DESIGN AND FABRICATION OF GLASS-FIBER COMPOSITE BODYWORK FOR UTeM FORMULA STYLE RACE CAR

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Laporan ini dikemukakan sebagai memenuhi sebahagiaan daripada syarat penganugerahan Ijazah Sarjana Muda Kejuruteraan Mekanikal (Automotif)

Fakulti Kejuruteraan Mekanikal
Universiti Teknikal Malaysia Melaka

MAY 2011

‘I have read this thesis
and from my opinion this thesis
is sufficient in aspects of scope and quality for awarding
Bachelor of Mechanical Engineering (Automotive)’

Signature	: …….……
Name of Supervisor	: En. Muhd Ridzuan Bin Mansor
Date	: ……...

DECLARATION

"I hereby declare that the work in this report is my own except for summaries and quotations which have been duly acknowledged."

Signature : …….

Author : Amar Ridzuan Bin Abd Hamid

Date : 16th May 2011

To my lovely parents Mr. Abd Hamid Bin Awang Nik

and Mrs. Manisah Bte Juki..

ACKNOWLEDGEMENT

Alhamdulillah and greatest thank to Allah Almighty for giving me strength while doing this project. Finally I have completed my Project Sarjana Muda report and research to fulfill one of the requirements for Bachelor Degree in Mechanical Engineering (Automotive). I would like to take the opportunity to thank the people who have supported and helped me in completing this PSM project. Without their generous support and kind help, it is difficult to finish this work.

This project could not have been done without Mr. Muhd Ridzuan Bin Mansor, who not only served as my supervisor but also encouraged and challenged me throughout my academic program. He patiently guided me through the study process, never accepting less than my best efforts. I want to express my gratitude to my family, friends and colleagues, whose support and good will kept me going through the project. My biggest thanks go to special friends, Mohd Zaini Bin Jamaluddin and Mohd Sabirin Bin Rahmat who always gave moral support in my difficult time. During the slow and often interrupted evolution of this project I have accumulated many debts, only a proportion of which I have space to acknowledge here. I am grateful to many people for help, both direct and indirect, in writing this technical report.

Thank you.

16th May 2011

ABSTRACT

This project is about design and fabrication of glass-fiber composite bodywork for UTeM formula style race car. The design of the bodywork is made using the CAD software named CATIA V5 to produce the detail 3D design. The determination of plies and orientation for the composite bodywork is made based on the highest flexural strength which is the Chopped Strand Mat (CSM) fiberglass which gives the result of 320.412 MPa flexural stresses at maximum flexural load applied. The method of fabricating the composite bodywork is using manual hand lay-up technique for the whole process. The overall bodywork weight is measured with the digital weighting scale and the overall weight of the bodywork is 9410 gram. The weight reduction of nose cone and side pod from previous bodywork is 1692 gram which gives 25% less weight compared to current bodywork and suggested to be implemented at the new UTeM formula style race car bodywork section.

ABSTRAK

Projek ini adalah mengenai merekabentuk dan fabrikasi bahagian luar komposit gentian kaca untuk kereta UTeM jenis formula. Rekabentuk bahagian luar kereta ini dihasilkan dengan menggunakan perisian CAD bernama CATIA V5 bagi menghasilkan rekabentuk 3D yang terperinci. Penentuan lapisan dan susunan bahagian luar kereta adalah berdasarkan kekuatan lentur tertinggi iaitu gentian kaca Chopped Strand Mat (CSM) yang menunjukkan 320.412 MPa tekanan lenturan pada lenturan maksimum yang diberikan. Proses fabrikasi yang digunakan adalah teknik menggunakan tangan bagi keseluruhan prosess. Keseluruhan bahagian luar kereta diukur dengan menggunakan skala berat digital dan berat keseluruhan bahagian luar kereta yang dicapai adalah 9410 gram. Pengurangan berat pada bahagian muncung hadapan dan sisi dari bahagian luar kereta yang sebelumnya adalah 1692 gram dimana memberikan 25% pengurangan berat dibandingkan dengan bahagian luar kereta yang terkini dan dicadangkan untuk dilaksanakan pada bahagian luar kereta jenis formula UTeM yang baru.

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LIST OF ABBREVIATIONS

UTeM = Universiti Teknikal Malaysia Melaka
3D = Three Dimension
2D = Two Dimension
FV = Formula Varsity
SAE = Society of Automotive Engineer
FRP = Fiberglass Reinforced Plastic
MPa = Mega Pascal
GFRP = Glass Fiber Reinforced Plastic
GRP = Glass-Reinforcement Plastic
MgO = Magnesium Oxide
CaO = Calcium Oxide
PDP = Product Delivery Process / Product Development Process
F1 = Formula One
PDS = Product Design Specification
CATIA = Computer Aided Three-dimensional Interactive Application
GPa = Giga Pascal
PAN = Polyacrylonitrile
CSM = Chopped Strand Mat
kN = Kilo Newton
ASTM = American Society for Testing and Materials
MEKP = Methyl Ethyl Ketone Peroxide
2K = 2 Komponent
g = Gram

LIST OF APPENDICES

CHAPTER I

INTRODUCTION

1.1 Background Of Project

Formula Varsity Race Car is constructed by student from Faculty of Mechanical Engineering for Formula Varsity race event each couple of year between the local high education institute in Malaysia. The outer panel of the car is divided into two sections. Front section is called nose cone while the middle section is called side pod as shown on Figure 1.1 below.

Figure 1.1: Section of Outer Panel of Formula Varsity Race Car

This project involve with these two elements from the beginning of the project to the end. If compare to Formula Student car that been made by university from other country, it has already used composite material which is carbon-fiber. The bodywork also has achieved a high standard of quality and performance to the car. So, the design and fabrication that will be made through this project will open a new potential to experience the new type of material for bodywork of Formula Varsity race car which using composite material instead of using sheet metal.

1.2 Project Significant

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This project will result to the design and fabrication of glass-fiber composite bodywork for UTeM Formula Style race car. The glass-fiber composite material used in the fabrication will replace old material of fabrication which is use sheet metal. The composite material will give a lot more advantages compare to sheet metal. In design aspect, old design will be replace by this new design which has more stylish compared to previous design. Furthermore, the composite material that will be used will provide weight reduction to the total weight of the bodywork also to the car. Through this project, there are chance to explore in glass-fiber composite manufacturing. The new nose cone and side pod that used glass-fiber composite material will be used in the next construction of Formula Varsity Race Car after this.

1.3 Problem Statement

The problem statement of this project is come out by researching the most common problem of designing and fabrication of the bodywork. The problems are stated as below:

i. To make a mould for the bodywork
ii. To create the safe bodywork

iii. To reduce the weight of the bodywork (Nose cone and Side pod)

1.4 Objectives

The objective of this project is to design and fabricate glass-fiber composite bodywork for UTeM formula style race car.

1.5 Scope

There are five scopes in this project in order to achieve the project objective.

i. Literature review
ii. To produce detail and 3D design of the bodywork using CAD software based on 2010 UTeM Formula Varsity specification and regulation.
iii. To determine the number of plies and orientation for the composite bodywork
iv. To fabricate the bodywork using manual hand lay-up technique.
v. To measure the overall weight of the bodywork.

1.6 Planning And Execution Task

		Week of Progress													
No	**Activities**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	Literature Review														
2	Design of Bodywork FV 2010														
3	Material Selection														
4	Analyze the Design of Bodywork FV 2010														
5	Report Writing 5.1 Chapter 1 : Introduction 5.2 Chapter 2 : Literature Review 5.3 Chapter 3 : Methodology 5.4 Chapter 4 : Design & Material Selection 5.5 Chapter 5 : Conclusion														
6	Presentation														
7	Report Submission														

Figure 1.2: Gantt Chart of Project Progress for PSM 1