UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND FABRICATION OF WELDING JIGS AND FIXTURES FOR FKP LAB

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

by

NAJIL BIN MAKONG

B051110298

921225-12-5047

FACULTY OF MANUFACTURING ENGINEERING

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DECLARATION

"I declare that this is my own work except for experts and summaries of each every one of them was me explain the source".

Signature :……

Name : Najil Bin Makong

APPROVAL

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

……

(Prof. Madya Dr Md Nizam Bin Abd Rahman)

ABSTRAK

Kimpalan adalah proses yang penting dalam sektor pembuatan dan pelajar FKP diwajibkan untuk belajar dan melaksanakan kimpalan robotik dan kimpalan manual. Dalam melaksanakan proses kimpalan, pelajar yang kurang kemahiran dan pengalaman akan menghadapi kesusahan seperti bahan kerja bengkok dan menyebabkan kerosakan pada meja kerja. Juruteknik juga terpaksa membuat koordinat baru setiap kali menjalankan makmal kimpalan robotik. Dalam menangani masalah ini, reka bentuk dan fabrikasi kimpalan jig dan lekapan untuk manual dan robot kimpalan untuk penggunaan makmal adalah jawapannya. Konsep reka bentuk adalah berdasarkan penemuan terdahulu oleh penyelidik lain dan data kajian yang dikumpul daripada juruteknik dan pelajar yang sudah mengambil subjek kimpalan. Empat konsep reka bentuk di lakukan dengan mengunakan sistem CAD. Reka bentuk terakhir dipilih daripada empat konsep reka bentuk dengan mengunakan kaedah pemeriksaan dan pemarkahan yang turut di bantu oleh golongan pakar. Reka bentuk terakhir ini di fabrikasi menggunakan aluminium. Setelah lekapan ini sudah di fabrikasi, satu lagi kajian lain akan dilakukan bagi mendapatkan maklum balas daripada pelanggan mengenai keberkesanan jig dan lekapan yang di buat untuk proses kimpalan. Berdasarkan jawapan responden, majority daripada mereka bersetuju yang lekapan ini boleh meningkatkan proses pembelajaran, meningkatkan kualiti kimpalan, mengurangkan gangguan haba dan penggunaan masa serta sesuai di gunakan semasa sesi bengkel.

ABSTRACT

Welding is an important process in manufacturing sector and FKP's students are required to learn and perform robotic and manual welding. In performing this welding process, student who is lack of welding experience will encounter difficulties such as bent workpiece and causing damage to worktable. The technicians also have to setup new coordinate system every time the robotic welding laboratory is to be conducted. In order to addressing these problems, design and fabrication of welding jig and fixture for manual and robotic welding for lab usage become a solution. The design concepts based on prior learning of other researchers and survey data collected from technicians and students who have taken subject on welding based on House of Quality approach. Three conceptual designs were done using CAD system. The final design was selected among four conceptual designs based on screening and scoring methods with assistance from experts. The final design was fabricated using aluminium. Once the fixture was fabricated, another survey was performed to seek feedback from the customer on the effectiveness of the fabricated the welding fixture. As the results, respondents said that the fixture can improve learning process, improve weld quality, reduce heat distortions and time consumptions and suitable used during lab session.

DEDICATION

For my beloved family:

Makong bin Girah

Abda binti Muhamad

And

All lecturer's and BMFP's Students

ACKNOWLEDGEMNT

First of all, I would like to impress my appreciation and gratitude to Allah S.W.T for giving me the strength and ability to carry out the entire task and work given. In this great pleasure and gratitude also, I want to thanks to those who gave me the possibility to complete this report.

A special thank to my final year project supervisor Prof Madya Dr Md Nizam Bin Abd Rahman whose help, stimulating suggestions and encouragement, helped me to coordinate my project especially in writing this report. I would also like to acknowledge with much appreciation the crucial role of the staff of FKP's Laboratory, who gave the permission to use all required machinery and the necessary material to complete the fabrication of fixture.

My special thanks goes to all of my friends that had supplied thought, advice, challenges, criticism, help and suggestion that have influenced my performance and increase my knowledge and understanding upon completing my Final Year Project. I would to appreciate the guidance given by other supervisor as well as the panels especially in our project presentation that has improved our presentation skills by their comment and tips.

I would like to conclude this section by recognizing and thanking to all of people who involved whether directly or indirectly towards completing the project.

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BOM	-	Bill of Material
CAD	-	Computer Aided Design
CAFD	-	Computer Aided Fixture Design
CAFDV	-	Computer Aided Fixture Design Verification
CAM	-	Computer Aided Manufacturing
CAPP	-	Computer Aided Process Planning
FKP	-	Fakulti Kejuruteraan Pembuatan
HOQ	-	House of Quality
GA	-	Genetic Algorithm
QFD	-	Quality Function Deployment
UTeM	-	Universiti Teknikal Malaysia Melaka

CHAPTER 1
INTRODUCTION

This chapter provides summary of the intended project. It consists of background of project, problem statement, objectives, scope and importance of the study.

1.1 Background of Project

According to Rajendar Singh (2006), welding is a process of joining two different parts by fusion or heat. Welding technique can be differentiated by the types of heat supplied during the process. The heat during welding process can be supplied by chemical reaction, gases, electric resistance or electric arc. Welding is suitable for most metal and is a permanent joint. In order to get the good welding joint, many parameters or conditions must be considered. One of the considerations that can facilitate welding process is the usage of welding fixtures.

Functions of welding fixtures are to hold, locate and support the workpiece during welding process. Similar to machining fixture, welding fixture consists of the locating and clamping elements. Locators are needed to position the part, while clamps are needed to hold the part in place and prevent any possible movements during welding process (Sivarao et al, 2014).

However, there are some important considerations must be taken into account during designing the welding fixtures. Effect of heat and the generation of weld spatter during welding process are the most significant factor to be considered, because these two factors will directly influence quality of welded parts. A good welding fixture should not be deformed or undergone distortion easily. This is showing that how important is the thermal properties for material of fixture in order to maintain the accuracy and quality of welded parts. With proper control of heat distribution in the weld zone, the parts can be produced within designated tolerances with minimum or no heat distortion.

1.2 Problem Statement

Welding process is one of the processes that must be learnt by all of student in manufacturing engineering course. Usually, first year student has to conduct the arc welding process. Most of first year students are lack of basic knowledge in welding process, as the results the work table usually damaged by the electrode or the workpiece will bend during the class. Usage of welding fixtures can address this problem.

The other welding process that needs to learn by student is the application of robot welding. During the class, students are required to perform programming task for the robot movement during welding operation. The program for the welding process is the same for all students but the coordinate will change since there is no fixed position for the workpiece placement. If researcher just places the workpiece to the table, it can damage the table and probably the workpiece will bend. Again, the welding fixtures can address this problem.

1.3 Objectives

The objectives of this report are:

- To design of welding fixture for usage of robotic welding.
- To fabricate a welding fixtures for lab usage.

1.4 Scope of Study

This project comprised of design considerations for welding fixture. For basic arc welding, the workpiece that considered is mild steel with length of 150mm, 50mm in width and 6mm of thickness (150mm × 50mm × 6mm). The fixture to be designed is for the butt joint, lap joint and T-joint. This fixture can be used for MIG, TIG and arc welding for both manual and robotic.

1.5 Importance of Study

The importance of this study is to ease the learning process for the students during welding laboratory session. By doing some research and analysis, then design and select the suitable material and shape of the fixtures to be fabricate. Thus, these fixtures will reduce the damage of the work table, improve the quality of welding work and give the good result of welding process.

CHAPTER 2
LITERATURE REVIEW

This chapter provides the basic knowledge for the project finding by researchers and the methodology used by other researchers was summarized.

2.1 Welding Process

According to Hoffman (2004), the main assembly method used for joining process is welding as it provides the most efficient and economical way to join two or more individual components together. Other than welding, there are also other available joining processes, including brazing, soldering, riveting and stapling.

Young et al. (2012) stated that welding process involved melting of several pieces of base metal and the workpieces are joined together due to solidification of the pool of molten material. Filler material is always used to add materials to the weld joint. Welding is distinct from soldering and brazing where the weld joint for both latter processes is formed by melting of low-melting-point materials without melting of base metals or workpieces.

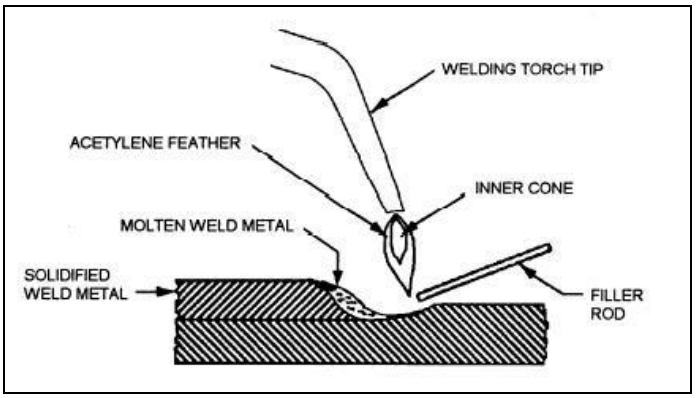

Figure 2.1: Welding Process.
(Source :< http://www.corrosionist.com/oxyfuel_gas_welding.htm/>)

Figure 2.1 above shows the acetylene feather that melt the metal to be joined together. This is what happens during most of welding process. The flame will generate heat and melt the metal so that the metal will be combined after it solidified. Distance of electrode to the material must be same along the welding process to get the better surface finishing and reduce the arising of slag.

Young et al. (2012) also mentioned that welding processes are categorized into few different types, for instance, arc welding, gas welding, robot welding, spot welding, laser welding, electron-beam welding, ultrasonic welding, gas flame welding and friction or friction stir welding. Basically, different types of welding use different types of ways to perform it. Different ways means different types of jigs or fixtures to hold it. But if it suitable, researcher can use it for same jigs and fixtures for different types of welding. But for this project, it more focus to arc welding and robot welding which commonly used in the lab for learning session.

According to Noberto et al. (2006), most of industries nowadays more prefer to use industrial robotics welding compare to manual one due to its smooth and constant operation. Besides, the robot welding can give high productivity when doing same welding process for same material and size of workpiece. This is because worker only needs to enter the codes once for many times of uses. The important in these types of welding is process parameters. This parameters influence by types and size of the materials that want to be weld. Figure 2.2 shows the example of application of robotic welding in industries.

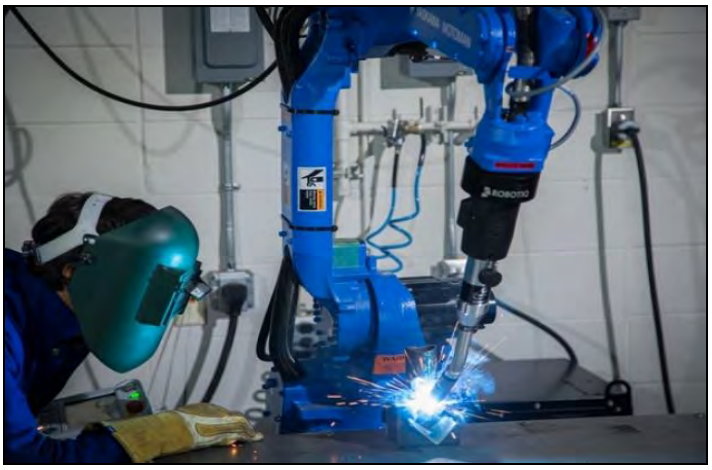

Figure 2.2: Application of Robot Welding.
(Source :< http://robotiq.com/applications/>)

2.2 Jigs and Fixture

Jigs and fixtures in manufacturing industries can help to increase the productivity of the product. It also eliminates frequent checking, individual marking and positioning. Besides, jigs and fixtures reduce the demand of skill worker due to this particular tools can make the worker easier to machine or weld the parts. In addition, this jigs and fixtures is interchangeability which means that no need for selective assembly. Lastly, this can reduce the cost and reduce the scrap. A fit jigs or fixture can make sure reducing of scrap of material. (P.H Joshi, 2003).

Sivarao et al. (2014) stated that fixture is one of a tool that used in production to hold, locate and support the workpiece. Overall, that were fixtures that used for machining and welding process. Jigs and fixtures can ease the work for the production line and also reduce the cost. Jigs and fixtures are production tools used to accurately manufacture duplicate and interchangeable parts. Jigs and fixtures are specially designed so that large numbers of components can be machined or assembled identically, and to ensure interchangeability of components. Figure 2.3 shows example of jigs and fixtures that usually found in the market and used in laboratory or workshop.

Figure 2.3: Jigs and Fixtures.
(Source :< http://www.tradeindia.com/fp300455/Jigs-Fixtures>)

According to Campbell (1994), fixture as a tool and was established to holds things. Fixture used to make or examine manufactured parts for industry. Fixtures might use to hold workpiece that going to into a stamping process, load them into a press, hold them during pressing, remove them afterward, hold them during assembly to other parts, and hold them during inspection. This clearly means that the fixtures have many usages and also can use to other purpose.

Andrew et al. (2004) mentioned that fixtures are normally designed for a definite operation to process specific workpiece and designed and manufactured individually. Jigs are similar to fixtures instead they also used to guide the cutting tools in drilling or boring operations. This means that jigs also need fixtures while fixtures not necessarily need a jig to perform. Generally all fixtures will consist of locators, clamps, support and also fixtures body. Figure 2.4 shows the example of vise that widely found at the workshop or laboratory since it can be used for many purpose.

Figure 2.4: Vise as Fixture.
(Source :< http://www.mitchellgolf.com/Repair-Tools>)

2.3 Welding Fixture

Jigar et al. (2013) stated that jigs or fixture in welding can influence in cost, quality and productivity. Besides, jigs or fixture can decrease the distortion that happen in the welding process. Welding fixture also can reduce manufacturing lead time for welding, holding parts, and positioning with reduction of production loss of welding. This could make student to finish their welding faster than usual. This also can improve the welding experience to student for their knowledge in the future or for working experience. Figure 2.5 below shows the example of welding fixture that used in one of workshop.

Figure 2.5: Example of Welding Fixture.
(Source :< http://baedesignanddevelopment.com/weldfixtures>)

Sivarao et al. (2014) stated that for welding fixtures, it is used to decrease or eliminate distortion problem that happen during welding process due to large amounts of heat used. There were 3 types of welding fixtures that commonly used in industries such as tracking, welding and holding. Tracking is used to hold pieces of material together in several places until they are tack welded together. Tack means to join two pieces of material together. This is to avoid warping or distortion when welding process is complete.

For welding types, it is used to keep parts of an assembly in position and commonly for parts that are to be weld together. Basically, it is much heavier than tacking tools because it has to resist the added forces caused by the heat within the parts. Lastly, for holding types, it recently used after tack welded assemblies for finishing process. It should be rigid enough to avoid distortion and warping.

According to Campbell (1994), welding fixtures used to position and hold two or parts together while they are joined. A good welding fixture usually can also be used for brazing or soldering since the process is similar and the differences will not affect a fixture designed to hold parts undergoing them. He also stated that the fixture that to be designed must be accurate since the cost to build is expensive. Figure 2.6 below shows the welding fixture that surely expensive but can increase the productivity with the accurate and easy to use.

Figure 2.6: Manual Welding Fixture.
(Source :< http://www.royalengineers.co.in/assembly>)