DESIGN AND FABRICATION OF SHOE RACK

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DESIGN AND FABRICATION OF SHOES RACK

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Report submitted in partial fulfilment of the requirements
For the award of the degree of
Diploma in Mechanical Engineering

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24 NOVEMBER 2009

SUPERVISOR'S DECLARATION

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

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STUDENT'S DECLARATION

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

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ABSTRACT

This report presents the design and fabrication shoes rack for use in Masjid UMP. This design and fabrication of shoes rack according to the type of the place that we want to place it. Shoes rack is always used in many type of place such as school, office, Masjid, house and etc. The idea of the fabricating of this shoes rack is based on student's creativity and own inspiration. The selection of suitable materials in the fabricating of this shoes rack is a loaded material which has lightweight, long life-span and can detain heavy load. Materials are proposed for the fabrication of the shoes rack is a mild steel carbon material. In this report, we'll also be having more to the fabrication and analysis of this shoes rack.

ABSTRAK

Laporan ini membentangkan tentang merekabentuk dan penghasilan rak kasut untuk kegunaan di masjid UMP. Rekabentuk dan penghasilan rak kasut ini mengikut tempat atau kawasan yang hendak diletakkan. Rak kasut biasanya digunakan di kebanyakan tempat seperti sekolah, pejabat, masjid, rumah dan lain-lain. Idea penghasilan rak kasut ini adalah hasil inspirasi pelajar sendiri. Pemilihan bahan yang sesuai untuk digunakan bagi pembentukkan rak kasut ini merupakan bahan yang mempunyai berat yang ringan, jangka hayat yang tahan lama dan boleh menahan beban yang berat. Bahan yang dicadangkan untuk pembentukkan rak kasut ini merupakan material jenis mild steel karbon. Dalam laporan ini juga akan lebih memfokuskan kepada penhasilan dan analisis kepada rak kasut.

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LIST OF SYMBOLS

$T\mu$ Ultimate Strength (MPa)

A Area (m^2)

σ Stress (N/m^2)

F Concentrated force (N)

m Distance (m)

\

LIST OF ABBREVIATIONS

MIG	Metal Inert Gas Welding
SMAW	Shielded Metal Arc Welding
UMP	Universiti Malaysia Pahang

CHAPTER 1

INTRODUCTION

1.1 PROJECT SYNOPSIS

1.1.1 General Project Synopsis

This project about a design and fabricate a shoes rack for Masjid UMP. As the diploma final year project allocates the duration of 1 semester, this large man-hour project therefore requires significant number of students to participate. Basically the entire shoes rack could be divided into three stages, which are concept review and development, design and fabrication. The shoes rack is equipped by using mild steel material. This project manufactured by using MIG welding to joint the part and etc.

The process of development is initiated from designing the shape of the shoes rack 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 for example easy to use. It involves the measurement process before the materials are cut into pieces before joined together.

1.1.2 Specific Project Synopsis

My project title is Design and Fabricate of Shoes Rack for Masjid UMP. The project involves small analysis of the Shoes Rack frame body and fabrication of the Shoes rack itself with concerns regarding strength, durability, and convenience. Test need to be done to verify the strength of the Shoes Rack right before the fabrication process to avoid material and fund wasting. The projects prerequisites are Static, Dynamic and Strength of Material. Overall, the project will meet acquire skills of design, analysis, and fabrication.

1.2 PROBLEM STATEMENT

At mosque, there should be a proper shoes rack for the Muslim to keep their shoes from the rain. Beside that, the shoes at Masjid UMP not well arrange. The improvisation of their shoes rack should be started and this project aim to initiate the ideas of suitable shoes rack for Masjid.

1.3 PROJECT SCOPE

This project will be limited within the following scopes, which are:

1.3.1 Sketch the new design of shoes rack for Masjid UMP.

1.3.2 Sketching and designing using Solid Work or Auto Cad software in creating the design of shoes rack.

1.3.3 Fabricate and produce the shoes rack by using all necessary manufacturing process such as cutting, welding, grinding and etc.

1.3.4 Use the light weight material.

1.4 PROJECT OBJECTIVE

1.4.1 General Objective

Diploma final year project objective is to practice the knowledge and skill of the student that have been gathered before in solving problem using academic research, to born an engineer that have enough knowledge and skill.

This project also important to train and increase the student capability to get know, research, data gathering, analysis making and then solve a problem by research or scientific research.

The project also will educate the student in communication like in a presentation and educate them to defend their research in presentation. The project also will generate students that have capability to make a good research report in thesis form or technical writing.

This project also can produce and train student to capable of doing work with minimal supervisory and more independent in searching, detailing and expanding the knowledge and experiences.

1.4.2 Specific Project Objective

Basically this project is base on this objective:

- Design a good, suitable and user friendly shoes rack.
- Fabricate the structure which can be suitable use in Masjid.

1.5 PROJECT FLOW

Figure 1.1 shows the flow chart for this project. This project consists of eight phases, which are:

(i) Phase 1 - Determine the objective
(ii) Phase 2 – determine scope of project
(iii) Phase 3 - Problem identification
(iv) Phase 4 - Concept Design
(v) Phase 5 – Concept selection
(vi) Phase 6 – Methodology study
(vii) Phase 7 - Fabrication
(viii) Phase 8 – Result and discussion

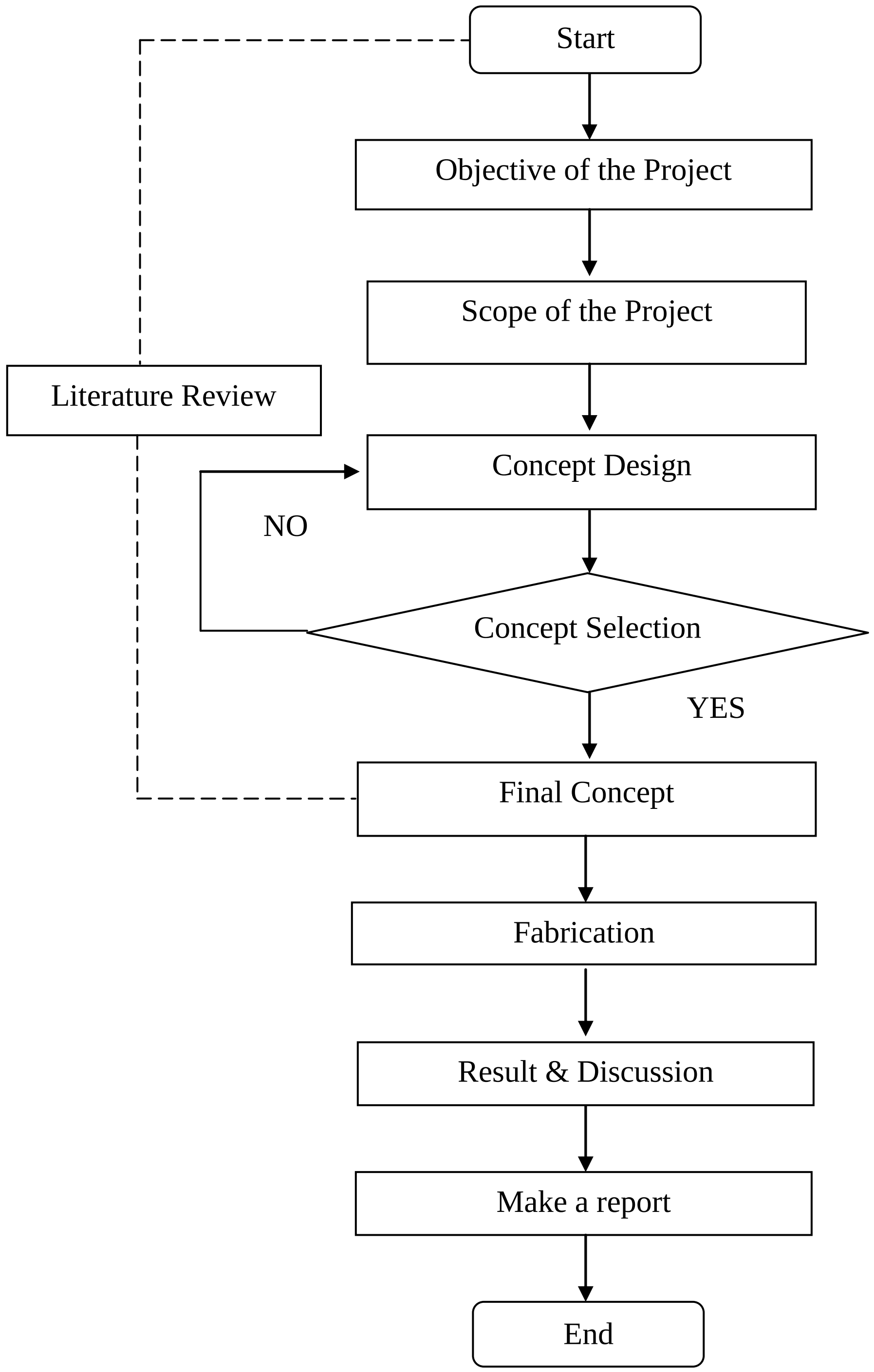


Figure: 1.1 Project Flow Chart

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

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

2.2 INTRODUCTION OF PRODUCT

The shoes rack is commonly use in nowadays. It is because it can make our place good looking and well arrange. Today, many design of shoes rack available in market. The design of the shoes rack is actually according to the place or environment situation. Beside that, the shoes rack can be found in many different type such as wood, plastic, and steel.

2.3 PRODUCT REVIEW

Today, there are many type of shoes rack available in market. Beside that, the shoes rack made from many type of material. This is example shoes rack in the market:

2.3.1 Five Shelf Shoe Cabinet With Two Upper Storage Bins

Figure 2.1: Five Shelf Shoe Cabinet with Two Upper Storage Bins

Source: Touch of Class 2008

2.3.1.1 Product Detail

- Organize your shoes with this fine storage cabinet
- Dresser features five shelves for storing up to 20 pairs of standard walking shoes
- Cabinet's two upper storage areas great for socks, shoe laces and more
- Perfect size for any closet or living room
- Made of fine medium-density composite wood for sanitary ventilation
- Available in dark coffee brown and beech color options

Dimensions: 33 inch Wide x 13 inch Depth x 47.5 inch Height
Materials: Composite Wood and Metal

2.3.2 Expandable Shoe Rack

Figure 2.2 Expandable Shoe Rack

Source: Touch of Class 2008

2.3.2.1 Product Detail

- Organize your home with this stylish expandable shoe rack
- Width expands from 25 to 46-inches of **s**hoe storage space
- Fashionable accessory is also functional
- Built with sturdy metal with a brilliant chrome finish
- Each rack will hold up to 6 pairs of shoes

Dimension: 25-46.75 inch Wide x 9 inch Height x 14 inch Deep
Materials: Metal

2.3.3 Victoriana Shoe Storage Bench

Figure 2.3: Victoriana Shoe Storage Bench

Source: Touch of Class 2008

2.3.3.1 Product Detail

Attractive Victoriana Shoe Storage Bench doubles as a place to store shoes, as well as a place to sit while removing them! Top and sides have recessed borders and an outer frame of hand carved mini floral; front has carved floral. Handcrafted wooden bench features a natural cherry finish.

- Natural cherry finish
- Handcrafted & hand carved
- Wooden shoe storage bench with dividers
- Holds approx. 12 pairs of shoes

Dimension: 30 inch Wide x 16 inch Depth x 24 inch Height
Material: Wood

2.4 MATERIAL SPECIFICATION

2.4.1 Mild and low carbon steel

Mild Steel is better than other material because of the price is not expensive and it beneficial for producing castings, forgings, stamping, rolling, welding, machining and heat treatment works.

Mild steel is the most common form of steel as its price is relatively low while it provides material properties that are acceptable for many applications. Low carbon steel contains approximately 0.05–0.15% carbon and mild steel contains 0.16–0.29% carbon, therefore it is neither brittle nor ductile. Mild steel has a relatively low tensile strength, but it is cheap and malleable; surface hardness can be increased through carburizing.

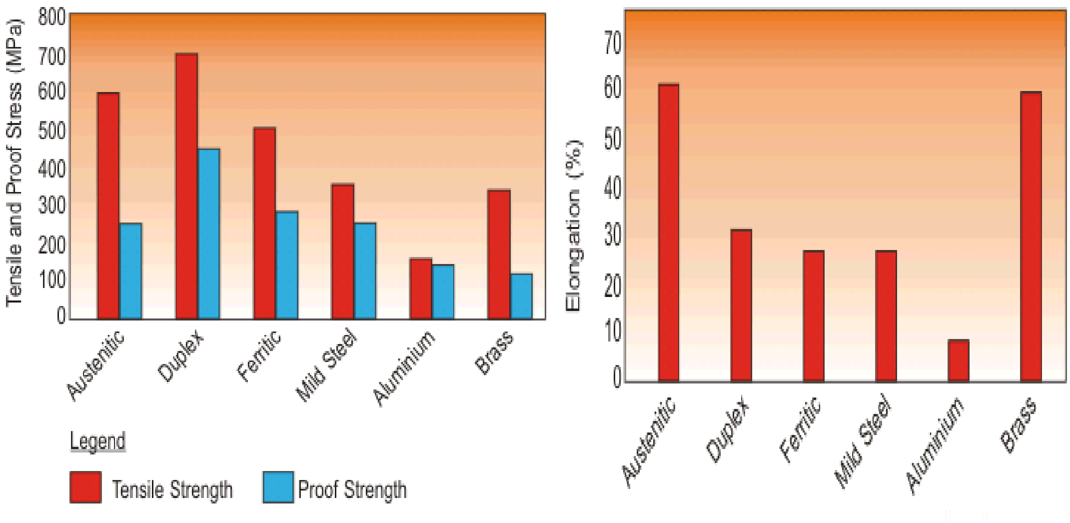


Figure 2.4: Mild Steel Material Properties

Source: The A to Z of Materials 2004

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

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

2.4.2 Medium carbon steel

Approximately 0.30–0.59% is carbon content. Balances ductility and strength and has good wear resistance; used for large parts, forging and automotive components.

2.4.3 High carbon steel

Approximately 0.6–0.99% is carbon content. Very strong, used for springs and high-strength wires.

2.4.4 Ultra-high carbon steel

Approximately 1.0–2.0% is carbon content. Steels can be tempered to get great hardness. Used for special purposes like (non-industrial-purpose) knives, axles or punches. Most steels with more than 1.2% carbon content are made using powder metallurgy. Note that steel with carbon content above 2.0% is considered cast iron.

Steel can be heat treated which allows parts to be fabricated in an easily-formable soft state. If enough carbon is present, the alloy can be hardened to increase strength, wear, and impact resistance. Steels are often wrought by cold working methods, which is the shaping of metal through deformation at a low equilibrium or stable temperature

2.4.5 Polycarbonate

Polycarbonates are long-chain linear polyesters of carbonic acid and dihydric phenols, such as biphenyl A.

Figure 2.5: Polycarbonate

Source: Polycarbonate (2007)

2.4.5.1 Properties of polycarbonate

Before starting to list properties of polycarbonate, it is probably wise to explain why the properties are the way they are. First, the technical stuff take a look at the above diagram. In it, you will see two six-sided structures. These are called phenyl groups. You will also see two groups identified by the label CH3. These are methyl groups. The presence of the phenyl groups on the molecular chain and the two methyl side groups contribute to molecular stiffness in the polycarbonate. This stiffness has a large effect on the properties of polycarbonate. First, attraction between of the phenyl groups between different molecules contributes to a lack of mobility of the individual molecules. This results in good thermal resistance but relatively high viscosity (i.e., low melt flow) during processing. The inflexibility and the lack of mobility prevent polycarbonate from developing a significant crystalline structure. This lack of crystalline structure (the amorphous nature of the polymer) allows for light transparency.

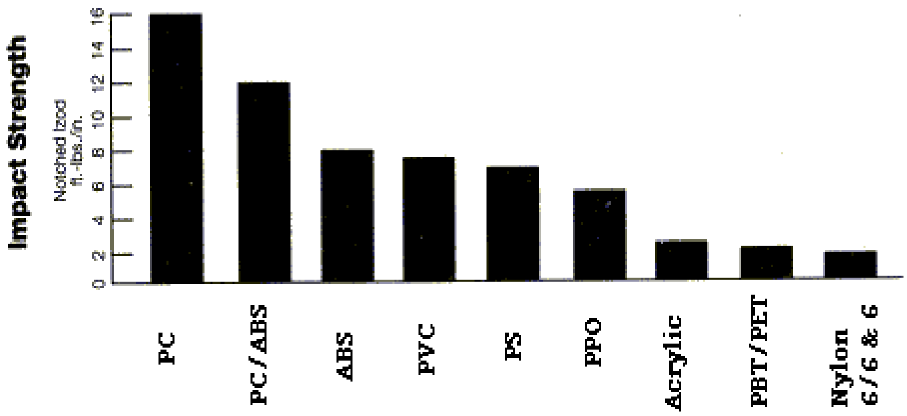
Polycarbonate is naturally transparent, with the ability to transmit light nearly that of glass. It has high strength, toughness, heat resistance, and excellent dimensional and colour stability. Flame retardants can be added to polycarbonate without significant loss of properties.

The general properties can be summarized as follows:

- excellent physical properties
- excellent toughness
- very good heat resistance
- fair chemical resistance
- transparent
- moderate to high price
- fair processing

2.4.5.2 Polycarbonate compare to other materials

One of the biggest advantages of polycarbonate is its impact strength. The following diagram compares the impact strength of polycarbonate to other commonly sold plastics.



Polycarbonate does have its disadvantages. It has only fair chemical resistance and is attacked by many organic solvents. It is also fairly expensive compared to other plastics. It has been as much as double the price of ABS. In applications where lower heat and impact are needed, ABS can be quite a bargain compared to polycarbonate.

2.4.5.3 Glass fibre reinforced grade of polycarbonate

The addition of glass fibre to polycarbonate significantly increases the tensile strength, flexural strength, flexural modulus, and heat deflection temperature of the polycarbonate while causing a decrease in the impact strength and tensile elongation. (See Glossary of Plastic Properties for an explanation of each term.) The greater the amount of glass fibre added to the polycarbonate, the greater the effect on each property will be.

2.4.5.4 Polycarbonate used

It can be injection molded; blow molded, and extruded and is an ideal engineering plastic with good electrical insulating properties, finding applications in electric meter housings and covers, casket hardware, portable tool housings, safety helmets, computer parts, and vandal-proof windows and light globes. The price of polycarbonate restricts its use to mainly engineering applications.

Other engineering applications include the following:

- equipment housings
- exterior automotive components
- outdoor lighting fixtures
- nameplates and bezels
- non automotive vehicle windows
- brackets and structural parts
- medical supply components
- plastic lenses for eyeglasses

2.5 MACHINING EQUIPMENT

2.5.1 Drilling

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

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

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

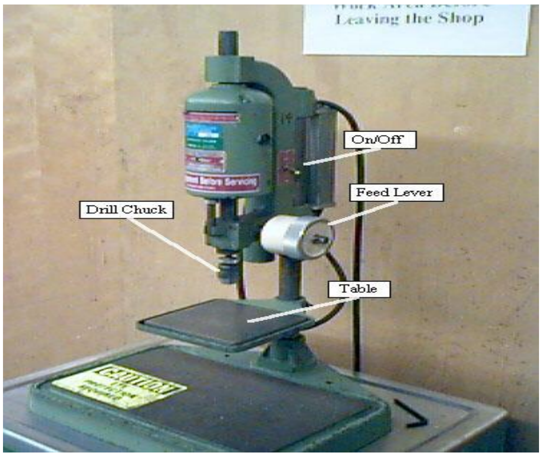


Figure 2.6: Press Drilling Machines

Sources: Engineering Dartmouth, Drill Press Machine (2004)

A drill press Figure 2.2 (also known as pedestal drill, pillar drill, or bench drill) is a fixed style of drill that may be mounted on a stand or bolted to the floor or workbench. A drill press consists of a base, column (or pillar), table, spindle (or quill), and drill head, usually driven by an induction motor. The head has a set of handles (usually 3) radiating from a central hub that, when turned, move the spindle and chuck vertically, parallel to the axis of the column. The table can be adjusted vertically and is generally moved by a rack and pinion; however, some older models rely on the operator to lift and re clamp the table in position. The table may also be offset from the spindle's axis and in some cases rotated to a position perpendicular to the column. The size of a drill press is typically measured in terms of swing. Swing is defined as twice the throat distance, which is the distance from the center of the spindle to the closest edge of the pillar. For example, a 16-inch (410 mm) drill press will have an 8-inch (200 mm) throat distance.

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

- Less effort is required to apply the drill to the work piece. The movement of the chuck and spindle is by a lever working on a rack and pinion, which gives the operator considerable mechanical advantage.
- The table allows a vise or clamp to position and lock the work in place making the operation much more secure.
- The angle of the spindle is fixed in relation to the table, allowing holes to be drilled accurately and repetitively.

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

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

2.5.2 welding machines

Joining involves in assembly stage. Commonly used method to join metal part is Metal Inert Gas (MIG) welding and Shielded Metal Arc Welding (SMAW).

2.5.2.1 Metal Inert Gas (MIG) Welding

Figure 2.7: Metal Inert Gas (MIG) Welding

Sources: Wikipedia, Metal Inert Gas (MIG) Welding (2009)

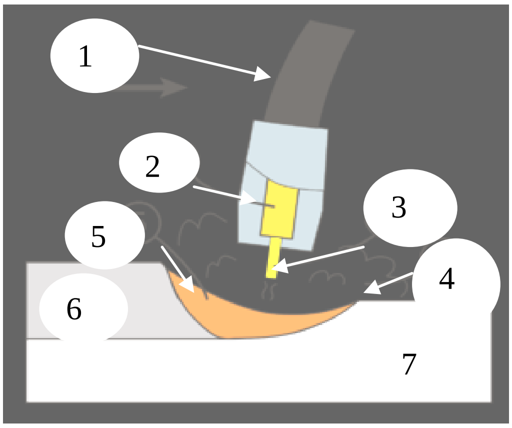
MIG (Metal Inert Gas) or as it even is called GMAW (Gas Metal Arc Welding) uses an aluminum alloy wire as a combined electrode and filler material. The filler metal is added continuously and welding without filler-material is therefore not possible. Since all welding parameters are controlled by the welding machine, the process is also called semi-automatic welding.

The MIG-process uses a direct current power source, with the electrode positive (DC, EP). By using a positive electrode, the oxide layer is efficiently removed from the aluminum surface, which is essential for avoiding lack of fusion and oxide inclusions. The metal is transferred from the filler wire to the weld bead by magnetic forces as small droplets, spray transfer. This gives a deep penetration capability of the process and makes it possible to weld in all positions. It is important for the quality of the weld that the spray transfer is obtained.

There are two different MIG-welding processes, conventional MIG and pulsed MIG:

a) Conventional MIG uses a constant voltage DC power source. Since the spray transfer is limited to a certain range of arc current, the conventional MIG process has a lower limit of arc current (or heat input). This also limits the application of conventional MIG to weld material thicknesses above 4 mm. Below 6 mm it is recommended that backing is used to control the weld bead.

b) Pulsed MIG uses a DC power source with superimposed periodic pulses of high current. During the low current level the arc is maintained without metal transfer. During the high current pulses the metal is transferred in the spray mode. In this way pulsed MIG is possible to operate with lower average current and heat input compared to conventional MIG. This makes it possible to weld thinner sections and weld much easily in difficult welding positions.



MIG weld area. **(1)** Direction of travel, **(2)** Contact tube, **(3)** Electrode, **(4)** Shielding gas, **(5)** Molten weld metal, **(6)** Solidified weld metal, **(7)** Work piece

Figure 2.8: Schematic of Metal Inert Gas (MIG) Welding

Sources: Wikipedia (2003)

GMAW is frequently referred to as MIG welding. MIG welding is a commonly used high deposition rate welding process. Wire is continuously fed from a spool. MIG welding is therefore referred to as a semiautomatic welding process.

2.5.2.2 Shielded Metal Arc Welding (SMAW)

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

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

Figure 2.9: Shielded Metal Arc Welding Machine

Sources: Pekan Mechanical Lab (2009)

To strike the electric arc, the electrode is brought into contact with the work piece in a short sweeping motion and then pulled away slightly, with a movement like lighting a match. As the electrode melts, the flux covering disintegrates, giving off vapours that protect the weld area from oxygen and other atmospheric gases. In addition, the flux provides molten slag which covers the filler metal as it travels from the electrode to the weld pool. Once part of the weld pool, the slag floats to the surface and protects the weld from contamination as it solidifies. Once hardened, it must be chipped away to reveal the finished weld. As welding progresses and the electrode melts, the welder must periodically stop welding to remove the remaining electrode stub and insert a new electrode into the electrode holder.

The actual welding technique utilized depends on the electrode, the composition of the work piece, and the position of the joint being welded. The choice of electrode and welding position also determine the welding speed. Flat welds require the least operator skill, and can be done with electrodes that melt quickly but solidify slowly. This permits higher welding speeds. Sloped, vertical or upside-down welding requires more operator skill.

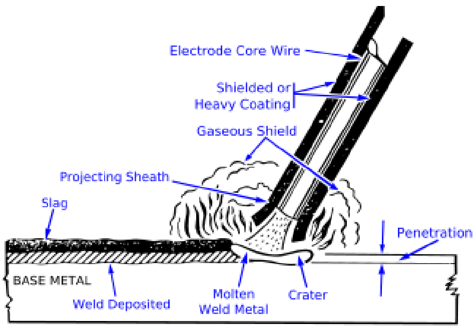


Figure 2.10: Shielded Metal Arc Welding Diagram

Source: Weld cop (2009)

2.5.3 Rivet

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

Figure 2.11: Blind Rivet (POP Rivet)

Source: Wikipedia (2004)

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

2.5.4 Grinding Machines

Grinding is a finishing process used to improve surface finish, abrade hard materials, and tighten the tolerance on flat and cylindrical surfaces by removing a small amount of material. Information in this section is organized according to the subcategory links in the menu bar to the left.

In grinding, an abrasive material rubs against the metal part and removes tiny pieces of material. The abrasive material is typically on the surface of a wheel or belt and abrades material in a way similar to sanding. On a microscopic scale, the chip formation in grinding is the same as that found in other machining processes. The abrasive action of grinding generates excessive heat so that flooding of the cutting area with fluid is necessary.

Figure 2.12: Grinder

Sources: Tradevv, Grinder (2005)

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

This chapter consists about the conceptual design, concept selection, and selection of the final design. It also explained about the method of fabricate such as the cutting of the material, drilling, welding, fastening and grinding. I also will explain about the design that had been chosen to be as the final idea to be produced or fabricate. All the fabrication process in this project is going to be explained in details.

3.2 FLOW CHART OF METHODOLOGY

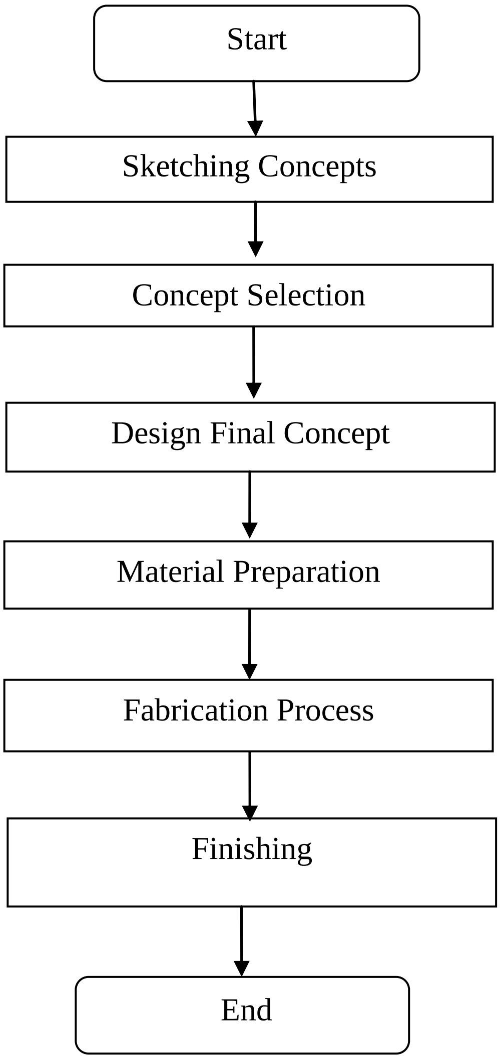


Figure 3.1: Flow Chart of Methodology

3.3 CONCEPT GENERATION

After brainstorming to generate a few designs of shoes rack, the concept will come out with three design of shoes rack. All the concepts must go through concept selection to determine which one is the best design to be fabricated among all the three design of the shoes rack.

3.4 SKETCHING CONCEPT

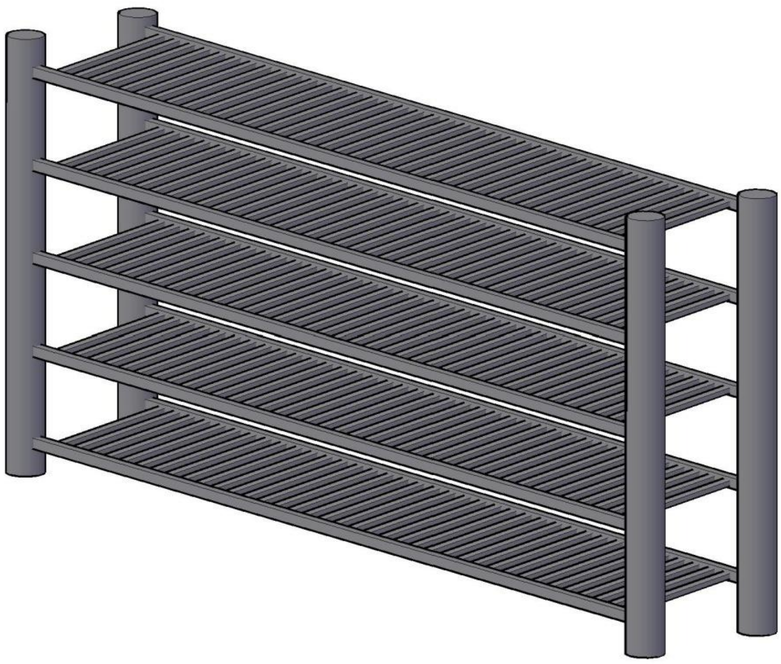


Figure 3.2: Concept A

Concept A design has a few advantages which are easy to use, long life time, can store many shoes, low cost and high durability. Beside that, it also have few disadvantages that are the design is difficult to move and difficult to manufacture and cannot protect shoes from rain.

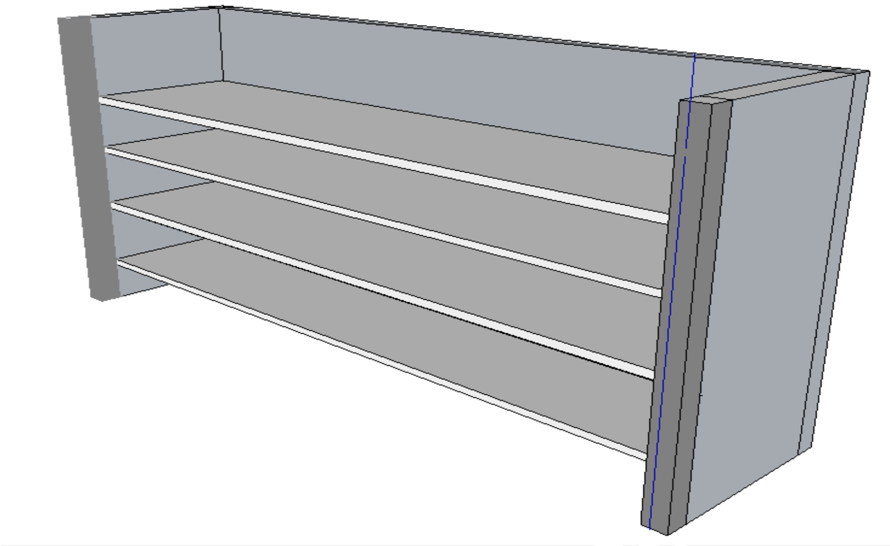


Figure 3.3: Concept B

For concept B, its advantages are it has stability, easy to use, high durability, low cost, easy to fabricate and can put many shoes. But, this concept difficult to move it, use large space and cannot protect shoes from rain.

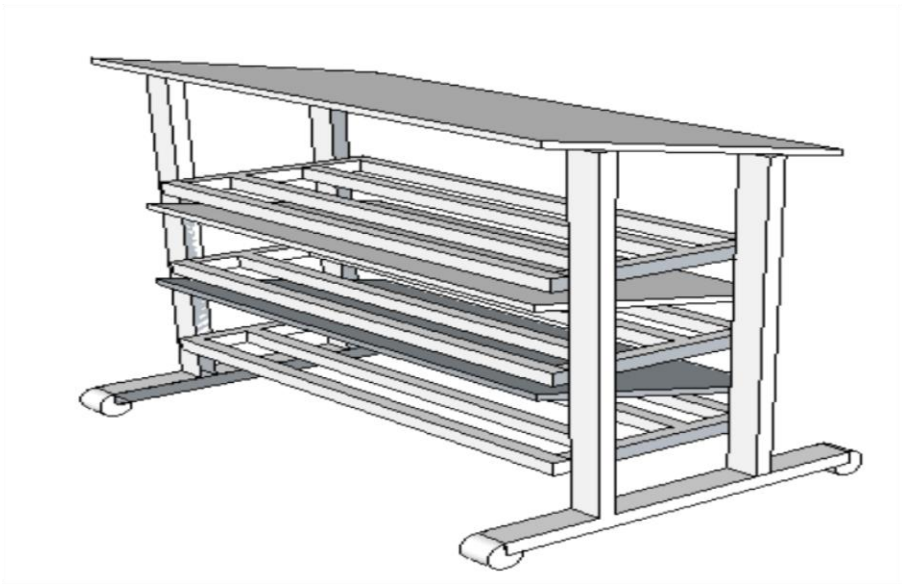


Figure 3.4: Concept C

Concept C design has a few advantages which are easy to use, easy to move, can protect shoes from rain, high durability, can store many shoes and it is stable. But, this concept quite expensive

3.5 CONCEPT SELECTION

In order to determine which design is the best to be fabricated, all of the concept must undergo concept selection (Pugh Method). The result of the selection is as shown in the table below.

Table 3.1: Concept Selection Table

Selection Criteria		**Concepts Variants**	
	A	**B(Datum)**	**C**
Easy to move	-	-	+
Easy to handle	+	+	+
Can Protect Shoes From Rain	-	-	+
Easy to use	0	0	+
Easy to fabricate	-	+	-
Stability	0	0	0
Low Cost	0	+	-
Durability	+	+	+
Can Store Many Shoes	+	+	+
Plusses	3	5	6
Same	3	2	1
Minuses	3	2	2
Net	0	3	4
Rank	**3**	**2**	**1**
Continue	X	√	√

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

From the table 3.1, the Concept C get the highest net score followed by Concept B and then the lowest net scores is Concept A. Due to that, Concept C is chose as the concept to be fabricated in this project.

3.6 FINAL CONCEPT

After go through the concept selection, the final concept that is going to be fabricated which is Concept C will be drawn by using AutoCAD.

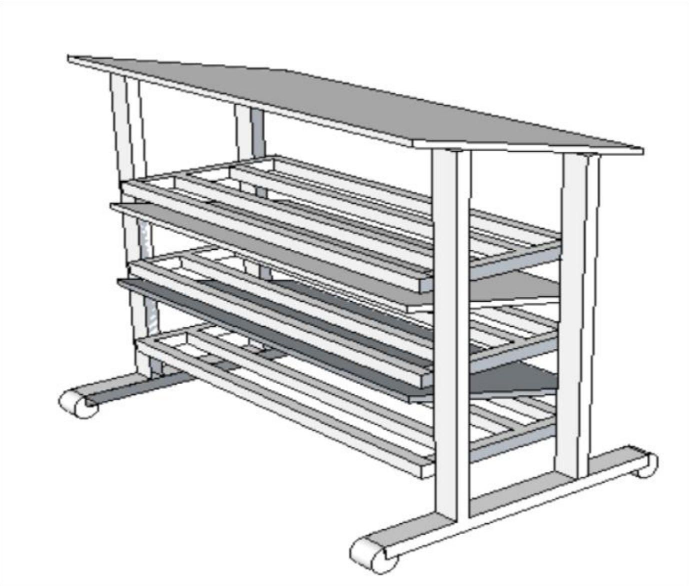


Figure 3.5: Final Concept (Concept C)

This design is simple design that can protect shoes from rain. This design of the shoes rack very is interesting and unique that will attract the customer to buy it. It also gives comfort where the user can move the shoes rack anywhere.

3.7 MATERIAL PREPARATION

After we get the final design, we need to prepare all of the material that we need to fabricate the shoes rack. Below are all the parts that are needed

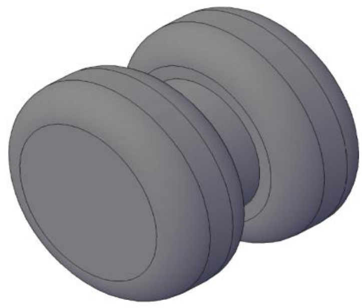


Figure 3.6: Wheel

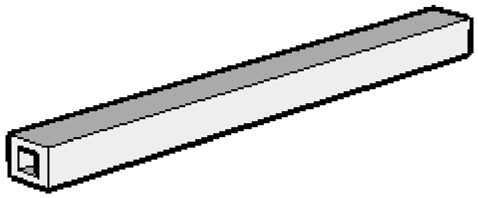


Figure 3.7: Hollow Steel

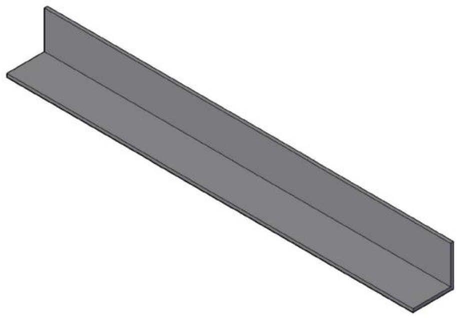


Figure 3.8: Angle Bar

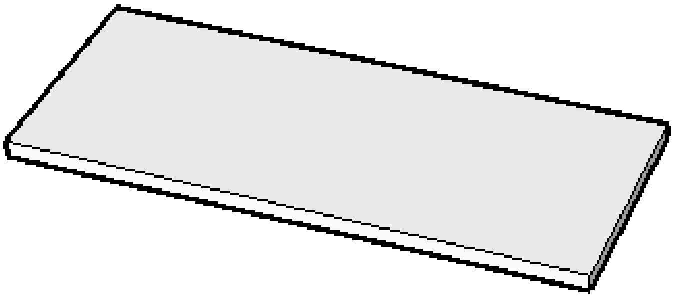


Figure 3.9: Polycarbonate

The table of Bill of Material below shows the dimension and the quantity of all the parts that are going to use to fabricate the shoes rack.

Table 3.2: Bill of Material

No.	Parts	Dimension (mm)	Quantity
1.	Wheel	50 mm Dia.	4
2.	Hollow Steel	600 x 50 x 50	2
3.	Hollow Steel	950 x 50 x 50	4
4.	Hollow Steel	1100 x 20 x 20	12
5.	Hollow steel	350 x 20 x 20	6
6.	Poly Carbonate	1200 x 500	1
7.	Poly Carbonate	1050 x 500	2
8.	L Bar	350 x 40 x 40	6

3.8 FABRICATION PROCESS

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

3.8.1 Measuring and Marking

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

To perform this process, we will need a measuring tape and scriber to measure the work piece.

(a) Using measuring tape **(b)** Using scriber

Figure 3.10: Marking Process

3.8.2 Cutting

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

(a) Using floor cutting disc **(b)** Using knife

Figure 3.11: Cutting Process

3.8.3 Drilling

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

(a) Using press drilling

(b) Using hand drill

Figure 3.12: Drilling Process

3.8.4 Joining

As the parts are cut, the joining process will take place to join all the parts. There are two process uses to join the parts which are welding and fastening. The machines use for welding process is Metal Inert Gas (MIG) welding.

Figure 3.13: Welding Process Using MIG

3.8.5 Grinding and Filing

The purpose of that using grinder is to remove chip, rough surface and sharp edge because it can cause accident and injuries to user. Beside that, we using grinder to get good finishing surface at the joining.

Figure 3.14: Grinding Process Using Grinder

3.8.6 Painting

After all of sharp edges is removed, the shoes rack is ready for the second last process which is removed rough surface using sand paper and painting.

(a) Using sand paper

(b) Using spray

Figure 3.15: Painting Process

3.8.7 Fastening

The last process after finish painting is join the plastic part using fastening tool.

Figure 3.16: Fastening Process Using Rivet

CHAPTER 4

RESULTS AND DISCUSSION

4.1 INTRODUCTION

The final fabrication of the shoes rack 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

After finish the fabrication, the result shown as the figure above:

Figure 4.1: Isometric View

Figure 4.2: Front View

Figure 4.3: Side View

4.2.1 Product Specification

This is another example of analysis process. The product specification is shown on the table below:

Table 4.1: Product Specification

CATEGORIES	RESULT
Length	1200mm
Width	500mm
Height	1000mm
Weight	15 kg
Maximum shoes can be load	15
Colour	Blue black

4.2.2 Cost Analysis

Some of the material that need to be purchased such as the thing that not available in mechanical laboratory:

Table 4.2: Cost Analysis

PART	PRICE	QUANTITY	TOTAL
Spray	RM 6.00	2	RM 12.00
Rivet	RM 2.50	For 50 unit	RM 2.50
Poly carbonate	RM 50.00	For 1300mm x 2000mm	RM 50.00
Roller	RM 12.00	For 4 unit	RM 12.00
Rubber cover	RM 1.00	4	RM 4.00

4.2.2 Stress Analysis

This example analysis of a shoes rack when have a load:

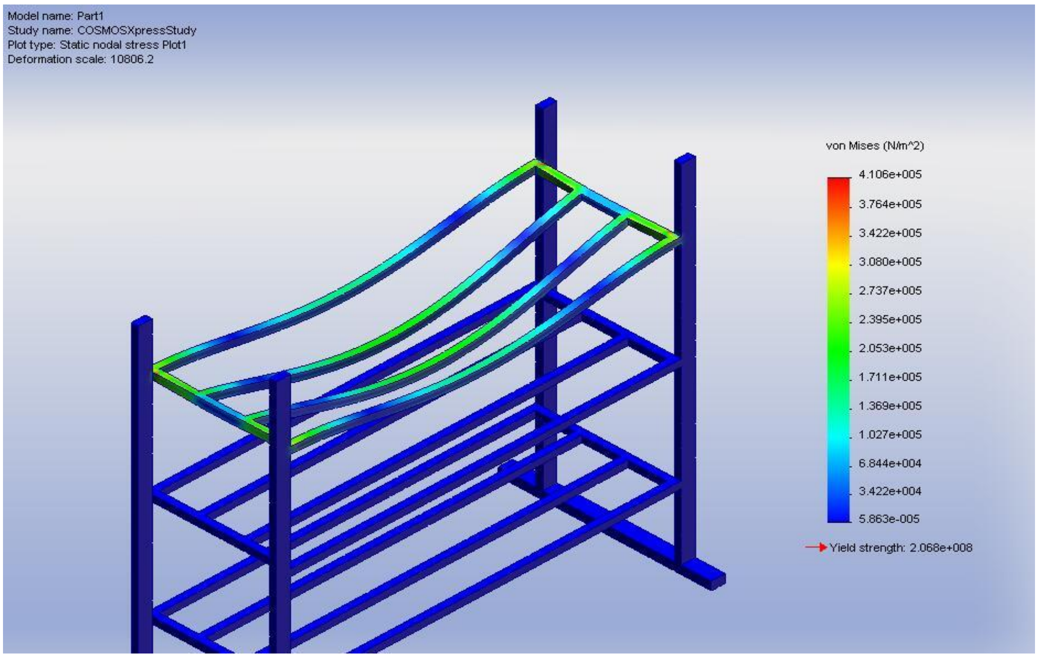


Figure 4.4: Normal Stress on the Rack

From the analysis, the maximum value of normal stress when 30 N load is applied on the shoes rack is 410616 N/mˆ². It indicates that the highest stress occur at the area when load is applied on it. After analysis by using COSMOS software, the higher stress is at the rack. The area is involved in high stress because load from shoes is applied on it.

4.2.4 Displacement from Load on the Shoes Rack

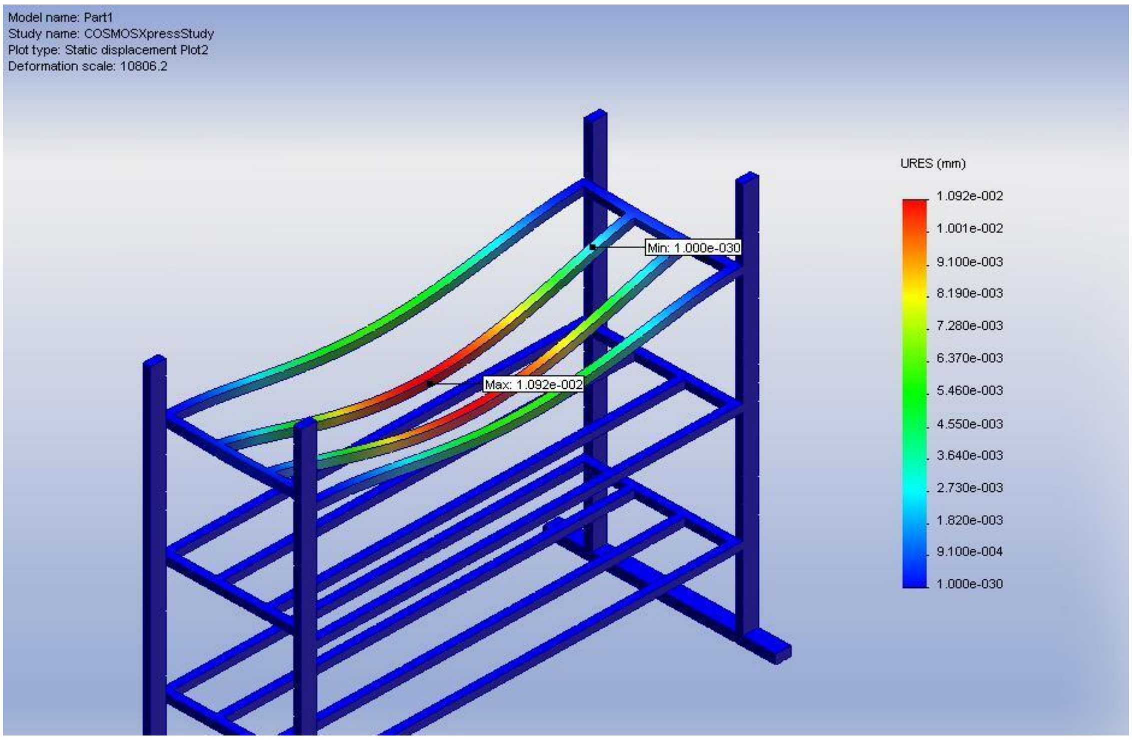


Figure 4.5: Displacement Result on the Shoes Rack after Performing the Analysis

In the analysis, the result of displacement is 0.0109197 mm. Consequence from the load applied on the rack is there is a displacement happen at the certain part. However, the displacement is too little if the part can withstand from a certain load. The large value of displacement on the certain area will consume that the part can’t withstand with the certain load.

The area colour with red colour shown that it is the most involved area that effected in displacement after load is given. The areas that consist of blue colour are totally not or less effected in displacement.

4.3 DISCUSSION

In this project, several observations have been done with respect to the fabrication of the shoes rack. The outcome design and fabricate of shoes rack was achieve the objective of this project. The shoes rack can function in good condition for example the shoes rack can be move and the shoes rack can protect shoes from rain.

Besides that, this material can be corrosion if it surface exposed with oxygen and water. The painting method can be used to prevent this problem.

Figure 4.6: Corrosion on the Steel

During fabrication process, there are so many things happen such as defect. This defect happens because lacks of skill to operate a machine such as when handling MIG welding machine. Although this problem happened, its can gives an experience to avoid the same problem to be repeated again at the future.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

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

5.2 CONCLUSION

The objectives of the project that are to design and fabricate of shoes rack are successfully done and achieved. Although there are a lot of obstacles, the project can finish within the given time. There are many things throughout this project such as skill and knowledge that we can get especially during fabrication process. These valuable experiences get will be useful in the future.

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

5.3 RECOMMENDATION

5.3.1 Design

The shoes rack that I have made can only protect shoes from normally rain or highly rain. For the future, we can made the new design of shoes rack with is make a full cover to make the shoes rack can full protect shoes from rain.

5.3.2 Space

Before that, the space of the shoes rack very small and can be load only 15 shoes at the same time. For the future, we can make the large space of shoes rack and the shoes rack can be load at least 50 shoes at the same time.

5.3.3 Other Material

Maybe in the future, we can change the material to make a shoes rack stronger. Not only the material is stronger and light weight so that it can easily be move around the workplaces. For example use stainless steel as the material is better because it can protect the shoes rack from rust, stronger and light weight.

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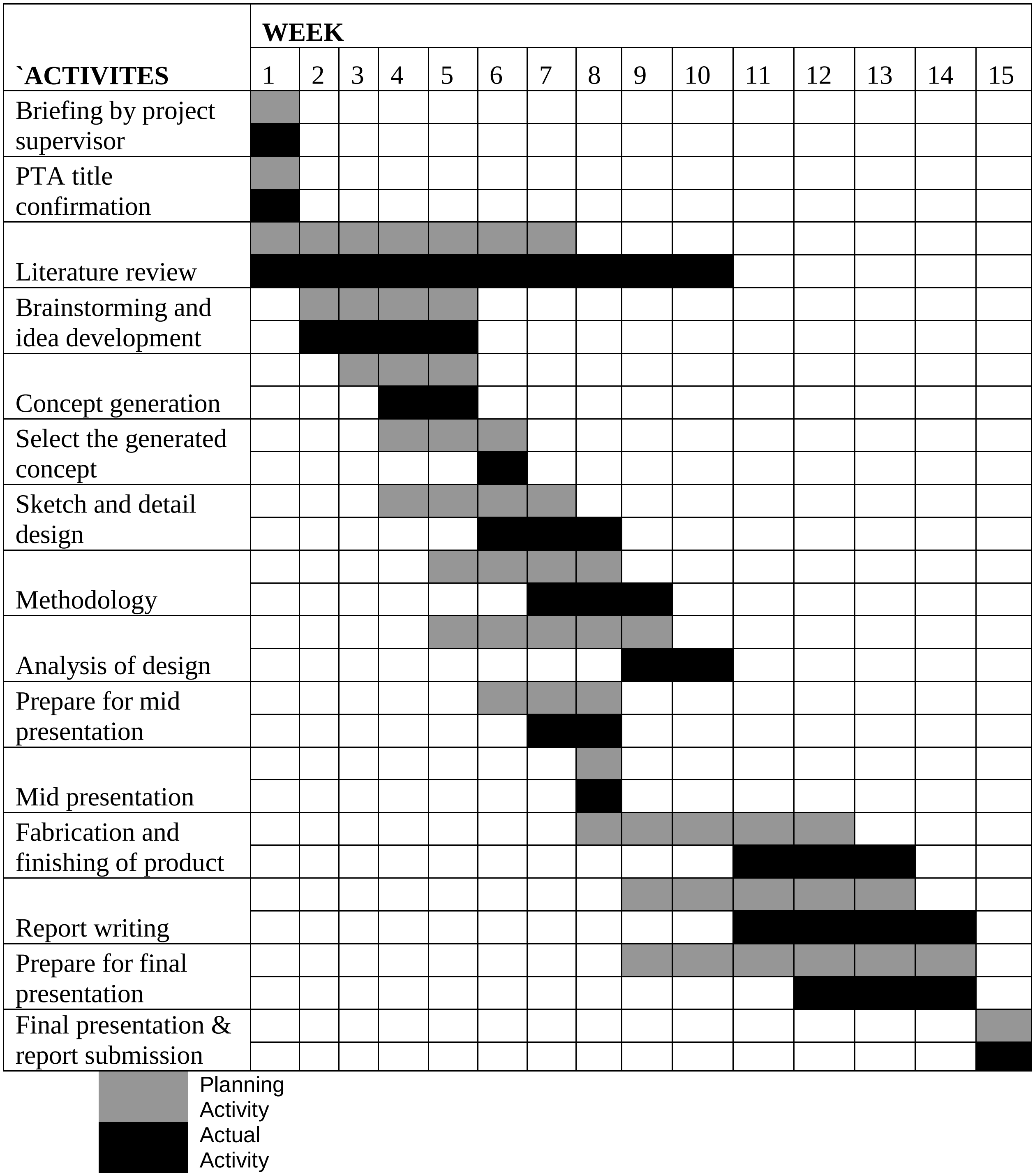
APPENDIX A

GANTT CHART


WEEK
`ACTIVITES
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Briefing by project supervisor
PTA title confirmation
Literature review
Brainstorming and idea development
Concept generation
Select the generated concept
Sketch and detail design
Methodology
Analysis of design
Prepare for mid presentation
Mid presentation
Fabrication and finishing of product
Report writing
Prepare for final presentation
Final presentation & report submission
Planning Activity
Actual Activity

GANTT CHART

APPENDIX B

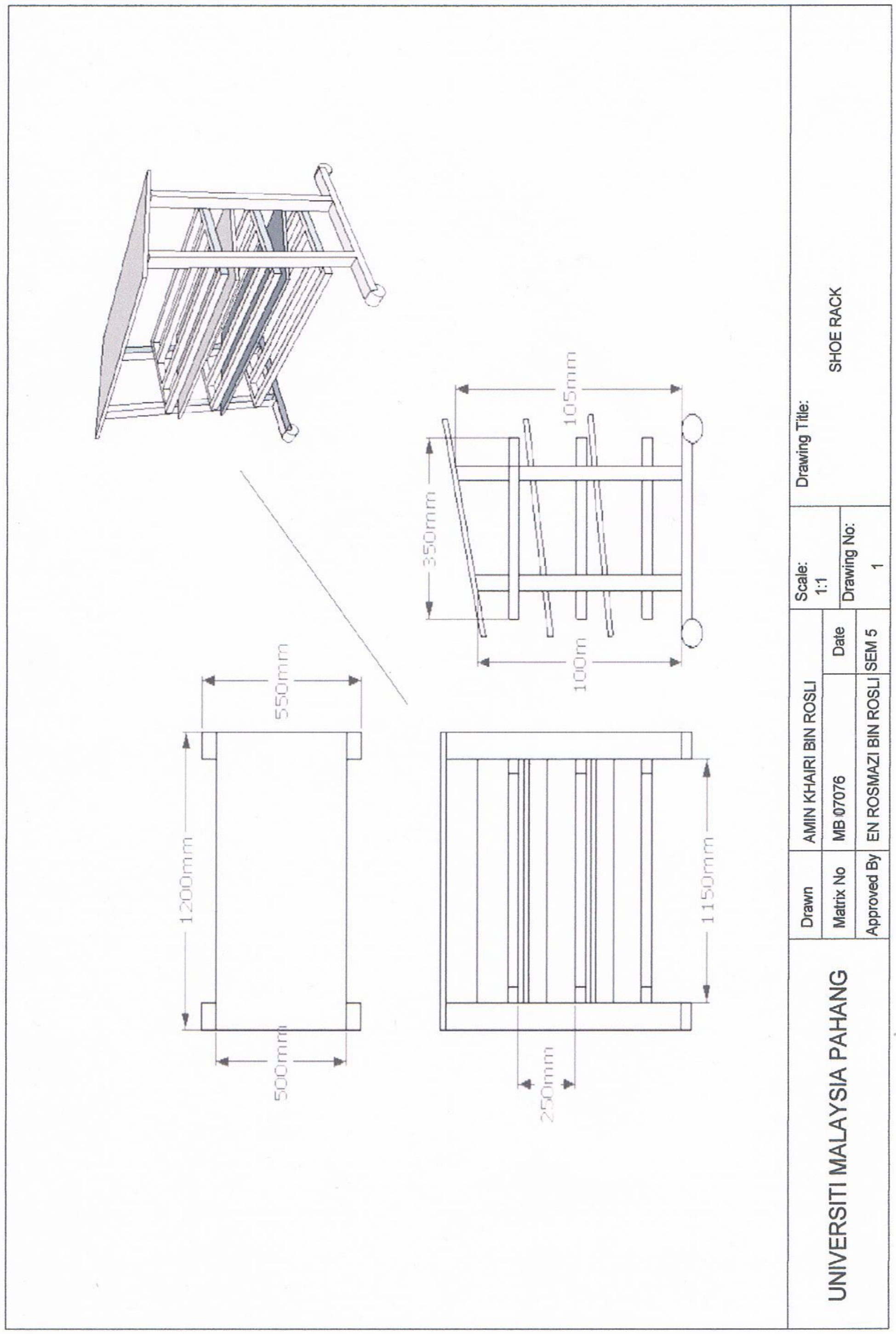
TYPICAL OF YIELD STRENGTH

TYPICAL YIELD STRENGTH

Material	**Yield strength (MPa)**	**Ultimate strength (MPa)**	**Density (g/cm^3)**
Structural steel ASTM A36 steel	250	400	7.8
Steel, API 5L X65 (Fikret Mert Veral)	448	531	7.8
Steel, high strength alloy ASTM A514	690	760	7.8
Steel, prestressing strands	1650	1860	7.8
Steel Wire			7.8
Steel (AISI 1060 0.6% carbon) Piano wire	2200-2482 MPa		7.8
Stainless steel AISI 302 - Cold-rolled	520	860	
Cast iron 4.5% C, ASTM A-48	276 (??)	200	
Titanium alloy (6% Al, 4% V)	830	900	4.51
Aluminium alloy 2014-T6	400	455	2.7
Copper 99.9% Cu	70	220	8.92
Cupronickel 10% Ni, 1.6% Fe, 1% Mn, balance Cu	130	350	8.94
Brass	approx. 200+	550	5.3
Tungsten		1510	19.25
Glass		50 (in compression)	2.53

APPENDIX C

DRAWING


1200mm
500mm
550mm
250mm
1150mm
350mm
100mm
105mm
UNIVERSITI MALAYSIA PAHANG
Drawn
AMIN KHAIRI BIN ROSLI
Matrix No
MB 07076
Date
Approved By
EN ROSMAZI BIN ROSLI
SEM 5
Scale:
1:1
Drawing No:
1
Drawing Title:
SHOE RACK