DESIGN AND FABRICATION OF THE MULTIPURPOSE CONTAINER

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DESIGN AND FABRICATION OF MULTIPURPOSE CONTAINER

ANAS MUZAMIL BIN HAMIDDIN

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

Faculty of Mechanical Engineering
UNIVERSITI MALAYSIA PAHANG

NOVEMBER 2009

SUPERVISOR'S DECLARATION

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

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

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DEDICATION

To my beloved parents, Mr. Hamiddin bin Abdul Aziz and Mrs. Hazirah binti Ismail, family and 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.

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I acknowledge my sincere indebtedness and gratitude to my parents for their love, dream and sacrifices throughout my life. I cannot find the appropriate words that could properly describe my appreciation for their devotion, support and faith in my ability to reach my goals.

ABSTRACT

This project is about to design and fabricate a multi-purpose container. Multipurpose container is important equipment because it reduces the working area and provides a practical and suitable place to put stuff while working. However, former multi-purpose existing in the market do not have security features that can protect consumers from hazards where it has a sharp corner. It also has a low level of stability which increases the risk of equipment to fall when they are removed or stored. But the reason we need a new concept for a multi-purpose container. The main features of multipurpose container are easy to open without using hands. This idea emerged as a result of the lack of modification is available on the product time. The idea to form multi-purpose container is based on the students own creativity. The selection of materials suitable for the formation is based on the weight of a suitable material, durable and ability to withstand load. Material proposed for the formation of multi-purpose container is sheet metal. Several processes are necessary and when they form a multi-purpose container contained in this report.

ABSTRAK

Objektif projek ini adalah untuk mereka dan membentuk bekas pelbagai guna. Bekas pelbagai guna merupakan suatu peralatan penting di mana ia mengecilkan kawasan kerja and menyediakan tempat yang praktikal dan sesuai untuk meletakkan peralatan semasa bekerja. Namun begitu, bekas pelbagai guna yang sedia ada di pasaran tidak mempunyai ciri-ciri keselamatan yang dapat melindungi pengguna dari bahaya di mana ia mempunyai bucu-bucu yang tajam. Ia juga mempunyai tahap kesetabilan yang rendah yang mana meningkatkan risiko peralatan untuk jatuh semasa ia dikeluarkan atau disimpan. Maka dengan alasan tersebutlah kita memerlukan concept baru bagi sesebuah bekas pelbagai guna. Ciri-ciri utama bekas pelbagai guna ini ialah mudah untuk dibuka tanpa menggunakan tangan. Idea ini tercetus akibat daripada kurangnya pengubahsuaian yang terdapat pada produk semasa. Idea membentuk bekas pelbagai guna ini adalah berdasarkan kreativiti pelajar sendiri. Pemilihan material yang sesuai untuk pembentukan pula berdasarkan berat material yang sesuai, tahan lama dan kebolehan untuk menahan beban. Material yang dicadangkan untuk pembentukan bekas pelbagai guna ini ialah sheet metal. Beberapa proses juga diperlukan semasa mereka dan membentuk bekas pelbagai guna yang terkandung di dalam laporan ini.

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Kg	Kilogram – the force that apply to the stainless steel bar
MPa	Mega Pascal – the pressure that apply to the stainless steel bar
N	Newton
RM	Ringgit Malaysia
A	Area - Area of rectangular steel

LIST OF ABBREVIATIONS

CAD	Computer Aided Design
CNC	Computer Numerical Control
DC	Direct Current
EP	Electrode Positive
FKM	Faculty of Mechanical Engineering
MIG	Metal Inert Gas Welding
UMP	Universiti Malaysia Pahang
SMAW	Shielded Metal Arc Welding

CHAPTER 1

INTRODUCTION

1.1 Project Synopsis

This chapter explained about the project objectives, project background, project scope, and the problem statement of the project. Besides that, this chapter also covers the project flow of this project.

1.2 Project Background

In industry, many company or organization had implemented 5'S as their working style. 5's can be implemented anytime and anywhere especially at our working desk. Sometimes it is difficult to implement 5'S at our table or desk because we had not enough space to manage them. Therefore, we need to develop a design of a multipurpose container to overcome this problem.

This final year project allocates the duration of one semester to be finished. The fabrication of the multipurpose container inquires me to have skills in handling several machines such as welding machines, bending machine, cutting machines, drilling machines, riveting, grinding machines and many more to make the product.

1.3 Project Scope

The scope of the project is limited to the below parameter and material:

(i) Material
- Galvanized Iron (Sheet Metal 1.5mm thickness)
- Aluminum (Sheet Metal 2.5mm thickness)
- Steel (L Shape 30x30mm with 3mm thickness)

(ii) Sketching and Drawing
- SolidWorks software
- AutoCAD software

(iii) Fabrication
- Vertical Saw
- MIG
- SMAW

1.4 Project Objective

(i) To design a new concept of multipurpose container which will ensure the item that already store is being kept securely.

(ii) To produce a multipurpose container with cap or lid that can be open without using hand.

(iii) To design and invent a multipurpose container with more space for other item to be place.

1.5 Project Problem Statement

(i) Current Container is not easy to use because it will be open by hand

(ii) Current Container have low space or load

(iii) The Container must be stable to stand at high load

For this chapter, we can conclude this chapter can clear about the objective and do the project easily. In this day, we have many multipurpose container so this project is to design and fabricate the new multipurpose container. In conducting a project like this project, well arrangement of works is really important to keep the momentum of this study.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The purpose of this chapter is to provide a review of past research efforts related to multipurpose container. This chapter will explain about the research of the project that has been chosen and explained about multipurpose container features and specifications. A review of other relevant research studies is also provided. Substantial literature has been studied on history, types of material needed, techniques and machines use in fabrication and many other things that are related to this project.

2.2 Material

2.2.1 Introduction to Sheet Metal

Sheet Metal is simply metal formed into thin and flat pieces. It is one of the fundamental forms used in metalworking, and can be cut and bend into a variety of different shapes. Thicknesses can vary significantly, although extremely thin pieces of sheet metal would be considered to be foil or leaf, and pieces thicker than ¼ inch or a centimeter can be considered plate. [1]

Sheet metal is generally produced in sheet less than 6mm by reducing the thickness of a long work piece by compressive forces applied through a set of rolls. This process is known as rolling and began around 1500 A.D. Sheet metals are available as flat pieces or as strip in coils. It is characterized by its thickness or gauge

of metal. The gauge of the metal ranges from 30 gauge to about 8 gauge. The higher the gauge, the thinner the metal is. There are many different metals that can be made into sheet metal. Aluminum, brass, copper, cold rolled steel, mild steel, tin, nickel and titanium are just a few example of metal that can be made into sheet metal. Sheet metal has applications in car bodies, airplane wings, medical tables, roof for building and many things. [1]

Sheet metals are usually formed in rolling mills from large ingots of metal (large blocks formed by casting). The metal is run through a series of series of rollers which squeeze the metal thinner and thinner until it is the desired thickness. Sheet metals are widely used in the industry because they are easily shaped by cold working method such as punching, shearing, bending, forming, and folding. [1]

The thickness of a metal sheet is referred to as gauge. It is designated by a series of numbers which represent a decimal part of an inch. Gauge also refers to the tool used to determine the thickness of sheet metal. The gauge is marked with numbers which are opposite a series of slots. The measurement is taken by sliding the edge of the sheet metal into the various slots until the smallest slot it will fit in is reached. [1]

2.2.2 Process of Sheet Metal

The main feature of sheet metal is its ability to be formed and shaped by a variety of processes. Each process does something different to the metal giving it a different shape or size. [1]

2.2.2.1 Stretching

Stretching is a process where sheet metal is clamped around its edges and stretched over a die or form block. This process is mainly used form the manufacture of aircraft wings, automotive door and window panels. [1]

2.2.2.2 Cutting

Cutting sheet metal can be done in various ways from hand tools called tin snips up to very large powered shears. With the advances in technology, sheet metal cutting has turned to computers for precise cutting.

2.2.3 Galvanization

2.2.3.1 History of Galvanization

Galvanization or galvanization refers to any of several electrochemical processes named after the Italian scientist Luigi Galvani. Originally, galvanization was the administration of electric shock (in the 19th century also termed Faradism, after Michael Faraday). It stemmed from Galvani's induction of twitches in severed frogs' legs, by his accidental generation of electricity. This archaic sense is the origin of the meaning of galvanic when meaning 'affected/affecting', as if by a shock of electricity; startled. It is claims to health benefits have largely been disproved, except for some limited uses in psychiatry in the form of electroconvulsive therapy (ECT). Later the word was used for processes of electrodeposition. This remains a useful and broadly applied technology, but the term "galvanization" has largely come to be associated with zinc coatings, to the exclusion of other metal.[2]

In current use, the term typically refers to hot-dip galvanizing, a metallurgical process that is used to coat steel or iron with zinc. This is done to prevent galvanic corrosion (specifically rusting) of the ferrous item; while it is accomplished by non-electrochemical means, it serves an electrochemical purpose.[2]

Hot-dip galvanized steel has been effectively used for more than 150 years. The value of hot-dip galvanizing stems from the relative corrosion resistance of zinc, which, under most service conditions, is considerably better than those of iron and steel. In addition to forming a physical barrier against corrosion, zinc applied as a hot-dip galvanized coating cathodically protects exposed steel. Furthermore,

galvanizing for protection of iron and steel is favored because of its low cost, the ease of application, and the extended maintenance-free service that it provides.[2]

2.2.3.2 Zink Coating

Zinc coatings prevent corrosion of the protected metal by forming a physical barrier, and by acting as a sacrificial anode if this barrier is damaged. When exposed to the atmosphere, zinc reacts with oxygen to form zinc oxide, which further reacts with water molecules in the air to form zinc hydroxide. Finally zinc hydroxide reacts with carbon dioxide in the atmosphere to yield a thin, impermeable, tenacious and quite insoluble dull grey layer of zinc carbonate which adheres extremely well to the underlying zinc, so protecting it from further corrosion, in a way similar to the protection afforded to aluminium and stainless steels by their oxide layers.[3]

Hot dip galvanizing deposits a thick robust layer that may be more than is necessary for the protection of the underlying metal in some applications. This is the case in automobile bodies, where additional rust proofing paint will be applied. Here, a thinner form of galvanizing is applied by electroplating, called "electrogalvanization". The hot-dip process slightly reduces the strength of the base metal, which is a consideration for the manufacture of wire rope and other highly-stressed products. The protection provided by this process is insufficient for products that will be constantly exposed to corrosive materials such as salt water. For these applications, more expensive stainless steel is preferred. Nevertheless, most nails made today are electro-galvanized.[3]

As noted previously, both mechanisms are often at work in practical applications. For example, the traditional measure of a coating's effectiveness is resistance to a salt spray. Thin coatings cannot remain intact indefinitely when subject to surface abrasion, and the galvanic protection offered by zinc can be sharply contrasted to more noble metals. As an example, a scratched or incomplete coating of chromium actually exacerbates corrosion of the underlying steel, since it is less electrochemically active than the substrate.[3]

The size of crystallites in galvanized coatings is an aesthetic feature, known as spangle. By varying the number of particles added for heterogeneous nucleation and the rate of cooling in a hot-dip process, the spangle can be adjusted from an apparently uniform surface (crystallites too small to see with the naked eye) to grains several centimeters wide. Visible crystallites are rare in other engineering materials. Protective coatings for steel constitute the largest use of zinc and rely upon the galvanic or sacrificial property of zinc relative to steel.[3]

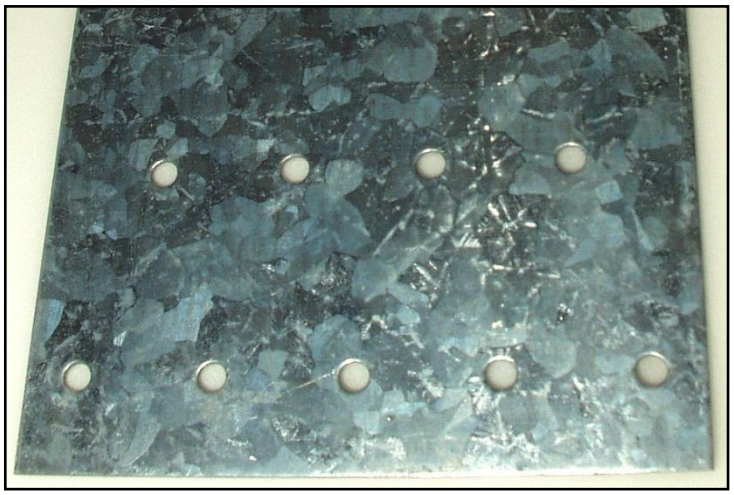


Figure 2.1: Galvanized surface with visible spangle

Thermal diffusion galvanizing is a new "green" process which creates a zinc coating metallurgically similar to hot dip galvanizing. Instead of dipping parts in molten zinc, zinc is applied in a powder form with accelerator chemicals. The parts and the zinc compound are sealed in a drum which is rotated in an oven. Due to accelerator chemicals added to the zinc powder, the zinc/iron diffusion (alloying) takes place at a lower temperature than hot dip galvanizing, and results in a more uniform and wear resistant coating. The process also eliminates the need for hazardous caustic, acid, and flux baths required to prepare parts for hot dip galvanizing. The unique crystal structure formed by the process provides a strong bond with paint, powder coating, and rubber overmolding processes.[3]

2.3 Punching Process

Punching in metal fabrication is the process of using a machine to press a shape through a sheet of metal and into a die cutter to create that shape in the metal. These machines use hydraulic, pneumatic, or electrical power to press the shape with enough force to cut the metal.[4]

A misconception about punching is that the shape does the cutting, when in fact the shape presses the material into a die that cuts the metal. The die is also given a tolerance that is measured in thousands of an inch.[4]

Punching can be better understood as pressing the material against a die with a huge force, this force pushes the material into the die shape and sheers of excess material.[4]

2.4 Bending Process

In engineering mechanics, bending (also known as flexure) characterizes the behavior of a slender structural element subjected to a lateral load. A structural element subjected to bending is known as a beam. A closet rod sagging under the weight of clothes on clothes hangers is an example of a beam experiencing bending.[5]

Bending produces reactive forces inside a beam as the beam attempts to accommodate the flexural load; in the case of the beam in figure 2.6, the material at the top of the beam is being compressed while the material at the bottom is being stretched. [5]

There are three notable internal forces caused by lateral loads: shear parallel to the lateral loading, compression along the top of the beam, and tension along the bottom of the beam. These last two forces form a couple or moment as they are equal in magnitude and opposite in direction. This bending moment produces the sagging deformation characteristic of compression members experiencing bending.[5]

The compressive and tensile forces induce stresses on the beam. The maximum compressive stress is found at the uppermost edge of the beam while the maximum tensile stress is located at the lower edge of the beam. Since the stresses between these two opposing maxima vary linearly, there therefore exists a point on the linear path between them where there is no bending stress. The locus of these points is the neutral axis. Because of this area with no stress and the adjacent areas with low stress, using uniform cross section beams in bending is not a particularly efficient means of supporting a load as it does not use the full capacity of the beam until it is on the brink of collapse.[5]

2.4.1 Springback in Bending

Because of the metal's elastic properties, it wants to decompress on the inside radius and return to its flat shape on the outside radius, which causes springback. Also know as elastic recovery, springback is present in all metal bending operations.

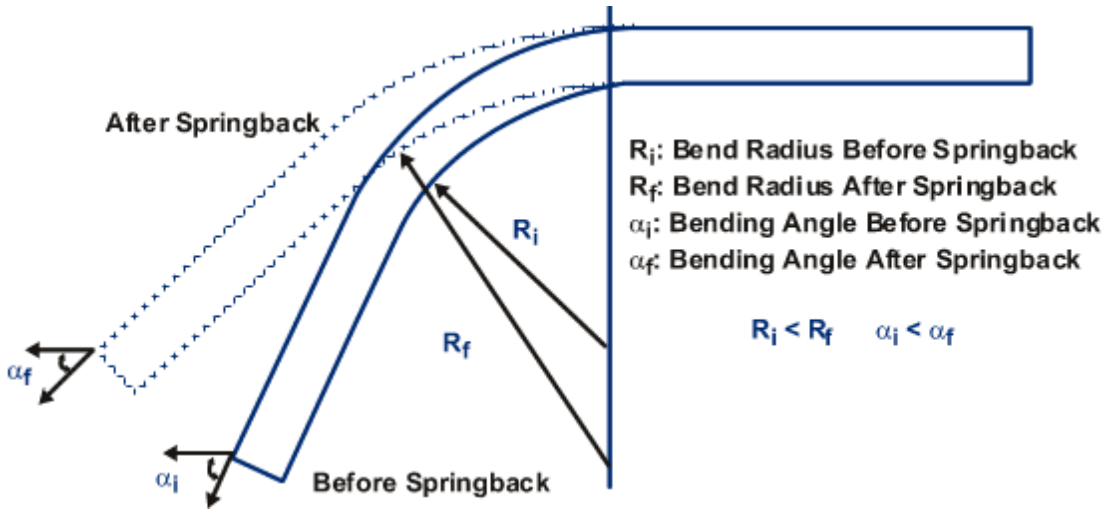


Figure 2.2: Springback

Springback must be predicted in bending operations and then the punch position adjusted accordingly. Springback is an elastic recovery of a material after unloading. In **Figure 2.3**, the final bend angle after springback (a_f) is smaller than the bend angle before springback (a_i), and the final bend radius after springback (R_f) is larger than the bend radius before springback (R_i).[6]

It is difficult for design engineers to predict springback because many variables affect it, such as material properties, tool geometry, sheet thickness, and punch stroke. As a rule, however, the smaller the punch radius, the smaller the springback, and the greater the bending angle, the greater the springback.[6]

2.5 Drilling

A drill or drill motor is a tool fitted with a rotating cutting implement used for drilling holes in various materials. The drill bit is gripped by a chuck at one end of the drill and rotated while pressed against the target material. The tip of the drill bit does the work of cutting into the target material, either slicing off thin shavings (twist drills or auger bits), grinding off small particles (oil drilling), or crushing and removing pieces of the workpiece. Specially designed drills are also used in medicine, space missions and other applications.

A drill is a tool with a rotating drill bit used for drilling holes in various materials. Drills are commonly used in woodworking, metalworking, and construction.

The drill bit is gripped by a chuck at one end of the drill, and is pressed against the target material and rotated. The tip of the drill bit does the work of cutting into the target material, either slicing off thin shavings (twist drills or auger bits), grinding off small particles (oil drilling), or crushing and removing pieces of the workpiece.

Figure 2.3: Press Drilling Machines

Sources: justoffbase.co.uk (2009)

A drill press Figure 2.3 (also known as pedestal drill, pillar drill, or bench drill) is a fixed style of drill that may be mounted on a stand or bolted to the floor or workbench. A drill press consists of a base, column (or pillar), table, spindle (or quill), and drill head, usually driven by an induction motor. The head has a set of handles (usually 3) radiating from a central hub that, when turned, move the spindle and chuck vertically, parallel to the axis of the column. The table can be adjusted vertically and is generally moved by a rack and pinion; however, some older models rely on the operator to lift and reclamp the table in position. The table may also be offset from the spindle's axis and in some cases rotated to a position perpendicular to the column. The size of a drill press is typically measured in terms of swing. Swing is defined as twice the throat distance, which is the distance from the center of the spindle to the closest edge of the pillar. For example, a 16-inch (410 mm) drill press will have an 8-inch (200 mm) throat distance.

A drill press has a number of advantages over a hand-held drill:

- less effort is required to apply the drill to the workpiece. The movement of the chuck and spindle is by a lever working on a rack and pinion, which gives the operator considerable mechanical advantage.

- the table allows a vise or clamp to position and lock the work in place making the operation much more secure.
- the angle of the spindle is fixed in relation to the table, allowing holes to be drilled accurately and repetitively.

Speed change is achieved by manually moving a belt across a stepped pulley arrangement. Some drill presses add a third stepped pulley to increase the speed range. Modern drill presses can, however, use a variable-speed motor in conjunction with the stepped-pulley system; a few older drill presses, on the other hand, have a sort of traction-based continuously variable transmission for wide ranges of chuck speeds instead, which can be changed while the machine is running.

Drill presses are often used for miscellaneous workshop tasks such as sanding, honing or polishing, by mounting sanding drums, honing wheels and various other rotating accessories in the chuck. This can be dangerous on many presses, where the chuck arbor is held in the spindle purely by the friction of a Morse taper instead of being held securely by a drawbar.

2.6 Rivet

A rivet is a permanent mechanical fastener. Before it is installed it consists of a smooth cylindrical shaft with a head on one end. The end opposite the head is called the buck-tail. On installation the rivet is placed in a punched or pre-drilled hole. Then the tail is "upset" (i.e. deformed) so that it expands to about 1.5 times the original shaft diameter and holds the rivet in place. To distinguish between the two ends of the rivet, the original head is called the factory head and the deformed end is called the shop head or buck-tail.

Figure 2.4: Blind Rivet (POP Rivet)

Source: fastenercorp.com (2009)

Blind rivets are tubular and are supplied with a mandrel through the center. The rivet assembly is inserted into a hole drilled through the parts to be joined and a specially designed tool is used to draw the mandrel into the rivet. This expands the blind end of the rivet and then the mandrel snaps off. (A POP rivet is a brand name for blind rivets sold by Emhart Technologies.) These types of blind rivets have non-locking mandrels and are avoided for critical structural joints because the mandrels may fall out, due to vibration or other reasons, leaving a hollow rivet that will have a significantly lower load carrying capability than solid rivets. Furthermore, because of the mandrel they are more prone to failure from corrosion and vibration. Unlike solid rivets, blind rivets can be inserted and fully installed in a joint from only one side of a part or structure, "blind" to the opposite side.

2.7 Welding Process

Figure 2.5: Welding Process

2.7.1 Introduction

Welding is a fabrication or sculptural process that joins materials, usually metals or thermoplastics, by causing coalescence. This is often done by melting the workpieces and adding a filler material to form a pool of molten material (the *weld pool*) that cools to become a strong joint, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. This is in contrast with soldering and brazing, which involve melting a lower-melting-point material between the workpieces to form a bond between them, without melting the workpieces.

Many different energy sources can be used for welding, including a gas flame, an electric arc, a laser, an electron beam, friction, and ultrasound. While often an industrial process, welding can be done in many different environments, including open air, under water and in outer space. Regardless of location, however, welding remains dangerous, and precautions are taken to avoid burns, electric shock, eye damage, poisonous fumes, and overexposure to ultraviolet light.

2.7.2 Shielded Metal Arc Welding (SMAW)

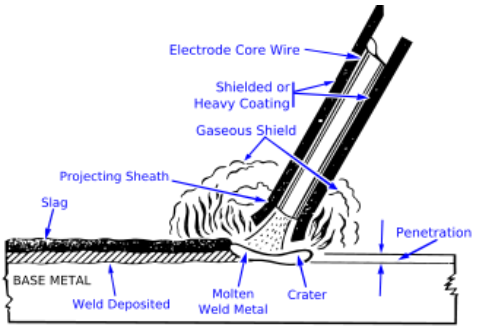


Figure 2.6: Shielded Metal Arc Welding Diagram

Source: Weldacop 2009

Shielded metal arc welding (SMAW), 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 a shielding gas and providing a layer of slag, both of which protect the weld area from atmospheric contamination.

Because of the versatility of the process and the simplicity of its equipment and operation, shielded metal arc welding is one of the world's most popular welding processes. It dominates other welding processes in the maintenance and repair industry, and though flux-cored arc welding is growing in popularity, SMAW continues to be used extensively in the construction of steel structures and in industrial fabrication. The process is used primarily to weld iron and steels (including stainless steel) but aluminum, nickel and copper alloys can also be welded with this method.

2.7.3 Metal Inert Gas Welding (MIG)

Gas metal arc welding (GMAW), sometimes referred to by its subtypes metal inert gas (MIG) welding or metal active gas (MAG) welding, is a semi-automatic or automatic arc welding process in which a continuous and consumable wire electrode and shielding gas are fed through a welding gun.

2.7.4 Advantages Of MIG Welding

(i) High productivity, because you don't have to stop to change rods or chip and brush the weld frequently. (No checking watch, counting money, smoking cigarette, talking to buddy).
(ii) Easy to learn and makes great-looking welds.
(iii) Almost no cleanup.
(iv) Can weld on stainless steel, mild steel, and aluminium.

2.7.5 Disadvantages of MIG Welding

(i) Can't check, count money, smoke cigarette, or talk to buddy as often
(ii) Requires a cumbersome bottle of shielding gas
(iii) Costs money for consumables, such as tips and nozzles
(iv) Isn't worth a dang on paint, rust, or dirty surfaces
(v) Not good for thick steel, because it doesn't get the proper penetration

2.7.6 Spot Welding

Spot welding is a type of resistance welding used to weld various sheet metals. Typically the sheets are in the 0.5-3.0 mm thickness range. The process uses two shaped copper alloy electrodes to concentrate welding current and force between the materials to be welded. The result is a small “spot” that is quickly heated to the melting point; this forms a nugget of welded metal after the current is removed. The amount of heat released in the spot is determined by the amplitude and duration of the current. The current and duration are chosen to match the material, the sheet thickness and type of electrodes. Applying the current for too long can result in molten metal being expelled as weld splash, or can even burn a hole right through the materials being welded.

CHAPTER 3

METHODOLOGY

3.1 Project Flow Chart

In fabrication of the multipurpose container, there is a planning of the overall progress to assure the project can be finish on a schedule.

From the flow chart in figure 3.1 below, this project started with the literature review and research about the title. The main important of the project is determination the objective. Then, study and make a lot of investigation about multipurpose container and machining process involved. This is including a review of types of materials, strength of material, way to produce, and machining process involved. These tasks have been done through research on the internet, books and other sources.

Then the information has been collected and gathered. After that, the project is continued with the design process. In this stage, the knowledge and lessons that have been studied will be applied. It is important to make a suitable design for the project. After several design sketched, design consideration have been made and one of the design have been chosen. The designs have been chosen by using Pugh's selection method. The selected sketch is then transferred to solid modeling and engineering drawing by using SolidWorks and AutoCAD software.

After the design was completed, the attention now is to prepare the material. The information about the material was gathered from internet to get the best material to produce an multipurpose container. Ability to hold and carry a large

amount of load was the first priority in choosing a material. And the material must not too heavy so that wills easier the user to carry it.

After the chosen material was decided, the drawing was used as a reference for the next process, which it is fabrication stage. This process is consists fabricate all the parts that have design before by following all the dimension using various type of manufacturing process. The manufacturing process included in this process is punching process, bending process, and welding process. During the fabrication process, if there is something wrong occur, such as not balance dimension to the process will be stop and go back to previous step, make a modification against.

After all the fabrication process above is done, all the material for report writing is gathered. The report writing process will be guided by the UMP final year project report writing. This process also included the presentation slide making for the final presentation of the project.

The project ended after the submission of the report and the slide presentation has been present.

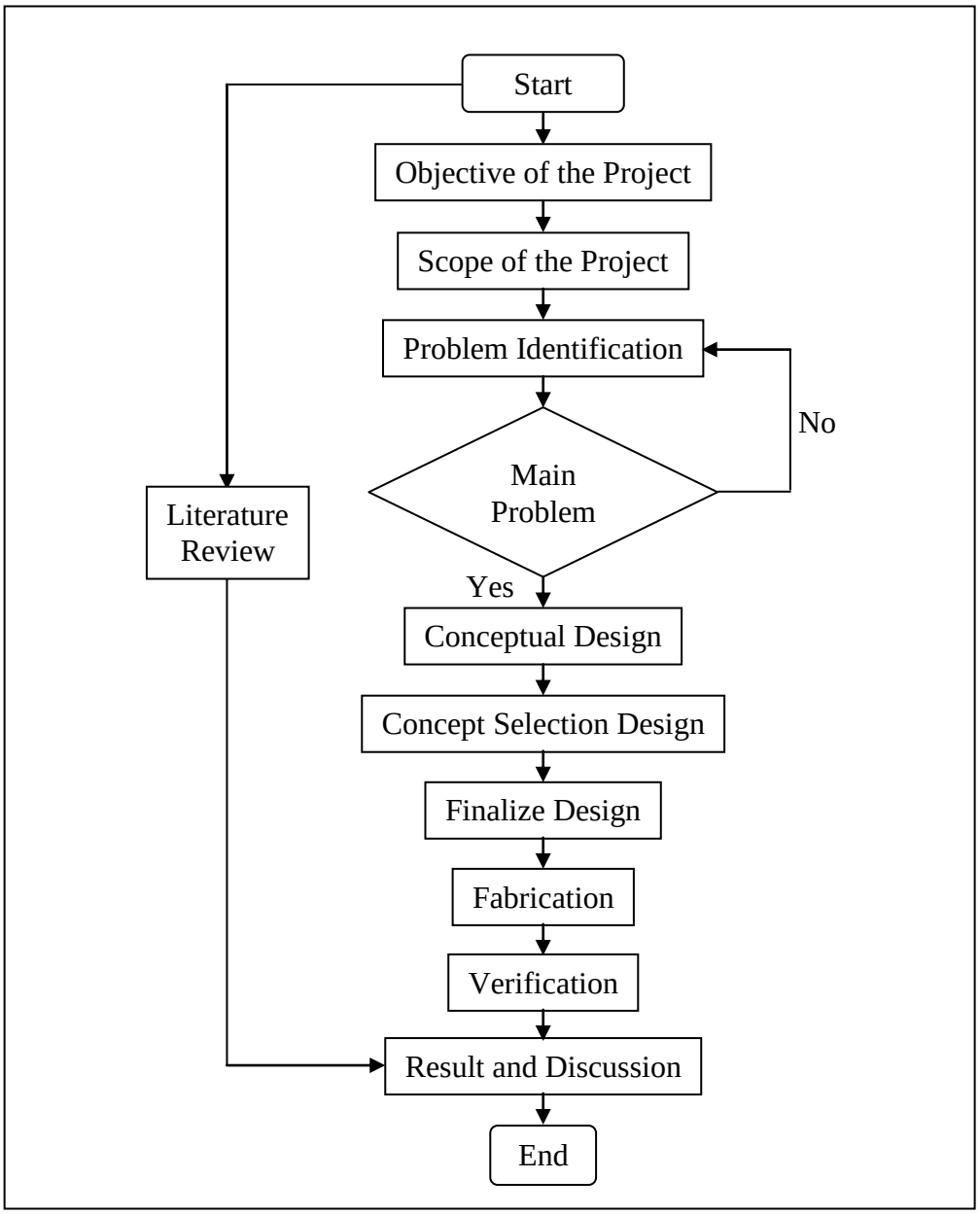


Figure 3.1: Project Flow Chart

3.2 Design and Sketching

3.2.1 Introduction

In this subchapter, the product will be detailed explanation where the design and sketching of the multipurpose container need to undergo a several design aspects and the compliance of design need to follow step by step. When doing design process, consideration of design must be done carefully and properly to make sure the design can be applied in fabrication stage and the system are been functioning. This subchapter also will explain about the design and sketching that had been chosen to be as the final idea to be produce or fabricate.

3.2.2 Design

The Design of the multipurpose container must be compliance to several aspects. The design consideration must be done carefully so the design can be fabricated and the parts are all functioning. The aspect that must be consider in designing the multipurpose container are:

(i) Material: The suitable material is important to make sure the multipurpose container able to endure long

(ii) Strength: It is one of important criteria in designing the multipurpose container and it will show the toughness and durability of the design

(iii) Machining: The design must be relevant to the machining process

3.2.3 Concept Generation

3.2.3.1 Datum Concept

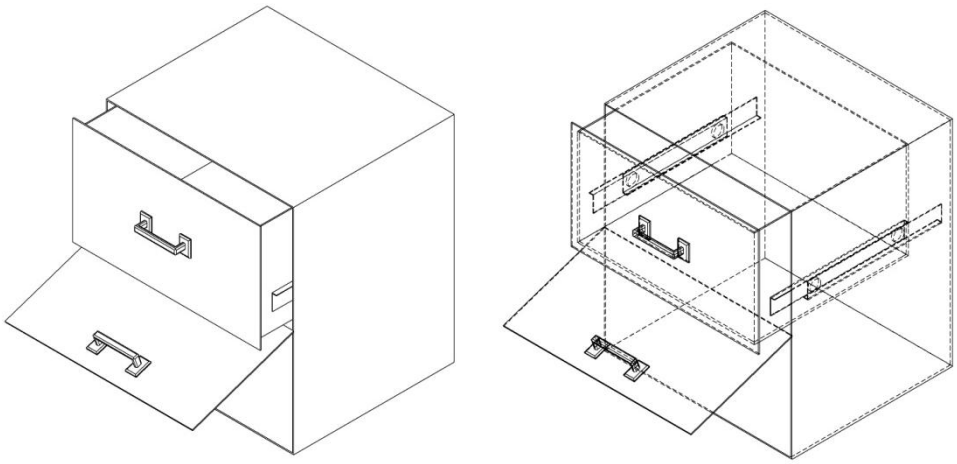


Figure 3.2: Datum Concept

Datum concept of the multipurpose container was very basic and even can be produce by using wood. This is what are many people use to store their paper or anything that can be store. From this concept, human change the shape to increase function of multipurpose container. Also the modification will ensure that product will have a good look. This datum concept of multipurpose container was produced from sheet metal or wood. This shape was using drawer and door concept. The advantages of this concept are cheap and easy to manufacture.

3.2.3.2 Sliding Door Concept

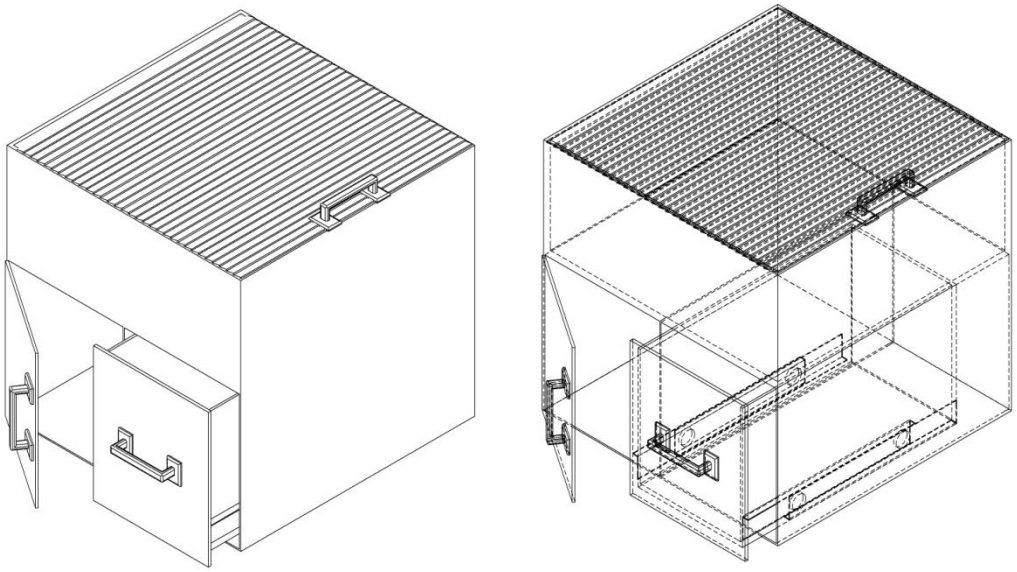


Figure 3.3: Sliding Door Concept

This sliding door concept of multipurpose container was developed from the datum concept. Sliding door has becomes extra concept and it is the most outstanding characteristic in this product. There are three spaces or partition that can be used to store the equipments. The upper partition can be open by slide the door to the left.

3.2.3.3 Pedal Concept

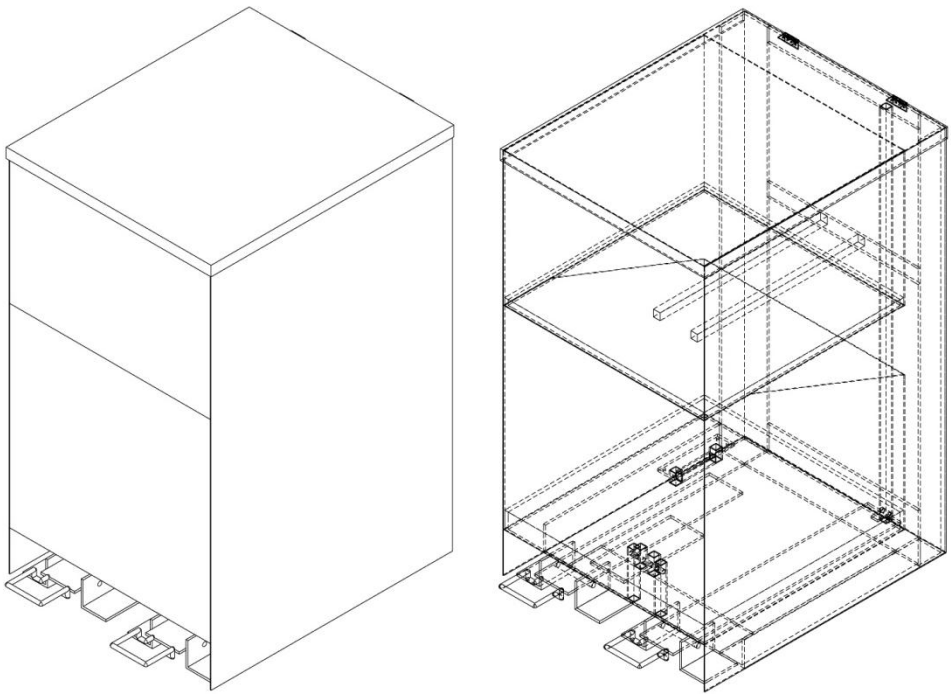


Figure 3.4: Pedal Concept

This pedal concept of multipurpose container was totally different from the entire concept above. As we can see, this product is double pedal that can be use to open the container. The upper partition have using lid to cover their storage and lower partition can be open by slant the partition down.

3.2.4 Concept Generation and Evaluation

This is table to determine the best concept for fabricate an multipurpose container

Table 3.1: Concept generation and evaluation

Selection Criteria	**Concepts Variants**		
	A (Datum)	B Sliding Door	C Pedal
Ease of use	0	0	+
Ease to manage	0	-	0
Ease of manufacture	0	0	-
Safe to use	0	-	+
Durability	0	0	+
Lightweight	0	+	-
Lasts a Long Time	0	0	+
High Capacity	0	0	+
∑+ (PLUSES)	0	1	5
∑0 (SAMES)	8	5	1
∑- (MINUSES)	0	2	2
Net Score	0	-2	3
Rank	2	3	1

Notes:

+ = Better

- = Worse than

0 = Same as

3.2.4.1 Summarized of Concept Generation and Evaluation

This table shows the advantages and disadvantages of other concept refer to datum concept. The criteria that have been consider with, are ease to use, ease to manage, ease to manufacture, safe to use, durability, lightweight, lasts a long time and high capacity. Compare with other concepts, pedal concept was most functionally and able to store lots of paper or equipments. The ability to open the cover without using hand by pushes the pedal down make this product flexible with user's necessity. This product is safe and able to stand at high capacity or load. From that table, pedal concept of multipurpose container has been chosen to be fabricated.

3.2.5 Designed in SolidWorks Software

After the selected design was chosen, now the selected design or concept sketched is transfer to solid modeling and engineering drawing using SolidWorks software. Below show the actual design of the clothesline.

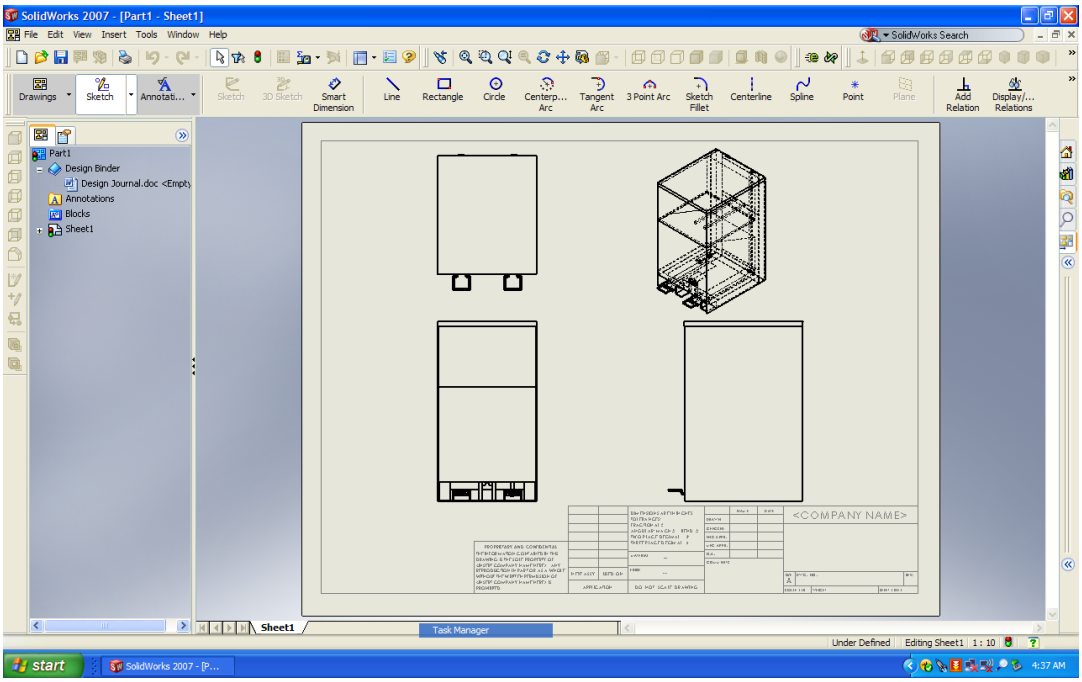


Figure 3.5: SolidWorks Drawing

3.2.6 Product Design Specification (PDS)

3.2.6.1 Material

All the material for the frame or chassis is using rectangular hollow steel. This is type of the beam for the design needed:

T**able 3.2:** Bill of Material

No.	Part	Dimension /length (mm)	Quantity
1	L bar (30x30x3)mm	500	9
2	L bar (30x30x3)mm	260	2
3	L bar (30x30x3)mm	225	1
4	Rectangular bar (20x3)mm	225	2
5	Hollow rectangular bar (15x15x3)mm	535	1
6	Hollow rectangular bar (15x15x3)mm	250	2
7	L bar (30x30x3)mm	50	4
8	Sheet Metal 1.5mm	550x1020	1
9	Sheet Metal 1.5mm	200x1200	1
10	Sheet Metal 1.5mm	290x1200	1

3.3 Fabrication Process

3.3.1 Introduction

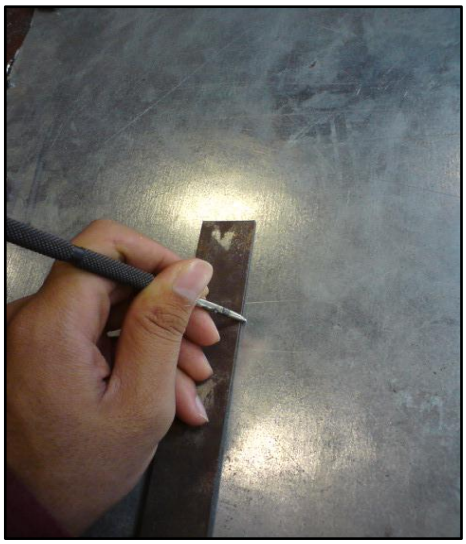
After the designing phase, here comes the fabrication process. This process is about using the material selection and makes the product base on the design and by followed the design dimension stated in the Bill of Material (BOM). Many methods will be used to fabricate the product such as measuring and marking, cutting, drilling, joining and finishing. Fabrication process is difference from manufacturing process in term of production quantity. Fabrication process is a process to make only one product rather than manufacturing process that focus to large scale production. As there are a lot of processes of fabrication, there also need a lot of machines and tools to perform the processes.

3.3.2 Measuring and Marking

Before we cut the material to the dimension we want, we need to measure and mark the material first. This is to ensure the precision of the material's length which is quite important in the fabrication process. It is also to avoid the waste of the material because we undersize while cutting it.

To perform this process, we will need a measuring tape, scriber and a vernier height gauge.

Figure 3.6: Measuring Process



(a) Using Scriber

(b) Using Vernier Height Gauge

Figure 3.7: Marking Process

3.3.3 Cutting

In this process, hand saw and grinder will be use to cut the materials according to the measuring that have been marked.

(a) Using Handsaw

(b) Using Hand Grinder

Figure 3.8: Cutting Process

3.3.4 Drilling

Then the all material that had been cut will drill at the several locations to make the holes for rivet, bolts and nut. There are two types of drilling machines was used during this process which is hand drill and press drill.

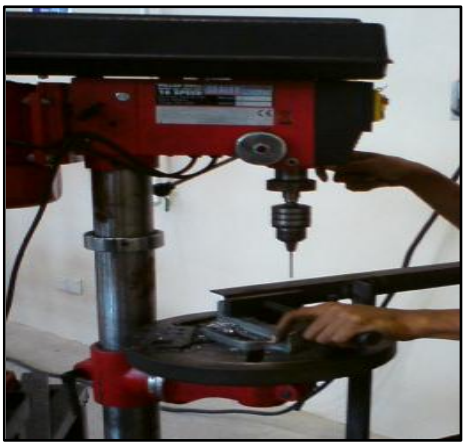


Figure 3.9: Using Press Drill

Figure 3.10: Using Hand Drill

3.3.5 Bending

To fabricate the platform, the sheet metal need to be bend on each corner to make sure there are no sharp edges on the platform. It is also to avoid the tool from falling to the floor.

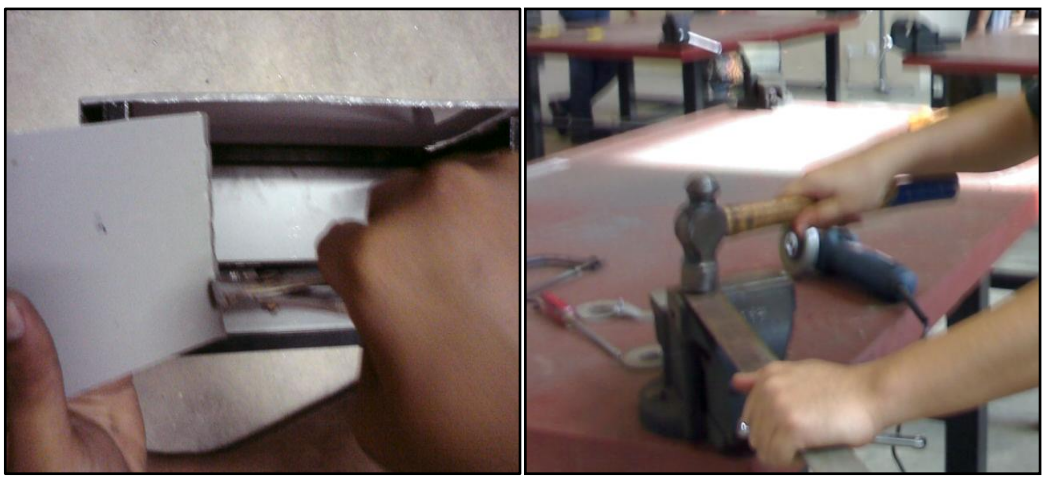


Figure 3.11: Bending Process

As the bending machine is not fully setup, the bending process is done alternatively where I only use pliers and vise to bend the sheet metal. Although the bend is not as good as the result of bending machine, it is enough to fulfill the requirements that are to eliminate the sharp edges and the bend can avoid tools from falling to the floor.

3.3.6 Joining

As the parts are cut, the joining process will take place to join all the parts. There are two process uses to join the parts which are welding and riveting.

The machines use for welding process is Metal Inert Gas (MIG) welding and Shielded Metal Arc Welding (SMAW).

Figure 3.12: Using SMAW

Figure 3.13: Using MIG

There are also parts that are join by using rivet like the platform. As the platform is made of thin sheet metal, it is not suitable to weld to join it with other parts.

Figure 3.14: Using Rivet

3.3.7 Finishing

Then again, we use hand grinder to make smooth surface at the welding points and to eliminate sharp edges. After all of the sharp edges is removed, the adjustable work positioner is ready for the last process which is painting.

3.4 Final Product

After all of the fabrication process, the multipurpose container is finished and ready to be use. The final product in several views is shown below.

Figure 3.15: Final Product

Figure 3.16: Pedal Right

Figure 3.17: Pedal Left

CHAPTER 4

RESULTS AND DISCUSTION

4.1 Introduction

The final fabrication of the multipurpose container is done from only limited times due to several problems occur to the project. There are also a few problems that I have to face to finish the fabrication process. This chapter will discuss mainly about the problems encountered during the whole project was been carried out. It also covers the analysis of the multipurpose container.

4.2 Mechanism Analysis

An analysis on the mechanism has been done in order to determine whether the product can work properly.

4.2.1 Mechanism Pedal Right (Upper Partition)

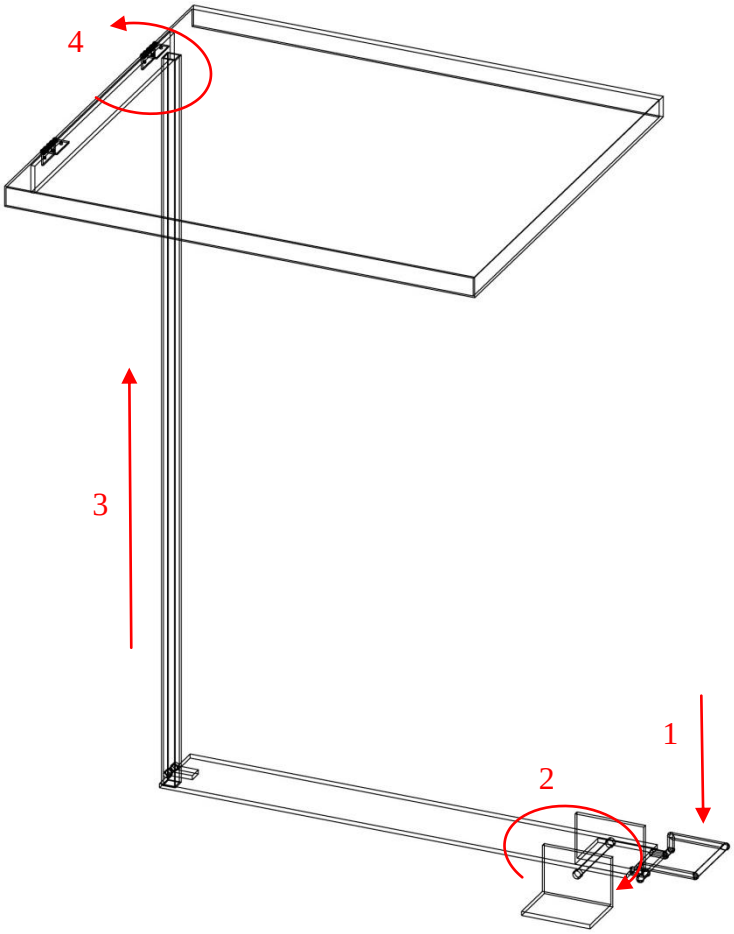


Figure 4.1: Mechanism Pedal Right

To open the cover or lid that be design to close the upper partition just can be open by rotary movement (4). So, the linear movement downward that have being given or produce by user will be convert to rotary movement (2) at clockwise. After that, rotary movement (2) will be convert to linear movement upward 3). Finally, linear movement upward will be convert to rotary movement at counterclockwise (4).

4.2.2 Mechanism Pedal Left (Lower Partition)

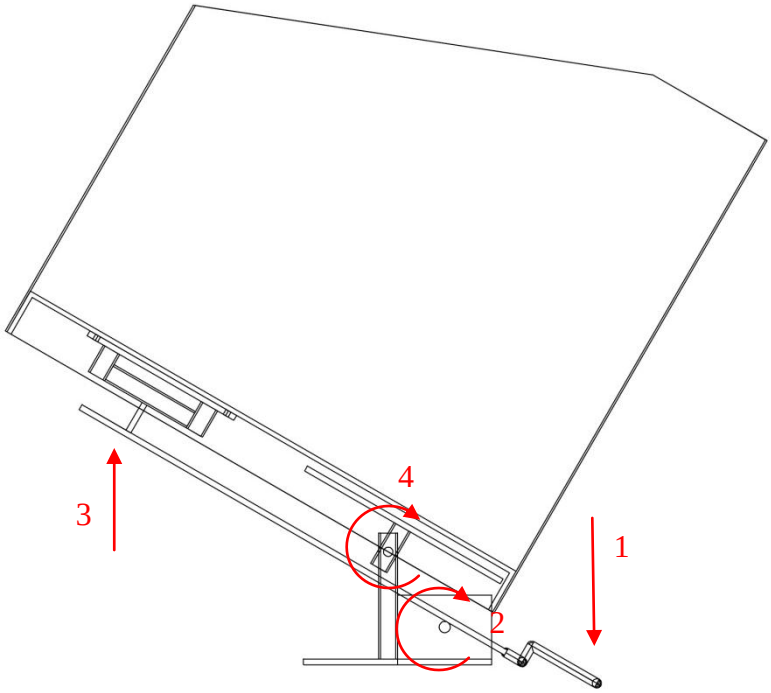


Figure 4.2: Mechanism Pedal Left

To open the second partition can be open by rotary movement (4). So, the linear movement downward that have being given or produce by user will be convert to rotary movement (2) at clockwise. After that, rotary movement (2) will be convert to linear movement upward (3). Finally, linear movement upward will be convert to rotary movement at clockwise (4).

4.3 Problem Faced During Fabrication Process

4.3.1 Lack of Equipment

As all of us know that the Faculty of Mechanical just moved from Gambang Campus to Pekan Campus, so there are few machines that are cannot be use yet. There are problems to use machines such as disc cutter machine and bending machine. In order to overcome this problem, I have other type of equipment to perform the same task such as some of the parts is cut by using hand saw and cover of the multipurpose container is bend manually by using only pliers and vise. The processes cost me a lot of energy.

Furthermore, there are several equipment that I need to take instead of from the mechanical lab such as I need to borrow rivet, hand grinder and hand drill from my friends because at the mechanical lab, there are only a few hand drill and hand grinder available but we need to queue to use it because there are a lot of student waiting to use them at the same time.

4.3.2 Lack of Time

Although I start the fabrication quite early, I still need to rush the process in order to make sure the product is finished before the due date. This because of the time I wasted for the bus travel from Gambang Campus to Pekan Campus. A lot of things that I plan to do for the project are ruin because I need to stick with the bus schedule. It makes me postpone the things to another time.

4.3.3 Short of Material

There are several materials that I have to get it from the hardware store because I cannot get it inside such as in order to get a circular rod that is to be the padel left and right. I have to buy them on a hardware store located at Indera Mahkota. To get to their hardware store is not a problem at all but as my trip back from Pekan is evening, the hardware store usually already close when I arrive at the Gambang Campus around 5p.m in the evering.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Introduction

This final chapter represents about conclusion and recommendation for the project. In this chapter will discuss mainly about the conclusion of the project, concluding all the process that involved. Besides that this chapter also contains recommendation about the project. So for this recommendation it can make improvement about the project in the future.

5.2 Conclusion

The objectives of the project that are to design an multipurpose container are successfully done and achieved. Although there are a lot of obstacles, I am really thankful that I can finish this project within the time given. I am also really satisfied where I have learned a lot of knowledge and skill in so many things throughout this project. I hope these valuable experiences I get will be useful to me in the future.

This project also generates my capabilities as a responsibility person. This is because I had to take care and take a look for my project. Finally, I can conclude that final year project is very important because we can learn a lot of things that are important for us to use them while we are working in the future.

5.3 Recommendations

5.3.1 Partition

The multipurpose container that I have made can only have two partitions for storage. To make the multipurpose container a lot more convenient to use, the partition of the storage can be increase to give the user more side while they use.

5.3.2 Other Material

Maybe in the future, we can change the material to make a stronger multipurpose container. Not only the material is stronger, it is also lighter than the multipurpose container so that it can easily be move around the workplaces.

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[3] http://www.midwestmetalfabrication.com/galvanizedsteel-whiterust.html dated on 11 November 2009

[4] http://www.vmchoppyandsons.com/laser-cutting.cfm dated on 11 November 2009

[5] http://www.answers.com/topic/bendin

[6] http://www.thefabricator.com/ToolandDie/ToolandDie_Article.cfm?ID= 1698

APPENDIX A

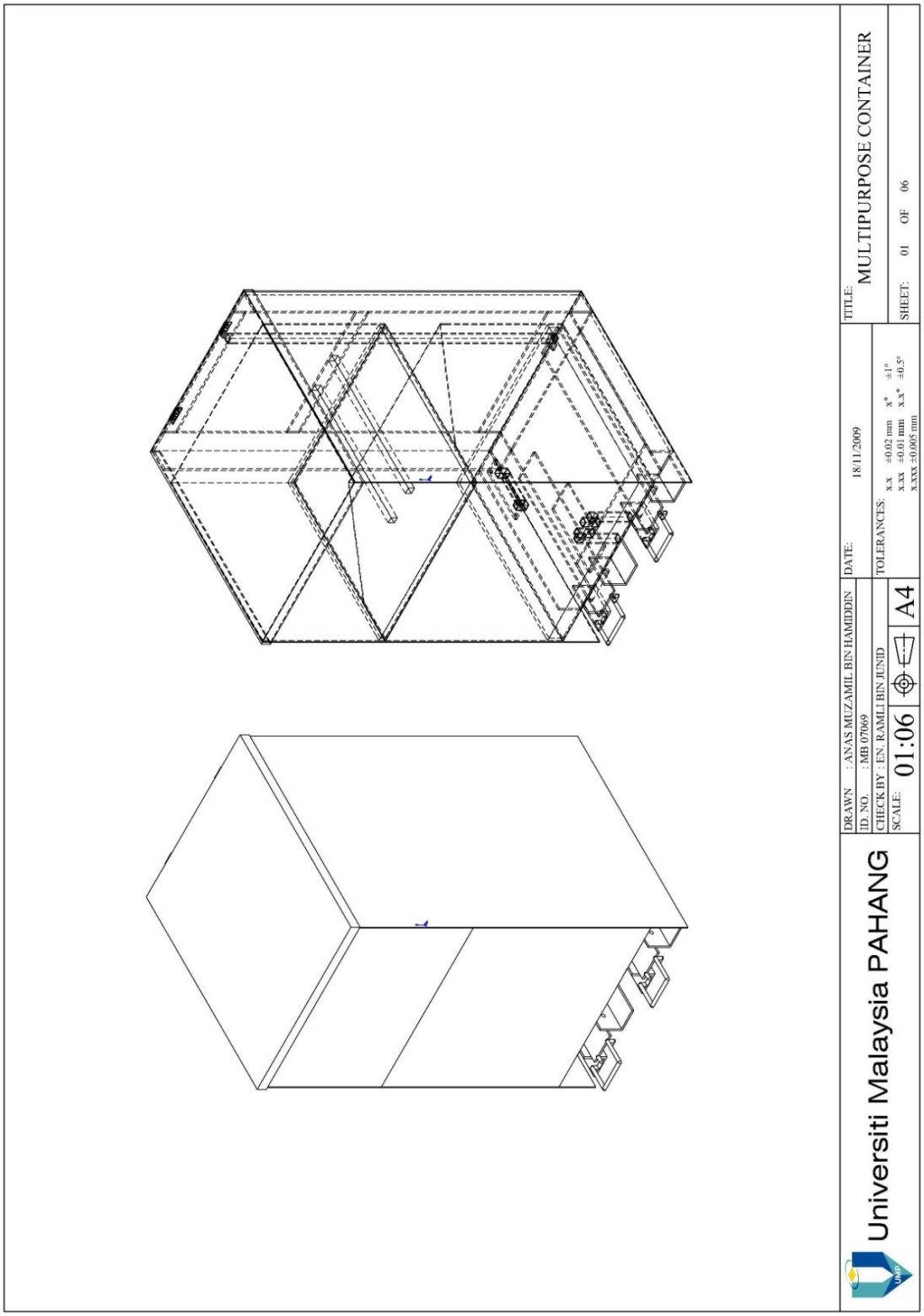
Gantt Chart of the Project

Project Activities	Week														
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Briefing by project supervisor	Plan														
	Actual														
PTA title confirmation	Plan														
	Actual														
Literature review	Plan	Plan	Plan	Plan	Plan	Plan	Plan								
			Actual	Actual	Actual	Actual	Actual								
Brainstorming and idea development		Plan	Plan	Plan	Plan										
					Actual	Actual									
Concept generation			Plan	Plan	Plan										
						Actual									
Select the generated concept				Plan	Plan	Plan									
					Actual	Actual									
Sketch and detail design				Plan	Plan	Plan	Plan								
				Actual	Actual	Actual	Actual								
Methodology					Plan	Plan	Plan	Plan							
					Actual	Actual	Actual								
Analysis of design					Plan	Plan	Plan	Plan	Plan						
					Actual	Actual	Actual								
Prepare for mid presentation						Plan	Plan	Plan							
							Actual	Actual							
Mid presentation								Plan							
								Actual							
Fabrication and finishing of product								Plan	Plan	Plan	Plan	Plan			
											Actual	Actual	Actual	Actual	Actual
Report writing									Plan	Plan	Plan	Plan	Plan		
														Actual	Actual
Prepare for final presentation									Plan	Plan	Plan	Plan	Plan	Plan	
													Actual	Actual	Actual
Final presentation and report submission															Plan
															Actual

Plan
Actual

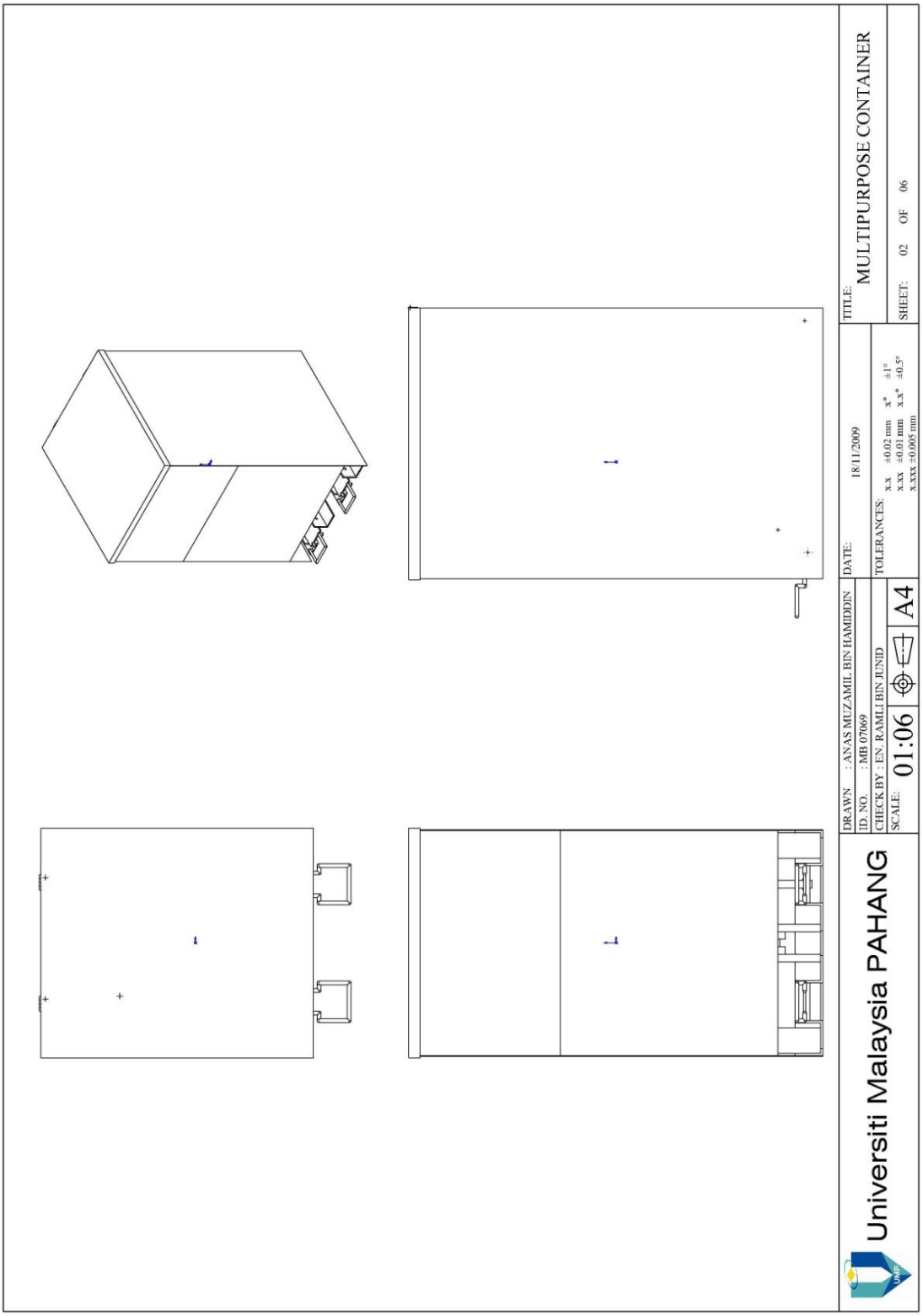
APPENDIX B

Drawing A



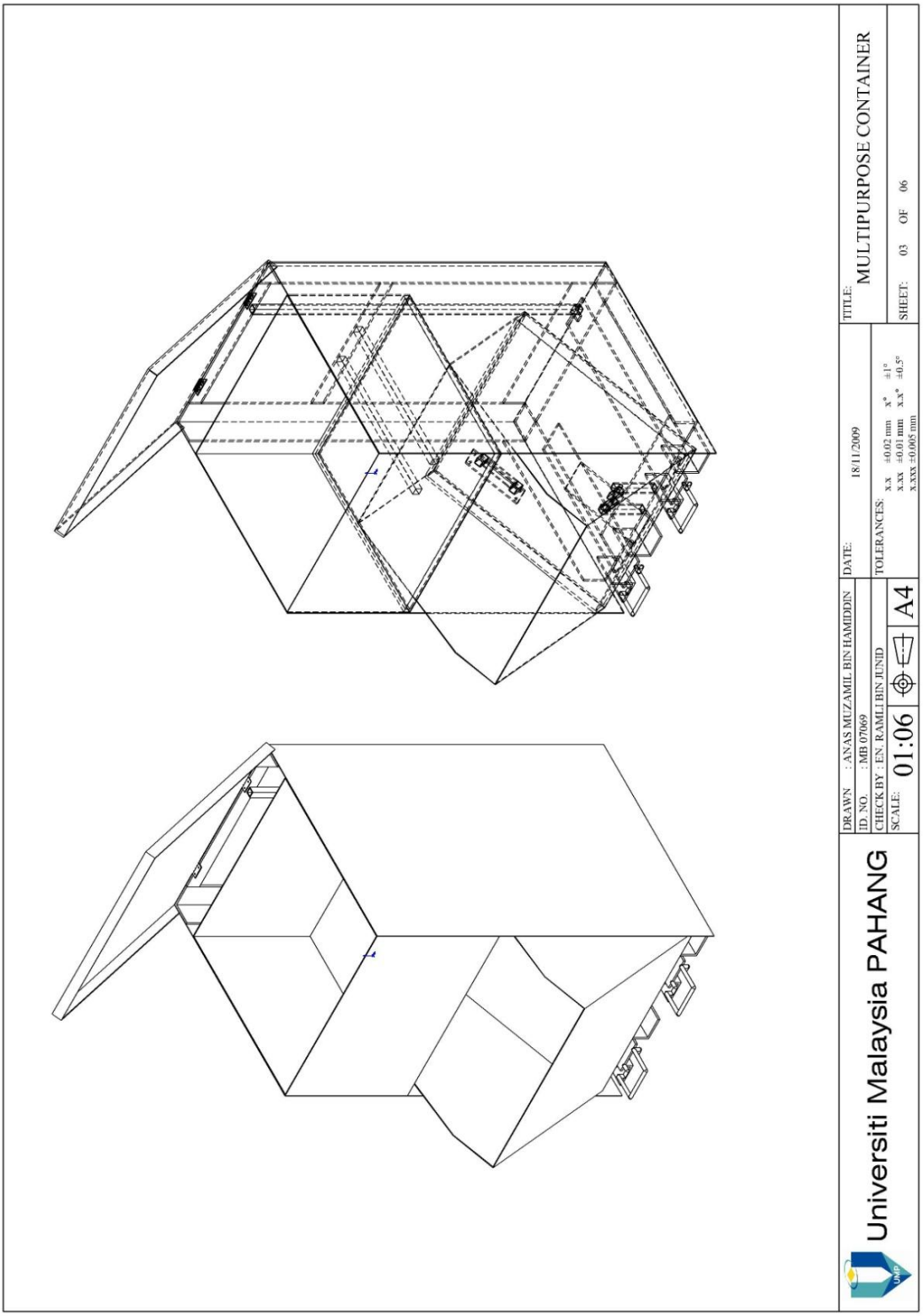
APPENDIX C

Drawing B



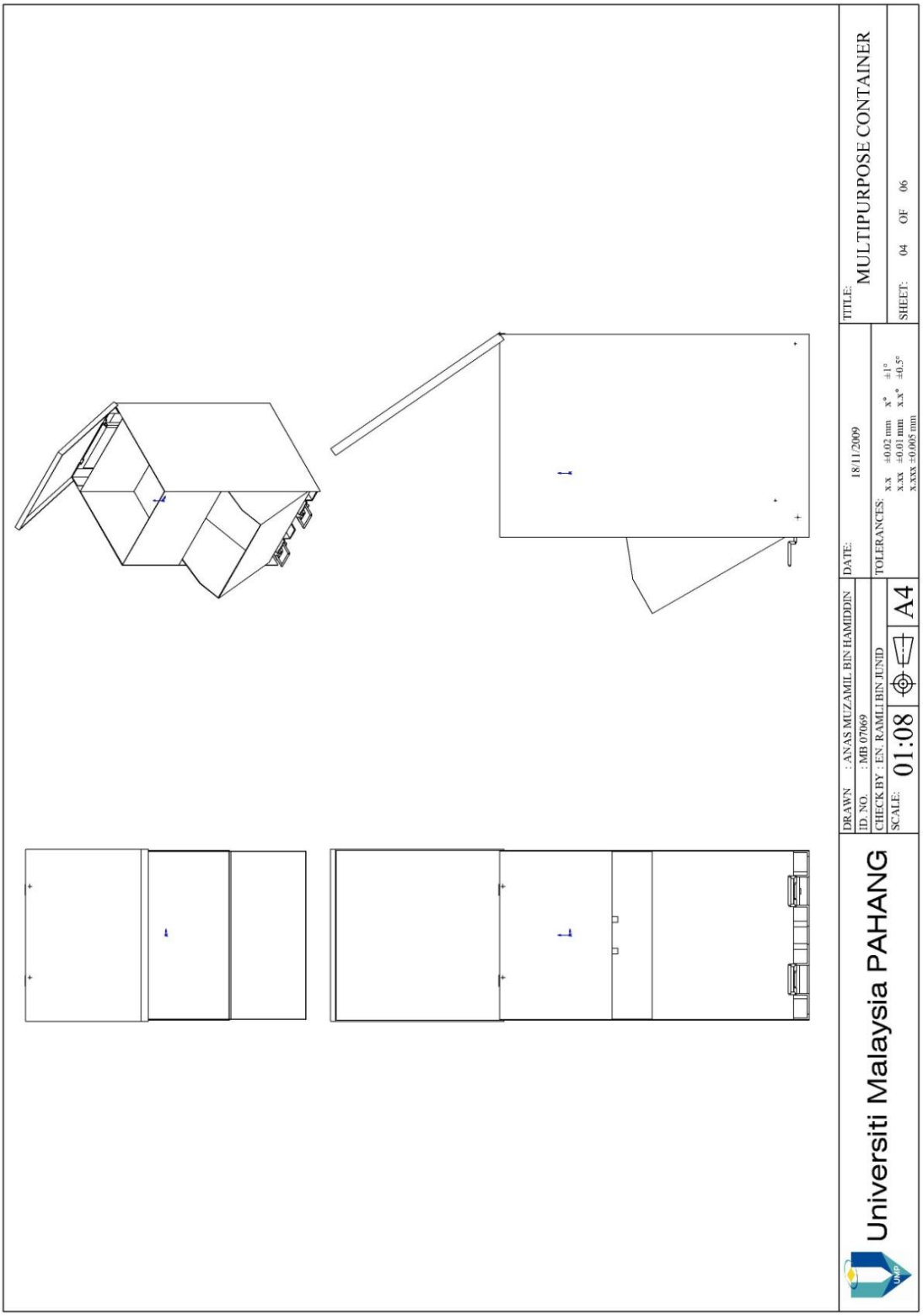
APPENDIX D

Drawing C



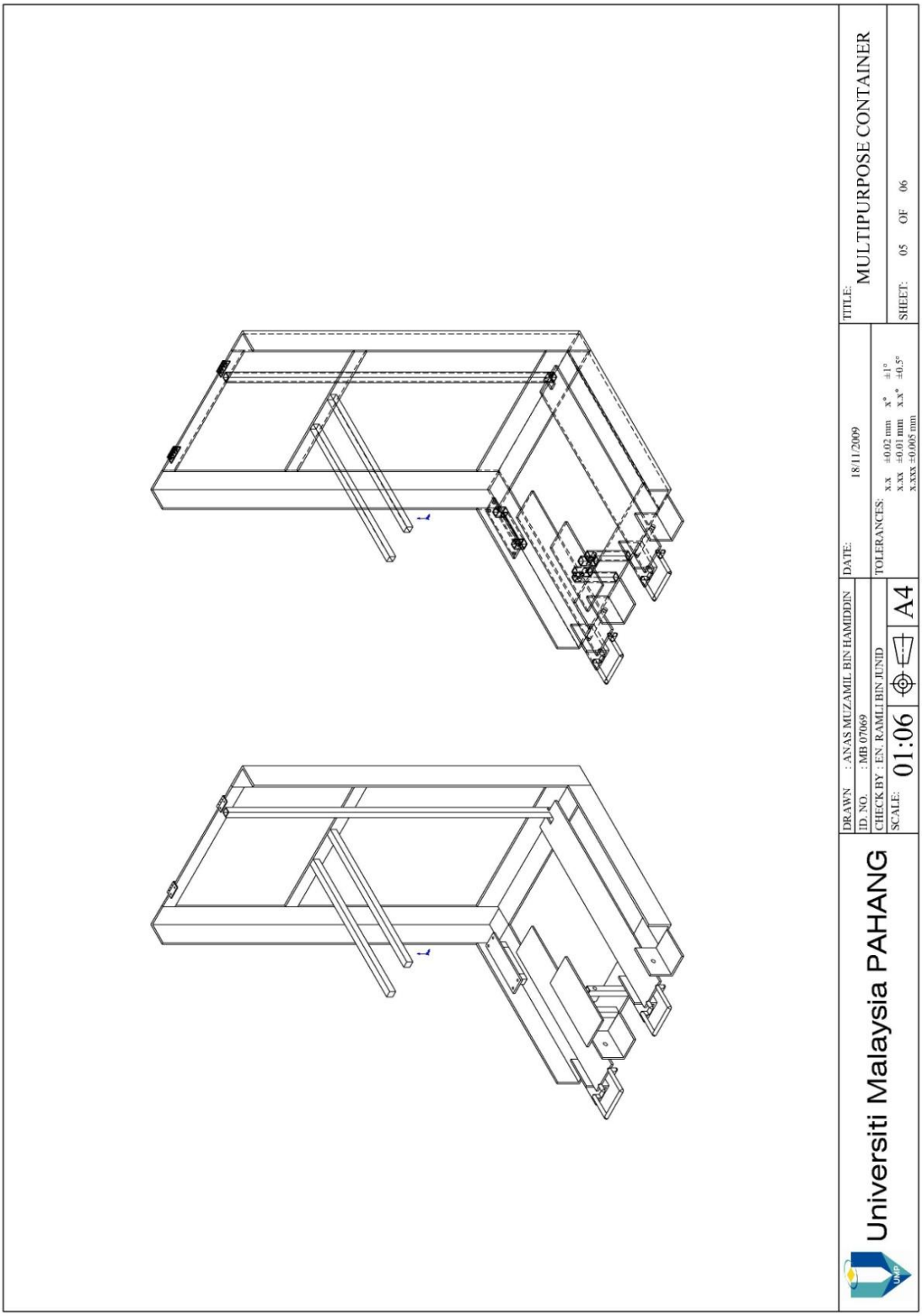
APPENDIX E

Drawing D



APPENDIX F

Drawing E



APPENDIX G

Drawing F