



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**DESIGN, ANALYZE, OPTIMIZE AND FABRICATE A
BODYWORK STRUCTURE OF MODULAR 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 Technology) with Honours

by

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DECLARATION

I hereby, declared this report entitled Design, Analyze, Optimize and Fabricate a Bodywork Structure of Modular Food Truck is the result of my own research except as cited in reference.

Signature :

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Date :

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Automotive Technology) with Honours. The member of the supervisor is as follow:

.....

(En Mohd Hafizi bin Abdul Rahman)

ABSTRACT

This study focused on bodywork structure design, analyze, optimization and fabrication of food truck. The goals and objectives of this project are to produce a new bodywork structure of food truck based on LEGO concept. The designs are produced using solid work software and fabricate using mild steel. The bodywork structure is then analyzed using topology optimization to determine the strong structure. The fabrication process proceeds by using standard manufacturing methods.

ABSTRAK

Kajian ini tertumpu kepada reka bentuk, menganalisa, mengoptimun dan pembinaan pada struktur badan trak makanan. Matlamat dan objektif projek ini adalah untuk menghasilkan struktur badan baru untuk trak makanan berdasarkan konsep LEGO. Reka bentuk yang dihasilkan menggunakan perisian kerja kukuh (Solid work) dan membina struktur badan menggunakan keluli lembut. Struktur badan trak makanan kemudiannya dianalisis dengan menggunakan pengoptimuman topologi untuk menentukan struktur yang lebih kukuh. Proses pembuatan dijalankan dengan menggunakan kaedah pembuatan yang standard.

DEDICATION

This work is dedicated to my parents Amran bin Harun and Zubaidah binti Ibrahim, my family, my friends, my co-supervisor Mr Mohd Idain Fahmy bin Rosley and to my supervisor Mr. Mohd Hafizi bin Abdul Rahman.

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CHAPTER 1

INTRODUCTION

1.0 Food truck

1.0.1 History

Food truck idea came from Charles Goodnight, the Inventor of Food truck as viewed at <<https://restaurantsuccess.touchbistro.com/food-truck/the-history-of-the-food-truck>>

Furthermore, the history of food trucks can be tracked through a young man from Rhode Island from 130 years ago. In 1691 New York is now known as New Amsterdam regulates street vendors selling food. After that, the revolution continued and in 1872, the first mobile diner was set up in a horse-drawn covered express wagon. Then food trucks continue to change over time until in 1960, mobile food trucks make their presence known to construction sites around the

world. Then, food truck revolutions continue to grow so that in 2010 Southern California Mobile Food Vendors Association is related to protect the rights of gourmet truck owners.

1.0.2 Design

Food trucks come in various designs such as truck tacos, truck pizza and ice cream trucks. What is to be seen, all kinds of food trucks are rectangular and cylinder-shaped. However, what distinguishes the current food truck is the way the food truck is transformed to more sophisticated and attractive. Nowadays, the food truck companies make a winning designs and smart branding as they face fierce competition from other trendy food trucks. This is very good among traders because with the design and the form of attractive food truck can attract customers to visit more as viewed at <http://www.printmag.com/branding/7-ingenious-food-truck-designs/>

1.0.3 Functionality

Nowadays, food truck has brought change to be one of the main attractions in the food industry and food truck are created to fulfill the needs of the most demanding customers who wish to run a business. This is because the food truck can move. Accordingly, this food truck does not have fixed locations. This is because it suitable for use in any place such as concerts, grand occasions and for business on weekends. In addition, the food truck is not only synonymous with traditional foods instead of preparing the quality foods like western foods. Furthermore, the food truck is trending and popular among chefs because of the advantages that can move and use a low cost. In addition, food truck is a large vehicle that has equipment to cook and sell food as viewed at

<<https://restaurantsuccess.touchbistro.com/food-truck/the-history-of-the-food-truck/>>.

1.0.4 Demand

Food truck industry is growing rapidly and is forecast to continue to grow in the coming years according to some recent studies. With a wide range of affordable options in terms of food, low prices and different places. The food truck business comes to all the family business to business for college students and society as viewed in < <https://foodtruckr.com/2017/09/what-data-can-tell-us-about-the-state-of-the-food-truck-industry/>>. This is due to the high demand from traders and buyers in the food truck business. In recent years, food truck trend has growing into Malaysia that brings to a whole new level. It is suitable for a quick lunch during works hours, supper with friends, or roaming the markets and festivals; there's bound to be a food truck somewhere around the corner. For example, in Subang Jaya by La Famiglia that running the business over 3 years selling western foods and in Kuala Lumpur by Flaming Wheels East Menu that comprises of local and international favorites ranging from traditional Malaysian cuisine, curries, and stir-fries, right up to European Gourmet meals, hotpots, sandwiches, and burgers as viewed in <[http:// http://thesmartlocal.com/read/food-trucks-malaysia](http://thesmartlocal.com/read/food-trucks-malaysia)>

In the present work the used food truck as the referral vehicles to come out with new design of mobility vehicle. The project is involved to design, analyze, optimize and fabrication strategy of modular bodywork food truck structure. The concept will based on LEGO which is easy to build, modular, light weight and low cost. The designing of body structure will based on food truck.

1.1 Problem Statement

The existing food truck is used as a referral vehicle for this project to come out with a new system to improve the market available food trucks. In addition, the present food trucks have several issues such as high cost, weight and limited functionality. Hence, the need for new bodywork structure of the food truck should consider these factors.

This lead to reconstruct a new design must be achieve our target to overcome the problem. Therefore, the new design may be different in order to tackle these issues. This conversion to the bodywork and towing mechanism have significant improvement in term of bodywork structure needs to be helps to accommodate the body and towing function of the food truck. The new design will consider the following factors:

- 1) Easy to repair, modular and light weight
- 2) Low maintenance cost and market ready.
- 3) Tolerance toward in High Humidity-High Temperature weather.
- 4) Use materials that is available in welding ordinary workshop in Malaysia
- 5) Can be used in any situation not only like a restaurant

1.2 Objective

The objectives of this project are as follows:

- i. To proposed new design concept of food truck body structure for Malaysian market that lightweight and low cost.
- ii. To optimize the new design concept of Food Truck Bodywork Structure (FTBS) using Topology Optimization.
- iii. To fabricate the proposed design concept using standard manufacturing practice.

1.3 Scope

The scopes of this project begin with the design of the structure body for FTBS follow by the structural analysis. The overall scopes of the project are as follow:

- 1) The design of the FTBS only uses the market availability spare part.
- 2) The Topology Optimization and Solid work is used to conduct analysis of new FBTS.
- 3) The framework of Rover Defender HCPU Malaysian Army (4x4) is used as a platform for the FTBS size and dimension guidance.
- 4) The fabrication processes follow the standard manufacturing process practice.

1.4 Organization of Thesis

The remainder of this thesis is comprised of eight further chapters as summarized below.

Chapter 2: A review of literature relevant to the present study comprising of the bodywork structure of modular food truck, strength and the material choose.

Chapter 3: The new methodology, proposed through the integrated FE approach is described. This uses selected software simulation to study the structure on bodywork of modular food truck and construction drawing of CAD data in different test.

Chapter 4: Design construction on the selected design. This determines the selection of designs to be used and the results will make improvements and develop for future and will be discussing on Topology Optimization. In this section, the selected design will be optimized for the decision to reduce the deficiencies in the old design. The experimental work evaluates the structure performance by measuring the displacement, factor of safety, max shear stress, compression, Von Misses Stress, and Major Principal Stress. In this section after testing on selected designs, a new design will be created and continued with process fabrication. The fabrications involved are MIG welding, steel cutter chop, and Bosch angle grinder.

Chapter 5: Conclusion are drawn from the overall finding of the research along with recommendations for future work.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will discuss and explains about the fundamentals, theories and concepts of this project. This chapter also review about the perspective, materials and process handling that will be used in this project. The concept of the food truck body is discussed and explained is more about design and comparison.

2.1.2 Food Truck

The food truck market has experienced rapid growth over the past several years, driven by the emergence of the “gourmet food truck”, it is tending to serve higher quality food at higher prices than more traditional mobile vendors. According to the National Restaurant Association in 2011, food trucks are the single fastest growing sector of the restaurant industry. The benefit to being able to serve different locations is that consumers have a taste for variety in their day to day food consumption. The food truck can avoid customers which have already been served recently. The cost to be a food truck is that there is uncertainty as to whether a location will be accessible on any given day. For

example, all the parking spots at a location may be taken before the food truck arrive,(Anenberg & Kung 2015).

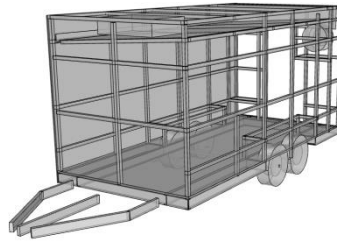


Figure 2-1: Food truck chassis structure

(Source:<https://aapfoodtruck.wordpress.com/2012/06/12/168/>>)

2.3 Software

2.3.1 Solid work

There are various types of software that can help engineers to design in the shortest time possible at lower cost in their development task. Currently, there are software that enables the design and simulation of various types of objects in three dimensional (3D),(Hanif *et al.*, 2014).

SolidWorks software was chosen as it had been used effectively by other researchers in the development of product models. It offers shorter development time, better product design and increasing product performance due to better simulation process.(Hanif *et al.* 2014)

2.4 Optimization method topology and shape

2.4.1 Introduction

Topology optimization (TO) is a mathematical method that optimizes material layout within a given design space, for a given set of loads, boundary conditions and constraints with the goal of maximizing the performance of the system,(Belytschko *et al.* 2003).

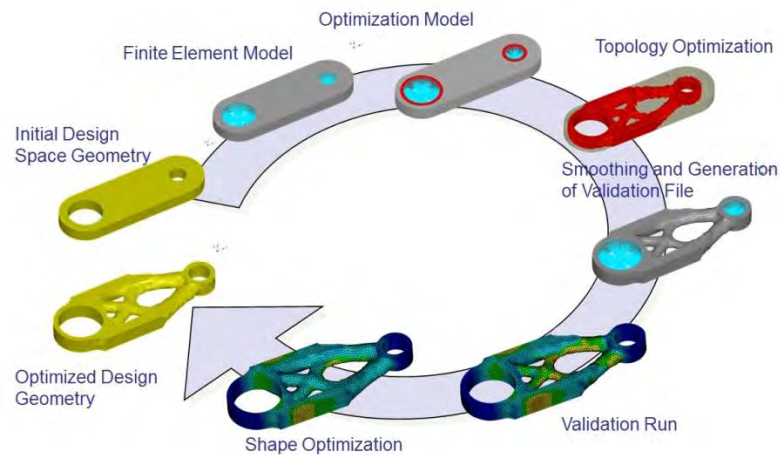


Figure 2-2: Optimization method

(Source: <<https://caelinx.com/how-tosca-optimization-software-improve-your-product-development-process>>22/04/14)

Topology optimization is formulated in terms of the nodal variables that control an implicit function description of the shape. The implicit function is constrained by upper and lower bounds, so that only a band of nodal variables needs to be considered in each step of the optimization. Besides that, the topology optimization constructed follow by the equations of equilibrium to solve the solutions,(Belytschko *et al.* 2003).

Structural optimization has been successfully used in many industries such as automotive industries. Structural optimization can be classified into sizing,