DESIGN AND FABRICATION OF SPACE FRAME CHASSIS FOR UTeM FORMULA STYLE RACE CAR

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and from my opinion this thesis
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Bachelor of Mechanical Engineering (Automotive)’

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This report is presented in partial
fulfillment of the requirements for the honor of
Bachelor of Mechanical Engineering (Automotive)

Faculty of Mechanical Engineering
Universiti Teknikal Malaysia Melaka

MAY 2011

"I declare this report is on my own work except for summary and quotes that I have mentioned its sources"

Signature : ……..

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Date : 16th May 2011

For my beloved mum, Mrs. Mariam bt Ismail and my caring dad,
Mr. Ashari bin Burok

ACKNOWLEDGEMENTS

I would like to express my gratitude to all those who gave me the possibility to complete this project. I want to thank to Allah S.W.T for giving me good health to do the necessary research work. I have furthermore to thank my fellow friends who encouraged me to go ahead with my project.

I am deeply indebted to my supervisor, Mr. Muhd Ridzuan bin Mansor from the Faculty of Mechanical Engineering Department whose help, stimulating suggestions and encouragement helped me in all the time of research and writing of this Projek Sarjana Muda (PSM).

I thank the laboratory management especially the lab technicians for their cooperation and support and also not leas thank my friend Mohd Zaini, Mohd Sabirin, Mohd Faliq, Amar Ridzwan, Kamal Khalid and Ammar Alfaiz for all thier assistance on generating the use of Catia programming and fabrication chassis. My housemates, who were great, help in difficult times.

Lastly, I would like to give my special thanks to my parents whose patient love enabled me to complete this work, sacrifice their money for hoping me that I can finish my project on time. I hope that all that have been study and research in this thesis can be use as references to the other student in the future

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UTeM

May 2011

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ABSTRACT

This thesis presents the design and analysis of a student competition based formula style racing car named as Formula Varsity. The goal and target of this project are to design, analyze and fabricate a new space frame chassis which are based on rule and regulation of Formula Varsity 2010. This event organized by Universiti Teknikal Malaysia Melaka. The race car chassis design was developed using CATIA V5R16 CAD software and commercial grade A36 low carbon steel was chosen as the material for the chassis construction. The chassis was later analysed for its structural performance using similar software. Results show that the new chassis design has higher maximum torsional stiffness of 4874.50 Nm/deg compared to the previous UTeM 2010 race car chassis with maximum torsional stiffness of 4415.189 Nm/deg. The new chassis design was also 39.5% lighter than its predecessor. The findings reveals that the new chassis design can provide higher power to weight ratio compared to the previous UTeM race car while in the same time gives better structural strength, thus giving the needed advantage in winning the event.

ABSTRAK

Kajian ini menunjukkan rekabentuk dan analisa mahasiswa untuk pertandingan perlumbaan jentera berasaskan Formula satu disebut sebagai Formula Varsiti. Tujuan dan sasarannya adalah rekabentuk, menganalisa dan membina sebuah casis kerangka yang baru berdasarkan kepada ketentuan dan peraturan Formula Varsiti 2010. Acara ini diadakan oleh Universiti Teknikal Malaysia Melaka. Rekabentuk casis jentera dihasilkan menggunakan perisian CAD CATIA V5R16 dan bagi menbina casis bahan yang digunakan adalah besi berkarbon rendah A36. Casis jentera kemudiannya dianalisa untuk memastikan struktur benar-benar kuat dengan menggunakan perisian yang sama. Keputusan kajian menunjukkan bahawa simpulan daya kilas rekabentuk casis baru sebanyak 4874.50 Nm/deg lebih baik berbanding casis lama sebanyak 4415.189 Nm/deg. Rekabentuk casis baru juga menunjukkan pengurangan berat sebanyak 39.5% daripada casis lama. Kajian menunjukkan bahawa rekabentuk casis baru dapat memberikan kuasa yang lebih tinggi disebabkan nisbah berat berbanding rekabentuk casis jentera UTeM sebelumnya dalam masa yang sama memberikan kekuatan struktur yang lebih baik, sehingga memberikan peluang untuk memenangi acara tersebut.

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CHAPTER I

INTRODUCTION

1.1 Project Introduction

Spaceframe chassis have been in use since the start of the motor sport scene. A spaceframe consists of steel or aluminum tubular pipes placed in a triangulated format to support the loads from the vehicle caused by; suspension, engine, driver and aerodynamics.

There are two main types of chassis used in race cars, steel spaceframes and composite monocoque. Although spaceframes are the traditional style they are still very popular today in amateur motorsport. Their popularity maintains because of their simplicity, the only tools required to construct a spaceframe is a saw, measuring device and welder.

The spaceframe still has advantages over a monocoque as it can easily be repaired and inspected for damage after a collision. The chassis has to contain the various components required for the race car as well as being based around a driver's cockpit. The safety of the chassis is a major aspect in the design, and should be considered through all stages. The design also has to meet strict requirements and regulations set by the UTeM Formula Varsity organizers. Due to limited budgets and time constraints the design of the chassis will need to be geared towards simplicity and strength.

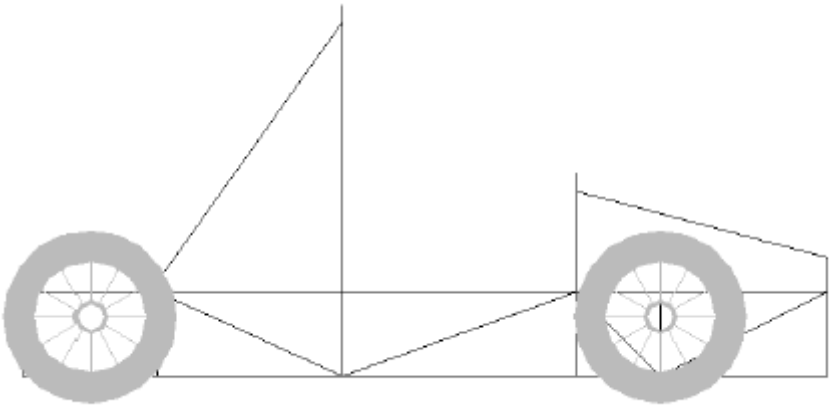

Figure 1.1: Basic Formula Student Race Car
(Baker, 2004)

1.2 Objective

The main objective of this project is to design, analyze and fabricate a new spaceframe chassis for UTeM formula style race car. New chassis must comply with the rule and regulation stated in the Formula Varsity 2010 competition.

1.3 Problem Statement

The design of a chassis for a 2010 UTeM Formula Varsity Race Car must contain all necessary components to support the car and the driver. It must also comply with the Formula Varsity 2010 rules. In order to produce a competitive vehicle with optimum chassis performance, many areas need to be studied and tested.

As we know, weight is the main point that affected the performance of the car. So, the main purpose of this project is to design and develop a lightweight and strength chassis. The new chassis is must be light and maintain the strength of the chassis when load is applied on it.

There was some factor that can effected weight of a vehicle which is the types of material used, the diameter or dimension of tubes use to built space frame chassis, and also the design geometry of chassis.

This project carried out all of the necessary background research required to sustain an accurate database of design criteria. Design criteria then allowed the design process and methodology to be derived and to allow for smooth construction of an efficient and effective space frame chassis. Once construction of the chassis was completed, analyses were conducted to investigate the effects of working loads on the chassis. Finite element analysis was used to simulate the conditions of various load combinations.

1.4 Scope

i. To produce detail and 3D design of the chassis using CATIA based on 2010 UTeM Formula Varsity specification and regulation.
ii. To select suitable material for the chassis through material selection analysis.
iii. To calculate the load acting on chassis during operation.
iv. To perform the static Finite Element Analysis to the chassis.
v. To evaluate the torsional stiffness foe the chassis based on the load analysis using CATIA
vi. To fabricate the chassis using suitable manufacturing process

GANTT CHART PSM 1

Table 1.1: Gantt Chart PSM 1

		Week of Progress													
No	**Activities**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	Select Of PSM Topic														
2	Confirmation of PSM topic														
3	Literature Review														
4	Material Selection														
5	Design of Space frame FV 2010														
6	Analyze the Design of Space frame FV 2010														
7	Report Writing 7.1 Chapter 1 : Introduction 7.2 Chapter 2 : Literature Review 7.3 Chapter 3 : Methodology 7.4 Chapter 4: Design and Material Selection 7.5 Chapter 5: Result, Analysis and Discussion 7.6 Chapter 6 : Conclusion														
8	Presentation														
9	Report Submission														

GANTT CHART PSM 2

Table 1.2: Gantt Chart PSM 2

		Week of Progress													
No	**Activities**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	Literature Review														
2	Fabricate the Space frame FV 2010														
3	Balancing and Testing														
4	Measure and Decision														
5	Report Writing 5.3 Chapter 7: Fabrication 5.4 Chapter 8: Conclusion and Recommendation														
7	Presentation														
8	Report Submission														

FLOW CHART

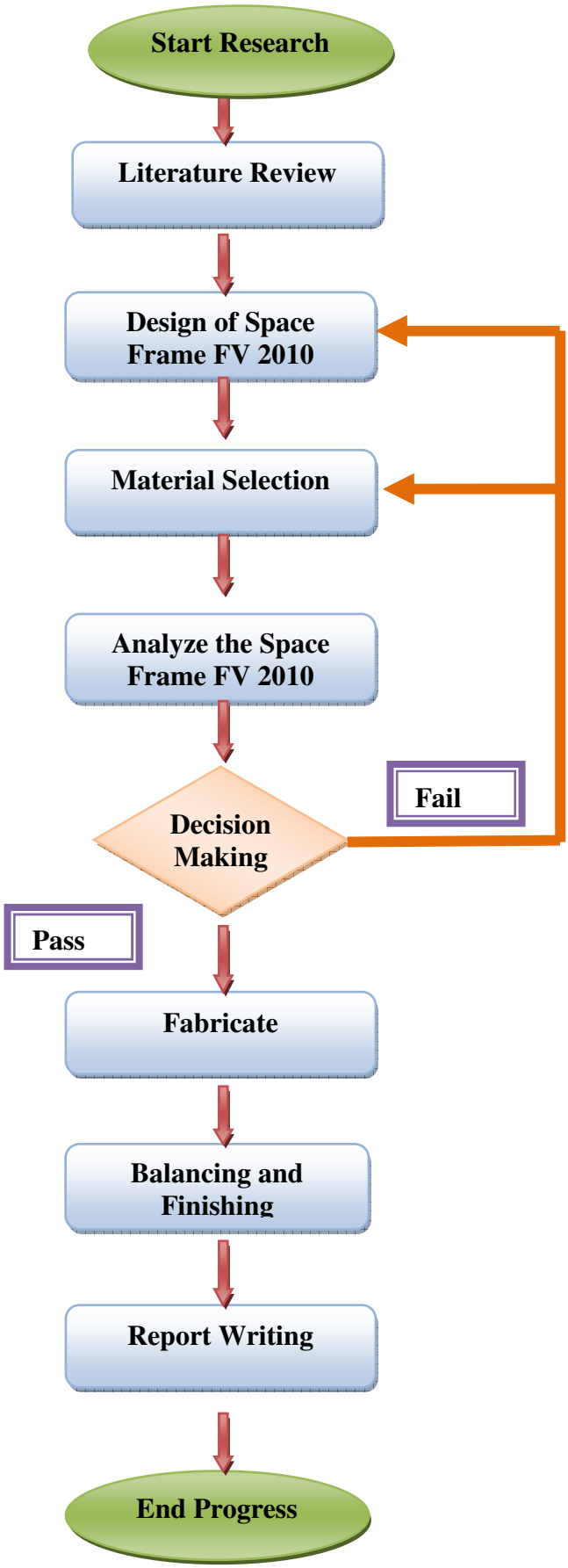

Figure 1.2: Overall Flow Process Chart