thermal conductivity:** Plastics are relatively good thermal insulator.
v. **Variety of optical properties:** Many plastics have an almost unlimited colour range, and the colour goes throughout, not jus on the surface. Both transparent and opaque materials exist.
vi. **Surface finish:** Excellent surface finishes can be obtained by the same processes that produce the shape. Additional surface finishing may not be required.
vii. **Comparatively low cost:** The low cost of plastics generally applies to both the material itself and the manufacturing process. Plastics frequently offer reduced tool costs and high rates of production [13].