

UNIVERSITI MALAYSIA PAHANG

BORANG PENGESAHAN STATUS TESIS ♦

JUDUL: DESIGN AND FABRICATE STORAGE CABINET FOR TURRET PUNCH TOOL

SESI PENGAJIAN: 2006-2009

Saya, **MUHAMMAD AFIQ BIN AHMAD MUSTAZA (880412-10-5457)**
(HURUF BESAR)

mengaku membenarkan tesis Projek Tahun Akhir ini disimpan di perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Tesis ini adalah hakmilik Universiti Malaysia Pahang (UMP).
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. ****Sila tandakan (✓)**

☐

SULIT

(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)

☐

TERHAD

(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi / badan di mana penyelidikan dijalankan)

☒

TIDAK TERHAD

Disahkan oleh:

(TANDATANGAN PENULIS)

(TANDATANGAN PENYELIA)

Alamat Tetap:

No: 1 Jln Kubah u8/62
Bkt Jelutong, Shah Alam
40150 Selangor

EN. HAZAMI BIN CHE HUSSAIN
(Nama Penyelia)

Tarikh: **NOVEMBER 2008**

Tarikh: **NOVEMBER 2008**

CATATAN: * Potong yang tidak berkenaan.

** Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali tempoh tesis ini perlu dikelaskan sebagai SULIT atau TERHAD.

♦ Tesis dimaksudkan sebagai tesis bagi Diploma secara penyelidikan atau disertai bagi pengajian secara kerja kursus.

DESIGN AND FABRICATE STORAGE CABINET FOR TURRET PUNCH TOOL

MUHAMMAD AFIQ BIN AHMAD MUSTAZA

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

NOVEMBER 2008

SUPERVISOR'S DECLARATION

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

Signature :.....

Name of Supervisor : Hazami Bin Che Hussain

Date :.....November 2008

STUDENT'S DECLARATION

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

Signature :.....
Name : Muhammad Afiq Bin Ahmad Mustaza
ID number : MB 06035
Date :November 2008

ACKNOWLEDGEMENTS

This project was conducted under the supervision of Mr. Hazami b. Che Hussain in the University Malaysia Pahang (UMP). I am very grateful to him for his patience and his constructive comments that enriched this project. His time and efforts have been a great contribution during the preparation of this thesis that cannot be forgotten for ever.

I would like to thank to lecturers and technicians at the faculty of mechanical engineering for their valuable comments and sharing their time and knowledge on this project during my last trip to submit the project. I also gratefully acknowledge the assistance of everybody who helped me in the execution of this project in UMP. I would like to thank to Mr. Hazami b. Che Hussain and Mr. Mohd Rozikin b. Kamaluddin for general help with the facilities, for giving me the opportunity and the workshop time to operate the Bending Machine, Shearing Machine, Turret Punch Machine and etc.

I also thank to the Mechanical Students for their friendship and help when thinking through the problems and for sharing their knowledge and giving ideas. Finally, I thank my family for their continuous support and confidence in my efforts.

ABSTRACT

Designing and fabricating a storage cabinet is a product fulfills customer needs. This project is mostly related to storage cabinet and turret punch tool. This project uses many materials such as zinc, hollow steel bar, galvanized iron and other. This project involves with some mechanical process in the fabrication and assembling procedure such welding, bending, shearing and etc.

Overall, this project involves with many processes, starting from the designing concept, fabrication and assembling. Even though there are many types of cabinet in the market, the completion of this new model provides a more practical usage.

ABSTRAK

Mereka bentuk dan membuat kabinet penyimpan merupakan satu produk yang penting berdasarkan ciri-ciri yang diperlukan. Projek ini menggunakan pelbagai jenis bahan seperti zink, besi berongga dan sebagainya. Projek ini juga memerlukan proses mekanikal seperti pematrian, belokan, pemotongan dan sebagainya di dalam proses fabrikasi dan pencantuman.

Keseluruhan projek ini memerlukan pelbagai proses, bermula dari mereka bentuk, fabrikasi dan juga pencantuman. Walaupun terdapat pelbagai jenis kabinet berada dipasaran, namun kecirian dan kelebihan kabinet ini telah dilakukan bagi memastikan ianya lebih praktikal digunakan.

TABLE OF CONTENT

| CHAPTER | TITLE | PAGE |
|---------|---------------------------------|------------|
| | SUPERVISOR’S DECLARATION | ii |
| | STUDENT’S DECLARATION | iii |
| | ACKNOWLEDGEMENT | iv |
| | ABSTRACT | v |
| | ABSTRAK | vi |
| | TABLE OF CONTENTS | vii |
| | LIST OF TABLES | x |
| | LIST OF FIGURE | xi |
| | LIST OF APPENDICES | xiv |

1 INTRODUCTION

| | | |
|-----|-------------------|---|
| 1.1 | Synopsis | 1 |
| 1.2 | Problem statement | 1 |
| 1.3 | Scope | 4 |
| 1.4 | Project Objective | 5 |
| 1.5 | Project planning | 5 |

2 LITERATURE REVIEW

| | | |
|-----|-----------------------------------|----|
| 2.1 | Introductions | 9 |
| 2.2 | Prelim investigation | 9 |
| 2.3 | Turret Punch Machine’s background | 10 |
| 2.4 | Tools of Turret Punch Machine | 12 |
| 2.5 | Cabinet definitions | 13 |
| 2.6 | Existing product | 14 |

| | | |
|-------|-----------|----|
| 2.6.1 | Cabinet 1 | 15 |
| 2.6.2 | Cabinet 2 | 16 |
| 2.6.3 | Cabinet 3 | 17 |
| 2.6.4 | Cabinet 4 | 18 |

3

PROJECT METHODOLOGY AND PROCESS

| | | |
|--------|---|----|
| 3.1 | Introduction | 19 |
| 3.2 | Flow chart project | 20 |
| 3.3 | Drawing and design | 23 |
| 3.3.1 | Introduction to design | 23 |
| 3.3.2 | Drawing | 25 |
| 3.4 | Sketching drawing selection | 26 |
| 3.4.1 | Design 1 | 26 |
| 3.4.2 | Design 2 | 27 |
| 3.4.3 | Design 3 | 28 |
| 3.5 | Concept evaluation | 29 |
| 3.6 | Final product / idea | 31 |
| 3.7 | Fabrication | 35 |
| 3.8 | The fabrication process | 35 |
| 3.8.1 | Measuring and marking | 36 |
| 3.8.2 | Cutting | 37 |
| 3.8.3 | Drilling | 37 |
| 3.8.4 | Rivet | 38 |
| 3.8.5 | Welding | 38 |
| 3.8.6 | TOP300 software | 39 |
| 3.8.7 | Marking sheet metal | 40 |
| 3.8.8 | Shearing | 40 |
| 3.8.9 | Trimming | 41 |
| 3.8.10 | Bending | 42 |
| 3.8.11 | Laser cutting | 43 |
| 3.8.12 | Attach handle, locking device and hinge | 44 |
| 3.8.13 | Finishing | 45 |

| | | |
|----------|--------------------------------------|----|
| 4 | RESULT AND DISCUSSION | |
| | 4.1 Introduction | 47 |
| | 4.2 Result | 48 |
| | 4.3 Product Design Specification | 50 |
| | 4.4 Discussion | 50 |
| | 4.4.1 Types of defect | 50 |
| | 4.4.2 Correcting defects | 51 |
| 5 | CONCLUSION AND RECOMMENDATION | |
| | 5.1 Introduction | 53 |
| | 5.2 Conclusion | 53 |
| | 5.3 Recommendation | 54 |
| | REFERENCES | 56 |
| | APPENDICES | |
| | A Detail drawing | |
| | B Tools and equipments | |

CHAPTER 1

INTRODUCTION

1.1 SYNOPSIS

From the title of the project, my task is to design and fabricate storage cabinet for turret punch tool. In the design process, I have to design the cabinet to fulfill the customer needs. The design of the cabinet should help consumer to keep the tools well organized. In the fabrication process, I have to use the skills and knowledge gained from the previous semester such as welding, cutting, drilling and other mechanical methods to produce the product. The product that I invented to produce is a cabinet which has partitioned trays, drawers, have safety features and it is moveable. The project starts with making few concept ideas, selecting best design, determine materials to be used and start the fabrication process.

1.2 PROBLEM STATEMENT

The mechanical lab currently is having a problem in keeping turret punch tool for turret punch machine. The current cabinet is not suitable for keeping the turret punch tools. Due to the problem, tools are not well organized. Under these kinds of conditions, it can lead to many different types of problems such as tool lost, not easy to find the correct tool to use, tools are not easy to identify and etc.



Figure 1.1: Current Cabinet

From Figure 1.1, tools are not well organized. From the figure shown, the cabinet has no labels and it makes consumer not easy to choose the correct tool to use. The cabinet also is not fully used and there is many waste of space left.



Figure 1.2 (a): Tools inside Tray

From Figure 1.2 (a), the main tool in the turret punch machine stored is tray. This tool will need to be change-over regularly. But in this kind of situation, it would definitely make the consumer hard to take out the tools. The tools are not easy to identify.



Figure 1.2 (b): Tools inside Drawer

From Figure 1.2 (b), tools are kept inside a drawer. The drawer does not have partitions to separate tools according to types and usage for instance. Tools are not well organized. This condition makes consumer hard to select tools to use and tools can just easily misplaced.



Figure 1.3: Small Tools inside Drawer

From Figure 1.3, small tools are kept inside a drawer. The size of the drawer is not suitable to keep the small tools. The drawer has no partition to make the tools don't look messy.

1.3 SCOPE

The scope of the project can be divided into three main points:

- i. To keep turret punch tool organized.

The design of the product should help to keep the tools organized. It is important because it can make the process of change over tools easier. It is also to make consumer easy to identify tools to use. If tools are organized in the cabinet, many problems can be solved such as tool lost, tool misplaced.

- ii. To fulfill customer needs.

The project also has to make sure the outcome is fulfilled customer needs. The main criterion is the materials used. The materials must be strong enough to support the tools. The cabinet also must be able to exert any certain forces. Besides, the cabinet should be user friendly. Locking device is needed and the tires as well to make the cabinet moveable.

- iii. To make suitable design.

In this project, I have to design a suitable cabinet to keep the turret punch tool. The design of the product should help to make the tools organized in the cabinet. The design also must not be too complicated. The design should not use too many materials and also must not use too many processes in fabricating but still maintaining the customer needs without reducing any main criteria of the cabinet.

1.4 PROJECT OBJECTIVE

The main objective of the project is to design and fabricate storage cabinet for turret punch tool. The design also should be as simple as possible. The product should fulfill all the customer needs. The main objective of the product is to keep the tools well organized. Besides, the design also must be easy to fabricate. The size of the product also must be suitable for turret punch tool.

1.5 PROJECT PLANNING

According to Table 1.1, Gantt chart of the project planning, I have planned my work. On the first week of this semester, we were told to be given a title for our final year project. But the title was released on the second week. There are many on the list need only one to be chosen. After I go through the list, I made a simple research on some of interesting title before I decide which title to choose. After gathered some information I decided to choose the title of design and fabricate storage cabinet for turret punch tool.

After the title is given, supervisor also will be assigned automatically to the students. After the title is given, I planned to see the supervisor to get more information about the project. After a short briefing from the supervisor, things were getting clearer.

I started to do some research regarding turret punch machine and its tools as well as the cabinet for the storage. Few ideas gathered and some information was saved for future reference. Then I started with the sketching process. A few draft sketching were sketched by free hand on a piece of paper. I sketched as many sketches as I can before I do details on it and before I finalize my drawings.

Those drawings were shown to the supervisor for comment. After that I will have to choose the best design and do the drawing in Solidworks software. As I begin the processes needed to complete the project, I will have to update my log book. I have to write down all the things I did in my log book.

After the design is chosen, I have to make proper dimensions to proceed with the Solidworks software. I have to determine the suitable length and height for the cabinet to keep the turret punch tools. Also I have to count how many tools to keep kept inside the cabinet, how to arrange the tools to keep it organized.

After finish with the Solidworks process, I will have to do some research for my mid presentation. I will also have to start with my project report. In order to finish my project report, many of information need to be gathered and assemble properly by sequence given by the supervisor.

After the mid presentation, I will continue with the fabrication process. I will have to decide what materials are suitable to be used before I start with the cutting process on so on. Some materials need to order because out of stock. I began with the measuring and marking process. Define which part should be cut first, which part to be used first.

After the cutting process is done, I started with the mechanical joining method which welding. I started to finish the frame of the product first. The frame uses only hollow bar which needs be welded to bond them together. After that I proceed with the fabricating of tray process. I may need to use the turret punch machine, bending machine, and also shearing machine to produce the tray parts. I used galvanized iron sheet metal for trays. It is because the materials is easy to get, strong enough to hold the tools, quite heavy which will make the cabinet make solid.

I need to draw the open part of the trays in AutoCAD software to proceed with the turret punch machine. So I drew the open parts and generate it in TOP300 software before I can transfer it to the turret punch machine.

After the sheet metals are done with the turret punch machine, next I will have to use the bending machine to bend parts to make trays. After that I have to make sure the gap between sides parts of trays are attached together. This process will use mechanical joining method which is welding method to make thick weld.

After the frame part and trays part is finished, I can assemble all the parts to make one useful cabinet product. After the main parts are assembled, I have to attach all the extra equipment such as holder, locking device, et cetera. In the finishing process, I will have to check the connection between the assembled parts to make sure they are stick together properly. Also I have to make sure things to be just like I planned. Last is the painting process. The process is to smooth the product surface, to proper the product and to finalize all processes.

| TASK \ WEEK | | | | | | | | | | | | | | | | |
|---|---------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|---------|---------|---------|---------|---------|
| TASK | WEEK | 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 | WEEK 15 |
| RESEARCH ITEM | Planned | | | | | | | | | | | | | | | |
| | Actual | | | | | | | | | | | | | | | |
| | Planned | | | | | | | | | | | | | | | |
| Choosing Title | Actual | | | | | | | | | | | | | | | |
| Make Proposal | Planned | | | | | | | | | | | | | | | |
| | Actual | | | | | | | | | | | | | | | |
| | Planned | | | | | | | | | | | | | | | |
| Do literature review and gather information | Planned | | | | | | | | | | | | | | | |
| | Actual | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| CONCEPT DESIGN | Planned | | | | | | | | | | | | | | | |
| | Actual | | | | | | | | | | | | | | | |
| | Planned | | | | | | | | | | | | | | | |
| Brainstorming Session | Actual | | | | | | | | | | | | | | | |
| | Planned | | | | | | | | | | | | | | | |
| | Actual | | | | | | | | | | | | | | | |
| Sketching | Planned | | | | | | | | | | | | | | | |
| | Actual | | | | | | | | | | | | | | | |
| | Planned | | | | | | | | | | | | | | | |
| CONCEPT SELECTION | Planned | | | | | | | | | | | | | | | |
| | Actual | | | | | | | | | | | | | | | |
| | Planned | | | | | | | | | | | | | | | |
| DETAIL DESIGN | Actual | | | | | | | | | | | | | | | |
| | Planned | | | | | | | | | | | | | | | |
| | Actual | | | | | | | | | | | | | | | |
| Structural Analysis | Planned | | | | | | | | | | | | | | | |
| | Actual | | | | | | | | | | | | | | | |
| | Planned | | | | | | | | | | | | | | | |
| Mechanism Design | Planned | | | | | | | | | | | | | | | |
| | Actual | | | | | | | | | | | | | | | |
| | Planned | | | | | | | | | | | | | | | |
| PROTOTYPE | Planned | | | | | | | | | | | | | | | |
| | Actual | | | | | | | | | | | | | | | |
| | Planned | | | | | | | | | | | | | | | |
| Design Using Autocad Or Solid Work | Planned | | | | | | | | | | | | | | | |
| | Actual | | | | | | | | | | | | | | | |
| | Planned | | | | | | | | | | | | | | | |
| Fabrication Process | Planned | | | | | | | | | | | | | | | |
| | Actual | | | | | | | | | | | | | | | |
| | Planned | | | | | | | | | | | | | | | |
| MID PRESENTATION | Planned | | | | | | | | | | | | | | | |
| | Actual | | | | | | | | | | | | | | | |
| | Planned | | | | | | | | | | | | | | | |
| PROJECT REPORT | Planned | | | | | | | | | | | | | | | |
| | Actual | | | | | | | | | | | | | | | |
| | Planned | | | | | | | | | | | | | | | |
| continue fabricating and improvise product | Planned | | | | | | | | | | | | | | | |
| | Actual | | | | | | | | | | | | | | | |
| | Planned | | | | | | | | | | | | | | | |
| FINAL PRESENTATION | Planned | | | | | | | | | | | | | | | |
| | Actual | | | | | | | | | | | | | | | |
| | Planned | | | | | | | | | | | | | | | |

Table 1.1: Gantt chart Project

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

In this chapter, in order to finish this project successfully, I have to do some research about the turret punch machine, cabinets and tools to be kept in the cabinet. Research and study must be done frequently so that all the information needed is gathered for future reference. This will help to produce the best product and to achieve its own objectives.

2.2 PRELIMINARY INVESTIGATION

The investigation is very important before begin the project. This is because when we want to make or create a new product we must do some research or investigation about the product. When we investigate the product, many results will come out regarding the product such as the existing product in the market, function and types available, their advantages and other else. The important thing is to get as many information as we can gain from the research. Analysis according to the information gathered is needed in understanding process about project title. To make this project mare accurate and suitable, the information about this topic must be gained and the information collection must be done.

By referring to the information, study about the topic must be done, and more than two weeks in needed to make a literature review. Every week, the improvement of knowledge is needed to make sure this project will be performing very well. Methods used in gathered information are as followed:

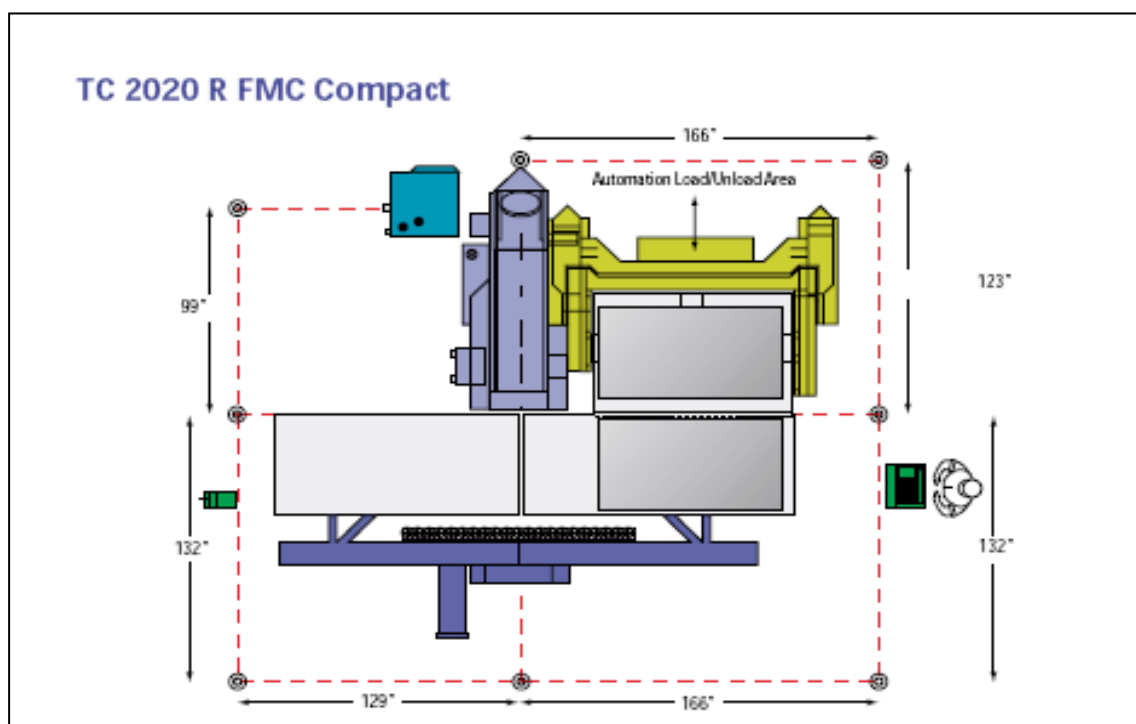
- i. Browsing the internet
- ii. Meeting session with the project supervisor
- iii. Discuss and training with guidance and also observing
- iv. Checks journals, articles and book.

2.3 TURRET PUNCH MACHINE'S BACKGROUND

Designed and manufactured in the United States, the TRUMATIC 2020 Rotation FMC Compact is a must for any sheet metal fabricator seeking to improve productivity and quality. With its compact footprint, the TRUMATIC 2020 Rotation FMC Compact can achieve lights-out production without requiring additional floor space.

The turret punch machine is machining which capable of doing cutting process, punching process, shearing and etc. The TRUMATIC 2020 Rotation FMC Compact offers a 50" x 100" working range and the ability to accommodate industry standard 4' x 8' sheets. This offers users the ability to minimize costs by purchasing pre-cut sheets rather than shearing them to size on the shop floor. A larger work area also allows more freedom to create nested sheet layouts optimizing material utilization. The TRUMATIC 2020 Rotation FMC Compact is designed to ensure users do not sacrifice accuracy for speed. The linear tool changer is fully integrated into the coordinate guide rail and the ball-transfer table to form a single structure. This reduces vibrations and allows accurate punching at high speeds across an entire sheet. Stroke rates are 2200 per minute for marking/ beading and 900 per minute for punching (at 0.040" pitch).

The PC control on the TRUMATIC 2020 Rotation FMC Compact is simple and easy to use. The platform is a Pentium processor with Windows. It can be networked for fast program downloads and is equipped with ToPs Lite basic CAD/CAM software. All machine processes can be monitored at a glance and integrated on-line help can answer most questions as they arise. The PC Controls are equipped to identify in advance which tools should be changed for an upcoming job. This feature simplifies the process of changing tooling cartridges off line and minimizes downtime during tooling change-overs. [6]



Technical Data – Automation

| | |
|-------------------------------------|-------------------------------------|
| Lifting Capacity | 6,000 lbs |
| Maximum Sheet Size | 48" x 96" |
| Supported Sheet Sizes | 48" x 48" 40" x 80" 40" x 40" |
| Maximum Sheet Thickness | 0.250" |
| Minimum Sheet Thickness | 0.040" |
| Maximum Sheet Stock Height | 5" |
| Loading Station minimum skid height | 4" |
| Loading Station maximum skid height | 6" |
| Overall Dimensions | Length (L) 22' |
| Machine with | Width (W) 25' |
| Automation | Height 8' |
| | Weight Automation 66,000 lbs |
| | Weight Machine 25,000 lbs |

2.4 TOOLS OF TURRET PUNCH MACHINE

For the turret punch machine, it has many different types of tool used to do processes such as slitting, cutting and shearing. There are many different sizes and shapes of tool available. Shapes of tool available are such as oblong, rectangle, square and round.^[7]

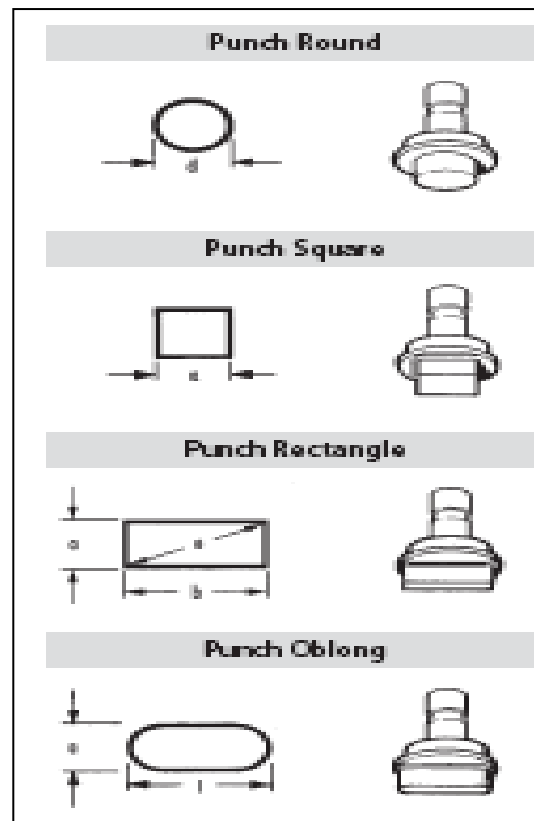


Figure 2.2: Shapes of Punching Tool

TRUMPF tooling is made of high-speed tool steel. Small punches are manufactured from M2 tool steel. Special high-speed PM M4 steel is used for the medium-sized and heavy-duty punches for plate and high tensile strength materials.^[7]



Figure 2.3: Main Tools of Turret Punch Machine; the Cartridge



Figure 2.4: Accessories for Turret Punch Tool

2.5 CABINET DEFINITIONS

From The American Heritage® Dictionary of the English Language, Fourth Edition, and the definitions of cabinet can be derived as below:

Cabinet is an upright, cupboard like repository with shelves, drawers, or compartments for the safekeeping or display of objects. For the Computer Science, the box that houses the main components of a computer, such as the central processing unit, disk drives, and expansion slots.

The other meaning of cabinet is often cabinet which is a body of persons appointed by a head of state or a prime minister to head the executive departments of the government and to act as official advisers.

For Archaic, it is a small or private room set aside for a specific activity. It is suitable for storage or display in a cabinet, as because of size or decorative quality. ^[1]

The objective of the cabinet is to keep the turret punch tool inside. Without the cabinet, tools can easy lost or misplace. In order to keep the tools safe, we need a cabinet to store the tools. The cabinet must be suitable enough for the turret punch tool.

2.6 EXISTING PRODUCT

As I do my research and study about the project, I may need to do some survey and make some comparisons about the product. These are some picture example of existing cabinets and its specifications as well as the suitability for use. In market today, we have many types and functions of storage cabinet. For literature review, I studied four different types of cabinet to analyze.

2.6.1 Cabinet 1



Figure 2.5: Existing Cabinet 1

From Figure 2.5, this cabinet is not suitable for lab use especially for keeping turret punch tool. The size is too small and it has no partitioned compartment to keep tools organized. It is made from plastic which the material is not strong enough. The main function of the cabinet is store small and light item such as bottles and brush. The advantages of the product are the size is small and does not require much space; the weight is light which can be easy carried away. The disadvantages of the product are that the materials used are not suitable enough, the design does not help to keep the tools organized, the cabinet has no locking device and it is not portable which those are the important needs of a cabinet.^[2]

2.6.2 Cabinet 2



Figure 2.6: Existing Cabinet 2

From Figure 2.6, this storage bag is only suitable for keeping tools which need to be carried or moved regularly. The main function of the cabinet is to keep small and very light weight tools such as screw driver and spanner. It is not suitable for turret punch tool because we don't always bring the tools to many other places. We need the tools to always be near to the machine. The size of the cabinet also is too small to keep some amount of tools. The cabinet is made of steel. The advantage of the product is it is portable and the disadvantage is that the cabinet doesn't have enough space to keep turret punch tool. ^[3]

2.6.3 Cabinet 3



Figure 2.7: Existing Cabinet 3

From Figure 2.7, this cabinet is not suitable for turret punch tool due to the size is not big enough also it does not have much space to keep the tools. The cabinet is obviously not specially designed for turret punch tool. The cabinet is a bit heavy in weight because it is made from very thick and hard sheet metal materials. The main function of the cabinet is to keep tools such as cans, hand drill and hand grinder. The advantage of the product is the material used is strong enough. The disadvantage of the product is the cabinet does not have enough space to keep turret punch tool. ^[4]

2.6.4 Cabinet 4



Figure 2.8: Existing Cabinet 4

From Figure 2.8, this cabinet can also be used to keep turret punch tools but it is not suitable enough because it is made of wood. The materials used won't be able to last longer and not strong enough to stand any impact exerts on it. The cabinet is not suitable to be placed in lab. The cabinet is always has to be faced in front and it has no tires to move the cabinet. The main function of the cabinet is to store tools such as hammer, saw and screw driver. The advantage of the product is the design helps to keep tools organized. The disadvantage of the product is the material used is not suitable. ^[5]

CHAPTER 3

PROJECT METHODOLOGY

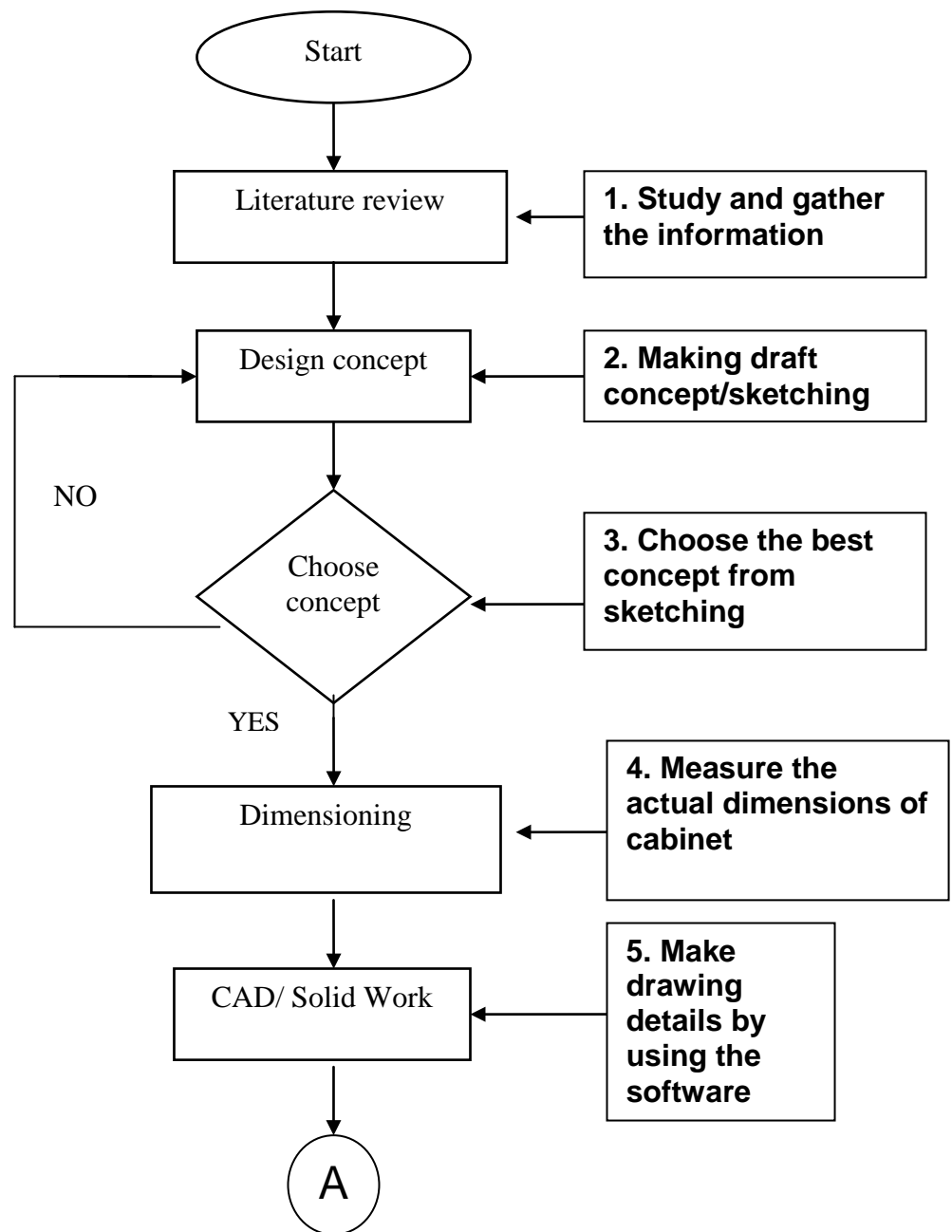
3.1 INTRODUCTION

In this chapter, I have to discuss about methodology and procedure to fabricate the product. There are states of methods that I used in my turret punch storage cabinet project. It is especially about process flow process based on my actual schedule.

So in fabrication step, there are certain process must be done such as cutting, joining, punching, bending and other related process. I have to follow my entire schedule made and by using the method that I have planned to make my product more efficient and get good result.

This methodology process also needs me to think how to produce the product and how to choose or decide which materials and process is the best for the product. Effective methods will give clear view on how to do research, so I have to follow and use some guidelines from the internet and the supervisor to complete the project.

3.2 FLOW CHART



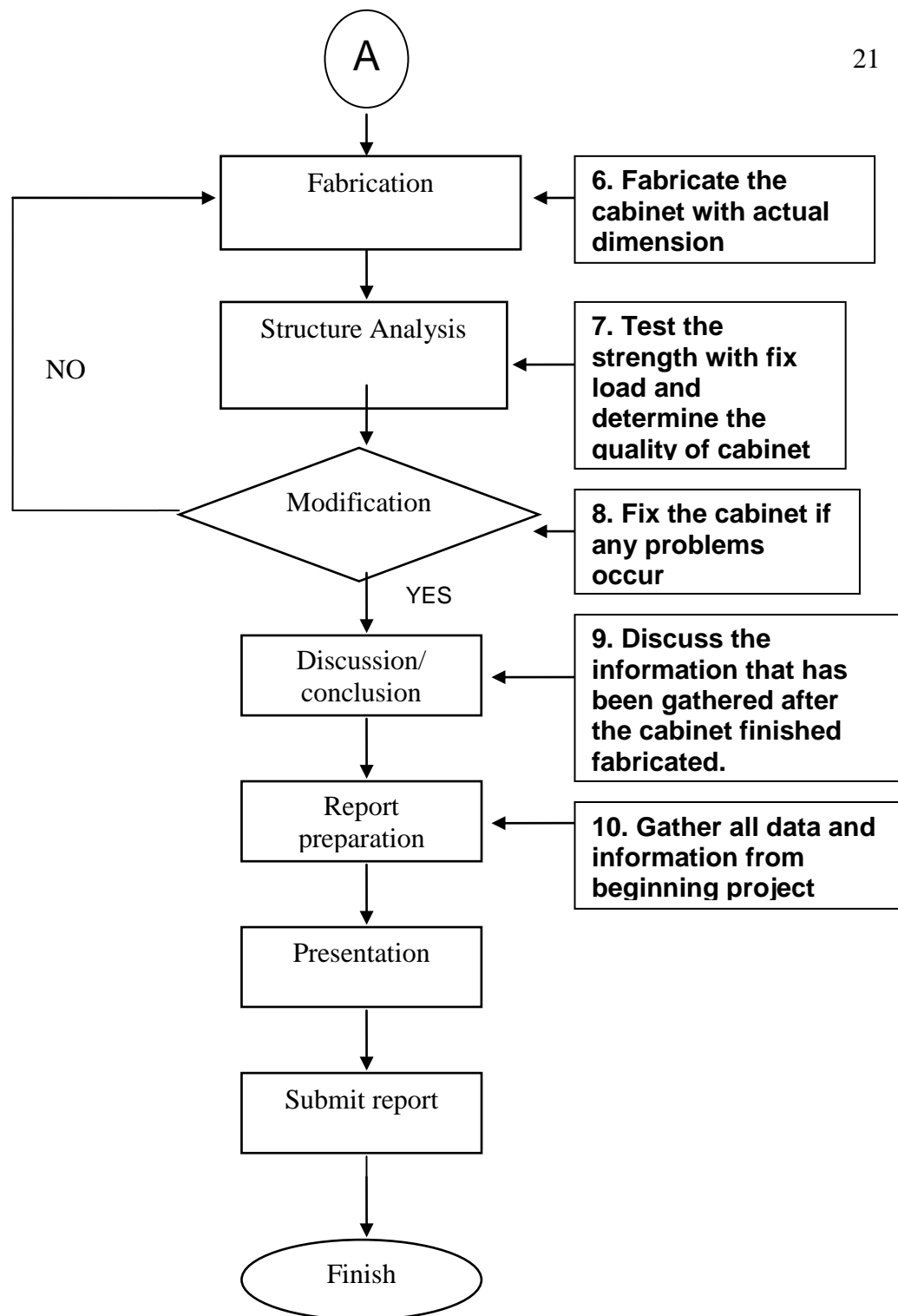


Figure 3.1: Flow chart Project

According to Figure 3.1, flow chart project, it starts with doing literature review. All the information gained is gathered for future use. In this process I will have to study and make a lot of investigation about storage cabinet. This includes a study about concept of storage cabinet, process to fabricate, and material. These tasks have been done through study on the internet, books and others.

The next process is to do design concept. This includes by making draft concept/sketching about the product. It is important to make the best design for the project. After several designs are sketched, the best concept has been chosen through its advantages. The selected design is then transferred to detail drawing by using Solidworks software. The drawing should be in full proper and finalized dimensions.

After all the drawing process is done, the drawing has been used as a reference for next process, which is fabrication process. Mechanical processes needed in this project are such as welding, cutting, drilling, bending and others. During the fabrication process, if any problems occurred the modification steps will be taken.

Next would be the structure analysis process. The process includes testing the strength with fix load and determines the quality of the cabinet. Analysis stage has been implemented after fabrication stage. The evaluation is by considering the strength, durability, safety and others.

After all the process mentioned is done, next step is to do discussion upon the product. Discuss the information that have been gathered after the cabinet finished fabricated. Then, start making report. Gather all data and information from the beginning of the processes and make it in a full format of report. After that, prepare for the presentation and submit report.

3.3 DRAWING AND DESIGN

3.3.1 Introduction to Design

Before begin the fabricating process, the basic process need to be done first is drawing. This is because my project depending on the drawings. About my drawing, I started my project model with the sketching first. After completing the sketching process, the next stage is doing a selection method to choose the best sketching for a model of my turret punch storage cabinet project. After that I used Solidworks software to finalize the sketching process. Besides that, I also had lay down my programming drawing for punching process.

The storage cabinet that I intend to outcome with is specially design for the use of the turret punch tool. It is made to keep the tools organized. It is also helps to prevent from any accident happens some how due to the safety factors studied before to apply on the cabinet. The cabinet has three level of storing compartment which can be divided into three groups and that is the top, the middle and also the bottom.

The design of the cabinet should not be too complicated. The design has to be as simple as possible for easy to fabricate. It should not need too much process to be taken upon it. But the criteria of the main objective should remain the same without exceeding the main objectives. The color of the cabinet is depending on orders from anyone who ordered the product.

The characteristics should be included in my turret punch storage cabinet project are such as:

- i. **Materials:** the materials used to produce the product must be strong enough and suitable for lab use. The materials also must not be too expensive.
- ii. **Appearance:** the design must not be too complicated. The design must be simple but suitable for turret punch tool. The color of the product also must be desirable.
- iii. **Accessories:** the cabinet must have extra features such as suitable compartment, divider, locking device, top-cover, fully covered cabinet and etc. these accessories will give extra point to the product.
- iv. **Purpose:** the purpose of the cabinet is able to keep the entire important turret punch tool organized.
- v. **Size:** the size of the cabinet must be suitable and able to keep turret punch tool. The cabinet must not be too large because it requires much space. The cabinet also cannot be too small because the cabinet has to store many different types of tools.
- vi. **Conditions:** the cabinet has to be easy maintenance. The product also must last long and has all the safety features needed.
- vii. **Process:** the fabrication process must be easy. The fabrication steps must not use complicated process.

3.3.2 Drawing

These processes are very important because it can affect the product in the production process. The drawings can be divided into two main categories, which are:

- i. **Sketching:** this process needs me to generate my brain to make sketching as many as I can relate to the title of project. All the ideas must be sketched on a paper first before selecting the best one.
- ii. **CAD software:**
 - Solidworks:** to draw a model before fabrication.
 - AutoCAD:** to draw part when to use turret punch machine. The part must be saving under dxf type.

3.4 SKETCHING DRAWING SELECTION

For the sketching section, I have already sketched 3 draft drawings. It includes the features for each drawing. This is my first step before I proceed to the Solidworks software. Those sketches were done by using free hand without additional drawing tools like ruler or drawing compass. At the end I will need to choose only one design which is the best design. Decisions must be based on few considerations. Below are figures of my sketching model:

3.4.1 Design 1

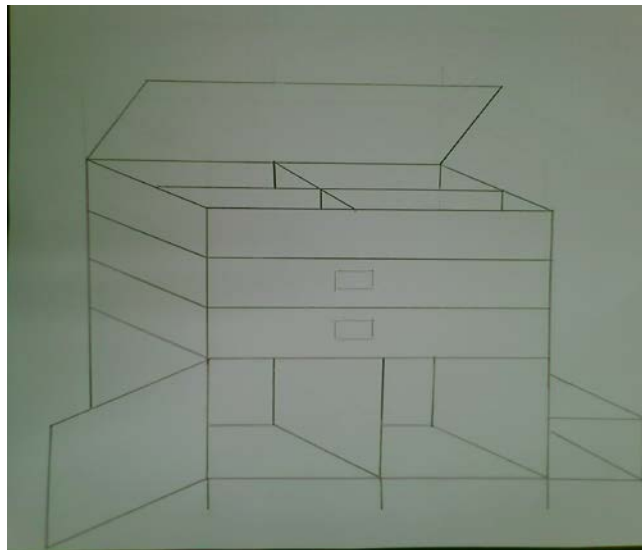


Figure 3.2: Concept 1

From Figure 3.2, this cabinet is not moveable. It has two wide drawers, two large free compartments space at the bottom, one small free compartment space and a partitioned compartment at top of it with cover. The size of the cabinet is large and it required space. But most of the compartments are covered meaning not exposed. The main material used for the cabinet is Zink sheet metal. The advantage is the product is light weight because it is made of Zink. The disadvantage of the product is that the product is too large for turret punch tool and it is not suitable enough.

3.4.2 Design 2

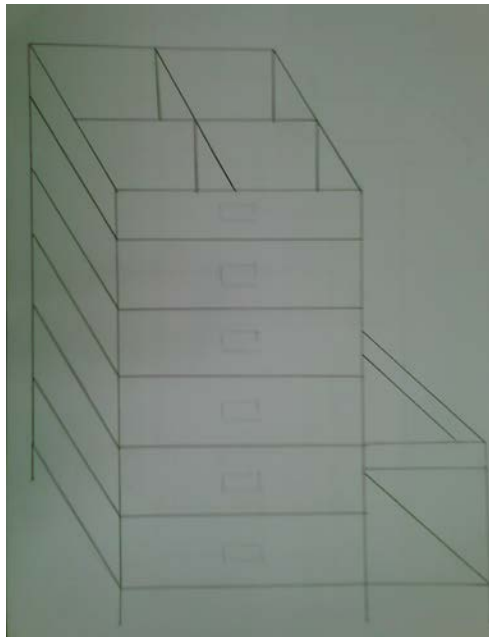


Figure 3.3: Concept 2

From Figure 3.3, this cabinet is not moveable. It has six drawers in the middle, a free space compartment at the side bottom and a partitioned compartment on top of it with no cover. The size of the cabinet is large size. All compartments are exposed which means it has no cover. The main material used for the product is steel. The advantages of the product are the material used is suitable for cabinet and the cabinet has many compartments to keep the tools organized. The disadvantage is the size which is too large and not suitable enough and it is not moveable.

3.4.3 Design 3



Figure 3.4: Concept 3

From Figure 3.4, this cabinet is moveable. It has two drawers at the bottom, two angled trays in the middle and a partitioned compartment at the top with cover. The size is medium size and it's not too heavy due to light weight materials used. The main material used to build the cabinet is galvanized iron. The material is strong enough to stand force. The advantage is the product keeps the tool organized. The disadvantage is the design is quite complicated to fabricate.

3.5 CONCEPT EVALUATION

This idea evaluation step is important because this step will determine the best design and the most suitable design to fabricate. The design is to be chosen based on the needs and some important criteria needed to be at the cabinet. The selection method must be done by doing some analysis upon those designs. The criteria can be concluded as table shown below:

| | Design | 1 | 2 | 3 |
|------|---|------------|-----------|------------|
| Bil. | Needs | | | |
| 1 | portable | - | - | + |
| 2 | aesthetic value | + | - | + |
| 3 | Use high tensile stress and hardness material | + | + | + |
| | | | | |
| 4 | product safety | + | - | + |
| 5 | easy to maintain | + | 0 | 0 |
| 6 | easy to produce | 0 | - | + |
| 7 | long life spent | 0 | + | 0 |
| 8 | can stand high temperatures | + | + | + |
| | | | | |
| 9 | large space required | - | - | + |
| 10 | easy to replace parts damaged | + | + | - |
| | | | | |
| 11 | enough/suitable compartment | + | - | + |
| | | | | |
| 12 | user friendly | 0 | + | 0 |
| 13 | reasonable price | - | 0 | 0 |
| | pluses | 7 | 5 | 8 |
| | same | 3 | 2 | 3 |
| | minuses | 3 | 6 | 1 |
| | net | 4 | -1 | 7 |
| | rank | 2 | 5 | 1 |
| | continue | Yes | No | Yes |

Table 3.1: Pugh Concept

Notes:

+ = Better than

- = Worse than

0 = Same as

After all the designs are sketched, every design has their own characteristic, advantage and disadvantage. In order to choose the best design, I made a conclusion on the advantages and disadvantages and put it in a table. By referring to the table below, it helps me to decide which design gives more advantages and which design to choose.

| design 1 | advantages | disadvantages |
|---------------------|---|---|
| | many large compartments not moveable cabinet has top and compartment cover can insert many tools, suitable for larger tools has partitioned compartment, manageable | size too large, occupied space less safety factor, no locking device no supporting device to support top-cover not portable compartment is way too large for the tool |
| design 2 | advantages | disadvantages |
| | have partitions to keep tools organized have many free space to keep tools drawers have locking device no holder bars, can save space height is quite suitable for lab use | not moveable too many drawers less safety factor, no locking device many compartments exposed, uncovered size is too big, occupied space |
| design 3 | advantages | disadvantages |
| | portable or moveable cabinet have partitions to keep tools organized complete locking device size is suitable for lab use easy process to produce angled tray, easy to keep tools transparent top-cover | no holder bars exposed compartment |

Table 3.2: Conclusion Concept

From the information gathered and after finished the selection concept method, I chose concept 3 for my final design. The design has the most advantages among the rest designs. The design also fulfills the criteria needed.

3.6 FINAL PRODUCT/IDEA

From figure 3.5, it shows the final idea to produce the storage cabinet. The cabinet has 4 important parts:

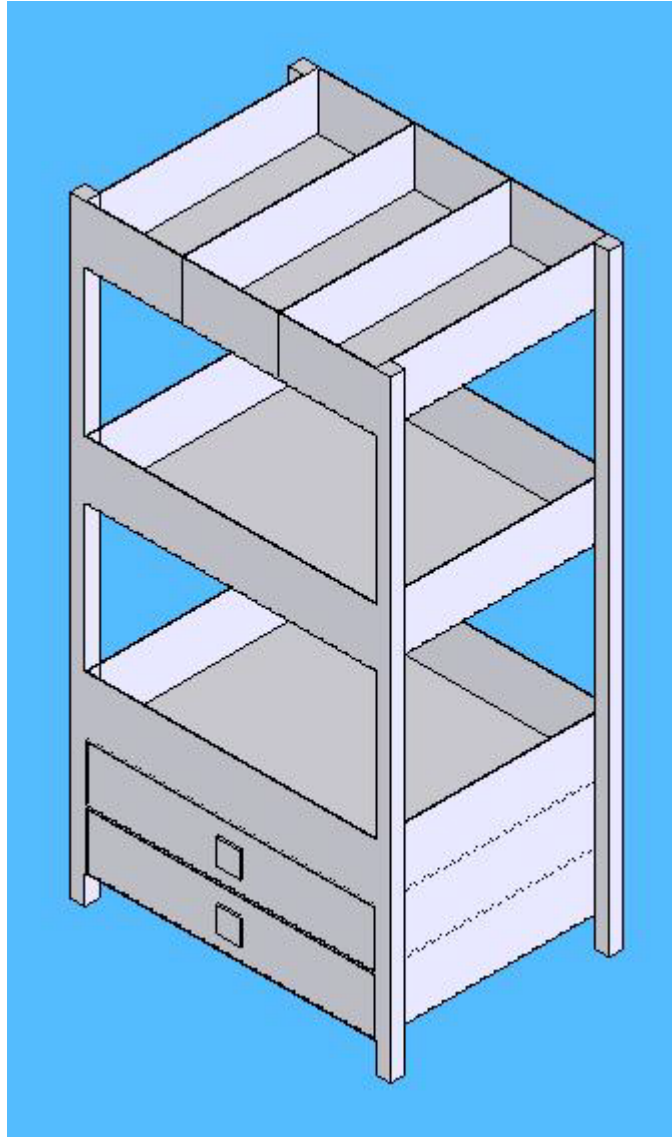


Figure 3.5: Final Idea; Assembly Part

i. **Frame:**

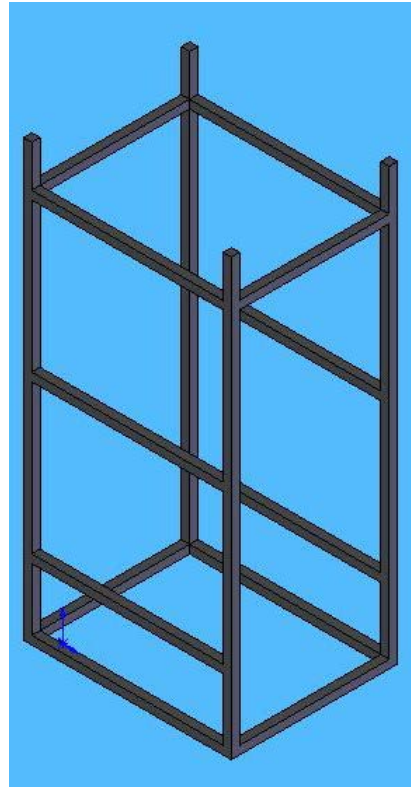


Figure 3.6: Frame

From Figure 3.6, it shows the part which helps to hold and to be attached all components of the product. This part also gives strength to the product. The frame part is made from hollow steel bar. Size for each bar is 2" x 2". The process involves is arc welding method for joining process and cutting process.

ii. **Partition compartment:**

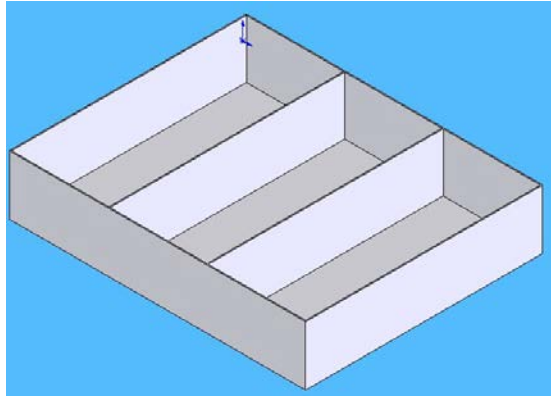


Figure 3.7: Partitioned Compartment

From Figure 3.7, the partitioned compartment will be located at the top of the cabinet. The compartment has 2 partitioned spaces to keep tools according size. It is made from galvanized iron. This part will organize the tools. Tools will be arranged according to size and weight before place in the compartment.

iii. **Tray:**

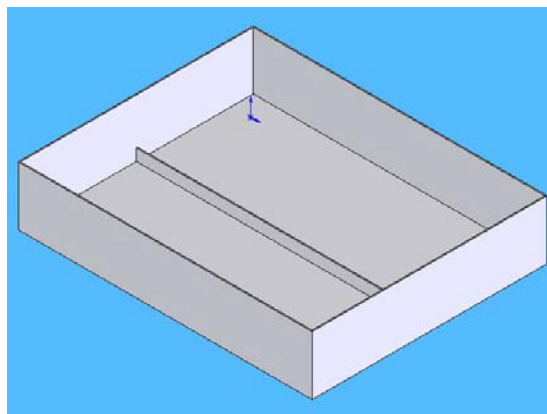


Figure: 3.8: Tray

From Figure 3.8, the cabinet has two trays which located in the middle of the cabinet. The tray has a plat in the middle to divide into two parts.

Tools will be more organized in the tray. It is made from galvanized iron. This is where small tools will be kept inside. The tools will be easier to identify in the tray.

iv. **Drawer:**

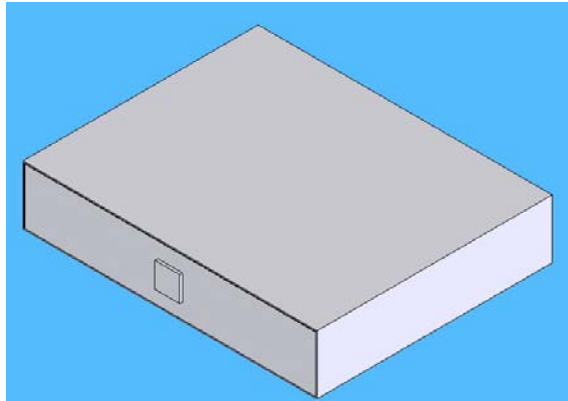


Figure 3.9: Drawer

From Figure 3.9, the cabinet has two drawers which located at the bottom of the cabinet. The function is to keep larger tools because it does not have partitioned plat on it. This is the part where important tools will be kept. It is important to prevent from any lost of tools occurred. It is made from galvanized iron material.

3.7 FABRICATION

The fabrication process is starting after designing phase and selection the materials process. Metal fabrication is value added process that involves the construction of machine and structures from various raw materials. This process is based on the design and by following the design dimension. For this project I have used a lot of methods like measuring, marking, cutting, the materials, joining, shearing, bending and other methods. This fabricating process is different from manufacturing process in terms of production quality. The manufacturing process is producing a large number of quantities of product while fabrication process is only producing only one product. The fabricating process is a very time consuming process because it is a hands on process. Fabricating process is used at the whole system production. This was including creating parts by parts then proceeds to the assembling.

3.8 THE FABRICATION PROCESS

These are some of the pictures taken while finishing the fabrication process. Those pictures are arranged by sequence of the fabrication. In order to get the best result in fabrication, I have to follow the sequence as I planned.

3.8.1 Measuring and Marking



Figure 3.10: Measuring and Marking Process

From Figure 3.10, the first step of fabrication is by doing the measuring step. Measure the length of raw materials which need to be cut according to dimensions by referring to the drawing. Next is by doing the marking step upon the raw materials. Mark which of the part need to cut by using scribe. This process has to be according to dimensions made and always refer to the drawing. The measuring and marking process is needed to be done as accurate as possible. It is because the result after the cutting process will mostly be determined by the measuring and marking process.

3.8.2 Cutting



Figure 3.11: Cutting Process

From Figure 3.11, after the raw materials have been measured and marked, continue to the cutting process. By using the disc cutter, I cut the hollow bar according to dimensions. The hollow bar will use to make the frame part.

3.8.3 Drilling



Figure 3.12: Drilling Process

From Figure 3.12, drilling process needs to be done to attach the L-shape plat to the bars. I used the riveting process to attach the L-shape plat to the hollow bar. I used 5mm drill bit in the drilling process. The objective of attaching the L-shape plat is to level the trays when attaching the trays to the frame.

3.8.4 Rivet



Figure 3.13: Riveting Process

From Figure 3.13, after the hollow bars drilled to make holes on it according to dimensions, I attached the L-shape plat to the bars by using the rivet method. The result of the attachment is great and the L-shape plat is well attached to the bars.

3.8.5 Welding



Figure 3.14: Arc Welding Process 1

From Figure 3.14, to make the frame part, I used the arc welding method to attach all the hollow bars. By using the arc welding, the bars will be well welded to each other. I have to define the proper voltage to be used to avoid damages to the bars before I start the welding process.



Figure 3.15: Arc welding Process 2

From Figure 3.15, I used the arc welding type to weld tires to the base part. The base part is then will be welded to the frame to make the cabinet moveable.

3.8.6 TOP300 Software

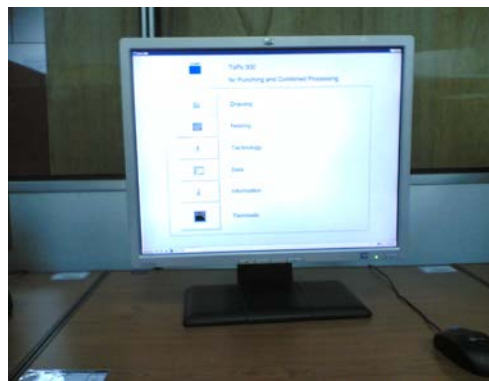


Figure 3.16: Generating TOP300 Software

From Figure 3.16, to use the turret punch machine, first I have to draw the open part for each tray by using AutoCAD software and save it in DXF format. Then I have to generate a program from the drawings in the TOP300 software to gain the programming which later on I will have to transfer to the turret punch machine and run the punching and shearing process. The program is then saved in a diskette and ready to transfer to the machine.

3.8.7 Marking Sheet Metal



Figure 3.17: Marking Sheet Metal

From Figure 3.17, the marking process must be done to each sheet metal before the shearing process. This involves measuring and marking to the sheet metal and the dimension is according to the drawing.

3.8.8 Shearing



Figure 3.18: Shearing Process

From Figure 3.18, I used the shearing machine to cut the sheet metal from a large piece of sheet to a smaller size according to dimensions. I have to plan the work to avoid from any waste of the sheet metal. The machine can run automatically by inserting the value of x-axis length of the sheet metal that needs to cut. I used this machine to cut all the sheet metal used to make the tray part and base part of the product.

3.8.9 Trimming

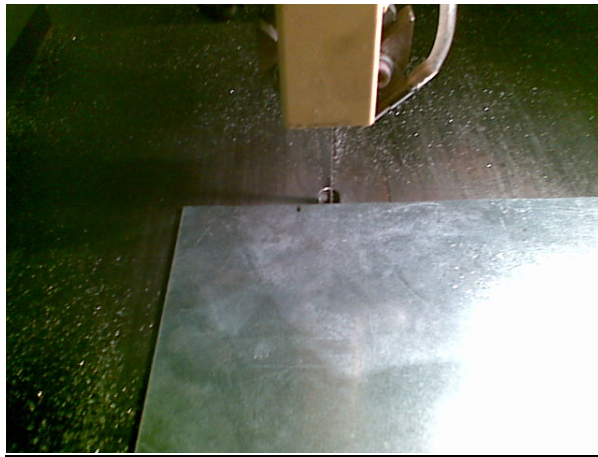


Figure 3.19 (a): Trimming Sheet Metal



Figure 3.19 (b): After Trimming Sheet Metal

From Figure 3.19 (a) and Figure 3.19 (b), to make the tray part, I used the bending machine. Before I proceed to the bending process, I will have to do another step that is the trimming process by using vertical saw machine. I have to make a proper shape in trimming process of sheet metal before I can bend it to make tray.

3.8.10 Bending

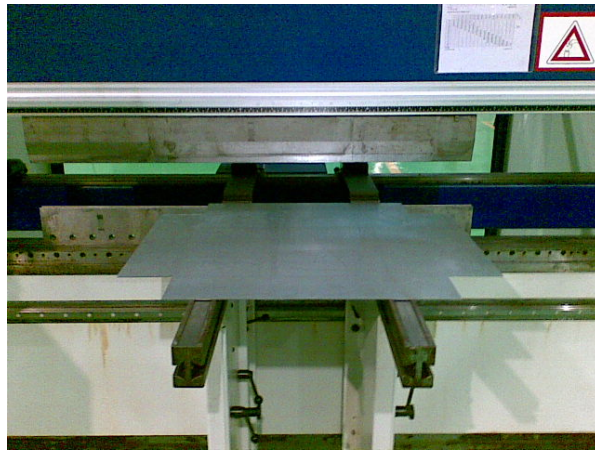


Figure 3.20: Bending Process

From Figure 3.20, I also have to plan the work of bending process so that the process can be done and the result is just like what I expected. Otherwise, I will have to start the making trays process all over again and also to avoid waste of raw materials. The machine runs automatically. I just need to insert few values needed by the computer and run the machine. Small defects can be fixed by putting the correct value back to the machine and rerun the process. The machine type I used is TRUMPF TruBend Series model. Besides making tray part, this machine is capable of bending sheet metal at any desired radius.

3.8.11 Laser Cutting

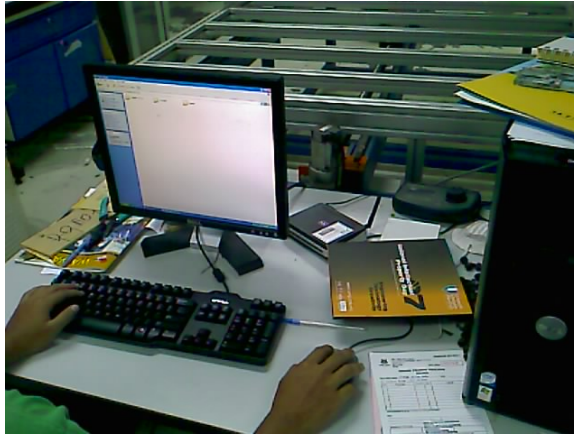


Figure 3.21: Laser Cutting Process

From Figure 3.21, to make the top-cover of the product, I used the acrylic material. First I have to draw a design by using the Solidworks software and transfer it to pcnc.ese software before I can start with the laser cutting process. The process does not take too much time. The result of the cutting process is accurate enough. Before the cutting process begins, I have to set the correct amount of voltage manually by using try and error method use to cut the acrylic. With the wrong amount of voltage used, if the machine uses too low voltage, the machine would not be able to cut the material and if the machine uses too high voltage, the result of cutting acrylic would be worse with burning mark to the material.

3.8.12 Attach Handle, Locking device and Hinge

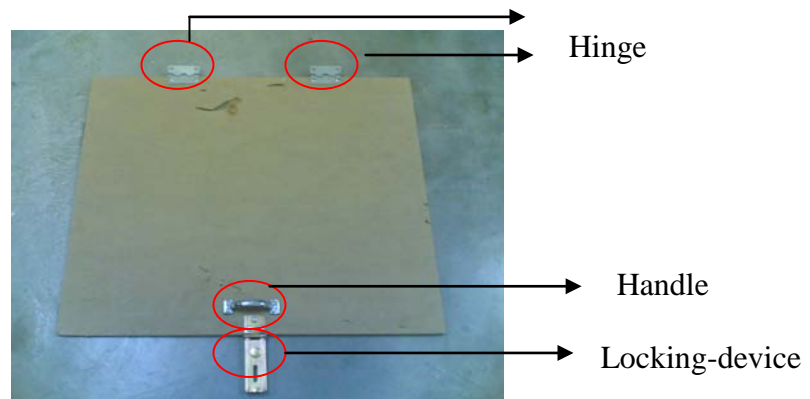


Figure 3.22: Attaching Equipments

From Figure 3.22, after the cutting process of acrylic is finished, I then attached the equipments needed to the part such as locking device, handle and also hinge to the acrylic. I have to attach the equipments stated first before I install the part to the tray to make the fabrication process easier. The attaching equipments process consists of drilling and riveting process. The size of drilled hole for rivet is 5mm diameter. The size of rivet should be strong enough to attach the handle, locking device and hinge.

3.8.13 Finishing



Figure 3.23: Finishing Process

From Figure 3.23, after the trays, base part and top-cover are all assembled by using welding method, I do the finishing process. The process consists of grinding the welded part, use sand paper and wipe some turpentine to clean the product before I can proceed to the painting process. The color of the product is black. I chose black color because it makes the cabinet look tidy and easy to clean.

CHAPTER 4

RESULT AND DISCUSSION

4.1 INTRODUCTION

After fabrication process is finished, the results are specifically focused on the quality of my product. It includes the design of the product, characteristics of the product, any defects and problems happened in this project. These results concentrate on how to get the product market in the future. Based on these results I can also say that there are still a lot of works need to be improved. There are also should be more comparisons between the existing products with the product made from this project. It is to identify the weaknesses and advantages of the product.

4.2 RESULT



Figure 4.1: Front View of Cabinet



Figure 4.2: Side View of Cabinet

At the top of the cabinet, there is a partitioned compartment. To be more safety, I attached a plat of transparent plastic cover on top of the compartment with a locking device on it.

At the middle part of the cabinet, there is one partitioned tray. It has two partitions on each tray. It helps to keep the tools organized. From the front view of this part, we can see that it is exposed to help people to reach the tools. To help consumer easy to choose which tool to use, I'll paste a card holder at the front side and label the tools specification needed according to its position or coordinate.

The bottom part of the cabinet consists of two drawers. The upper drawer has two partitioned plat. It helps to separate tools according to size, usage and function of the tools. The lower drawer does not have partitioned plat because larger tools will need a larger space.

To make the cabinet to be portable or moveable, wheels/tires are welded. The set of wheels came with tire locking device which helps to make the cabinet static at any desired position. To make the cabinet more suitable and user-friendly based on safety factors, a transparent plastic plat is attached at the both sides right and left side of the cabinet and at the back side of the cabinet.

The cabinet also has a few safety equipments and also safety factors are applied to it which means locking device are attached to it, less sharp edges to prevent cuts, lock-able tires/wheels set. A mat or plastic carpets are laid at all trays which it helps to organize the tools somehow. It makes the product look neat and tidy besides of preventing oil clogging.

4.3 PRODUCT DESIGN SPECIFICATION

| Category | Result |
|----------|------------|
| Weight | 45kg |
| Color | Flat black |
| Width | 550mm |
| Height | 1050mm |
| Length | 400mm |

Table 4.1: Product Design Specification

4.4 DISCUSSION

4.4.1 Types of Defects

While finishing the process of fabrication, there are several defects occurred on my product. This is happened because of mostly lack of skills in doing some mechanical jobs. Besides, the condition of the equipments/tools used can also cause those defects to my product. Sample pictures are show:

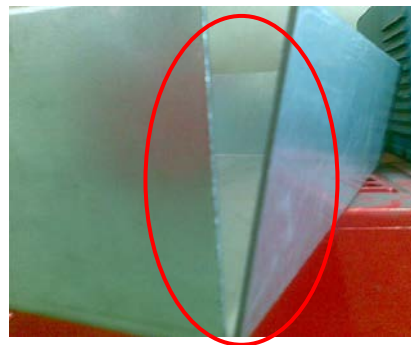


Figure 4.3: Trays Are Not Stick Well

From Figure 4.3, after the tray is finished with the bending process, this kind of the defect occurred to my product. The defect is there is a gap between two sides of the tray. They are not stick or closed enough to each part. This happened probably because of inserting wrong value to the bending machine.



Figure 4.4: Gap

From Figure 4.4, the defect of this part is there is a small gap between two hollow bars. This part is from the frame part of the product. The defect is caused by making mistakes in the measuring, marking and cutting process.

4.4.2 Correcting Defects

In order to get the best results for the product, I will have to repair those defect. In the correcting process, some mechanical methods were used such as grinding and welding. These are some pictures taken for the repairing defects:



Figure 4.5: Grinding Process

From Figure 4.5, grinding process is made after the cutting process. After the cutting process is done, there will always an error in the material such as the surface is not smooth enough; the length is not according to dimension.

So in the way of correcting those defects, I used hand grinder to grind the surface. In the finishing process also I used the grinder to grind the welding defects. The process is to smoothen and proper the welded part.



Figure 4.6: Manually Bending Process

From Figure 4.6, the trays were manually bended by clamping one side of the tray part and smack certain part with a hammer. The result of the process is the side part of the tray will get closer. The gap between two sides of tray will be reduced. This correcting process is done to every part of trays.

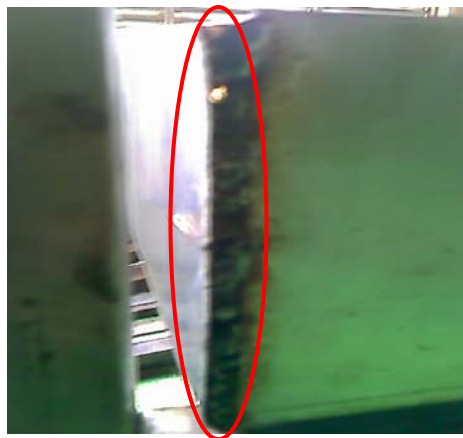


Figure 4.7: Weld Gap Part of Tray

From Figure 4.7, after all trays have been manually bended, the gap between two sides of the tray is reduced. The next step in the correcting process is to weld between the two sides of the tray.

This will help to close the gap and to make the sides of the tray stick to each other. This process is done to every part of the tray to ensure the size of the trays is within specifications.



Figure 4.8: Welded Part of Trays

Figure 4.8, shows the inside part of a tray after the two sides of trays have been welded in the correcting defect process. The process uses MIG welding type and the voltage used cannot be too high to avoid from making any damage to the product.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

For the final chapter it represent about conclusion and recommendation regarding the project. The important thing is that in this chapter is mainly about the problems I have encountered during the whole project was been carried out. The problems are including the process planning that I had done. The problems also make the students to think out of the box that makes us to be more creative in terms of solving problems and planning decision. In this chapter also will discuss about the conclusion of the project concluding all the process that involved. Besides that, this chapter also contains recommendation about the project. So far these recommendations could help to improve anything regarding the project.

5.2 CONCLUSION

As the conclusion, the objective of the project was achieved. The cabinet has better space for better arrangement of turret punch tool. This is because the dimension of the cabinet is 500 x 400 x 1050 mm. So it has very suitable space to storage the tools. Besides that this cabinet has trays and partitioned compartment that have been designed to storage the tools specifically. So the messy situation when storage the tool can be solves. This cabinet also provide better ergonomic factor for the comfortable situation when using it. It also was introduced new concept of the table that suitable with costumer specification.

5.3 RECOMMENDATION

For my recommendation, I would like to upgrade the product in terms of the quality and features. To obtain a better result, I would like to add some more extra features to the product such as more quality of locking device, do some more extra finishing work to get a perfect result.

I would also like to add sheet metal to cover the product and left only the front side exposed. I would also like to recommend that the cabinet should have more advanced features.

In this project, I have made a few modifications. Those modifications were made mainly to improve the quality of the product. Also after I did some study and research about the product, there are several parts need to be modified.

First modification is the frame of the product. The previous design is not strong enough to hold the trays on it. So I made some adjustment by adding materials and parts to the frame to make it much stronger.

Second modification is the trays. From the previous design, I will have to make one tray to be on top, two trays in the middle. After I calculated the number of tools to be stored, the cabinet only need to partitioned trays which will be located on top and middle part of the cabinet.

Third modification is about the drawer. The inner part is still the same just like I planned, but the outer part which is the casing part is a little bit different from the previous design. This happened because of malfunction of machine. The outer part was supposed to cover the whole part of the inner, but now only to support the inner part. But still use the drawer concept.

Forth modification is the base of the product. I add a thick plat on the very bottom of the product, attached wheels on it and assembled it to the main part. This will make the product much stronger and more stable.

Fifth modification is I drilled the hollow bar to make holes and attached L-shape plat to the bars to make the drawers and trays aligned and level.

REFERENCES

1. <http://dictionary.reference.com/browse/cabinet>
The American Heritage® Dictionary of the English Language, Fourth Edition - Cite This Source
Copyright © 2006 by Houghton Mifflin Company.
Published by Houghton Mifflin Company. All rights reserved.
2. <http://www.amtonline.com/publication/article.jsp?pubId=1&id=2008>
3. <http://www.keepingthecastle.com/forbes-affordable-luxuries-for-spring-cleaning>
4. <http://www.hdtools.co.uk/cart/index.php?act=viewProd&productId=1>
5. <http://www.homeorganizershops.com/STDS22.html>
6. www.us.trumpf.com/31.punchingmachines_1.html
7. http://www.wilsonstool.com/punching/punch_trumpf.html

LIST OF TABLES

| TABLE NO. | TITLE | PAGE |
|------------------|------------------------------|-------------|
| 1.1 | Gantt Chart | 8 |
| 3.1 | Pugh Concept | 29 |
| 3.2 | Conclusion Concept | 30 |
| 4.1 | Product Design Specification | 50 |

LIST OF FIGURES

| FIGURE NO. | TITLE | PAGE |
|-------------------|------------------------------------|-------------|
| 1.1 | Current cabinet | 2 |
| 1.2 (a) | Tools inside tray | 2 |
| 1.2 (b) | Tools inside drawer | 3 |
| 1.3 | Small tools inside drawer | 3 |
| 2.1 | Turret Punch Machine overview | 11 |
| 2.2 | Shapes of punching tool | 12 |
| 2.3 | Main tools of Turret Punch Machine | 13 |
| 2.4 | Accessories of turret punch tool | 13 |
| 2.5 | Existing cabinet 1 | 15 |
| 2.6 | Existing cabinet 2 | 16 |
| 2.7 | Existing cabinet 3 | 17 |
| 2.8 | Existing cabinet 4 | 18 |
| 3.1 | Flow chart project | 20 |
| 3.2 | Concept 1 | 26 |
| 3.3 | Concept 2 | 27 |
| 3.4 | Concept 3 | 28 |
| 3.5 | Final idea; assembly part | 31 |
| 3.6 | Frame | 32 |
| 3.7 | Partitioned compartment | 33 |
| 3.8 | Tray | 33 |
| 3.9 | Drawer | 34 |
| 3.10 | Measuring and marking | 36 |
| 3.11 | Cutting process | 37 |
| 3.12 | Drilling process | 37 |
| 3.13 | Riveting process | 38 |
| 3.14 | Arc welding process 1 | 38 |
| 3.15 | Arc welding process 2 | 39 |

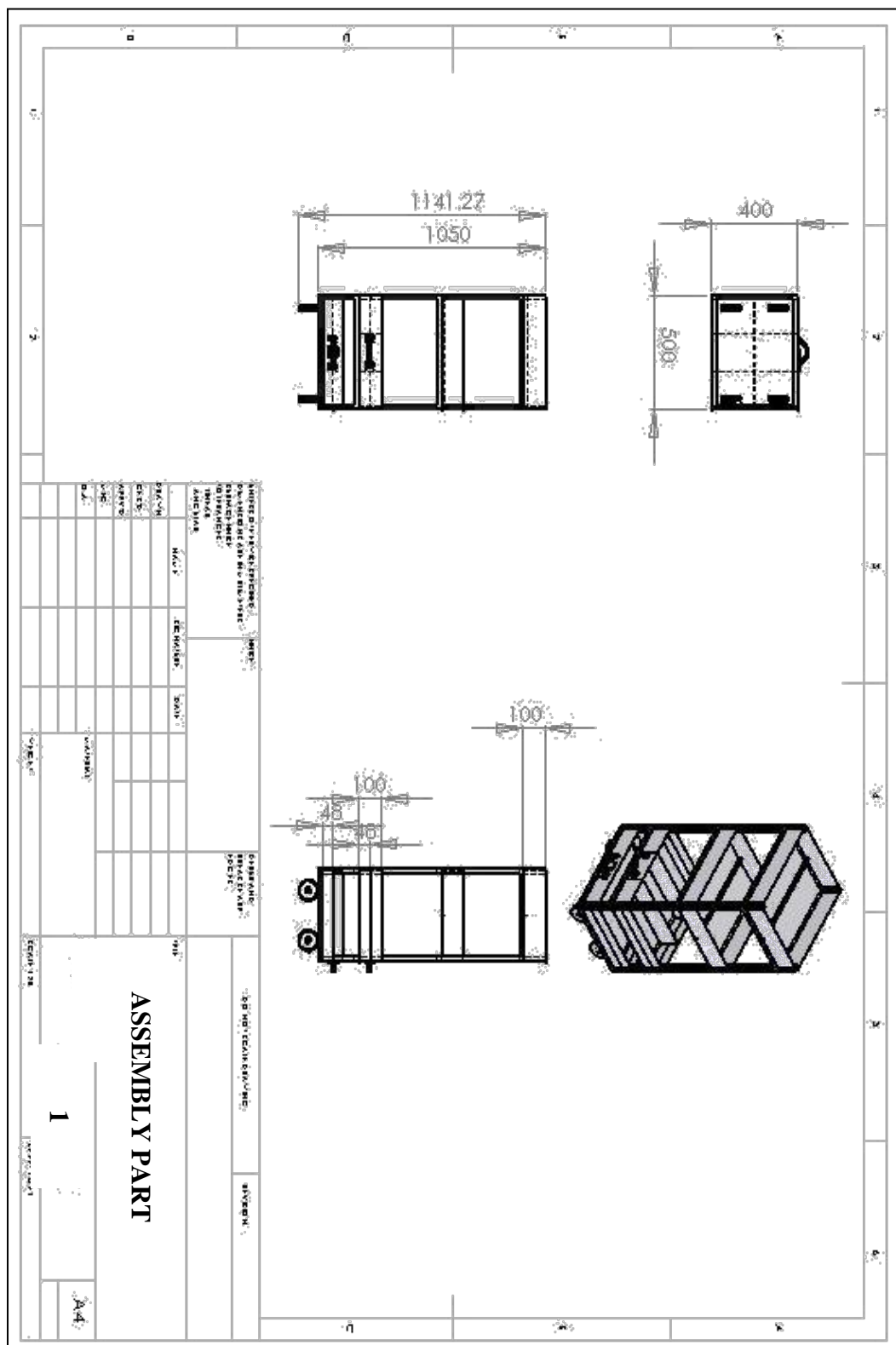
| | | |
|----------|-----------------------------|----|
| 3.16 | Generating TOP300 software | 39 |
| 3.17 | Marking sheet metal | 40 |
| 3.18 | Shearing process | 40 |
| 3.19 (a) | Trimming sheet metal | 41 |
| 3.19 (b) | After trimming sheet metal | 41 |
| 3.20 | Bending process | 42 |
| 3.21 | Laser cutting process | 43 |
| 3.22 | Attaching equipments | 44 |
| 3.23 | Finishing process | 45 |
| 4.1 | Front view of cabinet | 48 |
| 4.2 | Side view of cabinet | 48 |
| 4.3 | Trays are not sticking well | 50 |
| 4.4 | Gap | 51 |
| 4.5 | Grinding process | 51 |
| 4.6 | Manually bending process | 52 |
| 4.7 | Weld gap part of tray | 52 |
| 4.8 | Welded part of tray | 53 |

LIST OF APPENDICES

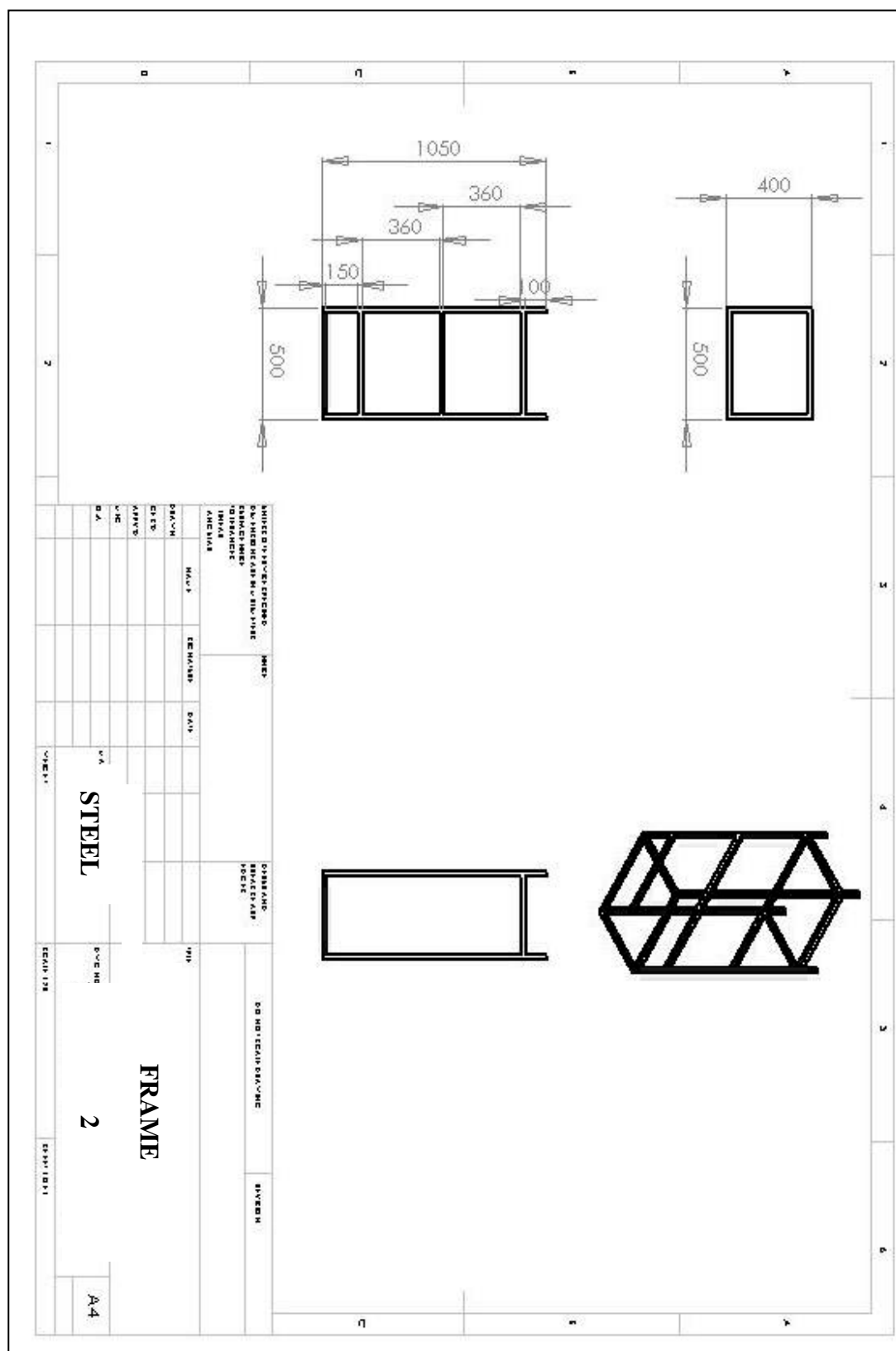
| APPENDIX | TITLE | PAGE |
|-----------------|----------------------|-------------|
| A | Detail drawing | 60 |
| B | Tools and equipments | 65 |

APPENDIX A

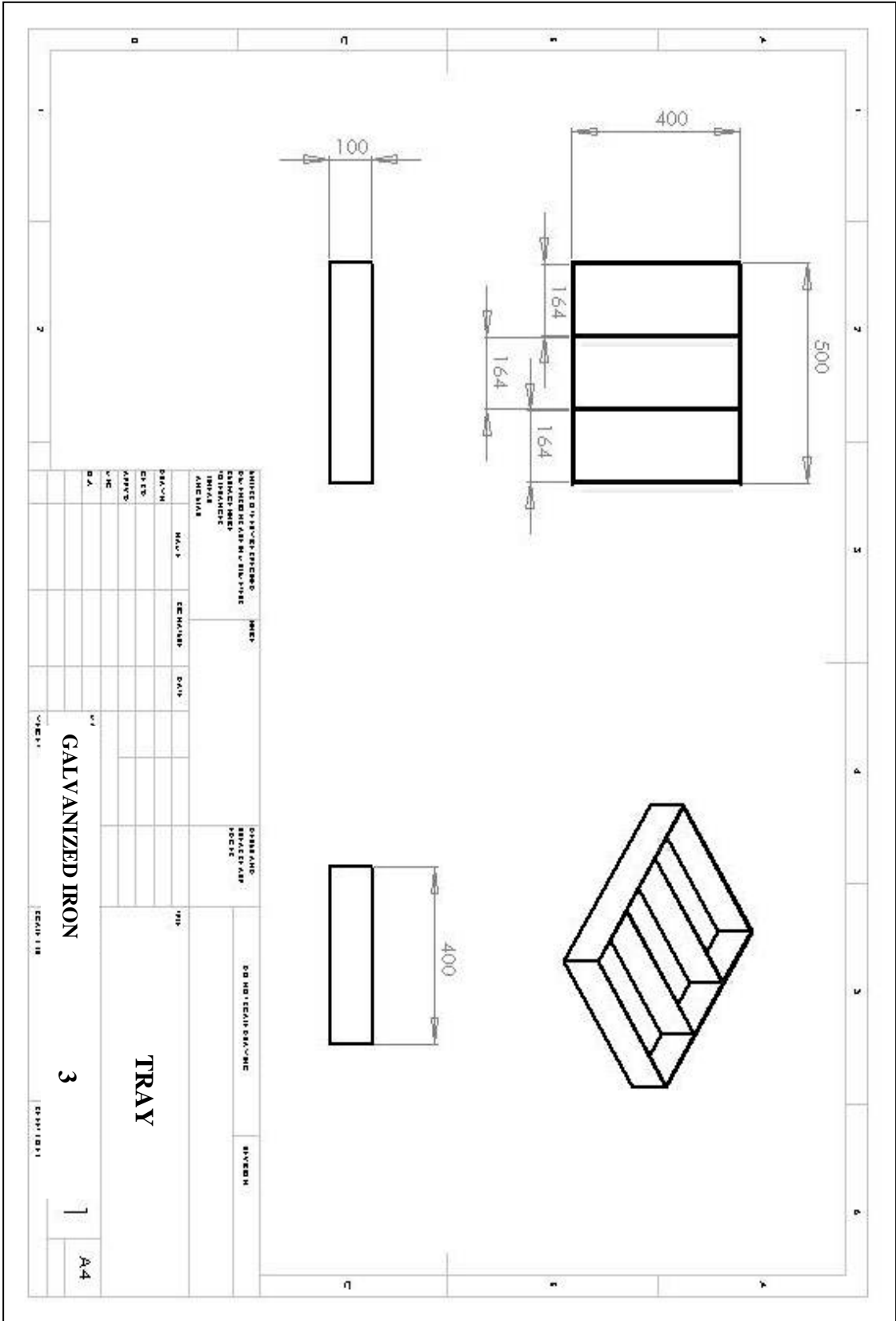
DETAIL DRAWING



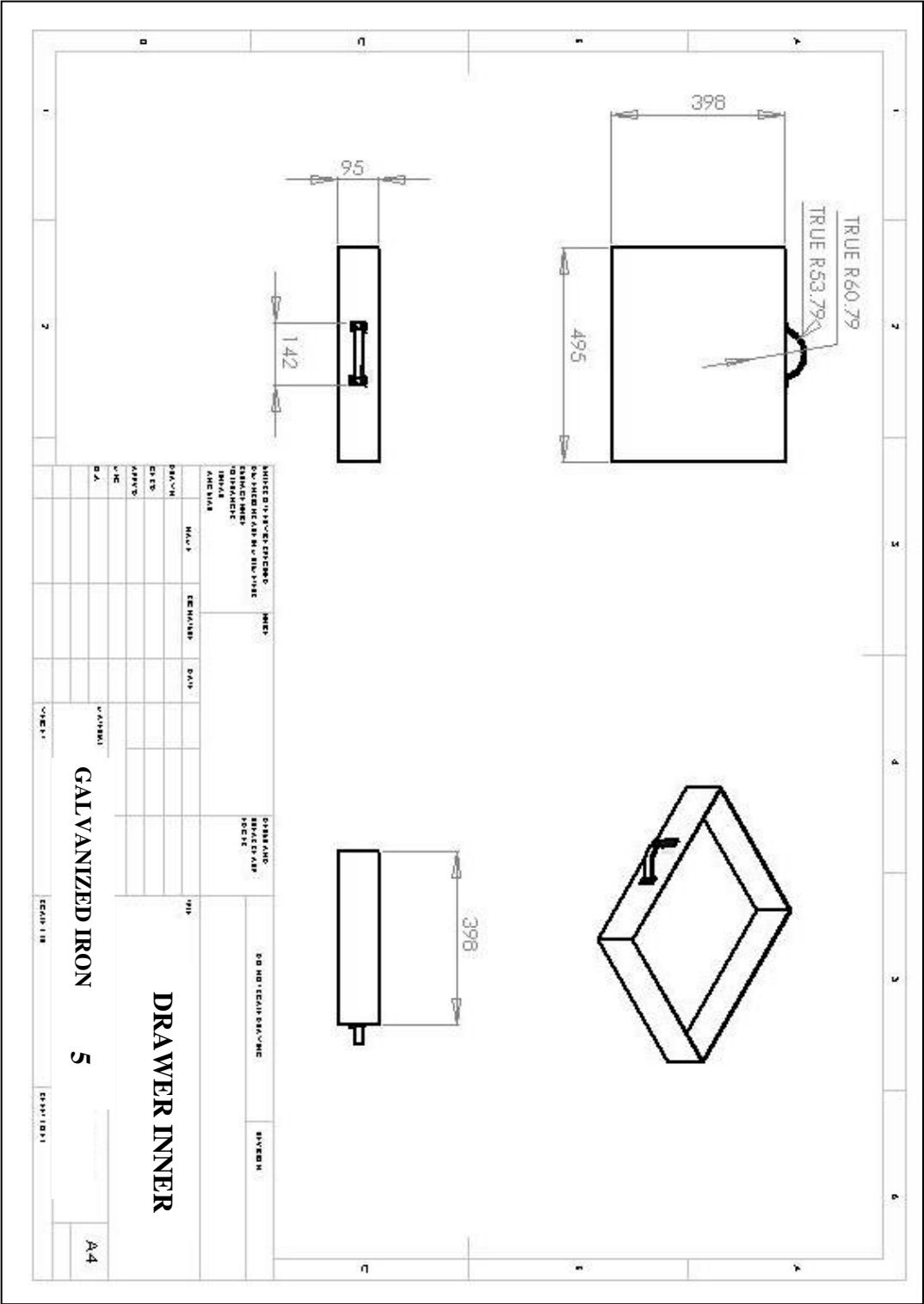
ASSEMBLY PART



FRAME



TRAY



DRAWER INNER PART

APPENDIX B

TOOLS AND EQUIPMENTS



BENDING MACHINE



SHEARING MACHINE



TURRET PUNCH MACHINE



LASER CUTTING MACHINE



VERTICAL SAW



DISC CUTTER



HAND GRINDER



ARC WELDING



MIG WELDING