UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DEVELOPMENT OF AN EMERGENCY BRAKE SYSEM FOR UNDERBONE MOTORCYCLE IN MALAYSIA (BELOW 150CC ENGINE CAPACITY)

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BACHELOR OF MECHANICAL ENGINEERING TECHNOLOGY (AUTOMOTIVE TECHNOLOGY) WITH HONOURS

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in fulfillment of the requirements for the degree of
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DECLARATION

I declare that this Choose an item. entitled “Development of Emergency Brake for Underbone Motorcycle (Below 150cc Engine Capacity)” is the result of my own research except as cited in the references.

Signature : 

Name : Muhammad Nazreen Bin Abdul Rahim

Date : 15/1/2022

APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor Of Mechanical Engineering Technology (Automotive Technology) With Honours.

Signature : mohd zakaria

Supervisor Name : Ts Dr Mohd Zakaria Bin Mohammad Nasir

Date : 15/1/2022

DEDICATION

This dedication firstly to Allah S.W.T for giving strength and good health to perform this duty to complete this project. Great appreciation to my beloved and respectful parents. Thank you for always provide me with support and motivation, and I hope that this achievement will fulfil their dreams. Also dedicated appreciation to my supervisor, Ts Dr Mohd Zakaria Bin Mohammad Nasir, for always guide and advise me to do this all work.

Thank you.

ABSTRACT

The purpose of this project is to develop an emergency brake system for underbone motorcycles (engine capacity less than 150cc) by combining the front and rear brake systems. This combination brake system is broadly applied on motorcycles with large engines. This combination brake system is only applicable to motorcycles with a capacity of less than 150cc. This concept may be one of the safest brake systems available, reducing stopping distance compared to conventional brakes. This brake system is incredibly simple to install on any underbone motorcycle. Thus, two different callipers are employed in this project: the front calliper is a double calliper, while the rear calliper is a single calliper. This ensures that the brake distribution on the front calliper is greater than the rear calliper, preventing skidding. This combination brake system utilises both brake discs to improve braking performance. For the rear brake system only, a double calliper is added to the rear brake disc to serve as a backup brake in the event that the combined brake system fails. To determine the percentage difference in stopping distance, the motorcycle had to perform three different test with differents speeds and repeated the procedure three times to ensure the data was accurate. The stopping distance can be determined by placing a cone (marking for brake applied). The distance between the cone and the last motorcycle that can stop is measured. The results demonstrate the difference between conventional and combined brake systems that are combined brake system can reduce 30% in average of stopping distance for every test performed.

ABSTRAK

Tujuan projek ini adalah untuk membangunkan sistem brek kecemasan untuk motosikal underbone (kapasiti enjin kurang daripada 150cc) dengan menggabungkan sistem brek hadapan dan belakang. Sistem brek gabungan ini digunakan secara meluas pada motosikal dengan enjin berkapasiti tinggi. Sistem brek gabungan ini hanya diaplikasikan kepada motosikal berkapasiti kurang daripada 150cc. Konsep ini menjadi salah satu sistem brek paling selamat yang ada, mengurangkan jarak berhenti berbanding brek konvensional. Sistem brek ini sangat mudah dipasang pada mana-mana motosikal underbone. Oleh itu, dua angkup berbeza digunakan dalam projek ini: angkup hadapan adalah angkup berganda, manakala angkup belakang adalah angkup tunggal. Ini memastikan agihan brek pada angkup hadapan lebih besar daripada angkup belakang, mengelakkan tergelincir. Sistem brek gabungan ini menggunakan kedua-dua cakera brek untuk meningkatkan prestasi brek. Untuk sistem brek belakang sahaja, angkup berkembar ditambah pada cakera brek belakang untuk berfungsi sebagai brek sandaran sekiranya sistem brek gabungan gagal. Bagi menentukan perbezaan peratusan jarak berhenti, motosikal ini menjalankan tiga jenis ujian pada pelbagai kelajuan dan mengulangi prosedur sebanyak tiga kali bagi memastikan data adalah tepat. Jarak berhenti boleh ditentukan dengan meletakkan kon (penandaan untuk brek digunakan). Jarak antara kon dan motosikal terakhir yang boleh berhenti diukur. Perbezaan brek konvensional dan sistem brek gabungan dapat dilihat iaitu sistem brek gabungan dapat mengurangkan 30% secara purata dalam setiap ujian jarak berhenti.

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LIST OF SYMBOLS AND ABBREVIATIONS

d	-	Distance
F	-	Force
g	-	Gravity = 9.81m/s
μ	-	Coefficient of Friction
V	-	Velocity
kph	-	Kilometre per hour
CBS	-	Combined Brake System
ABS	-	Anti-lock Braking System
SAE		Society of Automotive Engineering
DOT		Department of Transportation

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CHAPTER 1

INTRODUCTION

1.1 Background

There are numerous classification systems for various types of motorcycles that describe how the motorcycles are used, the designer's intent, or a combination of these factors. It is classified into six broad categories: cruisers, sports, touring motorcycles, standard motorcycles, dual purpose motorcycles, and dirt bikes. Motorcycles and their smaller relatives, such as mopeds, scooters, and underbone motorcycles, are sometimes classified separately; however, other classification schemes include these as types of motorcycles as well. Each motorcycle type has its own set of riding styles, as well as its own set of safety and maintenance requirements, as well as its own set of operating costs. The underbone and moped have the lowest operating costs, prices, required safety features, and required maintenance. Indonesia, Malaysia, Vietnam, Thailand, and the Philippines are particularly fond of this dish.

Underbone is unique in that it is powered by a small engine capacity mostly used only a piston that is less than 150cc and is built around a structural tube frame covered with plastic panel. Fuel tank and tube frame are shared, as well as fitted bodywork and splash shields, while maintaining normal motorcycle wheel proportions, engine layouts, and transmission. The engine is located between the rider's feet, the back wheel is driven by a supplementary chain drive similar to that seen on a motorbike. Underbones are often equipped with spoke, or alloy wheels placed on shaft and are sized to fit small conventional motorcycle frames. These are substantially more capable of road holding and braking than

scooters. Underbones are often fitted with a three- to six-speed sequential gearbox, either with an automatic clutch or can be call centrifugal clutch or a normal manual hand clutch. It is then connected to a rear wheel via a sprocket and chain drive. Figure 1.1 illustrates one of Yamaha Motor Company's most recent underbones.

Figure 1. 1 Yamaha Y16ZR

The majority of the underpinning manufacturers are from Japan, specifically Honda, Yamaha, and Suzuki. Modenas from Malaysia, SYM motors from Taiwan, and Benelli from Italy are also very popular in ASEAN countries. Although it has been stated that an underbone motorcycle has a capacity of less than 150cc, the SYM VF3i from SYM Motors as in Figure 1.2 currently has the largest engine displacement in the underbone category at 183cc.

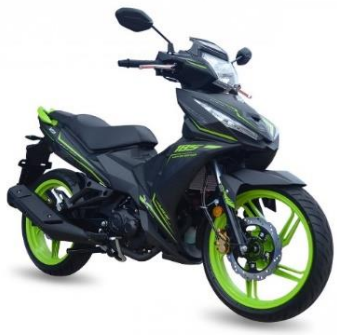

Figure 1. 2 SYM VF3i

According to motorcycle history, the Honda Super Cub as in Figure 1.3 is the most produced motorcycle of all time, with over 60 million units produced in 2008, 87 million units produced in 2014, and 100 million units produced in 2017. This demonstrates that

baseboard motorcycles are more popular than other types of motorcycles. The total number of underbone owners in Indonesia has already surpassed 120 million, accounting for nearly half of the country's population.

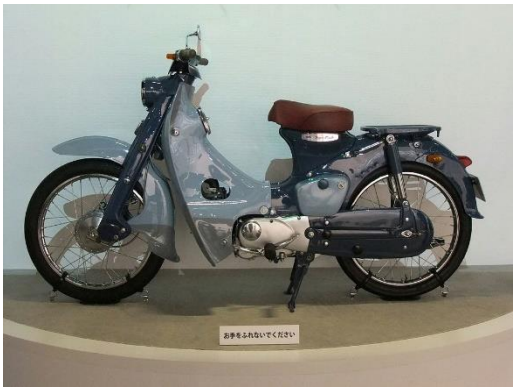

Figure 1. 3 Honda Super Cub (Honda Super Cub, wikipedia)

Malaysia's motorcycle market was the most resilient in the region in 2020 and showed a massive increase in the first quarter of 2021, while the other regional countries continue to struggle and perform well above expectations. According to MotorCycle Data (McD), Malaysia's motorcycle industry is expected to sell 499,000 units in 2020, ranking the country's motorcycle market 13th globally and fifth in the ASEAN region. Motorcycle sales in January and February 2020 increased by 22%. Malaysia's Prime Minister announced in the first quarter of 2021 that locally assembled motorcycles with an engine capacity of 150cc (underbone) or less will be exempt from excise duty entirely from April 1 to December 31, 2021. This announcement may result in an increase in the total number of underbone motorcycles sold in Malaysia (Abdul Manan & Várhelyi, 2012).

Malaysians require underbone motorcycles to save time, improve mobility, and cut costs. Most motorcycle riders are workers or students, which makes commuting to work or school easier. This is a significant contributor to accidents in Malaysia. Around 4,200 people are killed each year in fatal motorcycle accidents involving both riders and pillion riders. This figure accounts for roughly 60% of all fatal accidents involving all vehicle types.

1.2 Problem Statement

The Malaysian Institute of Road Safety Research, or MIROS, hosted an online meeting using Webex to discuss fatal motorcycle accidents in Malaysia. According to Dr. Ahmad Azad Ab. Rashid, motorcycle accidents are common on straight highways throughout the day, particularly in rural areas (Chief Research Officer MIROS). Additionally, he stated that brake failure accounts for approximately 70% of motorcycle accidents in Malaysia. As a result, the rider is unable to bring the motorcycle to a rapid stop. The other cause is the rider's inability to respond quickly enough to an object in front of him.

While modern brake technology, such as the anti-lock braking system (ABS), can quickly stop a motorcycle, the majority of underbone motorcycles do not. Hezeri Samsuri (Careta author/influencer) stated at the MIROS forum that Malaysia's acceptance in ABS is extremely difficult due to the company's profit orientation. ABS is prohibitively expensive for them to install on motorcycles under 150cc. In Malaysia's domestic market, a growing number of motorcycles under 150cc already feature disc brakes on both the front and rear axles. This system will enhance a motorcycle's braking performance. Certain motorcycle manufacturers, however, continue to use drum brakes for the rear brakes or for both the rear and front brakes. By utilizing a drum brake system, it is possible to reduce the cost of motorcycles. When riding on the highway, regardless of whether the motorcycle is equipped with drum brakes or disc brakes, the level of safety remains low.

As a result, the purpose of this research is to identify alternative methods for improving the braking performance of motorcycles under 150cc (underbone) using a low-cost solution that meets the criterion of increased bike safety. By utilizing a low-cost product, the motorcycle's safety features can be enhanced without increasing the market price. The problem statement that will be mainly focused here are:

a) What is the improvement that can be used to the conventional brake?

b) How to design the most reliable and safest brake system in underbone motorcycles?

c) Is this brake system can be modified in underbone motorcycle?

1.3 Research Objective

The major goal of this research is to enhance safety brake systems for motorcycles under 150cc, with the following objectives:

a) To conduct research into the development of a more effective brake system for underbone motorcycles using a combined front and rear brake system.

b) To fabricate a combined brake system for underbone motorcycles.

c) To measure and evaluate the stopping distance during braking.

1.4 Scope of Research

The scope of this research are as follows:

- Conduct a survey to ascertain the most frequently used brakes by motorcycle riders and develop a design concept for motorcycle brakes under 150cc.
- Conduct an analysis of conventional braking systems using CATIA software.
- Develop a new brake system.
- Testing and research of new combined brake system performance.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Demand for underbone motorcycles was quite high in the first quarter of this year, indicating how important this type of motorcycle is to Malaysians. As a result, manufacturers such as Yamaha, Honda, and SYM have made tremendous strides over the last decade. The underbone utilises fuel injection rather than a carburetor, which is one of the noticeable changes. Additionally, the majority of underbones incorporate electronic panels that adhere to the trend of modern superbikes, as well as the electronic system. The electronic system is monitored and controlled by an Electronic Control Unit (ECU), which can control valve timing, air-fuel mixture, suspensions, and other parameters. The electronic system and modern exhaust system enable the underbones to meet European emission standards, thereby lowering air pollution levels in Malaysia. Additionally, the underbone brake technology is not as sophisticated as that of a superbike, touring motorcycle, or other large engine capacity motorcycle.

2.1.1 Motorcycle Brake's History

Motorcycles in the early years were essentially bicycles with a motor attached, with no braking system other than slowing down and stepping out. In 1902, Philadelphia's Steffey Motorcycles produced one of the first motorcycles with any type of braking system. This was accomplished using a spoon brake that was limited to the front wheel. The example of a spoon front brake operated by a handlebar lever and connecting rod on an 1899 Royal Riley tricycle at the Heritage Motor Centre in Gaydon, England, is depicted in Figure 2.1.