

**DESIGN OF FOOD TRUCK THAT FULFILL THE ERGONOMIC PURPOSES**

**MUHAMMAD ASRUL BIN MAT PAUZI**

**UNIVERSITI TEKNIKAL MALAYSIA MELAKA**

**DESIGN OF FOOD TRUCK THAT FULFILL THE ERGONOMIC PURPOSES**

**MUHAMMAD ASRUL BIN MAT PAUZI**

**A report submitted  
in fulfillment of the requirements for the degree of  
Bachelor of Mechanical Engineering (Design)**

**Faculty of Mechanical Engineering**

**Universiti Teknikal Malaysia Melaka**

**MAY 2017**

## SUPERVISOR'S DECLARATION

I have checked this report and the report can now submitted to JK-PSM to be delivered back to supervisor and to the second examiner.

Signature : .....

Name of Supervisor : Mohd Nazim Bin Abdul Rahman

Date : .....

## **AUTHOR DECLARATION**

“I declared that this project report entitle DESIGN OF FOOD TRUCK ARRANGEMENT THAT MEET THE BUSINESS AND ERGONOMIC PURPOSES is a record of original work done by me under the guidance of Sir Mohd Nazim Bin Abdul Rahman except the ideas and summaries which I have clarified their sources.”

Signature : .....

Author : Muhammad Asrul Bin Mat Pauzi

Date : May 2017

## ABSTRACT

The main purpose of this project is to design the food truck arrangement that meet the business and ergonomic purposes. The scope of this project will be detailed on the design of the food truck by using the size of 250 kilogram truck with dimension of 17ft x 4ft x 6ft. However, the cost of the product will be not discussed during the research. To achieve the objective of this project, a good methodology was produced which will be started by identifying the problem statements regarding to the existing food truck. The literature review will be conducted properly to obtain enough information regarding to this project. After that, the observation towards the existing food truck was done to identify the customer needs. Next, the five type of conceptual design will produced by using morphological chart, then the best concept will select by using the weighted rating method where it was evaluated by the customer requirements. Configuration design was the next step where the general dimension, arrangement and the material used to each components are established. This project continued with the parametric design where the design will be analyse by using CATIA software. In this chapter, the ergonomic will be evaluate by using the Rapid Upper Limb Assessment (RULA) analysis. Based on the result obtained, the process will be proceed to the Digital Mock-Up Kinematics where to show the movement of each part on the product produced. Based on the result, the level of ergonomic obtain was low risk and change may needed. Therefore, the research was being conclude.

## ABSTRAK

*Tujuan utama projek ini adalah untuk mereka bentuk susunan trak makanan yang memenuhi keperluan perniagaan dan ergonomik. Skop projek ini akan menerangkan tentang reka bentuk trak makanan dengan menggunakan saiz trak 250 kilogram dengan dimensi 17 kaki x 4 kaki x 6 kaki. Walau bagaimanapun, kos produk ini tidak akan dibincangkan semasa penyelidikan. Untuk mencapai matlamat projek ini, metodologi yang baik telah dihasilkan dengan mengenalpasti pernyataan masalah mengenai trak makanan yang sedia ada. Kajian literatur akan dijalankan dengan baik untuk mendapatkan maklumat yang mencukupi mengenai penyelidikan ini. Selepas itu, pemerhatian terhadap trak makanan yang sedia ada telah dilakukan untuk mengenal pasti keperluan pelanggan. Seterusnya, lima jenis reka bentuk konseptual akan dihasilkan dengan menggunakan carta morfologi, maka konsep terbaik akan dipilih dengan menggunakan kaedah penarafan berwajaran di mana ia dinilai oleh keperluan pelanggan. Reka bentuk konfigurasi adalah langkah seterusnya di mana dimensi, susunan umum dan bahan yang digunakan untuk setiap komponen ditubuhkan. Projek ini diteruskan dengan reka bentuk parametrik di mana reka bentuk akan dianalisis dengan menggunakan perisian CATIA. Dalam bab ini, ergonomik akan dinilai dengan menggunakan analisis Rapid Upper Limb Rapid (RULA). Berdasarkan hasil yang diperolehi, proses akan diteruskan ke Kinematics Mock-Up Digital di mana untuk menunjukkan pergerakan setiap bahagian pada produk yang dihasilkan. Secara kesimpulan, kadar bagi mendapat sebarang kecederaan ataupun ergonomik adalah rendah dan perubahan mungkin diperlukan. Oleh itu, penyelidikan telah disimpulkan dengan sempurna.*

## ACKNOWLEDGEMENT

Through this acknowledgement, highest praise to Allah Almighty who gave me an opportunity to finished in preparing this thesis. Without His numerous blessings it would not have been possible.

I would like to extend my deepest gratitude to few people who are involve in accomplishing of this 'Project Sarjana Muda' thesis. I would like to thank to my supervisor, Sir Mohd Nazim bin Abdul Rahman for his guidance, support and also a valuable comments regarding to this thesis.

Next, my thanks are also delivered to Dr. Mohd Asri Bin Yusuff and Dr. Siti Nurhaida Binti Khalil as my second examiner who are willing to read this thesis. Besides that, a good recommendation also being suggest by them as to improve the quality of this thesis.

Last but not least, I owe my loving thanks to both of my parents, family members and friends for giving me consistent moral support that encouragement me in completing this project successfully.

## TABLE OF CONTENT

CHAPTER	CONTENT	PAGE
	<b>SUPERVISOR'S DECLARATION</b>	ii
	<b>AUTHOR DECLARATION</b>	iii
	<b>ABSTRACT</b>	iv
	<b>ABSTRAK</b>	v
	<b>ACKNOWLEDGEMENT</b>	vi
	<b>TABLE OF CONTENT</b>	vii
	<b>LIST OF TABLES</b>	x
	<b>LIST OF FIGURES</b>	xi
	<b>LIST OF ABBREVIATIONS</b>	xiii
	<b>LIST OF APPENDICES</b>	xiv
<b>CHAPTER 1</b>	<b>INTRODUCTION</b>	
	1.1 BACKGROUND STUDY	1
	1.2 PROBLEM STATEMENT	2
	1.3 OBJECTIVE	3
	1.4 SCOPE OF PROJECT	3
<b>CHAPTER 2</b>	<b>LITERATURE REVIEW</b>	
	2.1 INTRODUCTION	4
	2.2 FOOD TRUCK REGULATION	5
	2.2.1 Economic safety	6
	2.2.2 Public space	7
	2.2.3 Public health	8
	2.3 MATERIAL	9
	2.3.1 Stainless Steel	9
	2.3.2 Aluminum	10
	2.4 ERGONOMIC	11



<b>CHAPTER 3</b>	<b>METHODOLOGY</b>	
3.1	INTRODUCTION	14
3.2	PROBLEM STATEMENTS	16
3.3	LITERATURE RIEVIEW	16
3.4	CONCEPTUAL DESIGN	16
	3.4.1 House of Quality (HOQ)	17
	3.4.2 Product Design Specification (PDS)	18
	3.4.3 Morphological Chart	19
	3.4.4 Weighted Rating Method	19
3.5	CONFIGURATION DESIGN	20
	3.5.1 Selection of material and manufacturing process	20
	3.5.2 Dimension of parts	21
3.6	PARAMETRIC DESIGN	22
	3.6.1 DMU Kinematics	23
	3.6.2 Rapid Upper Limb Assessment (RULA)	23
3.7	DETAIL DESIGN	24
<b>CHAPTER 4</b>	<b>CONCEPTUAL DESIGN</b>	
4.1	INTRODUCTION	25
4.2	HOUSE OF QUALITY (HOQ)	25
4.3	PRODUCT DESIGN SPECIFICATION (PDS)	27
4.4	MORPHOLOGICAL CHART	28
4.5	CONCEPT DESIGNS	30
	4.4.1 Concept 1	30
	4.4.2 Concept 2	31
	4.4.3 Concept 3	32
	4.4.4 Concept 4	33
	4.4.5 Concept 5	34
4.6	CONCEPT EVALUATION	35

<b>CHAPTER 5</b>	<b>CONFIGURATION DESIGN</b>	
5.1	INTRODUCTION	37
5.2	MATERIAL	37
5.2.1	Wall and Ceiling	38
5.2.2	Floors	38
5.2.3	Kitchen Cabinet	38
5.2.4	Roof/ Awnings	39
5.2.5	Others equipment	39
5.3	SIZING	40
5.3.1	Body	40
5.3.2	Cashier	41
5.3.3	Drink Compartment	42
5.3.4	Folded Table	43
5.3.5	Sink	44
5.4	ARRANGEMENT	45
5.5	ORTHOGRAPHIC VIEW	47
5.6	BILL OF MATERIAL (BOM)	48
<b>CHAPTER 6</b>	<b>PARAMETRIC DESIGN</b>	
6.1	INTRODUCTION	50
6.2	DMU KINEMATICS	50
6.3	ERGONOMIC (RULA) ANALYSIS	55
<b>CHAPTER 7</b>	<b>CONCLUSION</b>	
		59
	<b>REFERENCES</b>	
		60
	<b>APPENDIX</b>	

## LIST OF TABLES

<b>TABLES</b>	<b>TITLE</b>	<b>PAGE</b>
2.1	Type of Musculoskeletal Disorders (MDs)	13
4.1	House of Quality (HOQ)	26
4.2	Product Design Specification	28
4.3	Morphological Chart	29
4.4	Weighted Rating Method	35
6.1	Level of MSD risk	55

## LIST OF FIGURES

FIGURES	TITLE	PAGE
2.1	La Famigla Food Truck Malaysia	4
2.2	Space provided for the food truck business	5
2.3	People are observing the price of food served	6
2.4	Public space provided for food truck businesses	7
2.5	Need to ensure the cleanliness in the food truck	8
2.6	Graph showing the level of corrosion resistance of JEF443CT with other stainless steel	10
2.7	Graph showing the volume per unit weight of the aluminium with other materials.	11
3.1	Flow chart of the methodology food truck	15
3.2	For houses of the complete QFD process	17
4.1	Concept design 1	30
4.2	Concept design 2	31
4.3	Concept design 3	32
4.4	Concept design 4	33
4.5	Concept design 5	34
4.6	The best concept design	36
5.1	The body of food truck	38
5.2	The dimension of cash register or cashier	39
5.3	The dimension of drink compartment	40
5.4	The dimension of folded table	41
5.5	The dimension of sink in kitchen	42
5.6	The dimension of sink on table	43
5.7	The arrangement inside the food truck	44
5.8	The design and arrangement in 3D view	44
5.9	Orthographic view of food truck	47
5.10	First Sheet of BOM	48
5.11	Second Sheet of BOM	49
6.1	Side body of food truck	51
6.2	Back side body of food truck	52

6.3	The roof of food truck	53
6.4	First stage of kinematic simulation	53
6.5	Motion of folded table and monitor	54
6.6	Second stage of kinematic simulation	55
6.7	Properties of three manikin	56
6.8	RULA analysis of first manikin	57
6.9	RULA analysis of second manikin	57
6.10	RULA analysis of third manikin	58

## LIST OF ABBREVIATION

Cr	Chromium
HOQ	House of Quality
PDS	Product Design Specification
CRs	Customer requirements
ECs	Engineering characteristics
IEA	International Ergonomics Association
MSDs	Musculoskeletal disorders
STS	Socio-technical system
QFD	Quality Function Deployment
FEA	Finite element analysis
BOM	Bill of Materials
ATM	Automated teller machine
PIM	Business Improvement Financing Scheme
NGO	Non-Government Organization
RULA	Rapid Upper Limb Assessment
DMU	Digital Mockup
FRP	Fibre-reinforced Plastic
1MMH	1Malaysia Mobile Hawker

## LIST OF APPENDICES

- Appendix A1 : Gantt Chart PSM 1
- Appendix A2 : Gantt Chart PSM 2
- Appendix A3 : Participant of 1MMH
- Appendix A4 : Located at Putrajaya (1MMH)
- Appendix A5 : Hot spot location at Presint 2, Putrajaya (Open everyday)
- Appendix A6 : Standard size of truck that was provide by KPDNKK
- Appendix B1 : Standard size of fryer equipment
- Appendix B2 : Standard size of Griddles equipment
- Appendix B3 : Orthographic view of kitchen cabinet with countertops
- Appendix B4 : Orthographic view of stainless steel kitchen cabinet
- Appendix B5 : Orthographic view of air ventilation inside the food truck
- Appendix B6 : Dimension of monitor for display the menu provides
- Appendix B7 : Orthographic view of preparation table
- Appendix B8 : Roof of the food truck dimension
- Appendix B9 : Right side awnings on the roof of the food truck
- Appendix B10 : Left side awnings on roof of the food truck
- Appendix B11 : Long side awnings on roof of the food truck
- Appendix B12 : Water tap / pipe provide for customer
- Appendix B13 : Stairs for customer to reach the platform
- Appendix B14 : Orthographic view of food truck before dissemble
- Appendix B15 : Orthographic view of first phase of motion
- Appendix B16 : Orthographic view after all the motion being done
- Appendix B17 : Isometric view from before motion until the end of the simulation

# CHAPTER I

## INTRODUCTION

### 1.1 BACKGROUND STUDY

Food truck was found by Chuckwagon which is the founder of American food truck. In 1866, Charles Goodnight or known as a “father of the Texas Panhandle” decorate the old United States Army wagon with some interior to keep some important things such as medical supplies and food. At the same time, the wagon also provided barrel of water and a sling as a medium to heat and cook some food.

Nowadays, the food truck is one of the medium where people can get involved into business. As stated in the New York Magazine in 2009, “largely transcended its roach-coach classification and is now a respectable venue for aspiring chefs to launch careers” where this food truck usually will be the starting point to the new chef to start their careers. The popularity of food trucks was growing where the United States government provided the food truck parks and food truck rallies. Furthermore, the popularity of the food trucks lead the creation of associations that protect and support their business right.

In Asia, the food truck provided usually reflect to the local culture and flavour. Food trucks commonly offered a simple dishes that requires simple skill, basic facilities with a small amount of capital. The food truck in Asia normally will be much smaller than the other region due to the average size of Asian people. The food truck is a modified of truck or van with a built in basic needs or machine depends on the food



that being served. For an example, a reliable flat grill, a couple of fryers, main cooking kit, fridges, freezers and hand washing is a common equipment to start a food truck business with menu of fast food.

Food truck also was being a new attraction to the people in Malaysia. Since this a best step for people to increase their private income, the Malaysian Government offered Business Improvement Financing Scheme (PIM) which one of the facilities provided was by giving RM 250,000 for companies to sole proprietorship or partnerships while RM500,00 for the company alone. Other than that, MARA also offered Business Advisory Service Scheme for food truck entrepreneurs who have a problem on improving their performance and productivity. This statements was being issued on Berita Harian Online on Monday, 4<sup>th</sup> July 2016.

## **1.2 PROBLEM STATEMENT**

Food truck is a large vehicle designed to cook and sell food. In recent years, associated with the pop-up restaurant phenomenon, food trucks offering gourmet cuisine and a variety of specialties and ethnic menus, have become particularly popular. Nowadays, food truck, along with portable food booths and food carts, are on the front line of the street food industry since people around the world preferred to have a food from a street rather from the restaurant. This can help them to save their time and money. Unfortunately, every country had different type of food truck. For an example, food truck in the Europe have the bigger size to synchronize with the size of the human population in the country. When the size of the food truck was being increased, the cost to maintain the truck also will be much expensive. Next, the design of the existing food truck was too common. The food truck must be redesign according to development of the latest technology. Furthermore, the arrangement of the food truck was not in a suitable for people in Asia. The most suitable way was by upgrading or improving the existing food truck with multitask function which are include chair and table, using solar as a power source and many more.

### **1.3 OBJECTIVE**

The objectives of this project are as follows:

- I. To design a food truck with multitask function
- II. To design a food truck that have an ergonomic condition.

### **1.4 SCOPE**

The scope of this research is mainly focused on the design of the food truck in an Asian region. To complete this research, an observation must be made on the existing food truck. Based on this, it will found out the pro and cons of existing food truck and make as a point to improve in the new design. From the information gained, fast food was being choose as a specific menu on this research. Next, the size of the 250 kilogram truck with dimension; length x height x width (17ft x 4ft x 6ft) was being selected. For this research, the head part of the truck was neglected. Moreover, the cost to develop this food truck also will be neglected. Then, the best concept design will being choose. Finally, the best concept design will being analysis by using the Digital Mock-up (DMU) kinematics and also Rapid Upper Limb Assessment (RULA) on the CATIA software.

## CHAPTER II

### LITERATURE REVIEW

#### 2.1 INTRODUCTION

In this chapter, the main objective is to collect all the information regarding to the project which is a food truck. This chapter will be divided into three section which the regulations of food truck, material and ergonomic condition on the food truck. Food truck have been introduced across the world that serving an affordable modern dining and delicious that rarely can be found. Nowadays, this food truck have become a new trend especially in Malaysia. Some of the Non-Government Organization (NGO) in Malaysia had organize some of the event which is one of the powerful engines of economic growth. Food truck also create jobs which contributes to decrease the number of unemployed in this country. For some reason, this food truck also will attract people to involve into the business which will help to reduce the level of poverty around the country.



Figure 2.1: La Famiglia Food Truck (Malaysia)

(Source: <http://www.worldofbuzz.com/16-must-try-food-trucks-in-klang-valley/>)

## 2.2 FOOD TRUCK REGULATIONS

McFarland and Pickren (July 27, 2015) has stated that the technology of food truck had being improved which lead to a better economic opportunities for works. The presence of food truck to the world had create a new alternative for the hopeful restaurant which increased the income of the restaurant since it is easier to handle and cost-friendly. Food trucks also have fulfil the desire of the customer based on the quality, value and the freshness of the food provided. Nowadays, many food truck was equipped with high-tech cooking equipment and device that help to save the time in preparing the food. Furthermore, the safety and health of the food produce from the food truck is important to be take care by following the regulations that create depends on the country. To have a good food truck, the city social need to be balanced with the regulations of the food especially in four policy areas which are:

- I. Economic activity
- II. Public Space
- III. Public health



Figure 2.2: Space provided for the food truck business

(Source: Food on Wheels: Best Practices for Integrating Food Trucks into City Life)

### 2.2.1 Economic Safety

Economic safety can be divided into two sections which are streamlining and cost of permits for food trucks. The meaning of economic safety is the private area that is provided by the government in which follows the aspect of food truck regulation. Usually, this can increase the development of economic in country. For the streamlining section, the regulation will decide whether the licenses and permits for the food truck are gained easily or not. This will be decided based on the impact of the food truck towards the surrounding especially to the customer. Next is about the cost of permitting which is one of the main steps to start a business. This will include the permitting fees and the cost of the food served that will be decided by the owner either an increase from the actual permit or decreased in cost determined by some vendor.



Figure 2.3: People are observing the price of the food served.

(Source: Food on Wheels: Best Practices for Integrating Food Trucks into City Life)

### 2.2.2 Public Space

Public space is an area provided to a food truck business that gather all type of food in a place. This will increased the demand of the customer and at the same time, limited space will create a competitive between the businesses. The advantages of public space is the customer can have different type of food in a place which can save customer time in having some food. At some point, the food truck must be located to a place where it is easy to be found such as in a city, street and maybe in front of company building. This will reduce the patronage at area restaurants.



Figure 2.4: Public space provided for a food truck businesses.

(Source: Food on Wheels: Best Practices for Integrating Food Trucks into City Life)

### 2.2.3 Public Health

Public health can be evaluate by the sanitation of the surrounding. Sanitation refers to the food truck proper cleaning such as a clean drink water and adequate disposal of garbage. This is an important rules that strictly need to be followed by the owner of the food truck. To prevent from contamination, the waste water tank must be located lower that the potable tank. Two or three sinks are needed do to washing which one of them is for washing the equipment and another one is for washing hands. Every country will developed a rules regarding to the sanitation that must be followed. Unfortunately, some of the workers or owners did not take this as a serious matter which will affect the customer health.



Figure 2.5: Need to ensure the cleanliness in the food truck.

(Source: Food on Wheels: Best Practices for Integrating Food Trucks into City Life)

## **2.3 MATERIAL**

Material selection must be precise and correct to have a better product. Some of the factors must be considered during choosing the material. One of them is on the material properties. The level of performance from the material must being satisfied the customer needs. Next, the cost and price must be affordable and easy to get the materials. The material used in the food truck usually being select based on the owner of the food truck. Nowadays, majority of the food truck used stainless steel and aluminium as the materials for the interior and exterior.

### **2.3.1 Stainless Steel**

Stainless steel is non-porous hygienic surface which is very good for the food preparation. This type of material allows the owner to easily wipe off the dirt and grease produced. The dirt can easily being cleaned by using soap and water since it is non-porous where the dirt and grease had no placed to collected. Furthermore, this material being applied on the walls and ceiling of the food truck. Some of the food truck will used stainless steel on the interior equipment such as counters, cabinets and shelving. Although the appearance of the surface is not good as a painted aluminium, but the quality is better than other materials. One of the type aluminium is 21Cr stainless steel that being produce by the JFE Steel Corporation (JFE443CT). This stainless steel have excellent corrosion resistance when the content of carbon and nitrogen was being reduced and be add by some Titanium. Other than that, this stainless steel also have excellent physical properties which less material weight used. The thermal conductivity of the material also is increased about 40% than other type of stainless steel (type304) produced by the company.