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"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)"

Signature : .....
Supervisor I : MOHD ADRINATA BIN SHAHARUZAMAN
Date : 8 JUNE 2011

Signature : .....
Supervisor II : .....
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For my beloved mum, Mrs. Zaiton binti Dollah and my caring dad,
Mr. Hamzah bin Buang

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ABSTRACT

The project is an experimental study for the steering wheel of a Formula Varsity Race Car UTeM 2010. The problem identified is the result of vibration on the steering wheel causing discomfort to the driver. Thus, to solve the problem, experiments have been conducted on the steering wheel to analyze the experiment in free-free boundary and the constraint condition. For the experiment in a free-free boundary condition, the steering wheel which is free movement will knock by impact hammer. For the experiments in a constraint condition, steering wheel fix at steering column will knock by impact hammer. For the behaviour of Formula Varsity steering wheel vibration, the analysis of the highest vibration level was conducted in static condition. The natural frequency of the steering wheel UTeM Formula Varsity Race Car 2010 is 160 Hz and the highest vibration level of steering wheel analysis gives over than 2m/s² which are an extremely uncomfortable to the driver. Finally for the conclusion, a lot of new experience and knowledge have gather during the period of time for this project.

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ABSTRAK

Tujuan dan matlamat projek ini ialah untuk mengkaji terhadap getaran pada roda stereng bagi kereta lumba Formula Varsity UTeM 2010. Getaran pada roda stereng telah menyebabkan ketidakselesaan kepada pemandu. Justeru itu, bagi mengkaji masalah tersebut, beberapa eksperimen telah dilakukan antaranya eksperimen menganalisis roda stereng dalam keadaan bebas dan keadaan tetap. Bagi eksperimen roda stereng dalam keadaan bebas, ini bermakna roda stereng bagi kereta lumba tersebut akan digantung pada meja kerja dan bebas bergerak. Manakala, bagi eksperimen roda stereng dalam keadaan tetap, ia akan di pasangkan pada batang stereng kereta lumba. Kajian juga dilakukan terhadap tahap getaran yang paling tinggi dihasilkan oleh kerete lumba tersebut. Oleh itu, perilaku roda stereng bagi kereta lumba lumba dapat dikenal pasti. Keputusan yang diperoleh mendapati bagi frekuensi semulajadi bagi roda stereng tersebut adalah 160Hz dan perilaku roda stereng telah melebihi 2m/s² iaitu amat tidak selesa mengikut garis panduan (ISO) kepada pemandu. Akhirnya, untuk kesimpulan, banyak pengalaman baru dan pengetahuan yang telah mengumpulkan selama tempoh masa projek ini.

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LIST OF SYMBOLS

k	=	Stiffness of shaft or system, N/m
m	=	mass, kg
Hz	=	Hertz
f	=	Frequency, Hz
f_n	=	Natural frequency, Hz
g	=	Standard gravitational constant, m/s²

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CHAPTER I

INTRODUCTION

1.1 BACKGROUND

UTeM Formula Varsity is an international student racing competition that challenges students to design, manufacture and race their single seat open-wheel formula style racing car in real track condition. This event is inspired by similar student based formula style racing events such as Formula SAE and Formula Student.

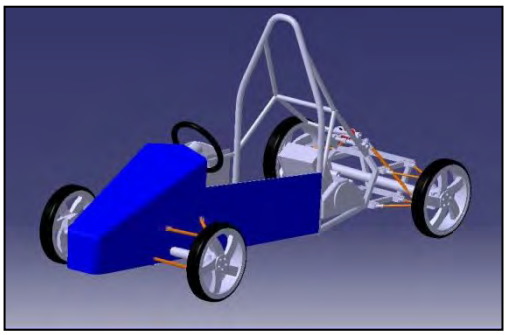

Figure 1.1: Catia Drawing of Formula Varsity race car.

The aim of the event is to provide a platform for Malaysian students with interest in motorsport engineering to put into practice their engineering knowledge and skills in developing a working model of a formula style racing car. The event hope to foster the tie and collaboration between all Malaysian and international higher education institutions especially among the students as well as to help create the needed competent human capitals for our country automotive industries.

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Figure 1.2: Formula Varsity race cars 2010.

1.2 HISTORY

The original of this program comes from the Formula SAE competition held in the United States and Canada. Although the car was developed in a small car size, it is not a race car in the true sense, it can be regarded as a mini-F1 of the university. This championship challenge engineering students to design, build and compete with the engine racing formula style. The competition is to provide opportunities for teams from a university to demonstrate and prove their engineering skills against teams from other universities. For automotive companies, this tournament is an opportunity to identify and recruit prospective graduates to serve with them.

Figure 1.3: Formula SAE car.

(Source: http://www.cardomain.com/ride/3227117/2008-honda-600)

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Formula SAE is a specific form of a student competition relating to design. Design competitions can be technical or purely aesthetic. The objective of technical competitions is to introduce students to real-world engineering situations and to teach students project-management and fabrication techniques used in industry. Aesthetic competitions usually require art and design skills. Both students and industry benefit from intercollegiate design competitions. Each competition allows students to apply the theories and information they have learning in the class room to real situations. Industry gains better prepared and more experienced engineers.

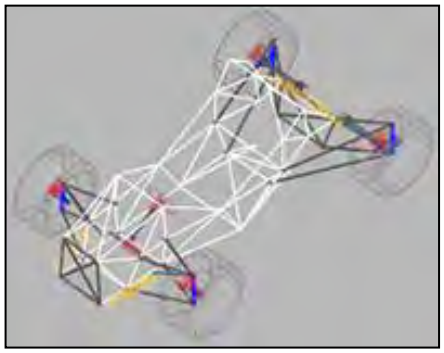

Figure 1.4: Adams car for Formula SAE vehicle.

(Source:
http://www.mscsoftware.com/university/view_success_story.cfm?storyId=2)

The concept behind Formula SAE is that a fictional manufacturing company has contracted a student design team to develop a small Formula-style race car. The prototype race car is to be evaluated for its potential as a production item. The target marketing group for the race car is the non-professional weekend autocross racer. Each student team designs, builds and tests a prototype based on a series of rules, whose purpose is both ensuring on-track safety (the cars are driven by the students themselves) and promoting clever problem solving.

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Figure 1.5: Formula Varsity UTeM 2010 logo
(Source: http://formulavarsity.utem.edu.my/)

1.3 FORMULA VARSITY OBJECTIVES

1. To give the realistic exposure to the student in the aspect of automotive engineering and product development in general.
2. To test the student creative thinking and robustness as this program involved the soft skills and also apply the classroom textbook theories to the real working experience.
3. To search for prospective motorsport racer and engineers.
4. To promote career and excellence in motorsport industry.

Figure 1.6: Formula Varsity race day 2010.

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1.4 PROBLEM STATEMENT

Vibration of steering wheel for UTeM Formula Varsity Race Car gives discomfort to the driver. The vibration response of the steering may not present a hazard but the vibration that transmitted to the hand-arm can cause discomfort, annoyance and fatigue (J. Giacomin and O. Abrahams, 2000). This will lead to Carpal Tunnel Syndrome if the vibration level is too high.

1.5 OBJECTIVES

1. To conduct experimental modal analysis for Formula Varsity steering wheel.
2. To study the behaviour of Formula Varsity steering wheel vibration.

1.6 SCOPES

1. UTeM Formula Varsity Race Car vehicle.
2. Experimental analysis of the steering wheel for free-free boundary and constraint condition.
3. To analyze the highest vibration level for a Formula Varsity race car in static condition.

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