

DESIGN AND DEVELOPMENT OF PLASMA CNC
MACHINE STRUCTURE (PLATE).

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**JUDUL: DESIGN AND DEVELOPMENT OF PLASMA CNC
MACHINE STRUCTURE (PLATE).**

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DESIGN AND DEVELOPMENT OF PLASMA CNC MACHINE STRUCTURE (PLATE).

MOHD HAMKA BIN MOHD JAAPAR

Report submitted in partial fulfillment of the requirements for the award of
Diploma of Mechanical Engineering

Faculty of Mechanical Engineering
UNIVERSITI MALAYSIA PAHANG

JUNE 2013

SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project and in my opinion, this project is adequate in terms of scope and quality for the award of the Diploma of Mechanical Engineering.

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STUDENT'S DECLARATION

I hereby declare that the work in this thesis is my own except for quotations and summaries which have been duly acknowledged. The thesis has not been accepted for any degree and is not concurrently submitted for award of other degree.

Signature : _____
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Date : 17th JUNE 2012

DEDICATION

*I specially dedicate to my beloved parents
(Hasidah binti Masadali), my siblings,
My supervisor and those who have guided
And motivated me for this project*

ACKNOWLEDGEMENT

In the name of Allah S.W.T the most gracious and merciful, first and foremost, after a year of struggle and hard work, with His will, this thesis is completed. Thanks to Allah for giving me the strength to complete this project and the strength to keep on living. I would like to convey heartiest appreciation to my supervisor, Sir Fadhlur Rahman bin Mohd Romlay for his consistency, advising and giving ideas throughout this thesis. I appreciate his consistent support from the first day I start doing the thesis.

To my parent, Mdm Hasidah binti Masadali, thank you for all the support and sacrifice that both of you gave me. Your sacrifice is too great to be measured and it will be never forgotten. Also to my brothers Mohd Hasmir bin Mohd Jaapar, Mohd Amrul Aliff bin Mohd Jaapar, Mohd Hasmadi bin Mohd Jaapar and my sisters Nurul Hazira binti Mohd Jaapar.

Last but not least, to all people that did not involve directly nor directly in succeeded the thesis, especially to all my beloved friend, that is cannot find appropriate words that could properly describe my appreciation for their devotion, support and faith in my ability to attain my goals. Hopefully, they will continue to support me and thanks for making this possible to happen.

ABSTRACT

Computer Numerical Control (CNC) machines are used in a variety of ways in supporting the development of new products and processes and can provide an excellent means to expose students to standardized control procedures as well as offer opportunities to effectively supplement the teaching of control systems and instrumentation. Using Mach3 for software control and stepper motors for power transmission, a relative low cost but effective CNC Plasma machine was developed by Western Carolina University (WCU) and Asheville-Buncombe Technical Community College through a joint partnership. This paper will present a logical approach to developing such a system and describe how applications have been integrated into curricula at both the two-year and university level programs through Project Based Learning (PBL). Educational merit and approaches will be described relative to respective educational levels.

ABSTRAK

Komputer Kawalan Berangka (KKB) digunakan dalam pelbagai cara dalam menyokong pembangunan produk baru dan proses malahan boleh memberikan cara terbaik untuk mendedahkan pelajar kepada prosedur kawalan yang seragam serta peluang tawaran yang berkesan menambah pengajaran sistem kawalan dan peralatan. Menggunakan Mach3 untuk perisian kawalan dan motor bagi penghantaran kuasa, kos yang relatif rendah tetapi berkesan mesin KKB plasma telah dibangunkan oleh Universiti Western Carolina (WCU) dan Asheville-Buncombe Kolej Komuniti Teknikal melalui perkongsian bersama. Kertas kerja ini akan membentangkan satu pendekatan yang logik untuk membangunkan sistem tersebut dan huraikan bagaimana permohonan telah disepadukan dalam kurikulum di kedua-dua program peringkat dua tahun dan universiti melalui Pembelajaran Berasaskan Projek (PBP). Merit pendidikan dan pendekatan akan diterangkan relatif kepada tahap pendidikan masing-masing.

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CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

Plasma cutting is a process that is used to cut steel and other metals of different thicknesses using a plasma torch. In this process, an inert gas is blown at high speed out of a nozzle at the same time an electrical arc is formed through that gas from the nozzle to the surface being cut, turning some of that gas to plasma. The plasma is sufficiently hot to melt the metal being cut and moves sufficiently fast to blow molten metal away from the cut.

1.2 PROBLEM STATEMENT

Current machine not very strong and always shaking when the machine running and the current machine use of inappropriate materials.

As solution, plate support is attached to prevent the structure from vibrating and shaking when the machine is used. Besides that, a stronger material to strengthen the structure is applied

1.3 OBJECTIVES

The main of the project is to design and create a new plate support and prototype the machine structure. Then, the study is preceded by sizing the structure components.

1.4 SCOPES

The scope of this project is applied the gantry concept in machine that uses ball-screw and linear guide concept.

The machine operates in 3-axis which is in x-axis, y-axis and z-axis. Design and fabrication a plate support to apply at machine structure.

1.5 PROJECT SCHEDULE

Gantt chart illustrates the start and end date of the terminal element and summary of a project. With Gantt chart, it helps us to guide the work process during this project. So, we can run the project smoothly and finish it on time. Refer to the appendix A1 to see the Gantt chart. zz

CHAPTER 2

LITERATURE RIVIEW

2.1 INTRODUCTION

Plasma cutting is a process that is used to cut steel and other metals (or sometimes other materials) using a plasma torch. In this process, an inert gas (Argon) is blown at high speed out of a nozzle and at the same time an electrical arc is formed through that gas from the nozzle to the surface being cut, turning some of that gas to plasma. The plasma is sufficiently hot to melt the metal being cut and moves sufficiently fast to blow molten metal away from the cut. Plasma can also be used for plasma arc welding and other applications.

Plasma is typically an ionized gas. Plasma is considered to be a distinct state of matter, apart from gases, because of its unique properties. Ionized refers to presence of one or more free electrons, which are not bound to an atom or molecule. The free electric charges make the plasma electrically conductive so that it responds strongly to electromagnetic fields.

The Arc type uses a two cycle approach to producing plasma. First, a high-voltage, low current circuit is used to initialize a very small high intensity spark within the torch body, thereby generating a small pocket of plasma gas. This is referred to as the pilot arc. The pilot arc has a return electrical path built into the torch head. The pilot arc will maintain until it is brought into proximity of the work piece where it ignites the main plasma cutting arc. Plasma arcs are extremely hot and are in the range of 15,000 degrees Celsius.

Oxy fuel cuts by burning, or oxidizing, the metal it is severing. It is therefore limited to steel and other ferrous metals which support the oxidizing process. Metals like aluminum and stainless steel form an oxide that inhibits further oxidization, making conventional oxy-fuel cutting impossible. Plasma cutting, however, does not rely on oxidation to work, and thus it can cut aluminum, stainless and any other conductive material. While different gasses can be used for plasma cutting, most people today use compressed air for the plasma gas. In most shops, compressed air is readily available, and thus plasma does not require fuel gas and compressed oxygen for operation.

Plasma cutting is typically easier for the novice to master, and on thinner materials, plasma cutting is much faster than oxy-fuel cutting. However, for heavy sections of steel (1inch and greater), oxy-fuel is still preferred since oxy-fuel is typically faster and, for heavier plate applications, very high capacity power supplies are required for plasma cutting applications.

2.2 PRINCIPLE OF PLASMA ARC CUTTING

This process uses a concentrated electrical arc which melts the material through a high-temperature plasma beam. All conductive materials can be cut. Plasma cutting units with cutting currents from 20 to 1000 amperes to cut plates with inert gas, 5mm to 160 mm thicknesses. Plasma gases are compressed air, nitrogen, oxygen or argon hydrogen to cut mild and high alloy steels, aluminum, copper and other metals and alloys.

The plasma arc process has always been seen as an alternative to the oxy-fuel process. In this part of the series the process fundamentals are described with emphasis being placed on the operating features and the advantages of the many process variants.

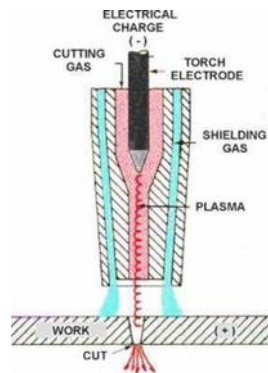


Figure 2.1: The principle of the plasma cutting

The plasma is additionally tied up by a water-cooled nozzle. With this energy densities up to 2×10^6 W/cm² inside of the plasma beam can be achieved. Because of the high temperature the plasma expands and flows with supersonic velocity speed to the work piece (anode). Inside the plasma arc temperatures of 30 000oC can arise, that realize in connection with the high kinetic energy of the plasma beam and depending on the material thickness very high cutting speeds on all electrically conductive materials.

The term for advisable state of plasma arc is called stability of arc. The stability of arc is keeping the plasma jet in desired form. It is possible to be provided by:

- a) Shape of Plasma Torch,
- b) Streaming Jet,
- c) Water.

We must monitor these parameters:

- Temperature and electrical conducting,
- Density of plasma jet,
- Diameter of plasma beam,
- Degree of the plasma beam focusing in output from nozzle.

For the cutting process first of all a pilot arc ignition by high voltage between nozzle and cathode takes place. This low- energy pilot arc prepares by ionization in parts the way between plasma torch and work piece. When the pilot arc touches the work piece (flying cutting, flying piercing), the main arc will start by an automatic increase in power

The basic principle is that the arc formed between the electrode and the work piece is constricted by a fine bore, copper nozzle. This increases the temperature and velocity of the plasma emanating from the nozzle. The temperature of the plasma is in excess of 20 000°C and the velocity can approach the speed of sound. When used for cutting, the plasma gas flow is increased so that the deeply penetrating plasma jet cuts through the material and molten material is removed in the efflux plasma.

The process differs from the oxy-fuel process in that the plasma process operates by using the arc to melt the metal whereas in the oxy-fuel process, the oxygen oxidizes the metal and the heat from the exothermic reaction melt the metal. Thus, unlike the oxy-fuel process, the plasma process can be applied to cutting metals which

form refractory oxides such as stainless steel, aluminum, cast iron and non-ferrous alloys.

The power source required for the plasma arc process must have a drooping characteristic and a high voltage. Although the operating voltage to sustain the plasma is typically 100 to 160V, the open circuit voltage needed to initiate the arc can be up to 400V DC. On initiation, the pilot arc is formed within the body of the torch between the electrode and the nozzle. For cutting, the arc must be transferred to the work piece in the so-called 'transferred' arc mode. The electrode has a negative polarity and the work piece a positive polarity so that the majority of the arc energy (approximately two thirds) is used for cutting.

In the conventional system using a tungsten electrode, the plasma is inert, formed using argon, argon-H₂ or nitrogen. However, as described in Process variants, oxidizing gases, such as air or oxygen can be used but the electrode must be copper with hafnium. The plasma gas flow is critical and must be set according to the current level and the nozzle bore diameter. If the gas flow is too low for the current level, or the current level too high for the nozzle bore diameter, the arc will break down forming two arcs in series, electrode to nozzle and nozzle to work piece.

The effect of 'double arcing' is usually catastrophic with the nozzle melting. The quality of the plasma cut edge is similar to that achieved with the oxy fuel process. However, as the plasma process cuts by melting, a characteristic feature is the greater degree of melting towards the top of the metal resulting in top edge rounding, poor edge squareness or a bevel on the cut edge. As these limitations are associated with the degree of constriction of the arc, several torch designs are available to improve arc constriction to produce more uniform heating at the top and bottom of the cut.

The process variants have principally been designed to improve cut quality and arc stability, reduce the noise and fume or to increase cutting speed. The inert or uncreative plasma forming gas (argon or nitrogen) can be replaced with air but this requires a special electrode of hafnium or zirconium mounted in a copper holder, by shearing. The air can also replace water for cooling the torch. The advantage of an air plasma torch is that it uses air instead of expensive gases. It should be noted that although the electrode and nozzle are the only consumables, hafnium tipped electrodes can be expensive compared with tungsten electrodes.

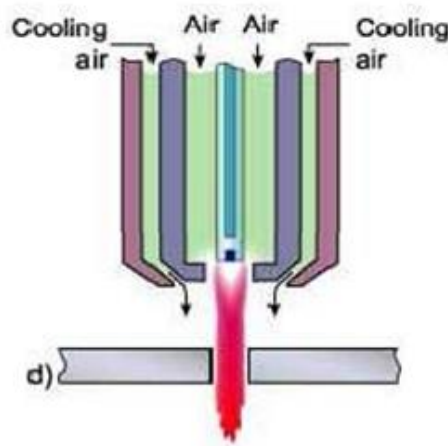


Figure 2.2: Air Plasma

This relatively new process differs from conventional, dry plasma cutting in that water is injected around the arc. The net result is greatly improved cut quality on virtually all metals, including mild steel. Today, because of advances in equipment design and improvement in cut quality, previously unheard of applications, such as multiple torches cutting of mild steel, are becoming common place.

2.3 PLASMA CUTTING CAPABILITY

Plasma is an effective means of cutting thin and thick materials alike. Hand held torches can usually cut up to 2 in (48 mm) thick steel plate, and stronger computer controlled torches can pierce and cut steel up to 12 inches (300 mm) thick. Formerly, plasma cutters could only work on conductive materials, however new technologies allow the plasma ignition arc to be enclosed within the nozzle thus allowing the cutter to be used for non-conductive work pieces. Since plasma cutters produce a very hot and much localized cone to cut with they are extremely useful for cutting sheet metal in curved or angled shapes.

In this work, Plasma Arc Cutter was utilized to perform Stainless Steel (316 L) material cutting. The system and the process are the important elements when utilizing plasma arc cutting. It is important to know current plasma arc cutting research areas to plan the direction of this work so that this work would contribute information that will be useful in future.

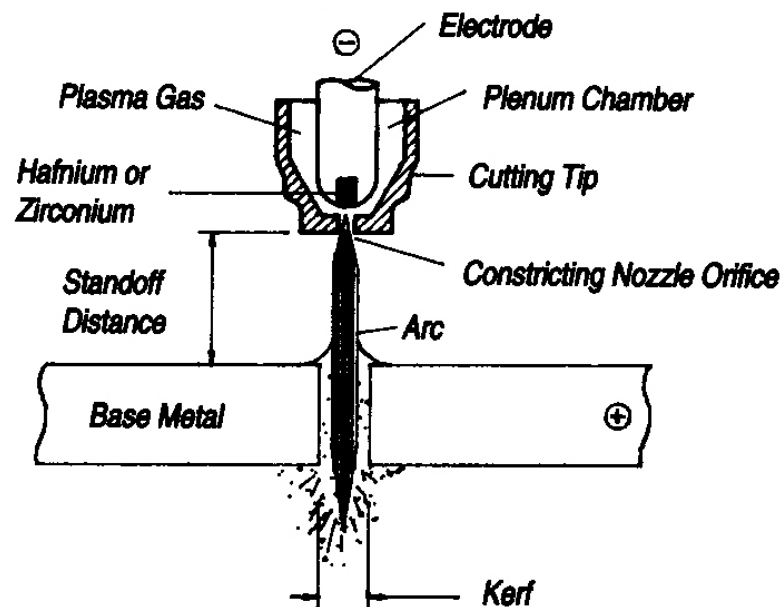


Figure 2.3: Plasma Arc Setup

2.4 ALUMINUM

For the introduction, Aluminum is an abundant metallic chemical element which is widely used worldwide for a wide range of products. Based on the periodic table, the aluminum element has an atomic number of 13, and it is identified with the symbol Al. It is classified in the poor metals, sharing the property of extreme malleability with metals like tin and lead. The international standard spelling is aluminum. In context engineering world, aluminum and its alloys are among the most versatile engineering and construction materials because of their unique characteristics. They have become the world's second most used metal after steel. Annual primary production of aluminum in 2006 was around 34 million tons and recycled production around 16 million tons. The total of some 50 million tons compares with 17 million tons of copper, 8 million tons of lead and 0.4 million tons of tin.

Aluminums alloys are typical engineering material used widely in heavy industry like automotive, aerospace and shipbuilding. This material is characterized by their light weight, high strength and high resistance corrosion. However, the strength of this material becomes a challenge to the laser cutting to perform good quality on this kind of material. There are several parameters that should be concluded due to cut the high reflectivity and thermal conductivity material like aluminum. By the way, the material is mostly used in different forms and shapes of the plate, but difficult to cut precisely in complex shapes. Laser cutting that use Laser Beam Machining (LBM) as the operating catalyst are capable to cut aluminum which exhibit high degree of hardness and brittleness. Besides, this material has strong, hard and lightweight which is widely used in aircraft construction.

2.5 COMMON FABRICATION METHOD

Before proceed to design and fabrication stage, research and knowledge about the common fabrication is needed, so that the step of fabricate can be planning.

2.5.1 Welding



Figure 2.4: MIG Welding

Source (<http://www.markthewelder.co.uk/id26.html>)

MIG welding is a welding process in which an electrical arc forms between a consumable wire electrode and the work-piece metal, which heats the work-piece metal, causing them to melt, and join. Along with the wire electrode, a shielding gas feed through the welding gun, which shields the process from contaminants in the air. The process can be semi-automatic or automatic. A constant voltage and power source is most commonly used with GMAW.

2.5.2 Milling

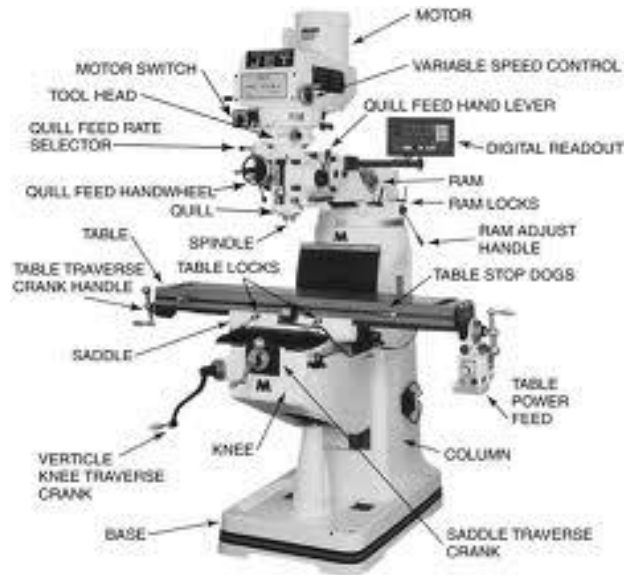


Figure 2.5: Milling machine

Source (<http://www.custompartnet.com/wu/milling>)

Milling is the most common form of machining, a material removal process, which can create a variety of features on a part by cutting away the unwanted material, work-piece, fixture, and cutter. The work-piece is a piece of pre-shaped material that is secured to the fixture, which itself attached to a platform inside the milling machine. The cutter is a cutting tool with sharp teeth that is also secured in the milling machine and rotates at high speeds. By feeding the work-piece into the rotating cutter, material is cut away from this work-piece in the form of small chips to create the desired shape.

2.5.3 Drilling



Figure 2.6: Drilling machine

Drilling is a cutting process that uses a drill bit to cut or enlarge a hole of circular cross-section in solid materials. The drill bit is a rotary cutting tool, often multipoint. The bit is pressed against the work-piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work-piece, cutting off chips from what will become the hole being drilled. Exceptionally, specially-shaped bits can cut holes of non-circular cross-section; a square cross-section is possible.

2.5.4 Cutting



Figure 2.7: Cutting tool

Source (<http://en.wikipedia.org/wiki/Cutting>)

Cutting is the separation of a physical object, or a portion of a physical object, into two or more portions, through the application of an acutely directed force. Implements commonly used for cutting are the knife and saw, or in medicine and science the scalpel and microtome. However, any sufficiently sharp object is capable of cutting if it has a hardness sufficiently larger than the object being cut, and if it is applied with sufficient force.

2.5.5 Bending



Figure 2.8: Bending tool

Source (http://www.efunda.com/processes/metal_processing/bending.cfm)

Bending is a process by which metal can be deformed by plastically deforming the material and changing its shape. The material is stressed beyond the yield strength but below the ultimate tensile strength. The surface area of the material does not change much. Bending usually refers to deformation about one axis.

Bending is a flexible process by which many different shapes can be produced. Standard die sets are used to produce a wide variety of shapes. The material is placed on the die, and positioned in place with stops and/or gages. It is held in place with hold-downs. The upper part of the press, the ram with the appropriately shaped punch descends and forms the v-shaped bend.

Bending is done using Press Brakes. Larger and smaller presses are used for specialized applications. Programmable back gages, and multiple die sets available currently can make for a very economical process.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

Chapter 3 will discuss about process and methodology for this research. Methodology is very important for doing analysis. Every process that will be discusses has their own importance according to the research. Start from find the article, journal, thesis, and books, the idea of thesis or another research which is related or same with this research will be use. The idea from that literature review will be compare the make the best conclusion for the research get the successfully result.

3.2 FLOW CHART

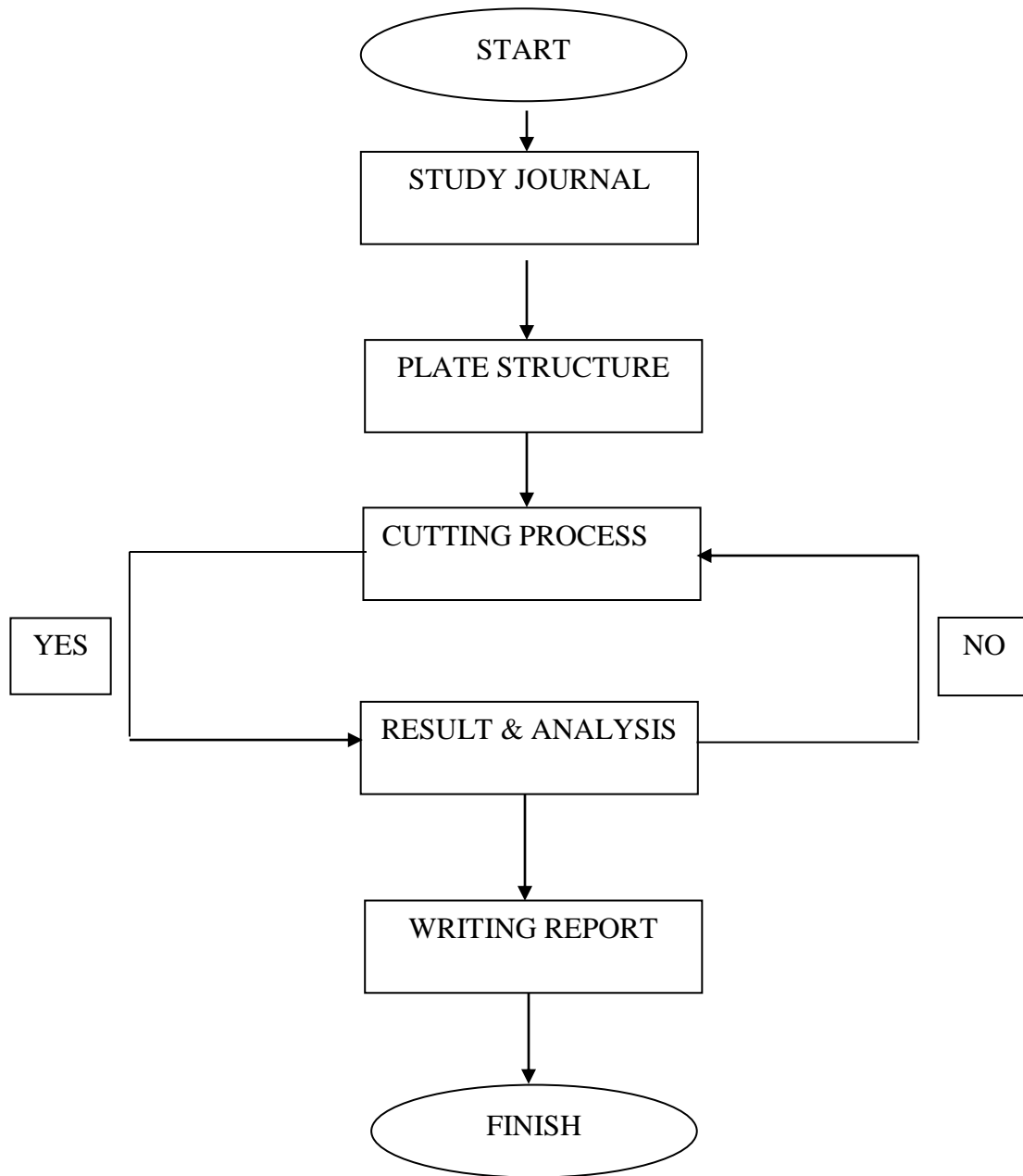


Figure 3.1: Flow for producing Plate support of Plasma CNC machine

3.3 DESIGN OF EXPERIMENT

Procedure

For the producing the plate support for plasma CNC machine, there are a few steps to take an action smoothly. The step of formation of this machine is established below:-

1. First, sketch the desired shape or design of plate support for plasma CNC machine.
2. After sketch the desired design of plate support for plasma CNC machine, assume suitable dimensions for all parts that want to produce in order of formation plasma CNC machine structure.
3. Then, by using the Solid works software, draw the proper design of desired plate support for plasma CNC machine include the dimensions. For the information, the SI unit for dimensions is in mm. Figure below shows the drawing of plate support for plasma CNC machine.

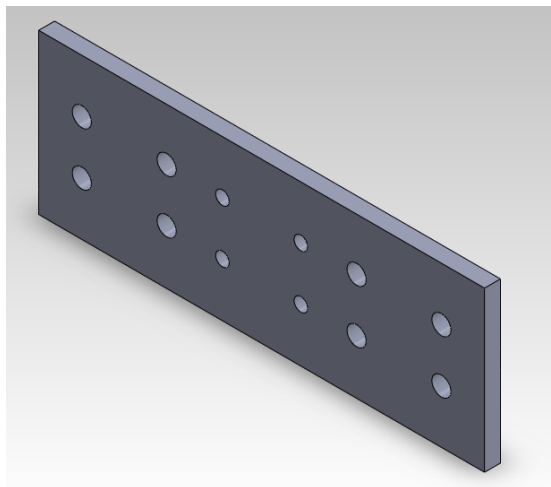


Figure 3.2: X-axis

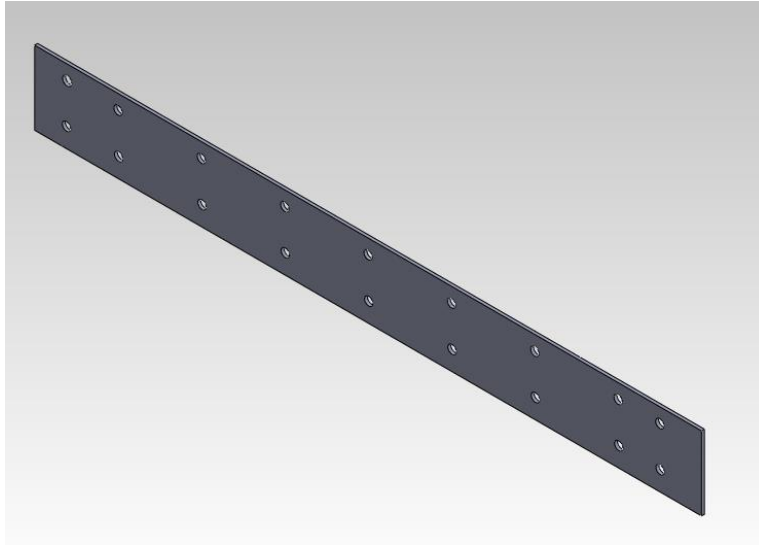


Figure 3.3: Y-axis

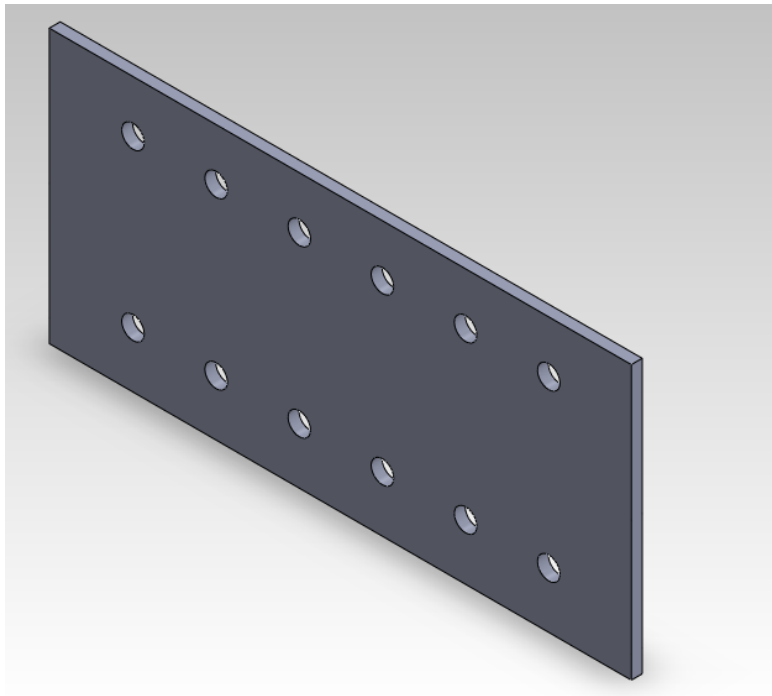


Figure 3.4: Z-axis

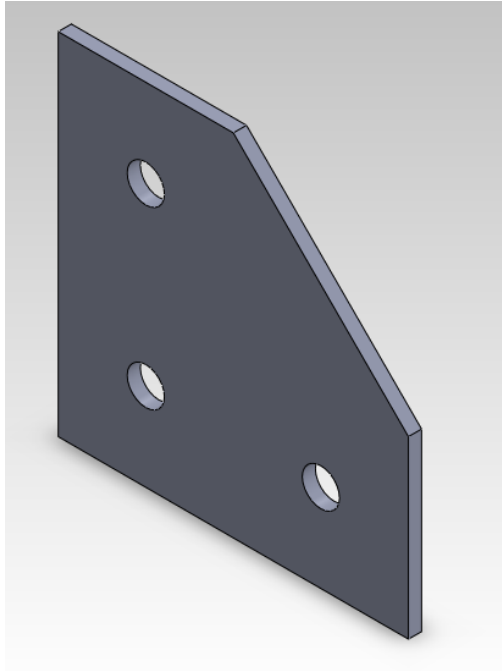


Figure 3.5: Angle plate

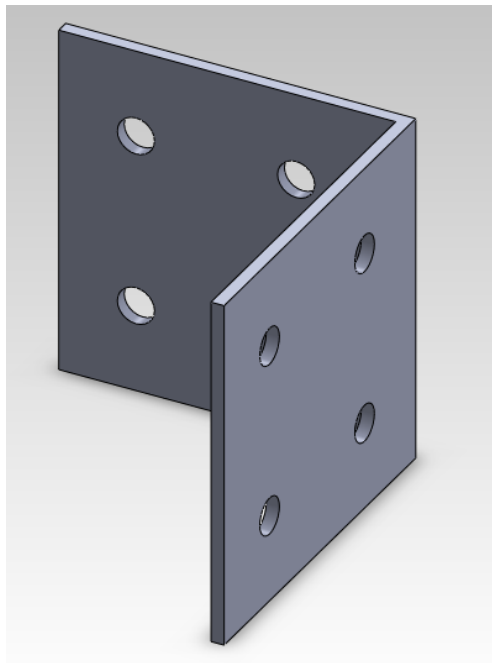


Figure 3.6: Conner plate

4. Next, list the components that want to use either for the body or frame and for the operating of this machine. From the table 2 below, show the listed components that want to order from supplier.

Table 1 : Listed component needed

No	Description	Quantity
1	Ball screw system, FEM-E-S Size : 40x10R	1
2	Ball screw shaft Size : 40x10R Length: 3268 mm	1
3	Ball runner block Size : 30	6
4	Ball guide rail Size : 30 Length : 3268 mm	2
5	Ball screw shaft Size : 32x10R Length : 1708 mm	1
6	Ball screw system, FEM-E-S 32x10R	1
7	Ball runner block Size : 25	4
8	Ball guide rail Size : 25 Length : 1708 mm	2
9	Ball screw system, FEM-E-C Size : 16x10R	1
10	Ball screw shaft Size : 16x10R Length : 412 mm	1
11	Ball runner block Size : 20	4
12	Ball guide rail Size : 20 Length : 412 mm	2

5. For the information, the material used for the frame or body of this machine is aluminum profile. Table below show the complete one the listed of aluminum profile that want to order to supplier included with specific dimension. For the joint process of aluminum profile, the gusset is suitable to use. From Table 3, 4 and 5 below also the size and quantities of aluminum profile and gussets that we want to order.

Table 2 : Listed aluminum profile size 40x80

Length (mm)	No of unit needed	Based on 5000 mm		Based on 6000 mm	
		Use	Less	Use	Less
2710	5	2710 (1)	2290	5420 (2)	580
		2710 (1)	2290	5420 (2)	580
		2710 (1)	2290	2710 (1)	3290
		2710 (1)	2290		
		2710 (1)	2290		
1220	4	4880 (4)	120	4880 (4)	1120
1440	2	2880 (2)	2120	2880 (2)	3120
440	2	880 (2)	4120	880 (2)	5120

Table 3 : Listed aluminum profile size 40x40

Length (mm)	No of unit needed	Based on 5000 mm		Based on 6000 mm	
		Use	Less	Use	Less
2710	2	2710 (1) 2710 (1)	2290 2290	5420 (2)	580
1220	14	4880 (4)	120	4880 (4)	1120
		4880 (4)	120	4880 (4)	1120
		4880 (4)	120	4880 (4)	1120
		2440 (2)	2560	2440 (2)	3560
810	4	3240 (4)	1760	3240 (4)	2760
490	2	980 (2)	4020	980 (2)	5020
200	4	800 (4)	4200	800 (4)	5200

Table 4 : Listed gussets needed

Size	No of unit
40x80	12
40x40	44

6. After supplier send to us all the ordered component, we stated do the cutting and assemble a few part until become a new one of Plasma CNC machine.
7. Next, open the computer with software uses to operate the Plasma CNC machine working.
8. After this machine open, before do the test of Plasma cutting on the material selected, we must do the test on the test work-piece like wood or paper as figure 3.6 below.



Figure 3.7: Tester work-piece

9. After test the cutting performance of Plasma, place the material selected on the board field.
10. With the selected operating parameters, do the Plasma cutting on the material.
11. Next, to see the formation of kerf width and surface roughness brings the already cut material into the metrology lab to see and measure the kerf width and surface roughness and also to see the heat-affected zone mechanism. By using measurement devices, which is optical measurement in metrology lab, measure the kerf width and surface roughness.
12. Then, interpret the data collected by using the experimental method in order to do the analysis.
13. Do the report.

3.4 FABRICATION PROCESS

STEPS TO FABRICATE THE FEW OF PLATE SUPPORT

The most of plate are made by galvanize iron. The five type of plate were made by using cutting, bending, and grinding machine. The hole on the plate is made by using milling machine which is step by step from edge finder, centre drill and drill.



Figure 3.8: Steps to fabricate plate support

3.5 FINISHING

The final fabrication process is the finishing process which is involving of assembly the reinforcement on the plate support to the frame structure. Before assemble all the parts of plate on the structure, the parts are make it by using the galvanize iron. This is because to improve the part appearance and to make the material used long lasting. After that, the assembly process is performed by assembly all the part as shown in the figures.



Figure 3.9: The final frame structure with plate support.

3.6 SUMMARY

This chapter present on how the project is being conducted. The plate support are usually need to very hard to support the structure. So many ways to dissolved the problem and make the perfect structure.

CHAPTER 4

RESULT AND DISCUSSION

4.1 INTRODUCTION

In this chapter will discuss detail about the functionality of the main parts of the plate supporting. This section will also discuss on the produce and variables affecting the function of the plate support. The focus of this chapter is solely on the product of this project. Once the target of this chapter is met, then only the whole project process and outcome can be concluded in the next chapter

4.2 FINAL PRODUCT

4.2.1 Overview of product

The whole plate support view part by part is shown below



Figure 4.1: Y-axis guide rail support



Figure 4.2: X-axis runner block support



Figure 4.3: Angle support



Figure 4.4: Corner support



Figure 4.5: Z-Axis guide rail support

4.2.2 Overview of structure

Figure 4.6 shows the result of the finished joining of the frame structure. This part was done using aluminum profile. The bolt and nut was used to complete the joining process of this part. The bases of the frame structure are using plate support which is easy to stable the structure when running experiment.



Figure 4.6: Frame structure with plate support

4.2.3 Overview of x-axis plate support

The figure below show the x-axis plate support and it function is to hold runner block and aluminum profile for y-axis.



Figure 4.7: X-axis Plate Support

4.2.4 Overview of y-axis plate support

Figure 4.8 show the y-axis plate support to attach guide rail for y-axis and all the z-axis structure.



Figure 4.8: Y-axis plate supports

4.2.5 Overview z-axis plate support

The figure below show the z-axis plate support for guide rail and motor of plasma CNC. The function of this plate to give more power to support heavy motor.



Figure 4.9: Z-axis plate supports

4.2.6 Overview of Conner support

Figure 4.10 below show the Conner plate support. The function of Conner plate support is to make the frame structure more stable when running the machine.



Figure 4.10: Conner plate support

4.2.7 Overview of angle support

Figure below show the angle support for y-axis frame structure. The function of this angle support is to authorize the y-axis when accommodate load from z-axis structure.



Figure 4.11: Angle plate support

CHAPTER 5

CONCLUSION

5.1 INTRODUCTION

In this chapter, the overall process of design and fabrication will be summarized. Furthermore, the recommendation for further design and development of plasma CNC machine structure (plate) will be included in this chapter.

5.2 PROBLEM FACED DURING THE PROJECT

During the design and fabrication process of design and development of plasma CNC machine structure (plate) project, many obstacles were faced. The first was obtaining the knowledge of who to create the new design and fabricate with manually. This knowledge is not through in one lecture but also with the chief engineer students. Therefore, internet and books from the library was the side source of information. The next problem faced was obtaining the material for fabrication. Most of the needed material was not available immediately because I need to order first. After discussed with supervisor, I choose to place an order with a large quantity, but it is still not enough because I use too many bolts and nuts during the fabrication process. While for the supporter I decide to use galvanize iron for plate support and motor holder, for guide rail I use stainless steel. After supervisors agrees and satisfy with the materials information, Fabrication is preceded when all the needed materials are available.

5.2 RECOMMENDATION

There are some recommendation Related to this project are material purchasing and receiving should be on schedule. This will help to complete fabrication process on schedule. Besides that, the material availability at mechanical laboratory must consider before decide the specification of design. The availability of material should be provided by laboratory instructor to reduce the time of searching for the correct material which delays the process.

Other than that, the thickness of the plate support can be change from 3 mm to 10 mm thick so that the vibrate of the frame structure will be reduce and make it more stable.

5.3 CONCLUSION

The project objective has been achieved. The final design of plasma CNC machine and the plate support is refer to current machine but development has been done to make more better to the current machine by add more plate support and z-axis. Solid works software is used to draw the best design. This plasma frame structure assemble is successfully fabricated within 14 weeks.

Basically, the plate support is a supporter system that is due to its balance the structure and it and it contributes significantly to reduce vibration on structures. To design and fabricate the plate support, research about the plate capability was made through the survey and the internet. Moreover, the matrix method of design concept specification learnt in the course “industrial design” is used to find out the best design concept. The flow of the fabrication was planned to have an effective work.

On the other hand, the fabrication which involved in cutting, welding, grinding, bending, milling, and drilling needs enough technique to make it good. Throughout the fabrication, the skills of handling these fabrication processes were improved. Furthermore, problems facing during the fabrication process are resolved with the solution at which critical thinking and problem solving skills were improved.

Therefore, the project successfully generates a new design of plate support and improves a person's skills and creativity and innovation.

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APPENDIX A2

Frame structure fullfil with the plate support



APPENDIX A3

Actual plate support with complete assemble design was produced.



x-axis plate support



y-axis plate support



z-axis plate support



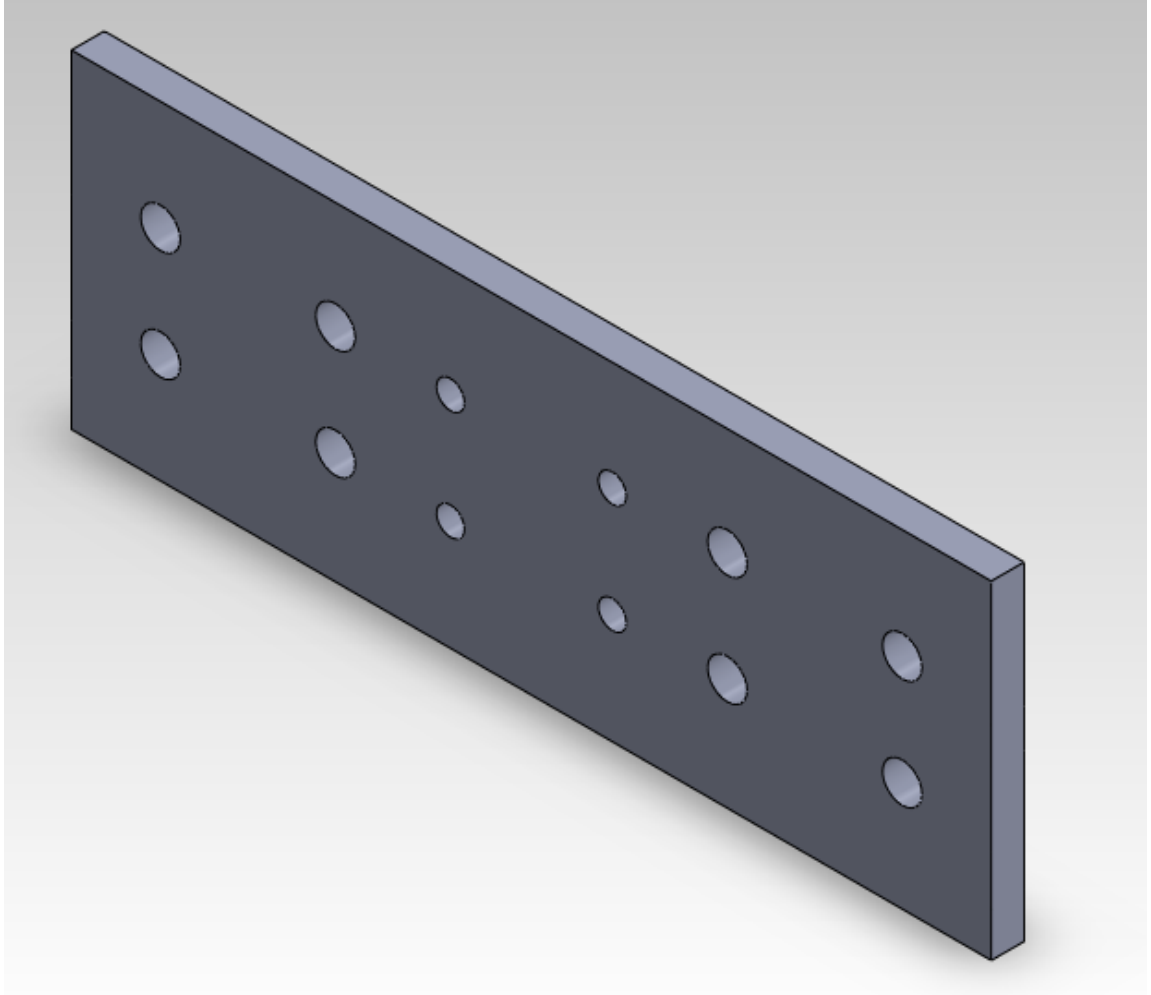
Conner plate support



Angle plate support

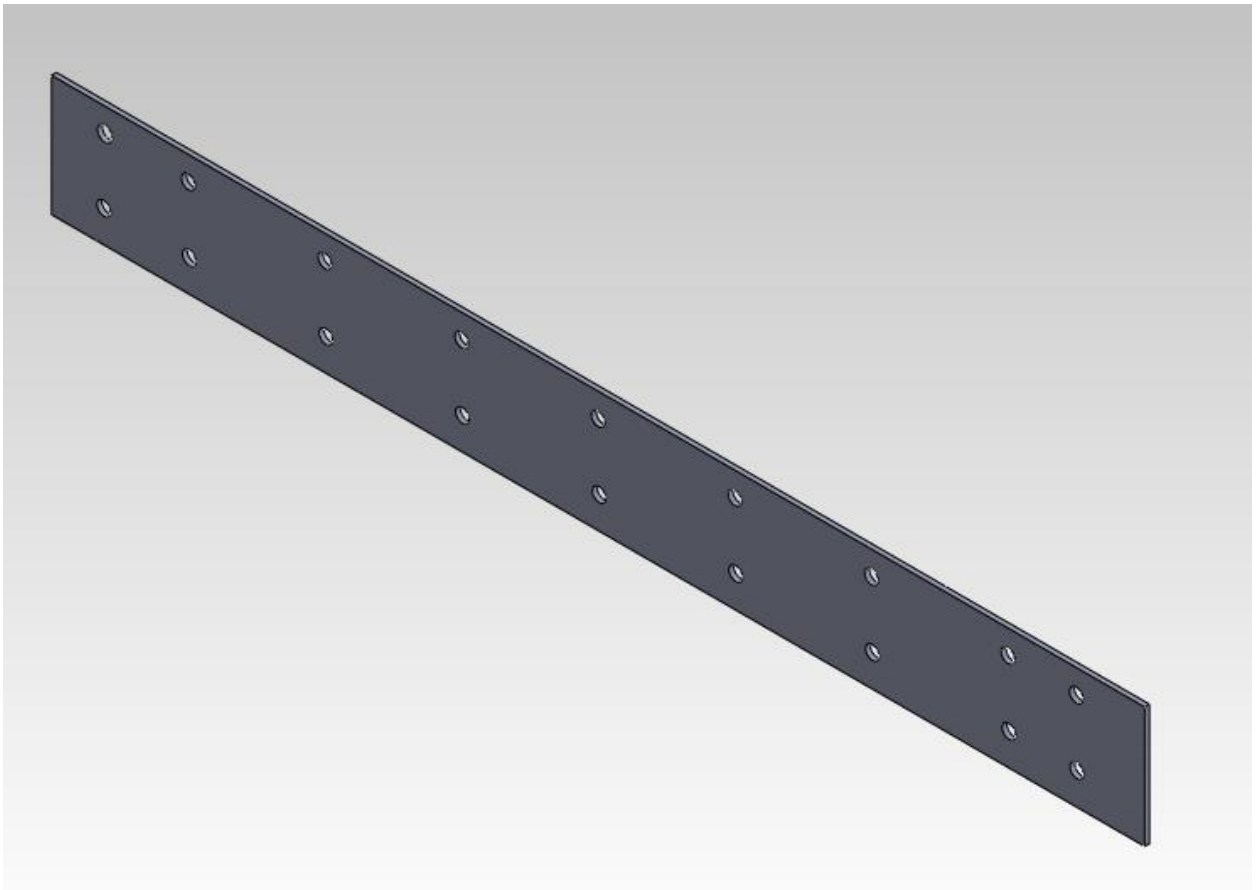
APPENDIX B1

X-axis plate support part drawing by using Solidwork 2010



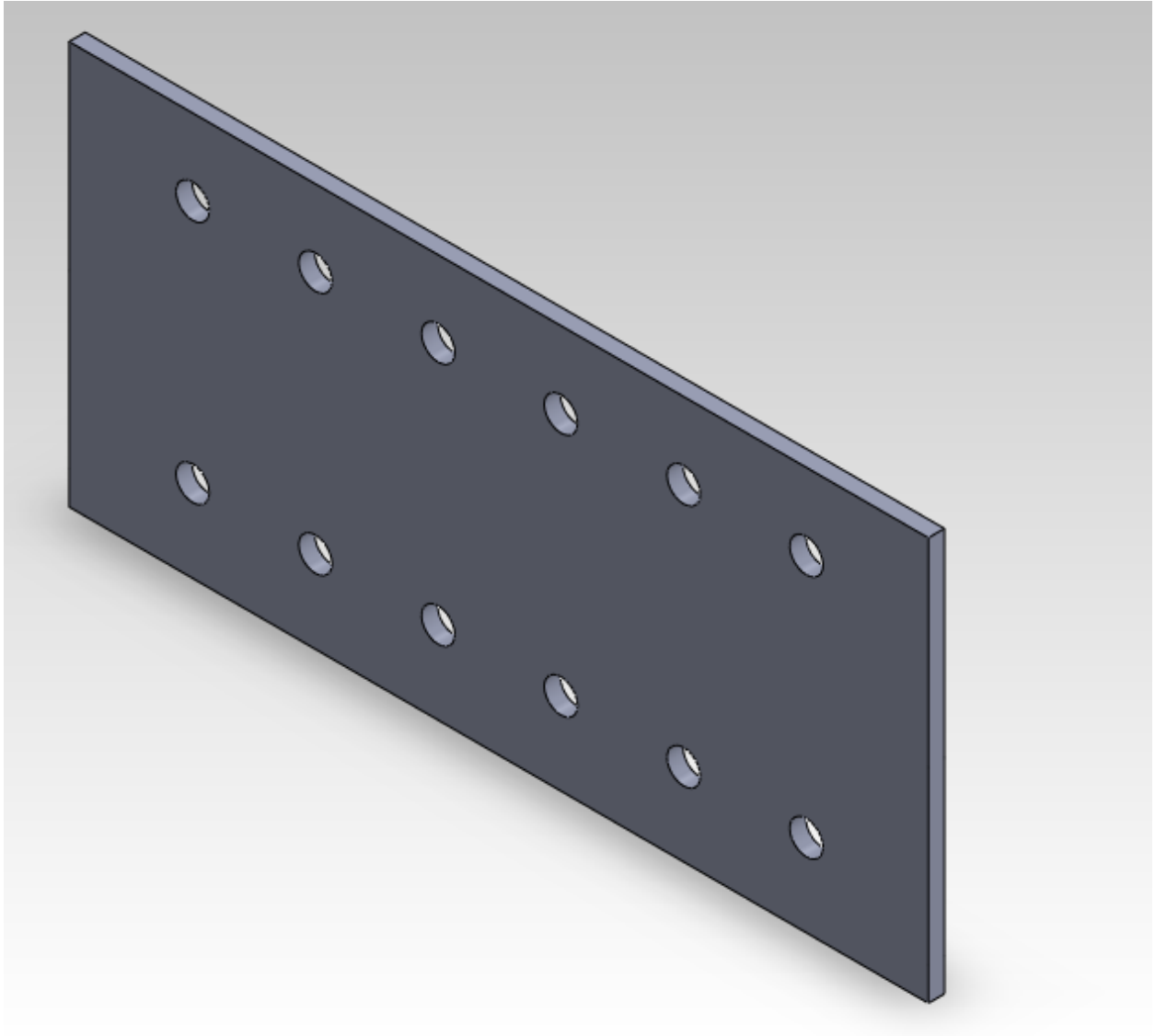
APPENDIX B2

Y-axis plate support part drawing by using Solidwork 2010



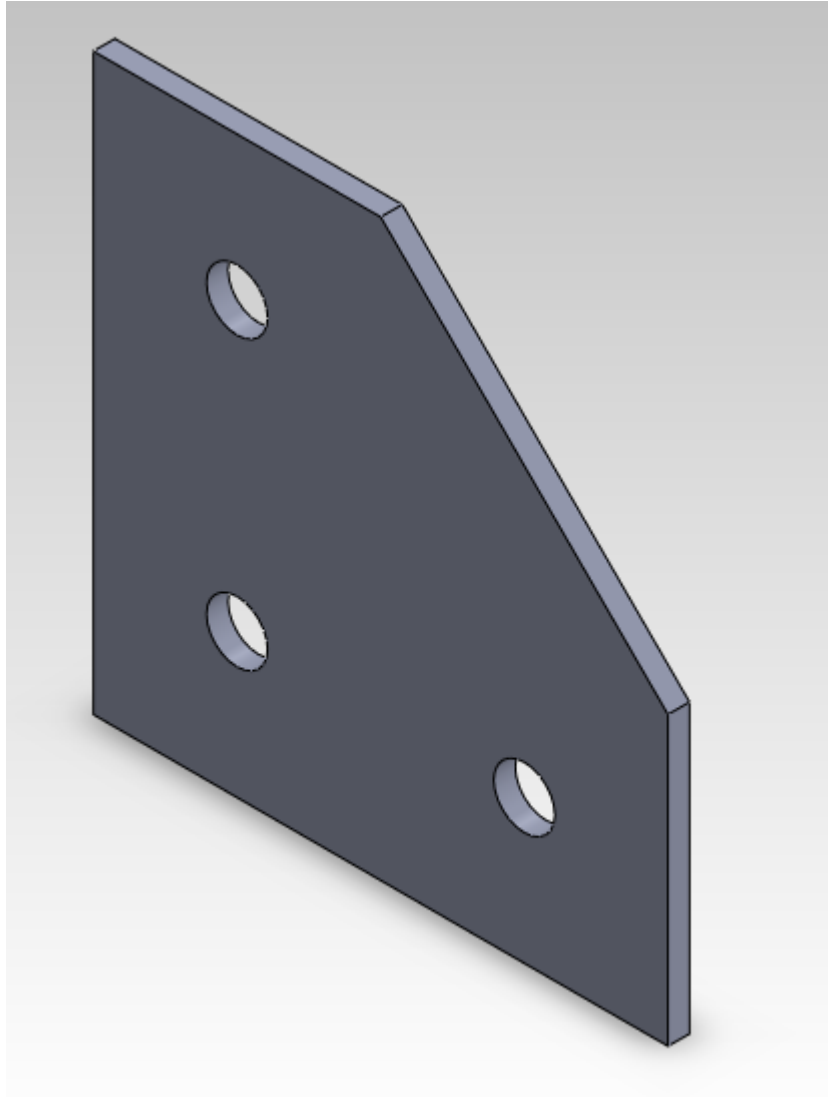
APPENDIX B3

Z-axis plate support part drawing by using Solidwork 2010



APPENDIX B4

Angle plate support part drawing by using Solidwork 2010



APPENDIX B5

Conner plate support part drawing by using Solidwork 2010

