STUDENT WORKSHOP EXPERIENCE PROGRAMME (SWEP) REPORT

BY

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1 8 6 3 4 5

MECHANICAL ENGINEERING

FACULTY OF TECHNOLOGY

AT

ISMAILA A. JIMOH VENTURES,

SHASHA AREA, EBEDI, IBADAN.

TME 299

2015/2016

Mechanical Engineering Department,

Faculty of Technology,

University of Ibadan,

Ibadan.

March 09, 2017.

The Director,

Industrial Training Coordinating Centre,

University of Ibadan,

Ibadan.

Dear Sir,

SUBMISSION OF INDUSTRIAL TRAINING REPORT

I write to bring to your notice that I have successfully completed the 2015/2016 session 8 weeks Student Work Experience Programme which commenced on the 21st day of December, 2016 and ended on the 10th day of February, 2016 at Ismaila Jimoh Ventures situated No 1, Opposite Conoil Petrol Station, Ebedi, Shasha Area, Oyo Road, Ibadan, Oyo State, where I was duly posted.

As required for a successful completion of the TIT 299 programme, I hereby tender this submission letter alongside my industrial training report and log book, in partial fulfillment of the requirements of the SWEP programme.

I greatly appreciate your effort and the effort of the Industrial Training Coordinating Centre

as a whole towards making the student work experience programme a fulfilled reality.

Yours faithfully,

Nasamu Emmanuel A.

ACKNOWLEDGEMENT

To God Almighty, I give my sincere appreciation for his mercies and loving kindness towards me, grace over me in my academic pursuit and his preservation on me during the achievement of yet another milestone.

My immense gratitude goes to my parents, for their spiritual, moral and financial support. I also appreciate my siblings for their encouragement.

I am also thankful to the managing director, the workers and the apprentices of Ismaila Jimoh Ventures.

I also express my gratitude to the University of Ibadan and ITCC for this innovative programme which enables us to have hands-on experience and practical application of some of the theoretical knowledge we have been impacted with in school in order to bridge the gap between

theoretical knowledge and practical skill which go and hand in hand for one to become a good engineer.

Finally, I sincerely appreciate the efforts of all others who in one way or the other contributed to the success of my industrial training.

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ABSTRACT

In manufacturing process, metal fabrication is very important as metal is an essential material for production and one of the most widely used material. Its uses cut across all aspect of engineering such as in construction, industries, etc.
This report examines and discusses the processes of fabrication with spotlight on welding using the metal arc welding which is the main fabrication activity at Ismaila Jimoh Ventures.

This write up also examine uses of various tools, properties of principal materials used in welding and safety practices in the workshop.

INTRODUCTION

Ismaila Jimoh Ventures is a metal workshop where fabrication of metal is being done for both industrial uses and home use such as burr mills, burglary proofs, mobile shops, worktables, parts of various machine and so on.

The major process in these various fabrications is welding using the shielded metal arc welding process.

After the completion of the training, I can state objectively that I have been able to learn, acquire, or imbibe the following:

- ✓ Ability to identify, and use some tools in the metal workshop.
- ✓ Implementation of safety rules.
- ✓ Ability to mark out precisely designs on metal sheets.
- ✓ Good interpersonal work relationships.
- ✓ Creative thinking and imaginative projections.

CHAPTER ONE

SAFETY RULES

General Workshop Safety Rules

Before you can use equipment and machines or attempt practical work in a workshop you must understand basic safety rules. These rules will help keep you and others safe in the workshop.

The following are the general safety rules in engineering workshop.

i. Always listen carefully to the teacher and follow instructions.
ii. Do not run in the workshop, you could 'bump' into another pupil and cause an accident.
iii. Know where the emergency stop buttons are positioned in the workshop. If you see an accident at the other side of the workshop you can use the emergency stop button to turn off all electrical power to machines.
iv. Always wear an apron as it will protect your clothes and hold loose clothing such as ties in place.
v. Wear good strong shoes. Training shoes are not suitable.
vi. When attempting practical work all stools should be put away.
vii. Bags should not be brought into a workshop as people can trip over them.
viii. When learning how to use a machine, listen very carefully to all the instructions given by the teacher. Ask questions, especially if you do not fully understand.
ix. Do not use a machine if you have not been shown how to operate it safely by the teacher.
x. Always be patient, never rush in the workshop.
xi. Always use a guard when working on a machine.
xii. Keep hands away from moving/rotating machinery.
xiii. Use hand tools carefully, keeping both hands behind the cutting edge.
xiv. Report any damage to machines/equipment as this could cause an accident.

METAL FABRICATION

Metal fabrication is the building of metal structures by cutting, bending, and assembling processes. In fabrication irrespective of what we are planning to manufacture, there are some basic steps to follow.

Designing

The first step comes in determining the design, concept or shape of the unit we want to build or weld. Sometimes it is something unique that we have designed ourselves and the owner can also have a design. More frequently in industry we have to build a part that conforms to a blueprint or technical drawing. It is from that drawing or sketch that we determine the steps necessary for fabrication. How many of this part, or which part comes first and which part goes second or just some of the many steps we need to think about before we start. A computer-aided diagram can be drawn using computer software such as AutoCAD.

Marking out

It is the process of transferring designs onto the fabrication materials or the demarcation of sizes, shapes and curves on metals.
Marking out tools includes scriber, steel rule, try square, trammel and divider.

Cutting

The design on the drawing will be a good guide to determine the amount of a specific part that is needed. Any necessary layout may also be required at this point. We may also need to prepare the edge of a joint or parts that require some prep before welding. This should be part of the initial plan so unnecessary mistakes are eradicated.
Cutting can be carried out by torching with hand-held torches (such as oxy-fuel torches or plasma torches); and via Computer Numerical Control (CNC) cutters (using a laser, mill bits, torch, or water-jet). Cutting tools includes hacksaw, shears and chisel.

Bending

This involve hammering which can be manual, powered or via press brakes and similar tools. Modern metal fabricators use press brakes either to coin or air-bend metal sheet into form. Computer Numerical Control (CNC)-controlled back gauges use hard stops to position cut parts in order to place bend lines in the correct position. Off-line programming software now makes programming the Computer Numerical Control (CNC)-controlled press brakes seamless and very efficient
Bending tools includes hammer, mallet and bending machine.

Fitting

Once all the parts are ready, we need the process of fit up to begin. As we fit up the parts, we need to consider how we are going to brace, clamp or secure the parts in position to prevent wrap up or distortion during the welding process. We also need to consider any shrinkage that may occur after welding. **Tacks welds** should be placed carefully so they can be consumed during the normal welding process of the component. Once we think fit up is complete, before we start welding, it advisable to inspect the part to make sure it meets the drawing requirements.

Fitting tools includes bench vice, clamp and screwdriver.

Assembling

Assembling is the joining of the different pieces by **welding**, binding with adhesives, riveting, threaded fasteners, or even yet more bending in the form of a crimped seam.
Structural steel and sheet metal are the usual starting materials for fabrication, along with the welding wire, flux, and fasteners that will join the cut pieces.
Assembling tools includes welding machine, screwdriver and allen key.

Finishing

After the part has been inspected and accepted, the finishing process can commence. We need to make sure that any weld cleanup needed is done before finishing starts. Depending on the drawing requirements the part may be painted, plated, powder coated, or other types of finishing. It's apart is made of steel something must be done to prevent corrosion or rusting. If the part is made of stainless sometimes the finish is a process called passivation. Electropolishing is also another type of finishing that can occur.
After the weldment has cooled, it is generally sand blasted, primed and painted. Any additional manufacturing specified by the customer is then completed.

BASIC WORKSHOP TOOLS

A workshop is a place where manual work is done. The tools in your workshop will depend on your areas of specialty, interests, and level of experience. Following is a list of some of the more essential hand-tools that are being used in Ismaila Jimoh ventures.

Hand tools

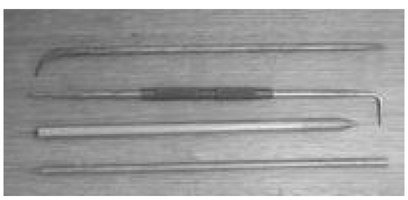
i. **Measuring steel Tape**

A tape measure or measuring tape is a ribbon of cloth, plastic, or metal with linear-measure markings, often in both imperial and metric units. It is a convenient, common measuring tool. Its flexibility allows for a measure of great length to be easily carried in pocket or toolkit and permits one to measure around curves or corners.

Self-retracting pocket tape measure

ii. **Scriber**

Scribers are hand tools used in the metal trades to mark lines on work pieces, prior to machining. This is used instead of pencils as the marks from pencils cannot be seen as clearly as Scriber marks. They consist simply of a rod of high-carbon steel, in its hardened state, that has been sharpened to a point at one or both ends. They are used by drawing the point over the surface of the work piece to leave a shallow scratch on its surface.



Self-retracting pocket tape measure

iii. **Try square**

A try square is a metal working tool used for marking and measuring a piece of metal. The *Square* refers to the primary use of the tool: measuring the accuracy of a right angle (90 degrees). Try square is sometimes spelled "tri-square", but this term can also refer to a combination square.

A typical Try square

iv. **Screwdriver**

The screwdriver is a device specifically designed to insert and tighten, or to loosen and remove, screws. The screwdriver comprises a head or tip which engages with a screw, a mechanism to apply torque by rotating the tip, and some way to position and support the screwdriver.

Flat head Screw driver

Hammers

Hammers come in a variety of styles for varying uses, and are available in different weights depending on how they'll be used, in metal working hammers are used to strike a work-piece into a require shape usually to straighten it. Commonly used hammers include tack hammers and standard nailing hammers. Rubber mallets are also useful, particularly for woodworking to make fit adjustments without marring the surface of the wood.

During my industrial training, hammers were used in the metal workshop to straighten the edges of the metal fabrications.

A sledge **ball peen hammer**

Cutting/Fitting Tools

Files

A file (or hand-file) is a hand tool used to shape material by cutting. A file typically takes the form of a hardened steel bar, mostly covered with a series of sharp, parallel ridges or teeth. Most files have a narrow, pointed tang at one end to which a handle can be fitted.

Files come in a wide variety of sizes, shapes, and tooth configurations. The cross-section of a file can be flat, round, half-round, triangular, square, knife edge or of a more specialized shape.

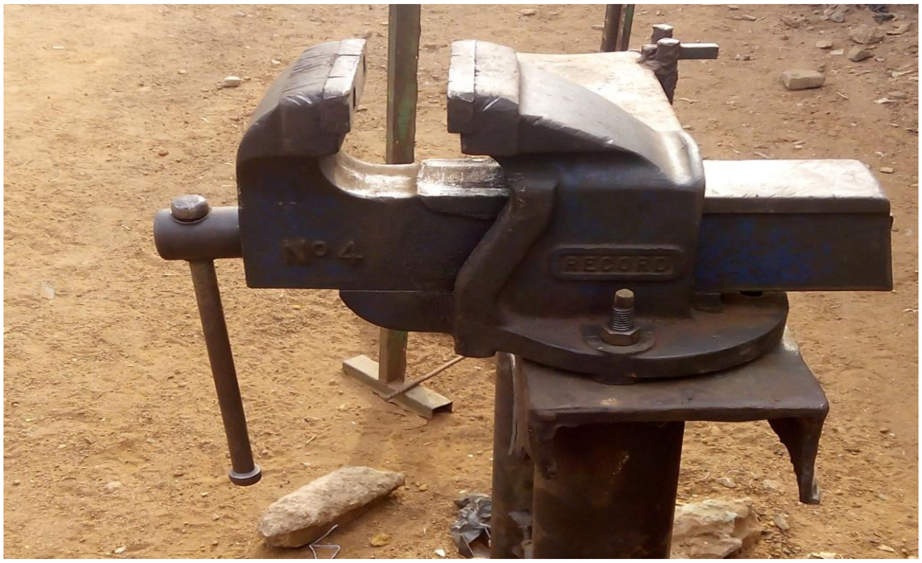
Hacksaws

A hacksaw is a saw for cutting metal or bones. Some of them have pistol grips which keep the hacksaw firm and easy to grip. It is a fine-tooth saw with a blade under tension in a frame. When cutting, the blade must be rigid and under considerable tension to cut properly. If it twists or kinks during the sawing process, great amounts of friction are generated and much energy is lost.

A hacksaw

Bench Vice

A bench vise is a type of vise grip which is designed to attach to a work bench vice grips are tools which are designed to be cranked shut to hold on to something. Essentially, a vise grip is like an extra pair of hands, but unlike hands, a vise grip can exert considerable pressure, and it will never tire out or get bored. Most vise grips consist of a pair of large jaws which can be moved closer together or further apart with the use of a crank, with safety measures or locks which hold the vice grip shut unless the user takes a specific action to open it



Bench Vice

Machinery used in Ismaila Jimoh ventures

Grinding machine

Grinding machines are machine tools equipped with precision grinding wheels and suitable means for holding, positioning, rotating, or traversing the workpiece so that it can be ground to the desired size, shape, and finish. They are used for producing very fine finishes, making very light cuts, or high precision forms using an abrasive wheel as the cutting device. The grinding wheel is mounted on a motor-driven spindle that turns the wheel at about 2000 surface meters (6500 ft.) per minute.

Grinding machine used at Ismaila Jimoh Ventures

CHAPTER 2

WELDING

Welding is a fabrication process used to join materials, usually metals or thermoplastics, together. During welding, the pieces to be joined generally called the workpieces are melted at the joining interface and usually a filler material is added to form a pool of molten material i.e. the weld pool that solidifies to become a strong joint.

Welding can also be referred to as a materials joining process, which produces coalescence of materials by heating them to suitable temperatures with or without the application of pressure or by the application of pressure alone, and with or without the use of filler material.

Welding is used for making permanent joints. It is used in the manufacture of automobile bodies, aircraft frames, railway wagons, machine frames, structural works, tanks, furniture, boilers, general repair work, ship building, burr mills, burglary proofs, mobile shops, work tables and so on.

It should be noted that welding is not the same as soldering and brazing. Soldering and brazing do not involve melting the workpiece but rather a lower-melting-point material is melted between the workpieces to bond them together.

Advantages of welding

It is portable, permanent, stronger than other joining processes.

It is the most economical method to join in terms of material usage and fabrication cost.

Disadvantages of welding

It requires expensive manual labour.

It requires high energy.

TYPES OF WELDING

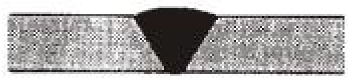
There are many different types of welding processes and in general, they can be grouped as:

1. **Arc Welding**: A welding power supply is used to create and maintain an electric arc between an electrode and the base material to melt metals at the welding point. In such welding processes the power supply could be AC or DC, the electrode could be consumable or non-consumable and a filler material may or may not be added. The most common types of arc welding are:

Shielded Metal Arc Welding (SMAW): A process that uses a coated consumable electrode to lay the weld. As the electrode melts, the (flux) coating disintegrates, giving off shielding gases that protect the weld area from atmospheric gases and 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, the slag must be chipped away to reveal the finished weld.

Gas Metal Arc Welding (GMAW): A process in which a continuous and consumable wire electrode and a shielding gas (usually an argon and carbon dioxide mixture) are fed through a welding gun.

Gas Tungsten Arc Welding (GTAW): A process that uses a nonconsumable tungsten electrode to produce the weld. The weld area is protected from atmospheric contamination by a shielding gas, and a filler metal that is fed manually is usually used.



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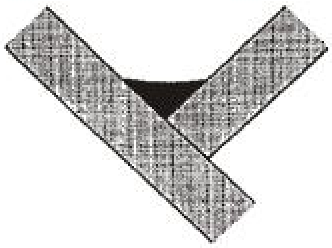
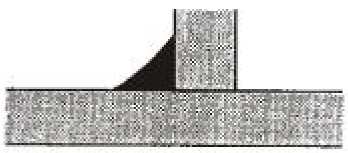
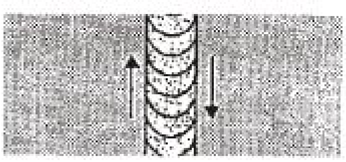
Butt-welded seams in gravity position



Gravity fillet welds



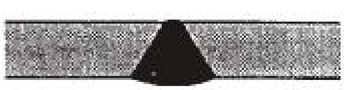
Horizontal fillet welds



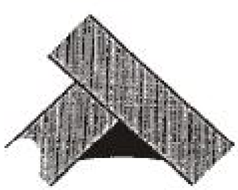
Vertical-up welding position

Vertical-down position

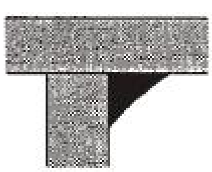
Vertical V butt wall



V butt inverted horizontal position



Overhead position



Horizontal overhead position

2. **Gas Welding**: In this method a focused high temperature flame generated by gas combustion is used to melt the workpieces (and filler) together. The most common type of gas welding is Oxy-fuel welding where acetylene is combusted in oxygen.

3. **Resistance Welding:** Resistance welding involves the generation of heat by passing a high current (1000–100,000 A) through the resistance caused by the contact between two or more metal surfaces where that causes pools of molten metal to be formed at the weld area. The most common types of resistance welding are Spot-welding (using pointed electrodes) and Seam-welding (using wheel-shaped electrodes).

4. **Energy Beam Welding:** In this method, a focused high-energy beam (Laser beam or electron beam) is used to melt the workpieces and thus join them together.

5. **Solid-State Welding**: In contrast to other welding methods, solid-state welding processes do not involve the melting of the materials being joined. Common types of solid-state welding include; ultrasonic welding, explosion welding, electromagnetic pulse welding, roll welding, friction welding (including friction-stir-welding), etc.

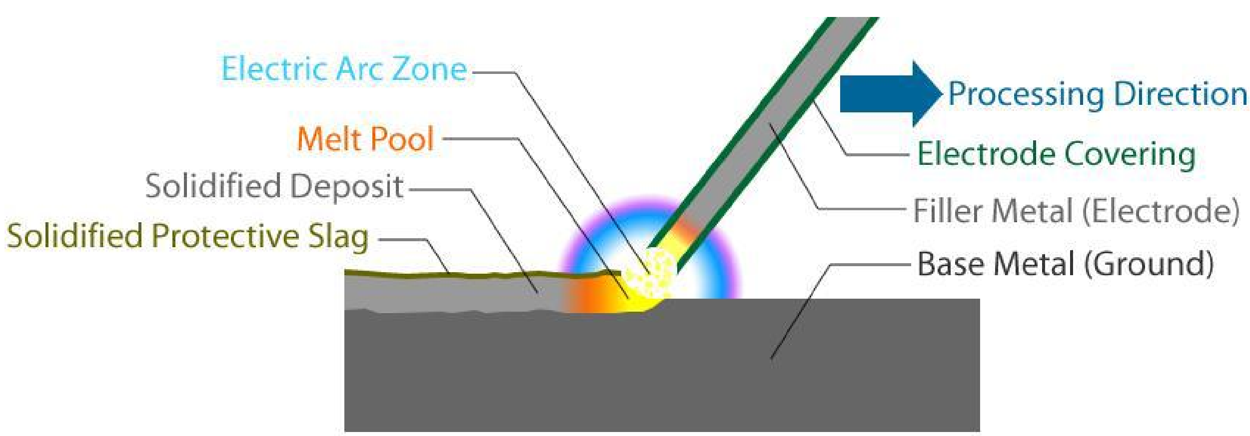
SHIELDED METAL ARC WELDING (SMAW)

Shielded metal arc welding (SMAW), also known as manual metal arc welding (MMA or MMAW), flux shielded arc welding or informally as stick welding, is a manual arc welding process that uses a consumable electrode covered with a 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. The workpiece and the electrode melts, forming the weld pool that cools to form a joint. As the weld is laid, the flux coating of the electrode disintegrates, giving off vapour 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 first and 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, Shielded metal arc welding continues to be used extensively in the construction of heavy steel structures and in industrial fabrication. The process is used primarily to weld iron and steels (including stainless steel) but aluminium, nickel and copper alloys can also be welded with this method.

SHIELDED METAL ARC WELDING MACHINE

WORKING PROCESS

To strike the electric arc, the electrode is brought into contact with the workpiece by a very light touch with the electrode to the base metal then is pulled back slightly. This initiates the arc and thus the melting of the workpiece and the consumable electrode, and causes droplets of the electrode to be passed from the electrode to the weld pool. Striking an arc, which varies widely based on electrode and workpiece composition, can be the hardest skill for beginners. The orientation of the electrode to workpiece is where most stumble, if the electrode is held at a perpendicular angle to the workpiece the tip will likely stuck which will fuse the electrode to the workpiece which will cause it to heat up very rapidly. The tip of the electrode needs to be at a lower angle to the workpiece, which allows the weld pool to flow out of the arc.



As the electrode melts, the flux covering disintegrates, giving off shielding gases that protect the weld area from oxygen and other atmospheric gases. In addition, the flux provides molten slag that 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. This activity, combined with chipping away the slag, reduces the amount of time that the welder can spend laying the weld, making Shielded metal arc welding one of the least efficient welding processes. In general, the operator factor, or the percentage of operator's time spent laying weld, is approximately 25%.

WELDING TECHNIQUE

The actual welding technique utilized depends on the electrode, the composition of the workpiece, 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, and often necessitates the use of an electrode that solidifies quickly to prevent the molten metal from flowing out of the weld pool. However, this generally means that the electrode melts less quickly, thus increasing the time required to lay the weld.

Angle of travel. When welding from left to right, maintain a 0- to 15-degree angle tilted towards the direction of travel. This is known as the ―drag‖ or ―backhand‖ technique.

Drag technique

WELDING DEFECTS

The most common quality problems associated with Shielded metal arc welding include weld spatter, porosity, poor fusion, shallow penetration, and cracking.
Weld spatter, while not affecting the integrity of the weld, damages its appearance and increases cleaning costs. It can be caused by excessively high current, a long arc, or arc blow, a condition associated with direct current characterized by the electric arc being deflected away from the weld pool by magnetic forces. Arc blow can also cause porosity in the weld, as can joint contamination, high welding speed, and a long welding arc, especially when low-hydrogen electrodes are used.

Porosity, often not visible without the use of advanced non-destructive testing methods, is a serious concern because it can potentially weaken the weld.
Another defect affecting the strength of the weld is **poor fusion**, though it is often easily visible. It is caused by low current, contaminated joint surfaces, or the use of an improper electrode.
Shallow penetration, another detriment to weld strength, can be addressed by decreasing welding speed, increasing the current or using a smaller electrode. Any of these weld-strength-related defects can make the weld prone to cracking, but other factors are involved as well. High carbon, alloy or sulfur content in the base material can lead to cracking, especially if low-hydrogen electrodes and preheating are not employed.
Furthermore, the workpieces should not be excessively restrained, as this introduces residual stresses into the weld and can cause cracking as the weld cools and contracts.

SAFETY

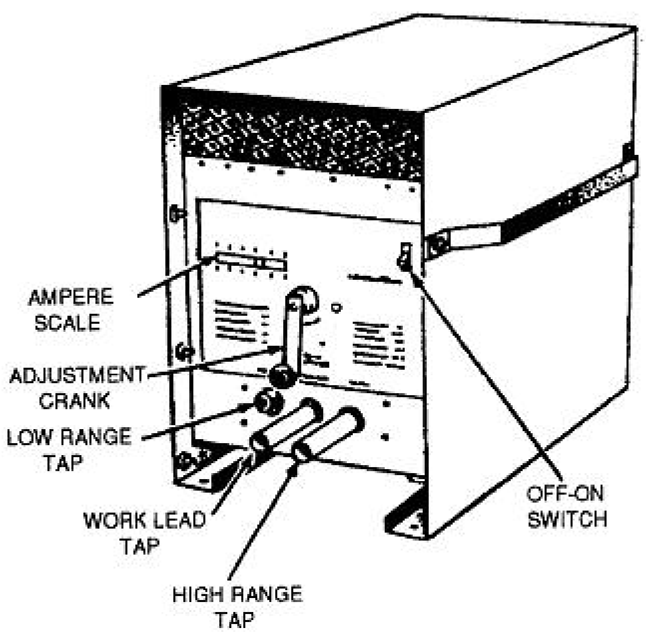
Shielded metal arc welding, like other welding methods, can be a dangerous and unhealthy practice if proper precautions are not taken. The process uses an open electric arc, which presents a risk of burns which are prevented by personal protective equipment in the form of heavy leather gloves and long sleeve jackets. Additionally, the brightness of the weld area can lead to a condition called arc eye, in which ultraviolet light causes inflammation of the cornea and can burn the retinas of the eyes. Welding helmets with dark face plates are worn to prevent this exposure, and in recent years, new helmet models have been produced that feature a face plate that self-darkens upon exposure to high amounts of UV light. To protect bystanders, especially in industrial environments, translucent welding curtains often surround the welding area. These curtains, made of a polyvinyl chloride plastic film, shield nearby workers from exposure to the UV light from the electric arc, but should not be used to replace the filter glass used in helmets.
In addition, the vaporizing metal and flux materials expose welders to dangerous gases and particulate matter. The smoke produced contains particles of various types of oxides. The size of the particles in question tends to influence the toxicity of the fumes, with smaller particles presenting a greater danger.
Additionally, gases like carbon dioxide and ozone can form, which can prove dangerous if ventilation is inadequate. Some of the latest welding masks are fitted with an electric powered fan to help disperse harmful fumes.

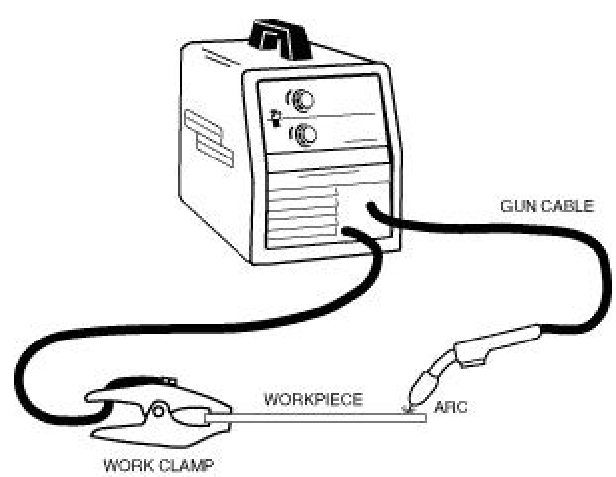
APPLICATION AND MATERIALS

Shielded metal arc welding is one of the world's most popular welding processes, accounting for over half of all welding in some countries. Because of its versatility and simplicity, it is particularly dominant in the maintenance and repair industry, and it is heavily used in the construction of steel structures and in industrial fabrication. In recent years its use has declined as flux-cored arc welding has expanded in the construction industry and gas metal arc welding has become more popular in industrial environments. However, because of the low equipment cost and wide applicability, the process will likely remain popular, especially among amateurs and small businesses where specialized welding processes are uneconomical and unnecessary. Shielded metal arc welding is often used to weld carbon steel, low and high alloy steel, stainless steel, cast iron, and ductile iron. While less popular for nonferrous materials, it can be used on nickel and copper and their alloys and, in rare cases, on aluminum. The thickness of the material being welded is bounded on the low end primarily by the skill of the welder, but rarely does it drop below 1.5 mm (0.06 in). No upper bound exists: with proper joint preparation and use of multiple passes, materials of virtually unlimited thicknesses can be joined. Furthermore, depending on the electrode used and the skill of the welder, Shielded metal arc welding can be used in any position.

EQUIPMENTS

Shielded metal arc welding equipment typically consists of a constant current welding power supply and an electrode, with an electrode holder, a 'ground' clamp, and welding cables (also known as welding leads) connecting the two.





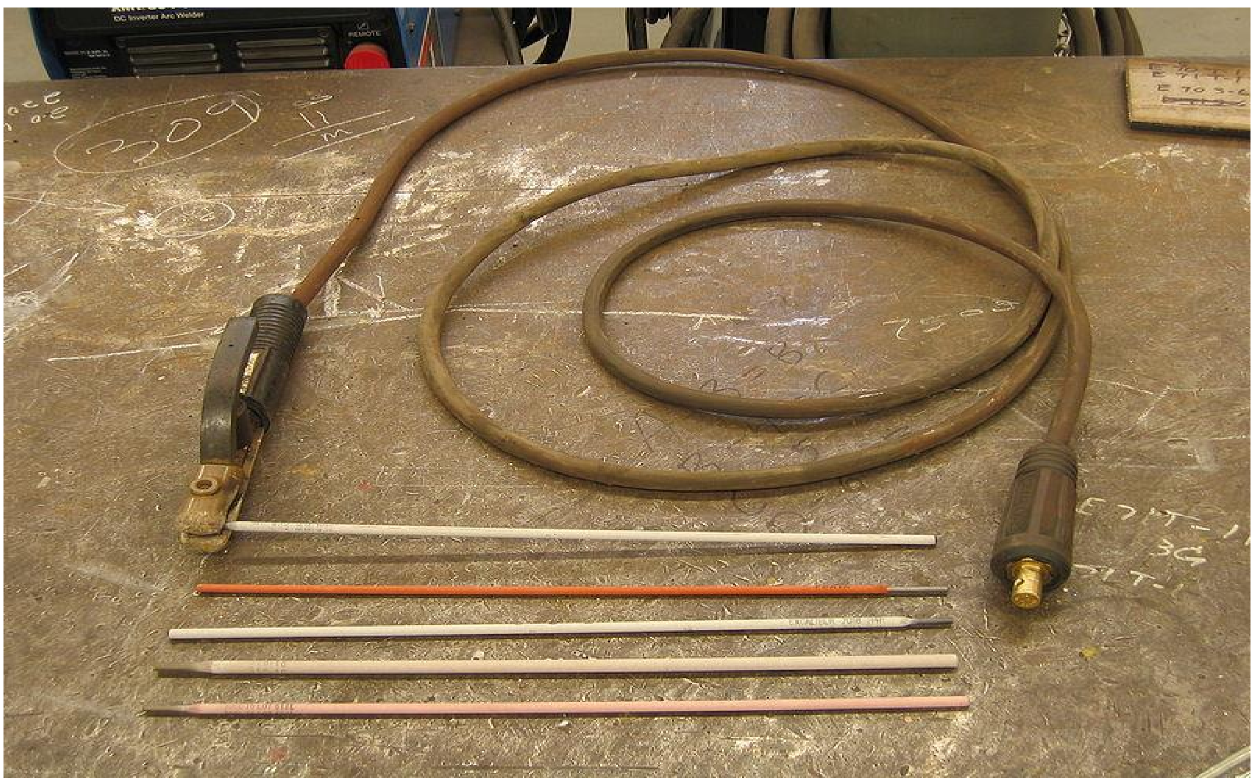
SOURCE OF POWER SUPPLY

The power supply used in Shielded metal arc welding has constant current output, ensuring that the current (and thus the heat) remains relatively constant, even if the arc distance and voltage change. This is important because most applications of Shielded metal arc welding are manual,

requiring that an operator hold the torch. Maintaining a suitably steady arc distance is difficult if a constant voltage power source is used instead, since it can cause dramatic heat variations and make welding more difficult. However, because the current is not maintained absolutely constant, skilled welders performing complicated welds can vary the arc length to cause minor fluctuations in the current.
The preferred polarity of the Shielded metal arc welding system depends primarily upon the electrode being used and the desired properties of the weld. Direct current with a negatively charged electrode (DCEN) causes heat to build up on the electrode, increasing the electrode melting rate and decreasing the depth of the weld.

ELECTRODES

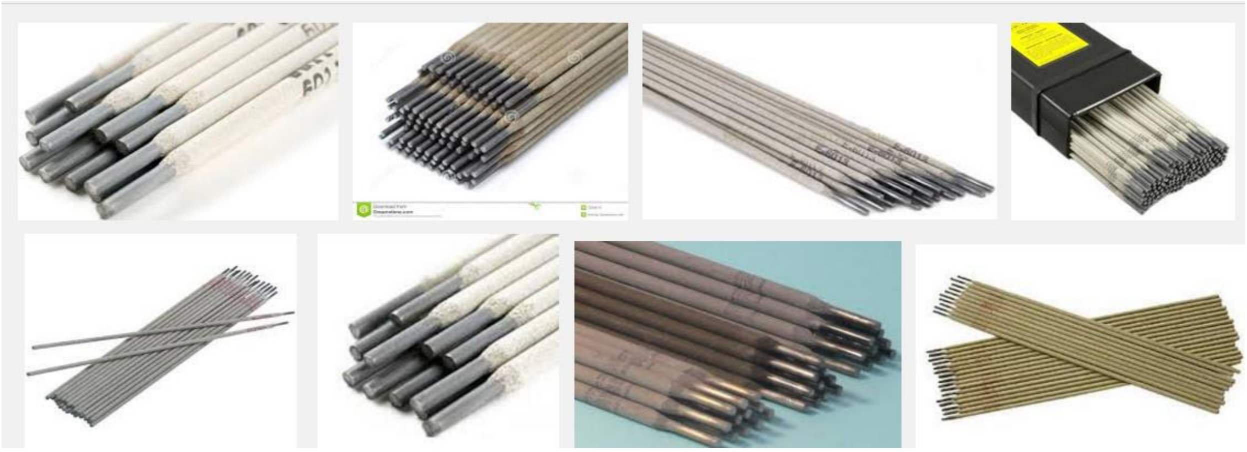
The choice of electrode for SMAW depends on a number of factors, including the weld material, welding position and the desired weld properties.



The electrode is coated in a metal mixture called flux, which gives off gases as it decomposes to prevent weld contamination, introduces deoxidizers to purify the weld, causes weld-protecting slag to form, improves the arc stability, and provides alloying elements to improve the weld quality.
Electrodes can be divided into three groups—

- "fast-fill" electrodes designed to melt quickly.
- "fast-freeze" electrodes designed to solidify quickly.
- "fill-freeze" or "fast-follow" electrodes which are intermediate electrodes.

Fast-fill electrodes are designed to melt quickly so that the welding speed can be maximized, while fast-freeze electrodes supply filler metal that solidifies quickly, making welding in a variety of positions possible by preventing the weld pool from shifting significantly before solidifying.

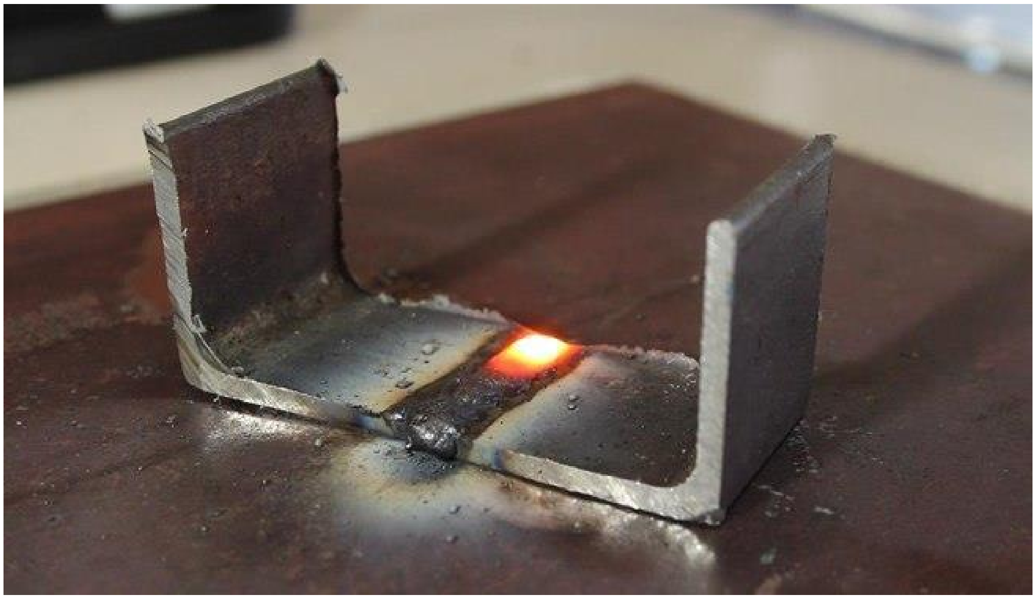


The composition of the electrode core is generally similar and sometimes identical to that of the base material. Nevertheless, even though a number of feasible options exist, a slight difference in alloy composition can strongly affect the properties of the resulting weld. This is especially true of alloy steels such as high-speed steels. Likewise, electrodes of compositions similar to those of the base materials are often used for welding nonferrous materials like aluminium and copper. However, sometimes it is desirable to use electrodes with core materials significantly different from the base material. For example, stainless steel electrodes are sometimes used to weld two pieces of carbon steel, and are often utilized to weld stainless steel workpieces with carbon steel workpieces.

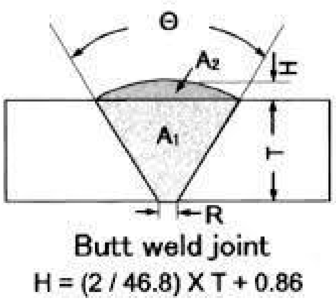
Electrode Diameter mm	Min Current	Max Current	Average Current
1.6	25	45	40
2.0	34	65	50
2.5	50	90	90
3.2	60	130	115
4.0	100	180	140
5.0	150	250	200
6.0	200	310	280

ELECTRODES

Types of Welded Joints



The weld joint is where two or more metal parts are joined by welding. The five basic types of weld joints are the butt, corner, tee, lap, and edge.
Butt Joint: it is used to join two members aligned in the same plane. This joint is frequently used in plate, sheet metal, and pipe work.



Corner and Tee Joints: these joints are used to join two members located at right angles to each other. In cross section, the corner joint forms an L-shape, and the tee joint has the shape of the letter T.
Lap Joint: this joint is made by lapping one piece of metal over another. This is one of the strongest types of joints available; however, for maximum joint efficiency, the overlap should be at least three times the thickness of the thinnest member of the joint.
Edge Joint: it is used to join the edges of two or more members lying in the same plane. This type is frequently used in sheet metal work for joining metals 1/4 inch or less in thickness that are not subjected to heavy loads.

How the fire may occur

Generally, as welding (and cutting) involves such high temperatures, fires occur when hot metal (sparks) comes into contact with some combustible material. To avoid confusion, it should be noted that in welding terminology, a 'spark' refers to the luminous particle that can be formed when an arc melts metal. Quite unlike the usual meaning of the word ‘spark’, which is a high voltage discharge.

Cutting of metals (arc and gas) poses more of a fire hazard than does welding. This is hardly surprising considering the relatively large amount of sparks produced as the metal is cut as opposed to when it is welded. As the metal is cut, (using welding techniques), sparks and hot, molten metal fly off in all directions. Furthermore, the sparks from cutting may travel some distance, and as they are small, may drop down through small holes causing a fire to start.

In arc welding or cutting, the temperature in an arc path may also be a competent ignition source. In fact, the power in a welding arc is enough to ignite nearly any combustible material. This very rarely happens however, as the arcing is so brief and localized that solid fuels such as wood or plastic cannot be ignited. The arc may cause the fire however, if it comes in contact with fuels with a high surface area to mass ratio, such as cotton batting and tissue paper, or combustible gases and vapours.

Electrical Connections

Before starting operations:

1. Make certain all electric lead welding connections are secure.
2. Firmly attach the ground connection as close to the work as possible.
3. Work leads shall be as short as possible.
4. The welding machine frame shall be grounded.

Electric Shock

1. It is important to take precautions to avoid electric shock. The following are especially
2. important precautions to be taken:
3. Clothing. shoes, gloves and other protective equipment shall be kept as dry as possible.
4. Always wear approved hand protection and never permit the metal part of an electrode or holder to touch your body.
5. Electrodes shall be removed from the holder when not in use.
6. Electrode holders when not in use shall be placed so they cannot make electrical contact with persons or conductive objects.
7. Be careful to avoid shock when changing electrodes.
8. Check equipment regularly to see that electrical connections and cable are in good condition.

9. Be particularly alert that the electrode holder cable connection is in good condition and secure. Only approved ground connecting devices and rod holders shall be used.
10. All welding lines and connections shall be insulated.
11. Welding machines shall be shut off when work is stopped.
12. Only authorized employees shall make repairs on welding machines.

WELDING OR CUTTING IN CONFINED SPACES

When welding or cutting in any confined space, such as a tank, boiler, pipeline or compartment, the space shall be cleaned, tested and ventilated during the welding operation. All Confined Space requirements as outlined in the University Program must be followed.

When entering a confined space through a manhole or other small opening, means shall be provided for quickly removing employee in case of an emergency.

When arc welding in a confined space is to be suspended for any substantial period of time all electrodes shall be removed from the holders and the machine shut off.

When gas welding or cutting in a confined space is to be stopped for any substantial period of time the torch valves shall be closed and the gas and oxygen supply to the torch positively shut off at some point outside the confined area. The torch and hose shall be removed from the confined space or disconnected from the gas supply during such times. Atmospheric tests shall be made before re-entering.

Do not allow unlighted gas or oxygen to escape and exercise extreme care that hoses and connections are free from leaks. The torch shall be lighted outside and passed with care to the employee inside.

Ventilation shall be provided to keep the space purged of any possible accumulation of flammable gas or vapors. If welding or burning is done on the outside of the structure and there is any possibility of flammable gases accumulating, the interior shall be properly purged to prevent any fire or explosion.

Welding or cutting is not to be done on or in any tank, pipe line, compartment or container which has contained flammable material until it has been thoroughly purged, cleaned and proved to be free from explosive vapors or any danger of explosion, by means of gas detector.

POST-WELDING OPERATIONS

1. **GRINDING -** This is the removal of excess carbon from the electrodes deposited on the welded spot by the use of grinding machine. Grinding is an abrasive material removal process. It is used on component which must be produced to a close dimensional tolerance and have a smooth finish.

2. **SANDPAPERING -** This is a surface finish operations which involves the use of abrasive paper to improve the surface of the metal and to enhance an improved surface finishing especially for painting purposes.

3. **PAINTING -** Painting is one of the most important of all the surface finish processes. Painting may be for protection against rusting, decoration or a combination of the two. Before painting is apply, all surface finished operation must have been done

4. **DRILLING** - Drilling is a process of producing round holes in a solid material or enlarging existing holes with the use of multi-tooth cutting tools called drills or drill bits. Various cutting tools are available for drilling, but the most common is the ***twist drill***.

CHAPTER THREE

MAJOR OPERATIONS CARRIED OUT

During the concluded training programme, various works were fabricated and constructed. However, the material used, tools, machine, and procedures of some selected works will be explained extensively in this chapter.

Wire Mesh Fence Installation

Wire-mesh fence also known as chain-link fence is a type of woven fence usually made from galvanized or LLDPE-coated steel wire. The wires run vertically and are bent into a zig-zag pattern so that each “zig” hooks with the wire immediately on one side and each “zag” with the wire immediately on the other. This forms the characteristic diamond pattern seen in this type of fence. It is used for high security fencing of piece of land, tennis courts, ball parks etc. The site where the fence installation took place was a six acre plot of land located at Opaleye in Akufo village in Ibadan.

Materials used

i. Metal wire often galvanized
ii. Binding wires
iii. Concrete mixture
iv. Electrodes
v. Galvanized pipes

Tools used

i. Pliers
ii. Pincers
iii. Digger
iv. Axe
v. Spade/shovel

PROCEDURE

The installation of chain-link fence involved setting posts into the ground and attaching the fence to them. The ground was dug round the work area and posts (made of galvanized pipes) were driven into the ground and set in concrete. End, corner or gate posts, commonly referred to as "terminal posts", were properly set in concrete footing to prevent leaning under the tension of a stretched fence. Posts were set between the terminal posts are called "line posts" and were set at intervals of 10 feet.

Poles on site that are already set

Before the fence is placed, it has to be set to ensure a homogeneous top and bottom levels and also for firmness of the wire mesh.

I and a colleague setting the wire mesh for placement

The fence was attached at one end, stretched, and attached at the other end of the pole, with the excess removed by "unscrewing" a wire. The fence was tied to the line posts with aluminium wire(binding wire). The bottom tension wire is stretched, sometimes referred to as "coil wire", between terminal posts to help minimize the in and out movement that occurs at the bottom of the chain-link mesh between posts. Top horizontal rails were also used.

Wire mesh fences attached to poles and set

Wire mesh Fence Gate

The gate is the entrance into the fenced site and is made up weld mesh wire nets and galvanized pipes (75mm diameter). The ground was dug and the gate was mounted and set with concrete

Weld mesh wire Gate

I and my Colleagues after fence and gate installation

Fabrication of Domestic Charcoal Pots

Charcoal pots are structural models of sheet metalwork designed for domestic usage in homes (cooking) and small local industries (where heating by coal is required). Coal pots are economical substitutes for petroleum fuel stoves.

Materials Used

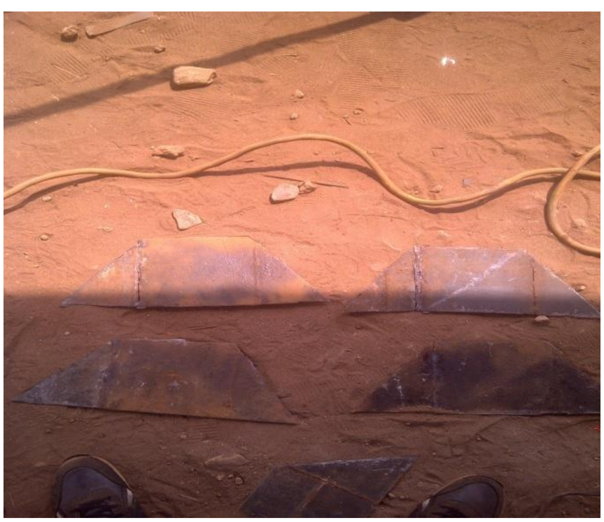
i. Sheet metal plates(iron with7mm thickness)
ii. Electrodes
iii. Steel rods(10mm)

Tools/Machinery Used

i. Hand Shear
ii. Chalk/scriber
iii. Steel tape-rule
iv. Arc-welding machine
v. Welding tong

PROCEDURE

The patterns (trapezium, square, rectangle) were measured and marked out using the tape rule and chalk/scriber on the iron plate. The patterns were cut out using the Shear. The parts were arranged to give a truncated prism shape, the sides were welded. Steel rods were arranged inside and also welded.



The trapezium parts cut out

The top part of coal part with steel rods

The rectangular part was bent into three faces.

The rectangle bent to three faces

The square part was placed at the bottom and welded to give the final shape of the coal pot.

The final shape of the coal pot

CONSTRUCTION OF COLUMN (PILLAR) REINFORCEMENT

Reinforced concrete is a composite material in which concrete's relatively low tensile strength and ductility are counteracted by the inclusion of reinforcement having higher tensile strength or ductility. The reinforcement is usually, though not necessarily, steel reinforcing bars(rebar) and is usually embedded passively in the concrete before the concrete sets. Reinforcing schemes are generally designed to resist tensile stresses in particular regions of the concrete that might cause unacceptable cracking and/or structural failure.

Materials Used

i. Steel rods(12mm
ii. Binding wires

Tools used

i. Bench vice
ii. Hacksaw
iii. Pincers
iv. Pliers
v. Measuring tape
vi. Scriber
vii. Bender

PROCEDURE

Production of Rings

- 0.64metres was measured with the measuring tape and mark with a Scriber.
- At an interval of 0.15m and allowance of 0.01m four marks were measured and made.
- The 0.64m long steel rod was cut out.
- The 0.64m long rod was placed on the vice and with the aid of the Bender, was bent at an angle of 90° at the 0.15m marks with a 0.01m allowance to give a square ring.
- Repeat the procedures to produce seven more rings.

Bender

Bench Vice

Square Rings

Production of Mat

- Six pieces 12mm steel rods of equal length 0.5m were measured marked and cut out.
- The pieces were arranged in form of a document table with three rows and three columns equidistant to the other
- Binding wires were used to bind(hold) them together

Concrete reinforcement mat

Production of the Reinforcement

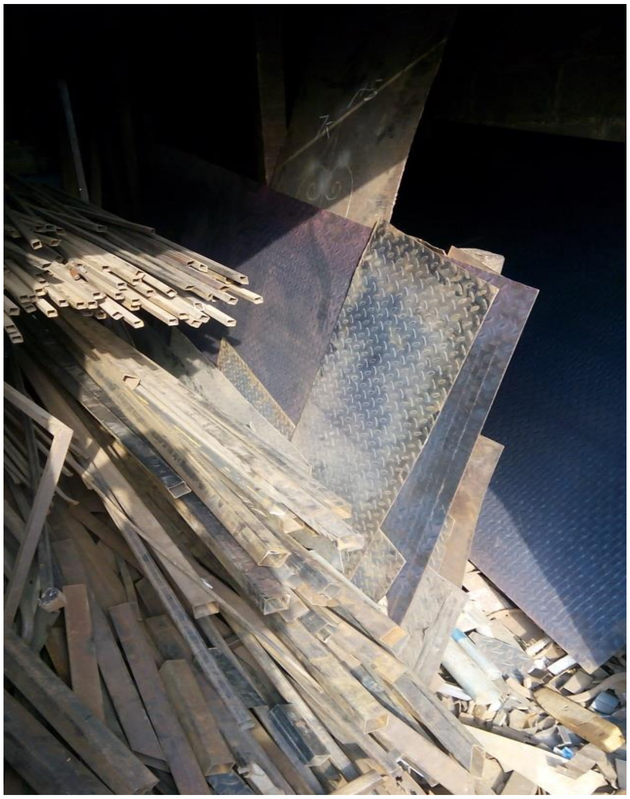
- Four pieces 12mm steel rods of length 5m were measured and cut
- Eight rings were arranged at an interval of 1ft into the 5m rods such that each rod is within the rings and at each corner of the rings.

After the reinforcement is produced, the mat is set into the foundation hole and the column is placed on and tied firmly on the mat using binding wires. Concrete is poured into it and allowed to set.

Reinforced concrete in foundation state

CHAPTER FOUR

CHOICE OF MATERIALS

IRON

Iron is a chemical element with symbol Fe (from Latin: *ferrum*) and atomic number 26. It is a metal in the first transition series. It is by mass the most common element on Earth, forming much of Earth's outer and inner core. It is the fourth most common element in the Earth's crust. Iron metal has been used since ancient times. Pure iron is relatively soft, but is unobtainable by smelting. The material is significantly hardened and strengthened by impurities, in particular carbon, from the smelting process.

The Physical properties of Iron are the characteristics that can be observed without changing the substance into another substance. Physical properties are usually those that can be observed using our senses such as colour, lustre, freezing point, boiling point, melting point, density, hardness and odour. The Physical Properties of Iron are as follows:

What are the Physical Properties of Iron?	
Colour	Silver-gray metal
Malleability	Capable of being shaped or bent
Ductility	Easily pulled or stretched into a thin wire
Lustre	Has a shine or glow
Conductivity	Good transmission of heat or electricity
Allotropy	It occurs in two or more crystalline forms in the same physical state
Tensile	It can be stretched without breaking
Ferromagnetic	Easily magnetized

STEEL

Although steel had been produced in bloomery furnaces for thousands of years, steel's use expanded extensively after more efficient production methods were devised in the 17th century for blister steel and then crucible steel. Steels are alloys of iron and carbon, widely used in construction and other applications because of their high tensile strengths and low costs. Carbon, other elements, and inclusions within iron act as hardening agents that prevent the movement of dislocations that otherwise occur in the crystal lattices of iron atoms. Although steel had been produced in bloomery furnaces for thousands of years, steel's use expanded extensively after more efficient production methods were devised in the 17th century for blister steel and then crucible steel.

The carbon in typical steel alloys may contribute up to 2.1% of its weight. Varying the amount of alloying elements, their formation in the steel is either as solute elements, or as precipitated phases, retards the movement of those dislocations that make iron so ductile and weak, and thus controls qualities such as the hardness, ductility, and tensile strength of the resulting steel. Steel's strength compared to pure iron is only possible at the expense of ductility, of which iron has an excess.

PHYSICAL PROPERTIES

I. **Lustre**: It is a shiny metal with a very attractive finish (architecture, cutlery, appliances)

II. **Conductivity**: It transfers heat and electricity, an example is saucepans.

III. **Malleability**: It can be rolled into thin sheets, rods, bars or beams (roofing, structural) or forged into different shapes (gears, tools).

IV. **Ductility**: It can be stretched or drawn out into thin wires (wire fences) or pressed into different shapes (auto body panels)

V. **Strength**: It is very strong and resistant to fracture (building frames, security doors, trains and ships).

VI. **Durability**: It is a long lasting material (buildings, rail lines, bridges) and resistant to wear (machines and equipment).

VII. **Alloying**: Adding other chemicals can change steel's properties. Stainless Steel contains the elements chromium, nickel and molybdenum to make it rust resistant for use in kitchens. Manganese is added to increase toughness, while steel for rods has tungsten and cobalt to keep it hard, even when it gets hot.
VIII. **Coating**: As well as having various recipes, steel can also be coated with different substances, such as other metals like tin, or plastics or paints. ZINCALUME steel has a protective coating of a zinc-aluminum alloy to protect it from the weather.

ALUMINUM

Aluminum as many people see it, is a just a metal, but really, it is a chemical element; which according to the periodic table has atomic number 13. It is in the Boron group. As a metal, it is a silvery white, soft, nonmagnetic, ductile material. Aluminum is the third most abundant element after Oxygen and Silicon, and the most abundant metal in the Earth's crust. It makes up about 8% by weight of the Earth's solid surface. Aluminum metal is so chemically reactive that native specimens are rare and limited to extreme reducing environments. Instead, it is found combined in over 270 different materials. The chief ore of Aluminum is Bauxite.

PHYSICAL PROPERTIES
Aluminum has a unique and unbeatable combination of properties that make it a versatile, highly usable and an attractive construction material.
1. **Mass**: Aluminum is a light metal with a density of 2,700 kg/m, one third that of steel. (8,400 kg/m)

2. **Elasticity**: The Young's modulus for aluminum (E=69 000 MPa) is a third that of steel. This means that the moment of inertia has to be three times as great for an aluminum extrusion to achieve the same deflection as a steel profile.

3. **Joining**: Aluminum can be joined using all the normal methods available such as welding, brazing, adhesive bonding and riveting.

4. **Corrosion resistance**: A thin layer of oxide is formed when exposed to air. This provides very good protection against corrosion even in corrosive environments. This layer can be further strengthened by surface treatments such as anodising or powder coating.

5. **Conductivity**: The thermal and electrical conductivities are excellent, even when compared with copper. Furthermore, an aluminum conductor has only half the weight of an equivalent copper conductor.
6. **Linear expansion**: Aluminum has a relatively high coefficient of linear expansion compared to other metals. This should be taken into account at the design stage to compensate for differences in expansion.

7. **Non-toxic**: Aluminum is non-toxic and is therefore highly suitable for the preparation and storage of food.

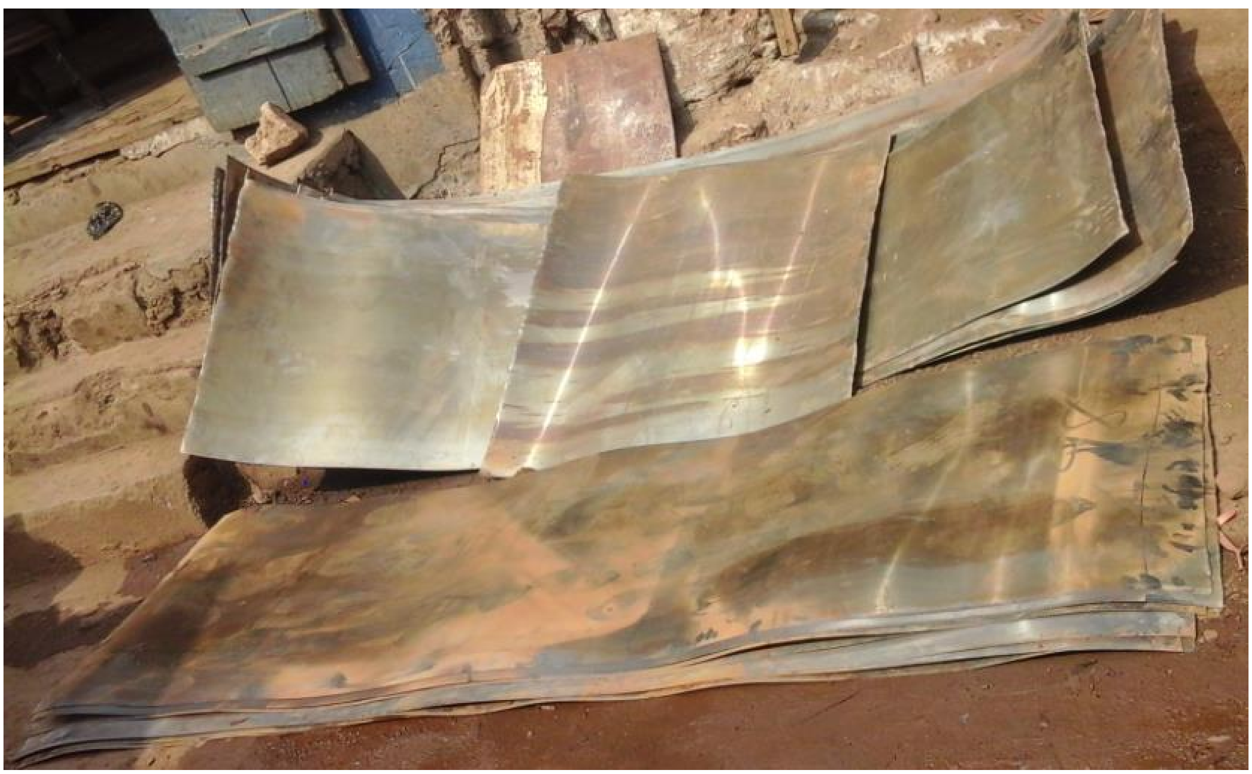
8. **Reflectivity**: Aluminum is a good reflector of both light and heat. Hulamin Extrusions Standard Profile Catalogue

9. **Strength**: Aluminum is strong with a tensile strength between 70 and 700 MPa, depending on the alloy and manufacturing process. Extrusions of the right alloy and design can be as strong as structural steel.

10. **Formability**: Aluminum has good formability in both hot and cold condition, a characteristic that is used in full in the extrusion process. Aluminum can also be cast, drawn and rolled.

11. **Machining**: Aluminum is very easy to machine. Ordinary fabrication equipment (saws and drills) and machining equipment (lathes and milling machines) can be used.

12. **Thermal Conductivity**: Aluminum thermal conductivity is half that of the equivalent sized copper element (8 900 kg/m), but has a density (2 700 kg/m) of less than a third of that of the copper element. The equivalent aluminum element therefore comes at less than half the price and is much easier to



ALUMINIUM SHEETS

CHAPTER FIVE

CONCLUSION AND RECOMMENDATIONS

CONCLUSION

The 8-weeks long Students Work Experience Programme at Ismaila Jimoh Ventures has afforded me and my colleagues the opportunity to have practical knowledge on several sheet metal structural fabrications, and the operations and processes involved. Several technical knowledge of fabrication operations I was able to acquire include; welding, drilling, cutting operations etc. Apart from the technical knowledge that was acquired, knowledge about work ethics especially the relationship with co-workers and colleagues from various backgrounds was also gained.

This training also bridged the gap between the theoretical knowledge I had learnt at workshop practice and the real practical applications.

Although I might not be an expert in the field yet, but with the knowledge acquired through this programme (SWEP), I am certainly not a novice.

RECOMMENDATIONS

The programme (SWEP) has been very successful so far. However, in order to make it more effective and efficient the following recommendations are hereby given:

1. The objectives of SIWES should be explained to students; this will help them to put in their best and also to be committed to the training.
2. Institution should organize an orientation programme for the industry based supervisor to educate them on their roles.
3. ITCC should inspect the company if they have safety equipment's and measures before posting students for training.
4. I also recommend that the university in collaboration with the Federal Government should fund the programme in order to encourage the employers and students.

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