

**DESIGN AND FABRICATION OF ENGINE MOUNTING FOR UTeM
FORMULA SYLE RACE CAR**

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DESIGN AND FABRICATION OF ENGINE MOUNTING FOR UTeM
FORMULA STYLE RACE CAR

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‘I have read this thesis
and from my opinion this thesis
is sufficient in aspects of scope and quality for awarding
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For my beloved mum, Mrs. Siti Hawa bt Daud and my caring dad,
Mr. Rahmat bin Md Zain

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ABSTRACT

The aim of this project is to produce a new engine mounting UTeM formula style race car. This project also generated according to the existing engine mounting based on Formula Varsity 2010 race car. In this project CATIA V5 was used software to create drawings and engine mounting formation in modeling 3-dimensional (3D). In the meantime, the selection of materials was performed using CES 2010 Edupack software Aluminum Alloy 6061 T6 for rear mounting bracket and additional brackets and Aluminum Alloy 6063 T6 front of mounting bracket was selected for the project. Further analysis of the project was carried out with two methods of computation to obtain the load at each point on mounting components and then using CATIA V5 generative structural analysis workbench to analyze the component mounting engine. The CNC milling machines was used to produce the front mounting bracket and additional brackets and used EDM Wire Cut machine was used to produce the rear mounting bracket. Finally, the overall weight of fabricated new engine mounting was found to be 1.334 kg which is lighter compared to weight of previous engine mounting which was 2.395 kg. In conclusion, with a selection of lighter and stronger material this research was able achieve the objective with the accomplishment of the total overall weight of new engine mounting to be reduced by 44 percent compared to the previous engine mounting design.

ABSTRAK

Projek ini adalah untuk menghasilkan satu rekabentuk enjin *mounting* yang baru untuk kereta lumba Formula Varsity 2010. Projek ini juga dihasilkan sesuai dengan enjin *mounting* yang ada berdasarkan kereta lumba Formula Varsity 2010. Dalam projek ini perisian CATIA V5 digunakan untuk membuat lukisan dan pembentukan enjin *mounting* pada pemodelan 3-dimensi (3D). Sementara itu, pemilihan bahan dilakukan dengan menggunakan perisian CES 2010 Edupack Aluminium Alloy 6061 T6 untuk pemasangan braket belakang dan braket tambahan dan Aluminium Alloy 6063 T6 bagi braket hadapan dipilih untuk projek tersebut. Analisis dari projek ini dilakukan dengan dua kaedah pengiraan untuk mendapatkan beban pada setiap titik pada bahagian enjin *mounting* dan kemudian menggunakan analisis CATIA V5 struktur generatif meja kerja untuk menganalisis komponen enjin *mounting*. Mesin *CNC milling* digunakan untuk menghasilkan braket *mounting* hadapan dan braket tambahan dan mesin *EDM Wire Cut* digunakan untuk menghasilkan pemasangan braket belakang. Akhirnya, berat keseluruhan enjin *mounting* baru adalah 1.334 kg lebih ringan berbanding dengan berat enjin *mounting* yang sedia ada iaitu 2.395 kg. Kesimpulannya, dengan pilihan bahan yang lebih ringan dan lebih kuat dalam kajian ini mampu mencapai matlamat dengan jumlah berat keseluruhan enjin *mounting* yang baru dapat dikurangkan sebanyak 44 peratus berbanding dengan rekabentuk enjin *mounting* yang sedia ada.

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LIST OF SYMBOLS

N = Newton

τ = Torsional shear stress (MPa)

T = Torque (Nm)

r = radius (m)

J = Polar moment of inertia (m⁴)

σ_y = Yield strength (MPa)

τ_{\max} = Maximum shear stress (MPa)

σ = stress

LIST OF ABBREVIATIONS

ARB = Anti Roll Bar

CAD = Computer Aided Design

CAE = Computer Aided Engineering

CES = Cambridge Engineering Selector

CNC = Computer Numerical Control

EDM = Electrical Discharge Machining

MIG = Metal Inert Gas

PDS = Product Design Specifications

SAE = Society of Automotive Engineers

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CHAPTER 1

INTRODUCTION

1.0 Introduction of Project

Formula Varsity race event is a student competition based on product they designed and fabricated of the race car. This concept of event also came from SAE championship held in UK, America and Canada but in Malaysia but in Malaysia events have different rules in terms of total capacity engines are using.

This project involve with two elements from the beginning of the project to the end. So that, one of two types of mounting brackets for Formula Student should be selected to ensure they are adequate for holding the engine. The two types of bracket mounting are stress member and non stress member. 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 engine bracket mounting of Formula Varsity race car which using aluminum alloy 6061 T6 instead of using mild metal.

1.1 Engine Mounting Layout

There are two major characteristics of a drivetrain that impact the performance of a car. First is the engine placement and second is the driving wheels location. The engine placement is a big factor to determine the moment of inertia and the weight distribution of car because many other mechanical and electrical

components of a car are usually located close to the engine. Engines are placed in one of four locations on vehicles. The locations are rear mounted, mid engine, linear mount, and transverse mount.

1.2 Problem Statement

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

- a) The available engine mounting for formula style race car is not properly design for upper and front rear mounting in term of the dimension (inaccurate and difficult to assemble work).
- b) The rubber pad selected on previous design at the platform structure of the rear mounting cannot absorb the engine vibration.
- c) The overall weight of engine mounting is too heavy in term of the number of component and the material used.
- d) The vibration from the engine was directly impact the chassis because the bush and rubber of the mounting engine is not properly designed and installed.

1.3 Objective of Project

The objective of this project is to design and fabricate a new engine mounting for UTeM formula style race car.

1.4 Scope of Project

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

- a) To produce detail and 3D design of the engine mounting using CAD software based on 2010 UTeM Formula style race car.
- b) To perform material selection and load analysis on the component.
- c) To fabricate the engine mounting component.
- d) To measure the overall weight of the engine mounting.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

The Formula Varsity is a student competition in Malaysia. The competition a such as like Formula SAE give impression for engineering student to gain experience in the design, manufacture and test of the vehicle. The concept of this event also came from SAE competition held in United Kingdom, America and Canada. The objectives of such event are to expose student to practical work, to give students to apply theories into practical and to develop new talent of students in automotive industry (Faieza et al., 2009).

In this research, the engine mounting have been design to obtain the best of reduce weight the component between the current design based on the Formula Varsity 2010. Engine mounting is used to mount the engine to the chassis for UTeM formula style race car. The engine must be mounted at the rear section of the car which follow the rules and regulation of the Formula Varsity 2010 technical specification. Any kind of materials considered exotic such as titanium or carbon fiber, are strictly prohibited from the car design include engine mounting (Rules for Formula Varsity UTeM, 2010).