UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Development of Material Handling System in Laser Cutting Machine

Thesis submitted in accordance with the partial requirements of the
Universiti Teknikal Malaysia Melaka for the
Bachelor of Manufacturing Engineering (Robotic and Automation)

By

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BORANG PENGESAHAN STATUS TESIS*

JUDUL: DEVELOPMENT OF MATERIAL HANDLING SYSTEM IN LASER CUTTING MACHINE

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APPROVAL

This thesis submitted to the senate of UTeM and has been accepted as partial fulfillment of the requirements for the degree of Bachelor of Manufacturing Engineering (Robotic and Automation). The members of the supervisory committee are as follow:

…….

Supervisor

En Hassan Attan

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DECLARATION

I hereby, declare this thesis entitled “Development of Material Handling System In Laser Cutting Machine” is the results of my own research
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ABSTRACT

Material handling system used to transfer something from one place to other place. Material handling also needed for laser cutting machine. Material handling system that applied for this project is the loading system. In this project, three sections have been divided to manipulate the loading operation of laser cutting machine. These three sections involved are storage system, loading system and end loading system. From these three of the section, the focus for this project is given to the loading system. This section will function as a loading mechanism to the machine which it will move the plate or sheet metal from the storage to the laser cutting machine bed. In this project, existing methods is studied and compare to find the most efficient method of loading used compare to manual. By applying the specific method of analysis can be done to produce the data for application of the system. The analysis will be discussed to determine the selection of the project component. Last step of this project is to adapt the conceptual system to the actual laser cutting machine. When simulating the system, some calculation or complication might arouse and adjustment and redesign will be done to improve and current the problem occurs.

DEDICATION

To my beloved father and mother,

May Allah bless you for all of the time.

To my brothers,

,

Thanks for giving all the support.

To all my friends,

Hope for this friendship lasting forever.

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LIST OF ABBREVIATIONS, SYMBOLS, SPECIALIZED NOMENCLATURE

CAD	-	computer aided design
FOS	-	factor of safety design
Ft	-	feet
Inch	-	inches
Kg	-	kilogram
UTeM	-	Universiti Teknikal Malaysia Melaka
mm	-	millimeter
m	-	meter

CHAPTER 1
INTRODUCTION

1.1 Introduction

Nowadays, the technology seems not just a desire but has to be the requirement to the human life. Since enter the millennium era, human have focuses a lot on the technology until it became very important things in human life. We can see the human lifestyle has change by the development of the world technology. The technologies make human life more flexible, easier, faster and simple.

Technology has been applied in many sectors of industries like manufacturing, food, telecommunication, agriculture and many more. In manufacturing sector, there are many development have been done that lead the country to become one of the best develop country in the world. When dealing with manufacturing sector, the technology mostly about the machine tools technology. Manual job by humans before have been develop to new automated system. As the human instinct like the easier life, the development of the technology has been applied to the machines that make it easier to operate. It also not just makes the human life easier, but the automation systems also makes the safety factor higher and also increase the quality of the production too.

One of the applications of technology is in the laser cutting machine. Laser cutting machine is machine which used laser as a cutting medium. It usually involved the sheet metal cutting for the complex shape and design. Laser cutting is defined as a technology which uses a laser to cut materials, and is usually used in industrial

manufacturing. Laser cutting works by directing the output of a high power laser at the material to be cut. The material then either melts burns or vaporizes away leaving an edge with a high quality surface finish. (http://www.wikipedia.org)

Although laser cutting machine looks like a very high level technology in producing the sheet metal product, it also must be supported by other additional equipment like loading system, unloading system, storage system, and other additional features. This is also known as a material handling equipment. The additional feature will make the cutting job more effective especially when the machine is used in the flow of some kind of production. One of the components that are very important to laser cutting machine is loading and unloading system. There are many types of loading and unloading system for laser cutting machine which is manual loading, semi automated loading and fully automated loading.

1.1.1 Function of loading and unloading system

As the explanation before, loading and unloading system is one of the developments in the laser cutting machine tool technology. Actually this loading and unloading system is not fixed to the laser cutting machine system only, but can applied to other machine that uses sheet metal as its raw material like turret punches, shears, and punch presses. The handling system will functioned to assist the loading and unloading process for the machines. Beside that, the material handling system can be combined with the storage system which can make the production flow smoother and more effective. Overall, the loading and unloading system is the system to transfer the raw material which is sheet metal to the laser cutting machine and remove the material after the cutting process is completed.

1.2 Research background

The development of material handling system at laser cutting machine involve in the research around the problem previously faced in laser cutting machine equipment. There are many problems for laser cutting machine to operate smoothly without reducing the quality of the product. All of the problems will be explained in problem statement section. Before the explanation goes further, it is important to know that this research is carried out at Universiti Teknikal Malaysia Melaka (UTeM) machine shop laboratory. At UTeM laboratory, there is a laser cutting machine which is still used without the loading and unloading system. The material handling system uses which requires people to lift the sheet metal and place it on the laser cutting machine bed. By designing the system make the handling job easier especially if the users are students. So, the research is on how to apply the loading and unloading system to the laser cutting machine.

1.3 Problem statement

Laser cutting is the new technology of cutting fundamental. Before this there is a lot of cutting method to cut the sheet metal. But after many researches that have been made, the laser cutting became some of the latest technology available. Although laser cutting technique is among the new technology nowadays, it also needs development in its material handling system. As the fact that have been state before, the laser cutting machine in UTeM still uses the traditional way of material handling method which by manual handling. By depending on manual handling, there are a lot of problem have occurred and might be occurring. The problems of manual handling system are:

- When moving the large sheet metal from storage to the laser cutting machine, requires space for storing and distance to move.

- The risk of injury might happen is high when human do the physical work directly.
- The operation of cutting process take several times as the material has to move first to the machine.
- The current loading method will involved at least two people to lift the sheet metal. This factor will be a problem when there are only one people to lift the material.

1.4 Objectives

The demands in manufacturing industry are ever changing, and become more and more challenging. Fulfilling the customer requirements is not just all about. Products have to be produced before customer needs in order to be first on the market. (Björn Johansson, Edward J. Williams and Tord Alenljung 2004)

In the demand of the higher technology, the objective of development must be clear and obvious. Whatever the people need, the technology must lead the demand by guide of a clear objective. As the explanation that have made before, the main objective of this research is to develop the material handling of laser cutting machine. The target must be set to avoid the research is out of title scope. The targets are not just design and develop, but also to solve the limitation of the machine system. The objectives of this research are:

- To develop the loading and unloading system for laser cutting machine.
- Reduce the injury of the usage of laser cutting machine.
- Produce the most effective way of loading system for laser cutting machine.
- Make the loading method simpler as it will affect the quality of production.
- Reduce the material defect when use manual loading method.

1.5 Scope of project

As we know, laser cutting machine have many operation component. Each component has the space of its own development. In this project, the development did not involve all the part or component of laser cutting machine. The project will only focus on development at loading and unloading system for the laser cutting machine or for more specific is at the intermediate system of the laser cutting machine. On the other word, the development only around the handling system and not involved the main operation system. Each laser cutting machine also has it own type of component or features. It means that the different application of machines will have different type of loading and unloading system. So, the development of the system must consider the type of the laser cutting machine. For this project, the laser cutting machine involved is the LVD laser cutting machine which located at Faculty of Manufacturing Engineering, phase B workshop.

As a whole, there are several sections have been divided to manipulate each operation to load and unload the sheet metal plate. The section that involved in this system is:

- Storage system
- Loading system
- End loading system with material removing process

From the list of the section above, the section that will be focus for this project is at the loading system. Loading system is the section that transfer the sheet metal plate from the storage system to the machine bed and remove the waste material to the end loading section when the cutting process done. Then end loading will stack the waste for later collection. The example of the system layout with these three sections is:

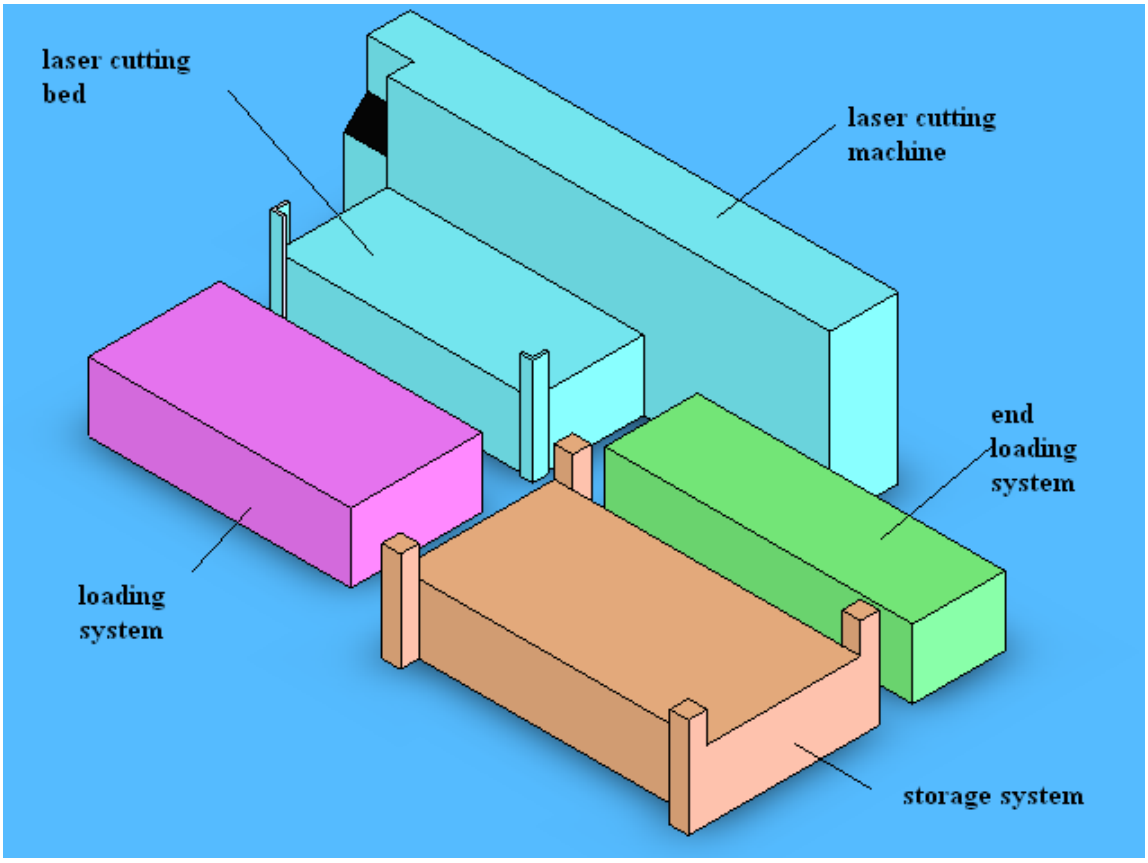

Figure 1.1: the example of loading system sections

1.6 Terminology

In this project, there are some term that will be use frequently to explain certain of the process. The main terms that involve for entire this project are material handling, laser cutting machine, and loading and unloading system.

1.6.1 Material handling

Material handling is define as the movement of raw goods from their native site to the point of use in manufacturing, their subsequent manipulation in production processes, and the transfer of finished products from factories and their distribution to users or sales outlets. (http://www.britannica.com). The similar definition also have been define in Farlex Free Dictionary which state material handling as act of loading and unloading and moving goods within for example factory especially using mechanical devices. In Farlex Free Dictionary also defines handling as manual or mechanical carrying or moving or delivering or working with something. With these sources of definition we can define material handling as the transportation of the raw material or goods from one section of production to other section by using some devices or manually (http://www.thefreedictionary.com).

1.6.2 Laser cutting machine

Referring to world book encyclopedia, laser is a device that produces a very powerful beam of light. Such a beam can travel over long distances or be focused to an extremely small diameter. Some tightly focused beams can drill 200 holes on a spot as tiny as the head of a pin. Some beams are powerful enough to pierce a diamond, the hardest natural substance (http://www.worldbook.com). A large laser system can trigger a small nuclear reaction. Laser beams have reached the moon and been reflected back to Earth. In All Expert Encyclopedia Beta, laser cutting was define as a technology which uses a laser to cut materials, and is usually used in industrial manufacturing. Laser cutting works by directing the output of a high power laser at the material to be cut. The material then either melts burns or vaporizes away leaving an edge with a high quality surface finish. So, laser cutting machine is a machine that use powerful beam of light as cutting medium (http://experts.about.com).

1.6.3 Loading and unloading system

Oxford English dictionary define loading as the application of a load to something (http://www.askoxford.com). System was define by Wikipedia Encyclopedia as an assemblage of entity or objects, real or abstract, comprising a whole with each and every component or element interacting or related to at least one other component. Any object which has no relationship with any other element of the system is not a component of that system (http://www.wikipedia.org). By combining these two words the loading system can be define as the work to load something by using or applied some difference components to make the loading works.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

There are some loading systems exist for laser cutting machine that have been used in industry. The uses of this kind of system are not so popular and costly in Malaysia. There are many different types of devices for loading the metal sheet into the laser cutting machine bed. There are three categories basically to divide the loading operation that they used; manual loading, automated loading and semi automated loading.

Manual loading is the basic loading operation by using human power to lift and move the sheet metal plate from the storage place to laser cutting machine. This kind of loading operation is the natural way as there are no automation systems before. As it is the old way for loading the material to the machine, at also have the advantage and disadvantage by using it. The detail about this kind of operation will be explained in the next section. Automated loading operation is the operation that did not need human energy to move the sheet metal from storage place to the laser cutting machine. For this type of operation, the system will be controlled by the computer or controller which it will function as the brain of the system. The system 'brain' will control the movement operation that will be done the combination of different automation system component. This automated system also has its own advantage and disadvantage which will be explain later. The third loading system is semi automated system. This system is the combination of the two systems that have been listed before; the manual system and automated system. DEMAG journal May 2002 have a list of advantage of the sources

changing from electrical power to pneumatic power to be applied in semi automated system. Some of them are more light, more flexible and dynamic storage. Normally the automation part will be function as supporter for the load and make the lifting job easier to the operator. There are also semi automated system that only required the operator or the human to control it and it will do the lifting and moving material job automatically.

2.2 Type of loading system

2.2.1 Manual loading system

Manual loading system is the traditional way of material handling. It involved the fully usage of human energy to lift and move the metal sheet plate from the storage place to the laser cutting machine. This kind of loading system has the advantages and also disadvantages to be applied in the laser cutting machine system. As it is the traditional way of material handling, it has been applied for a long time ago. The system also was upgraded by using some kind of the manufacturing management skill like layout planning, total quality management and others. Although the system has been upgraded for several times, some of the problem can not be recover as it still uses human energy or power to complete the process.

Human is very flexible when it comes as a tool or devices. Human can move freely without using any kind of transfer devices. Human also can be conducted easily without the programming code or wiring circuit. In case, if the system needed to be change as it is because the layout changing or the added of new machine, the loading system by human can be adjusted freely. Humans are not a fix machine, so it can move anywhere with just by himself. One important thing is that it will provide the continuous production without the breakdown problem. Although this kind of system will make the operation stop for several times because of tiring problem but it will take only short time. If compared to the breakdown problem, it will take a longer time to fix the breakdown.