THE ANALYSIS OF THE FORCES THAT ACT ON THE MOTORCYCLE BRAKE PEDAL DURING EMERGENCY BRAKE

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I/We admit that have read this report and in my/our opinion this report is enough in term of scope and quality to bestowal Bachelor of Mechanical Engineering (Automotive)

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Date :……

"I declare that this report is my own work except for any summary or quotation from every single source is explained"

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Date	: 10 APRIL 2009

To my beloved Mum and Dad,

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ABSTRACT

Brake system is an important safety system in every vehicle for controls of the vehicle movement. During emergency brake, force that acts on the rear brake pedal in motorcycle is maximum. In this situation, the force should be reacted by the brake pedal to avoid failure. This paper presents a strength analysis of a motorcycle brake pedal by using finite element method. A comparison study of design at structure of brake pedal was conducted. The existing motorcycle brake pedal are measured and created the using CATIA V5R16 to get the complete design. The design of pedal was then exported to MCS Patran&Nastran. Finite element method is used to validate the design whether it is strong enough when maximum load was applied. The critical area at brake pedal when maximum force applied was determined. The results show that the improvement by apply a radius at bend area between the pipe brake and collar pivot can decrease the maximum stress on brake pedal at critical area.

ABSTRAK

Sistem brek adalah sistem keselamatan yang penting dalam setiap kenderaan untuk mengawal pergerakan kenderaan. Semasa brek kecemasan, daya yang bertindak ke atas pedal adalah maksimum. Di dalam keadaan ini pedal seharusnya dapat menahan daya yang dikenakan tanpa gagal. Kajian ini membincangkan tentang analisis kekuatan satu injak brek motosikal dengan menggunakan kaedah “finite element method”. Satu kajian perbandingan reka bentuk pada struktur injak brek telah dijalankan. Injak brek motosikal yang sedia ada diukur dan dilukis menggunakan CATIA V5R16 untuk mendapat betuk sebenar injak brek. Reka bentuk kemudiannya dieksport kepada MCS Patran&Nastran. Kaedah “finite element method” digunakan menyahihkan reka bentuk tersebut sama ada ia adalah kukuh menahan beban maksimum telah dikenakan. Bahagian kritikal pada injak brek semasa daya maksimum telah ditentukan. Keputusan menunjukkan bahawa perubahan dengan meletakkan satu sudut pada bahagian lengkuk antara brek paip dan pangsi kolar injak brek motosikal boleh mengurangkan tekanan maksimum pada injak brek di bahagian kritikal.

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CHAPTER I

INTRODUCTION

This chapter will provide the information about this project. The function of the brake pedal in a motorcycle will be presented in this chapter. The problem statement, objective and scope of this project will also be included.

1.1 Background

Nowadays the vehicle industry is growing rapidly due to the high demand from users who feel their lives more convenient when using such vehicles. The vehicle industry, together with other sectors, also plays a vital role in the development of the country. The most important safety system in every vehicle is the brake system which is used to control the movements of the vehicle and also to stop the vehicle by pushing the

brake pedal which is connected to the brake system in the vehicle's movement equipment.

The basic function of brake system are to slow the speed of the vehicle, to maintain its speed during downhill operation, and to hold the vehicle stationary after it have come to a complete stop. Because of those factors, the braking system is considered by many people the most important system involved in the operation of a vehicle. The disk brake or drum brake systems will then work automatically when we push the brake pedal. This will slow and eventually stop the movements of the vehicle. Many of research and improvement are make to provide the best among the better of braking system. The ideal braking system is one system that will allow driver to stop their vehicle in the shortest possible distance. The vast majority of motorcycles use an independent brake system for the front and rear wheels, with a lever on the right handlebar controlling the front brake and foot pedal controlling the rear brake. Figure 1.1 shows the foot pedal controlling the rear brake.

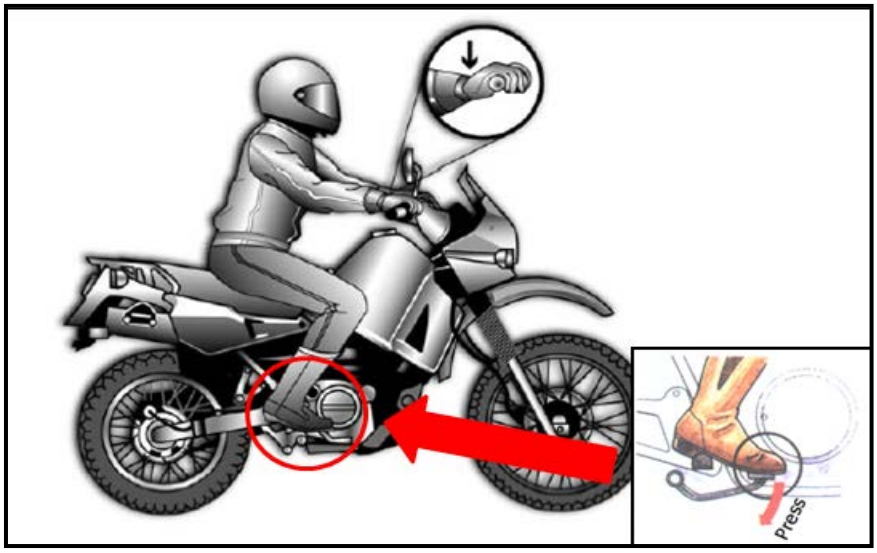

Figure 1.1: Motorcycle front and rear brake; foot pedal controlling the rear brake (Source: Basic Rider Course)

1.2 Problem Statement

When motorcycle riders brake with the shortest possible braking distance, normally riders will start by using the rear brake. The riders only use the rear brake to start a process of shifting weight from the rear to the front wheel. During emergency brake, force that acts on the rear brake pedal is maximum. In this situation, the force should be reacted by the pedal to avoid failure. Due to the lack of information on motorcycle brake pedal structure, designers are less able to improve the existing brake pedal construction. The effect of the force on the pedal structure during emergency brake is analyzed using Finite Element Method. The analysis is focus on the design and shape of the brake pipe. The force from rider's foot during pressing rear brake pedal was studied. Figure 1.2 shows the various types of the failure of brake pedal. The failures usually occur at the pipe brake. The study must prove that existing pedal designs are strong and safe to use at motorcycle.

Figure 1.2: Failure at motorcycle brake pedal

1.3 Objectives

The objective of this project is to analyze forces that act on the brake pedal during emergency brake using Finite Element Method software. By understanding the stress and deformation of force on the structure of the brake pedal, this will become helpful information for designers to improve existing brake pedal construction in order to avoid brake pedal failure.

1.4 Scopes

In order to analyze the motorcycle brake pedal, scopes are required to assist and guide development of the project. The scope should be identified and planned to achieve the objective of the project successfully on the time. The scopes for this project are:

1. To create the existing brake pedal:
    i. Measure the existing Honda EX5-Class motorcycle brake pedal using 3D scanner for accurate dimensions
    ii. Create the existing brake pedal using CATIA V5R16 to get the complete design
2. To analyze the structural strength for critical point of the brake pedal design using finite element analysis software

i. The design of pedal is then exported to MCS Patran&Nastran

ii. Carry out analysis on the forces the acts on the brake pedal using Finite Element Method.

iii. Determine the critical area at brake pedal when maximum force applied

3. Suggest and improve the design for most strength structure of motorcycle brake pedal and compare with existing brake pedal

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

Literature review is the study that is being done to previous research that relates to the topic. This chapter shows a concise summary of the journal or report and the methods that had been used and the results obtained.

2.2 Overview

In designing the brake pedal for stress analysis, it is needed to understand the related principle of design and stress analysis. Moreover, the test configuration and

previous brake pedal design must be study so that the suitable design, which fulfills the criteria and requirement of the test configuration, can be created. The basic function of brake system is to slow the speed of the vehicle. High speeds of motorcycle with a man rider influence the force on brake pedal during emergency brake. There is very limited time and obvious distractions when a motorcyclist is in an emergency braking situation. During the time that the rider is thinking about applying the brakes and moving foot to brake pedal, the vehicle will travel a certain distance depending on the speed of vehicle. After the brakes are applied, the vehicle will travel on additional distance before it is brought to a stop. Total stopping distance of a vehicle is the total of the distance covered during the rider reaction time and the distance during which the brakes are applied before the vehicle stops.

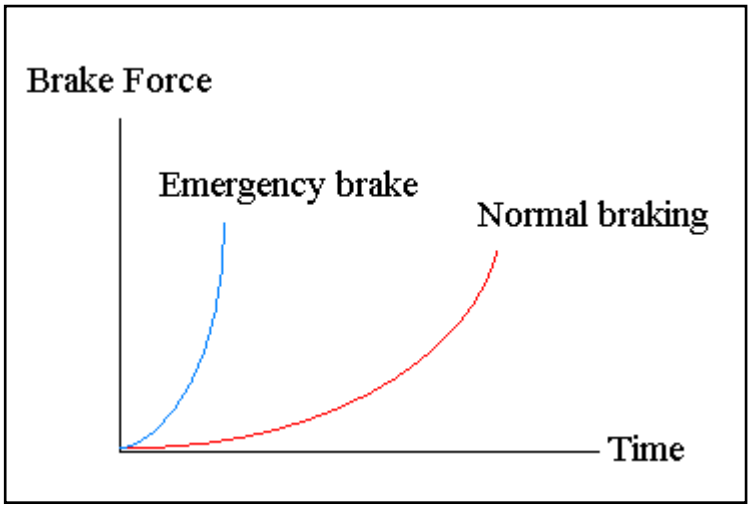

Figure 2.1: The motorcycle in normal braking and emergency brake (Source: Hudha, K (2009))

During emergency brake, riders normally apply too much force to a brake during a stop causes a wheel to stop turning. The effect of the force on the pedal structure during emergency brake is analyzed. This project represents the analysis of the motorcycle rear brake pedal using finite element method. Maximum force on the pedal

will cause the brake pedal damage or bend. Finite element method is use to study the stress on the pedal structure while riders apply force during emergency brake.

Figure 2.2: Motorcycle in emergency situation

Brake pedal for the automobile industry are made by press forming of steel strips formed to adequate shapes and dimensions. In order to prevent future failure during manufacturing processes, the origin of the cracking pedal problem was investigated. For the mechanical characterization of the material, hardness, tensile and bending tests have been carried out and the analysis was complement with detailed micro structural observations.

A detail study of the behavior of steel used has presented. The result obtained from comparative analysis between cracked and uncracked pedals showed different