FABRICATION OF DOUBLE METAL DOOR

BY

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A PROJECT SUBMITTED TO THE DEPARTMENT OF MECHANICAL ENGINEERING, INSTITUTE TECHNOLOGY (IOT), KWARA STATE POLYTECHNIC, ILORIN

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ABSTRACT

Fabrication of double metal door with lever key using Embossed Plate was done using locally available materials and was finished to standard.

The need for the project arose from the problems associated with using other materials such as; Wood or Leaves, Rubber sheets, for making doors. Cases of termites attack in wooden door, fire hazard in leaves were solved using metal door. The mild steel used was strong, durable, tough, locally available and relatively cheap. This made the door produce to be affordable. The embossed structure and the finishing of the door also contributed to its beauty.

Series of processes were adopted in making this fabrication available. Materials used were carefully selected, marked out and cut to sizes. These were joined together to form different component parts which were assembled together to produce the door. Rough edges were grinded, metal surfaces were smoothen using emry cloth before paint was applied to prevent rusting and to add to its beauty. The resultant door produced was strong, durable, affordable, resistant to fire and termite attack. It is therefore recommended for use at Home, Offices, Warehouse and Industrial Companies.

CERTIFICATION

I certify that this project work was carried out by **KOLAWOLE LUKMAN ABIOLA** with Matriculation Number **ND/23/MEC/PT/0041** in the Department of Mechanical Engineering, Institute of Technology (IOT) Kwara State Polytechnic, Ilorin as part of the requirement for the award of National Diploma in Mechanical Engineering.

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DEDICATION

This Project work is dedicated to the Almighty Allah who has made it possible for me to complete this NATIONAL DIPLOMA PROGRAM successfully.

ACKNOWLEGDEMENT

I give thanks to God almighty, the one who maintain, retain and sustain my life right from the beginning to this present day, He is the pillar that holds my life. He kept me, saved me from waters and fire of this journey that just ended.

To paraphrase an actor who just won an Emmy, “there are so many people to thank”. However, I will like to thank my supervisors Engr. A. A. GARUBA for his fatherly support, guidance and correction from the first to the last day of carrying out this project work may God help your children and prosper your ways.

TABLE OF CONTENT

CHAPTER THREE: RESEARCH METHODOLOGY

CHAPTER FOUR: RESULT AND DISCUSSION

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

List of Tables;

List of Figures;

CHAPTERONE

1.0 INTRODUCTION

A door is a moving structure used to block off, and allow access to an enclosed space, such as a building or vehicle. Fabrication of a double metal door using embossed plate entails a series of intricate procedures, ideas and raw materials to bring about an accurate and result. Similar exterior structures are called gates. Typically, doors have an interior side that faces the inside of a space and an exterior side that faces the outside of that space, (Flammy 2008).. While in some cases the interior side of a door may match its exterior side, in other cases there are sharp contrasts between the two sides, such as in the case of the vehicle door. Doors normally consist of a panel that swings on hinges or that slides or spins inside of a space. When open, doors admit people, animals, ventilation or light. The door is used to control the physical atmosphere within a space by enclosing the air drafts, so that interiors may be more effectively heated or cooled. Doors are significant in preventing the spread of fire. They also act as a barrier to noise. Many doors are equipped with locking mechanisms to allow entrance to certain people and keep out others. As a form of courtesy and civility, people often knock before opening a door and entering a room. Doors are used to screen areas of a building for aesthetics, keeping formal and utility areas separate. Doors also have an aesthetic role in creating an impression of what lies beyond. **(http://www.constructionwitness.com).** Doors are often symbolically endowed with ritual purposes, and the guarding or receiving of the keys to a door, or being granted access to a door can have special significance.

Different kinds of doors have specific names, depending on their purpose. The most common varieties of door in use are: single-leaf door, half door, saloon door, blind door, louvered door, composite door.

The single-leaf door which consist of a single rigid panel that fills the doorway. Many variations on this basic design are possible, such as double leaf door or double doors and French doors that have two adjacent independent panels hinged on each of the side of the doorway.

Half doors or Dutch door or Stable door is divided in half horizontally. Traditionally the top half can be opened to allow a horse or other animal to be fed, while bottom half remained closed to keep the animal inside. The style of door has been adopted for homes.

Salon doors are pair of lightweight swing doors often found in public bars, and especially associated with the American west. Salon door, also known as café doors, often use bidirectional hinges which close the doors regardless of which direction it is opened by incorporating springs. Salon doors that only extend from knee level to chest level are known as batwing doors.

Blind door or gibb door is a door with no visible trim or operable components. It is designed to blend with the adjacent wall in all finishes, and visually to be a part of the wall, a disguised door.

Louvered door has fixed or moveable wooden fins (often called slat or louvers) which permit open ventilation while preserving privacy and preventing the passage of light to the interior. Being relatively weak structures, they are most commonly used for wardrobes and drying rooms, where security is of less importance than good ventilation, although a very similar structure is commonly used to perform window shutters.

A composite door is a single door that can be solid or with glass and is usually filled with high density fam. Most composite doors carry secured designed accreditation number such as: PAS 23 and PAS 24.

A metal door: metal doors manufacturing using GL sheet (Zinc coated sheet) which are sturdy and resistant to rust corrosion and termites. These doors are hallowing metal doors filled in with impregnated Kraft paper. Honey comb which is glued to the inner surface of the door and sealed for acquiring much better strength than a normal wooden door. And there are different types of steel they are high speed steel, carbon steel, aluminum, copper, stainless steel, sterile metal and alloy of aluminum and copper.

The metal can produce good quality door with many desirable values but mild steel is used mainly because it is cheap and readily available locally. It has excellent properties and can be shaped and fabricated with considerable case.

1.2 DEFINITION OF TERMS ASSOCIATED WITH DOORS

Lever key :A fastener fitted to a door or drawer to keep it firmly closed.

Hinge: A joint that holds two parts together so that one can swing relative to the other.

Doorknob: A knob used to release the catch when opening a door often called door handle.

Threshold: The part of the door unit which is attached to the floor under the door.

1.3 STATEMENT OF THE PROBLEM

Formally, it is basically known that the problems associated with using other materials for doors such as; Wood, Glass and so on. So, cases like termite attack in wooden door, fire outbreak in leaves, breaking of glass part due to misplacement were solved using metal door. Because while making use of metal (Mild steel) for doors, the durability and life span cannot be compared to that of Wood.

Also, when we consider the physical properties of mild steel when used for door fabrication which includes; Strongness, Durability and toughness locally available and relatively cheap which made the door produced to be affordable for human usage.

1.4 AIM OF THE PROJECT

The aim of this project is to fabricate a double metal door with lever key.

1.5 OBJECTIVES OF THE PROJECT

The objectives of this work are to;

I. Fabricate a double metal door using an embossed plate and pipes.
II. Fabricate a strong, durable, and affordable metal doors.
III. Produce a double metal door with good surface finishing

1.6 SCOPE OF THE PROJECT

The project covers fabrication of double metal door with good finishing using an embossed plate and pipes.

1.7 CONTRIBUTION TO KNOWLEDGE

The project has contributed to knowledge in the following ways:

- Back up the theoretical knowledge which students acquired.

- Provide database for construction of double door.
- Serve as demonstration in the workshop.

CHAPTER TWO

2.0 LITERATURE REVIEW

It is obvious that humans are faced with a lot of risk as a result of factors that bothered on physical, biological, environmental, physiological, poor technical know-how, to mention but few. Other flaws are due to the problems of materials selection coupled with some rudiment considered in fabrications, construction and designing. These flaws are obtained during and after the fabrication process irrespective of the level of technology they were operating then. (Innovative Review, 2001)

Embossing refers to a way of marking or decorating with a continuous raised designs or symbols. It is also an ideological way to improve the hardness, strength and rigidity of the material in practice by pressing it in a specific pattern or design all through the area of the material. Embossing process is carried out using the process of roll forming and cold working.

This modern process is highly automated to achieve high productivity and low costs associated with labour. In the embossing process, sheet metal is pulled off huge rolls and through rolling dies that form the embossed.

After the sheet metal passes through the rollers, it is automatically sheared off at a desired length. The standard shape of embossed material is the knot or oval style, but can be easily modified to a variety of shapes and sizes by simply changing the dies. (Gibson, 2009)

The problems mention above has degenerated to an unforeseen level of technological caudal and for sure has contributed to failure in achieving productive aim due to loss of materials and human resources. In this respect, the project aim is to get rid

of the necessary problems that confronted human race in their primary stage. In Eumachia, is a painting of a door with three leaves? In the tomb of Theron at Agrigentum there is a single four-panel door carved in stone. In the Blundell collection is a bas-relief of a temple with double doors, each leaf with five pane. When it comes to the world's largest door, there is not just one, in fact there are four and they all belong to NASA's Vehicle Assembly Building at the Kennedy Space Center. The Vehicle Assembly Building was originally built to assembly of Apollo and Saturn vehicles and was then used to support Space Shuttle operations. Each of the four doors is 139 meters or 456 feet high, in comparison the Statue of Liberty is only 93 meters or 305 feet high. (Wikipedia, 2017)

The problems associated with construction approach in olden days are as follows: material selection from long choice of local material like: leaf, raffin palm and bamboo, to cover and secure themselves which are not good enough. When the sap in this materials are dried off through the action of sunlight, the fitting, rigidity, flexibility and security value of these materials will reduced. Still on physical action, when friction is set in, two contagious surface or two mating parts will be affected since this materials cannot sustain the pressure which it will be subjected to. (Adedoyin 2014).

Again, on biological factor, micro organism and living organism such as rodents and termites becomes a threat to the kinds of material mentioned above been used for construction. These animals and insect have gone a long way in damping the effort of technologist in time past.Lack of technological know-how concerning effect of machinery on materials limit and fit, clearance is considered in construction designing.(Onipede A.I.M 2000).

2.1 VARIOUS TYPES OF DOORS

Many kinds of doors have specific names depending on their purpose. The most common variety of door is the single-leaf door which consists of a single rigid panel that fills the doorway. Many variations on this basic design are possible, such as the double-leaf door or double doors and French windows that have two adjacent independent panels hinged on each side of the doorway.

A HALF DOOR or Dutch door or stable door is divided in half horizontally. Traditionally the top half can be opened to allow a horse or other animal to be fed, while the bottom half remained closed to keep the animal inside. This style of door has been adapted for homes.

SALOON DOORS are pair of lightweight swing doors often found in public bars, and especially associated with the American west. Saloon doors also known as café doors, often use bidirectional hinges which close the door regardless of which direction it is been opened by Incorporating swings. Saloon doors that only extend from knee-level to chest-level are known as batwing doors.

SLIDING DOOR or slide Gibb door is a door with no visible trim or operable components. It's designed to blend with the adjacent wall in all finishes, and visually to be a part of the wall, a disguised door.

A BARN DOOR is a door characteristic of a barn. They are often/always found on barns. And because of a barn's immense size doors are subsequently big for utility.

A FRENCH DOOR is a door style consisting of a frame around one or more transparent and /or translucent panels that may be installed singly in matching pairs or even as series. A matching pair of these doors is called a French window as it resembles a door height casement window.

A LOURRED DOOR has fixed or movable wooden fins which permit open ventilation while preserving privacy and preventing the passage of light to the interior. Being relatively weak structures, they are most commonly used for wardrobes and drying rooms, where security is of less important than good ventilation, although a very similar structure is commonly used to form window shutters. Double lour red doors were introduced into Seagate built in Florida in 1929 by Gwendolyn and Powel Cresley that provided the desired circulation of air with an added degree of privacy in that it is impossible to see through the fins in any direction.

A COMPOSITE DOOR is a single leaf door that can be solid or with glass, and is usually filled with high density foam. Most composite doors carry secured by design accreditation.

A FLUSH DOOR is a completely smooth door, having plywood fived over a light timber frame; the hollow parts are which are often filled with a cardboard core material. Skins can also be made out of hardboards, the first of which was invented by William mason in 1924

called Masonite, its construction involved pressing and steaming wood chips into boards. Flush doors are most commonly employed in the interior of a dwelling, although slightly more substantial versions are occasionally used as exterior doors, especially within hotels and other buildings containing many independent dwellings.

A MOULDED DOOR has the same structure as that of flush door. The only difference is that the surface material is a molded skin made of MDF. Skins can also be made out of hardboards.

A WICKET DOOR is a pedestrian door built into a much larger door allowing access without requiring the opening of the larger door. Examples might be found in the ceremonial door of a cathedral or in a large vehicle door in a garage or hanger.

A LEDGE AND BRACE DOORS is a door made from multiple vertical planks fixed together by two horizontal planks (the edges) and kept square by a diagonal plank (the brace).

A BIFOLD DOOR is a door that has several sections folding in pairs. Wood is the most common material and doors may also be metal or glass. Bifolds are most commonly made for closets, but may also be used as units between rooms.

A REVOLVING DOOR normally has several wings/leaves that hand on a central shaft forming compartment which rotate one way about a vertical axis. Doors using four wings are most common, but there are also examples with two, three, or six wings. The door may be motorized or pushed manually using push bars, people can walk out of and into the buildings at the same time. Between the point of access and the point of exit the user walks through an airlock. Revolving doors therefore create a good seal from the outside and help to reduce Air conditioning and heating costs climate control from the building. This type of door is also often seen as a mark of prestige and glamour for a building and it not unusual for neighboring buildings to install their own revolving doors when a rival building gets one.

2.2COMPARING THREE COMMON DOOR MATERIALS (WOOD, FIBERGLASS AND MILD STEEL)

When shopping for a door, design, colour, durability, security, and energy efficiency are a few of the factors one must think about. In today's door market, there are many options. Focus will be made on comparing the most popular choices: wood, fibreglass and mild steel.

Sometimes the materials to choose from are limited by ones opening. For example, certain sizes may only be available in a particular door material. A popular example is the curved top entry door, which is usually only found in wood.

There are very few differences in quality when comparing different door materials. A well-produced mild steel door will last just as long as a fibreglass one. The biggest difference between materials is aesthetic. For example, people sometimes prefer real wood to simulated wood grains, especially if the door is nearby other wood pieces in the home and needs to match as closely as possible; however, as technology emerges, simulated fibreglass wood grains can be stained to custom colours matched to wood trim and are virtually indistinguishable from real wood seven up close.

2.2.1 WOOD AS A DOOR MATERIAL:A wooden door is usually made with a thin piece of plywood or laminate on either side with a thicker piece of hardboard backer behind it. The panels are generally done with thicker plywood and wood pieces (much like cabinetry). This is the most efficient way to build a wood door in our climate; however, it does come with many problems especially in northern climates.

Anytime real wood (especially plywood or laminates) is exposed to the elements there will be problems. It won't be maintenance-free, and it will need to be refinished down the road. The thin laminates or plywood usually can't be sanded or can be sanded and refinished only a minimum number of times. The coverings will absorb moisture (many times from the inside, behind the protective clear coat finish) and they will peel or bubble out. Fading is always going to be a problem. A storm door will be necessary, but will also cause problems with the greenhouse heat it will create between the new entry door and the storm door's glass.

The second type of wood door one can find is a solid wood door. A solid wood door is 100% wood, through and through. It is by far the heaviest, most secure and beautiful door one can purchase. From a high quality manufacturer, they will resist most major shifting and expanding, although in wood this is always a risk. They will need to be kept up annually or there will be problems with the finish, but these doors can always be sanded and refinished down the road. The major disadvantage to a solid wood door is price. These doors are the most expensive door one can purchase, running as much as ten times or more the cost of a mild steel door. Wood is generally the most expensive door one can buy.

2.2.2 FIBRE GLASS AS A DOOR MATERIAL: Fibreglass is a relatively new material in doors today. It has a very low maintenance, resists denting and scratching, and is very strong and secure. It also offers a wood grain if one desire a wood-look. Another benefit to fibreglass is that unlike wood, it doesn't need to be finished to be considered low maintenance. Fibreglass, even when left unfinished, will last for years without fears of mold or deterioration. But fibreglass may crack (especially in cold weather) and fall apart. Its finish may deteriorate quickly and the inner core could rot. This is the pitfalls of a fibreglass door.

2.2.3 MILD STEEL AS A DOOR MATERIAL: It is important to note the huge range in quality and price when looking at mild steel doors. The most important thing to note when buying a mild steel door is the gauge. The higher the number the thinner the mild steel. 0.4mm mild steel doors are commonly found when shopping for an inexpensive door, such as those found at home stores. This is a good temporary solution, but will not last. Rusting and paint chipping is quite common. 0.4mm mild steel is practically paper thin, and it bends and flexes very easily with nothing but insulation behind it. This flexing causes the paint to chip off, which in turn leaves the steel unprotected and free to rust.

Today, mild steel is the common choice for door replacements. It's inexpensive (when compared to other materials), secure, very low maintenance and comes in a large variety of styles and colours to suit man’s needs.

In general, below are listed the advantages and limitations of the three door materials.

Table 2.1: Advantages of Three Different Door Materials

WOOD	MILD STEEL	FIBREGLASS
Beautiful wood grain Warm feel and touch Quality, high-end look, scratches are easy to repair, additions and alterations (such as a new wood stain) can be simply done.	Lower maintenance No cracking or bowing Less expensive Good insulating value Secure Longer life spans than other materials, fireproof, energy efficient.	Lowest maintenance Resists denting and scratching Offers wood grain and smooth finish look Energy efficient Can be painted or stained Won't warp, bow or twist

Table 2.2:Limitations of Door Materials

WOOD	MILD STEEL	FIBREGLASS
Very expensive than other door materials Absorbs moisture Can peel or bubble out Can bow, warp or twist Will fade with time Not energy efficient Requires regular maintenance	Easily dented Scratches can lead to rust Paint chipping can be common Temperature sensitive (making them cold or hot to touch depending on the outside air temperature	Low-quality fibreglass doors can crack, shorter life spans than other materials, requires the most maintenance

2.3 LIMITATIONS OF DOORS IN THE PAST

Majority of doors use until now are single- leaf and they are mostly of wood. They are of wood as paneleddoors, the tradition which has been in existence since the Second World War. It's used to be assembled by hand. It lost favour to mass-production, which is economical. Flush doors happen to lose its usefulness because of it lightweight vulnerability to fungus and insects infection.

2.3.1 THE USE OF METAL FOR DOOR PRODUCTION

The production and use of metal door has increased primarily as metal framed door recently as both flush and paneled door were made as better substitute to the former method of making doors (wood etc.). The use of mild steel bar is to make it (the door) more conspicuous and fascinating; it makes the door durable and suitable for all sorts of environmental conditions. Doors are now on hinge pivot, with sliding action. While facing the door from the outside or less secure side, if the hinge is on the right side of the door, the door is right handed or if the hinge is on the left, it is left handed. In other words:

Left hand hinge (LHH): Standing outside (or on the less secure side, or on the public side of the door), the hinges are on the left and the door opens in (away from you).

Right hand hinge (RHH): Standing outside (or on the less secure side), the hinges are on the right and the door opens in (away from you).

Left hand reverse (LHR): Standing outside the house (or on the less secure side), the hinges are on the left, knob on right, on opening the door it swings towards you (i.e. the door swings open towards the outside, or out swing)

Right hand reverse (RHR): Standing the house (i.e. on the less secure side) hinges are on the right, knob on left, opening the door by pulling the door towards you (i.e open swings to the on the less secure side, or on the public side of the door), the hinges are on the left and the door opens in (away from you).

Earlier works done concerning metal door is the use of galvanized roofing sheet as the sheet covering. This served the doors purpose to some extent till it became obsolete due to the inferiority in strength and lasting period of the galvanized roofing sheets. More research was done and the strength of such doors was increased by increasing the thickness of the metal sheet used. Such doors serve it purpose well and are used even till present date. Moreover, some difficulties associated with these types of doors include; lack of strength,

ability to deform or get dents when easily hit. To avoid some of these disadvantages, the thickness of the metal sheet is either increased or being embossed, and since we are taking economics into cognition, increasing the metal sheet's thickness will cost more. This is why embossed metal sheet is put into notice.

Embossing (Stanley gibbons stamp catalogue, 1840) refers to a way of marking or decorating with a continuous raised designs or symbols. It is also an ideological way to improve the hardness, strength and rigidity of the material in practice by pressing it in a specific pattern or design all through the area of the material. Embossing process is carried out using the process of roll forming and cold working. This modern process is highly automated to achieve high productivity and low costs associated with labor. In the embossing process, sheet metal is pulled off huge rolls and through rolling dies that form the embossed. After the sheet metal passes through the rollers, it is automatically sheared off at a desired length. The standard shape of embossed material is the knot or oval style, but can be easily modified to a variety of shapes and sizes by simply changing the dies.

Many materials today undergo the embossing process. The most common material is mild steel but may also span to stainless steel. Copper and aluminum are also used. Regular mild steels are the most common due to price and availability. Common sizes of embossed material can range from a very thin 0.5mm to a relatively thick 4mm.

Other materials such as plastic and fiberglass are also given the embossed look. Many applications are available for these products including using them with metal sheets to allow light to penetrate below. Embossed metal sheets are lightweight and easily transported. It was and still is widely used especially in heavy duty Lorries, gates, gutter covering and water tanks. Its unique properties were used in the development of countries

2.3.2 ADVANTAGES OF METAL DOOR OVER WOODEN DOOR

- ✓ It will withstand the devastating wings of fire out breaks
- ✓ Better security provision
- ✓ Better exterior design
- ✓ More rigidity
- ✓ More durable

2.3.3 HISTORY

The earliest in records are those represented in the paintings of the Egyptian tombs, in which they are shown as single or double doors, each in a single piece of wood. In Egypt, where the climate is intensely dry, there would be no fear of their warping, but in other countries it would be necessary to frame them, which according to Vitruvius was done with stiles and rails, the spaces enclosed being filled with panels (tympana) let into grooves made in the stiles and rails. The stiles were the vertical boards, one of which is tenoned or hinged known as the hanging stile, the other as the middle or meeting stile. The horizontal cross pieces are the top rail, bottom rail, and middle or intermediate rails. The most ancient doors were in timber, those made for King Solomon's temple being in olive wood (I Kings 6: 31-35), which were carved and overlaid with gold. The doors dwelt upon in Homer would appear to have been cased in silver or brass. Besides Olive wood, elm, cedar, oak and cypress were used. A 5,000-year-old door has been found by archaeologists in Switzerland.All ancient doors were hung by pivots at the top and bottom of the hanging stile which worked in sockets in the lintel and sill, the latter being always in some hard stone such as basalt or granite. Those found at Nippur by Dr. Hilprecht, along with his assistant Nola Begeja, dating from 2000 B.C. were in dolerite. The tenons of the gates at Balawat were sheathed with bronze. These doors or gates were hung in two leaves, each about 2.54 m wide and 8.2 m. High; they were encased with bronze bands or strips, 10 inches. High, covered with repousse decoration of figures, etc. The wood doors would seem to have been about 3 inches. Thick, but the hanging stile was over 360 mm diameter. Other sheathings of various sizes in bronze have been found, which proves this to have been the universal method adopted to protect the wood pivots. In the Hauran in Syria, where timber is scarce the doors were made in stone, and one measuring 1.63 m by 0.79 m is in the British Museum; the band on the meeting stile shows that it was one of the leaves of a double door. At Kuffeir near Bostra in Syria, Burckhardt found stone doors, 9 to 3.0 m. High, being the entrance doors of the town. In Etruria many stone doors are referred to by Dennis. The oldest door in England can be found in Westminster Abbey and dates from 1050.In England in the 17th century the door panels were raised with bolection or projecting moldings, sometimes richly carved, round them; in the 18th century the

moldings worked on the stiles and rails were carved with the egg and tongue ornament. Roman folding doors at Pompeii (1st century AD) The ancient Greek and Roman doors were either single doors, double doors, triple doors, sliding doors or folding doors, the last case the leaves were hinged and folded back. In Eumachia, is a painting of a door with three leaves. In the tomb of Theron at Agrigentum there is a single four-panel door carved in stone. In the Blundell collection is a bas-relief of a temple with double doors, each leaf with five panes. When it comes to the world's largest door, there is not just one, in fact there are four and they all belong to NASA's Vehicle Assembly Building at the Kennedy Space Center. The Vehicle Assembly Building was originally built to assembly of Apollo and Saturn vehicles and was then used to support Space Shuttle operations. Each of the four doors is 139 meters or 456 feet high, in comparison the Statue of Liberty is only 93 meters or 305 feet high

2.4 DOORS DIMENSIONS

Double internal doors ready-made, double leaf internal doors are often produced in imperial and metric sizes

Range of United Kingdom's imperial sizes for Double internal doors (Width x Height)

The standard sizes for cupboard or wardrobe doors are: 1981 x 457/533 x 35mm.

The most common internal door size in England and Wales are 2 by 6 : 1981 x 762 x 35mm.

Where wall space is restricted, and a smaller door must be fitted, the size should be: 1981 x 610/686 x 35mm.

Where wheel chair access is required, also known as a 2 by 9 door is: 1981 x 838 x 35mm.

Apparently, the most common door height in England and Wales is 1981mm 6 by 6 and, in Scotland, the average door height is slightly greater at 2040mm.

Metric standard door sizes?

Metric standard door sizes are commonly used in Scotland and Europe. The main difference between metric standard sized doors and standard doors is basically that metric standard doors are taller, with a door height of 2040mm and thicker at 40mm.

The metric standard door size is: 2040 x 526/626/726/826/926 x 40mm

CHAPTERTHREE

3.0 METHODOLOGY

FABRICATION PROCESS

Fabrication is the creation of metal structures by cutting, bending and assembling processes. Also, it is a value-added process involving the creation of machines, parts, and structures from various raw materials. (Wikipedia 2017).

3.1 WORKING DRAWING: Drawing is the language of engineering. In any engineering construction or fabrication, it is very vital to produce the working drawing of the product to be produced. At all points, the final design concept is represented in a conventional way which design can be produced anywhere in the absence of the designer.

On the working drawing, details and instruction on the fabrication of the embossed metal door were given in a conventional way.

3.2 MATERIAL SELECTIONS

There is always a need for proper selection because of the specification which must be met. Now to arrive at optimum selection, the deeper knowledge of the nature of material science

in engineering is highly essential. Cost of material is also considered during material selection so as to minimize the cost for acquiring these materials and getting the best and suitable materials for the construction at the same time.

3.2.1: MATERIAL SELECTION AND THEIR PROPERTIES

The accomplishment of the project was ensured by careful selection of material in order to obtain the primary goals of the project which includes flexibility, durability, security, resistance to corrosion etc.

Some engineering design parameter must be considered in order to determine the quality and quantity of material relevant to the constructing activities. Similarly, production and processing of metal has much impact in the course of selection. Therefore, materials need to be examined before they are selected as the choice of the construction activity.

Based on the properties displayed by metals, the choice of material depends on the characteristics, properties required for the construction.

Consideration was made in selection of a particular metal, which is steel. And from diverse varieties of steel, mild steel is selected as the best and most suitable for construction of the metal door. Below are listed different kinds of steel and their properties.

Table 3.1: Types of Steel, Content and Properties

S/N	STEEL TYPE	CONTENT	PROPERTIES
1.	Low carbon steel	0.15%	Moderate, strength, toughness and ductility
2.	Mild steel	0.15% -0.30%	Moderate, strength, toughness and easily machined
3.	Medium carbon steel	0.30% - 0.70%	High strength, toughness, especially when heated
4.	High carbon steel	0.70% – 1.60%	Very hard

In the same vein, Alloy Steel is classified as follows:

ALLOY STEEL

Table 3.2: Types of Alloy Steel, Content and Properties

S/NO	Steel	Content	Properties

1	Tungsten Steel	18-20%	Retain hardness and toughness at high temperature.
2	Chromium steel	5% chromium	Hard and wear resistance
3	Stainless	11% chromium	Anti-corrosion

Mercury glass is chosen to allow users view of outside from inside and obstructing view of inside from outside base on relative light intensity. Mild steel of 0.15%-0.30% of carbon, which is universally used in the production of pipes, bolts, nuts, rods, etc is chosen base on its moderate strength, toughness, ductility, and rigidity and machining properties. The choice of materials must be based on availability and economical value. The electrode to be used should be gauge 14 from materials table but gauge 12 is used with very low current because of scarcity gauge 14 n market and to avoid burning of the materials respectively.

3.3SEQUENTIAL PROCESSES INVOLVED IN FABRICATION

Table 3.3Operations involved in fabrication process and tools used

S/N	OPERATIONS	PROCESSES	MACHINES TOOLS USED
1	Marking out and center punching	The pipe (1½, 2X2 and 3x4) were marked to the required size length, breath, and depth of the assembly and angular degree of the frame and center punching the position of the holes to drill	Bench and bench vice, try square measuring table, scriber, hammer, and center punching.

2	Cutting and Drilling	The pipes were cut into the required size and drilling of holes already center punched.	Bench vice hacksaw and cutting machine.
3	Joining	Welding to the desired shape joined the metal members being out correctly.	Electric Arc welding machine
4	Assembly and Welding	Welding to the desired shape joined the metal members being out correctly. Angular side and parallel joining of metal member	Electric Arc welding machine
5	Grinding	Removal of the burnt carbon formed during welding to provides a smooth surface of the door	Grinding machine (Handtype)
6	Cleaning	The door was cleaned to remove dust and rust	Emry paper
7	Coating	The metal door was coated with corrosion resistance paint (red oxide)	Painting brush

8	Glass Fitting	The side of the door that will have direct contact with the glass was damped with damping materials. The dimensioned mercury glass was fitted into position	Glass cutter, diamond stone.
9	Painting	After the coating materials has dried, the glass area was covered with glossy paper followed by the spraying of paint to beautify the door.	Sprayer, glossy paper and tape
10	Lock fitting	The lock was screwed to the door for easy repair in the future after drilling and tapping holes at the appropriate points on the door.	Drilling machine, hand type taping tools and screw driver.
11	Finishing torches	The glossy paper was removed and missing spaces during painting was painted around the glass and lock.	Brush.

3.4 DIMENSIONS FOR CUTTING

Table 3.4 Measurement of Materials Cut

S/N	Description	Quality	Length (cm)	Breath (cm)
1	$\frac{3}{4}$ Pipe	Thick	202.2	114
2	1 ½ Pipe	Thick	200	77
3	$\frac{2}{2}$ Pipe	Thick	208.8	114
4	$\frac{3}{4}$ Pipe (Main frame)	Thick	175	25
5	Embossed plate (Inner frame)	Thick	202.2	114
6	Embossed plate (Inner frame)	Thick	175	25

3.5 THE CONSIDERATION OF WELDER

To satisfy the service requirements, welders must have reliable information on materials used. Most welding procedure is based on analysis of the stress imposed on the part(s) or structure. The welder must completely and accurately determine the load that will be encountered.

Therefore, it is important to point out that the more accurate these loads and stress will determine the more efficient welding operation will be. It is important that designer should take cognizance of the load stress and make use of standard instruments such as electronic strain gauges, electronic measuring derives and technique like classic examination of transparent model and the use of brittle lacquar, which crack under strain on actual part(s) under load. The working allowances (working stress) must also be determined. The value is sometime called (allowable unit stress. It is the maximum stress level that is allowed anywhere in the welding. The stress within welding is calculated by the various formula based on the type of loading. There are handbooks and textbooks, which provide

information based on code and specification.

CHAPTER FOUR

4.0 RESULT AND DISCUSSION

Following the under listed construction details the double door after it has been fully fabricated is shown in the Figure below.

Fig 1.1

4.1CONSTRUCTION DETAILS

In order to construct the double metal door, some procedurewere followed. These include: marking out, cutting, welding, grinding, assembling and coating.

4.1.1 MARKING-OUT-PROCESS

This process involves scribing of lines on metal sheet and pipes to indicate the profile cutting lines and region of cutting. The process is brought about to help the technologist in producing accurate dimension sizes of the materials required. It also helps in machining a component to a standard specification. Tools used were try-square, tape rule, scriber, centre punch odd-leg calliper gauges, straightedge, etc.

4.1.2 CUTTING PROCESS

This is a process that involves the cutting along the scribed lines on the metal sheets to provide the required metal members to be assembled. The process usually requires special technological attention because of its sensitivity to the success of the construction. Inability tocut along the scribed lines may amount to material damage and faulty assembly the tools used are: straight edge, bending and cutting machine hack saw, bench and bench vice, etc.

4.1.3 WELDING

This is an efficient method and reliable means of joining metals together by using heat (i.e electrodes). The method is universally accepted. Its level of application depends on metal thickness and these levels includes;

i. Very thick metals
ii. Thin plates
iii. Lap joints

4.1.4 WELDING PROCESS

This is an efficient and reliable means of joining metal together by the application of heat and it is universally accepted. Before welding can be effective and less time consuming, there must be some condition to be met:

1. Preparing support for the metals to be welded for proper alignment
2. Preparation of metal junctions: The clearing of metal junction before welding operation. The junctions are levelled and chamfered. The dirt is removed in order to ensure long lasting welding.

3. Welding the metal band junction: The electrode is selectedand held with the arc welding tong. The electrode is used to strike the metal surface. During the hear generation, the arc is truck between the tins. The heat generated melts the metals at the welding joint. The melted electrode also deposited molten, metals to the junction to be welded.
4. Removal of slag: After fusion, the molten metal is allowed to cool down. Hammer is employed to strike the welded surface in order to remove the covering slag while the surface is cleansed with wire brush.

4.1.5 FACTORS TO BE CONSDIEDED IN WELDING

Welding operation involves the efficient and economical use of selected materials- Proper welding of all welded joints makes the required assembly. In order to service requirement the welder must have reliable information of the performance of the object and the characteristic o the metal that are used. Having being familiarized with service and conditions to which the welding will be exposed and to be coated is needed to know the factors of safety, working stress and ultimate strength. These are factors the welder must consider in analysing the welding to meet the serving materials.

4.1.6 PROBLEM OF WELDING OPERATION

Welding process is facing a lot of problem in the world of metal joining, One of the inherent problems is known as hard zone cracking or under bead. This is the cracking that occurs at adjacent to the fusion boundary in the heat-affected zone. Cracking also arise after welding and inspection. Some of these were prepared at the coated electrode which function flux away impurity on the welding surface and to stabilize the arc, gaseous shield over the welding spot to prevent atmospheric contaminations of molten pool (metal) and slag to slow down the rate of cooling of the bend (weld).

4.2 ASSEMBLING

The main frame was first assembled and welded. The support frame was also assembled to the main frame and welded. The angular joint of the main frame is at angle 45 degree. The leaf parts are made by staking the metals sheets with tin metals to give the leaf rigidity authentic property. This is alternative to scaffolding which loss rigid but less expensive and light in weight. The leaf part was then inserted to the main frame and support frame at

drilled holes at the frame side corner to give the leaf swinging motion horizontally on it axis (left to right and right to left swinging motion).

Then the embossed plate was placed inside the main frame as well as the inner frame and was welded firmly on it.

Thereafter, the other component were joined with it and at the end after the full processes has been carried out, the fabricated door was stand for further finishing as stated above. Then the main design of the double metal door with lever key using an embossed plate was presented and fabricated successfully.

4.3 FINISHING

The process involves cleaning, and smoothening and painting of the components to provide the attractive surface required of product. The finishing torches include: Grinding, Cleaning &Smoothening, and Painting.

i. **GRINDING:** This is the process of removing burnt carbon formation on the surface of welded joint. This gives the job an attractive appearance and removes the blunt edges of the weld.
ii. **CLEANING AND SMOOTHENING:** This is the removal of the rust and dirt from the surface of the components, Emery paper is used in the process.
iii. **PAINTING:** This is the coating of the surface of the cornponent5 with paints. The process makes the component more attractive and prevents it from rusting and corrosion. Brush is used to apply the paint. Red oxide is used for prevention before painting.

4.4 COSTING OF MATERIALS

In order to appreciate the economic advantage of metal doors, it became necessary to produce an estimate of the product in terms of Naira and Kobo.

Table 4.1 Bill of Engineering Materials and Evaluation

S/N	Description	Quantity	Unit cost (#)	Total Cost (#)
1	Embossed Plate	1 ½ full length	12,0000	12,000
2	1 ½ Thick Iron Pipe	3 full lengths	3,350	10,050
3	$\frac{3}{4}$ Thick Iron Pipe	8 full lengths	920	7,360
4	$\frac{2}{2}$ Thick Iron Pipe	3 full lengths	2,500	7,500
5	Hack Saw	2 pieces	300	600
6	Original (Hero) Welding Electrode	1 packet	2,500	2,500
7	AutoCAD design	1 piece	3,000	3,000
8	Cutting Disc	3 pieces	300	900
9	Grinding Disc	3 pieces	300	900
10	Lever key	1 pair	4,000	4,000
11	Paint	1 gallon	4,000	4,000
12	Workmanship		7,000	7,000
13	Transport	To and Fro	4,150	4,150
	TOTAL			**63,960. 00**

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

Fabrication of double metal door was done following all engineering procedure necessary for a successful outcome. Metals and pipes were marked out and cut to sizes according to the specifications on the working drawing. These were joined together to form different component part which were assembled together with the embossed plate to produce the door.

The surfaces of the metal were prepared very well before red oxide paint was applied to prevent rusting. The resultant door produced was very strong, durable, resistant to fire and termite attack and affordable.

5.2 RECOMMENDATION

The double metal door produced was very strong, durable, affordable and resistant to fire and termite attack. The lever key used was of high quality so, it cannot be easily broken. The embossed plate and the paint used for the finishing added to the beauty of the door. These and many others are the advantages of the double metal door over door made from other materials such as wood. Hence, the double metal door produced is hereby recommended for use at Home, Offices, Warehouse and Industrial Companies.

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