DESIGN AND ANALYZE THE CHASSIS OF AN ELECTRIC VEHICLE FOR USE IN CAMPUS CONDITION

IZHAR HIFNIE BIN MOHD. AMIN

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

‘I/We hereby declared that I/We have read through this report and found that it has comply the partial fulfillment for awarding the degree of Bachelor of Mechanical Engineering (Design and Innovation)’

Signature : ……..

Supervisor’s name : ……..

Date : ……..

Signature : ……..

Supervisor’s name : ……..

Date : ……..

DESIGN AND ANALYZE THE CHASSIS OF AN ELECTRIC VEHICLE FOR USE IN CAMPUS CONDITION

IZHAR HIFNIE BIN MOHD AMIN

This report is submitted in partial fulfillment of requirement for the
Degree of Bachelor in Mechanical Engineering
(Design and Innovation)

Faculty of Mechanical Engineering
Universiti Teknikal Malaysia Melaka

APRIL 2009

"I hereby declared that this report is a result of my own work except for the excerpts that have been cited clearly in the references"

Signature : ……..

Name : IZHAR HIFNIE BIN MOHD AMIN

Date : APRIL 2009

DEDICATION

For my beloved father, Mohd Amin Bin Ahmad,
my mother,Norhayati Binti Kasim,
my friends and my wonderful siblings.

ACKNOWLEDGEMENT

The writer would like to deliver his praise to the Almighty for giving him the strength and blessing to conclude this report. He also would like to express his gratitude to the Almighty for giving him salvation and safety throughout his journey in completing this report.

Sincere thanks for Mr. Wan Mohd Zailimi Bin Wan Abdullah who with his guidance and support throughout this journey, make this happen. The writer would also like to express his appreciation to all UTeM's staffs that was involved in this project either directly or indirectly.

To all his friends, for all the time spent together during his duration in UTeM, all the memory will never be forgotten.

ABSTRACT

The objective of this project is to design and analyze the chassis of an electric vehicle for use in campus condition. The new design will contain several specifications that were prescribed in the problem statement. In order to get to the objective, any information about electric vehicle and its chassis were gathered to get a better insight about the research. Information about software such as CATIA and COSMOSWorks will also be gathered. These informations may come from books, journals, the internet, newspapers and the library. Throughout this project, there will be several concept designs created. The designs will be analyzed and the best concept that fulfilled the specification will be chosen as the final design.

ABSTRAK

Objektif utama bagi projek ini adalah untuk merekabentuk dan menganalisa casis bagi sebuah kenderaan elektrik yang akan digunakan di dalam kawasan kampus.Rekabentuk yang baru bagi casis tersebut perlu menepati penentuan-penetuan yang telah dinyatakan di dalam pernyataan masalah bagi projek ini.Untuk mencapai objektif yang telah ditetapkan, segala informasi mengenai kenderaan elektrik beserta casisnya akan dikumpulkan untuk mendapatkan pemahaman yang lebih jelas mengenai kajian tersebut.Informasi-informasi diperolehi melalui buku-buku, jurnal, internet, surat khabar dan juga perpustakaan.Mlelalui konsep kajian ini, akan ada beberapa rekabentuk konsep yang akan dihasilkan.Rekabentuk tersebut akan dianalisa dan rekabentuk konsep yang terbaik yang menepati spesifikasi yang telah ditetapkan akan dipilih sebagai hasil kajian.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOL

mm	Millimetre
EV	Electric vehicle
kg	Kilogram
bsj	Miles per hour
%	Percentage
N	Newton
m	Meter
m^2	Meter square
m^3	Meter cubic
K	Kelvin
J	Joule
G	Giga
Pa	Pascal
Ω	Ohm
Co	Celsius
M	Mega
F	Force
D	Diameter
L	Length
σ_x	Shear strength
τ_{xz}	Strain
R	Radius
η	Factor of safety

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

1.1 Project Background

This project will be focused on the frame and the design of the new vehicle that used alternative power source as it main energy. Chassis is one of the main components for the new vehicle. Chassis is a structural system that supports other components of a physical construction. Design is one of the main processes in producing the new vehicle. This will help to make a new vehicle that follows the criteria needed by the designer and the customer.

Design, usually considered in the context of applied arts, engineering, architecture, and other creative endeavors, is used both as a noun and a verb. As a verb, "to design" refers to the process of originating and developing a plan for a product, structure, system, or component. As a noun, "a design" is used for either the final (solution) plan (e.g. proposal, drawing, model, description) or the result of implementing that plan (e.g. object produced, result of the process). More recently, processes (in general) have also been treated as products of design, giving new meaning to the term *"process design"*.

There are three main sections in the frame such as body-on-frame, chassis and sub frame. All of these sections are important to support the entire body of the new Vehicle. The design and the analysis of these three sections will be done based on the criteria of the new vehicle. These sections will carry certain components such

as the motor, drive train, and suspension. These sections will be welded and/or bolted to the vehicle.

1.2 Problem Statement

This research was done to find the solution for the recent problem that occurs in our lifestyle. Nowadays, the majority of student in Universiti Teknikal Malaysia Melaka has their own vehicle in form of motorcycle or car for use to travel within the campus. Those who does not, either resort to car-pooling with their friend who has a vehicle or prefer to use the bus service provided by the university. Apparently, during this economic turmoil due to the global oil price skyrocketing, this has cause a lot of pressure to the student who has their own vehicle and to the university who provides the bus system.

What if, there exists a public transportation system that uses an alternative power source (anything other than oil)? That particular system will surely cut the running cost in the long run as many economical experts have speculated that the oil price will continue to rise in the future. Not to mention, student will have an option that will not burden the university (as the bus service does).Today, there are a lot of alternative power source vehicle that has been invented. Some of them are already on the market. The challenge is to design a vehicle system that is suitable for use inside campus, (specifically UTEM's main campus at Durian Tunggal) while low on the running cost. To design this new vehicle, the used of the chassis will be quite different. So, the design of the new chassis needs to be done. This design will be based on the problems occurred and by the research that will be done.

1.2.1 Chassis

To design an electric vehicle, the chassis must be designed based on the requirements and the ability of the electric energy to move it. The components involved in building the electric vehicle must be considered. The main components that will give an effect to the design of the chassis are the electric motor and the battery. The size, weight and the position of these components must be considered before designing the chassis. Hence, researches will be done to design and analyze the chassis that will be used on the electric vehicle. To define the specification for the chassis, I took the specifications of current EV in the market as the benchmark for my design. The specifications of the chassis that need to be achieved were shown below:

Table 1.1: The specifications for chassis design

Criteria	**Specifications**
Body and chassis	Lightweight,. High dimensional stability, Excellent impact/stiffness balance, have aesthetic value and suitable for use in campus condition.
Ground clearance	160 mm
Net weight	670 kg = 6572.7 N
Wheelbase	2860 mm
Seating capacity	6 person
Wheel hub	18”
Suspension system	4 wheel independent
Dimensions (L x W)	3450 x 1220

1.3 Objective

To design and analyze the chassis of the electric vehicle suitable for use inside of campus condition and fulfill the specifications needed.

1.2 Scope

a) To study about the design of the chassis of current vehicle.
b) Literature study on the chassis structure of an electric vehicle.
c) Analyze the material used for the electric vehicle based on types and the sizes.
d) Conceptual design.
e) Develop designs for the chassis of the electric vehicle.
f) Analyze the performance (using COSMOSWorks) of the new designs that follow the requirements of the new vehicle.
g) Propose the new design of the chassis based on the analyses that have been done.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

This chapter will be focused on the research information and the outcome of the study about the electric vehicle. This information then will be used as the guideline to find the most suitable material and design based on the factor and the supported theory to finalize the design of the chassis for the electric vehicle to be developed.

2.1.1 Electric Vehicle

Electric Vehicle (EV) as developed in early 1838 here the first EV produced was an electric locomotive with the speed of 4 bsj designed by Robert Davidson from Scotland. In 1914, *1914 Detroit Electric Model 47* was designed by Thomas Alva Edison. The EV was using nickel-iron battery as it source of energy. At that time, transportation using the fuel and gasoline was been made, but it is not too practical because of the price of the fuel is slightly expensive. It is also not practical because it make the user really hard to start the engine because it needed to start manually by using the engine's shaft crank. The starter key still not yet created at that time to facilitate the fired up process of the engine. The engine was also making the loud noise because there was no sound damper or the sound damper was not

effectively function. These factors motivate to acceptance of the EV transport by the user around United State of America where it records the use number of the EV around 50,000 units (Anderson, C.D., & Anderson, J. 2005).

The discovery of the cheaper fuel producing method was made the EV's popularity becomes lesser from time to time. The discovery of the new technique to start the engine also was one of the factors why the EV's popularity goes much lesser. The petrol engine's vehicle becomes more popular because it can travel longer than the previous model. There were researches about the engine that help to raise the quality of the engine especially on the pollution aspect. The research find out that the level of the pollution made by 1 car from that time is equal to 10 cars that we are using now. This shows that quality of the engine is slightly increased through the time (Anderson, C.D., & Anderson, J. 2005).

Nevertheless, the EV's technology was also expanding from time to time. The awareness for natural-resources dwindling made the technology and the quality of EV enhanced. There are so many technologies about the engines was developed such as the engine using water as its energy sources where the water was divided to its molecules (oxygen and hydrogen) and then it reacting in production of electricity to move the engine. This development brings the research of EV to the higher level to compete with the petrol's engine.

2.1.2 Electric Vehicle System

An EV has the following two features:

1. The energy source is portable and chemical or electromechanical in nature.
2. Traction effort is supplied only by an electric motor.

(Source: Husain, I 2003))

Figure 2.1 shown an EV system driven by a portable energy source. The electromechanical energy conversion linkage system between the vehicle energy

source and the wheels is the drive train of the vehicle. The drive train has electrical as well as mechanical component.

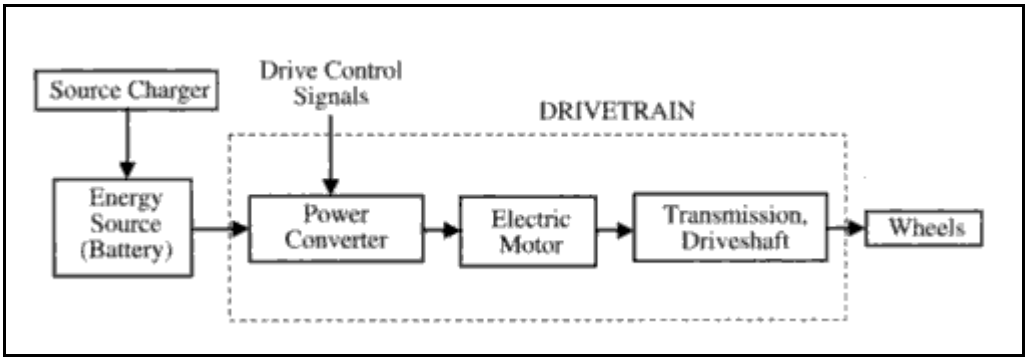

Figure 2.1:Top-level perspective of an EV system

(Source: Husain, I (2003))

2.1.3 Electric Vehicle's Components

An electric vehicle, or EV, is a vehicle with one or more electric motors for propulsion. This is also referred to as an electric drive vehicle. The motion may be provided either by wheels or propellers driven by rotary motors, or in the case of tracked vehicles, by motors. In this project, the electric vehicle that will be produced is the vehicle that follows the specification that was mentioned earlier in the problem statement. Generally, besides the electric motor and battery, the other major part of the electric car is the chassis. The chassis is where other parts of the vehicle are attached to. Most electric cars come in either 1/8 or 1/10 scale. In certain cases, you can even swap some body parts with each other even if they are a different scale. You may need to trim away the body or customize it slightly (Mom, G. 2004). The body should include the hood, frame, accessories, etc. It should be noted that high quality vehicles are created with aluminum or graphite chassis for strength and heat resistance.

Tires are another piece of equipment that most intermediate electric cars require. While basic and some intermediate electric cars do come with tires, others require a set to be bought separately. Depending on how you drive your vehicle and