UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND DEVELOPMENT OF MODULAR BODY BY AIR DRAG REDUCTION FOR FOOD TRUCK

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Automotive) with Honours.

by

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This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Automotive) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Projek ini akan memberi tumpuan lebih kepada badan trak makanan diatas platform kargo Land Rover Defender 110 kerana platform kargo ini akan digunakan sebagai rujukan untuk mereka bentuk badan trak makanan yang baru. Projek ini adalah mengenai kajian alat aerodinamik yang akan digunakan pada reka bentuk badan trak makanan. Trak makanan semasa mempunyai masalah dalam reka bentuk badan yang menyumbang kepada mengheret pekali. Untuk mencapai objektif projek ini, beberapa model trak makanan dibuat dengan peranti yang berbeza pada reka bentuk badan dan akan dianalisis untuk mendapatkan pekali seret. Selepas itu, pengiraan penggunaan minyak telah dilakukan dianatara model biasa dengan model yang telah diubah menggunakan alat yang dipilih. Hasilnya akan digunakan untuk membina prototaip baru badan trak makanan.

ABSTRACT

This project will be more focus on food truck body on Land Rover Defender 110 cargo platform because this cargo platform will used as reference to design a new food truck body. This project is about study the aerodynamics device that will be used on the food truck body design. The current food truck got some problem in body design that contributed to drag coefficient. To achieve this project requirement, some models of food truck are made with different device on the body design and will be analyzed to obtain the drag coefficient. After that, calculation fuel consumption have been made between standard model and modified model with device that have choose. The result will used to fabricate a new prototype of food truck body.

DEDICATION

I would like to dedicate this to my father, Mr. Mohd Azman Bin Abd Gani and my mother, Mrs. Nor Hida Binti Zaidani, my supervisor Mr. Mohd Mohd Idain Fahmy bin Rosley, and my teammate Mohd Anas, Muhd Suqkri and Muhd Mahadhir for supporting me from the beginning until this project completely finish..

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LIST OF SYMBOLS

D = Drag force

$\boldsymbol{\rho}$ = Density of free stream air

V = Velocity of free stream air

S = Cross sectional area or drag area

Cd = Coefficient of drag

Re = Reynolds number

L = Length of the body

$\boldsymbol{\theta}$ = Deflection angle

$\boldsymbol{\nu}$ = Kinematic viscosity of the fluid

$\mathbf{C_r}$ = Rolling Coefficient

$\mathbf{P_D}$ = Power to overcome the aerodynamic drag force

$\mathbf{F_r}$ = Rolling Resistance

$\mathbf{P_R}$ = Power to overcome the rolling resistance.

$\mathbf{P_T}$ = Power loss of transmission.

G = Fuel Consumption

LIST OF ABBREVIATIONS

CFD = Computational Fluid Dynamics

CAE = Computer Aided Engineering

VG = Vortex Generators

VWT = Virtual Wind Tunnel

CAD = Computer Aided Design

SLS = Selective Laser Sintering

JPJ = Road Transport Department Malaysia **(**Jabatan Pengangkutan Jalan).

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Food truck is a moving food store. Due to the cost of living and rental of high business sites, many traders or restaurant owners turn to the food truck business. This is because the food truck allows them to trade in different locations everyday from trading in just one location (Anenberg and Kung, 2015). In Malaysia, associate with the pop-up restaurant phenomenon which become particularly popular by offering gourmet cuisine and variety of specialties and ethic menus.

The good design for a food truck is important for long-term durability and is safe on the road. A good planning in the food truck design can save the cost and time of making a food truck. In this study, there is more focus on the design of the food truck body. Food trucks are used as reference designs to design a new food truck body. The goal of this project is to design, analyse, and compose the body for food trucks. This design is referred to the used trucks now. It can be adjusted, lightweight and withstand heavy loads. This project is based on the LEGO concept in which the food truck body can be adjusted and produce more space.

Material selection is important as the need for design must be simple, low cost, easy to fabricate at the same time light weight. Examples of these materials are fiberglass, aluminium sheets and light steel sheets that are similar to the advanced boating bodies. **Figure 1** is the example of standard food truck body.

Figure 1: Standards of food truck body

1.2 Problem Statement

This project is done to modify the Land Rover Defender HCPU to portable food trucks. If viewed on the Land Rover it is impossible to be used as a food truck due to the small truck chassis but if carefully planning for this modification, Land Rover is capable of being a fully equipped and affordable food truck.

The body designs nowadays often use heavy material, excessive and heavy structure designs to be loaded by the truck. The current food truck needed design with modular unit, low cost, compact, and low drag body. The modification of this food truck must also comply with the road specification set by JPJ to be safely used on the road.

Current food truck body fix and buyer need to buy additional vehicle as a supply truck. This food truck design must be durable, lightweight, and not over design. But there are some criteria that are considered which are materials used, functionality, and the building process. Additionally, this project also wishes to improve on the air drag reduction design on this existing food truck.

1.3 Project Objective

The objective of the present research is:

1) To develop a new design of food truck body.
2) To analyse the aerodynamics of food truck body.
3) To fabricate a low drag food truck body prototype.

1.4 Project Scope

The scope of the present research is :

1) Design a food truck body using SolidWork Software.
2) To study the analysis of the food truck body aerodynamics design using Virtual Wind Tunnel by HyperWork Software.
3) To study the fabrication process of food truck body on Land Rover Defender HCPU Malaysian Army cargo base platform.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will discuss and explain about the fundamental, theories and concepts of this project. This chapter also review about the perspective, materials and process handling that will be used in this project.

2.2 Food Truck

Food trucks are trucks specially designed for cooking and selling food with complete kitchen fittings. Some food truck dealers also sell frozen food, packaged food or cook food in the food truck itself like sandwiches, hamburgers, French fries, and other fast food. Developing to today, the food truck already grown as more extensive service scope, we can see the food truck anywhere and anytime. The food truck is the combination of delicious and fashion, it also growing in popularity all over the world.

In Malaysia, only two food trucks like La Famiglia launch in the Klang Valley in October 2014. Immediately continue today, and there are 70 food trucks today in the Klang Valley alone (Abirami Durai, 2016). In 2017, Selangor has about 130 food work trucks, and this amount is double by 2018, as Amirudin Shari, State Government Exco for Youth Development, Sports, Culture and Entrepreneurial Development (Anthony See Lum Lok, 2017).