



DESIGN AND DEVELOPMENT OF SQUARE HOLE DIGGING GROUND MACHINE

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by

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as a partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Hons.).

The members of the supervisory committee are as follow:

.....
(PROFESSOR MADYA DR. RAJA IZAMSHAH BIN RAJA ABDULLAH)

ABSTRAK

Kesukaran dan masa menggali yang lama secara manual untuk menggali kubur merupakan motivasi bagi projek ini. Walaupun banyak ciptaan mesin penggali tanah komersial telah dibangunkan seperti penggali, traktor, loader dan lain-lain, mesin ciptaan sedia ada tidak sesuai untuk digunakan di tapak perkuburan yang mencabar. Antara cabarannya adalah kawasan kerja yang terhad dari segi pengangkutan dan meletakkan mesin, untuk mengelakkan runtuh kubur bersebelahan dan/atau pemadatan yang berdekatan dan akhirnya untuk memastikan tahap bunyi yang rendah. Berdasarkan cabaran dan kesukaran yang dinyatakan di atas, pembangunan mesin penggalian lubang kubur yang cekap diperlukan. Selain menyelesaikan masalah yang dihadapi oleh mesin semasa, pembangunan mesin memerlukan pertimbangan yang luas seperti jenis tanah, sumber kuasa, analisis struktur, kaedah fabrikasi serta kos yang akan menjadi kandungan utama projek ini. Untuk merealisasikan perkembangan mesin, alat reka bentuk kejuruteraan telah digunakan iaitu Design for Manufacture and Assembly (DFMA), Kaedah Pemilihan Pugh dan Analisis Elemen Finit Struktur. Berdasarkan kekangan dan keperluan, tiga reka bentuk permulaan yang dicadangkan akan dinilai dan salah satu penyelesaian terbaik akan dipilih untuk pembangunan prototaip. Akhir sekali, keberkesanan prototaip akan di nilai dan disahkan. Berdasarkan prototaip mesin penggali kubur yang dibangunkan, didapati mesin tersebut dapat menggali lubang kubur dengan mudah, masa operasi yang munasabah dan senang untuk dibawa ke kawasan kerja yang terhad.

ABSTRACT

The difficulties and time consuming of manual labour process for digging an opening grave has motivated this project. Although significant invention of commercialized earth digging machines i.e. excavator, tractor, loader, etc. has been developed, the existing invented machines were not suitable to be used at the challenging graveyard site as well as its strict requirements. Few of the challenges are tight working areas in terms of moving and placing the machine, to avoid collapsing of adjacent graves and/or compaction of ones nearby and lastly to keep the environment noise as minimum as possible. Based on the aforementioned challenges and difficulties, the development of efficient square hole digging machine are necessitate. Apart on solving the discrepancies faced by the current machines, the development of the machine required extensive consideration such as soil type, power source, structural analysis, fabrication method as well as costing which will be the main contents of this project. To realize the development of the machine, engineering design tools were employed namely Design for Manufacture and Assembly (DFMA), Pugh's Selection Method and Structural Finite Element Analysis. Based on the constraints and requirements, three preliminary propose design are evaluate and one of the best solution will be select for the prototype development. Lastly the effectiveness of the prototype will be validate and evaluate. Based on the developed square hole digging machine prototype, it was found that the machine capable of digging square hole with ease, reasonable operating time and ease of transportation to the tight working area.

DEDICATION

Only

my beloved father, Azlan Bin Abdul Aziz

my appreciated mother, Akidah Binti Awang

my adored brothers and sister Muhammad Imran, Irdina Izzati and Muhammad Irfan
for giving me moral support, money, cooperation, encouragement and also understandings

Thank You So Much & Love You All Forever

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CHAPTER 1

INTRODUCTION

This chapter discuss on the background of study, problem statement, objectives and scopes of the project.

1.1 Background of Study

The process of grave digging can be considered as a solitary occasion of rapid ousting or a 'period case' because of the moderately short period of time in which the procedure is attempted (Agus et al., 2010). The process of refilling the grave for the most part brings about a result in the situation of proof and the human stays exhibit inside the grave structure (Henson, 2009).

A grave can be characterized as a removal in the earth for the acceptance of a dead body (Oxford English Dictionary, 2015). As a grave is excavated, it 'cuts' the common or potentially man-made layers called strata, which are evacuated and the stratigraphic arrangement is disturbed. This process results the arrangement of another surface which are walls and floor underneath the ground onto which a body or bodies are put (Eta, 1963). In this way, the expelled natural or man-made layers are set once again into the grave structure as a 'fill' over the body. Normally, however, these layers move toward becoming intermixed during their evacuation and substitution. Differences form in the shading, surface, science, conservativeness, volume, water maintenance, smell, natural substance and pH level between the aggravated zone related with the grave structure and that of the undisturbed characteristic/man-made layers through which it was burrowed (Sing *et al*, 1971) . These dissimilarities empower the archaeologist to define areas of disturbance allowing for burial locations to be recognized and excavated.

Focusing in the context of Malaysian Muslim cemetery system, 75% of the grave digging process are being done manually by 2 to 3 person. According to the author interview with the grave digger workers, it was found that for the normal grave size of 6' (length) x 4' (width) x 6' (depth), digging process took approximately 1 to 2 hours to be completed depending on the few factors namely graveyard location, soil condition and weather. For cemetery that are located at the hill terrace and during the raining season, the time taken to complete the digging process can be up to 4 hours. The digging process can be worsen if the grave need to be dig more than one in a day.

Usually the digging process are accomplish using the agricultural equipment such as hoe, soil auger, spade, shovel, rake, pick axe and mattock. Although significant invention of commercialized earth digging machines i.e. excavator, tractor, loader, etc. has been developed, the existing invented machines were not suitable to be used at the challenging graveyard site as well as its strict requirements. Few of the challenges are tight working areas in terms of moving and placing the machine, to avoid collapsing of adjacent graves and/or compaction of ones nearby and lastly to keep the environment noise as minimum as possible. Apart from that, others challenging factor that need to be considered for the grave digging process are soil types such as clays, sands, peat, alluvial soil, saline soil and loam soil. The properties in each soil are different and have their own peculiar properties. Therefore, based on the aforementioned challenges and difficulties for grave digging process, the development of an efficient special purpose grave digging machine is necessitate.

1.2 Problem Statement

Focusing in the context of Malaysian Muslim cemetery system, 75% of the grave digging process are being done manually by 2 to 3 person., while others 25% employed the commercialized earth digging machines i.e. excavator, tractor, loader, etc.

The main problem faced with the manual digging process is the human energy itself which relate with the processing time. In addition, the equipment used for the manual digging process such as hoe, soil auger, spade, shovel, rake, pick axe and mattock required 80% of normal person endurance in average. The manual digging process are worsen if the grave need to be dig of more than one in a day. Apart from that, the manual digging process are prone to create injuries. The most common injuries that result from manual operations are:

- i. Blistering of fingers and hands due to continuous used.
- ii. Toes, feet and lower legs being injury when they miss hit to the ground.
- iii. Dust affects the eyes when they digging the ground.
- iv. Strain injuries predominantly for the lower back, shoulder and arm muscles and joints.

As an alternative to solve the problems with the low processing productivity and injuries of manual grave digging process, a costly commercialized earth digging machines i.e. excavator, tractor, loader, etc. using a qualified operator can be employed. However, since the machine were not specifically designed according to the limited space of cemetery area, their applications are limited to a newly structured and landed cemetery area.

1.3 Objective

Based on the difficulties and the deficiency of existing hole digging machine available in the market, the main objective of this project is to develop a prototype of square hole digging ground machine/grave digging machine. The specific objectives of this research are:

1. To design and propose an efficient grave digging machine includes material, power, cost and practicality using Pugh's selection method.
2. To make an engineering analysis based on the selected design includes bucket capacity, exerted forces and structure stress analysis
3. To fabricate a prototype of grave digging machine.
4. To validate the effectiveness of the developed hole digging machine.

1.4 Scopes

The scopes of study are as follows:

- i. This study focuses on to select the best design of the square hole digging ground machine by using design method tool;
- ii. This study focuses on the grave for Muslim grave size 6' (length) x 4' (width) x 6' (depth);
- iii. This study focuses on digging the open soil type which is porous and contains tiny openings that water can pass through.

CHAPTER 2

LITERATURE REVIEW

Digging ground machine for digging graves is main device to achieve high productivity level to replace the manual method that be applied nowadays. Previously, there are many tools and techniques being invented to overcome this problem. However, none of the methods proved to be effective in terms of practicality to the scopes of this project. This chapter will thoroughly discuss on the relevant literatures includes soil types, cemetery requirement, method and process of grave digging, design method and engineering analysis. The aim of this chapter is to provide the considerations that need to be consider for the development of the grave digging machine.

2.1 Soil Type

Ramli, 1997 stated that there are six types of soil are common in Malaysia, there are clays, sands, peat, alluvial soil, saline soil and loam soil. The properties in each soil are different and have their own benefit.

Clays has little particles and is near each other. It is exceptionally expanded when wet and hard when dry. It is additionally extremely minimized among different kinds of soil. Because of the way that the particles are little and smooth, the air is exceptionally poor in the land, which implies poor ventilation. Clays is likewise exceptionally hard to get water. It is also difficult to digest and even though it has been sprayed but it hardens again after several times with water (Ramli, 1997)