UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND ANALYSIS OF FEEDER UNIT FOR OIL PALM FIBER INTAKE SECTION

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

by

MOHAMAD ASYRAF BIN ZUBIR

B051010187

880215-23-5113

FACULTY OF MANUFACTURING ENGINEERING

2014

DECLARATION

I hereby, declared this report entitled “Design and Analysis of Feeder Unit for Oil Palm Fiber Intake Section” is the results of my own research except as cited in references.

Signature : ……

Author’s Name : MOHAMAD ASYRAF BIN ZUBIR

Date : ……

APPROVAL

This report is submitted to the Faculty of Manufacturing Engineering of UTeM as a partial fulfillment of the requirement for the degree of Bachelor of Manufacturing Engineering (Manufacturing Design) (Hons.). The member of the supervisory committee is as follow:

……..

(ENGR. ZULKEFLEE BIN ABDULLAH)

ABSTRAK

Lekapan kimpalan ditakrifkan sebagai alat yang digunakan untuk memudahkan kerja-kerja kimpalan dan menjimatkan masa dalam menghasilkan produk. Penggunaan lekapan kimpalan juga merupakan salah satu langkah keselamatan mengelakkan pengimpal daripada kecederaan semasa mengendali proses kimpalan. Projek ini dijalankan untuk mengkaji parameter reka bentuk lekapan kimpalan yang baru yang digunakan untuk menyambungkan bahagian pintu pagar seperti pintu pagar yang digunakan di rumah. Di samping itu, tiga idea konsep telah dibincangkan. Tambahan pula, konsep yang terbaik telah digunakan dalam analisis ini berdasarkan 3 bahan calon yang berbeza. Bahan yang paling sesuai untuk lekapan kimpalan telah diperolehi melalui simulasi. Model lekapan kimpalan 3D dilukis dengan menggunakan perisian Solidwork 2013. Analisis terma sementara dan analisis struktur statik pada lekapan kimpalan dijalankan dengan menggunakan perisian ANSYS 14.0. Hasil daripada analisis struktur statik telah diinterpretasikan dalam lima aspek: tegasan setara, pengubahan bentuk, faktor keselamatan (F.O.S), hayat lesu dan kerosakan keletihan. Walau bagaimanapun, hasil daripada analisis terma sementara telah diinterpretasikan dalam dua aspek: suhu dan jumlah agihan fluks haba. Oleh itu, ia telah dicadangkan bahawa keluli tahan karat adalah yang sesuai untuk lekapan kimpalan.

ABSTRACT

Welding fixtures defined as a tool used to facilitate the work of welding and saving time to produce a product. The use of welding fixture is also one of a safety measure prevent the welder from injury while handling welding process. This project was undertaken to study the design parameters of the new welding fixtures used for joining the gate parts such as the gate used at home. In addition, three concept ideas were discussed. Furthermore, the best concept has been used in this analysis based on 3 candidate materials. The most suitable material for welding fixtures was obtained through simulation. 3D model welding fixture was created by using Solidwork 2013 software. Transient thermal analysis and static structural analysis were performed on welding fixture by using ANSYS 14.0 software. Result of static structural analysis was interpreted in five aspects: Equivalent stress, total deformation, factors of safety (F.O.S), fatigue life and fatigue damage. However, the result of a transient thermal analysis was interpreted in two aspects: temperature and total heat flux distribution. Therefore, it was proposed that stainless steel is the suitable for welding fixtures.

DEDICATION

To my beloved parent, siblings, friend, my respectful supervisor and examiner for their love and support

ACKNOWLEDGEMENT

First and foremost, gratefully wishes to the Almighty, ALLAH S.W.T for all His blessing. I would like to express my sincere gratitude to my supervisor, Dr Taufik, for his guidance in conducting and writing this report. I am grateful for his professionalism and his tolerance of my naive mistakes.

I acknowledge my sincere indebtedness and gratitude to my parents and family for their love, supported, and advices motivation.

Lastly, I would like to thank to every single individuals and groups who kindly provide assistance and spiritual support to me hesitations.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

ASTM	-	American Society for Testing and Materials
EBW	-	Electron-Beam Welding
FEA	-	Finite Element Analysis
FCAW	-	Flux Cored Arc Weldments
FOS	-	Factor of Safety
GMAW	-	Gas Metal Arc Welding
GTAW	-	Gas Tungsten Arc Welding
HSS	-	High Speed Steel
IGES	-	Initial Graphics Exchange Specification
MMAW	-	Manual Metal Arc Welding
MMA	-	Manual Metal Arc
OHNS	-	Oil Hardening non Shrinking
PAW	-	Plasma Arc Welding
PSM 1	-	Projek Sarjana Muda 1
PSM 2	-	Projek Sarjana Muda 2
SAW	-	Submerged Arc Welding
SMAW	-	Shielded Metal Arc Welding

CHAPTER 1

INTRODUCTION

This chapter describes the key of general terms that implemented for this project. It covers the background of the problem, objectives, scope, and significant and research methodology.

1.1 Background

Nowadays, fixture is an important thing in manufacturing field. In Malaysia, a lot of factory used the fixture to increase the productivity for their product. In manufacturing process, fixture is defined as a tool or the base for holding the workpieces (Zhang et al., 2009). The fixture is designed and created depend on the process involve on the workpieces. Usually, the fixture is used for inspecting the workpiece, assemble the part, machining process, and welding process.

A general tool such as clamps and locator used in welding fixtures is to coordinate and maintain various pieces for welding. Almost all welding equipment is designed and built to meet a specific need of a single assembly. Normally, the cost to build and designing the welding equipment is very expensive. Therefore, it takes a long time to produce a new design and installation of welding equipment at the plant (Zhang et al., 2009).

Welding fixtures can be produced in two different forms of process either manually or automatically. Usually, welding fixture is widely used in the automotive field for an automotive body welding assembly line. In manufacturing system cost, the cost of producing fixtures is about to 10-20% (Zhang et al., 2009). Therefore, a fixture system is designed and built for producing as many workpieces as possible to reduce manufacturing cost. In large production, the fixture size is large and must suitable follow the workpieces size. In low-to-medium production, the flexible fixture system is the one of improvement in order to reduce the unit cost of product (Hoffman, 2004).

1.2 Problem Statement

Gate is important for safety and protection. In order to join the gate part, welding is the best process used for joining the metal part. The quantity of gate part to assemble is a one of the problem to get less time produce and accuracy of welder. One of solving for this problem is built the welding fixture for joining the gate structure. The welding fixture was designed to hold the gate part during assembly processed. However, there is a lack of study in designing of fixture. In this research, the new design of welding fixture and the best material selection based on research were discussed. In addition, some analysis will be conducted to ensure the fixture material can withstand standard welding temperature and long term use based on dynamic load condition.

1.3 Objective

The objectives of this project are:

1. To investigate the design parameter for welding fixture by using Solidwork 2013 software.
2. To analyze the welding fixture by using ANSYS 14.0 software.
3. To determine the factor of safety for welding fixture.

1.4 Scope of project

Fixtures scope is not limited because it has many elements such as locators, clamps, essential features of fixture and others. However, this research only covers about the holding workpieces on welding fixture. The workpieces material is ASTM A500 grade A also known as 1027 plain carbon steel. The type of welding process involve in this research is Shielded metal arc welding (SMAW). In this welding process, the base metals are heated to fusion or melting temperature by an electric arc. The shielding gas is created as the flux covering on the electrode melts. When the flux solidifies, it forms a protective slag over the weld bead. The melting electrode wire furnishes filler metal to the weld welding process with initial temperature, for ASTM A500 grade A material. Besides that, the temperature is the assumed heat flow to the surface fixture during welding process. In this research, the temperature is base on the reduction of the heat as much as 40% from the welding temperature . Besides, there are no specific experiments performed to study the actual temperature of the heat flow to the fixtures surface in this analysis. Furthermore, the ambient temperature is assumed as surrounding temperature in welding room.

In this project, material selections in designing a new welding fixture are low carbon steel, stainless steel, and cast iron (ductile). The concept and design parameter for welding fixtures is the important thing to study before start to do the design. The selected concept will be drawn using Solidwork 2013 software to 3D models. In this project, the manufacturing process of fixtures part will not discuss.

The type of workpieces in this research will be focused on the structure of the gate. The fixture will be designed base on the geometry parameter of gate. Only two sizes for rectangular hollow steel bar will discussed. The part size is 40x60x4 mm and 30x50x4 mm. Furthermore, the best fixture design has been simulated and analyzed by using ANSYS 14.0 software. At the end of the result were discussed to the selection of material suitable for fixturing device A, B and C. However, the development and manufacturing process of the final design for the welding fixtures will not covered in this research.

CHAPTER 2

LITERATURE REVIEW

This chapter includes the important data and information through the attentive research of books, journals, and articles from past researchers.

2.1 Jigs and Fixtures

Jigs and fixtures used to hold a workpiece either with the help of basic tools jigs and fixtures or otherwise. Besides, it is also used to compile the workpiece as a guide before committing to a process (Joshi, 2003).

Fixtures also used to help workers hold the workpiece position is more accurate than manually without using fixtures during the work process operates. Furthermore, fixtures also holding work safer and more secure worker safety if using a fixture while performing a process such as welding and machining (Joshi, 2003).

Fixtures also known as a special tool during work process which is use as the guide the position of workpieces well and safe. The basic principle of fixtures is to support and clamp the workpieces. Furthermore, there are some devices that are used to support and clamp the workpiece during actual operations, whether before or after the operation (Henriksen, 1973).

The use of jigs and fixtures are intended to organize the workpiece quickly and in proper position, with good support and hold the workpiece more securely. In addition, the use of jigs and fixtures can reduce the time to produce the part through various processes compared with part produced manually without using jigs and fixtures. In addition, adjustment of work is also more organized and more efficient (Henrikson, 1973).

The fixtures also can reduce the cost of manufacturing in an assembly process, maintenance and also manufacture spare parts. Besides that, the fixtures are designed by professional groups such as designers and an engineer is to facilitate the work operated by unskilled workers. Furthermore, fixture design should also include the safety aspects in order to ensure the operator securely during the work from things that cause injuries (Henrikson, 1973).

Commonly, the fixtures are designed to have multiple functions although basically just for holding something during the work process. There is also a fixture designed placed on large machines to produce a variety of functions. In large projects such as the automotive industry and shipping, there are some fixtures that are designed to have multiple functions for various processes (Campbell, 1994).

2.2 Material Used in Jigs and Fixtures

Materials selection for jigs and fixtures are very important in ensuring the durability and can be used in a long time. There are some materials that are suitable for making jigs and fixtures. Furthermore, some of these materials through a specific process to increase the strength of the material. Besides, some of the material selected from the nonferrous metal is also suitable for making jigs and fixtures such as phosper bronze to reduce the wear of matting parts and nylon or fibre to avoid damage to the workpiece (Joshi, 2003).

High speed steel (HSS) is a one of ferrous metal which suitable to produce jigs and fixtures. High speed steel is contains 18% (or 22%) tungsten for toughness and cutting strength 4.3% chromium for better hardenability and wear resistance and 1% vanadium for retentions of hardness at high temperature (red hardness) and impact resistance. High speed steel can be air or oil hardened to RC 64-65 and is suitable for cutting tools such as drill, reamers and cutter (Joshi, 2003).

Die steel (high carbon) is also common material used to produce jigs and fixture with (1.5 – 2.3 %) carbon, high chromium (12%) (HCHC) cold working steels are used for cutting press tools and thread forming rolls. Hot die steels with lesser carbon (0.35%) and chromium (5%) but alloyed with molybdenum (1%) ad vanadium (0.3-1%) for retention of hardness at high temperature are used for high temperature work like forging casting and extrusion (Joshi, 2003).

Carbon steel is a familiar materials to produce jig and fixtures that contain 0.85 – 1.18% carbon and can be oil hardened to RC62-63. These can be used for tools for cutting softer materials like woodwork, agriculture, etc and also for hand tool such as files, chisel and rotors. The part of jigs and fixture like bushing and locators which are subjected to heavy wear can also be made from carbon steels and hardened (Joshi, 2003).

The other materials used to produce jig and fixture is Collet steels (spring steel). This material contains about 1% carbon and 0.5% manganese. Spring steels are usually tempered to RC 47 hardness (Joshi, 2003).

Oil hardening non shrinking tool steel (OHNS) contain 0.9-1.1% carbon, 0.5 -2% tungsten and 0.45-1% carbon, these are used for fine parts such as taps, hand reamers, milling cutters, engraving tools and intricate press tools which cannot be ground after hardening (RC 62) (Joshi, 2003).

Cast hardening steels also the material used to produce jig and fixture. It can be carburized and case hardened to provide 0.6-1.5% thick, hard (RC 59-63) exterior 17MnlCr95 steel with 1% manganese and 0.95% chromium is widely used. 15 Ni2CrlMo15 steel with nickel (2%) reduces thermal expansion up to . Case hardness steel are suitable for parts which requires only local hardness on small wearing surface where costlier, difficult to machine full hardening tool steels are not warranted (Joshi, 2003).

High tensile steels can be classified into medium carbon steels with 0.45%-0.65% carbon (En8-9) and alloy steel like 40 NiCrlMo28 (En24). The tensile strength can be increased up to 125 (RC40) by tempering. Medium carbon steels are used widely for fasteners and structural work while alloy steels are used for high stress application like press ramp (Joshi, 2003).

Mild steel is the cheapest and the most widely used material in jigs and fixtures. It contains less than 0.3% carbon. It is economical to make part which are not subject to much wear and highly stress from mild steel (Joshi, 2003).

Cast iron is contains with 2-2.5% carbon. As it can withstand vibrations well, it is used widely in milling fixture. Self-lubricating properties make cast iron suitable for machine slides and guide-ways. The ingenious shaping of a casting and the pattern can save a lot of machining time. Although the strength of cast iron is only half the strength of mild steel, a wide variety of grades have been developed. Nodular cast iron is as strong as