



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**DRIVING COMFORT STUDIES FOR DIFFERENT ABSORBER  
CONTENT: HYDRAULIC OIL VERSUS PRESSURE GAS**

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Automotive) with Honours.

by

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## **APPROVAL**

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Automotive) with Honours. The member of the supervisory is as follow:

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## **ABSTRAK**

Sistem suspensi dibina untuk menyediakan perjalanan yang selesa ketika melalui jalan yang kasar sambil memperbaiki pengendalian kenderaan. Ia juga membolehkan tayar kekal bersentuhan dengan permukaan jalan terutama di jalan kasar. Penyerap hentak adalah salah satu komponen yang berada dalam sistem suspensi untuk menghilangkan tenaga yang diserap oleh sistem suspensi. Sistem suspensi terdiri daripada roda ataupun tayar, spring, penyerap hentak ataupun strut, sambungan, sesendal dan beberapa komponen lain. Tajuk projek ini adalah untuk mengkaji keselesaan memandu antara dua kandungan penyerap yang berbeza iaitu minyak hidraulik dan gas bertekanan. Dua jenis penyerap hentak yang sedia ada di pasaran telah digunakan dalam projek ini sebagai model untuk melakukan kajian ini. Antara langkah yang dilakukan adalah menguji dan mengkaji kelakuan kedua-dua penyerap hentak dengan melakukan ujian mampatan dan melakukan pengiraan. Bagi mendapatkan data yang lebih baik, ujian simulasi telah dibuat untuk mengetahui tingkah laku kedua-dua penyerap hentak apabila melalui dua jenis keadaan jalan yang berbeza menggunakan perisian MatLab. Ujian getaran turut dilakukan menggunakan dua buah kereta dengan jenis penyerap hentak yang berbeza. Semua data dari setiap ujia telah dikumpulkan dan dibandingkan. Hasil kajian ini menunjukkan bahawa penyerap hentak jenis gas memberikan lebih keselesaan ketika memandu berbanding penyerap hentak jenis hidraulik.

## **ABSTRACT**

The suspension system is built to provide comfortable ride when travelling on the rough road while improve vehicle handling. It also allows the tires to remain in contact with road surface especially on rough road. Shock absorber is one of component install in suspension system to dissipate energy absorbed by suspension system. Suspension system are consisting of wheels or tires, coil spring, shock absorber or strut, linkages, bushing and several other components. This project title is to study the driving comfort between two different absorber content which are hydraulic oil and pressure gas. Two different type of shock absorbers that already available in the market were used in this project as a model to conduct this research. The steps of this project are to test and study the behavior of these two shock absorbers by conducted compression test and doing calculation. In order to get better data, a simulation test had been conducted to know the behavior of these two shock absorbers when travelling on two different road conditions by using MatLab software. Vibration test also has been done using two cars with different type of shock absorber. All data from all test has been collected and being compared. The outcome of this research shows that gas shock absorber gives more driving comfort compared to hydraulic shock absorber.

## **DEDICATION**

I would like to give special thanks for  
My beloved mother  
Mahani binti Muda



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## TABLE OF CONTENTS

	<b>PAGE</b>
<b>TABLE OF CONTENTS</b>	<b>x</b>
<b>LIST OF TABLES</b>	<b>xiii</b>
<b>LIST OF FIGURES</b>	<b>xiv</b>
<b>LIST OF SYMBOLS</b>	<b>xvii</b>
<b>LIST OF ABBREVIATIONS</b>	<b>xviii</b>
<b>LIST OF PUBLICATIONS</b>	<b>xix</b>
<b>CHAPTER 1 INTRODUCTION</b>	<b>1</b>
1.1 Background	1
1.2 Problem Statement	2
1.3 Project Objective	3
1.4 Project Scope	3
1.5 Project Significance	4
<b>CHAPTER 2 LITERATURE REVIEW</b>	<b>5</b>
2.1 Introduction	5
2.2 Suspension History	5
2.3 Type of Suspension	7
2.4 Shock Absorber	10

2.5	Shock Absorber Type	11
2.5.1	Metal Spring	11
2.5.2	Elastomeric Shock Observers	13
2.5.3	Hydraulic Dashpot	14
2.5.4	Pneumatic Cylinder	15
2.6	Principal of Shock Absorbers	16
2.7	Hydraulic Shock Absorber	19
2.8	Gas Shock Absorber	20
2.9	Literature Review Preview	22
<b>CHAPTER 3</b>	<b>METHODOLOGY</b>	<b>24</b>
3.1	Overview	24
3.2	Flow Chart	26
3.3	Comparison Between Two Shock Absorber	27
3.4	Compression Test	29
3.5	Calculation	31
3.6	MatLab Simulation	32
3.7	Vibration Test	34
<b>CHAPTER 4</b>	<b>35</b>	
4.1	Introduction	35

4.2	Finding of Fixed Variables	36
4.3	Calculation for Fixed Variables	42
4.4	Software Simulation	45
4.4.1	Step Function	48
4.4.2	Sine Wave Function	55
4.4.3	Comparing Between Two Road Condition	60
4.5	Real Car Suspension System Test	61
4.5.1	Vibration Test for Hydraulic Shock Absorber	63
4.5.2	Vibration Test for Gas Shock Absorber	66
4.5.3	Comparing Between Two Test	70
4.6	Discussion	70
<b>CHAPTER 5</b>	<b>72</b>	
5.1	Conclusion	72
5.2	Future Work	73
<b>REFERENCES</b>	<b>74</b>	
<b>APPENDIX</b>	<b>76</b>	

## LIST OF TABLES

<b>TABLE</b>	<b>TITLE</b>	<b>PAGE</b>
Table 2.1:	Journal Title and Description	22
Table 3.1:	Advantages and Disadvantages of Hydraulic Shock Absorber	28
Table 3.2:	Advantages and Disadvantages of Gas Shock Absorber	29
Table 4.1:	Shock Absorber Results Data	38
Table 4.2:	Name and Weight of Load Force	40
Table 4.3:	Spring Compression Test Data	41
Table 4.4:	Shock Absorber Calculation	43
Table 4.5:	Step High with Displacement for Gas and Hydraulic Absorber	50
Table 4.6:	Step High with Acceleration for Gas and Hydraulic Absorber	53
Table 4.7:	Percentages of Adherence for Hydraulic Shock Absorber	65
Table 4.8:	Percentages of Adherence for Gas Shock Absorber	69

## LIST OF FIGURES

<b>FIGURE</b>	<b>TITLE</b>	<b>PAGE</b>
Figure 2.1:	Suspension System Diagram	6
Figure 2.2:	Macperson Suspension System	8
Figure 2.3:	Double Wishbone Suspension System	9
Figure 2.4:	Multi-Link Suspension System	9
Figure 2.5:	Metal Spring	12
Figure 2.6:	Elastomeric Shock Absorber Type	13
Figure 2.7:	Hydraulic Dashpot Diagram	14
Figure 2.8:	Pneumatic Cylinder Work Diagram	15
Figure 2.9:	Dry Fiction Shock Absorber System	16
Figure 2.10:	Fluid Friction Principal	17
Figure 2.11:	Compression of Gas in Shock Absorber	18
Figure 2.12:	Working Principal of Hydraulic Shock Absorber	19
Figure 2.13:	Damping Force vs Piston Velocity of Hydraulic Shock Absorber	20
Figure 2.14:	Schematic Diagram of Gas Shock Absorber	21
Figure 2.15:	Damping Force vs Piston Lift of Gas Shock Absorber	21
Figure 3.1:	Flow Chart	26

Figure 3.2:	Example of Compression Test	30
Figure 3.3:	The Suspension System Force Diagram	32
Figure 3.4:	Equation for MatLab Simulation	33
Figure 4.1:	Shock Absorber Compression Test	37
Figure 4.2:	Coil Spring Compression Test	39
Figure 4.3:	Circuit Diagram for Simulation	45
Figure 4.4:	Simulation Subsystem Diagram	46
Figure 4.5:	Command Window in MatLab	47
Figure 4.6:	Step Function	48
Figure 4.7:	Step Function Body Vertical Displacement for 0.1m	49
Figure 4.8:	Step Function Body Vertical Displacement for 0.3m	49
Figure 4.9:	Step Function Body Vertical Displacement for 0.5m	49
Figure 4.10:	Step Function Maximum Body Vertical Displacement Graph	51
Figure 4.11:	Step Function Body Vertical Acceleration for 0.1m	52
Figure 4.12:	Step Function Body Vertical Acceleration for 0.3m	52
Figure 4.13:	Step Function Body Vertical Acceleration for 0.5m	52
Figure 4.14:	Step Function Maximum Body Vertical Acceleration Graph	54
Figure 4.15:	Sine Wave Function	56
Figure 4.16:	Sine Wave Body Vertical Displacement for 5Hz	57
Figure 4.17:	Sine Wave Body Vertical Displacement for 8Hz	57
Figure 4.18:	Sine Wave Body Vertical Displacement for 10Hz	57

Figure 4.19:	Sine Wave Body Vertical Acceleration for 5Hz	58
Figure 4.20:	Sine Wave Body Vertical Acceleration for 8Hz	59
Figure 4.21:	Sine Wave Body Vertical Acceleration for 10Hz	59
Figure 4.22:	Front Tyre on Square Base in Vibration Test	62
Figure 4.23:	First Vibration Test for Hydraulic Shock Absorber	63
Figure 4.24:	Second Vibration Test for Hydraulic Shock Absorber	64
Figure 4.25:	Third Vibration Test for Hydraulic Shock Absorber	64
Figure 4.26:	Percentages of Adherence Graph for Hydraulic Shock Absorber	66
Figure 4.27:	First Vibration Test for Gas Shock Absorber	67
Figure 4.28:	Second Vibration Test for Gas Shock Absorber	67
Figure 4.29:	Third Vibration Test for Gas Shock Absorber	68
Figure 4.30:	Percentages of Adherence Graph for Gas Shock Absorber	69



## LIST OF SYMBOLS

<b>D, d</b>	-	Distance
<b>F, Fd</b>	-	Force
<b>Cs</b>	-	Damping Coefficient
<b>X</b>	-	Displacement
<b>Ks</b>	-	Spring Stiffness
<b>Z</b>	-	Velocity
<b>s</b>	-	Second
<b>t</b>	-	Time
<b>N</b>	-	Newton
<b>m</b>	-	meter
<b>kg</b>	-	Kilo gram

## **LIST OF ABBREVIATIONS**

<b>CATIA</b>	Computer Aided Three-Dimensional Interactive Application
<b>MatLab</b>	Matrix Laboratory
<b>DOF</b>	Degree Of Freedom
<b>SOP</b>	Standard Operating Procedure
<b>PUSPAKOM</b>	Malaysian Computerized Vehicle Inspection Company
<b>ECU</b>	Electronic Control Unit

## **LIST OF PUBLICATIONS**

# CHAPTER 1

## INTRODUCTION

### 1.1 Background

For comfortable ride, the suspension system is worldwide used in automotive industries included design of bicycle until most modern vehicle to achieve comfortable ride. The objectives of using suspension system are to separate vehicle body from rough surface and to keep the wheel contact of road surface. A created suspension system must be in specific design which are can operates during full load and empty load vehicle, road condition, braking and speeding also maintain stability of vehicle during straight road and taking a corner.

Spring and damper are the main component of the suspension system that placed between the vehicle body and axles. For damper also known as shock absorbers, it main task is to absorb kinetic energy from disturbance road and prevent vibration go through into the vehicle body. This part works by convert the kinetic energy which is vibration cause from disturbances into thermal energy. Thermal energy produced from conversion will produced heat that absorb by hydraulic fluid.

Shock absorbers that commonly used widely are hydraulic shock absorbers and gas shock absorbers. Both types of shock absorbers still have same operation which is almost same design and shape. Its also usually comes with metal spring attach with shock absorbers to help return to initial condition after disturbance has been resolved. For design

a shock absorbers, the main factor to be consider are comfort and vehicle handling also road holding. The increasing or decreasing of settling time as known as time to shock absorbers return to initial condition can effect the comfort and handling. The effect of comfort and vehicle handling can cause more damage or disaster toward vehicle even driver itself.

For vehicle user, they choose their car's shock absorbers themselves based on their own reason. That why many manufacturers offer with various spec of shock absorbers and metal springs. But, the vehicle user commonly chooses between gas or hydraulic types of shock absorbers due to its widely used in the industries.

As a user, we must learn and know what the different between these two shock absorbers and their own benefit or disability. To know the comparison between gas shock absorbers and hydraulic shock absorbers available in the market must be study to know their different.

## 1.2 **Problem Statement**

There are several problems must be considered during doing the research such as:

- a) The ability of shock absorbers to maintain the comfort and increase the vehicle handling among different type of shock absorbers.
- b) The function of shock absorbers to remain the road holding during rough road to maintain stability of the vehicles.

- c) The suitable type of shock absorbers to be use based on vehicle purpose such as daily use or race.

### 1.3 **Project Objective**

For this project, there were some objectives that must be achieved. There are:

- a) To find the different between gas shock absorbers and hydraulic shock absorbers that already available in the market.
- b) To find the data related to these type of shock absorbers by doing some testing and calculation.
- c) To stimulate the behaviour of both types of shock absorbers by using simulation software.
- d) To assess the performance and capability between these shock absorbers by conduct real test in lab.

### 1.4 **Project Scope**

The project scope are limited to some used process and equipment:

- a) Conduct compression test by applying force onto these two types of shock absorbers and find the damping coefficient for each shock absorbers using calculation.

- b) Run simulation to get graph of shock absorbers behaviour on two different road condition by using MatLab software with standard measurement input data.
- c) Conduct a real test to measure the capability of shock absorbers as known as vibration test by using real selected cars with different types of shock absorbers.

### 1.5 **Project Significance**

From this research, student should be able to learn and improve the knowledge about the different between types of shock absorbers available in the market. Each types of shock absorbers used on same model of the car will give a different output in source of comfortable ride or car handling. That why many shock absorbers were designed specifically and in different type for selected car model to improve something important during driving the car. By doing this project or research, the different between the gas shock absorbers and hydraulic shock absorbers can be known after the comparison between them are successfully done using suitable method.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

Suspension framework is the system consist of tire, damper, spring and linkage in a vehicle connect through wheel to allow any related motion to happen between these two (Reza N. Jazar, 2008). In the meantime, it enhances traveller comfort and vehicle strength in a specific level. Conventional, commercial oriented suspension are detached and are for all time intended for comfort or stability purpose. The issue comprises in the exchange of connection amongst comfort and stability.

#### 2.2 Suspension History

R. Tredwell was inspired the first pattern of coil spring in 1763 and they did not have to be seperated and lubricated periodically compared to leaf spring as aadvantages of coil spring. Gottlieb Daimler in Germany is the leading exponent when some European car maker had tried coil spring for their suspension system. A leaf spring is a straightforward type of spring normally utilized for the suspension in wheeled vehicles. Initially called a covered or carriage spring, and now and then alluded to as a semi-circular spring or truck spring, it is one of the most seasoned types of springing, showing up on carriages in England after 1750 and from that point moving to France and Germany (Sheldon Axle Company, 2008). The venerable leaf spring still used in rear suspension today that introduced today by Obadiah Elliot of London in 1804. General Motors,