SUPERVISOR DECLERATION

"I hereby declare that I have read this thesis and in my opinion this report is sufficient in terms of scope and quality for the award of the degree of Bachelor of Mechanical Engineering (Automotive)"

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AN EXPERIMENTAL STUDY OF STEERING WHEEL
VIBRATION IN STATIC CONDITION

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DECLARATION

"I hereby declare that the work in this report is my own except for summaries and quotations which have been duly acknowledged."

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ABSTRACT

Vibration causes discomfort situation when driving car. Vehicle such as cars are regularly exposed to vibration. The purpose of this project is to determine the dynamic properties of steering wheel and to analyze the highest vibration level for Perodua Kancil in Static condition. The modal analysis method is used to complete this project. Modal analysis cans analysis the steering wheel vibration characteristic. The limitation in this project is in static condition with is the experiment will be conduct in free-free boundary and constraint condition. For the first experiment, modal analysis is use to determine the natural frequency of 2, 3 and 4 spoke steering wheel in free-free boundary. The second experiment also will be use modal analysis method to determine the natural frequency but in constrain condition for 2, 3 and 4 spoke steering wheel. The third experiment is to analyze the highest vibration level for Perodua Kancil in static condition. So the result of this project will be the natural frequency of 2, 3 and 4 spokes steering wheel in free-free boundary and constraint condition. The highest vibration level for Perodua Kancil also will be determined after completing this project. Today's car is much more comfortable and has improved so much in many ways including in vibration aspect.

ABSTRAK

Getaran menyebabkan situasi tidak selesa semasa memandu kereta. Kenderaan seperti kereta secara umumnya lebih terdedah terhadap getaran. Tujuan projek ini adalah untuk menentukan sifat-sifat dinamik stereng dan menganalisis tahap getaran tertinggi bagi Perodua Kancil dalam keadaan statik. Kaedah analisis modal digunakan untuk menyelesaikan projek ini. Modal analisis akan memberikan ciri-ciri getaran stereng tersebut. Keterbatasan dalam projek ini adalah dalam keadaan statik dan dilakukan dalam keadaan bebas dan sekatan . Untuk eksperimen pertama, analisis modal ini digunakan untuk menentukan natural frekuensi untuk 2, 3, dan 4 spoke stereng kereta. Eksperimen kedua juga akan menggunakan kaedah analisis modal untuk menentukan natural frekuensi dalam keadaan sekatan bagi 2, 3, dan 4 spoke stereng kereta. Eksperimen ketiga adalah untuk menganalisis tahap getaran tertinggi bagi Perodua Kancil dalam keadaan statik. Jadi hasil keputusan dari projek ini adalah natural frekuensi untuk 2, 3 dan 4 spoke stereng kereta. Tahap getaran tertinggi bagi Perodua Kancil juga akan ditentukan selepas menyelesaikan projek ini. Kereta pada hari ini jauh lebih selesa dan telah meningkat begitu banyak cara, termasuk dalam aspek getaran.

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LIST OF SYMBOL

HAV	=	Hand Arm Vibration
WBV	=	Whole Body vibration
Hz	=	Hertz
A	=	Amplitude
f	=	Frequency, Hz
ω	=	Omega
π	=	Pi
a	=	Acceleration, m/s^2
k	=	Spring constant
c_d	=	Damper constant
m	=	Mass, kg
x	=	Displacement, meter
P	=	Force, N
t	=	Time, s
ICP	=	Integrated Circuit Piezoelectric
BNC	=	Bayonet Neill Concelman

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Nowadays, transportation is one of most important element in helping people to move. Transports give human the freedom to move from one place to another place. People do not have to told how important the automobile in their live. The automobile such as car, van and also heavy duty vehicle is used to help people in completing their daily life activities. The automotive industry was starting about more than 100 years ago. Years by years, a lot of new technologies grow rapidly. As an example, in 1860, the first practical Internal Combustion engine has been invented by J.J.E. Lenoir, the engine technology is grow rapidly within the innovation in our automotive technology. Increasing of vehicle use over the years has directly increased the design element and characteristic in the vehicle to achieve more efficiency, cleaner, more economy and more reliable.

The modern vehicle is totally different from the vehicle of years ago. Vehicle nowadays are designed to produce fewer emission and less pollution. Modern vehicle also is more save if compare to the vehicle years ago. The green technology in automotive industry such as hybrid technology, help to protect our environment from the pollution of the vehicle. A lot of world brand use the environment issue in creating their new model. Figure 1.0 and Figure 1.1 show the evolution in automotive industry by

Ford, from the first model, Model T 1908, to the new styling and futuristic model, Ford Fusion 2010.

Figure 1.0: Model T at 1908 by Henry Ford
(Source: http://www.auto123.com)

Figure 1.1: New Ford Fusion 2010
(Source: http://theautomedia.com)

Today, an innovation is taking place in steering system technology in automotive industry. Steering technology in automotive grow rapidly. There have two basic type of steering system which is recirculating ball and rack and pinion. In the 1950's, General Motor introduces the hydraulic assisted power steering system. This system used recirculation ball system. The rack and pinion steering system, eventually develop and used in many lighter and sportier vehicle.The steering system is used to control the direction of the vehicle. The steering system is design to control the direction of the front wheel over all type of road condition, with through turn and at different speed of the vehicle.

1.2 PROBLEM STATEMENT

Vibration causes discomfort situation when driving car. Vehicle such as car are regularly exposed to vibration. In recent research (Kim K.C. et al. 2007), the sources of vibration include the engine, wheel, tires, and the profile of road surface. The sources of vibration travel through the engine and the body structure of the car. When the vibration sensed by the driver through steering wheel, it is described as steering vibration.

1.3 OBJECTIVES

The main objective of these final years project is to conduct experimental modal analysis of steering wheel vibration for Perodua Kancil 850cc. Two experiments will be conducted which are free-free boundary and constraint condition. Natural frequency and the mode shape of the steering wheel will be determined. The next objective is to study the behavior of steering wheel vibration for 2-spoke, 3-spoke and 4-spoke steering wheel. The analysis for this experiment are more focusing to this 3 type of spoke which is can fixed into Perodua Kancil 850 cc steering column. The highest vibration level for Perodua Kancil at static condition also will be determined.

1.4 SCOPE

The scope of these final year project is:

a) The car type that use in these experiment is national compact car with automatic transmission, front wheel drive and non-power steering.

b) The experimental analysis for the steering wheel for free-free boundary condition and constraint condition.

c) The experiment will be conduct for the stationary passenger car (Static).

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The automotive industry is one of the most influential technological advances of this time. People use transportation every day for travel from one place to another place. This chapter will discuss about how steering system works and what is the vibration of steering wheel.

2.2 HISTORY OF STEERING SYSTEM

Function of steering system is to control the direction of a vehicle's motion. Steering system was not needed until the growing of the modern vehicle technology that follows the time frame of vehicle improvement. Before the modern steering system was develop, steering consists of getting the animal pulling the vehicle to move in the desire direction or to change the direction of the vehicle. The earliest vehicle steering system utilized a tiller or handle, which was connected to the wheel by simple linkage. The handle worked well when vehicle were small and light, but when the weight and size of the vehicle increase, its replace with the steering system to multiply the turning force of the wheel.

Figure 2.0: The vehicle use tiller or handle system.
(Source: http://www.ausbcomp.com/~bbott/cars/carhist.htm)

Today's drivers have become accustomed to the fact that steering a vehicle no longer requires much effort. The driver gets a lot of benefit from the hydraulic or electric power steering systems that are powered by the engine and support even the slightest steering wheel movement. Modern power steering systems give the driver directs feedback by instantly responding with the right amount of power corresponding to the vehicle speed and driving situation. The modern steering system has been improving a lot of driving situation.

Figure 2.1: Modern steering wheel
(Source: http://www.muslimrahman.com)