



DESIGN AND ANALYSIS OF MOBILE TEST BAY (ELECTRICAL EQUIPMENT) FOR TRAINING PURPOSE

This report is submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for Bachelor Degree of Manufacturing Engineering (Hons.)

by

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BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

Tajuk: **DESIGN AND ANALYSIS OF MOBILE TEST BAY (ELECTRICAL EQUIPMENT) FOR TRAINING PURPOSE**

Sesi Pengajian: **2019/2020 Semester 2**

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DECLARATION

I hereby, declared this report entitled “Design and Analysis of Mobile Test Bay (Electrical Equipment) for Training Purpose” is the result of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of Universiti Teknikal Malaysia Melaka as partial fulfilment of the requirement for Degree of Manufacturing Engineering (Hons). The supervisory committee is as follow:



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ABSTRAK

Ruang ujian atau ruang latihan adalah kemudahan yang digunakan untuk menjalankan latihan pemasangan, pemeriksaan dan penyelenggaraan peralatan elektrik Perlindungan Letupan (Ex) di kawasan berbahaya. Secara khusus, peralatan ini dapat mengelakkan kemalangan secara maksimum walaupun terdedah di kawasan berbahaya. Walau bagaimanapun, tanpa latihan yang betul, pemasangan dan pemeriksaan peralatan akan gagal. Dalam industri, ruang ujian digunakan untuk menyediakan perkhidmatan latihan bagi calon untuk mendapatkan sijil ISO mereka untuk bekerja di lapangan. Sebilangan besar pekerja industry yang terdedah kepada persekitaran berbahaya seperti industri minyak dan gas memerlukan latihan ini. Kajian ini memfokuskan pada ruang ujian semasa yang tidak mudah alih dan mudah alih. Lokasi perkhidmatan akan terhad, perkhidmatan juga terhad kepada satu tempat sahaja. Untuk mengatasi masalah ini, ruang ujian perlu mudah di bawa ke mana-mana dan mudah alih. Beberapa analisis produk perlu dilakukan untuk menghasilkan ruang ujian yang inovatif dengan bahagian pemasangan yang mudah, mesra pengguna dan ergonomik terhadap postur badan pengguna. Untuk memastikan bahawa keseluruhan rancangan berjalan lancar, pengurusan masa dan perancangan yang baik mesti menjadi keutamaan. Kajian ini memperoleh reka bentuk yang sesuai yang boleh dipertimbangkan sebagai struktur mudah alih. Reka bentuknya terdiri daripada ketinggian pelbagai untuk keselesaan pengguna dengan pemasangan roda untuk pergerakan dan penutup peralatan untuk perlindungan peralatan. Analisis FEA dan RULA menunjukkan bahawa reka bentuk memenuhi sasaran dan selamat digunakan. Kegunaan bahan untuk struktur badan sesuai dengan kekuatan yang mencukupi dan dibandingkan dengan bahan lain. Lembaran berlubang ini dapat memasang 4 peralatan elektrik dengan ruang tambahan untuk lenturan kelenjar kabel. Berat keseluruhan ruang ujian berat kerana peralatan dan penggunaan bahan, namun kekurangan ini dapat diabaikan kerana ukuran ruang uji mudah alih ini masih boleh

dibawa dengan kenderaan trak. Untuk meningkatkan kestabilan ruang uji, jisim struktur perlu berat untuk mengelakkan ruang uji jatuh. Kajian ini menunjukkan bahawa ruang ujian digerakkan tetapi tidak mudah alih kerana beratnya.

ABSTRACT

A test bay or training bay is a facility which is used to conduct training on installation, inspection and maintenance of Explosion Protection (Ex) electrical equipment in hazardous areas. Specifically, this equipment can avoid maximum explosion even when it is exposed in hazardous area. However, without proper training the installation and inspection of the equipment may faulty. In industry, test bay is used to provide training service for candidates to gain their certificate of ISO to work in actual fieldwork. Majority of worker's industries that are exposed to the hazardous environment likes oil and gas industry needs training. This study focuses on the current test bay that is not mobile and portable. The service location will be limited, the service also restricted to one place only. In order to eradicate this problem, test bay need to be mobile and portable. Several analyses of product need to be done to generate innovative test bay with simple assembly part, user friendly and ergonomic toward user's body posture. To make sure that the entire plan is going smoothly, time management and good planning must be priority. This study gains suitable design that can be considerate as a mobile structure. The design consists of adjustment height for user comfortability with wheel attach for easy movement and equipment cover as protection. Analysis of FEA and RULA gain shows that the design meets the target and safe for used. The material uses for body structure are suitable with adequate strength and lightest compare with others material. This perforated sheet can attach 4 electrical equipment with extra space for cable gland bending. The total weight of the test bay is heavy due to the equipment itself and materials use, however this lack can be ignored since this size of mobile test bay still can be carried by truck vehicle. To increase the stability of test bay, the mass of the structure need to be heavy to avoid the test bay from fall. This study show that test bay is mobilized but not portable because of the weight.

DEDICATION

I wholeheartedly dedicated this Final Year Project Report

To my family and love ones,

To my industry supervisor and members,

To all my lecturers,

To my fellow friends,

For giving me moral support, money, cooperation, encouragement and understandings

Thank You So Much.

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LIST OF ABBREVIATIONS

BHD	-	Berhad
DFMA	-	Design for Manufacture and Assembly
2/3D	-	2/3 Dimension
E&I	-	Electrical and Instrument
Ex	-	Explosive Protection
FEA	-	Finite Element Analysis
FOS	-	Factor of Safety
IEC	-	International Electrotechnical Committee
IECEX	-	International System for Certification of Equipment for Use in Explosive Atmospheres
IP	-	Ingress Protection
ISO	-	International Organization for Standardization
MATRADE	-	Malaysia External Trade Development Corporation
MSD	-	Musculoskeletal Disorders
PVC	-	Polymerizing Vinyl Chloride
RULA	-	Rapid Upper Limb Assessment
SDN	-	Sendirian
SLDPRT	-	SolidWorks Part
UTEM	-	University Technical Malaysia Malacca

LIST OF SYMBOL

A	-	Ampere
°C	-	Celsius
CH ₄	-	Methane
O ₂	-	Oxygen
CO ₂	-	Carbon Dioxide
2 H ₂ O	-	Heavy Water
Cm	-	Centimetre
Kg	-	Kilogram
N	-	Newton
Nm	-	Newton meter
T	-	Temperature
V	-	Voltage
Mm	-	Millimetre
Gb	-	Gigabit
Db	-	Decibel
Hz	-	Hertz
K	-	Kelvin
Ø	-	Diameter
W	-	Watt
kW	-	Kilowatt
1 st	-	First
2 nd	-	Second

CHAPTER 1

INTRODUCTION

1.1 Research Background

Test bay or training bay is a facility that provide illustration and training for worker regarding on installation, inspection and maintenance of explosion protected (Ex) electrical equipment in hazardous area. The training provided candidate with the essential knowledge and practical skill to enable safe working in potentially explosive circumferences mostly in the oil and gas industry. By completing the training, candidate will be had licence/certificate to work on field. Rankin (2007) said that, ‘if it’s not broken don’t fix it’, which is same goes to Electrical Equipment in Hazardous Areas (EEHA) inspections. In some countries, a specific electrical certification is required to take responsibility for hazardous areas of electrical installations, as shown in Figure 1.1 (instep.my).



Figure 1.1: Immobile Test Bay

Furthermore, Jr. (2005) said that at industrial plants where flammable product is process like plastics, varnished, oil refineries etc., there are some locations where the possibility of an explosive atmosphere existing is identified Jr. (2005). To ensure the safe operation of the industrial plant, it is not only necessary to properly define and install all Ex equipment, but also to be properly maintained in compliance with the requirements of technical standards. Due to that, it becomes necessary to invest in specialist training of maintenance and inspection team. An inspection scheduled to cover technical installation requirements applied to Ex installations would also contribute to effective plant safety at hazardous area.

Moreover, Onoh and Onyebuanyi (2017) said that education is the method of gaining (practical and theoretical) knowledge and it is one of the academic goals. Installation skills such as designing the design and installation of wiring, checking of security electrical work, competence of equipment, successful use of material, electrical installation inspection, understanding of cable drawing and likes are highly necessary for job creation. Ex electrical equipment inspection is vital to ensuring the continued integrity of protective types which enable it to be used in potentially flammable atmospheres. They believed that when these skills are taught, it would facilitate job creation and self-reliance in industry.

This research title has been set up from previous internship placement, where due to the EXS Synergy SDN BHD lack of facility. Due to that, collaboration with EXS SYNERGY SDN BHD has been created. The project focuses on an innovation of the test bay which in term of mobilized and portability. Current bay that exist is a rigid body are originally mounted on wall, floor or any specific surface that rigid. The project consists of designing phase and fabrication phase. Due to the agreement with EXS SYNERGY SDN BHD, this project only cover design phase which is include all the engineering analysis. When it is done, the design or patent will be sent to EXS SYNERGY SDN BHD for construction only.

In design analysis method, screening and scoring method will be used for selection of the most suitable design of mobile test bay. This method will generate more idea and finalized suitable concept by eliminating the design that not relate. For the development analysis, design for manufacture (DFM) and design for assembly (DFA) method will be

used. This method eases of manufacture and assembly product constituent part and select the most cost-effective process in theory. This method also reducing the assembly cost by minimizing the number of assembly operations.

1.2 Problem Statement

Majority of existing test bay is immobilized. The location of the training service will be limited, every candidate that want to undergo training need to go to trainee location. This will become compulsory for every industry and company that provide training service to own their own facility of test bay.

However, most of the industry and company that provide training service don't have test bay. Existing test bay that can be mobilized is big and high cost. Mobilized test bay required skill and manpower for assemble part. The spaces needed is high and assembly process is complicated. Roughly, it is like the mounted test bay. Regarding on how to use and handle, existing mobile test bay is difficult to handle and assemble.

Problem also happen when the instructor needs to go to clients place for training services. The demonstration cannot be on the go. The understanding and illustration of the training services will be not so clear during presenting due to that.

1.3 Objectives

The objectives of this study:

- To design test bay that is mobile and portable
- To apply the engineering analysis of product design needed for test bay

1.4 Project Scope

The scope of this project is to build a test bay that will function accordingly based on objective and to solve the problem faced maximally. The scope of this project is to build test bay that can be mobilized, portable and do demonstration on the go. This project was initiated to ease the company that don't have facility for training services.

The test bay must consist of one or more panel that can attached at least 4 electrical equipment. The structural of the bay can withstand weight more than 10kg of equipment. The bay must consist at least 2 wheels for easy movement, handle and simple to assemble if the part of bay is detachable. The test bay needs to be ergonomic, which is the maximum height of the bay must be within human height where is more than 160 cm height. All the engineering analysis will be done and tested by using Computer Aided Design software include material selection.

The limitation of this project is to create the bay within size of luggage. This is because, the electrical equipment itself already big and exceeding the luggage dimension of length. To overcome this, the equipment need to be detach during mobility. The construction will be done by company. The project will be completed by the end of PSM 2.

1.5 Organization of The Report

For this project to flow according to the plan without failure and well organize, planning needs to be done. This report will be conducted as follows:

Chapter 1: Introduction

This chapter will be simply introduced about the project. this chapter consist of research background, problem statement, objective and project scope.

Chapter 2: Literature review

In this chapter will be discuss regarding on previous and current research which relevant that related on this project.