



DESIGN AND DEVELOPMENT OF ROTARY JIGS

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

by

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I hereby, declared this report entitled “Design and Development of Rotary Jig” is the results of my own research except as cited in reference.

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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 member of the supervisory committee is as follow:

.....
(Wahyono Sapto Widodo)

ABSTRACT

This project is about the design and development of a rotary jig for drilling process on round metal plate. The objectives of this project are to design and develop a rotary jig for drilling process on round metal plate. Besides that, it also to make checking form for a product of drilling by using this jig to validate its accuracy. The problem statement of this project is the industries required low cost equipment to give high production rate that can duplicate a product by following the standard specification from the original part. Critical parts of the product are accuracy and tolerance. So, every critical part needs to be evaluated in detail to ensure that the round metal plate is in good condition and smooth operation during production line. The methods that used for design and develop the rotary jig are start from the design stage, whereby reverse engineering is used to obtain the geometrical data from actual round metal plate. After that, a suitable design is proposed based on the research done and the best design is chosen. The finalized design dimensions are transferred into 3D drawing using Catia V5 to produce the detailed drawing. The manufacturing process involved simple and complex machining, which are the simple machining contain the making of simple pocket and hole; and complex machining contain the assembly of all parts until produced the drilling jig. Lastly, the jig has been tested using a test plate and quality inspection has been done. Data is collected from the sample and filled in check sheet form.

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LIST OF ABBREVIATIONS

3D	-	3 Dimension
CAD	-	Computer Aided Design
CATIA V5	-	Computer Aided Three Interactive Application Version 5
CNC	-	Computer Numerical Control

CHAPTER 1

INTRODUCTION

This chapter will describe the introduction of the project. It includes the background, problem statement, objectives and the scope of work of this project. The investigation of checking jig also involved in this project.

1.1 BACKGROUND

Easy assembly interchangeability and reduction of unit cost is a level of successful running for any mass production. Fast and easy method are most likely recommend for mass production methods which focusing work for accurate operations. Jig and fixture are production tool that is used in industries to help fasten and ease the process for accurately interchangeable parts and manufacture duplicate in production line which is usually use in assemble, machine and inspection. Jigs and fixtures are specially designed so that large numbers of components can be machined or assembled identically, and to ensure interchangeability of components. According to (Abouhenidi, 2014), jig and fixture can be describe as a component of machine-tool installation which has been designed in each case on aligning position of the work piece, keep it steady in place, and as a guidance of the power tool operate.

Guiding jig are among the important tool that been used in industry. It is a work holding device that supports, holds and locates the work piece and for specific operation, it guides the cutting tool. Jigs are usually comes with strengthen steel bushing as drilling guidance. It is a type of tool that is use to control the location and/or motion of another tool to provide high repeatability, accuracy, and interchangeability in the manufacturing of

products. Mostly jig is not fix to the machine and it is necessary to be clamp to avoid it from moving around which can cause a danger to the user.

1.2 PROBLEM STATEMENT

Currently, expeditiously growth in industrial sector create a very high opportunity for the new and small industries to grow rapidly due to the economics and the market demand. High demand from consumer makes industries have to come up with newborn solution to solve the production problem. Existing technology of jig are already far ahead for certain aspect, but it still need some improvement in term of cost and the design of the jig to increase the productivity. High demand from customer create a new start up for the industry to come up with new design of jig. The design need to be simple but fully operated which reduce the manual procedure of the jig. Less movement of jig part create higher productivity.

(Venkataraman, n.d.) Stated that jig are commonly used for drilling operation which known as holder or a guided for tool to operate. It is necessary for manual operated machine to guide the tool to get the exact size and dimension of product. Defect on the product will affect the production especially in assembly production line. The part are not fit or have wrong dimensional cannot be used and production does not come in a single product, huge part need to be rework or become a waste. Every production create critical part with high accuracy eventually need a detail production process to ensure that the sheet metal part in a good condition and smooth operation during production line.

OBJECTIVE

The main purpose of this study is to make the design and development of a rotary jig for drilling process on round metal plate.

The objectives of this study are:

- (a) To identify the suitable jig for drilling process.
- (b) To design the rotary jigs for jig for drilling process on round metal plate.
- (c) To develop the rotary jigs for jig for drilling process on round metal plate.

Scope of Work

In this study, the main focused on the design and development of a rotary jigs for jig for drilling process on round metal plate. The round metal plate consist of four hole that need undergoes high precision drilling process that will be used in machinery. The round metal plate need to follow the specific requirement and highly accurate to make sure it fit with it application.

CHAPTER 2

LITERATURE REVIEW

This chapter will describe the summarizing of all literature review gathered from the many academic resources. It includes the study of checking fixture, automotive body part, and automotive stamping process. Besides that, this chapter also will summarize the method that will involve in this project.

2.1 Jig

2.1.1 Definition of Jig

Edward G. Hoffman (2011) state that jig's is a main use to get high repeatability, accuracy, and interchangeability in the production of products. Mostly, jig will come along with fixture which create some confused understanding between them. Fixture more likely work as a holder to hold a work in static position. Jigs can be consider more effective which it does both functions that hold the work static while guiding a tool. Concept of jig can be define; when a key is duplicated, the old one is use to create a same path on the new one. Since the present of computer numerical controlled (CNC) and automated machine, the use of jig become unrecognized which is become easier to used automated machine due to tool path is digitally programmed and stored in memory. During it time in the old industrial jig and template are well known do to it function that improve productivity.

Jig are create in many type and design but each one of it already specified to do certain job. Jig was created to accomplish their specific task. One was made to increase

productivity using their consistency, to do a job more precisely or to do repetitive activities. Perhaps jigs are made for continuous usage or may be improvised from nothing to something which depend on the task given.

Drill jigs and boring jigs among the common jigs used today. Basically, those tool are the same but they are difference base on the size, type, and location of the drill bush. Boring jigs likely have larger drill bush compared to other. Normally drill jigs are the most-widely used form of jig. Drill jigs are used for drilling, reaming, counter boring, tapping, chamfering, countersinking, and other similar operations. Sometimes, drill jigs also used to perform assembly work and to do so, the bushings guide pins, dowels, or other assembly elements are needed.

Specialized industry applications have led to the development of specialized drill jigs. For example, the need to drill precisely located rivet holes in aircraft fuselages and wings led to the design of large jigs, with bushings and liners installed, contoured to the surface of the aircraft. A portable air feed drill with a bushing attached to its nose is inserted through the liner in the jig and drilling is accomplished in each location.

2.1.2 Type of Jig

Jigs are easy to identify by their basic construction. There are two common type of jigs which is open jig and closed jig. Often, open jigs only operate on only one, may be sometimes two on the sides of a work piece. But not for closed jigs, it can operate on two or more sides of the work piece, as stated by Joshi, P. (2010)

Depend on their construction and method required, drill jig can be group as follow:

- Open Jig
- Plate Jigs
- Sandwich Jigs
- Angle Plate Jigs.

- Box Jig
- Channel Jig
- Leaf Jig
- Template Jigs

Jigs form frequently more rely on the application of the tool not on their construction to confirm their identity.

- Open Jig

The top part of the jigs is open and the workpiece is placed on the top.

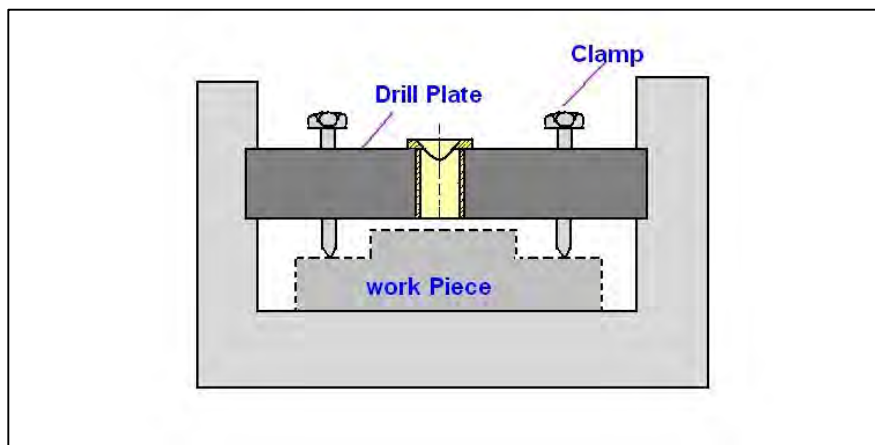


Figure 2.1.1(a): Open Type Jig

- Plate Jig

Plate jig is the improvement of template jig. Figure 2.1.1(b) show that the template jig comes with drill bushes to guide the tool. Clamp is use to make sure that the workpiece keep steady on place while the hole been drill. Plate jig are used to drill holes in large number of parts, maintaining accurate spacing with each other.

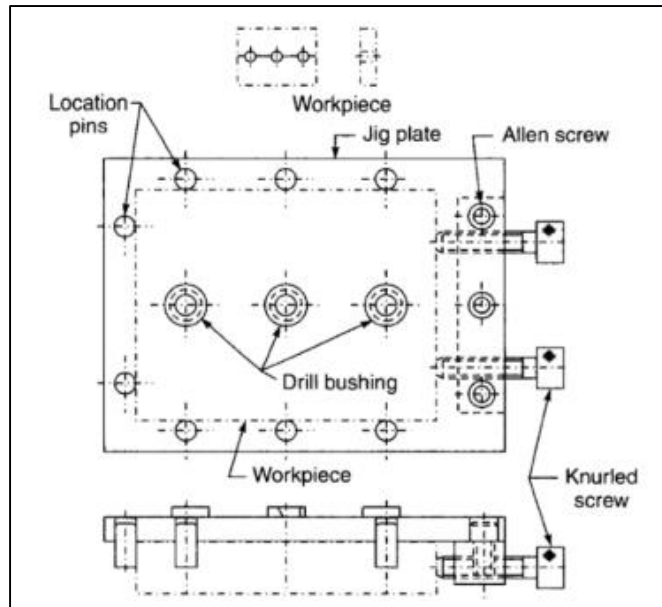


Figure 2.1.1(b): Plate Type Jig (Joshi, 2003)

- Sandwich Jig

Sandwich jigs have several similarities with plate jig but with a back plate to support the clamping process. Thin or soft parts that could warp or bend are suitable with this type of jig. Here again, the use of bushings is determined by the number of parts to be made.

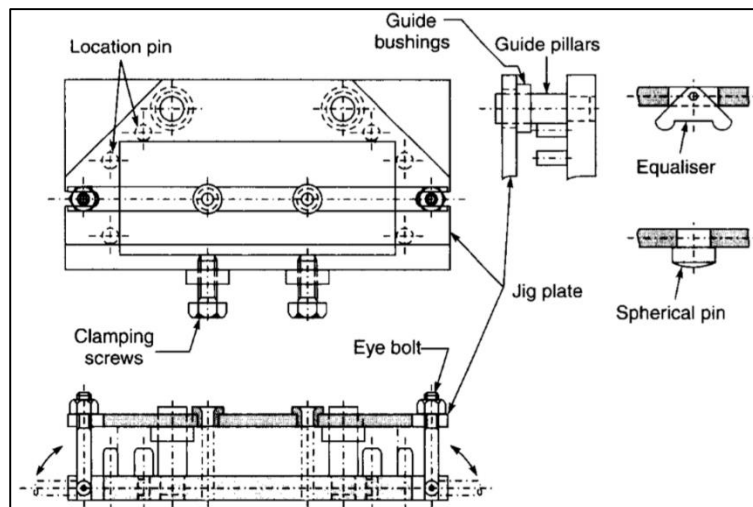


Figure 2.1.1(c): Sandwich Jig (Joshi, 2003)

- Angle - plate Jig

Angle-plate jigs functioning as a holder to hold parts while machined at right angles to their mounting locators. This type of jig use some parts such as pulleys, collars, and gears. “The angle-plate fixture is a variation of the plate fixture. With this tool, the part is normally machined at a right angle to its locator. While most angle-plate fixtures are made at 90 degrees, there are times when other angles are needed. In these cases, a modified angle-plate fixture can be used.” (G. Hoffman (2011))

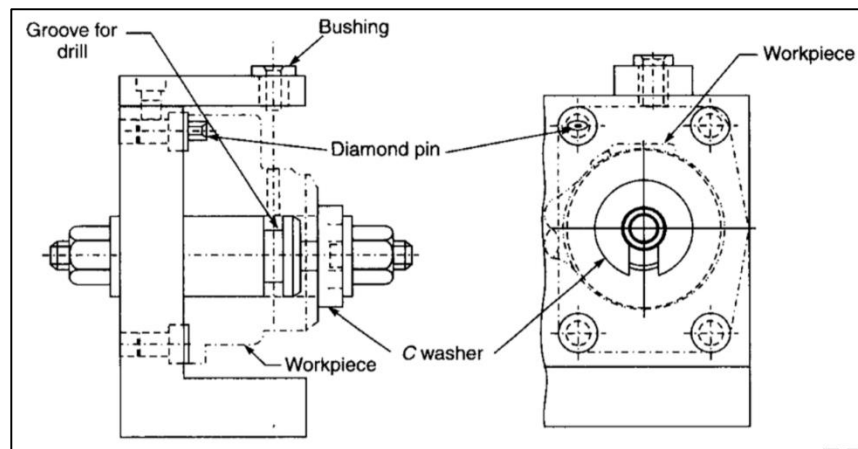


Figure 2.1.1(d): Angle - Plate Jig(Joshi, 2003)

- Box Jig

When the workpiece need to drill more than one holes, this jig can provide the number of bushes in the plate holes are to perform drill operation. Refer to (G. Hoffman (2011)) “This style of jig allows the part to be completely machined on every surface without the need to reposition the work in the jig”. Based on Figure 2.1.1(e), there will be one swinging leaf on the top that is use for loading and unloading the workpiece and the whole body shaped like a box. Around the box, there will be some part such as pin locator, clamping mechanism, bushes and others. This type of jig should be design as light as it can since it will have lifted over and over again.

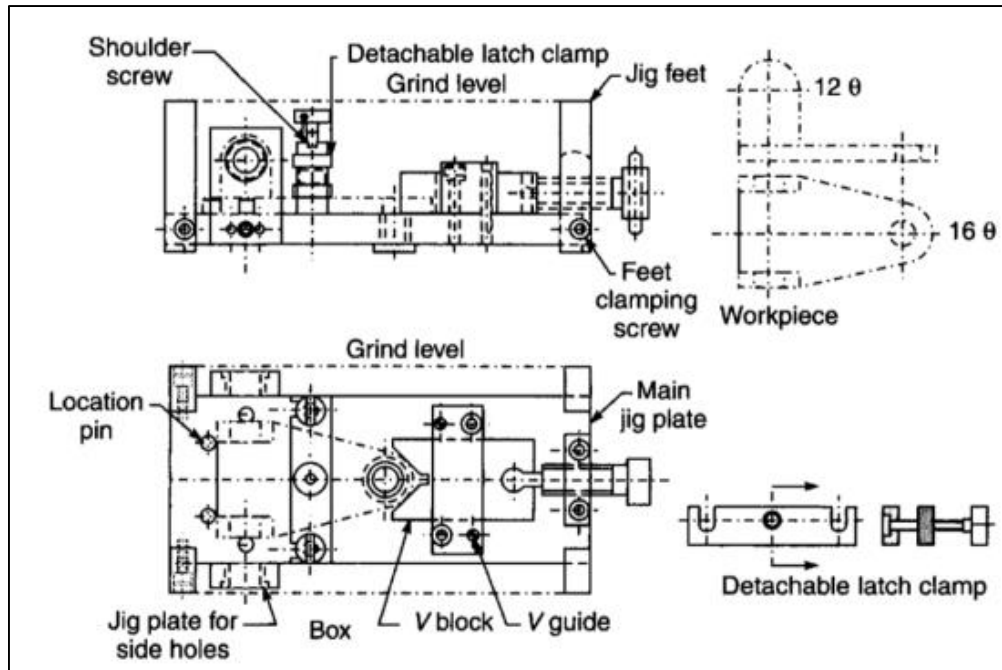


Figure 2.1.1(e): Box Jig (Joshi, 2003)

- Channel Jig

The channel jig is a straightforward kind of jig having channel like cross area. The part is fitted inside the channel properly and the knob is twist to clamp. After that, the drill bush guided the tool to perform the operation.

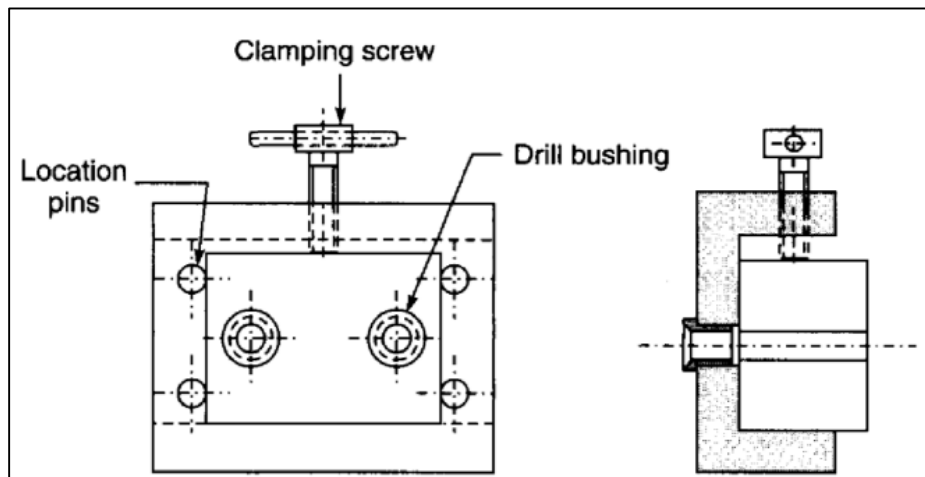


Figure 2.1.1(f): Channel Jig (Joshi, 2003)

- Leaf Jig

Leaf jig is also open type of jig, which is the top plate are design to swing about a rotation point , to create a clear access for the workpiece to be loading and unloading. The plates fitted with the drill bushes to guide the tool and latch that act as clamping mechanism is tighten.

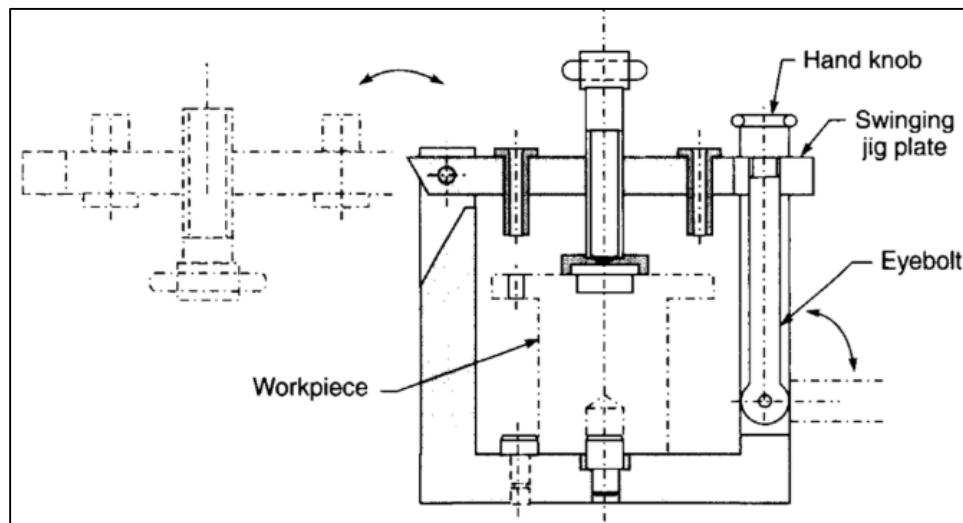


Figure 2.1.1(g): Leaf Jig (Joshi, 2003)

- Template jig

Among all type of jig, template jigs this is the simplest type of jig. It just a plate that is made to the shape and size similar to the workpiece with a holes based on the requirement. It will be placed on the top of the workpiece and the drilling process is perform guided by the existing hole on the template jig. Due to that, the template plate should be hardened to avoid its from ware and need frequent replacement. This type of jig are not suitable for large production.

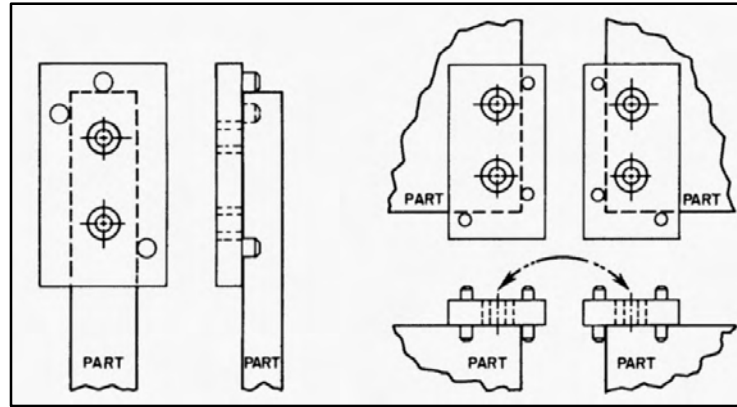


Figure 2.1.1(h): Template Jig (E. Hoffman, 2011)

2.2 Jig Design Process

2.2.1 Design Process

In (Kulkarni & Phadtare, 2017) theory said that in a jig design for manufacturing usage, the jig designer must consider the following points before starting to design the jigs:

1. Designs jig that are foolproof (Poka Yoke) to prevent any misuses by production operator
2. Design jig that is easy to operate to increase efficiency
3. Design jig that can be manufactured at the workshop using lowest costs
4. Design jig that can withstand the tool life by select the appropriate materials
5. Design jig that consistently produce parts with consistent high quality
6. Design jig that will provide the safety to production operator that fulfills the customers OSHA requirement

Therefore for jig designers, it is important for them to be involved in concurrent engineering. Concurrent engineering allows the jig designer to be involved for the products design and productions where their expertise of jigs and manufacturing processes will result in fewer errors to be discovered in productions.