



**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**DRIVING COMFORT STUDIES THROUGH  
DIFFERENT FRONT COIL SPRING**

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

**MOHD NORHAKEEM B MUSA**

**B071510706**

**941217-04-5475**

FACULTY OF MECHANICAL AND MANUFACTURING ENGINEERING  
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.....

.....

MOHD NORHAKEEM B MUSA

EN AHMAD ZAINAL TAUFIK B

ZAINAL ARIFFIN

Alamat Tetap:

Cop Rasmi Penyelia

Lot 2058, Seri Najeeha,  
 Jalan Imam Hj Hassan,  
 78300, Masjid Tanah,  
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Date:

## **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:

Signature: .....

Supervisor : EN AHMAD ZAINAL TAUFIK B ZAINAL  
ARIFFIN

Signature: .....

Co-supervisor: EN OMAR B ASAROON

## **ABSTRAK**

Sistem suspensi adalah salah satu sistem yang terdapat di dalam setiap kenderaan ringan mahupun berat. Tujuan utama penggunaan sistem suspensi ini adalah untuk memaksimumkan hubungan antara tayar dan permukaan jalan, menyediakan kestabilan semasa memandu dan memberi keselesaan kepada penumpang dan pemandu sesebuah kenderaan. Salah satu komponen utama yang terdapat di dalam sistem suspensi adalah spring. Tahap getaran yang terdapat pada spring kenderaan akan mempengaruhi keselesaan pemanduan sesebuah kenderaan. Oleh itu, sebuah tesis yang bertajuk Pengajian Keselesaan Memandu Melalui Spring Hadapan yang Berbeza telah dibukukan. Tujuan utama penghasilan tesis ini adalah untuk mengkaji tahap getaran di bahagian hadapan sesebuah kenderaan melalui dua jenis spring yang berbeza. Di dalam tesis ini akan menerangkan langkah-langkah eksperimen antaranya penganalisan melalui MATLAB Simulink dan penggunaan mesin Ravaglioli. Bagi mendapatkan tahap getaran spring yang terbaik untuk digunakan hasil daripada eksperimen ini akan dibandingkan dan dianalisis.

## **ABSTRACT**

Suspension system is one of the systems that use in every lightweight vehicle. The main purpose of this suspension system is to maximize the relationship between the tires and the road surface, providing stability while driving, and providing comfort to passengers and drivers of a vehicle. One of the main components found in the suspension system is spring. The vibrational level found in the vehicle's spring will affect the safety of a car. Hence a thesis titled Driving Comfort Studies through Different Front Coil Spring has been done. The main purpose of this thesis is to study the degree of vibration at the front of a vehicle through two different types of spring. In this thesis will describe the experimental measures including analyzing through MATLAB Simulink and the use of Ravaglioli machines. Hence, to obtain the best spring vibration level to use in daily life, the results of this experiment will be compared and analyzed

## **DEDICATION**

This thesis is dedicated to my father, En. Musa Bin Abu Hassan who taught me that the best knowledge is what is learned for his sake. It is also dedicated to my mother, Pn. Norlisa Binti Adli who taught me that even the greatest task can be accomplished if one step at a time is completed.



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## TABLE OF CONTENTS

	<b>PAGE</b>
TABLE OF CONTENTS	x
LIST OF TABLES	xiv
LIST OF FIGURES	xv
LIST OF APPENDICES	xix
LIST OF SYMBOLS	xx
LIST OF ABBREVIATIONS	xxi
LIST OF PUBLICATIONS	xxii
<b>CHAPTER 1      INTRODUCTION</b>	<b>1</b>
1.1    Background	1
1.2    Research Background	2
1.3    Aim and Objective of Study	3
1.3.1            Aim	3
1.3.2            Objective	3
1.4    Scope of Study	4
<b>CHAPTER 2      LITERATURE REVIEW</b>	<b>5</b>
2.1    Introduction	5
2.2    History Background	6

2.3	Suspensions System	7
2.4	Types of Suspension	8
2.4.1	Front Suspension System	8
	2.4.1.1 Independent Front Suspensions	8
	2.4.1.2 Dependant Front Suspensions	11
2.4.2	Rear Suspension System	12
	2.4.2.1 Independent Rear Suspensions	12
	2.4.2.2 Dependent Rear Suspensions	12
2.5	Types of spring	14
2.5.1	Coil Spring	14
2.5.2	Leaf Spring	15
2.5.3	Torsion Bars	16
2.6	Previous Research	17
2.6.1	Introduction	17
2.6.2	Fundamental Studies, Designing and Failure Analysis of Coil Spirals Using Finite Elements	18
<b>CHAPTER 3</b>	<b>METHODOLOGY</b>	<b>22</b>
3.1	Introduction	22
3.2	Selection Types of Coil Spring	22
3.3	Analysis Method	24

3.3.1	MATLAB Simulink Software	24
3.3.2	Passive Suspension Math Model	25
3.3.3	Road Input Signals	28
3.3.1	Suspension Performance Evaluation Standard	31
3.4	Experimental Method	32
3.4.1	Testing Machine	33
3.4.2	Preparation and Measurement of Custom Base on the Testing Machine	34
3.4.3	Drilling the Base According the Coil Spring Specifications	35
3.4.4	Coil Spring Installation on Testing Machine	37
3.4.5	Testing on Both Coil Spring	39
3.4.6	Ravaglioli Testing Machine	41
3.4.7	Swapping Process of Coil Spring on the Vehicle	43
3.4.8	Vibration Suspension Test	47
3.4.9	Adherence Test and Procedure	47
<b>CHAPTER 4</b>	<b>RESULTS AND DISCUSSION</b>	<b>52</b>
4.1	Introduction	52
4.2	Simulation under MATLAB Simulink	52
4.3	Step Analysis	55
4.4	Step Analysis Graph Discussion	59

4.5	Sine Wave Analysis	60
4.6	Sine Wave Analysis Graph Discussion	64
4.7	Ravaglioli Machine Graph Discussion	65
<b>CHAPTER 5 CONCLUSION AND RECOMMENDATION</b>		<b>67</b>
5.1	Introduction	67
5.2	Summary	67
5.3	Recommendation	68
<b>REFERENCES</b>		<b>69</b>
<b>APPENDIX</b>		<b>71</b>

## LIST OF TABLES

<b>TABLE</b>	<b>TITLE</b>	<b>PAGE</b>
Table 1	Ravaglioli adherence testing reading	48
Table 2	Parameter used in system simulation	53

## LIST OF FIGURES

<b>FIGURE</b>	<b>TITLE</b>	<b>PAGE</b>
Figure 2.1	The MacPherson Struts	8
Figure 2.2	Double wishbone suspension	9
Figure 2.3	Trailing arm suspension	10
Figure 2.4	Multi-link suspension	11
Figure 2.5	Coil Spring	14
Figure 2.6	Leaf Spring	15
Figure 2.7	Torsion Bars	16
Figure 2.8	Common spring materials and engineering properties	19
Figure 2.9	Basic coil spring measurement	20
Figure 3.1	Sport coil spring	23
Figure 3.2	Standard coil spring	23
Figure 3.3	1/4 Math model of passive suspension system	26
Figure 3.4	Passive suspension system labelling	27
Figure 3.5	Equation of mathematical modelling	28
Figure 3.6	Unit step signal Simulink model.	28
Figure 3.7	Unit step input signal.	29

Figure 3.8 Sine wave signal Simulink model.	29
Figure 3.9 Unit sine input signal.	30
Figure 3.10 The spring testing machine.	33
Figure 3.11 Measurement of custom base.	34
Figure 3.12 Portable drilling machine.	35
Figure 3.13 Drilling process	36
Figure 3.14 Coil spring tied using cable tight	37
Figure 3.15 Coil spring tied using metal chain	38
Figure 3.16 Tools and equipment	38
Figure 3.17 Complete process on testing machine	39
Figure 3.18 Ravaglioli Testing Machine	42
Figure 3.19 Suspension Tester	42
Figure 3.20 Dimensions of sport coil spring	43
Figure 3.21 Dimension of standard coil spring	44
Figure 3.22 Swapping process to sport coil spring (a)	45
Figure 3.23 Swapping process to sport coil spring (b)	45
Figure 3.24 Swapping process to standard coil spring (a)	46
Figure 3.25 Swapping process to standard coil spring (b)	46
Figure 3.26 Ravaglioli main menu display	49
Figure 3.27 Adherence test selection button	49
Figure 3.28 Adherence test	50



Figure 3.29 Adherence test display	50
Figure 4.1 Standard coil spring in Simulink equation	54
Figure 4.2 Sport coil spring in Simulink equation	54
Figure 4.3 Passive suspension system with step input	55
Figure 4.4 Final value of 0.1	55
Figure 4.5 Final value of 0.3	56
Figure 4.6 Final value of 0.5	56
Figure 4.7 Displacement vs Time (0.1)	57
Figure 4.8 Displacement vs Time (0.3)	57
Figure 4.9 Displacement vs Time (0.5)	57
Figure 4.10 Acceleration vs Time (0.1)	58
Figure 4.11 Acceleration vs Time (0.3)	58
Figure 4.12 Acceleration vs Time (0.5)	58
Figure 4.13 Passive suspension system with sine wave input	60
Figure 4.14 Frequency (rad/sec) of 5 Hz	60
Figure 4.15 Frequency (rad/sec) of 8 Hz	61
Figure 4.16 Frequency (rad/sec) of 10 Hz	61
Figure 4.17 Displacement vs Time (5 Hz)	62
Figure 4.18 Displacement vs Time (8 Hz)	62
Figure 4.19 Displacement vs Time (10 Hz)	62
Figure 4.20 Acceleration vs Time (5 Hz)	63

Figure 4.21 Acceleration vs Time (8 Hz)	63
Figure 4.22 Acceleration vs Time (10 Hz)	63
Figure 4.23 Standard coil spring graph discussion	65
Figure 4.24 Sport coil spring graph discussion	66

## LIST OF APPENDICES

APPENDIX	TITLE	PAGE
Appendix 1	Ravaglioli Graph Results	71

## LIST OF SYMBOLS

<b>D, d</b>	-	Diameter
<b>F</b>	-	Force
<b>g</b>	-	Gravity = 9.81 m/s
<b>I</b>	-	Moment of inertia
<b>l</b>	-	Length
<b>m</b>	-	Mass
<b>N</b>	-	Rotational velocity
<b>P</b>	-	Pressure
<b>Q</b>	-	Volumetric flow-rate
<b>r</b>	-	Radius
<b>T</b>	-	Torque
<b>Re</b>	-	Reynold number
<b>V</b>	-	Velocity
<b>w</b>	-	Angular velocity
<b>x</b>	-	Displacement
<b>z</b>	-	Height
<b>q</b>	-	Angle

## **LIST OF ABBREVIATIONS**

**PCA**      Principal Component Analysis

## LIST OF PUBLICATIONS

# CHAPTER 1

## INTRODUCTION

### 1.1 Background

In an automotive world, the power of a vehicle is measured by the amount of horsepower that it can produce and its acceleration rate. However, the power is only in vain if the suspension aspects of a vehicle are not concerned. This issue causes several engineers to turn their attention in upgrading the suspension system to produce a comfortable and stable vehicle. In any automobile, the comfort it will deliver is greatly tied to its suspension system. The duty of a vehicle suspension is to maximise the friction between the tires and the street surface, to produce steering stability with sensible handling and to ensure the comfort of the driver and passengers.

Karen *et al.*, 2012 expressed that vehicle ride comfort is playing an increasingly important role in customer selection and is an important factor in terms of competitiveness among manufacturers. The term “ride comfort” is expounded to absorption of the energy from road bumps and its dissipation without inflicting undue oscillation in vehicle (Sharma *et al.*, 2016). According to Karen *et al.*, 2012 ride comfort primarily depends on the aptitude of tires and the properties of the suspension system for absorbing the vibrations induced from road roughness.

## 1.2 Research Background

For most common of vehicles, the coil spring played an important role in this system. The spring need to have a good and quality in material, high endurance, long life span and rugged to serve comfortability and safety in the suspension system of vehicle.

There has been loads of analysis on the purpose of coil springs. Paper of Vukelic *et al.*, 2016 can fill in as an introduction to vehicle suspension coil springs, their elementary stress distribution, material characteristic, assembling and causes for common failures. Besides, Zhu, Wang and Huang, 2014 had conducted a similar experimentation and investigated the premature failure of a helical coil spring caused by inherent material defects and corrosion. In addition, Murtaza and Akid, 2000 confirmed the results of previous researched by running an experiment to study the crack initiation and growth progress in Si-Mn spring steel. Meanwhile, looking to boost performance of springs, it is vital to grasp the action of spring material. Paper of Angelova *et al.*, 2016 gave in depth the defined of weariness conduct of spring steels DIN 17223C and 55Si7 followed by mathematical models of typical  $da/dN$  diagrams. Moreover, Izaham *et al.*, 2013 also had studied the physical testing on the spring in tension using a 10-tonne universal testing machine, UTM. Results made from the testing are spring constant, maximum force, elongation and tensile strength, are to be verified for their specification conformity.