SUPERVISOR DECLARATION

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering with Manufacturing Engineering.

Signature : .....

Supervisor : Azizuddin Bin Abd Aziz

Date : .....

DESIGN AND ANALYSIS OF PLATFORM MOTORCYCLE DYNAMOMETER

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A report is submitted in fulfillment
Of the requirements for the award of the degree of
Bachelor of Mechanical Engineering with Manufacturing Engineering

Faculty of Mechanical Engineering
Universiti Malaysia Pahang

NOVEMBER 2008

STUDENT DECLARATION

I declare that this thesis entitled "*Design and Analysis of Motorcycle Dynamometer"* is the result of my own research except as cited in the reference. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....
Name : Mohd Hanif Bin Mokhtar
Date : 10 November 2008

Dedicated to my beloved

Mother and Father,

Brothers and Sisters

My friends

ACKNOWLEDGEMENT

First of all, I feel grateful to Allah S.W.T because this project has successfully completed. In the process of completing this final year project, I was in contact with many people that contributed toward my understanding and problem solving. In particular, I wish to express my sincere appreciation to my project supervisor, Mr. Azizuddin bin Abd Aziz for his guidance, advice and encouragement. I also deeply thankful to everyone who assisted me on this project especially to all staff FKM laboratory for their assistance and support.

Besides that, I also would like to dedicate my appreciation to all my fellow friends for their support, advice and encouragement. Not forgetting my father and mother in giving me lots of supports in the aspects of moral, social and financial during my degree. This project definitely cannot exist without full encouragement from them.

ABSTRACT

The performance of a motorcycle usually measured by the producing of horsepower, HP and torque force, TQ, due to maximum revolution of tire per minute, RPM. In order to measure the HP and TQ of a motorcycle, the motorcycle dynamometer is very suitable and efficient. This machine is quite new and latest technology in Malaysia and still not be used wisely by the Malaysian until today because lack of knowledge and technology of development of a motorcycle dynamometer. Thus, there is a needed to study and understand the technology used behind the development of a motorcycle to increase the use of it at any automotives laboratories or workshops in Malaysia. This study was done in order to design and analysis of platform motorcycle dynamometer due to the capability of machines and materials available in Faculty of Mechanical Laboratory. In this study, the reverse engineering was used to design the machine by review the available motorcycle dynamometer which already exists and produced by various manufacturers around the world. Then, design of a tough platform motorcycle dynamometer which can support load and able to absorb the vibrations was produced. To design and analysis this platform and its inertia roller, the CAD software and CAE software were used to design and illustrate the structure. Lastly, as the results, the design analysis with different materials of structure was done to illustrate the stress von Mises.

ABSTRAK

Keupayaan sesebuah motorsikal dalam menentukankan prestasinya adalah kebanyakannya diukur melalui jumlah penghasilan "kuasa kuda" *(horsepower, HP)* dan juga "daya tujahan"*(torque force, TQ)* berdasarkan jumlah maksimum putaran roda dalam seminit *(revolution perminute, RPM)*. Untuk mengukur HP dan TQ berdasarkan maksimum RPM sesebuah motorsikal, peralatan atau mesin yang paling sesuai dan efisyen untuk digunakan ialah *"motorcycle dynamometer"*. Mesin ini adalah merupakan satu teknologi yang masih baru, dan belum lagi digunakan secara meluas di Malaysia, apatah lagi penerokaan ilmu pengetahuan dalam pembinaan sesebuah mesin *motorcycle dynamometer* ini masih lagi kurang dikalangan rakyat Malaysia. Oleh itu, adalah amat penting dan perlu untuk difahami dan diketahui ilmu serta kajian tentang bagaimana teknologi disebalik mesin *motorcycle dynamometer* ini dibangunkan demi untuk meningkatkan lagi pengunaannya dimana-mana sahaja bengkel ataupun makmal automotif untuk dimajukan lagi sektor automotif di Malaysia. Lantaran itu, kajian ini adalah dilaksanakan untuk tujuan merekabentuk dan membangunkan sebuah mesin *motorcycle dynamometer* mengikut kemampuan makmal dan peralatan yang sedia ada di makmal Fakulti Kejuruteraan Mekanikal. Dalam kajian ini, kejuruteraan berbalik untuk rekabentuk mesin *motorcycle dynamometer* yang sedia ada di makmal automotif di seluruh dunia dinilai dan diambil rekabentuk dan kaedah pembangunannya. Seterusnya, kaedah melakar dan merekabentuk *platform motorcycle dynamometer* yang kukuh semasa menampung beban yang tinggi dan mampu menyerap getaran yang dihasilkan. Untuk memodenkan rekabentuk platform dan tapaknya ini, perisian *CAD (Computer Aided Design) dan CAE (Computer Aided Engineering)* diperlukan dan digunakan untuk merekabentuk dan menganalisis struktur platform. Keputusan akhir platform dengan berbagai bahan struktur ditunjukkan dalam bentuk *stress von Mises*.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

HP/ hp	Horsepower
DC	Direct Current
AC	Alternate Current
TQ	Torque Force
T	Torque
R/r	Radius
F	Force

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Project Background

Dynamometers are typically used by mechanics and tuners to evaluate the change in power output of an engine before and after a modification are made to that engine. Motorcycle dynamometer is developed in order to aid performance tuning of motorcycle engines such as Horse Power (HP) and Torque Force (TQ). Dynamometer consists on a metallic structure in which the bikes are placed through a ramp. Bike is tied to the dynamometer by the front wheel through a clamp that can be moved ahead and back with the purpose of fitting the position of the back wheel. This wheel is placed over a solid roller of steel that is fixed on the structure with two bearings. The main of any engine development program is an improvement in on-track performance, but track testing engine changes can be difficult.

Dynamometer, or "dyno" for short, is a machine used to measure torque force (TQ) and rotational speed (rpm) from which power produced by an engine, motor or other rotating can be calculated. The dynamometer is a much more effective way of evaluating engine changes, since non-engine variables can be eliminated from this type test (Winther, 1975). There are many types of dynamometer exist in the world today since it was an effective device in evaluating the performance of a machine. To evaluate the motorcycle performance, chassis dynamometer is suite for us in order to evaluate the horsepower (HP) and TQ.

Chassis dynamometer's structure has three main parts; inertia roller, frame and additional frame. This project will concentrate on the design, and analysis of

motorcycle dynamometer which used recycles stuff as its material. As the main mechanical part of a motorcycle dynamometer, the platform and the inertia roller or the heavy roller is very important to be built accurately and precisely. The platform important to support weight of motorcycle and person who on motorcycle.

1.2 Problem Statements

From the research and study by journal and article, it has been found that there is various type of motorcycle dynamometer made from different manufacturer. As it was a very effective device to evaluate the real performance of a motorcycle, it is important to have right and good motorcycle dynamometer to give a real situation of road and load since the motorcycle is run directly to the dynamometer. To get the suitable or quality motorcycle dynamometer, one should refer to the established manufacturer to test the performance of his motorcycle. In Malaysia, the motorcycle dynamometer is still one of the latest devices which use in any workshop or research centre.

As it still new and not easily found, this project is aimed to study the development of a motorcycle dynamometer and how can it be developed with another method and by using Faculty of Mechanical's Laboratory equipments. Although to develop a motorcycle dynamometer is really complex job and need much consideration of many parameters, but a simple motorcycle dynamometer which utilize the platform concept can be considered as a new found of knowledge in this field of study.

1.3 Objective of Project

The aims of this project are:

- To design a simple structure of platform for motorcycle dynamometer.
- To analysis the stress of the designed structural with the consideration of the stability and with different material of platform motorcycle dynamometer.

1.4 Scope of Project

In order to achieve the list of objectives above, there a few constraints of scopes that must be achieved. The scopes of this project are:

- Determination of the current platform design structures and the parameters.
- Design the platform motorcycle dynamometer using SolidWork software.
- To focus on material and shape of the design of platform for motorcycle dynamometer.
- Analyze the design using Finite Element Analysis (FEA) software known as ALGOR software for failure analysis.

1.5 Flow Chart of Project

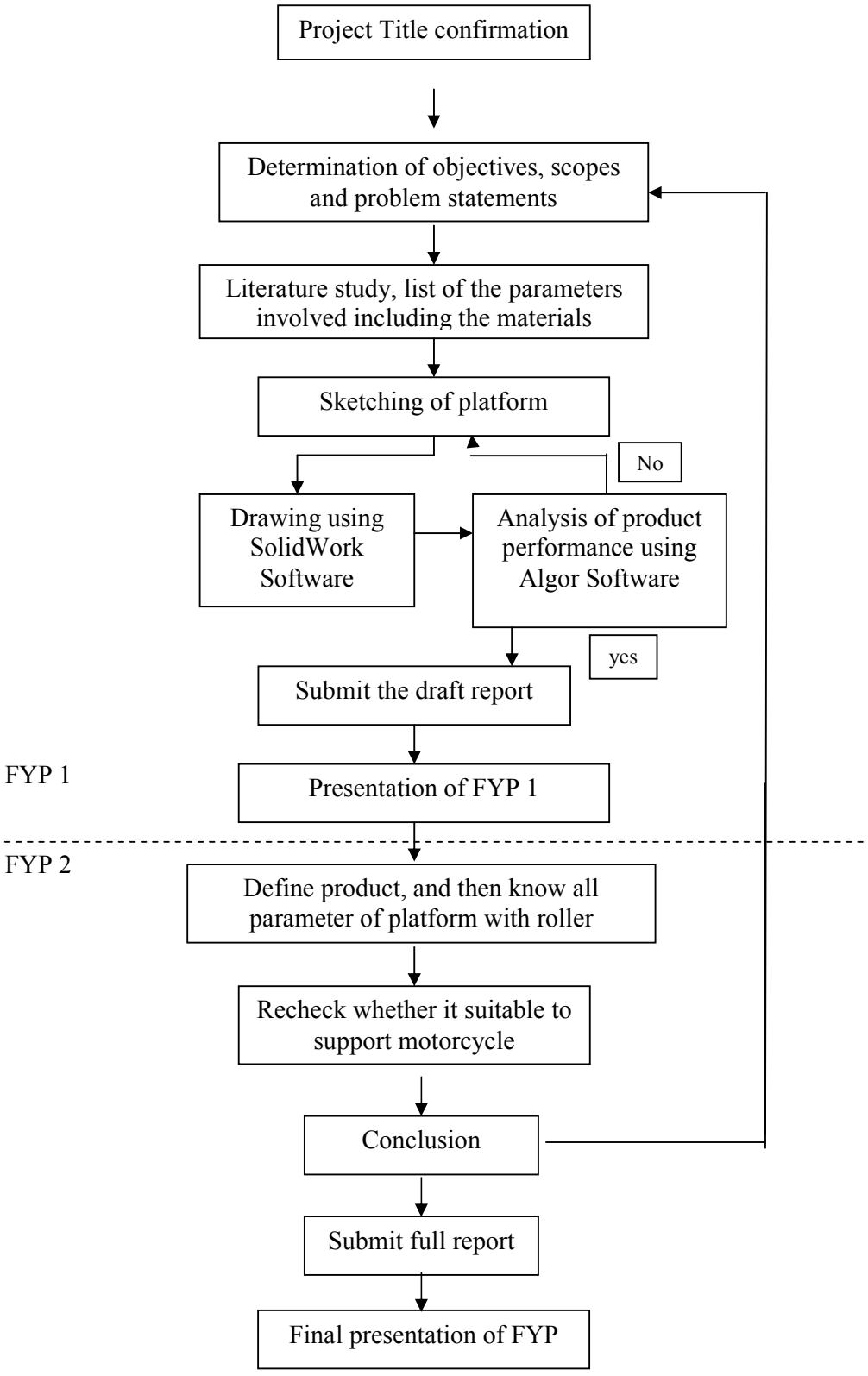

Figure 1.1 The project flow chart

1.6 Organization of Project Report

This project report was organized with a few chapters which describe details about the progress and time frame of making the platform dynamometer project. The report was detailed in all five chapters and the project management (time frame) is attached in the appendix.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The aim of this project is to develop a tool to aid performance tuning of motorcycle engines. The tool should allow the user test a motorcycle, modify the engine in some way, run a second test then compare the two sets of results and hence evaluate the effect the modification to the engine intact if the result was satisfactory or try something else if it was not. To give some overview information about the motorcycle dynamometer which in the subject of platform motorcycle dynamometer. In this chapter, the explanations and details of dynamometer histories, the previous research and findings, the theories are included. It also will describe the basic design, analysis and fabrication process of the platform motorcycle dynamometer.

2.2 History of Dynamometer

One of the key to any engine development program is the ability to effectively evaluate changes to the engine. The goal of any engine development program is an improvement in on-track performance, but track testing engine changes can be difficult. The dynamometer is a much more effective way of evaluating engine changes, since non-engine variables can be eliminated from this type test.

Dynamometer can be referred to the dyno inventor which success in their project in order to measure the performance of machine or any particular part. The earliest inventor of dynamometer is Gaspard de Prony. He invented the 'de Prony brake' in 1821. The de Prony brake (or Prony brake) is considered to be one of the earliest dynamometers in the world. Besides, Froude Hofmann of Worcester, UK manufactures engine and vehicle dynamometers. They credit William Froude with the invention of the hydraulic dynamometer in 1877 and say that the first commercial dynamometers were produced in 1881 by their predecessor company, Heenan & Froude (Winther, 1975).

In 1928, the German company "*Carl Schenck Eisengießerei & Waagenfabrik*" built the first vehicle dynamometers for brake tests with the basic design of the today's vehicle test stands. The eddy current dynamometer was invented by Martin and Anthony Winther in about 1931. At the same time, DC Motor/generator dynamometers had been in use for many years. A company founded by the Winthers, Dynamatic Corporation, manufactured dynamometers in Kenosha, Wisconsin until 2002. Dynamatic was part of Eaton Corporation from 1946 to 1995. In 2002, Dyne Systems of Jackson, Wisconsin acquired the dynamatic dynamometer product line. Starting in 1938, Heenan and Froude manufactured eddy current dynamometers for many years under license from Dynamatic and Eaton (Winther, 1975)

2.3 Dynamometer

The ability to measure key performance characteristics such as fuel flow, airflow, and blow-by, is the key to increase the understanding of the engine combination. The dynamometer also allows us to analyze the shape of the torque and power curves, something a stopwatch and the racetrack cannot do. The dynamometer is not only a development tool but also the final quality control check before the engine is shipped.

The purpose of using a dynamometer is to get accurate and repeatable data on the engine being tested. If a dynamometer is not capable of returning consistently repeatable test results day in and day out, it's not effective. The level of competition in all forms of motorsports increases every year. Engine builders are challenged to continually find more and more power. In the past, gains of 5 hp were common. Today, the level of engine development is so high the only way you will find 5 hp is to add together five gains of 1 hp each. To do this, a dynamometer must be able to detect 1 hp consistently. Accurate and repeatable testing is the result of carefully controlling the variables that affect engine performance so that only the planned changes to the engine affect the torque and power (John Dinkel, 2000).

Dynamometers are typically used by mechanics and tuners to evaluate the change in power output of an engine before and after a modification are made to that engine. Motorcycle dynamometer is developed in order to aid performance tuning of motorcycle engines such as HP and TQ. Dynamometer consists on a metallic structure in which the bikes are placed through a ramp. Bike is tied to the dynamometer by the front wheel through a clamp that can be moved ahead and back with the purpose of fitting the position of the back wheel. This wheel is placed over a solid roller of steel that is fixed on the structure with two bearings (Philip, 2004).

Basically, the dynamometers can be divided into two types; engine dyno and chassis dyno. Both of them have similar functions and aim, but it’s quite different of structure or machine due to the objective of research and power output obtain. These two types of dynamometer is developed by a few ways and they are different each

other due to the types. The common types of them are hydraulic and electric. For electric dynamometer, it contains three types; DC Dyno, AC Dyno and Eddy Current Dyno which explained at the next pages (Winther and Martin, 1976).

For this project, it has been concentrated on basic design of platform motorcycle dynamometer and analysis the structure. A platform was needed to support the motorcycle and the rider. The platform was used in which the front of the motorcycle accelerates to provide a load on the engine.

2.4 Types of Dynamometers

In addition to classify as absorption, motoring or universal as described above, dynamometers can be classified in other ways. A dyno that is coupled directly to an engine is known as an engine dyno. A dyno that can measure torque and power delivered by the power train of a vehicle without removing the engine from the frame of the vehicle is known as a chassis dyno. The tree chart of the types of dynamometer can be viewed as in Figure 2.1.

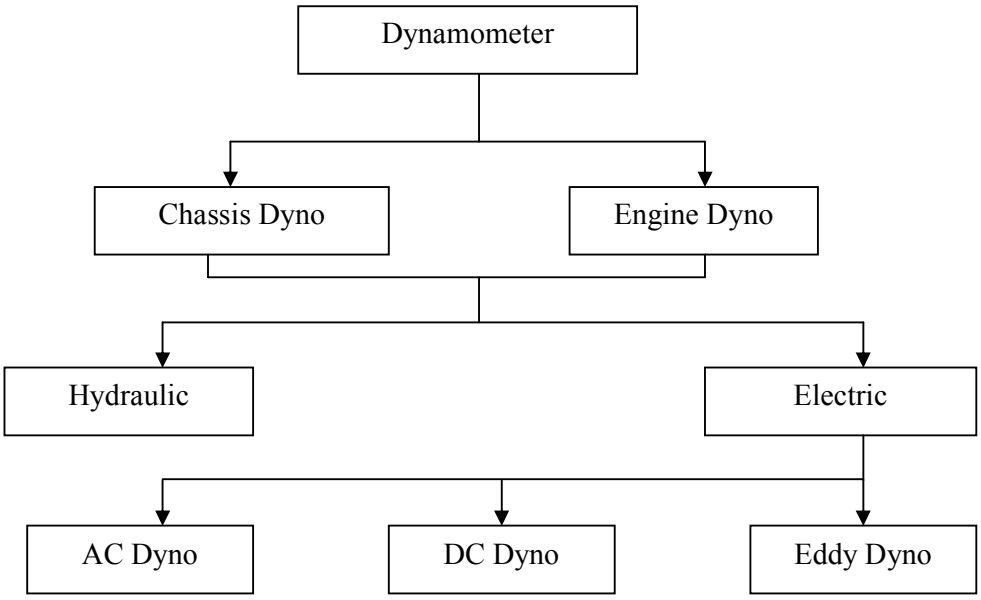

Figure 2.1 The Tree Chart of Automotive Dynamometers (John Dinkel, 2000)

Dynamometers can also be classified by the type of absorption unit or absorber/driver that they use. Some units that are capable of absorption only can be combined with a motor to construct an absorber/driver or universal dynamometer. The following types of absorption/driver units have been used: