DESIGN AND FABRICATION MULTIPURPOSE RACK STRUCTURE

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BORANG PENGESAHAN STATUS TESIS

JUDUL **<u>DESIGN AND FABRICATION MULTIPURPOSE RACK STRUCTURE</u>**

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DESIGN AND FABRICATION MULTIPURPOSE RACK STRUCTURE

MOHD NOOR HAFIZ BIN AHMAD

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

Faculty of Mechanical Engineering
University Malaysia Pahang

NOVEMBER 2009

SUPERVISOR DECLARATION

I hereby declare that I had read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the purpose of the granting of Bachelor of Mechanical Engineering.

Signature : ……………………………………

Name of Supervisor : Mohd Azrul Hisham Bin Mohd Adib

Date : 20 November 2009

AUTHOR DECLARATION

I declare that this thesis entitled "*Design and fabrication multipurpose rack structure*" is the result of my own research except as cited in references. The thesis has not been accepted for any diploma and is not concurrently submitted in candidature of any other diploma.

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DEDICATION

To my beloved mother and father

Tuan Haji Ahmad Bin Hassan

Pn. Hajjah Zuyah Binti Mat Bazin

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ABSTRACT

The use of rack was already about a long time ago which made it has a own history. The multipurpose rack structure had a objective to be design and fabrication the multipurpose rack structure with mechanical skill. Furthermore this rack has own rule specifications of safety to prevent like the other rack in market are higher risk to consumer which has a sharp edge. Made with major material is wood and combine of zinc and magnet. Portable which is others name can be bring anywhere because has ideal weight and comfortable holder. Beside a maximum load can put in content is a 5 kg. Anew design to rack has a magazine rack and clock structure. It also has a high stability because of the design very good to multipurpose rack structure. A little drawer which can put some small thing to prevent from broke. A few recommendations and work progress had be written in this report.

ABSTRAK

Penggunaan rak yang telah sekian lama membuatkan tempat penyimpanan barang ini mempuyai sejarah tersendiri. Rak pelbagai guna dan mudah alih ini di letakan objektif nya untuk direka dan dibuat secara skill yang berkaitan dengan mekanikal. Namun begitu,rak pelbagai guna dan mudah alih ini telah ditetapkan keselamatan tersendiri dimana kebanyakkan rak di pasaran tidak mempunyai ciri-ciri keselamatan. Kebanyakannya rak yang berada di pasaran mempunyai bucu-bucu tajam melibatkan risiko yang tinggi kepada pengguna. Seterusnya struktur nya yang telah direka daripada pengunaan major adalah kayu digabungkan dengan bahan minor seperti zink dan magnet. Mudah alih dengan kata lain boleh dibawa kemana-mana akibat daripada berat yang ideal dan pemegang yang bersesuaian dengan manusia. Tambahan pula berat maksimum bagi barang yang boleh diletakkan di dalam nya adalah sebanyak 5 kilogram. Satu pembaharuan iaitu sebuah rak beserta struktur jam dan juga majalah kecil. Ia juga mempunyai tahap kesetabilan yang tinggi dimana rak telah direka dengan bentuk yang sangat stabil dan menampung beban. Laci kecil yang bersesuain telah diletakkan didalam struktur rak . Laci yang boleh memuatkan beberapa jenis barang kecil sesuai bagi menyimpan barang yang mudah rosak.Beberapa perkara pembaharuan and process cara kerja telah dimuatkan didalam laporan ini.

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LIST OF SYMBOLS

N	Newton's
Kg	Kilogram
Cm	centimeter
M	Meter
F	Force
δ	Deflection
l	Length
t	Thickness
t_e	Edge thickness
t_f	Face thickness
W	Energy
RM	Ringgit Malaysia
Ms	Margins

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CHAPTER 1

INTRODUCTION

1.1 Background

The project involves designing and fabricating a multipurpose rack structure. As the Diploma final year project allocates the duration of 1 semester, this large man-hour project therefore requires significant efforts of the students to participate. Basically the can opener could be divided into three stages, which are concept safety, designing and fabrication.

The multipurpose rack structure is equipped by using material which include, rectangular plate steel, wood and zinc in manufacturing process by perform drive to join the parts and etc. The advantages of the proposed multipurpose rack structure to be developed can be seen to be decorating a house.

The process of development is initiated from designing the shape of the product by considering the function as well. In order to produce more safety product that is suitable to the consumer, consideration to the ergonomic factor is taken into account. It involves the measurement process before the materials are cut into pieces before joined together.

1.2 Problem Statement

The problem statements of this project are:

(a) Material Factors – To produce a good product must select a good material.

(b) Safety - Some of the rack have a sharp edge which not be covered.

(c) Human factors - People needs comfortable holder to hold.

(d) Design factors - Selection of sliding part and magnet terminal.

1.3 Objective

To design and fabricate the multipurpose rack structure with mechanical skills.

1.4 Scope

The scopes of this project are:

(i) Design the multipurpose and portable rack

(ii) Magazine only fit o the small magazine.

(iii) Rack like furniture which can place anyplace.

(iv) Max rack load only 5 kg.

(v) Can put anywhere of house area.

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

A multipurpose rack structure designed for carrying things. It is larger than salver, a diminutive version commonly used for lighter and smaller serving, and it can be fashioned from numerous, including silver, brass, wood and melamine. Some examples have galleries, handles and magnet.

This project was given ‘Design and fabrication multipurpose rack structure’. This project involve designing and fabricating an assignment rack that entirely different from existing assignment rack in market. Basically, this project will have 4 stages:

(i) Article review, researching and gathering information.

(ii) Design , sketching by hand , and draw using computer software

(iii) Produce the selected product, using machining process

(iv) Writing the project report

2.1 Type of Rack

2.1.1 Magazine rack

Figure 2.1 : Small Magazine Rack

Also suitable for storing caps, scarves and other small items. This product requires assembly environment renewable material (cotton).[1]

2.1.1.1 The care instructions

Can wash on Machine washing, warm 104 F(40°C). Precaution do not bleach and do not tumble dry. It also can iron, low temperature with do not dry-clean

2.1.1.2 Product description & measurements

(i) Length: 39 cm
Width: 34 cm
Height: 38 cm

2.1.2 GORM

FIGURE 2.2: Wood structure rack

Source: IKEA

This product requires assembly environment shelf/corner shelf/bottle rack/post: renewable material (wood).Can be used with GORM end cap to prevent moisture penetration into the cross-cut wood.[1]

2.1.2.1 Care instructions Metal

(i) Wipe clean with a damp cloth. Use only water or a non-abrasive detergent and wipe dry with a clean cloth.

2.1.2.2 Product description & measurements

(i) Post/ shelf/ corner shelf/ bottle rack: solid pine or spurce
(ii) Cross-brace: steel , Galvanized
(iii) Depth: 35 cm
(iv) Height: 110 cm
(v) Width left: 144 cm
(vi) Width right: 144 cm

2.1.3 GRUNDTAL

FIGURE 2.3: Grundesert

Source: IKEA

The Key features is saves space on the countertop can be hung on GRUNDTAL rail or directly on the wall and an be used in high humidity areas. This product requires assembly. The material in this product may be recyclable. Please check the recycling rules in your community and if recycling facilities exist in your area different wall materials require different types of fasteners. Use fasteners suitable for the walls in your home (not included).Combines with other accessories in the GRUNDTAL series.[1]

2.1.3.1 Product description & measurements

(i) Main parts: Stainless steel, Stainless steel

(ii) Hook: Stainless steel

(iii) Width: 30 cm

(iv) Depth: 18 cm

(v) Height: 22 cm

2.2.1 WOODS

Wood is an organic material produced as secondary xylem in the stems of woody plants, notably trees and other woody plants. In a living tree it conducts water and nutrients to the leaves and other growing tissues, and has a support function, enabling plants to reach large sizes. Wood may also refer to other plant materials and tissues with comparable properties, and to material engineered from wood, or wood chips or fiber.[5]

People have used wood for millennia for many purposes, primarily as a fuel or as a construction material for making houses, tools, weapons, furniture, packaging, artworks, and paper. Wood can be dated by carbon dating and in some species by dendrochronology to make inferences about when a wooden object was created. The year-to-year variation in tree-ring widths and isotopic abundances gives clues to the prevailing climate at that time.

2.2.2 STAINLESS STELL

In metallurgy, stainless steel is defined as a steel alloy with a minimum of 10% chromium content by mass. Stainless steel does not stain, corrode, or rust as easily as ordinary steel but it is not stain-proof. It is also called corrosion-resistant steel or CRES when the alloy type and grade are not detailed, particularly in the aviation industry. There are different grades and surface finishes of stainless steel to suit the environment to which the material will be subjected in its lifetime. Common uses of stainless steel are cutlery and watch straps.[2]

Stainless steel differs from carbon steel by amount of chromium present. Carbon steel rusts when exposed to air and moisture. This iron oxide film is active and accelerates corrosion by forming more iron oxide. Stainless steels have sufficient amount of chromium present so that a passive film of chromium oxide forms which prevents further surface corrosion and blocks corrosion spreading in the metal's internal structure.

2.2.3 Plastic

Plastic is the general common term for a wide range of synthetic or semi synthetic organic amorphous solid materials suitable for the manufacture of industrial products. Plastics are typically polymers of high molecular weight, and may contain other substances to improve performance and/or reduce costs.[2]

The word derives from the Greek (*plastics*), "fit for molding", from *πλαστός* (*plasters*) "molded”. It refers to their malleability or plasticity during manufacture that allows them to be cast, pressed, or extruded into an enormous variety of shapes — such as films, fibers, plates, tubes, bottles, boxes, and much more.

The common word "plastic" should not be confused with the technical adjective "plastic", which is applied to any material which undergoes a permanent change of shape (a "plastic deformation") when strained beyond a certain point. Aluminum, for instance, is "plastic" in this sense, but not "a plastic" in the common sense; while some plastics, in their finished forms, will break before deforming and therefore are not "plastic" in the technical sense.

There are two types of plastics, thermoplastic and thermoses. Thermoplastics, if exposed to heat, will melt in two to seven minutes. Thermoses will keep their shape until they are a charred, smoking mess. Some examples of thermoplastics are grocery bags, piano keys and some automobile parts. Examples of thermoses are kid's dinner sets and circuit boards.

2.3 Type of watch

2.3.1 Analog

FIGURE 2.4: Analog Watch
Source **:** IKEA

Traditionally, watches have displayed the time in analog form, with a numbered dial upon which are mounted at least a rotating hour hand and a longer, rotating minute hand. Many watches also incorporate a third hand that shows the current second of the current minute. Watches powered by quartz usually a have second hand that snaps every second to the next marker. Watches powered by a mechanical movement have a "sweep second hand", the name deriving from its uninterrupted smooth (sweeping) movement across the markers, although this is actually a misnomer; the hand merely moves in smaller steps, typically 1/5th of a second, corresponding to the beat (half period) of the balance wheel. In some escapements (for example the *duplex* escapement), the hand advances every two beats (full period) of the balance wheel, typically 1/2 second in those watches, or even every four beats (two periods, 1 second), in the *double duplex* escapement. All of the hands are normally mechanical, physically rotating on the dial, although a few watches have been produced with “hands” that are simulated by a liquid-crystal display.[3]

Analog display of the time is nearly universal in watches sold as jewelry or collectibles, and in these watches, the range of different styles of hands, numbers, and other aspects of the analogue dial is very broad. In watches sold for timekeeping, analog display remains very popular, as many people find it easier to read than digital display; but in timekeeping watches the emphasis is on clarity and accurate reading of the time under all conditions (clearly marked digits, easily visible hands, large watch faces, etc.). They are specifically designed for the left wrist with the stem (the knob used for changing the time) on the right side of the watch; this makes it easy to change the time without removing the watch from the hand. This is the case if one is right-handed and the watch is worn on the left wrist (as is traditionally done). If one is left-handed and wears the watch on the right wrist, one has to remove the watch from the wrist to reset the time or to wind the watch.

2.1.3 Digital

FIGURE 2.5: Digital watch

Source: Timex

Since the advent of electronic watches that incorporate small computers, digital displays have also been available. A digital display simply shows the time as a number, *e.g., 12:08* instead of a short hand pointing towards the number 12 and a long hand 8/60 of the way round the dial. The digital display watch was the newest way to tell time in 500 years.[3]

The first digital watch, a Pulsar LED prototype in 1970, was developed jointly by Hamilton Watch Company and Electro-Data. John Berger, the head of Hamilton's Pulsar division, said that he was inspired to make a digital timepiece by the then-futuristic digital clock that Hamilton themselves made for the 1968 science fiction film *2001: A Space Odyssey*. On April 4, 1972, the Pulsar was finally ready, made in 18-carat gold and sold for $2,100. It had a red light-emitting diode (LED) display.

Digital LED watches were very expensive and out of reach to the common consumer until 1975, when Texas Instruments started to mass produce LED watches inside a plastic case. These watches, which first retailed for only $20, reduced to $10 in 1976, saw Pulsar lose $6 million and the Pulsar brand sold to Seiko.

Most watches with LED displays required that the user press a button to see the time displayed for a few seconds, because LEDs used so much power that they could not be kept operating continuously. Usually the LED display color would be red. Watches with LED displays were popular for a few years, but soon the LED displays were superseded by liquid crystal displays (LCDs), which used less battery power and were much more convenient in use, with the display always visible and no need to push a button before seeing the time. The first LCD watch with a six-digit LCD was the 1973 Seiko 06LC, although various forms of early LCD watches with a four-digit display were marketed as early as 1972 including the 1972 Green Teletype LCD Watch, and the Cox Electronic Systems Quartz.

2.4 Magnet

A magnet is a material or object that produces a magnetic field. This magnetic field is invisible but is responsible for the most notable property of a magnet: a force that pulls on other ferromagnetic materials and attracts or repels other magnets.

A permanent magnet is one made from a material that stays magnetized. An example is a magnet used to hold notes on a refrigerator door. Materials that can be magnetized, which are also the ones that are strongly attracted to a magnet, are called ferromagnetic (or ferromagnetic). These include iron, nickel, cobalt, some rare earth metals and some of their alloys (e.g. Alnico), and some naturally occurring minerals such as lodestone.

Although ferromagnetic (and ferromagnetic) materials are the only ones with an attraction strong enough to a magnet to be commonly considered "magnetic", all other substances respond weakly to a magnetic field, by one of several other types of magnetism.

An electromagnet is made from a coil of wire which acts as a magnet when an electric current passes through it, but stops being a magnet when the current stops. Often an electromagnet is wrapped around a core of ferromagnetic material like steel, which enhances the magnetic field produced by the coil. The overall strength of a magnet is measured by its magnetic moment, while the local strength of the magnetism in a material is measured by its magnetization.

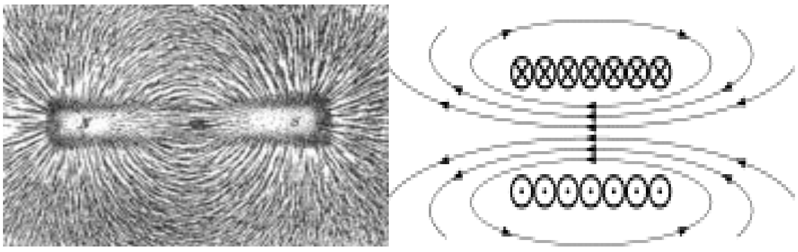


FIGURE 2.6: Magnet Pole

CHAPTER 3

METHODOLOGY

3.1 Introduction

Project methodology is a body of practices, procedures and rules used by those who work in a discipline or engage in an inquiry and a set of working methods. In this chapter, I will explain about the process that involved during the fabrication process. I also will explain about the design and analysis that had been chosen to be as the final idea to be producing or fabricate. All the fabrication process in this project is going to be explained in details.

3.1.1 Project Methodology

(i) Identify the problem statement and find the solution.
(ii) Concept design.
(iii) Finalize concept and evaluation.
(iv) Material selection.
(v) Fabrication process.
(vi) Testing and improvement process.
(vii) Finishing.

3.2 Project Flow Chart

In fabrication of the multipurpose rack structure, there is a planning of the overall progress to assure the project can be finish on a schedule (Refer to Appendix C)

From the flow chart in figure 3.1 above , 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 the multipurpose rack structure and machining process involved. This is including a review of types of materials, strength of material, way to produce and machining process. These tasks have been done through research on the internet, books and others 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 be chosen. The design have been chosen by the Pugh's selection method. The selected sketch is the transferred to solid modeling and engineering drawing by using 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 material to produce a product. 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.

Now the fabricate stage. This process consists fabricate all the parts that have design before by following all the dimension using various type or manufacturing process. During the fabrication process, if there is something wrong occur , such as not balance dimension so the process will be stop and go back to previous step, make a modification against.

After all the fabrication 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 slide slide presentation has be present.

3.3 Design

The Design of the multipurpose rack structure 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 aspects that must be considered in designing the can opener are:

(i) **Strength**: Must have certain strength to ensure in designing the rack and it will show the toughness and durability of the design.

(ii) **Suit to environment**: The multipurpose rack structure must be suitable to be use in house area.

(iii) **Durability**: The multipurpose rack structure can be use in several years.

3.3.1 Concept selection Method

The concept method must be consider with 2 method:

(i) Concept generation.

(ii) Concept screening.

3.3.2 Concept generation

Concept generation is a concept that we can make to design our product. It include about the part-part we need to do. This is a concept generation four my product:

3.3.2.1 Concept 1

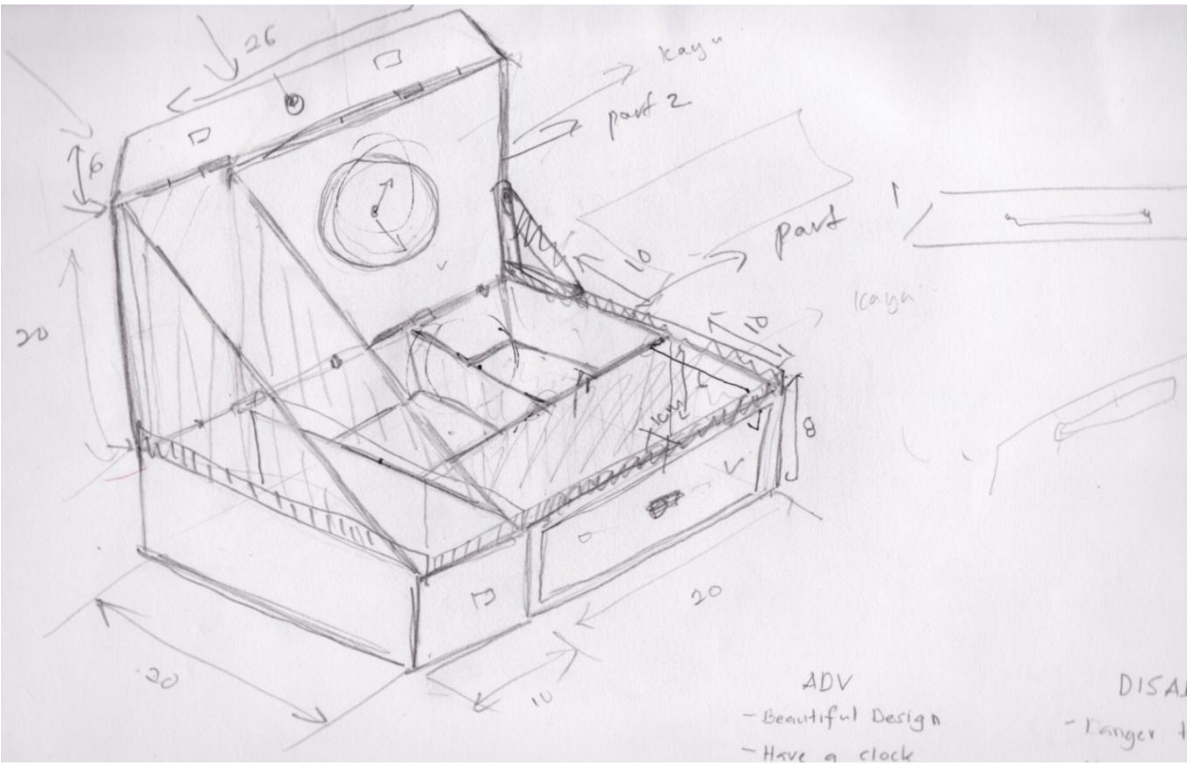


Figure 3.2: Structure wood

The concept 1 made with wood structure with have addition drawer and clock. The advantages the concept 1 is a has magazine structure, many space, portable and many function. But the disadvantages is have sharp edge and battery.

3.3.2.2 Concept 2

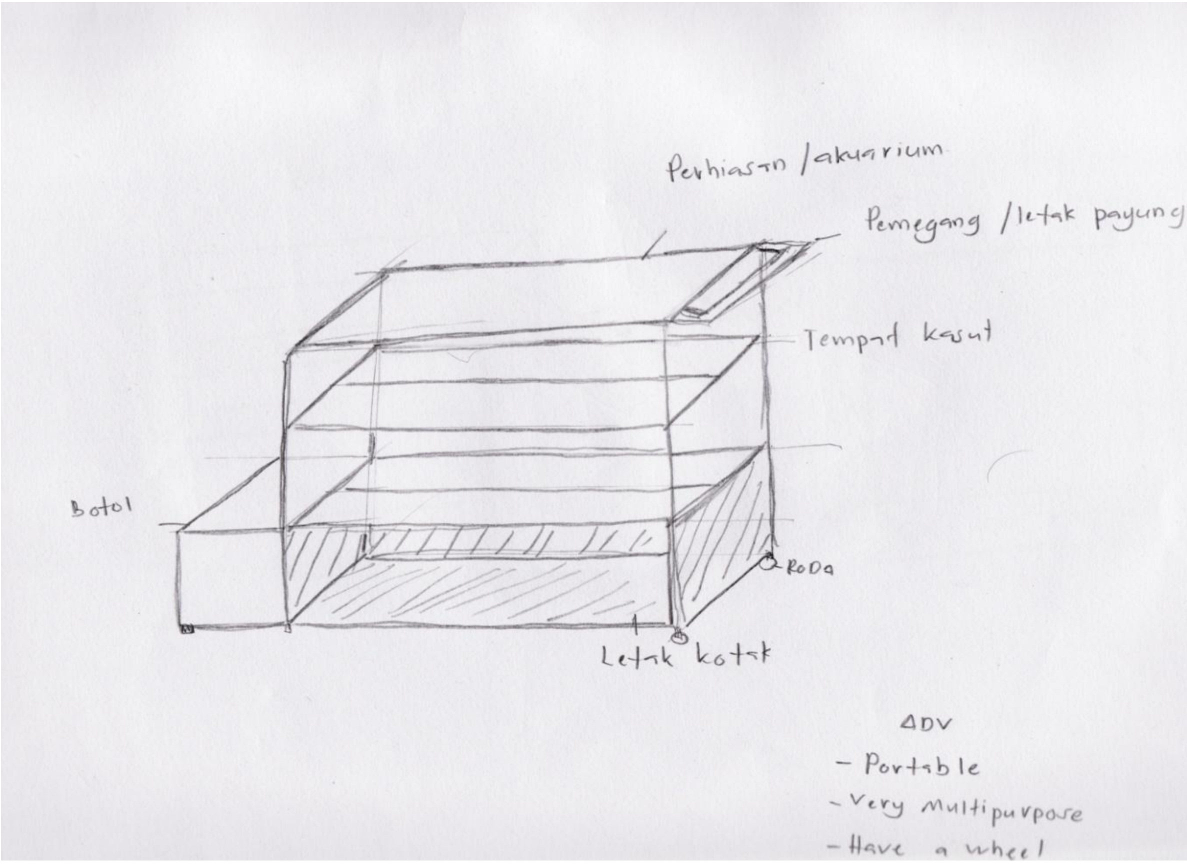


Figure 3.3: Shoe rack

Concept 2 for the outdoor of house. The advantages of the concept 2 is a multipurpose, have a wheel, umbrella structure and portable. The disadvantages is big and heavy.

3.3.2.3 Concept 3

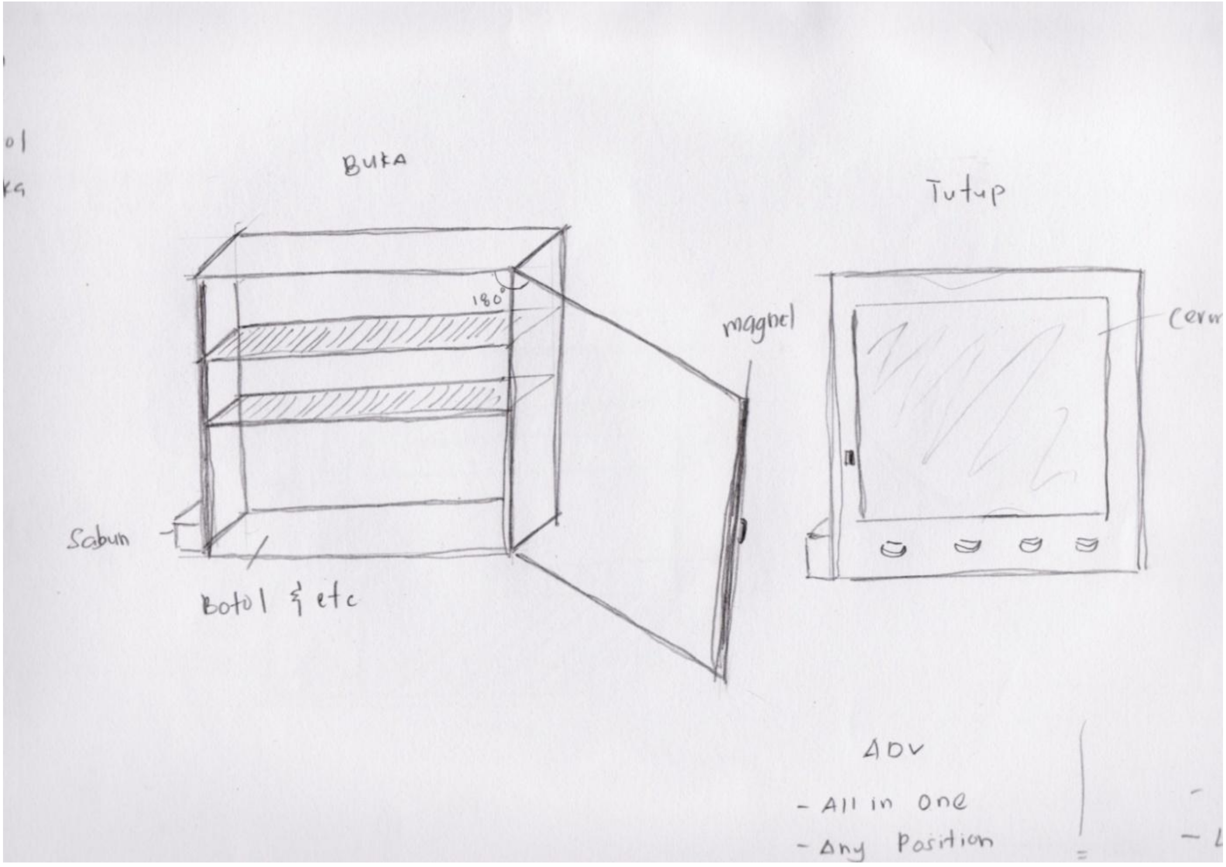


Figure 3.4: Bathroom rack

The selection concept 3 is for the bathroom. The advantages are anti rust because made from plastic, always clean and multipurpose. The disadvantages are it material , limited content load and place.

3.3.2.4 Concept 4

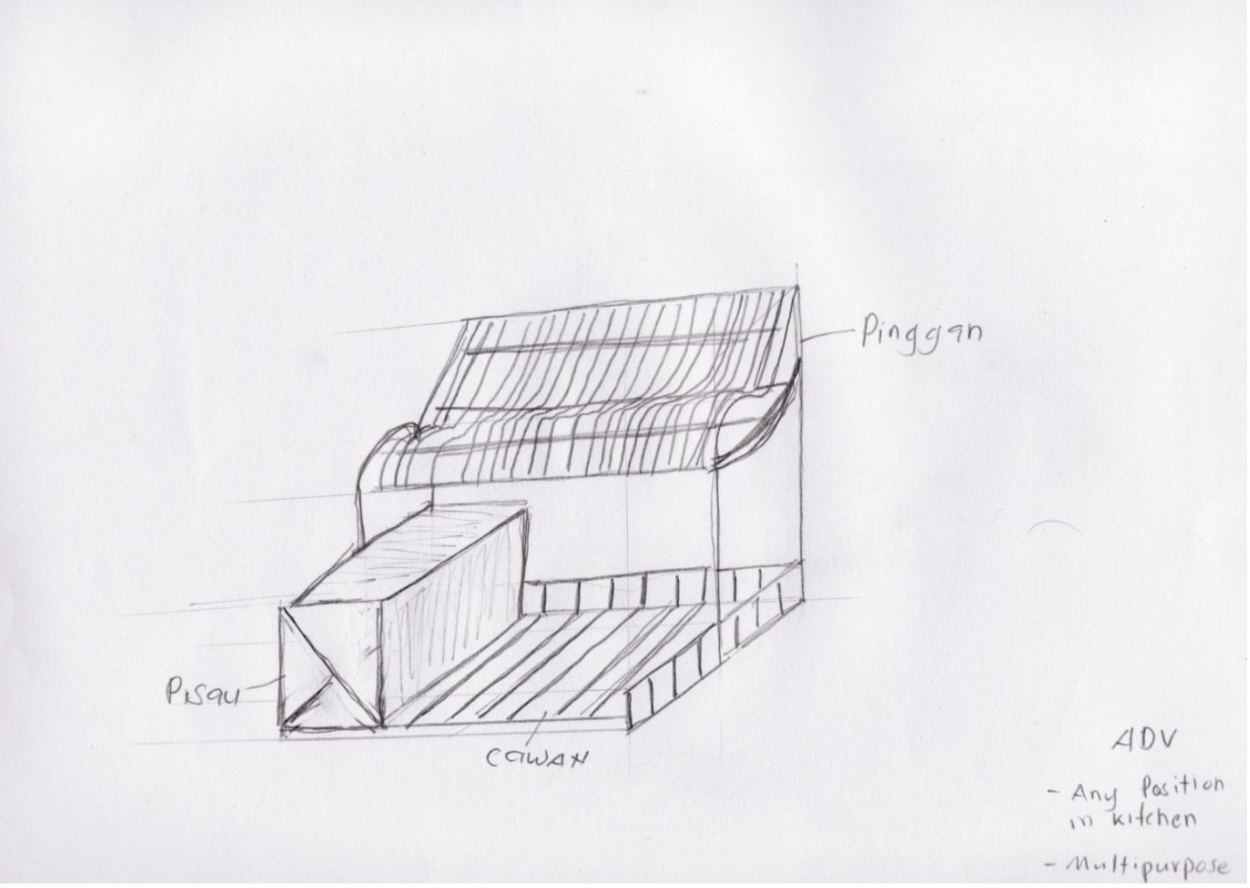


Figure 3.5: Blade rack

Concept 4 made from steel and for kitchen space. The disadvantages are the design hard to be made and limited load. The advantages blade space, glass and anti rust.

3.3.2.5 Concept 5

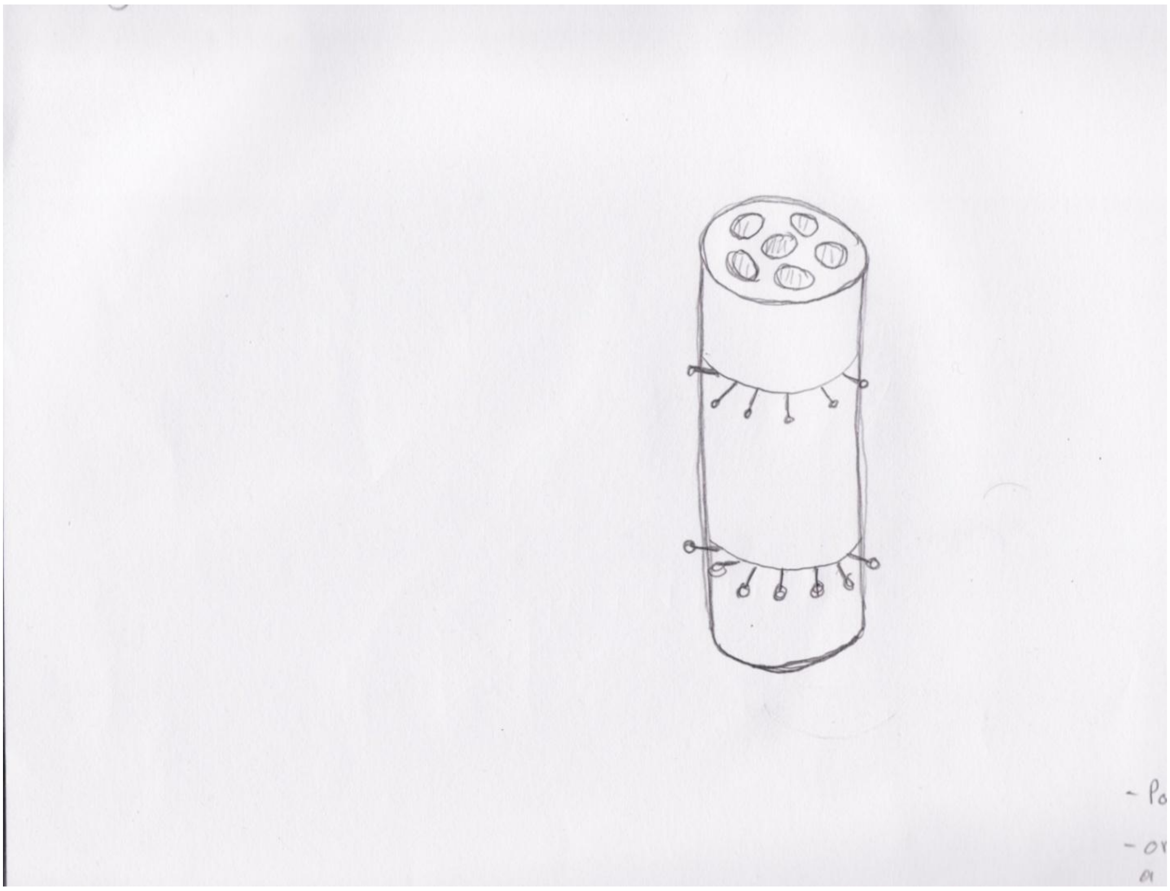


Figure 3.6: Umbrella rack

The concept 5 is the last concept. Made for home ground and the advantages are simple and portable. The disadvantages are danger to children and limited content.

3.3.3 Concept screening.

Table 3.5: Pugh' Concept

	Concept Variants					
Selection Criteria	Concept 1	Concept 2	Concept 3	Concept 4	Concept 5	Datumm
multipurpose (structure)	(+)	0	(+)	(-)	(-)	0
Easy to use	(+)	0	0	(+)	0	0
Easy to move (portable)	(+)	0	(-)	0	(+)	0
Fabrication	0	(-)	(-)	(-)	(+)	0
Strength	0	(+)	(-)	(+)	0	0
Load	(+)	(+)	0	(-)	(-)	0
Function	(+)	(-)	0	(-)	(-)	0
Pluses	5	2	1	2	2	0
Sames	2	3	3	1	2	0
Minuses	0	2	3	3	3	0
Net	5	0	-2	-1	-1	0
Rank	1	2	5	3	4	0
Continues	YES	NO	NO	NO	NO	

Studies of the concept screening table show that concept 1 get the highest positive sign. So, as a result, concept 1 is the best concept to be produce.

3.3.4 Final concept

After take every sight the final concept is the design one. This is AutoCad design of final design.

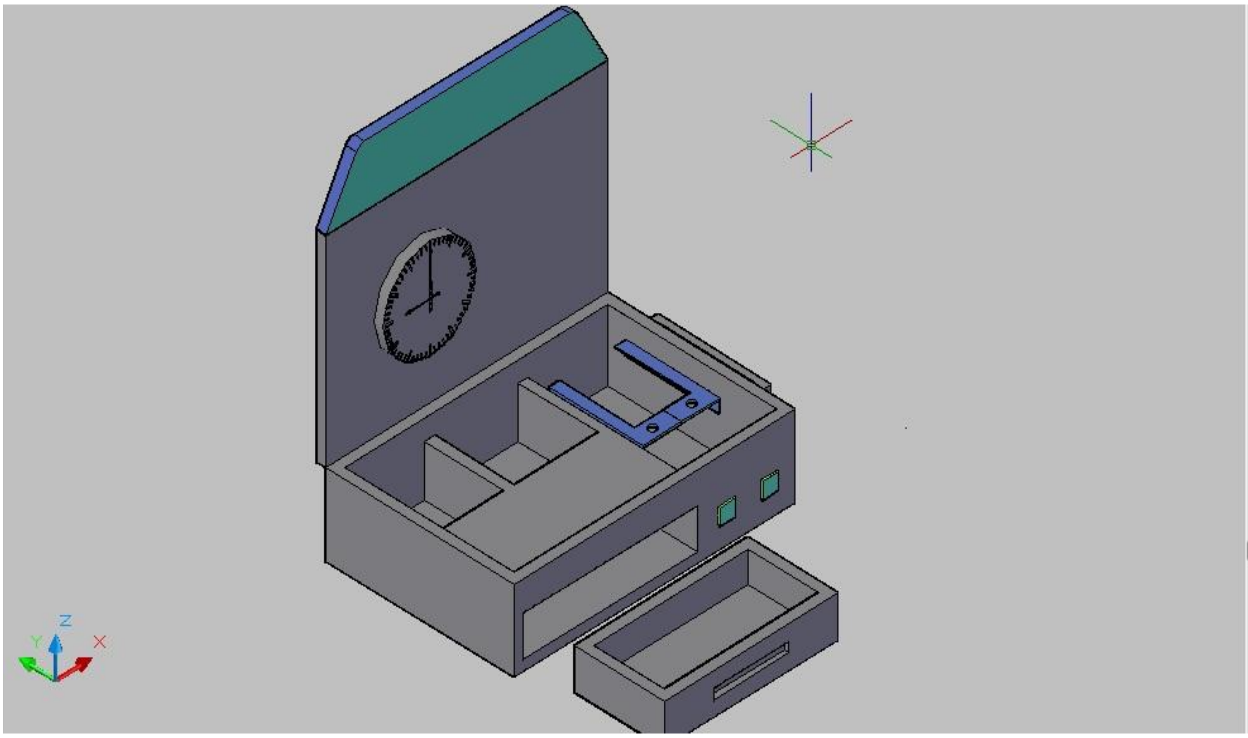


Figure 3.7: South west Isometric view

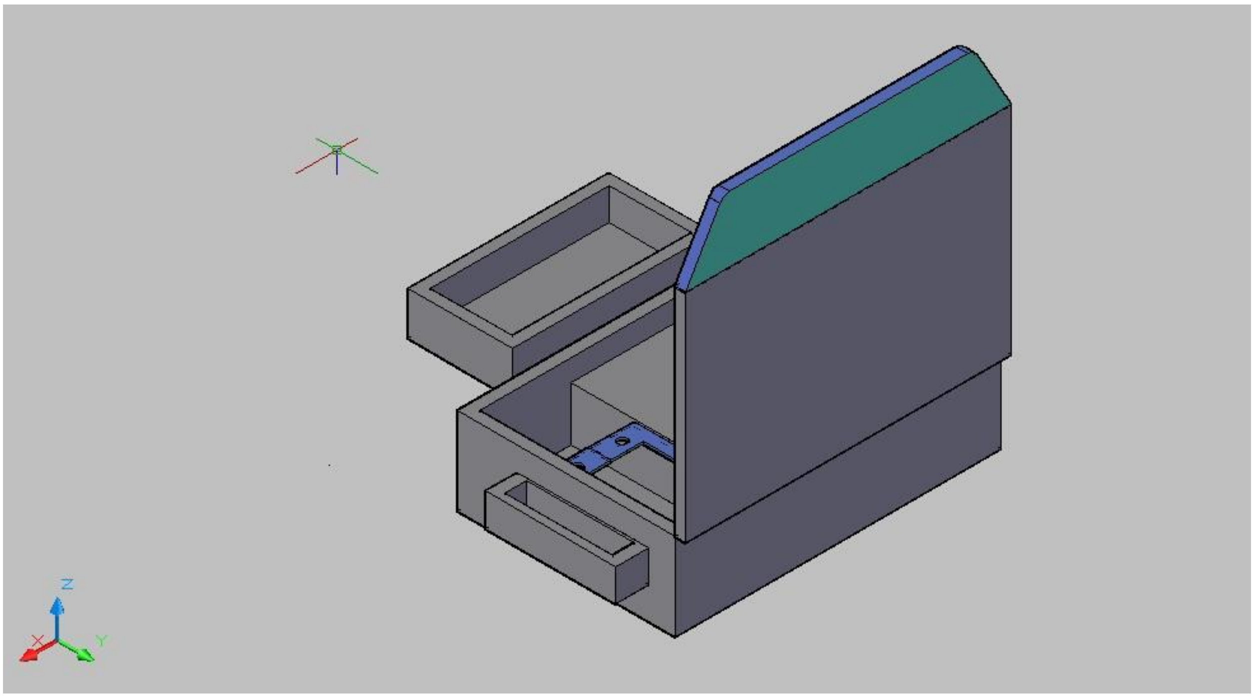


Figure 3.8: North east Isometric view

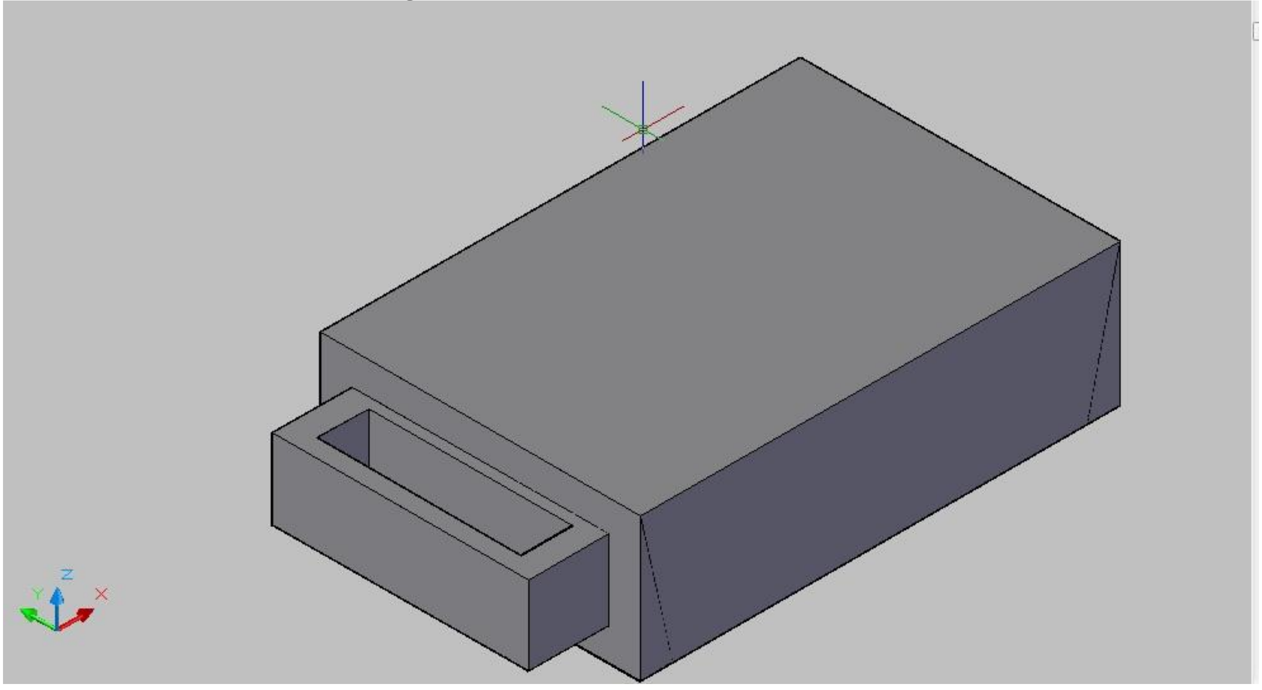


Figure 3.9: Rack Closed

3.4 Fabrication

3.4.1 Introduction

There are five main phases that have been recognized to be the guideline throughout the
Research:

(i) Phase 1 – Measuring the material

(ii) Phase 2 – Cutting the material

(iii) Phase 3 – Drilling process

(iv) Phase 4 – Drive and process

(v) Phase 5 – Finishing process

3.4.2 Map Concept

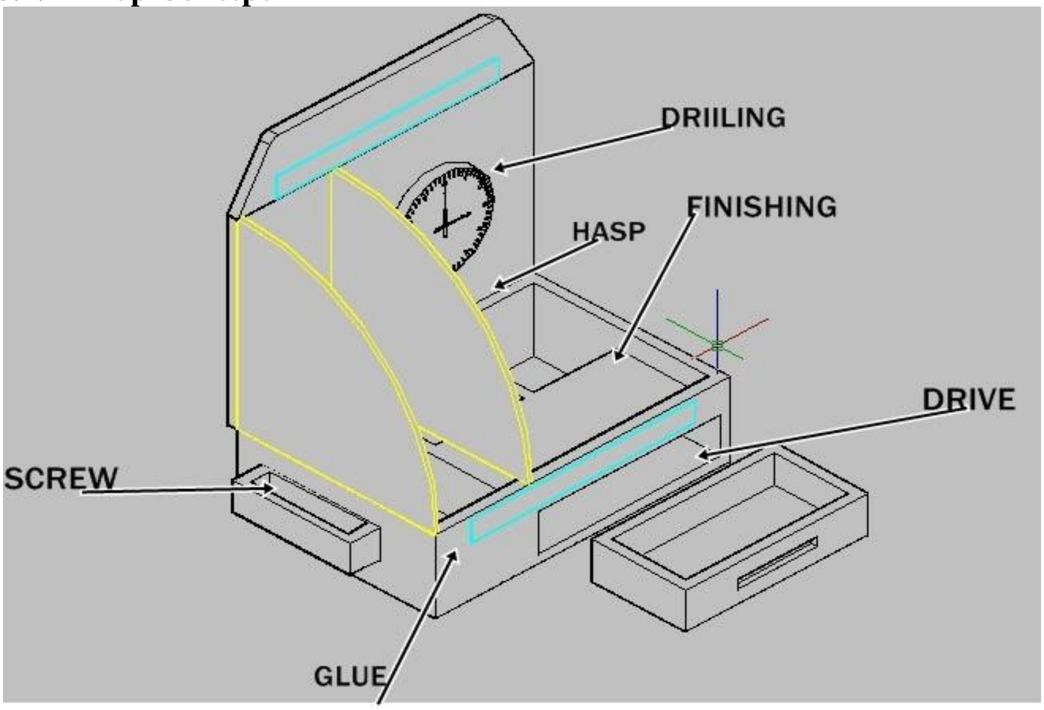


Figure 3.10: Map concept view

3.4.3 Bill of material

Table 3.6: Bill Of Material Rack

Part	Material	Dimension (cm)	Quantity
1	Wood A	20x4.5x0.8	2
2	Wood B	30x4.5x0.8	2
3	Plywood	30x22	2
4	Zinc	30x22	1
5	Plate	30x5.5	1
6	*Wood C*	100x3x1	1

3.4.4 Phase 1 – Measuring material

3.4.4.1 Venire Caliper

Device used to measure the distance between two symmetrically opposing sides. Venire calipers can measure internal dimensions (using the uppermost jaws in the picture at right), external dimensions using the pictured lower jaws, and depending on the manufacturer, depth measurements by the use of a probe that is attached to the movable head and slides along the centre of the body. This probe is slender and can get into deep grooves that may prove difficult for other measuring tools.[4]

3.4.4.2 Thickness Gauge

Measures pipe thickness from 0.1 to 200 mm (0.03 to 7.9 inches). Works on various metallic and non-metallic pipe materials such as steel, aluminum, titanium, plastics and ceramics.[4]

3.4.4.3 Steel Ruler

A ruler, or rule, is an instrument used in geometry, technical drawing and engineering/building to measure distances and/or to rule straight lines. Strictly speaking, the *ruler* is essentially a straightedge used to rule lines and the calibrated instrument used for determining measurement is called a "measure". However, common usage implies that a ruler is a straightedge that is calibrated for making measurements.[2]

3.4.4.4 Tape Measure

A tape measure or measuring tape is a flexible form of ruler. It consists of a ribbon of cloth, plastic, fiber glass, or metal strip with linear-measurement markings. It is a common measuring tool. Its flexibility allows for a measure of great length to be easily carried in pocket or toolkit and permits one to measure around curves or corners. Today it is ubiquitous, even appearing in miniature form as a keychain fob, or novelty item

3.4.5 Phase 2 – Cutting the material

3.4.5.1 Sawing

A saw is a tool that uses a hard blade or wire with an abrasive edge to cut through softer materials. The cutting edge of a saw is either a serrated blade or an abrasive. A saw may be worked by hand, or powered by steam, water, electric or other power.[2]

3.4.5.2 Marking

Have been marking by use a pencil for get a good shape, size and measure.

3.4.6 Phase 3 – Drilling process

Drilling is the cutting process of using a drill bit in a drill to cut or enlarge holes in solid materials, such as wood or metal. Different tools and methods are used for drilling depending on the type of material, the size of the hole, the number of holes, and the time to complete the operation.

Drilling is a cutting process in which a hole is originated or enlarged by means of a multipoint, fluted, end cutting tool. As the drill is rotated and advanced into the work piece, material is removed in the form of chips that move along the fluted shank of the drill

3.4.6 Phase 4 – Drive and process

3.4.6.1 Nails

In engineering, woodworking and construction, a nail is a pin-shaped, sharp object of hard metal or alloy used as a fastener. Formerly wrought iron, today's nails are typically of an alloy of steel, often being dipped or coated to prevent corrosion in harsh conditions or improve adhesion.

Nails are typically driven into the work piece by a hammer, a pneumatic nail gun, or a small explosive charge or primer. A nail holds materials together by friction in the axial direction and shear strength laterally. The point of the nail is also sometimes bent over or *clinched* after driving to prevent loosening.

3.4.6.2 Hammer

A hammer is a tool meant to deliver an impact to an object. The most common uses are for driving nails, fitting parts, forging metal and breaking up objects. Hammers are often designed for a specific purpose, and vary widely in their shape and structure. The usual features are a handle and a head, with most of the weight in the head. The basic design is hand-operated, but there are also many mechanically operated models for heavier uses.

3.4.6.3 Screw and Bolt

A screw, or bolt, is a type of fastener characterized by a helical ridge, known as an *external thread* or just *thread*, wrapped around a cylinder. Some screw threads are designed to mate with a complementary thread, known as an *internal thread*, often in the form of a nut or an object that has the internal thread formed into it. Other screw threads are designed to cut a helical groove in a softer material as it is inserted. Their most common use is to hold objects together or locate objects.

3.4.7 Phase 5 – Finishing process

3.4.7.1 Sand paper

Sandpaper is a form of paper where an abrasive material has been fixed to its surface. Sandpaper is part of the "coated abrasives" family of abrasive products. It is used to remove small amounts of material from surfaces, either to make them smoother (painting and wood finishing), to remove a layer of material (e.g. old paint), or sometimes to make the surface rougher (e.g. as a preparation to gluing).

3.4.7.2 Shellac

Shellac is a resin secreted by the female lace bug to form a cocoon, on trees in the forests of India and Thailand. It is processed and sold as dry flakes (pictured at right), which are dissolved in denatured alcohol to make liquid shellac, which is used as a brush-on colorant, food glaze and wood finish much like a combination of stain and polyurethane. Shellac functions as a tough all-natural primer, sanding sealer, tannin-blocker, odor-blocker, stain (pigment), and high-gloss varnish. Shellac was also once used in electrical applications as it possesses good insulation qualities and it seals out moisture.

3.4.7.3 Varnish

Varnish is a transparent, hard, protective finish or film primarily used in wood finishing but also for other materials. Varnish is traditionally a combination of a drying oil a resin, and a thinner or solvent. Varnish finishes are usually glossy but may be designed to produce satin or semi-gloss sheens by the addition of "flatting" agents. Varnish has little or no color, is transparent, and has no added pigment, as opposed to paints or wood stains, which contain pigment and generally range from opaque to translucent. Varnishes are also applied over wood stains as a final step to achieve a film for gloss and protection. Some products are marketed as a combined stain and varnish.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

The final fabrication of the 'MULTIPURPOSE RACK STRUCTURE' is done from only limited times due to several problems occur to the project. In this chapter will discuss mainly about the result of the project, analysis about the project and all problems encountered during the whole project was been carried out.

4.2 Result

This figure shown about the result for my project:

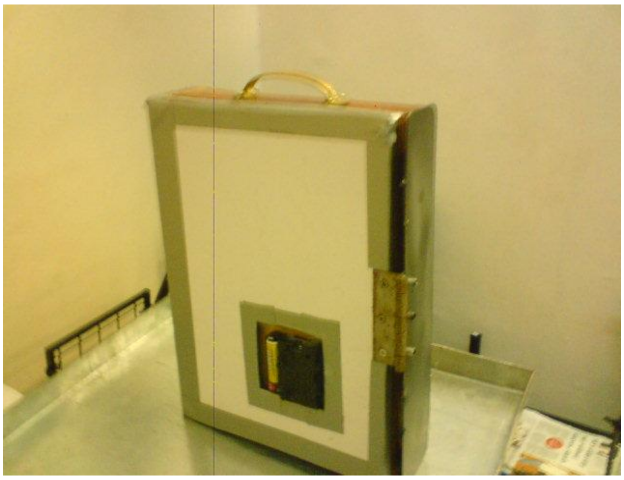


Figure 4.1: Multipurpose rack structure close

Figure 4.2: Multipurpose rack structure Open

4.3 Standard Operation Produce

4.3.1 Multipurpose rack structure open.

(i) Firstly, confirm the body of structure outside not crack

(ii) Pull the steel plate up follow the zinc upside and plywood at downside.

(iii) Pull it out of hasp.

(iv) Then pull the magazine holder in the magazine structure and hold at the wall.

4.3.2 Multipurpose rack structure close.

(i) Take back the holder at the wall to the magazine structure side back.

(ii) Close the plywood side back

(iii) Confirm the steel plate touch the magnet

(iv) Hold the holder to bring anyway

4.3.3 Clock

(i) Put the battery triple A inside clock motor

(ii) Set the time for the alarm

4.4 Factors of Safety

The factor of safety also known as Safety Factor, is used to provide a design margin over the theoretical design capacity to allow for uncertainty in the design process. The uncertainty could be any one of a number of the components of the design process including calculations, material strengths, duty, manufacture quality. The value of the safety factor is related to the lack of confidence in the design process. The simplest interpretation of the Factor of Safety is

FOS = *Strength of Component / Load on component*

If a component needs to withstand a load of 100 Newton's and a FoS of 4 is selected then it is designed with strength to support 400 Newton's.

So use a number 1.5- 2 for my FOS:

FOS = 2 / (5 X 9.81)
= 0.04077 N

The selection of the appropriate factor of safety to be used in design of components is essentially a compromise between the associated additional cost and weight and the benefit of increased safety and/or reliability. Generally an increased factor of safety results from a heavier component or a component made from a more exotic material or / and improved component design

The factors of safety listed below are based on the yield strength..

TABLE 4.1: Factors of safety

Factor of Safety	Application
1.25 - 1.5	Material properties known in detail. Operating conditions known in detail Loads and resultant stresses and strains known with with high degree of certainty. Material test certificates, proof loading, regular inspection and maintenance. Low weight is important to design.
1.5 – 2	Known materials with certification under reasonably constant environmental conditions, subjected to loads and stresses that can be determined using qualified design procedures. Proof tests, regular inspection and maintenance required
2-2.5	Materials obtained for reputable suppliers to relevant standards operated in normal environments and subjected to loads and stresses that can be determined using checked calculations.
2.5-3	For less tried materials or for brittle materials under average conditions of environment, load and stress.
3-4	For untried materials used under average conditions of environment, load and stress.

(i) **Repeated Cyclic loads :**

The factors established above must be based on the endurance limit (fatigue strength) rather than to the yield strength of the material. The strength calculations should also include for stress concentration factors.

(ii). **Impact Shock forces :**

The factors given in items 3 to 6 are acceptable, but an impact factor (the above dynamic magnification factor) should be included.

(iii). **Brittle materials :**

The ultimate strength is used as the theoretical maximum, the factors presented in items 1 to 6 should be approximately doubled.

(iv). **Impact Shock forces :**

The higher factors of safety given above (2.5 to 4) may be used but based on stress levels calculated based on the resulting dissipated energy at impact.

Where higher factors might appear desirable, a more thorough analysis of the problem should be undertaken before deciding on their use.

Extreme care must be used in dealing with vibration loads, more so if the vibrations approach resonant frequencies. The vibrations resulting from seismic disturbances are often important and need to be considered in detail.

4.4.1 Margins

Most designs can actually support loads somewhat above the ultimate loads. The extra load-carrying capability is called the *margin of safety*, or simply the *margin*. Margins are reported in different ways.

Civil engineers typically report the actual safety factor. If the bridge above could actually carry a 65 ton truck, the factor of safety is reported as 6.5.

Aerospace engineers, on the other hand, report an actual margin of safety, or *MS*. The *MS* is defined as the percentage of load above the ultimate which can be carried:

MS = Load Capability / Ultimate Load - 1

A margin of 0 means the structure is predicted to fail at the ultimate loads; a margin of 0.10 means the structure is predicted to fail at 10% over the ultimate loads.

My margins

Ms= 3 X 9.81/ (5 X 9.81) – 1

=0.612 N

When weight is very critical, a zero margin is desired. In practice, margins will be positive for a number of reasons:

(i) Materials or stock profiles may only be available in finite sizes.
(ii) Multiple failure modes cannot be optimized simultaneously. A zero margin for bending stresses may give a positive margin for buckling.
(iii) Some failure modes require positive margins because of greater uncertainty.
(iv) Management may decide they are uncomfortable with the initial level of risk.

Two common cases where positive margins are required are buckling and fastened joints. Buckling models are notoriously inaccurate, and it is common to see a minimum required margin of 0.15 (or loads must be multiplied by an additional factor of 1.15 for buckling calculations). For fastened joints with large numbers of fasteners, it is unrealistic to expect all fasteners to carry the load.

4.4.2 Test load

Aerospace structures will be tested to some level at or above limit loads. A dedicated test structure is called a *qualification* unit and is usually tested to ultimate loads.

Flight units are sometimes tested to limit loads (this is called an *acceptance* test), but these tests are often skipped for metallic structures. Because of the greater uncertainties in composite manufacturing processes, composite flight structures are almost always acceptance tested, and the levels are often bumped up to 1.10 times limit loads.

If a program can't afford a dedicated qual unit, the flight unit will be tested to *protoflight* levels, or 1.10 times limit loads. This is true for both metallic and composite structures. Furthermore, without a qualification test, the flight structures must always be tested to protoflight levels.

4.5 Costing

Table 4.7: Costing Table

NO	ITEMS	QUANTITY	PRICE(RM)
1	WOODS	2	31.00
2	SCREW AND DRIVE	4	10.00
3	SHELLAC AND VARNISH	1	6.00
	TOTAL		47.00

Labor cost = RM 0.50 per unit

Shipping cost = RM 1.00 per unit

Total + labor cost + shipping cost =

RM47.00 + RM 0.50 + RM 1.00 = RM 48.50

4.6 Project Problems

4.6.1 Literature Review: The concept and ideas review for this project are not very wide because it is not widely modified by the manufacturer. Students should come with their ideas on the project.

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

4.6.3 Fabrication Process: Students need to be given more time to finish fabricating their product because of slackness of skill and training, the joining finishing was not so god but yet can still reliable.

4.6.4 Material Preparation: Some of the needed material needs to buy at the city. University should prepare the material or either provides the place where the material can be obtained from.

4.6.5 Budget Preparation: It is not so effective to use student's money to get the materials. University should provide budget at first stage so that student's expenses are not interfere.

4.7 Problem During Fabrication Process

4.7.1 Material

Problem during this stage is very critical when the certain of the material need to buy by student in city or other place. So, this time we need to use our money to buy it. Certain student need to delay their project because no enough money to buy the material.

4.7.2 Joint Process

During drive process some problem has occurs. Using the drive process need to set a suitable wood. If the thickness to small, the material like wood will be crack or broken.

4.7.3 Laboratory located.

The Mechanical Metal Foaming Laboratory in Kuala Pahang, Pekan is located far from UMP Gambang. The students need to make bus reservation to go there. Furthermore, the journey to Kuala Pahang needs to take around two hours. In that two hours, the students can do their final year project if the metal foaming laboratory is still in Gambang.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

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

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

5.2 Recommendation

5.2.1 Student budget

Some of the materials also need the student to buy such the things that doesn’t have in mechanical laboratory. For the budget, the faculty should provide the budget to student at first. Precise planning of the work progress will make sure that the project can be done in a shorter time. Having a good time management can guaranty that any of student task to complete in a good ways and also give more time to focus on others subject.

5.2.2 Future work

The final year project is a most important subject that must be learns in the final semester. It is because this project can make the student practice their skill of machining process since semester one. Its include using welding machine, , drilling machine, CAD software, Solid work software and others else. So for my can opener project, I think a lot of things can be improved in the future. The improvement could be in the characteristics like a body frame that it I need to made it small than this product. Beside that I also need to change the type of clamper that more suitable to clamp the tin. In the future also I should use all material should be lightweight and hardy. Besides that, the financial is very important to develop this can opener sophisticated and could be produce to the market in the future.

REFERENCES

1) http://en.wikipedia.org/wiki/nail

2) www.ikea.com.my

3) www.casio.com

4) www.citcat.net

5) http://www.forestry.gov.my/index.php

6) www.timex.com

7) **Kroemer K H E and Grandjean**, “A Textbook of Occupational Ergonomics 5th edition.

8) **Dul J and Weerdmeester B.** Ergonomics for Beginners .

9) **Wilson JR and Corlett EN**. Evaluation of human work: A practical ergonomics methodology.

10) **McGraw-Hill** Strength of Material

Appendix’s

Appendix A

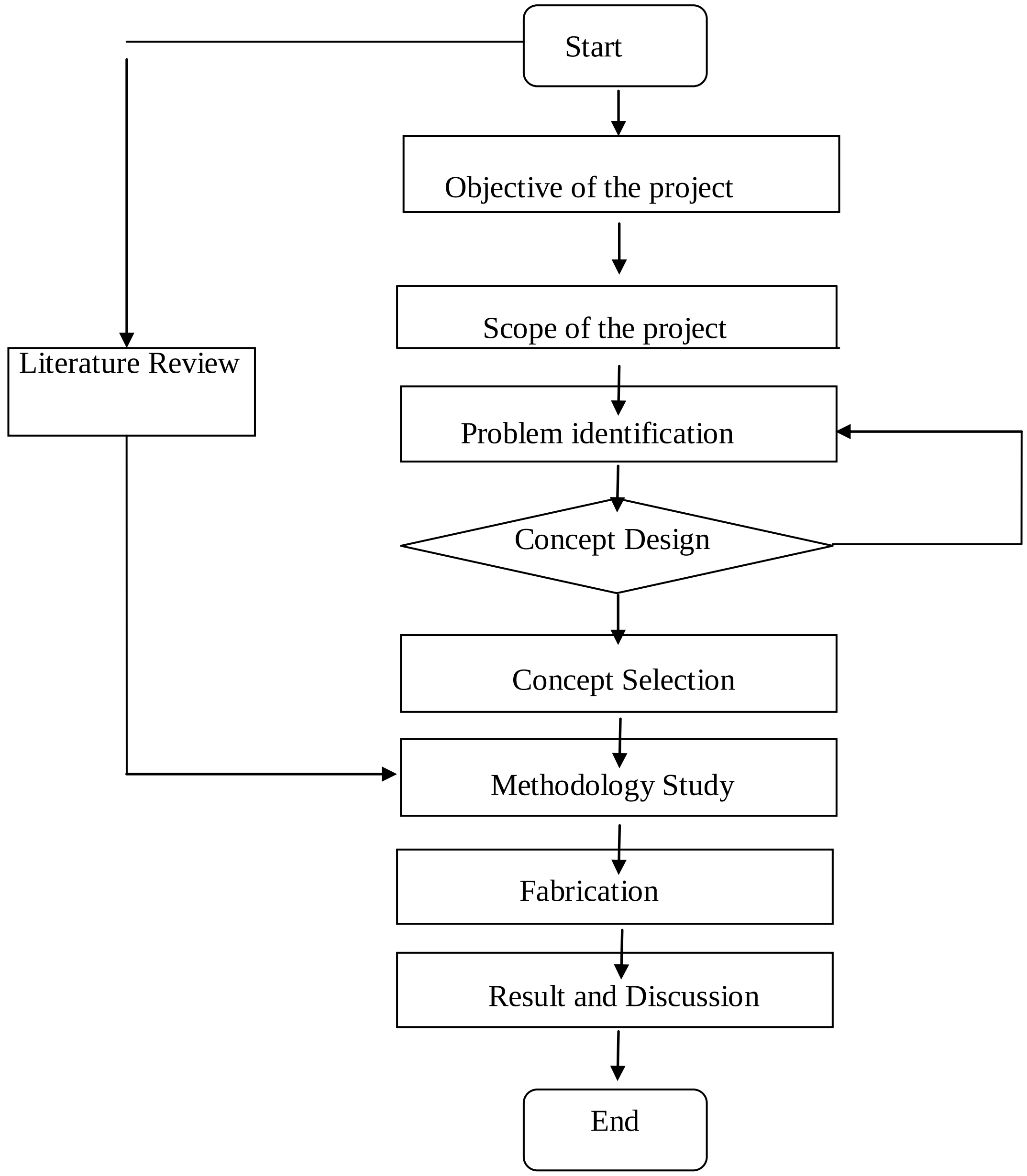
Wood price reference

SPESIES / *SPECIES*	2005	2006	2007	2008
Balau	925	1,625	1,850	1,850
Balau Merah	650	1,250	1,250	1,250
Cengal	1,268	2,142	2,221	2,288
Merbau	927	1,175	1,200	1,228
Campuran Kayu Keras Berat / *Mixed Heavy Hardwood*	524	460	531	580
Kempas	554	643	695	795
Keruing	650	769	775	795
Kapur	627	732	750	778
Mengkulang	630	790	790	800
Tualang	530	640	650	670
Campuran Kayu Keras Sederhana / *Mixed Medium Hardwood*	457	470	495	552
Meranti Merah Tua	747	797	831	858
Meranti Merah Muda	710	788	820	830
Meranti Kuning	498	629	780	800
Meranti Putih	592	750	780	788
Meranti Merah	705	793	800	828
Mersawa	700	746	750	760

Guide to Thesis Preparation. 2007. School of Graduate Studies, University Putra Malaysia, Selangor, Malaysia.

Appendix B

Flow chart



Appendix C

Gantt Chart

ACTIVITIES	WEEK													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
CHOOSE A TITLE AND BRIEFING BY SUPERVISIOR	↔													
DRAFT AND SEARCH SCOPE WITH THE LITERATURE REVIEW	←	—	→											
WRITE A OBJECTIVE AND PROBLEM STATEMENT		↔												
SKECTH AND DESIGN SELECTION PROJECT AND THEN DISCUSS WITH SUPERVISIOR			←	→										
CHOOSE A FINAL CONCEPT AND DRAW BY USING SOLIDWORK SOFTWARE					↔									
ANYLYSIS CONCEPT AND PREPARE FIRST HALF PRESENTATION						←	→							
START PROCESS FABRICATION							←	—	—	→				
FINALIZE DESIGN											↔			
WRITE A FINAL REPORT												←	→	
PREPARE FINAL PRESENTATION														↔