DESIGN AND MANUFACTURE THE OUTER SHELL OF A DIESEL FURNACE

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DESIGN AND MANUFACTURE THE OUTER SHELL OF DIESEL FURNACE

TUAN MOHD SHAKIR BIN ABU BAKAR

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

Faculty of Mechanical Engineering

Universiti Malaysia Pahang

DECEMBER 2010

SUPERVISOR'S DECLARATION

I hereby declare that have read this project report and in my opinion this project report is sufficient in terms of scope and quality for the award of the Diploma of Mechanical Engineering

Signature :

Name of Supervisor : Mr. Asnul Hadi bin Ahmad

Date : 20th DECEMBER 2010

STUDENT'S DECLARATION

I declare that this report entitled "Design and Manufacture the outer shell of diesel furnace" is the result of my own research expect as stated in the references.The report has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature :

Name : Tuan Mohd Shakir Bin Abu Bakar

Date : 20TH DECEMBER 2010

DEDICATION

To my parents,friends,without whom and his /her lifetime efforts, my pursuit of higher education would not have been possible and I would not have had the chance to study for a mechanical course.

Also to my supervisor's, Mr. Asnul Hadi Bin Ahmad and Instructor Engineer, without whose wise suggentions, helpful guidance and direct assistance, it could have neither got off the ground not ever been completed.

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ABSTRACT

There are a lot of diesel furnaces on the market today. The diesel furnace that is more synonymous with the duty of non-ferrous metal melting. Today, this material has been readily adopted into the diesel furnace which has a different function and form designing. However, there is no diesel furnace designs and inventions that have various functions in the market. By creating a diesel furnace is functional, is expected not only to attract the attention of consumers because of the nature and function more effectively but also can help users to work more comfortably by using a tool only and is not directly save costs and time expense of consumers. The results showed the original objectives of the project to produce diesel furnace and various functions can be used for a variety of situations is achieved. Any problems and suggestions related to the products discussed in this final chapter.

ABSTRAK

Terdapat banyak relau bagas diesel di pasaran hari ini. Relau bagas diesel yang lebih sinonim dengan tugasnya meleburkan besi bukan ferus. Hari ini bahan ini telah di adaptasikan menjadi relau bagas diesel yang mempunyai pelbagai fungsi dan rekaan bentuk. Namun, belum terdapat rekaan dan ciptaan relau bagas diesel yang mempunyai pelbagai fungsi di pasaran. Dengan terciptanya relau bagas diesel pelbagai fungsi ini, diharapkan bukan sahaja dapat menarik perhatian pengguna disebabkan bentuk dan fungsinya yang lebih efektif malah dapat membantu pengguna melakukan kerja dengan lebih selesa dengan mengunakan satu alatan sahaja dan secara tidak langsung menjimatkan kos perbelanjaan dan masa pengguna. Keputusan kajian menunjukan objektif asal projek untuk menghasilkan relau bagas diesel pelbagai fungsi dan boleh digunakan untuk pelbagai situasi ini tercapai. Sebarang permasalahan yang berkaitan dan cadangan mengenai produk ini dibincangkan di bab terakhir.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

CHAPTER 1 is the introduction chapter of this project. Generally, it discuss about the project background, problem statement, the objective, scope of project, and project gantt chart.

1.2 PROJECT BACKGROUND

This project focuses on designing the outer shell to support the furnace diesel part in diesel furnace, such as buffer, refactory lining steel piles, bricks and a crucible. A diesel furnace as a device to generate a high heat using a diesel fuel from combustion of its burning system . The furnace is used exclusively to mean industrial furnaces which are used for many things, such as the extraction of metal from ore (smelting) or in oil refineries and other chemical plants, for example as the heat source for fractional distillation columns.

The term furnace can also refer to a direct fired heater, used in boiler applications in chemical industries or for providing heat to chemical reactions for processes like cracking.The heat energy to fuel a furnace may be supplied directly by fuel combustion, by electricity such as the electric arc furnace, or through Induction heating in induction furnaces.

1.3 PROBLEM STATEMENT

Mostly, current the diesel furnace has limited space. It cannot put anything on their diesel furnace. This project is to design the outer shell and the hanger on the diesel furnace.

1.4 OBJECTIVE

The objective of this project is:

i. To design and manufacture the outer shell of diesel furnace.
ii. To design and manufacture the hanger for diesel furnace.

1.5 SCOPE

In this project, scope performed a range in the completion of a project.The scopes of this project are:

i. This study is focused on making the outer shell of diesel furnace.
ii. The size of the diesel furnace is 586mm for diameter and 570mm for high.
iii. Function to apply in foundry lab.

1.6 GANTT CHART

Gantt chart is an important to guide work process during this project. With gantt chart what need to be done first can be plan accordingly.Other than that, this project will run smoothly and finish on time. Refer Appendix A to see a gantt chart diagram.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

CHAPTER 2 is the literature review of the project.In this chapter, there are type of furnace available in market of various design and use various material as a source of combustion in manufacture.It also have fabrication planning process.

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2.2 TYPES OF FURNACES

2.2.1 Furnace 1

Pusher Type Forging Furnaces is another name for variety of Batch Type Forging Furnaces which are largely used for ferrous and non ferrous forgings. The range of forging furnace design, use the best mix burner and is renowned providing optimum heat performance. It also comes with optional accessories which includes Automatic on/off system panel board.In-order to improve the efficiency of the furnace and the quality of the products, the burner is fitted into the roof so that the materials below on the hearth are heated directly. Further, use a recuperator to enhance the operations of the furnace and to provide more energy saving based on figure 2.1 and figure 2.2.

Figure 2.1: Batch type forging furnace

Figure 2.2: Box Type Tampering Furnace

2.2.2 Furnace 2

Used for an extensive variety of ferrous materials like steel and cast iron, the electrically heated nitriding liquid is an expedited nitride in nitrocarborising bath. After treatment, the component has less resistance diffusion layer, which is very effective in imparting greater life to the material.The figure 2.3 shown liquid nitriding furnace.Distinctive components treated by nitriding liquid are:

i. Timing gears
ii. Rocker arm shaft
iii. Water dies
iv. Sliding gate valves
v. Plastic extrusion screws
vi. Punching dies

Figure 2.3: Liquid Nitriding furnace

2.2.3 Furnace 3

Pigeon Type Up-setter Forging Furnace is for its world class quality, precise functioning, and accurate performance based on figure 2.4 and figure 2.5. These furnaces are available in varied capacities, moreover even provide range for using it These cost-effective, sturdy and durable furnaces are in great demand due to the following features:

i. Automatic on/off system
ii. Uniform temperature
iii. High class refractory used for radiation losses to maintain skin temperature.

Figure 2.4: PIT Type Gas Carburizing Furnace

Figure 2.5: Pigeon Type Upsetter Forging Furnace

2.2.4 Furnace 4

Muffle Type Furnace, which finds application in various chemical industries including otherwise. the designing furnaces as per the specifications to faster of material in burn show in figure 2.5. Additionally, the furnaces design are heated quickly and consume less fuel are useful for the following process:

1. Normalizing
2. Stress-relieving
3. Hardening

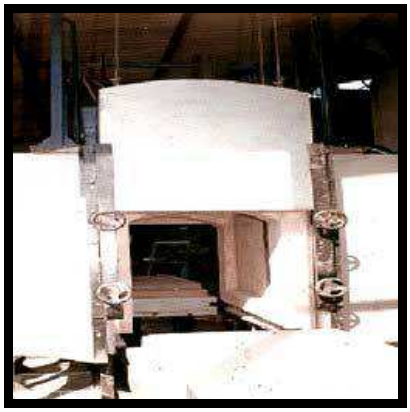

Figure 2.6: Muffle Type Furnace

2.3 FABRICATION PLANNING PROCESS

2.3.1 Shearing

Cutting processes are those in which a piece of sheet metal is separated by applying a great enough force to cause the material to fail. The most common cutting processes are performed by applying a shearing force, and are therefore sometimes referred to as shearing processes.

The shearing process is performed on a shear machine, that can be operated manually (by hand or foot) or by hydraulic, pneumatic, or electric power. A typical shear machine includes a table with support arms to hold the sheet, stops or guides to secure the sheet, upper and lower straight-edge blades, and a gauging device to precisely position the sheet.

The sheet is placed between the upper and lower blade, which are then forced together against the sheet, cutting the material. In most devices, the lower blade remains stationary while the upper blade is forced downward. The upper blade is slightly offset from the lower blade, approximately 5-10% of the sheet thickness. Also, the upper blade is usually angled so that the cut progresses from one end to the other, thus reducing the required force.

It plan to cut the mild sheet metal according to the actual size was decided. Figure 2.7 below show how the shearing process work.

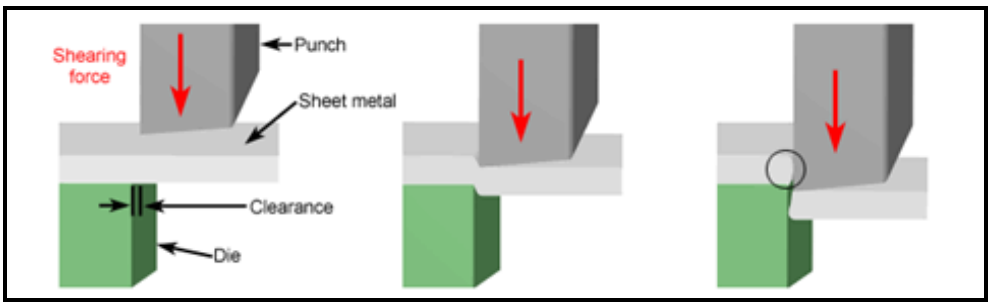

Figure 2.7: Shearing process

2.3.2 Lathe

A lathe is a machine tool which turns cylindrical material, touches a cutting tool to it, and cuts the material. A material is firmly fixed to the chuck of a lathe. The lathe is switched on and the chuck is rotated. And since the table which fixed the byte can be moved in the vertical direction and the right-and-left direction by operating some handles.

In order to get an efficient process and beautiful surface at the lathe machining, it is important to adjust a rotating speed, a cutting depth and a sending speed as shown in Figure 2.8. It plan to use lathe machine for mild steel shaft and hollow shaft. Use it to make a facing and material remove to get an actual dimension.

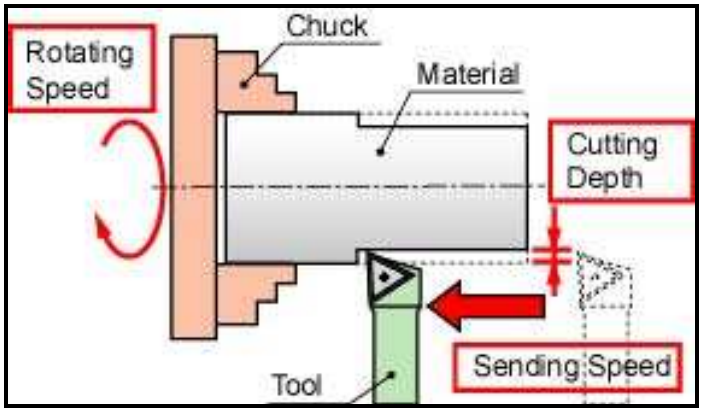

Figure 2.8: Important element of lathe machine

2.3.3 Shielded metal arc welding (SMAW)

Shielded metal arc welding (SMAW) as shown the figure 2.9, also known as manual metal arc (MMA) welding or informally as stick welding, is a manual arc welding process that uses a consumable electrode coated in flux to lay the weld.An electric current, in the form of either alternating current or direct current from a welding power supply, is used to form an electric arc between the electrode and the metals to be joined.As the weld is laid, the flux coating of the electrode disintegrates,giving off vapors that serve as ashielding gas and providing a layer of slag,both of which protect the weld area from atmospheric contamination.

Figure 2.9: Shielding metal arc welding

2.3.4 Rolling

Flat rolling or Rolling is defined as the reduction of the cross-sectional area of the metal stock, or the general shaping of the metal products, through the use of the rotating rolls. It allows a high degree of closed-loop automation and very high speeds, and is thus capable of providing high-quality, close tolerance starting material for various secondary sheet metal working processes at a low cost.

2.3.5 Schematic Drawing of Rolling Process

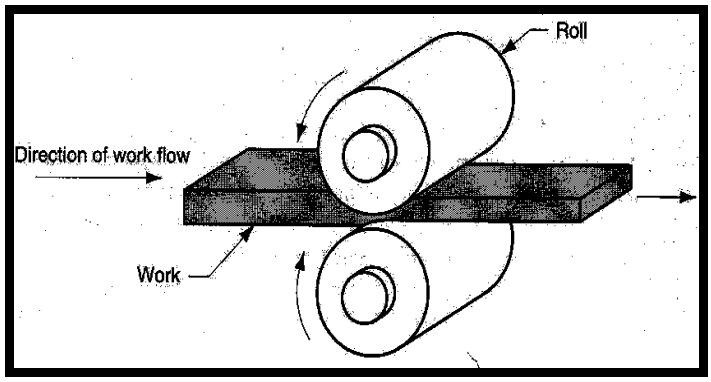

Figure 2.10: Rolling Process

Source: tradekey

The rolls rotate as illustrated in Figure 2.10 to pull and simultaneously squeeze the work between them. The basic process shown in Figure 2.10 is flat rolling, used to reduce the thickness of a rectangular cross section.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

CHAPTER 3 is the methodology has been used to make the outer shell of diesel furnace. In this chapter, a project flow chart is defined. The information that included is enstablish target specification,drawing,sketching and drawing selection,select final design and improvement of the design, select material of the product and fabrication of the product. It also allows others to replicate study and run new and different studies that are based on methodology.

3.2 PROJECT FLOW CHART

The first matter that need done is researching some info regarding the available the furnace. There are done with the help of the some information from books and internet and with help thing others.

This process involved finding the right material to be used for the project, literature review and the objective of the project takes about four weeks to be completed. After all the above stated information is obtained, continue with the scope of the project. This is important in order to achieve the objective of the project.

Many design concept have been produced but only four will be choosen to be finalize. In order to choose the finalize design, need to list down the advantages and disadvantages of each sketch and do the screening method. And finally from this, can get the final design of project.

After the finalize design have been completed, now can start with fabricating process of project.The figure 3.1 is flow chart.

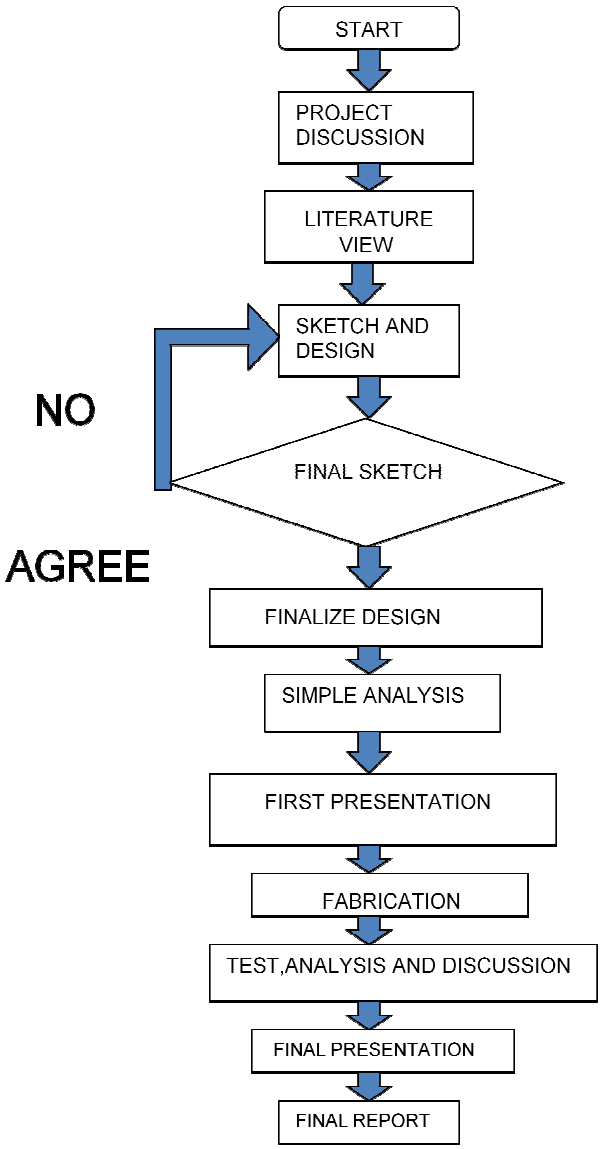

Figure 3.1: Flow chart

3.3 ESTABLISH TARGET SPECIFICATION

After the investigation of the objective, criteria selection will be developed. Criteria selection here means the criteria that what people will look on the product. It is focus on the existing product on the market. Then, when the new product is done, compare it with the existing product on the market. The new good design should have better criteria than the product on the market.

This is the criteria that had to use to the new design for the outer shell of diesel furnace.

i. Save
ii. Easy to use
iii. Long life time
iv. Strong
v. No easy to crack
vi. Have large space
vii. Multifunction
viii. Low cost

3.4 DRAWING

The drawings are divided into two categories which are:

i. Sketching : All the ideas for the diesel furnace are sketched to ensure that the ideas selection can be made after this.
ii. AutoCAD/SolidWorks Software: The selected design or selected concept that have been sketched is then transfer into 3D solid modelling and engineering drawing by using AutoCAD and SolidWorks software.

3.5 SKETCHING AND DRAWING SELECTION

The aim of this project is to design the diesel furnace which can be apply in foundry laboratory .The objective for this project is to improve function on the diesel furnace that most of no have it. So the new design need made to improve the function on the diesel furnace to give comfort to user.So,the design has been created and has been selected the datum.

3.5.1 First Design

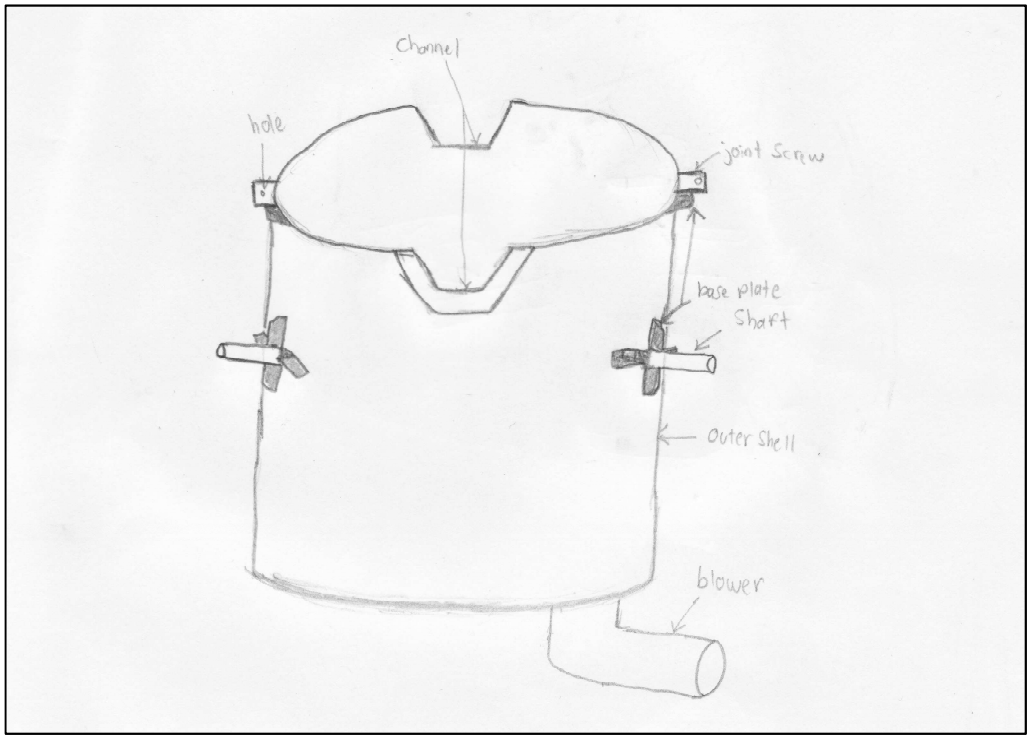

Figure 3.2: First design

3.5.2 Second Design

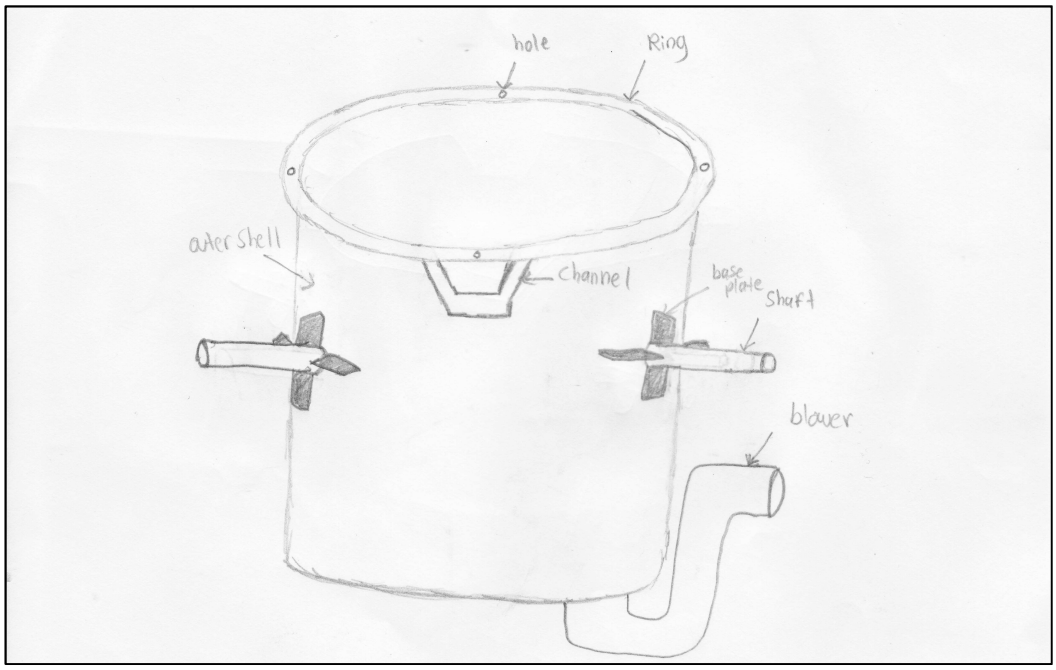

Figure 3.3: Second design

3.5.3 Third Design

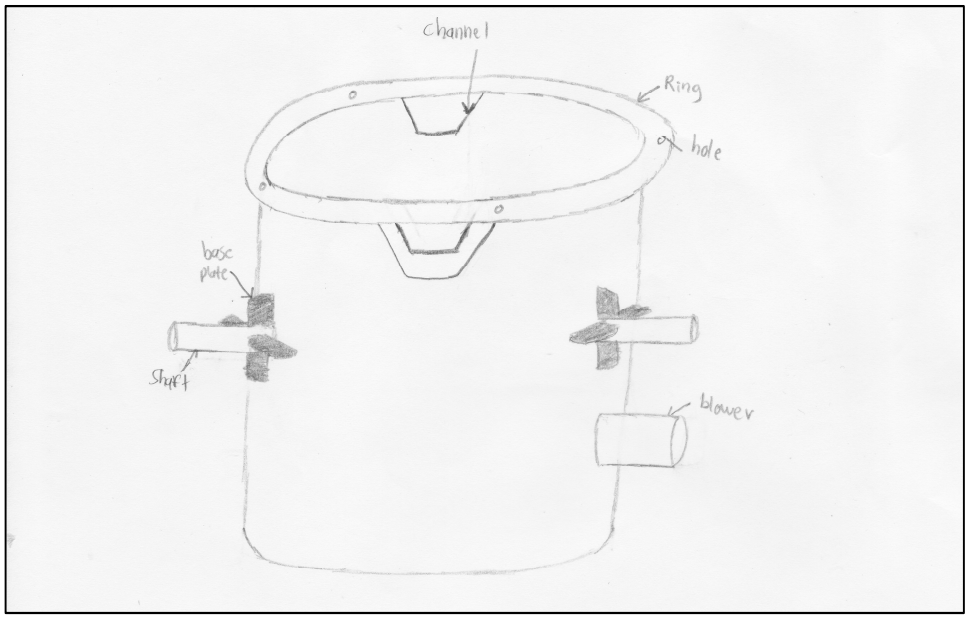

Figure 3.4: Third design

3.5.4 Fourth design

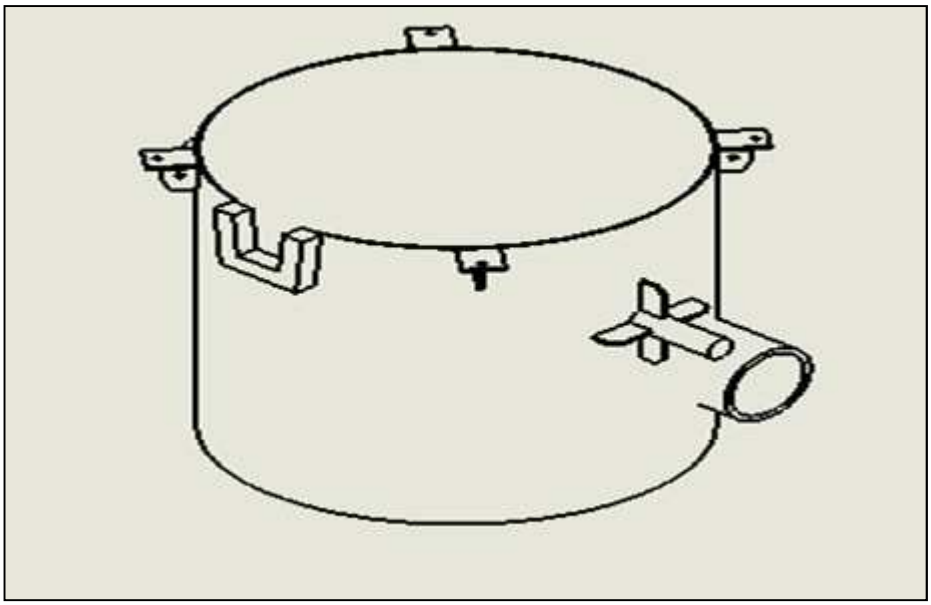

Figure 3.5: Fourth design

3.6 SELECT FINAL DESIGN AND IMPROVEMENT OF THE DESIGN

After design concept was made, the best design and relate it with criteria selection was selected. For this project, fourth design is the best after consider the all criteria selection.

Table 3.1 : Concept selection table

Selection Criteri	Design 1	2	3	4	Datum
Easy to use	+	-	+	+	0
Safe	-	-	+	+	0
Llong life time	-	0	+	+	0
Having large space	-	0	+	+	0
No easy to crack	-	0	+	+	0
Multifunction	-	-	0	+	0
Low cost	+	+	-	+	0
Strong	0	+	+	+	0
∑+	2	2	6	8	0
∑0	1	3	1	0	0
∑-	5	3	1	0	0
Net Score	-3	-1	5	8	0
Rank	4	3	2	1	0

Notes:
+ = Better than
- = Worse than
0 = Same as

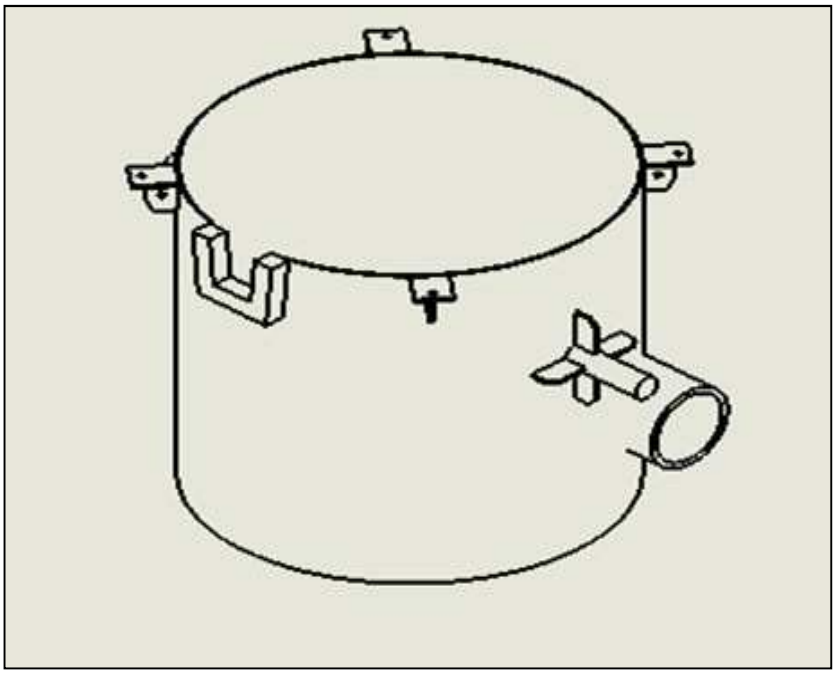

Figure 3.6: Finalize Design

Design 4 have the higher rank score than the other design. So this design had been chosen to be the finalize design and will be fabricate.

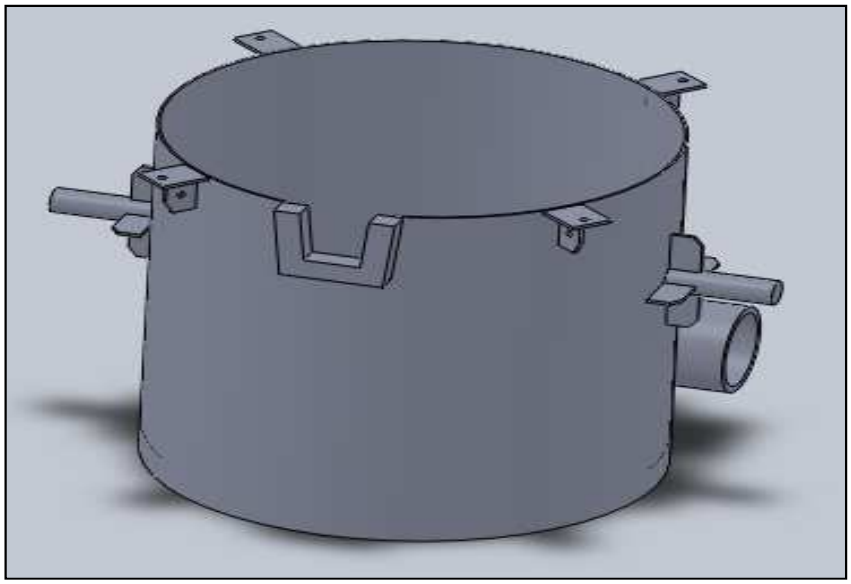

Figure 3.7 : Drawing using Solidwork

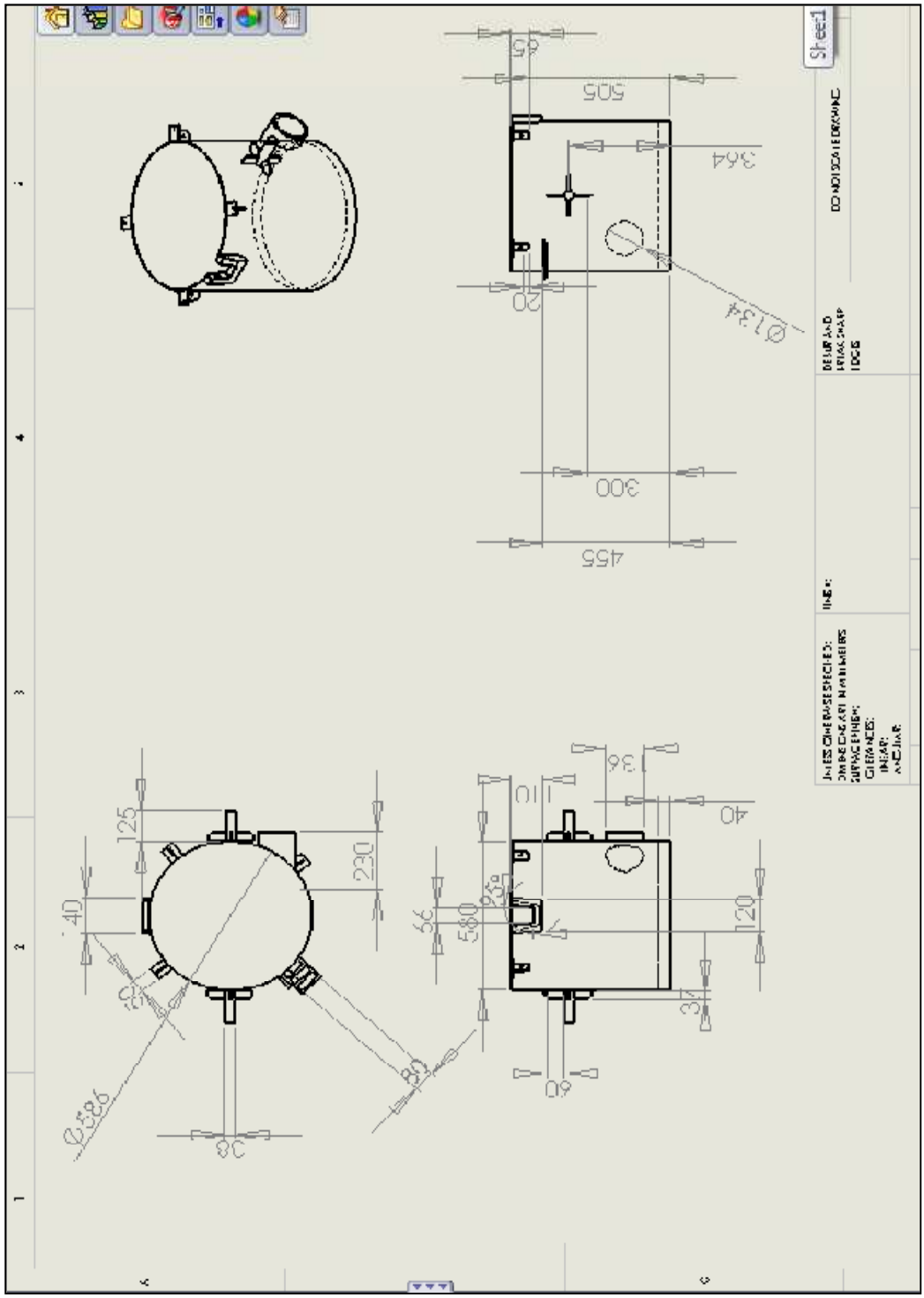

Figure 3.8 : Drawing using AutoCAD

3.6.1 Exploded View

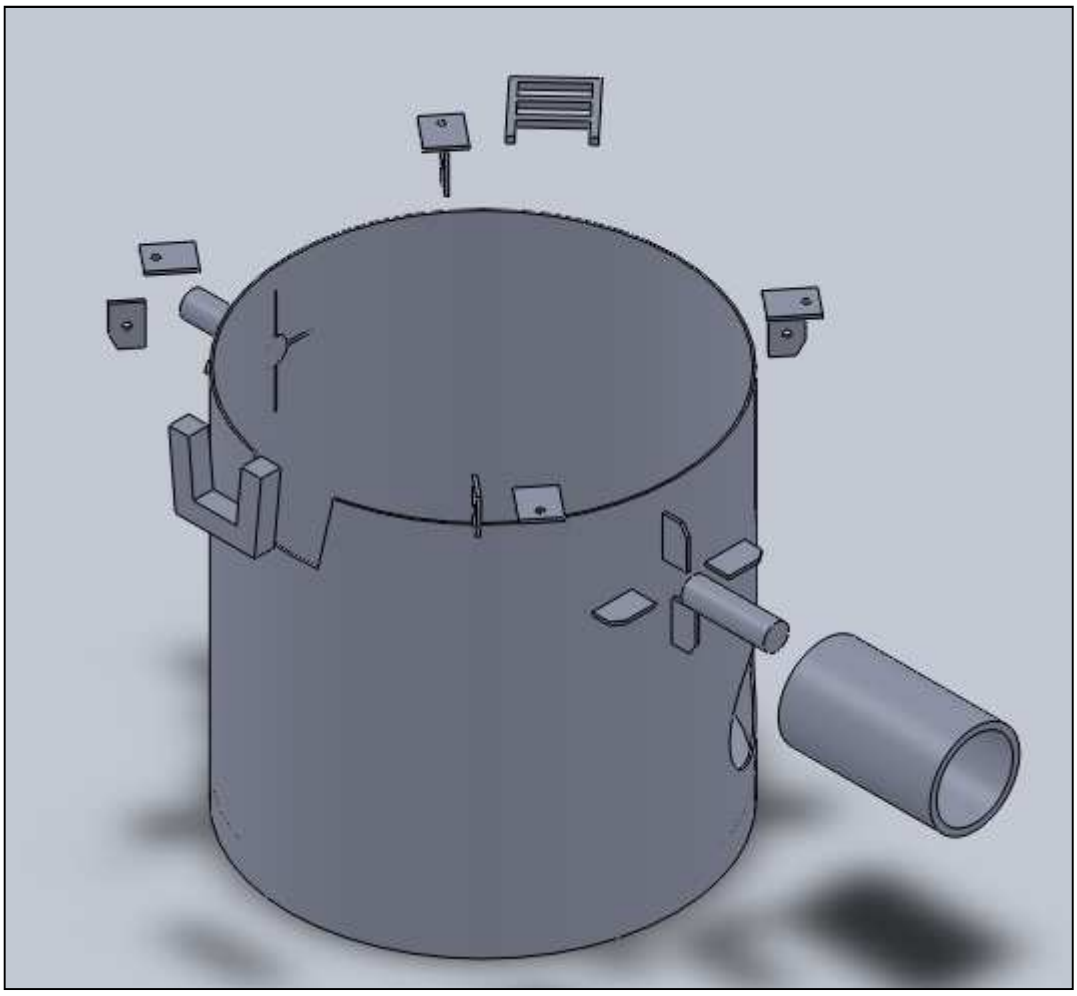

Figure 3.9: Exploded view selected in Solidwork drawing

3.7 SELECT MATERIAL FOR THE PRODUCT.

For this project, plan to make a full scale for produce the real product.The material using for fabricate the diesel furnace is mild steel sheet,flat bar steel,angle bar steel and rod steel.Main body of diesel furnace is made from mild steel plate.The column using flat bar steel.The channel is made from angle bar steel.The hold the outer shell is made from rod steel.This section need strongly because it will be the cornerstone of strength for the weight of others parts.Overaul,this project are uses mild steel and steel as main material to fabricate.

3.7.1 Mild steel

Mild steel is a type of steel alloy, that contains a high amount of carbon as a major constituent. An alloy is a mixture of metals and non-metals, designed to have specific properties. Mild steel is the most common form of steel because its price is relatively low while it provides material properties that are acceptable for many applications. Low carbon steel contains approximately 0.05–0.15% carbon and mild steel contains 0.16–0.29% carbon, therefore it is neither brittle nor ductile. Mild steel has a relatively low tensile strength, but it is cheap and malleable; surface hardness can be increased through carburizing.

It is often used when large quantities of steel are needed, for example as structural steel. The density of mild steel is approximately 7.85 g/cm^3 (0.284 lb/in^3) and the Young's modulusis 210,000 MPa (30,000,000 psi).

Low carbon steels suffer from yield-point runout where the material has two yield points. The first yield point (or upper yield point) is higher than the second and the yield drops dramatically after the upper yield point. If a low carbon steel is only stressed to some point between the upper and lower yield point then the surface may develop Lüder bands.

3.7.2 Steel

Steel is any alloy of iron, consisting of 0.2% to 2.1% of carbon, as a hardening agent. Besides carbon, there are many metal elements that are a part of steel alloys. The elements other than iron and carbon, used in steel are chromium, manganese, tungsten and vanadium. All these elements along with carbon, act as hardening agents. That is, they prevent dislocations from occurring inside the iron crystals and prevent the lattice layers from sliding past each other. This is what makes steel harder than iron. Varying the amounts of these hardening agents, creates different grades of steel. The ductility, hardness and mild steel tensile strength is a function of the amount of carbon and other hardening agents, present in the alloy. The amount of carbon is a deciding factor, which decides hardness of the steel alloy. A steel alloy with a high carbon content is mild steel, which is in fact much more harder and stronger than iron.

The figure 3.10 is mild steel sheet.It use to make the outer shell of the diesel furnace.

Figure 3.10: Mild steel plate

The figure 3.11 is angle bar steel.It use to make the channel of the diesel furnace

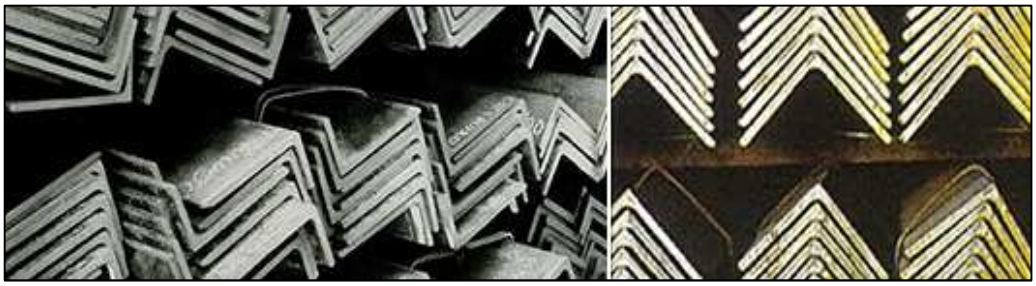

Figure 3.11: Angle bar steel

The figure 3.12 is flat bar steel.It use to makes base plate and column.

Figure 3.12: Flat bar steel

The figure 3.13 is round bar steel.It use to make the shaft at the outer shell of diesel furnace.

Figure 3.13: Round bar steel

Table 3.2 below is the bill of of material that needed to fabricate this product**.**

Table 3.2: Bill of material

Part	**Material**	**Dimension**	**no**
Outer shell	Mild steel plate	586mm x 580mm (d x h)	1
Rod	Round bar steel	38mm x 125mm (d x l)	2
Channel	Angle bar steel	500mm x 50mm (l x w)	1
Base plate	Flat bar steel	50mm x 25mm (l x w)	4
Column	Flat bar steel	50mm x 50mm (l x w)	12
Pipe	Mild steel hollow rod	136mm x 230mm (d x l)	1

3.8 FABRICATION OF THE PRODUCT

This process use the materials that selected, make the product base on the selected design and then followed by the selected dimension. In this process, many methods are used in order to make the design become reality. There are several fabrication methods that have been applied in the fabrication of the diesel furnace. The processes involve are as below.

i. Measuring and marking
ii. Cutting
iii. Rolling
iv. Lathe
v. Joining
vi. Finishing

3.8.1 Measuring And Marking

Before start to fabricate,the process involved are the process of measuring and marking which are mild steel plate,round bar steel,flat bar steel and angle bar steel to follow the design and dimension was decided.The apparatus which are used during the measuring process are measuring tape,try square,steel rulers,and vernier caliper based on figure 3.14, figure 3.15, figure 3.16 and figure 3.17.For the marking process are used hammer,scriber and pencil.

Figure 3.14: Measuring tape

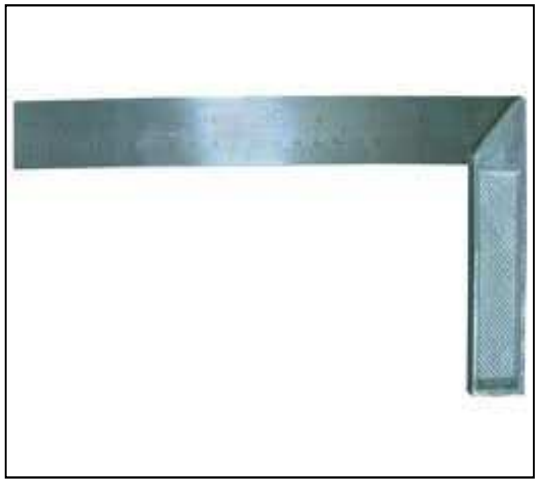

Figure 3.15: Try square

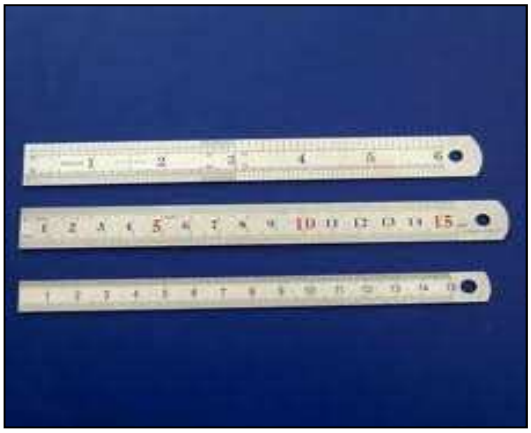

Figure 3.16: Steel ruler

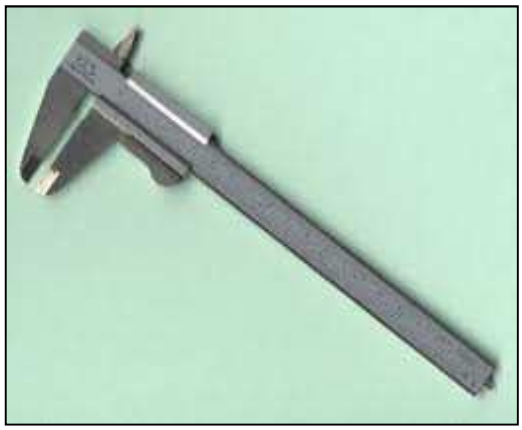

Figure 3.17: Vernier caliper

3.8.2 Cutting

The process of cutting involve in the fabrication of diesel furnace is the process of cutting the material which are mild steel plate,flat bar steel,angle bar steel and round bar steel into the desired size.The machines which used during the cutting process based on figure 3.18, 3.19 and figure 3.20.

Figure 3.18: The pneumatic sharing machine

Figure 3.19: Band saw machine

Figure 3.20: Disc cutter

3.8.3 Rolling

The process of rolling in this fabrication is the rolling of mild steel plate have thickness is 3mm.Th machine involve in the process is rolling machine.The figure 3.21 is the rolling machine.

Figure 3.21: The rolling machine

3.8.4 Lathe

The process of lathe in this fabrication is the lathe of round bar steel.The machine involve in lathe is lathe machine.The figure 3.22 is the lathe machine.

Figure 3.22: The lathe machine

3.8.5 Joining

The process of joining is needed to combine the structure of diesel furnace which consist of mild steel plate,angle bar steel,round bar steel and flat bar steel.The whole joining process which are used welding arc based on figure 3.23.

Figure 3.23: The joining process by using welding arc.

3.8.6 Finishing

a) Sandpaper

Sandpaper backings may be glued to the paper or form a separate support structure for moving sandpaper, such as used in sanding belts and discs. Stronger paper or backing increases the ease of sanding wood, so decent quality sand paper is much better than low cost and low quality sandpaper. The harder the backing material is behind the sandpaper, the faster the sanding, the faster the wear of the paper and the rougher the sanded surface.

For this project, using sand paper P60 and P80, this is because it easy to make the surface finishing and it can make smooth and uniform surface.

b) Paint

Last step for this project will be complete by spray.When this project coated by paint, it can make the project is interesting and resistant to rust.

Chapter 4

RESULT AND DISCUSSION

4.1 INTRODUCTION

This chapter is explained about result and discusion of this project.The final fabrication of the outer shell of furnace is done from only limited times due to several problems occurs to the project.The result will be use to find the ways to solve the problems and make some improvements to the product.

4.2 FINAL PRODUCT.

The final products was finally fabricated.The step of fabrication is followed according to the project planning with literature review,design and sketching and solid modeling using SolidWorks application,fabrication process such as measuring, cutting,rolling,lathe,joining, and finishing process.The final design and final product in several views are shown in figure 4.1 and figure 4.2.

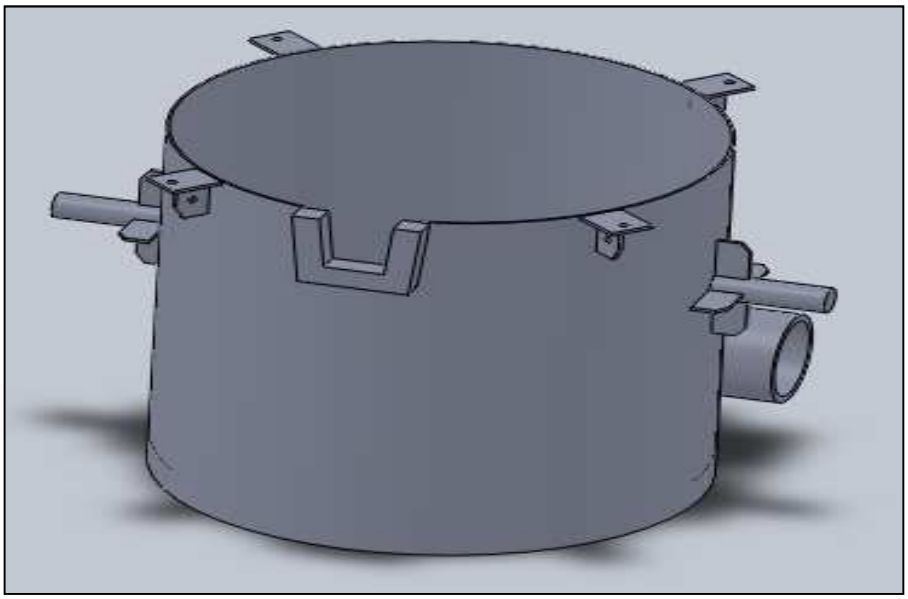

Figure 4.1: Drawing final design

Figure 4.2: Final product (Front view)

4.2.1 Material selection

To fabricate and produce this product,various types of materials are used such as angle bar steel,round bar streel,flat bar steel,mild steel hollow rod and mild steel sheet.Table 4.1 shows the selection of materials with their dimension.

Table 4.1: Material selection

Part	**Material**	**Dimension**
Outer shell	Mild steel plate	586mm x 580mm (d x h)
Rod	Round bar steel	38mm x 125mm (d x l)
Channel	Angle bar steel	500mm x 50mm (l x w)
Base plate	Flat bar steel	50mm x 25mm (l x w)
Column	Flat bar steel	50mm x 50mm (l x w)
Blower	Mild steel hollow rod	136mm x 230mm (d x l)

4.2.2 **Components Of Products**

The components for this product are outer shell,shaft,channel,base plate and blower as shown the figure 4.3.

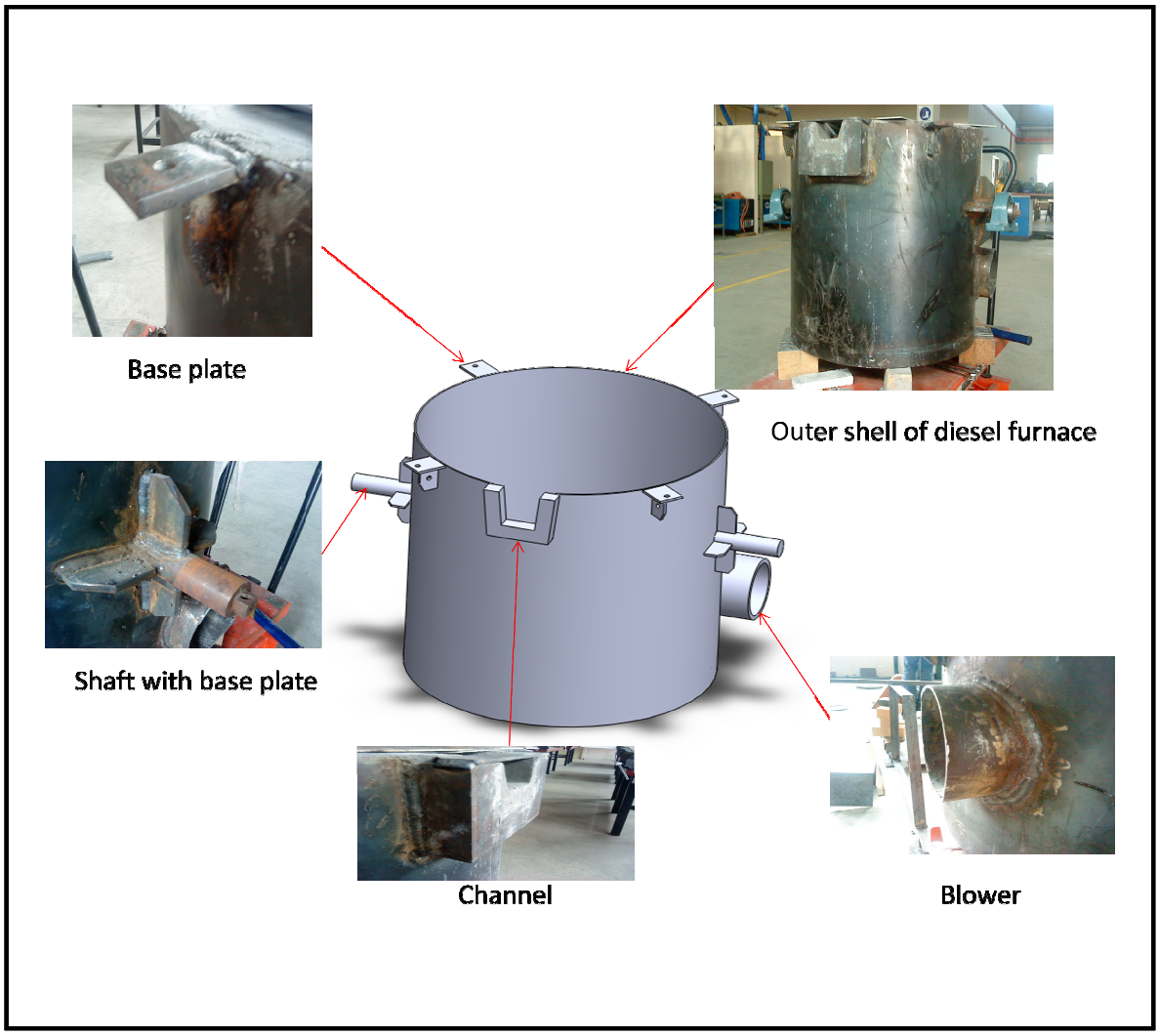

Figure 4.3: Components of product

4.2.3 Function of components

Table 4.2 shows the function of every part on the product.

Table 4.2: Function of component

Part	Picture	Function
Base plate		To hold the top head of the furnace and acts as a supporter on the shaft.
Shaft		To connecting the bearing and disc locker from the base.
Channel		To distribute the materials were melted
Blower		To connecting the burner from the base.
Outer shell		To support the frame in.

4.3 DISCUSSION

Many problem had been facing during makes this project.The problem occurs from at the beginning until the finishing of producing this product.

4.3.1 Project Problems

i. Designing and Sketching

Because of the idea were from the student directly, so there are no references that can be referred. All the drawing and dimension need to generate by student itself.

ii. Material preparation

Some of the needed material needs to buy at the hardware shop.University should prepare the material or either provides the place where the material can be obtained from.

iii. Literature review

The concept and ideas review for this project are not wide because it is not widely modified by the manufacturer.There was difficult to find the complete information about the manufacturing process of a diesel furnace.Student should come with their ideas on the project.

4.3.2 Problem During Fabrication Process

i. Material

The problem is when the material buying handling by supervisor is undergoing strict procedure and the budget for the project is in unknown situation.Because of this problem the fabrication process cannot be run according to schedule.This because , no material neede is ready to fabricate.

ii. Welding process

During welding process some problem has occurs.There are so many things happen in fabrication the product during welding process such as defect.This defect happens because lacks of skill to operate a machine such as SMAW welding.There are many type of defect occur during the fabrication such as gap and bead.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

CHAPTER 5 is the conclusion and recommendation of this project.In this chapter,it contains the objective of this project is fullfilled and some weakness that need to be improve.

5.2 CONCLUSION

As a conclusion, the project to design and manufacture the outer shell of diesel furnace was achieves the objective succesfully.This project was done around eightteen week included the report,almost the step such as literature review, design, fabrication process and others. If the calculated time, the time taken to complete only about fourteen weeks, but when to manufacture, there has been an accident. , The most damaged the furnace, so take the time to repair.Better than this, take the time to complete a period of eighteen weeks.The design of this diesel furnace is giving a lot of benefits in order to make the human life easier.

5.3 RECOMMENDATION

The diesel furnace has its weakness which will need to be improved to get a better result.

5.3.1 Product

Insulator material can be used to reduce the hot of the diesel furnace and this material should be placed on outer shell of diesel furnace.So that the person operating the furnace is about no to feel the heat when the furnace is used.

5.3.2 Facilities

Based on the progress of the project that had done, so many things in facilities aspects can be improvedespecially in welding process.It is because the MIG welding machine doesn’t have enough quantity for the studentr user, so the faculty especially must provide more MIG welding machine for the student user because amount of student is increase by a year.

5.3.3 Task Final Year Project

The task for every student who is taking the final year project subject must be explaining more detail within first and second week by supervisor.This information will briefly the student about the project and speedy their progress.

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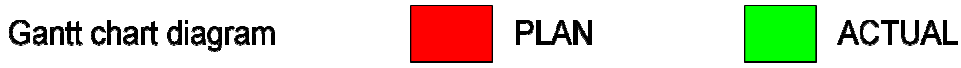
APPENDICES

APPENDIX A1
PROJECT SCHEDULE

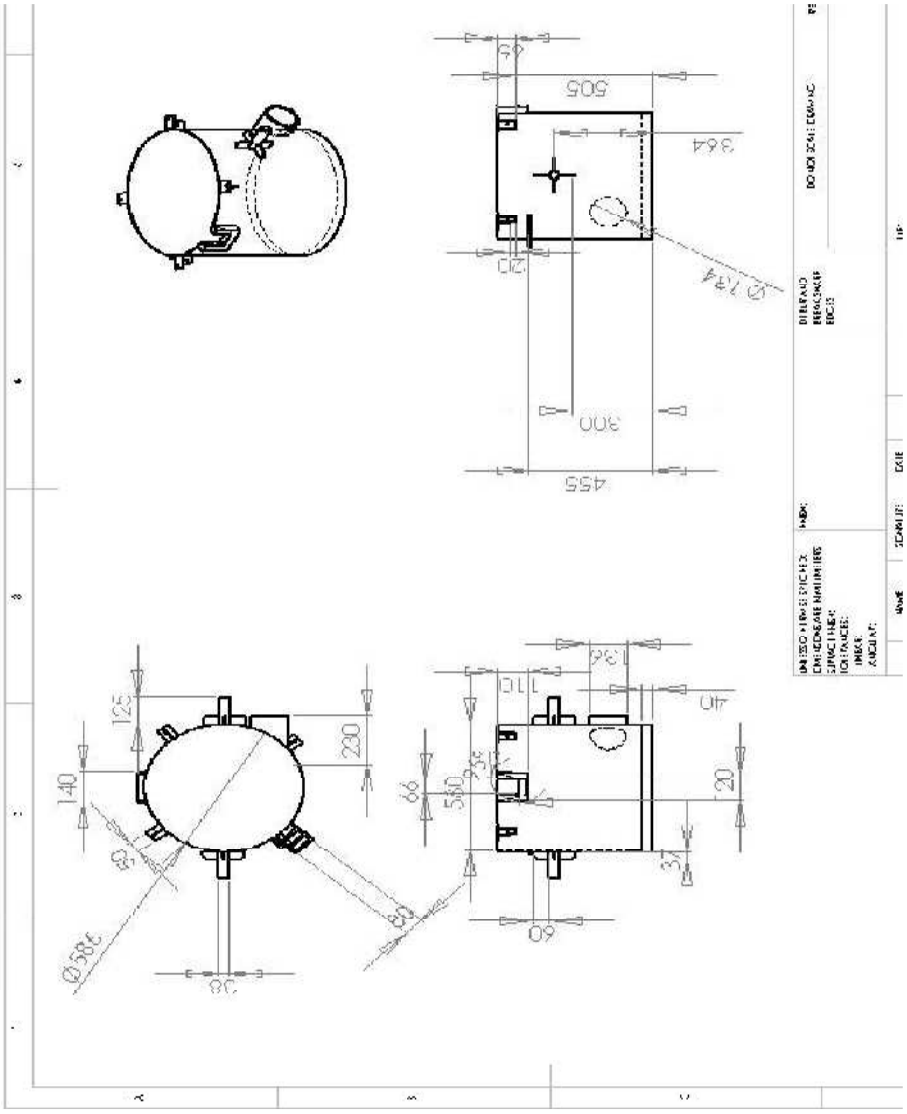
Gantt chart



PROJECT ACTIVITIES		WEEK 1	WEEK 2	WEEK 3	WEEK 4	WEEK 5	WEEK 6	WEEK 7	WEEK 8	WEEK 9	WEEK 10	WEEK 11	WEEK 12	WEEK 13	WEEK 14
DISCUSSION REGARDING PROJECT	PLANNING														
	ACTUAL														
LITERATURE REVIEW	PLANNING														
	ACTUAL														
SKETCH AND DESIGN	PLANNING														
	ACTUAL														
FINALIZE DESIGN	PLANNING														
	ACTUAL														
SIMPLE ANALYSIS	PLANNING														
	ACTUAL														
FIRST PRESENTATION	PLANNING														
	ACTUAL														
FABRICATION	PLANNING														
	ACTUAL														
TEST, ANALYSIS AND DISCUSSION	PLANNING														
	ACTUAL														
FINAL PRESENTATION	PLANNING														
	ACTUAL														
FINAL REPORT	PLANNING														
	ACTUAL														

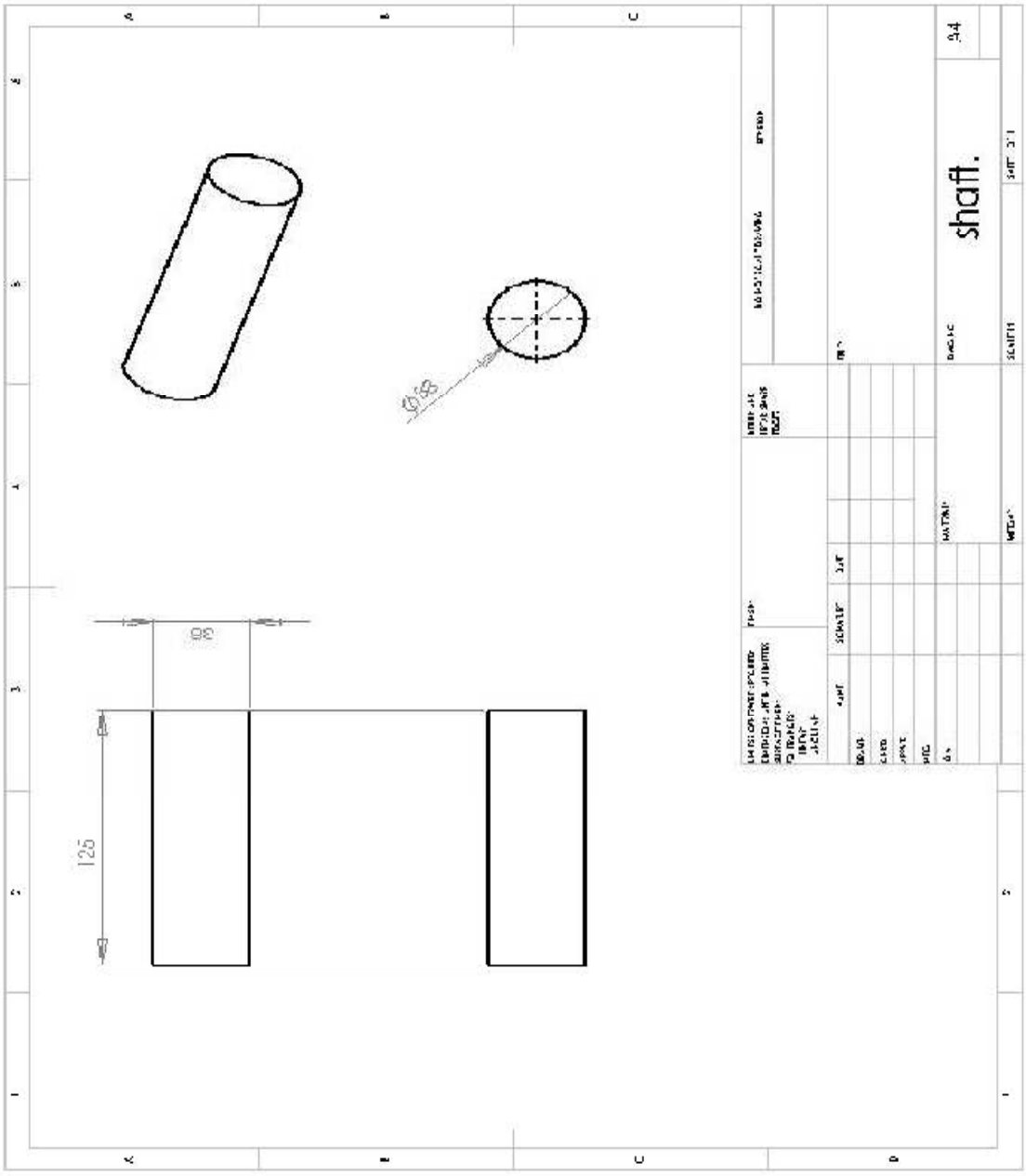
APPENDIX A2

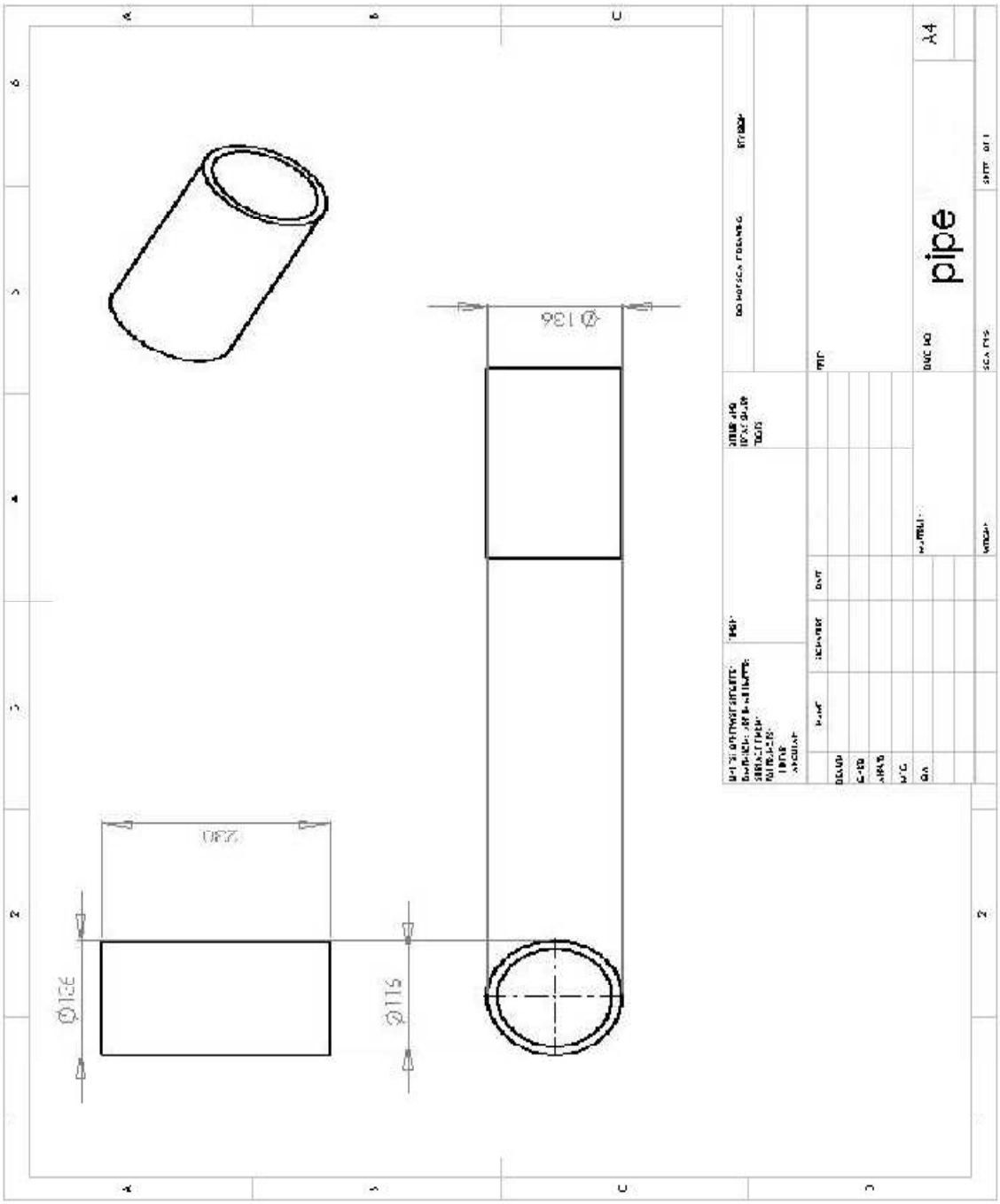
DIMENSION DRAWING

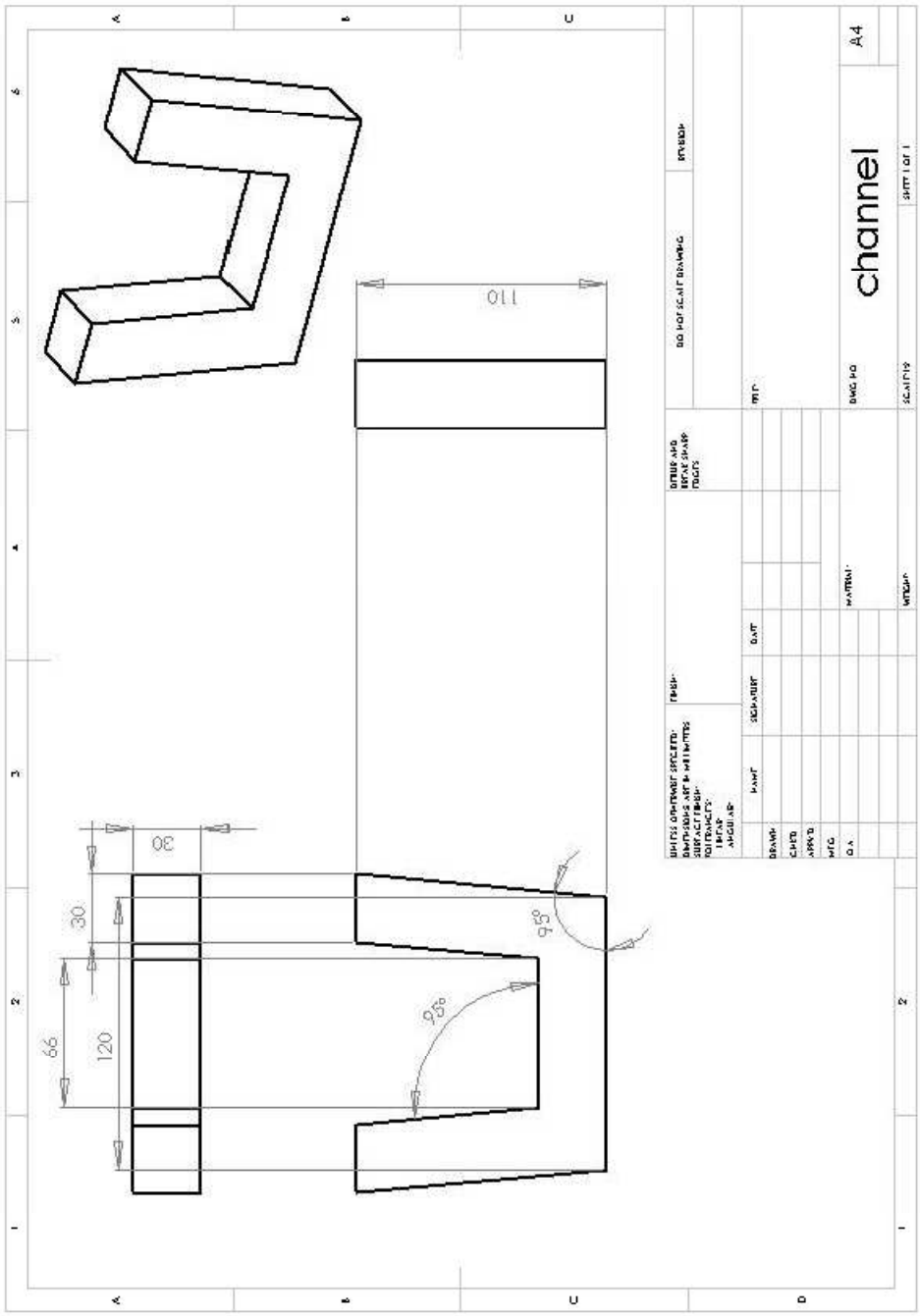


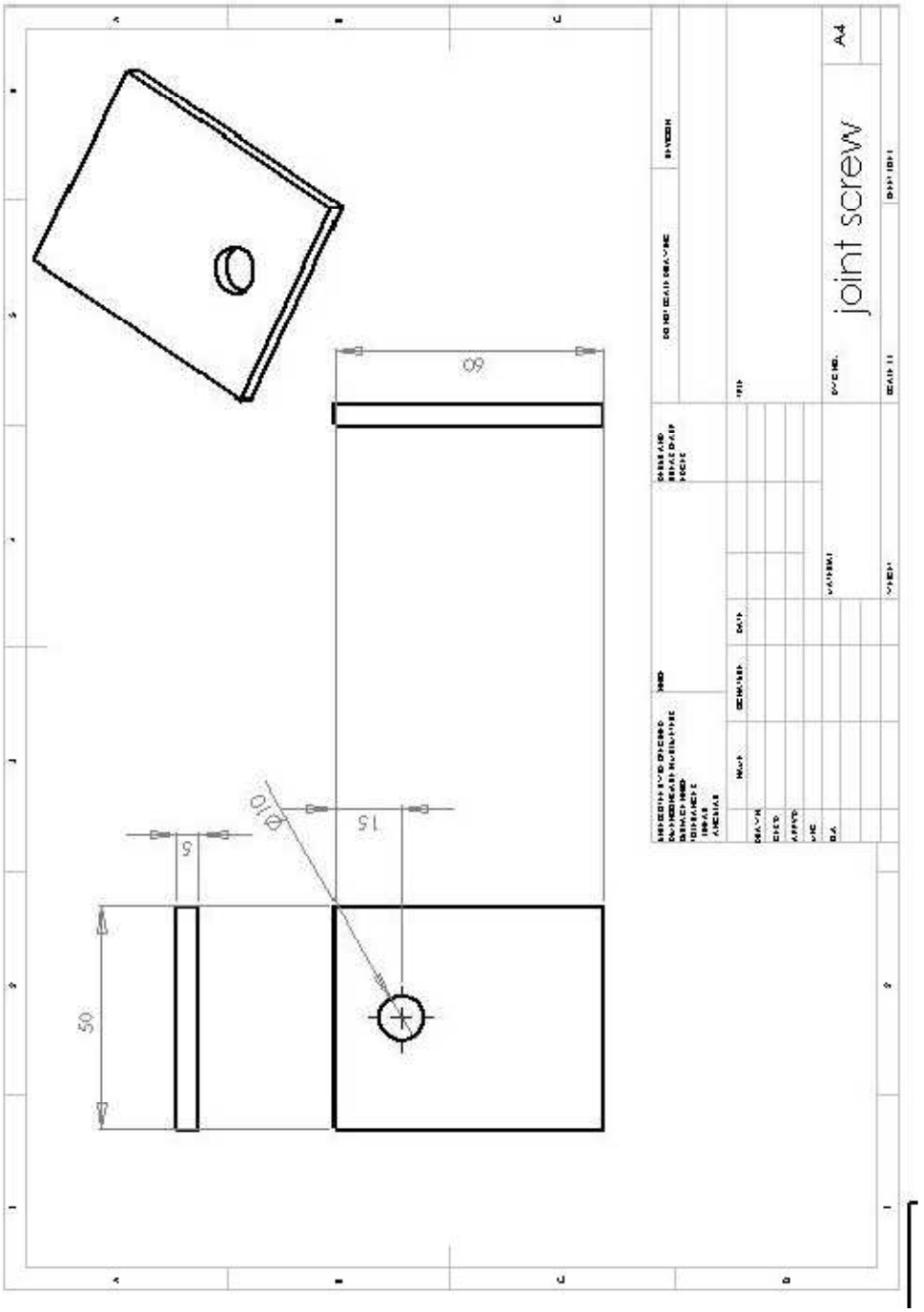
APPENDIX A3

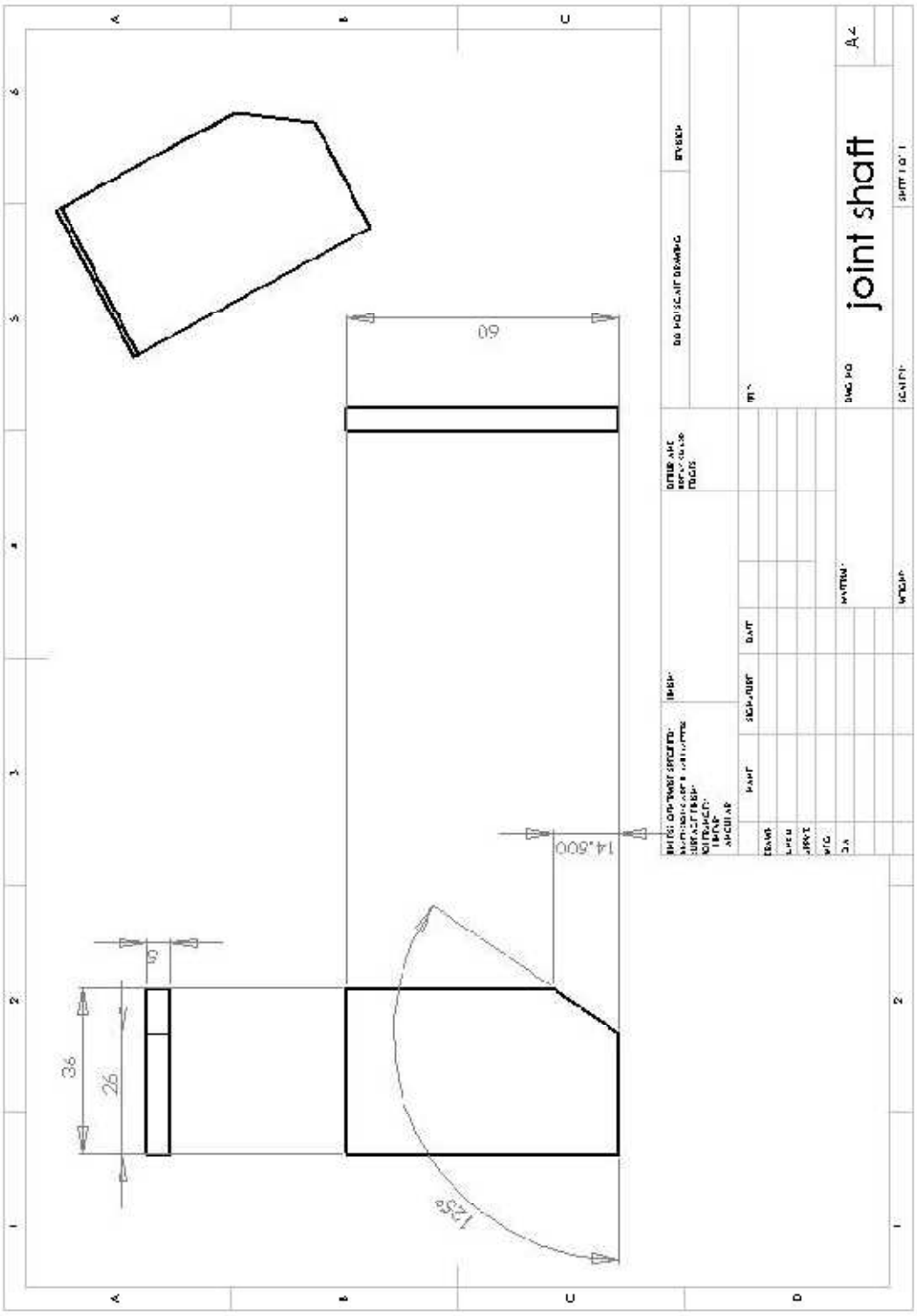
DIMENSION BY PART

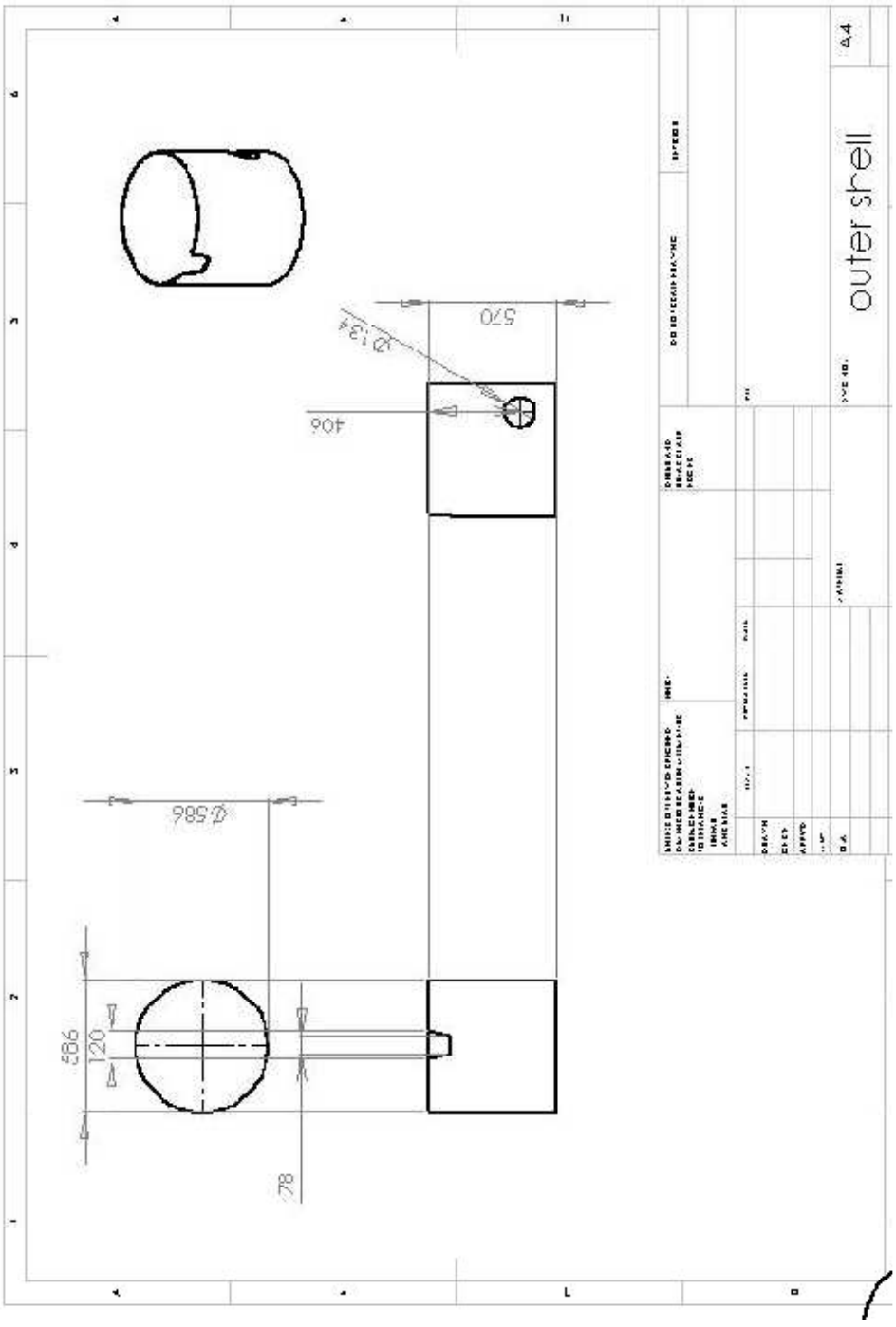


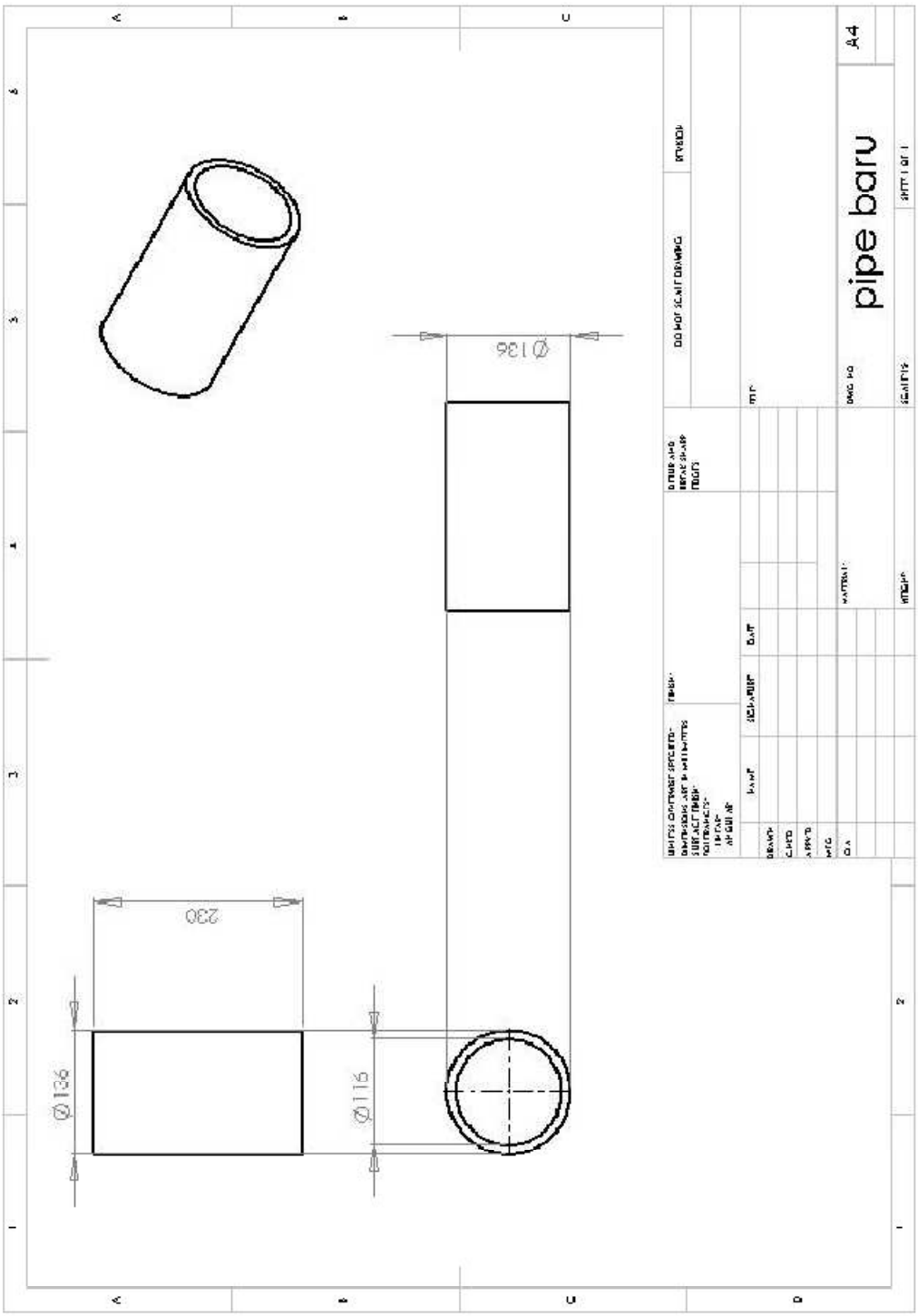

pipe
A4
Ø136
230
Ø116
Ø116


channel
A4
110
30
30
66
120
95°
95°


joint screw
A4
60
15
5
50
Ø10


joint shaft
60
14.600
36
26
6
125°


outer shell
4.4
570
406
Ø586
586
120
78


pipe baru
A4
Ø136
230
Ø116
Ø136

APPENDIX A4

FINAL PRODUCT