

STUDIES AND DESIGN OF SUSPENSION SYSTEM FOR A FORMULA SAE
RACING CAR

AIZAT FUAD BIN AHMAD SHATAR

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

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RACING CAR

AIZAT FUAD BIN AHMAD SHATAR

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“I admit that have read this work and in my opinion this work was adequate from scope aspect and quality to award in purpose Bachelor of Mechanical Engineering (Automotive)”

Signature :.....
1st Supervisor’s name:.....
Date :.....

Signature :.....
2nd Supervisor’s name:.....
Date :.....

“I hereby, declare that ideas, design, results, analyses and conclusion set out in this thesis entitled Studies and Design of Suspension System for a Formula SAE Racing Car are entirely my own effort, except where otherwise indicated and acknowledged.”

Signature :
Name : AIZAT FUAD BIN AHMAD SHATAR
Date : 18TH MAY 2009

To my beloved father, Ahmad Shatar Bin Azizan
and my beloved mother, Nor Haiyati Binti Hashim

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ABSTRACT

Formula SAE is a student designed competition, organized by SAE International to take students out of the classroom and allows them to apply the textbook theories to the real work experiences. Today, the competition has expanded around the world and this is one of the best ways to promote UTeM globally. This project is to study and design the suspension system for Formula SAE race car. The designed suspension system must follow all the Formula SAE rules and regulations thus compete with other race car around the world. All the required steps in designing the suspension system are conducted in this project in order to produce a race car with optimum handling and cornering performance. At the end of this project, the designed suspension system must be competitive enough which can be used for further development.

ABSTRAK

Formula SAE merupakan sebuah perlumbaan yang dianjurkan oleh SAE International khas untuk pelajar bagi membolehkan pelajar mengaplikasikan segala teori dan ilmu pengetahuan yang telah diajar di dalam kelas dan mendedahkan pelajar kepada persekitaran sebenar alam pekerjaan. Dewasa ini, perlumbaan Formula SAE telah berkembang ke seluruh dunia dan ini merupakan antara langkah yang terbaik untuk mempromosikan UTeM secara global. Projek ini adalah bertujuan untuk membina sistem gantungan bagi kereta lumba Formula SAE. Sistem gantungan yang telah dibina haruslah mengikut segala syarat dan peraturan yang telah ditetapkan oleh Formula SAE dan juga mampu memberikan saingan kepada kereta lumba pasukan lain dari seluruh dunia. Segala langkah yang diperlukan bagi membina sistem gantungan telah dipraktikkan agar dapat menghasilkan sebuah kereta lumba yang bukan sahaja mempunyai kuasa enjin yang baik, malahan juga memiliki keupayaan kawalan dan membelok yang mantap.

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CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

Universiti Teknikal Malaysia Melaka (UTeM) currently has a Formula Varsity race car that is built to compete in the Formula Varsity Race. Its suspension system utilizes the double wishbone design that made from mild steel and can be said that it did perform well when comparing with other cars in Formula Varsity Race. However, the suspension system design does not apply the rules and regulations of the Formula SAE, thus cannot be used in the Formula SAE competition.

The aim of this project is to design and develop the suspension system for UTeM Formula SAE race car according to the Formula SAE rules and regulations. The suspension system that will be design must be able to improve the car cornering ability and handling performance in order to make sure the car to be competitive with other team around the world.

Having excellent engine performance and braking power is good but without sufficient cornering ability and good handling performance, the driver will feel difficult to drive the car, thus unable to use the full potential of the car performance. This means that the cornering ability and handling performance is very important to the overall performance of the race car.

To achieve this goal in the given time, several tasks were set, that are:

- a) Study on the type of suspension system use in automotive vehicle.
- b) Study on the open wheel and Formula SAE race car suspension system.
- c) Study the technology of composites (carbon fibre).
- d) Suggestion for the design and construction of the suspension system.
- e) Identifying the important parameters for competitive suspension system.
- f) Design and analysis of the system design by using CAD and CAE software.

By identifying the critical areas that are important for the competitive suspension system, the handling and cornering ability of the car can be improved, thus will allow faster speed into and exit out of the corners. This will result in quicker lap time, better performance and higher overall standing in Formula SAE competition.

Besides that, reliability also is one of the main concerns in designing the suspension system. In order to avoid the failure of the suspension system, the design analysis of the suspension system will be conducted.

If all things go well according to the plan, the suspension system that is competitive with other team that have more experience in Formula SAE competition can be designed at the end of this project.

1.2 PROBLEM STATEMENT

In this research, the student is responsible to study and design the suspension system for Formula SAE race car. As a beginning, the student will refer to the existing Formula SAE car that has been design by the Short Term Grant Researcher Group of UTeM and look for the optimization and redesign opportunities on the way to have better quality of suspension design, which reflect to better ride and handling. The design should refer to the Formula SAE standards and regulations, in term of technical performance and safety. The designed suspension system should be analyzed virtually using related CAE software, based on the analysis characteristics been established during the literature stage. Aim of this research is the suspension system is fit enough in term of quality and safety, and can be fabricated and produce in future research to be used as a suspension system for UTeM Formula SAE race car.

1.3 OBJECTIVES

1. To design the suspension system for UTeM Formula SAE race car.
2. To understand the concept of suspension and its application, in this case it is specific to the Formula SAE race car application.
3. To understand the quality of suspension system and its criteria, and do the analysis based on the criteria that have been established.
4. To understand the concept of formula race car suspension system and its application.
5. The application of self technical knowledge, CAD and CAE tools, understand related high-tech material and its production process, and the application and the advantage of the designed item.