



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

**“ERGONOMIC STUDIES FOR PORTABLE ABLUTION
SYSTEM BY APPLYING SEQUENTIAL EQUATION
MODELING”**

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

by

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APPROVAL

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 (Product Design) with Honours. The member of the supervisory is as follow:

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ABSTRAK

Pemodelan persamaan struktur (SEM) adalah teknik analisis statistik multivariate yang digunakan untuk menganalisis hubungan struktur. Teknik ini adalah gabungan analisis faktor dan analisis regresi berganda, dan ia digunakan untuk menganalisis hubungan struktur antara pembolehubah yang diukur dan pembinaan laten. Kaedah ini disukai oleh penyelidik kerana menganggarkan kebergantungan berganda dan saling berkaitan dalam satu analisis. Dalam analisis ini, dua jenis pembolehubah digunakan pembolehubah endogen dan pembolehubah eksogen. Pembolehubah endogen bersamaan dengan pembolehubah bergantung dan bersamaan dengan pembolehubah bebas. Fungsi pemodelan persamaan struktur (SEM) dalam projek ini untuk memastikan analisis selidik memperoleh data ergonomik untuk sistem wuduk mudah alih. Selain itu, perisian Catia V5 juga digunakan dalam projek ini untuk menganalisis setiap postur Muslim dalam membuat wabak ritual. Ini untuk memastikan wabak mudah alih yang menghasilkan cukup ergonomik sesuai dengan keselesaan pengguna.

ABSTRACT

Structural equation modeling (SEM) is a multivariate statistical analysis technique that is used to analyse structural relationships. This technique is the combination of factor analysis and multiple regression analysis, and it is used to analyse the structural relationship between measured variables and latent constructs. This method is preferred by the researcher because it estimates the multiple and interrelated dependence in a single analysis. In this analysis, two types of variables are used endogenous variables and exogenous variables. Endogenous variables are equivalent to dependent variables and are equal to the independent variable. Function of this structural equation modeling (SEM) in this project to ensure the analyse of survey to obtained an ergonomic data for the portable ablution system. Besides that, the function of the sequential equation modeling (SEM) to analyse data obtained from an ergonomics survey on ablution using Sequential Equation Modelling. To produce an ergonomics data for Muslim ablution using CATIA V5. Plus, the Catia V5 software also use in this project for analyse each posture of Muslim in making the ritual ablution. This is to ensure the portable ablution that produce is ergonomic enough suitable with the comfortability for the users.

DEDICATION

To my beloved parents and siblings

Tohiran Bin Salleh
Salmiah Binti Tembol
Noor Fadhilah Binti Tohiran
Noor Faezah Binti Tohiran
Mohd. Fadhli Bin Tohiran
Nur Hidayati Binti Tohiran
Mohd. Shukri Bin Tohiran
Nur Syuhadah Binti Tohiran
Mohd. Hakimi Bin Tohiran
Nur Masyitah Binti Tohiran

Thank you for all supports, sacrifices and patients that has been shared with me.

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Encik Mohd. Fariduddin Bin Mukhtar & Encik Mohd. Hidayat Bin Abdul Rahman

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LIST OF ABBREVIATIONS

SEM	Sequential Equation Modeling
CATIA	Computer Aided Three Dimensional Interactive Application
PBUH	Peace Be Upon Him
OLS	Ordinary Regression Models
AMOS	Analysis Moment Of Structures
SPSS	Statistical Package for the Social Sciences
IBM	International Business Machines
RULA	Rapid Upper Limb Assessment
RMSEA	The Root Mean Square Error of Approximation
AVE	Average Variance Extracted
CR	Composite Reliability
MSD	Musculoskeletal disorders
D.O.F	Degree Of Freedom
V5	Version 5

CHAPTER 1

INTRODUCTION

1.0 Research Background

Recently, researchers have shown an increased interest in designing an ablution workstation according to the users' convenience. It shows that ablution workstation is really important in Muslim daily life as it is one of the daily routines for a Muslim who should be practicing for their religion. Ablution defines as a cleaning process that using water with washing the certain part of the body before performing a prayer. As the whole of the ablution process, it involves the washing of face, both of hand, head and feet which follow the sequence with repeated as two or three times. Ritual ablution need clean and holy water to make sure the ablution is accepted by God. Ablution is really synonym with water, so Muslim have been introduced the place to perform this ritual activity. Previous studies have reported many idea and design were established near the prayers house such as Mosque and Musollah. Each of the design ablution system workstations in the mosque will design in many variations as human behavior that will influence the way a Muslim performing the ablution.



Figure 1.1: Masjid MITC Melaka

Water is important in making ritual ablution. In Islamic hadith, water that needs for a Muslim to make a ritual ablution is only about half to two liters only. Usually, a process of ablution required six to nine liters of water in volume. Some of Muslim use the water with austerity but some will waste the water. To solve this problem some of invention or innovation has been developed for Muslim to the conservation of water when making a ritual ablution in daily life. It will be made in many ways as uses from the low until high technology. Besides from conserving the water, this kind of invention also can ease the process of make ritual ablution. One of the examples of this invention is the Automated wudhu machine which helps Muslims save water. This automated wudhu machine uses a high technology which enables a Muslim use only 1.5 liters of water each time they make a ritual ablution. The cost of one unit of this machine is quite expensive about RM9000.



Figure 1.2: The automated wudhu washer that conserves water

Based on research reported by Doctor Ahmed Mokhtar in 2015 there are design guidelines for ablution spaces in Mosques and Islamic praying facilities to make sure the ablution space is suitable for the behavior of the Muslim.(Mokhtar, 2005) There are certain requirements that needed to be considered when designing the ablution workstation such as the horizontal distance between adjacent ablution units should be wide enough to perform ablution without the users hitting one another which the recommended minimum distance is 82 cm, the ablution station should be safe to reach and leave-taking into consideration the wet feet condition to avoid the slipping accident and the most important The design should consider the elderly and sick users. All this requirement is involved in ergonomic factors which it is safe for the user and feels comfortable.

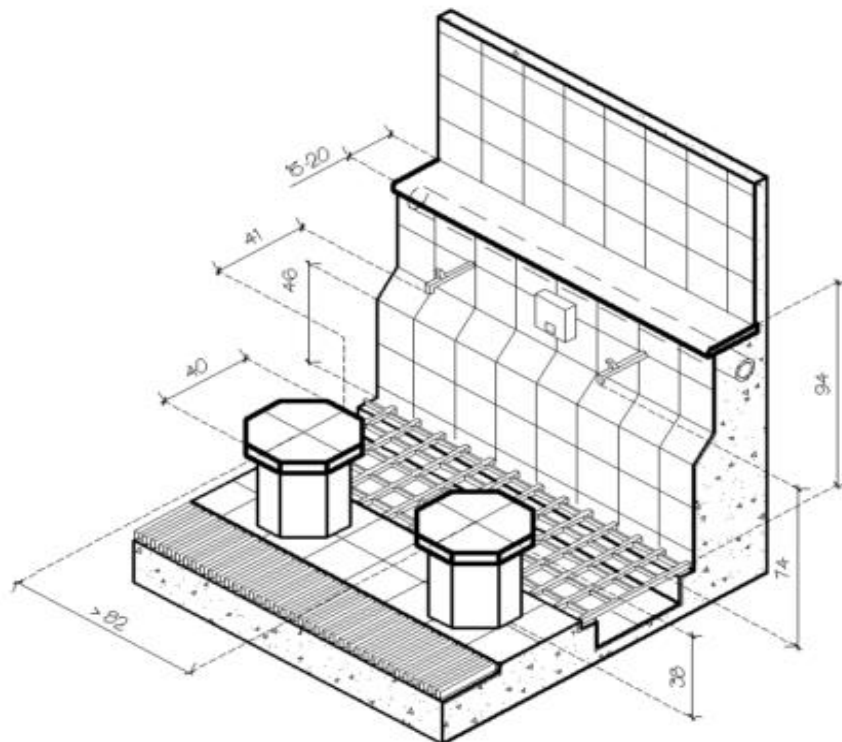


Figure 1.3: Design guidelines for ablution station with seats

1.1 Problem statement

As the previous study and research, ablution system is mostly not ergonomic enough which is the design of the ablution station not following the requirement of Muslim behavior (Johari, Hassan, Anwar, & Kamaruzaman, 2013). Based on the previous study, ergonomic is beyond to safety and health. But, a most problem when a Muslim make a ritual ablution is the place station of ablution when the designer does not consider all types people of Muslim such as sick people, elderly people, and handicapped person.

Most of the designer make the ablution station for only a normal person. The design of ablution station in Mosque which using the pipe system will consume more water in ablution process. In Islam, we as a Muslim need to conserve the water because wasting is one of devils temperament. Most of the research, the design of ablution station need about six to nine liters of water to make the full ablution process. The wasting of water will be one of the main problems in making the ritual ablution.



Figure 1.4: Example of ablution system using a pipe system

In the recent years, there are also several portable ablution systems which made by some inventors. As an example, a portable ablution station named WuduMate Compact design by WuduMate Company The WuduMate Compact established in 2007 which provide the next generation of washing appliances for ablution in prayers room, homes, and mosque. This product is easy to install at the building and it was supplied with an optional seat handle, making it easier for the elderly and infirm to stand and sit. It also designs together with a number of taps, in each case the tap spout located in the most comfortable position for wudu, with the direction of water-flow designed to minimize splashing to make sure the users clothe is not wet in making the ritual ablution. The WuduMate Compact is good enough in design and function but it difficult the user to bring everywhere when they go the place with no water. This is also the problem always user face when using the portable ablution systems. But the constraint is it is heavy and difficult for the user to bring this kind of portable ablution when they need to make ritual ablution.



Figure 1.5: WuduMate Compact

Besides than WuduMate Compact another example of the portable ablution Wudu Pal design by WuduMate Company. It was designed for wudu and istinja'.It is one of a design solution for Muslim to make instinja' which washing the intimate areas before performing ablution for prayers.The benefits of this product are compact, portable, hygienic and discrete.It is in a compact size which can carry in the pocket or purse. It has a liter of water which more than water bottles normally used to make ritual ablution. After each use disposes of leftover water, fold it back and easily store in the given pouch again for use next time for an ablution process.But a preview of user customers mostly said that this product not long lasting because made of plastic and quickly damaged.This is the types of material used in this product and the way users use it.



Figure 1.6: Wudu Pal Product

1.2 Objectives

- i.To study the ergonomic of ablution system for a Muslim user.
- ii.To analyze data obtained from an ergonomics survey on ablution using Sequential equation Modelling.
- iii. To produce an ergonomics data for Muslim ablution using CATIA V5.