DESIGN AND FABRICATION OF MICROWAVE OVEN RACK AT THE WEST STATION FOOD OUTLET

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BORANG PENGESAHAN STATUS TESIS ◆

JUDUL: DESIGN AND FABRICATION OF MICROWAVE OVEN RACK AT THE WEST STATION FOOD OUTLET

SESI PENGAJIAN: 2012/2013

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MOHD HAFIZUL HAKIM BIN BASHARUDIN

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

Faculty of Mechanical Engineering
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DECEMBER 2012

SUPERVISOR'S DECLARATION

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

Signature :

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

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ABSTRACT

This report presents about the hangingmicrowave oven rack that usually used for place the microwave oven especially at kitchen. This is the device which important in order to place the microwave oven easily, and can save the workplace utilization in kitchen. Besides that, it also has other function like ventilation system where it used to reduce the hot air or smoke surrounding which cause by the microwave oven.. The idea of the fabricatefor this hanging rack is based on student's creativity. The selection of suitable materials in the fabricating of this hanging rack is a loaded material which has ease to form, long life-span, can detain heavy load and corrosion resistance. Materials are used for the fabrication of the hanging rack is a galvanized plate and mild steel.

ABSTRAK

Laporan ini membentangkan tentangrak gantung ketuhargelombang mikroyangbiasanya digunakanuntuktempatketuhar gelombang mikroterutamadi dapur. Iniadalahalatyangpentingdalam usahauntuk meletakkanketuhar gelombang mikrodenganmudah, dan bolehmenjimatkanpenggunaantempatkerjadi dapur. Selain itu, ia juga mempunyaifungsilain sepertisistem pengudaraandi manaia digunakan untukmengurangkanudara panasatau asapsekitaryangmenyebabkanolehketuhar gelombang mikro. Ideauntuk membetukanrakiniadalahberdasarkankreativitipelajar. Pemilihanbahan-bahanyangsesuaidalamrekarakgantung iniadalahbahan yangdimuatkanyangmempunyaimudahuntuk membentuk, jangkahayat yang panjang, boleh menahanbeban yang beratdan rintangan terhadap karat. Bahanyang digunakan untukmembentukanrakgantungadalah“*galvanized plate*” dan“*mild steel”.*

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LIST OF SYMBOLS

mm	Milimeter
cm	Centimeter
∑	Sum

LIST OF ABBREVIATIONS

CAD	Computer Aided Design
MIG	Metal Inert Gas Welding
SMAW	Shielded metal arc welding
UMP	UniversitiMalaysia Pahang

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

This chapter explained about the project background, project objectives, project scope, and problem statement that been conducted.

1.2 BACKGROUND

Microwave ovens are a common utility in the kitchen, used as a quick method for heating leftovers, thawing frozen foods or cooking an entire meal. They use heat coils to heat the food. Microwave ovens are often heavy and require a stable and solid place in the kitchen. There are few ways to place a microwave oven in the kitchen. For an example microwave oven are place at the cabinet,at the microwave oven rack either at the hanging microwave oven rack.

1.3 PROBLEM STATEMENT

1) The microwave oven rack is not strategic located in the kitchen at the west station food outlet which is on the floor.
2) Not much space in the kitchen for the microwave oven.
3) Will cause some difficulties for the worker to do their work in the kitchen.
4) The owner of west station food outlet want the hanging microwave oven rack.

1.4 OBJECTIVE

The objective of this project are:

1) To design and fabricate the hanging microwave oven rack at the west station food outlet.
2) To reduce the workspace utilization in the kitchen.

1.5 SCOPE OF WORK

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

1) Focused on the fabricate the hanging microwave oven rack.
2) Focused on small kitchen at the west station food outlet.
3) Focused on the hanging rack that can support the load between 6-9 kg.

1.6THESIS ORGANISATION

Chapter 1- Introduction

Chapter 2- Literature review

Chapter 3- Methodology

Chapter 4- Result and discussion

Chapter 5- Conclusion and recommendation

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

The purpose of this chapter is to provide a review of past research efforts related to the hanging microwave oven rack. A review of other relevant research studies is also provided. Substantial literature has been studied on history, types of microwave oven rack and material needed.

2.2 TYPE OF MICROWAVE OVEN RACK

2.2.1 Microwave Oven Stand

This micorwave oven stand with storage area below is a convenient practical unit that has many uses. It is great for storage of microwave oven and everyday kitchen items such as bowl,cup and others. This microwave oven stand is made from stainless steel. It comes in the size of 24cm x 12cm x 13cm.

The advantages of this product are :

1) Can store kithchen items.
2) Conventional.
3) Hard to corrode.
4) Long lasting.

The disadvantages of this product are :

1) Hard people to use microwave oven because force them to bow.
2) Need space in the kitchen to place this rack in the bottom.

Figure 2.1: Microwave oven stand

Source: Home care life style

2.2.2 Microwave Oven Cart

This microwave oven cart is featuring two fixed shelves for extra storage and a stainless steel metal frame, this kitchen helper is as functional and durable as it is attractive. Four side hooks allow to store those utensils or pans that just won't fit in cabinets or drawers. With four casters mounted on the bottom, we can easily move your microwave oven cart from one location to another. Clean-up is simple with a damp cloth. This microwave oven cart is made of stainless steel and come with dimension of 26cm x 18cm x 52cm.

The advantages of this product are :

1) Easy to be used in the kitchen.
2) Hard to corrode.
3) Can store kitchen items.
4) Attractive.
5) Long lasting.

The disadvantages of this product are :

1) Hard people to use microwave oven because force them to bow.
2) Need space in the kitchen to place this rack in the bottom.

Figure 2.2: Microwave oven cart

Source: Home and garden

2.2.3 Microwave oven Shelf

As the same as previos rack,this rack is made of stainless steel. But the different is this rack is hanging microwave oven rack. This hanging microwave oven rack comes with dimension of 24cm x 16cm x 14cm. It looks simple but can save the place in the kitchen plus easy to be used.

The advantages of this product are :

1) Easy to be used in the kitchen.
2) Can reduce workspace utilization in the kitchen.
3) Hard to corrode.
4) Conventional

The disadvantages of this product are :

1) Does not last long.
2) Can not support too heavy microwave oven.
3) Can not store kitchen items.

Figure 2.3: Microwave oven shelf

Source: Chef in training

2.2.4 Microwave Oven Wall Shelf Stainless Steel

This hanging microwave oven rack is same as the previous rack which is made from stainless steel. The size of this hanging microwave oven rack is 25cm x 16cm x 16cm. This hanging microwave oven rack will hold 24cm wide microwave oven. The top is designed to hold cups,canister or general bric-a-brac. It also include 3 stainless steel hooks for hanging small pots,cups and others. The hole cutout for power cord or plug.

The advantages of this product are :

1) Easy to assemble and install.
2) Easy to be used in the kitchen.
3) Hard to corrode.
4) Can reduce the workspace utilization in the kitchen.
5) Can store kitchen items.

The disadvantages of this product are :

1) Does not last long.
2) Can not support too many heavy kitchen items

Figure 2.4: Microwave oven wall shelf stainless steel

Source: Kitchen source

2.3 TYPE OF MATERIAL

2.3.1 Mild Steel

Mild steel is a type of steel that only contains a small amount of carbon. It is softer and more easily shaped. It also bends instead of breaking. It is used in nails and some types ofwire. Can be used to make bottle openers.The properties of mild steel and its uses in various fields of technology are mild steel has a maximum limit of 2% carbon in the manufacture of carbon steel, the proportions of manganese (1.65%), copper (0.6%) and silicon (0.6%) are fixed, while the proportions of cobalt, chromium, niobium, molybdenum, titanium, nickel, tungsten, vanadium and zirconium are not. Next is high amount of carbon makes mild steel different from other types of steel. Carbon makes mild steel stronger and stiffer than other type of steel. However, the hardness comes at the price of a decrease in the ductility of this alloy. Carbon atoms get affixed in the interstitial sites of the iron lattice and make it stronger.What is known as mildest grade of carbon steel or 'mild steel' is typically carbon steel, with a comparatively mild amount of carbon (0.16% to 0.19%). It has ferromagnetic properties, which make it ideal for manufacture of electrical devices and motors. Plus, the calculated average industry grade mild steel density is 7.85 gm/cm3. Its Young's modulus, which is a measure of its stiffness is around 210,000 MPa.Mild steel is the cheapest and most versatile form of steel and serves every application which requires a bulk amount of steel. Lastly, the high amount of carbon, also makes mild steel vulnerable to rust. Naturally, people prefer stainless steel over mild steel, when they want a rust free technology. Mild steel is also used in construction as structural steel. It is also widely used in the car manufacturing industry.

These are some of the mild steel properties and its uses. Mild steel is used in almost all forms of industrial applications and industrial manufacturing.

Figure 2.5: Microwave oven rack make from mild steel

Source: Dongguan YingguangMetalware Co., Ltd.

2.3.2 Galvanized Plate

Galvanization (or **g**alvanisation) is the process of applying a protective zinc coating to steel or iron, in order to prevent rusting. The term is derived from the name of Italian scientist Luigi Galvani. Although galvanization can be done with electrochemical and electrodeposition processes, the most common method in current use is hot-dip galvanization, in which steel parts are submerged in a bath of molten zinc. In current use, the term refers to the coating of steel or iron with zinc. This is done to prevent rusting of the ferrous item. The value of galvanizing stems from the corrosion resistance of zinc, which, under most service conditions, is considerably greater than that of iron and steel. The zinc serves as a sacrificial anode, so that it cathodically protects exposed steel. This means that even if the coating is scratched or abraded, the exposed steel will still be protected from corrosion by the remaining zinc - an advantage absent from paint, enamel, powder coating and other methods. Galvanizing is also favored as a means of protective coating because of its low cost, ease of application and comparatively long maintenance-free service life.

The term galvanizing, while technically referring specifically to the application of zinc coating by the use of a galvanic cell (also known as electroplating), is also generally understood to include hot-dip zinc coating. The practical difference is that hot-dip galvanization produces a thick, durable and matte

gray coating - electroplated coatings tend to be thin and brightly reflective. Due to its thinness, the zinc of electroplated coatings is quickly depleted, making them unsuitable for outdoor applications (except in very dry climates). When combined with subsequent painting (which slows zinc consumption), electroplating is durable enough to be used in some premium auto body coatings.

Nonetheless, electroplating is used on its own for many outdoor applications because it is cheaper than hot dip zinc coating and looks good when new. Another reason not to use hot dip zinc coating is that for bolts and nuts size M10 (US 3/8") or smaller, the thick hot-dipped coating fills in too much of the threads, which reduces strength (because the dimension of the steel prior to coating must be reduced for the fasteners to fit together). This means that for cars, bicycles and many other 'light' mechanical products, the alternative to electroplating bolts and nuts is not hot dip zinc coating but making the bolts and nuts from stainless steel (known by the corrosion grades A4 and A2).

Electroplated steel is visually indistinguishable from stainless steel when new. To determine whether a part is electroplated or stainless steel, apply a magnet. The most common stainless steel alloys (including those used for bolts and nuts) are not magnetic or only very slightly attracted to a magnet.

Figure 2.6: Microwave oven rack make from galvanized plate

Source: Globe equipment company

2.4 WELDING

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

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

Figure 2.7: Welding process

Source: Wikipedia (1995)

2.4.1 Arc Welding

One of the most common types of arc welding is shielded metal arc welding (SMAW), which is also known as manual metal arc welding (MMA) or stick welding. Electric current is used to strike an arc between the base material and consumable electrode rod, which is made of steel and is covered with a flux that protects the weld area from oxidation and contamination by producing CO_2 gas during the welding process. The electrode core itself acts as filler material, making separate filler unnecessary.

The process is versatile and can be performed with relatively inexpensive equipment, making it well suited to shop jobs and field work. An operator can become reasonably proficient with a modest amount of training and can achieve mastery with experience. Weld times are rather slow, since the consumable electrodes must be frequently replaced and because slag, the residue from the flux, must be chipped away after welding. Furthermore, the process is generally limited to welding ferrous materials, though special electrodes have made possible the welding of cast iron, nickel, aluminum, copper, and other metals. Inexperienced operators may find it difficult to make good out-of-position welds with this process.[6]

2.4.2 MIG Welding

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. [6]

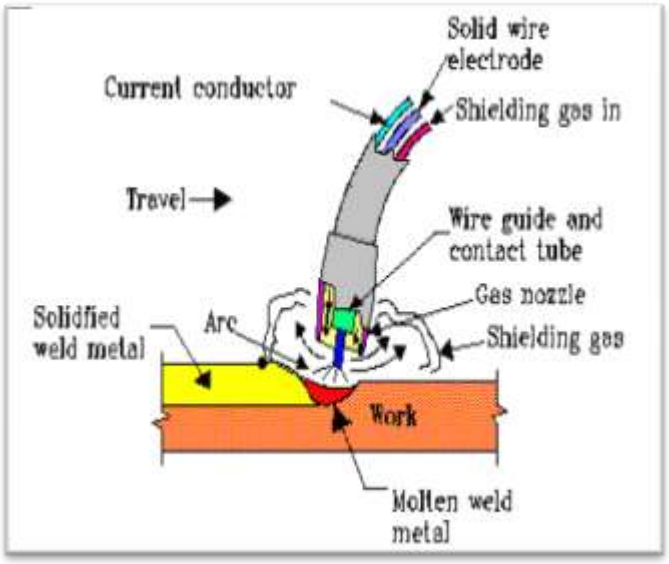

Figure 2.8: Schematic of Metal Inert Gas (MIG) Welding

Source: Wikipedia (1995)

2.5 DRILLING

Drilling is easily the most common machining process. One estimate is that 75% of all metal-cutting material removed comes from drilling operations. Drilling involves the creation of holes that are right circular cylinders. This is accomplished most typically by using a twist drill, something most readers will have seen before. The chips must exit through the flutes to the outside of the tool. As can be seen in the figure, the cutting front is embedded within the work piece, making cooling difficult. The cutting area can be flooded, coolant spray mist can be applied, or coolant can be delivered through the drill bit shaft.

2.5.1 Drill Press

A typical manual drill press is shown in the figure below. Compared to other powered metal cutting tools, a drill press is fairly simple, but it has evolved into a versatile necessity for every machine shop.

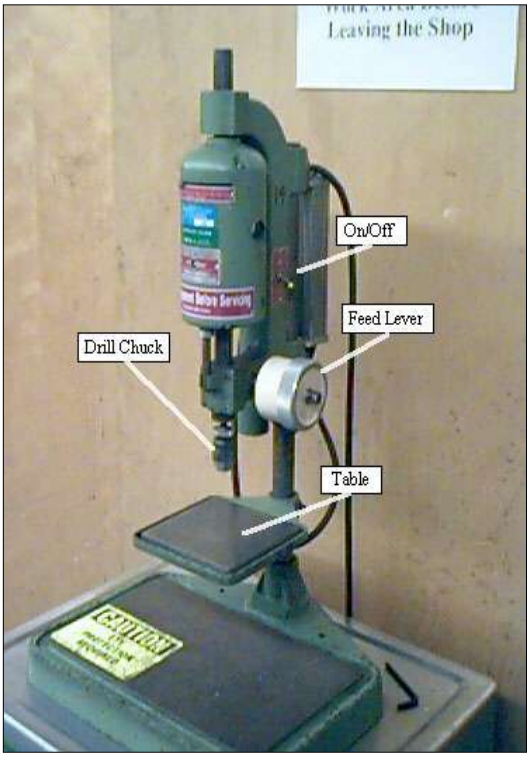

Figure 2.9: Drill Press Machine

Source: Wikipedia (1997)

2.5.2 Hammer Drill

The hammer drill is similar to a standard electric drill, with the exception that it is provided with a hammer action for drilling masonry. The hammer action may be engaged or disengaged as required. Most electric hammer drills are rated (input power) at between 600 and 1100 watts. The efficiency is usually 50-60% i.e. 1000 watts of input is converted into 500-600 watts of output (rotation of the drill and hammering action).

The hammer action is provided by two cam plates that make the chuck rapidly pulse forward and backward as the drill spins on its axis. This pulsing (hammering) action is measured in Blows Per Minute (BPM) with 10,000 or more BPMs being common. Because the combined mass of the chuck and bit is comparable to that of the body of the drill, the energy transfer is inefficient and can sometimes make it difficult for larger bits to penetrate harder materials such as poured concrete. The operator experiences considerable vibration, and the cams are generally made from hardened steel to avoid them wearing out quickly. In practice, drills are restricted to standard masonry bits up to 13 mm (1/2 inch) in diameter. A typical application for a hammer drill is installing electrical boxes, conduit straps or shelves in concrete.

In contrast to the cam-type hammer drill, a rotary/pneumatic hammer drill accelerates only the bit. This is accomplished through a piston design, rather than a spinning cam. Rotary hammers have much less vibration and penetrate most building materials. They can also be used as "drill only" or as "hammer only" which extends their usefulness for tasks such as chipping brick or concrete. Hole drilling progress is greatly superior to cam-type hammer drills, and these drills are generally used for holes of 19 mm (3/4 inch) or greater in size. A typical application for a rotary hammer drill is boring large holes for lag bolts in foundations, or installing large lead anchors in concrete for handrails or benches.

A standard hammer drill accepts 6 mm (1/4 inch) and 13 mm (1/2 inch) drill bits, while a rotary hammer uses SDS or Spline Shank bits. These heavy bits are adept at pulverising the masonry and drill into this hard material with relative ease.

Figure 2.10: Hammer drill

Source: Wikipedia (1997)

2.6 GRINDING PROCESS

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 2.11: Hand grinder

Sources: Tradevv, Grinder (2005)

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

This chapter discusses about all the information and data that required and fabrication process for this project. Firstly, to design the hanging microwave oven rack skill in drawing and time is required. This kind of data is required to design the concept of hanging microwave oven rack.

3.2 OVERALL RESEARCH METHODOLOGY

Overall this project is following the flow chart from take the title from the supervisor, then the second task from taking the title is finding the related literature review for the project given. Then, sketch some design of the hanging microwave oven rack to be choose the best design using concept screening method. After that, draw the final design selected using Solid Work. After the fabrication is finish, the report documentation is writing do describe all the process since the beginning to the end of the project. Figure 3.1 shows the flow chart of the PTA project.

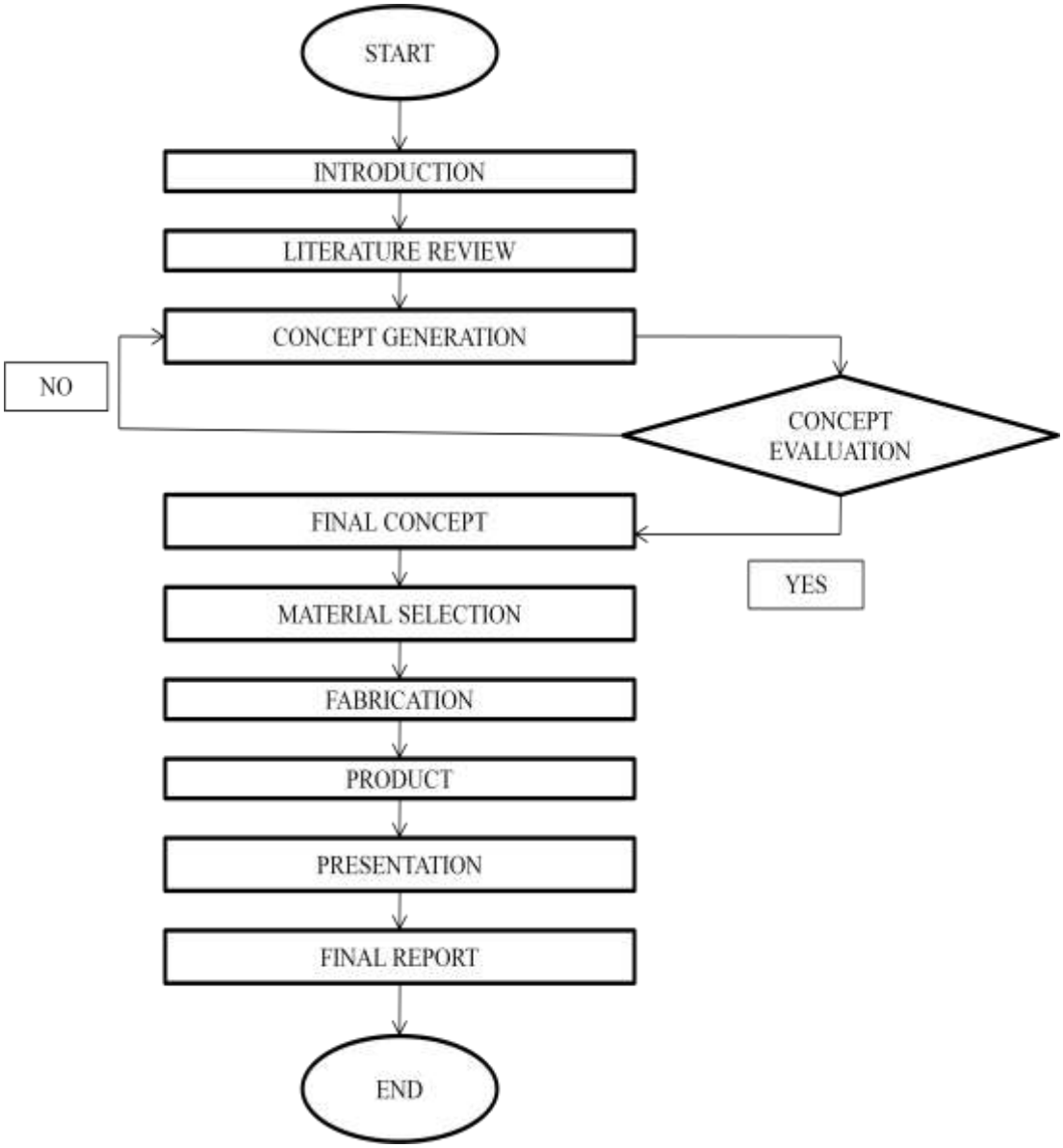

Figure 3.1: Flow chart

3.3 DESIGN

The design of the hanging rack must be compliance to several aspects. The design consideration must be done carefully so to the design can be fabricated and functioned well. The aspect that must be considered in designing the hanging rack are:

3.3.1 Ergonomic factors : The hanging rack must be user friendly as easy to use and convenience.The hanging rack should be easy to install it and easy to use it.

3.3.2 Safety : The hanging rack must be the characteristic of safety since it is used for heat the food. The hanging rack should not be danger to the user that will cause wound or injury if touch the hanging rack.

3.3.3 Hygiene : The hanging rack must be stainless since it used for food. This is because the rusting rack would effect to the food that used the microwave oven which lead to the food poisoning.So that, the material selection to fabricate the hanging rack is very important.

3.4 DRAWING

The drawing divided into two categories which are:

3.4.1 Sketching: All the ideas for the rack's fabrication are sketched first so that the idea selection can be made. The sketching is made by using pencil on A4 paper. There are three types of sketching before the final concept is made.

3.4.2 Solid modeling: The final concept is transfer to solid modeling by Solidwork software. The final concept is based on the sketching and with an additional improvement to the product so that it will fulfill the all aspect for the hanging microwave oven rack. The dimension of the hanging microwave oven rack also will show for the final concept.

3.5 DESIGN SELECTION

From the exist ideas, only three sketching that had been chosen to be consideration as the final idea which are:

3.5.1 First concept

FIGURE 3.2: Concept A

The advantages of this hanging microwave oven rack are:

1) Easy to install.
2) Easy to be used in the kitchen.
3) Can reduce the workspace utilization in the kitchen.
4) Hard to corrode.

The disadvantages of this hanging microwave oven rack are:

1) Can not store other kitchen items.
2) Does not long lasting.
3) Does not attractive.

3.5.2 Second concept

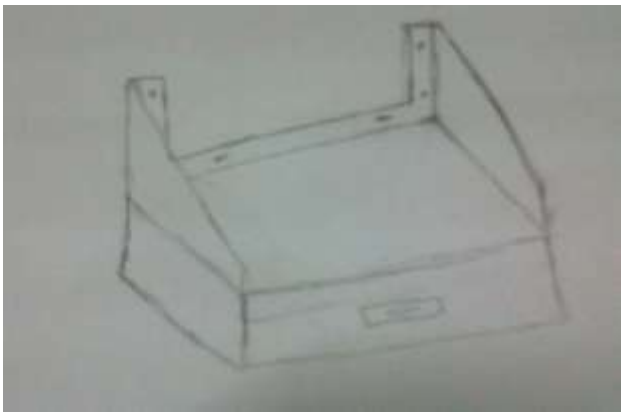

FIGURE 3.3: Concept B

The advantages of this hanging microwave oven rack are:

1) Easy to be used in the kitchen.
2) Hard to corrode.
3) Easy to be install.
4) Can reduce the workspace utilization in the kitchen.
5) Can store other kitchen items.

The disadvantages of this hanging microwave oven rack are:

1) Does not attractive.
2) Does not long lasting.

3.5.3 Third concept

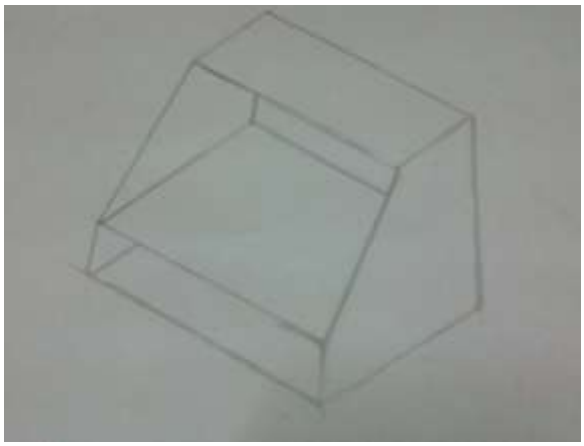

FIGURE3.4: Concept C

The advantages of this hanging microwave oven rack are:

1) Easy to be used in the kitchen.
2) Can queue other food at the below microwave oven.
3) Hard to corrode.
4) Attractive.
5) Can reduce the workspace utilization in the kitchen.
6) Easy to install.

The disadvantages of this hanging microwave oven rack are:

1) Does not long lasting.

3.5.4Concept Generation And Evaluation

Three design for the hanging microwave oven rackwere are develop then evaluated against the datum of the hanging rack using Pugh concept. Concept comparable is shown in **table 3.5**

Table 3.5: Pugh's Selection Method

CRITERIA	CONCEPT		
	A	B	C
Easy to install	+	+	+
Easy to use	+	+	+
Corrosion resistance	+	+	+
Long lasting	-	-	-
Attractive	-	-	+
Multipurpose	-	+	+
Save workplace utilization in kitchen	+	+	+
∑+	4	5	6
∑-	3	2	1
Netscore	1	3	5
Ranking	3	2	1

"-" : worse that "+" : better than

Concept C was chosen as final design and with additional of ventilation system so that the hanging rack would not surround with hot air that can cause the hanging rack to damage slowly.

3.5.5 Finalize design

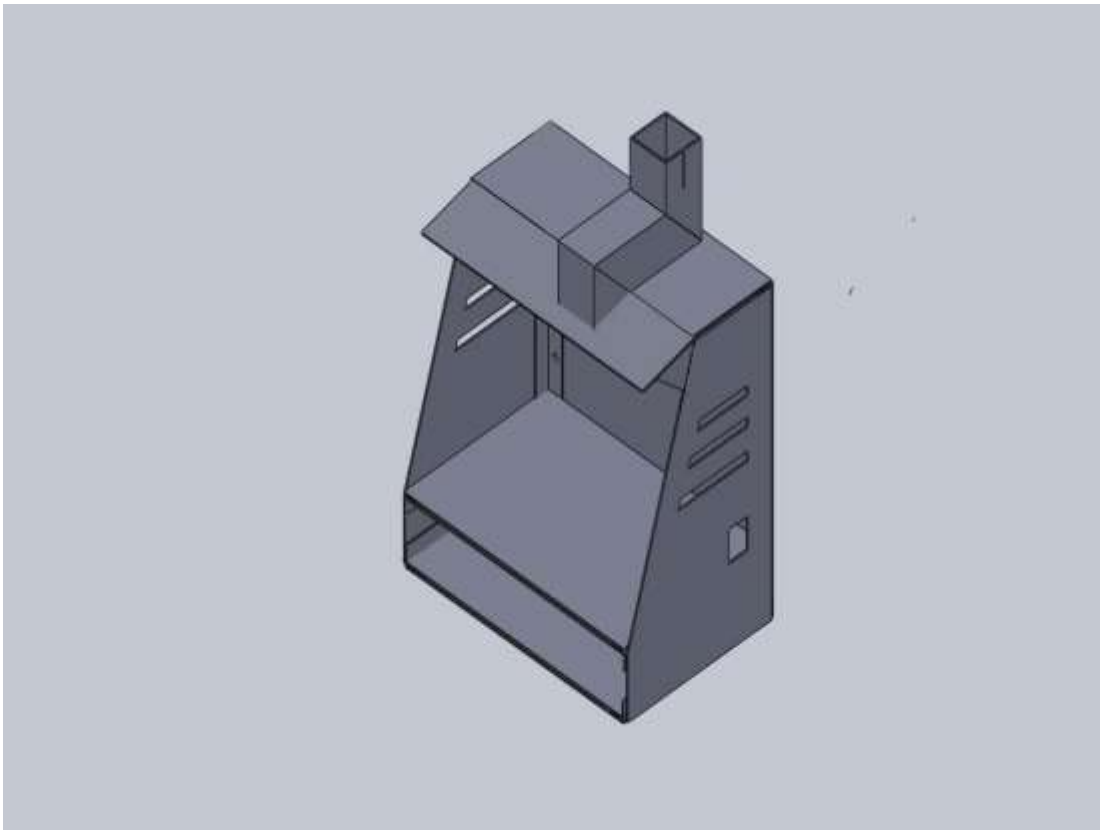

Figure 3.6: Final design in three dimensional

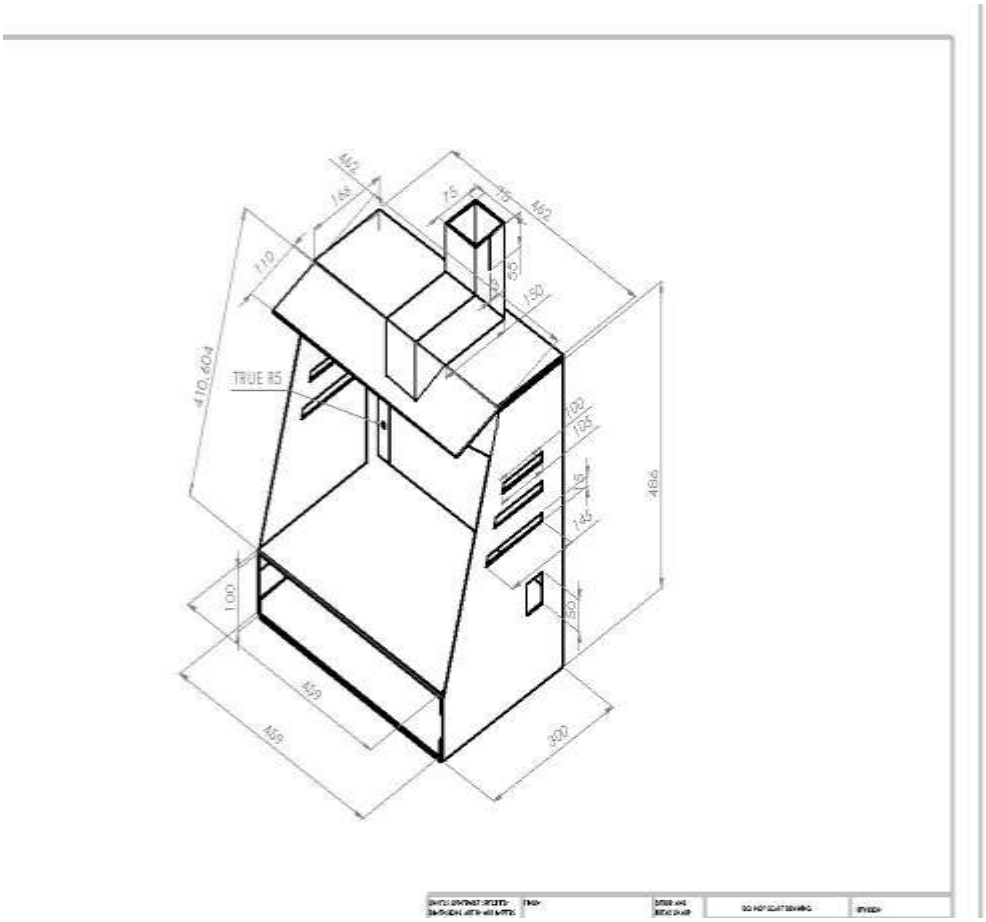

Figure 3.7: Final design in two dimensional with dimension in milimeters

3.6 MATERIAL SELECTION

Table 3.8: Bill of material

No.	Material	Dimension	Quantity
1	Electrode galvanized (sheet metal)	1218mm x 2438mm x 1mm	7
2	Angle bar	32mm x 32mm x 3mm	10
3	Flat bar	15mm x 2mm	3
4	Hollow bar	75mm x 75mm x 2mm	3
5	Wall plug	Dia-9mm x 50mm	4

3.7 FABRICATION

After designing phase, comes fabrication process. These processes is about using the material Selection and make the product base on the design and by followed the design dimension. Many methods can be used to fabricate a product, like welding, fastening, cutting, drilling and many more method. 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. In the project fabrication process needed to make the base plate, framework of display board and display board. Fabrication process was used at the whole system production. This was include part by part fabrication until assembly to others component.

3.7.1 Fabrication flow

Figure 3.10 shows the fabrication flow chart for this project. This project consists of seven phases, which are:

1) Phase 1 – Measure the dimension
2) Phase 2 – Marking the dimension
3) Phase 3 – Cut the material
4) Phase 4 – Welding the material
5) Phase 5 – Drill
6) Phase 6 – Finishing
7) Phase 7 - Painting

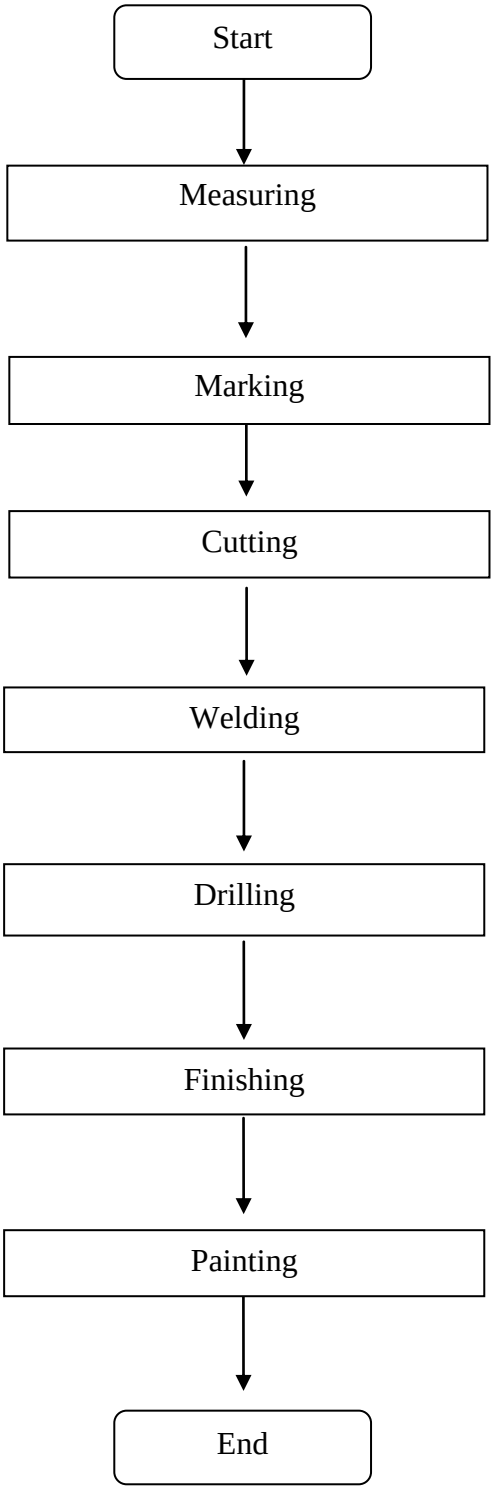

Figure 3.9: Fabrication flow chart

3.7.2 Fabrication Process

In order to make the design come to reality, fabrication process needs to be done first. The fabrication process starts from dimensioning the raw material until it is finish as a desired product. The processes that involved are:

1) Measuring Process

The materials are measured to desire dimensions or location based on design specification.All the measuring process is done measuring tape.

Figure 3.10: Measure the material using measuring tape

2) Marking Process

All measured materials need to be marked to give precise dimension by using steel marker.

Figure 3.11: Marking the material using steel marker

3) Cutting Process

The marked materials were cut into several pieces by using Grinding Machine.

Figure 3.12: Cutting materials by using grinding machine

4) Drilling

Then, the marked holes were drilled for wall plug placing to hang the rack.

Figure 3.13: Drilling process

5) Welding Process

The material joined by using welding method

Figure 3.14: Welding process

6) Finishing Process

Any rough surface cause by welding spark were grind to give smooth and safe surface using grinding machine and filing by filers and sand paper to give a smooth edge and followed by painting process.

Figure 3.15: Grinding process

7) Painting process

The last process which is to made the hanging microwave oven rack look more attractive.

Figure 3.16: Painting process

CHAPTER 4

RESULT AND DISCUSSION

4.1 INTRODUCTION

The purpose of this chapter is to show the result after fabrication. This chapter will also discuss about the hanging microwave oven rack after fabrication and list out the advantages of this hanging microwave oven rack.

4.2 FINAL PRODUCTS

The final product in several views are shown in figures below.

Figure 4.1: Isometric view of the product

Figure 4.2: Front view of the product

4.3 PRODUCT ADVANTAGES

4.3.1 Ventilation system

The ventilation system can reduce the hot air or smoke surrounding which cause by the microwave oven. This also can make the hanging rack long lasting.

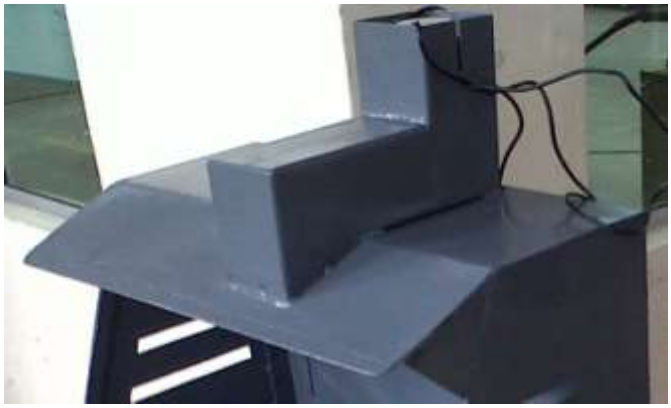

Figure 4.3: Ventilation system

4.3.2 Place for queue the food

The hanging rack also provided for the queue food while waiting the food in the microwave oven ready to served.

Figure 4.4: Place for que the food

4.3.3 Easy install to wall

The hanging rack is easy install to the wall using wall plug.

Figure 4.5: The hole for the wall plug to install the hanging rack at the wall

4.4 DISCUSSION

In this project, several observations have been done with respect to the fabrication of the hanging microwave rack. The outcome hanging microwave oven rack was achieve the objective of this project.

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CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 INTRODUCTION

The purpose of this chapter to give conclusion and recommendation of this project. It will also include the objective of this project whether it is fulfilled or not and gives suggestion to improve the project.

5.2 CONCLUSION

This project has practice and gives more knowledge about many mechanical properties such as machining and many others material during the fabrication process. Besides that,I can gain knowledge about the material type, structure and others else. This product also has produces to make an improvement compare to other microwave rack that had been exist in the market. Finally, the objectives of this project that to design and fabricate has been achieved.

5.3 RECOMMENDATION

The recommendations canimprove this product in the future:

1) Adopt bigger hose for ventilation system.
2) Adopt bigger fan so that it can suck the smoke or hot air effectively.

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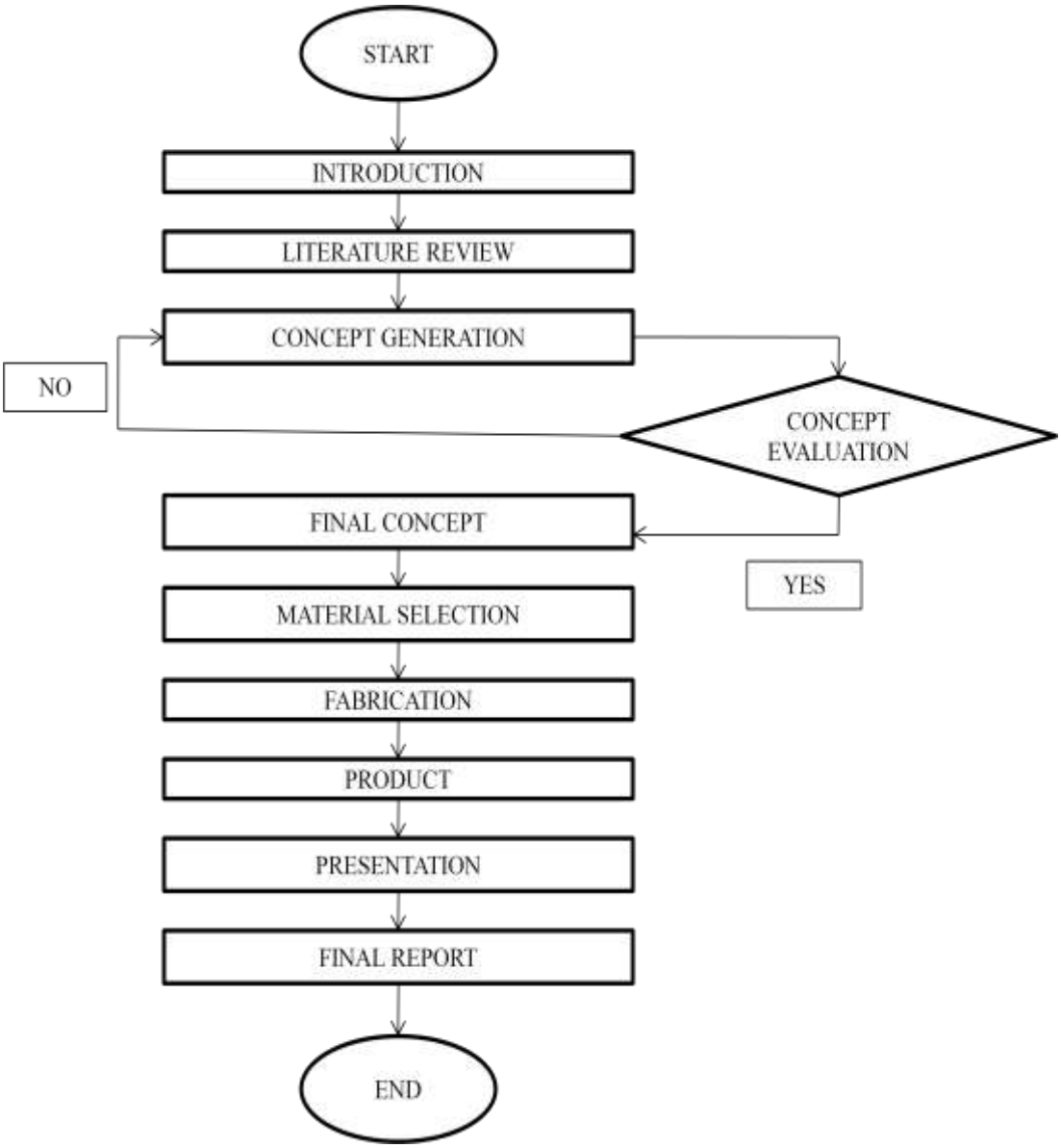
APPENDIX

PROJECT FLOW



PROJECT SCHEDULE

ID	TASK	WEEK													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Briefing With Supervisor														
2	Discussion title,objective,problem statement														
3	Sketching project design														
4	Finalize design														
5	Slide for first presentation														
6	First presentation														
7	Fabrication														
8	Marking final slide														
9	Final presentation														
10	Final report														