

Fabrication and Assemblage of Window Burglarproof and Red Coloured Aluminium Double Swing Window Frames and Glasses

K. E. Madu¹; E. I. Nwankwo¹; G. O. Okoronkwo² and A. C. Aneke³

¹*Department of Mechanical Engineering
Chukwuemeka Odumegwu Ojukwu University
Uli, Anambra, Nigeria*

²*Department of Chemical Engineering
Chukwuemeka Odumegwu Ojukwu University
Uli, Anambra, Nigeria*

³*Department of Mechanical Engineering
Petroleum Training Institute
Effurun, Delta, Nigeria*

Abstract: The gap between what aluminum fabricators and glaziers offer and the demands of the labour market is widening by the day. Engineering graduates are more exposed to theory than the practical aspects of their training. In recent time, there has been increased awareness on the need to match engineering theories with practices, hence, the need for Students' Work Experience Programme. The fabrication and assembly of burglarproof and red coloured aluminum double swing window frames and glasses were done undertaken at Wisdom and sons aluminum, Irete Imo State, Nigeria by researchers. The burglarproof were fabricated according to designed specifications with the help of shielded metal arc welding utilizing 16mm mild steels, painted with antirust paint to prevent corrosion.

Keywords: Window Burglarproof, Red Coloured Aluminum Frames, Design and Fabrication, Shielded Metal Arc welding.

1. Introduction

Wisdom and Sons Aluminum Company is among numerous companies where technical and engineering students undertake vacation programs in-house at the end of 200 and 400 levels for Students' Work Experience Programme (SWEP). The students' Work Experience Programme (SWEP) was established to enable students of tertiary institutions have basic technical knowledge of industrial works based on their specialty areas of study before the completion of their programs in their respective institutions. The scheme was designed to expose students to industrial environmental experiences and enable them develop occupational competencies so that they can readily contribute their quota to national, economic and technological development of Nigeria after graduation. Theoretical knowledge alone would be insufficiently in the preoperational processes of an educated person for the wilder world. A university graduate must not only be knowledgeable theoretically but must also be versatile in the application of skills to perform defined task.

2. Welding Process

The term welding is used to cover a wide range of bonding techniques. Welding is a manufacturing process used to join sculptural materials, usually metals or thermoplastics, by coalescence. This is often done by fusing the work pieces and adding a filler material to form a pool of molten material (the solder bath) that cools to become strong, with pressure sometimes used in conjunction with heat, or by itself, to produce the weld. The term weld-ability has been defined as the capacity of metal to be welded under the fabrication conditions imposed into a specific, suitably designed structure and to perform satisfactorily in the intended service [1]. There are different types of welding process in the welding history. For instance (Gas welding, arc welding, resistance welding, solid state welding, etc.), described as depicted below. To prevent injuries especially the eyes, a welder must wear personal protective safety equipment such as welding goggle, leather glove, coverall, welding helmet etc.

2.1. Gas Welding

Gas welding is a welding process that uses fuel gases and oxygen during welding operation. Gas welding is one of the oldest welding processes. Still used in industry, in recent times it has been less widely utilized in industrial applications as other specifically devised technologies have been adopted. It is still widely used for welding pipes and tubes, as well as repair work. It is also frequently well-suited, and favored, for fabricating some types of metal-based artwork. As well, gas welding has an advantage over electric welding and

cutting processes in situations where accessing electricity (e.g., via an extension cord or portable generator) would present difficulties; it is more self-contained, in this sense — hence "more portable"

2.2. Arc Welding

Arc welding is a method of welding that uses a welding power supply to create an electric arc between an electrode and the base materials to melt the metals at the welding point. It involves the use of either direct (DC) or alternating (AC) current, and consumable or non-consumable electrodes. The welding region is usually protected by some type of shielding gas, vapour, or slag. Arc welding processes may be manual, semi-automatic, or fully automated [2], [3]. Today it remains an important process for the fabrication of steel structures and vehicles. For the purpose of work, shielded metal arc welding is used. The shielded metal arc welding is one of the most common types of arc welding [4], highly versatile and can be performed with relatively inexpensive equipment [5]. Pipeline and structural welders use this method the most because of its deep 'penetration' (how much it digs into the base metals), and pressure handling capabilities [6].

2.3. Resistance Welding

Resistance welding is a welding technique in which the parts to be joined are held together under pressure and heat is produced by passing a current through the contact resistance formed between the two surfaces.

2.4. Solid State Welding

This is a process of joining two metals together by vibrating them at high frequency and under high pressure. The equipment and methods involved are similar to that of resistance welding, but instead of electric current, vibration is used to provide energy input. Welding metals with this process does not involve melting the materials; instead, the weld is formed by introducing mechanical vibrations horizontally under pressure. Broadly, welding processes could be classified as plastic, fusion welding and solid- phase welding [7].

A. Plastic welding: In this case, pieces of metals to be joined are heated to the plastic state and forced together by external pressure without the additions of a filler material e.g. forge welding, thermit welding etc.

B. Fusion welding: This is the process of joining metals by the application of heat and a filler material. The metals at the joint are heated to a molten state and allowed to solidify. e.g. gas welding, arc welding etc.

C. Solid phase welding: This involves making welds by the creation of metallic bond between the surfaces being joined.

To obtain satisfactory weld, the followings were taken into considerations:

1. A source of energy to create union by fusion or pressure;
2. A method of protecting metal from atmospheric contamination; the surfaces which are to be joined by any welding process were sufficiently clean to permit clean metallic surfaces to come in contact
3. Control of weld metallurgy;
4. A method of removing contaminants;
5. Fluxes were used in welding all types of metals except mild steel, so that the oxide formed during heating is dissolved and sound welded joint can be obtained; and
6. The selections of the welded joints were such that satisfied the requirements of design, cost and practical welding.

The choice of a particular welding process adopted depends on the following factors: Cost of production, type of metal and its metallurgical characteristics, structural size, desired performance and type of joint: its location and welding position etc. The quality of welding depends on the following parameters: Skills of welder, welding environment, work layout, dimensional accuracy, protection from wild wind during- on- site welding as well as correct processes and procedures[7]etc.

Welding is used as a fabrication process in every industry, large or small. It is a principal means of fabricating and repairing metal products and has the following advantages:

1. The process is efficient, economical and dependable as a means of joining metals. It is the only process which has been tried in the space. The process finds its application in air, underwater and in space.
2. Welded joint have high resistance to corrosion compared to bolted or riveted joint.
3. Different types of joints are possible with welding.
4. Welded joint can be altered easily and economically.
5. Welded joints are compact, fluid tight for tanks and vessels.

Welded joints can be butt joint, lap joint, -joint, and corner joint or edge joint. For any welding operation, heat input is given as:

$$hi = V * IS \quad (2.1)$$

Where:

hi =heat input (joule/mm or MJ/m); V=Voltage (volts); I=Current (ampere); and S=Welding speed (mm/sec).

3. Aluminium Frames

Aluminum is a silvery-white light metal, mined in the form of bauxite. It is both light and strong. Aluminum is one of the most important metals for vehicle and aircraft construction, electrical engineering and structural connections. Aluminum is highly regarded due to its low specific weight and its excellent usability and processing characteristics [8]. The following are benefits of aluminum frames over some other sort of frames:

1. Durability and Low Maintenance: The corrosion resistant quality of aluminum provides a low maintenance frame and is resistant to weathering under a range of harsh environmental conditions. Unlike many other materials, it will not swell, crack, split or warp over time; ensuring an extended product life.
2. Affordability: Aluminum frames can be significantly less expensive than other framing options, providing a strong yet economical window and door solution, while also achieving excellent energy outcomes.
3. Recyclability: Aluminum has one of the highest recycling rates of any metal and is an environmentally sustainable material. Recycling of aluminum requires only five percent of the initial energy consumed to create it. This inherent property differentiates it from other framing materials, reinforcing its sustainable credentials.
4. Short Payback Period: Payback periods on high performance aluminum windows are typically far shorter than for other alternatives which offer only marginally improved performance at a far higher price. Such options can take several decades to deliver a payback.etc

4. Materials And Method

The following are the materials; tools and equipment's used in the fabrication of the aluminum window burglary proof



Fig.1 (a): welding machine



Fig.1 (b): return current cable(earth)



Fig.1 (c): hack saw

4.1. Welding Machine: This machine is coupled with the electrode holder and the return current cable known as earth by non-engineers. It is made up of primary coil and the secondary coil, with the two hands of the primary coil connected to the electric source bringing current into the welding machine and the two hands of the secondary coil connected to the electrode holder and the return current cable. From private study and literatures on welding, it was realized that the welding machine is working like a transformer because it converts electric current from the primary coil into electromagnetic field sent into the secondary coil used in welding the mild steel iron together [9].

4.2. Vice: It is a holding tool used in holding the mild steel iron when cutting it.

4.3. Chipping Hammer: The Chipping hammer is used to remove some dark portion called slag or carbon that covers the welded portion and also using this hammer makes the welded portion to look like real metal. The chipping hammer was not available, locally improvised chipping hammer was made by welding two metals together to look like the chipping hammer.

4.4. Hack saw: The arc saw blade was fixed to its frame and was used in cutting the mild steel iron. Arc saw is of different teeth/ blade i.e. the 18 or 24 teeth. Selection is based on type of work.

4.5. Electrode: In arc welding an electrode is used to conduct current through a work piece to fuse two pieces together. Electrodes are of different gauges but for the assembly process, gauge 12 was used and it's of 2.5 mm thickness. If the electrode is positively charged, the base metal will be hotter, increasing weld penetration and welding speed. Alternatively, a negatively charged electrode results in more shallow welds [10].

5. Design and Fabrication of Burglarproof

The following is the description of the work done while fabricating the burglary proof window:

- (1) **Design of burglarproof:** This involves detail calculation and drawing of the burglary to be fabricated.
- (2) **Measuring of mild steel:** This involves the measurement of the sixteen mm mild steel iron to prescribed lengths as shown in the detailed diagram. It is done with the aid of a measuring tape.
- (3) **Cutting of Mild Steel:** Mild steel were cut in accordance with the prescribed measurement and designed values using hand saw.
- (4) **Welding:** Arc welding was used for the purpose of this work. It is welding process whereby coalescence is produced by heating the work piece with an electric arc set up between a flux coated electrode and the work piece. The shielded metal arc welding is the preferred type of arc welding because of its deep penetration. The flux covering decomposes due to arc heat. The electrode itself melts and supplies the necessary filler material. The electric arc welding was used due to numbers of reasons, such as stable supply of electricity and also because the method was feasible. Also, arc welding may be done using direct current or alternating current (D.C or A.C) but for the purpose of this welding A. C. was used and during private study and research by consulting available literatures, it was realized that using A.C current was preferable to D.C because it reduces the risk of environmental pollution in the sense that more carbon oxide will be emitted to the environment during D.C. Also, the current selection was based on the type of electrode gauge used and also the thickness of the mild steel iron to be welded. In the case of 12 gauge electrode, current selection would be within the range of 85amps – 100 amps and for 10 gauge electrode, current selection would be within the range of 100amps- 125amps. Current selection can easily be done by spinning the control gear on the welding machine. The first step in executing welding was identification of welds, type of joint, calculation of weld area by stress analysis and preparation of drawing with specifications. This is followed by selection of appropriate welding process. Welding process execution therefore commenced by putting electrode into the electrode holder and the earth was connected to the work piece. Then the two metals to be welded were connected and welded together but sometimes, base metals were needed to a distance of 1mm – 1.5mm between work and the electrode. The welding continued till all parts of the burglary were welded. This stage was followed by slag removal, weld dressing and testing by non-destructive methods.
- (5) **Finishing:** The burglary was then painted so as to beautify it and at the same time, to prevent corrosion. Also, the following materials, tools and equipment were used while assembling the aluminum widow frame



Fig.2. (a) Cutting Machine



Fig.2. (b) Red coloured double swing aluminum frames



Fig.2.(c) Completed Double Swing Red Coloured Aluminum Frames Window



Fig.2. (d) White Window Burglarproof and Completed Double Swing Red Coloured Aluminum Frames Window



Fig.2. (e) Hand drill.

- 1. Cutting Machine:** The cutting machine was used in cutting the aluminum frame into the required specifications according to the given design. The machine consists of the track through which its blade slides through, the jack for adjustment into different positions and number of parts.
- 2. Hand Drill:** During the processes of assembling the aluminum frames, this machine was used to drill holes or secure the aluminum firmly with the glass.
- 3. Milling Machine:** This machine was also used for machining flat surfaces and for producing holes to specifications.
- 4. Hammer Mallet:** It was used to hit aluminum in order to amend, adjust or clinch it together.
- 5. Files:** It was used to smoothen parts of aluminum that was too sharp.
- 6. Screw driver:** It was used to drive screws into holes joining two or more aluminum to form joints.
- 7. Pliers:** The pliers were used to hold aluminum or other materials firmly during assembly.
- 8. Silicon:** Use of silicon was part of finishing operation. It was used to cover clearances left up to 2 mm after the assembly has been fixed in its final position.
- 9. Window Roller and Closer:** It was used in aiding sliding in sliding windows. Also, a closer was used in case of a swing door which enables the door to come back to close position after which it has been opened.
- 10. Diamond:** It was used for cutting the glass. Diamond is specifically used because it is the hardest known substance and can easily penetrate any other substance.

6. Assembly of Aluminium Glass Window

The following showed the detailed procedure undertaken while assembling aluminum glass window.

- (1) Design of aluminum frame to be assembled, which involved detail calculations and drawings.
- (2) Measuring of aluminum frames to prescribed lengths as shown in the diagram with the use of measuring tape.
- (3) Cutting of aluminum frames in accordance with the prescribed measurement specifications.
- (4) Drilling and milling of aluminum frames under study in accordance to design.
- (5) Cutting of the glasses with the help of diamond. Diamond was used because it is the hardest known substance and can go on glass easily.
- (6) Assembling of aluminum frame with the aid of screws.
- (7) Fitting of the glass into the already assembled aluminum frame.
- (8) Fixing glazing rubber in between the red aluminum frames and glasses.

7. Gained Experience

During the whole activities in the Wisdom and sons workshop, welding was made easy through exposure to window burglary fabrications, also, techniques for assembling double swing aluminum window red frames were made known.

8. Results and Discussion

After successful completion of the design and fabrication stages, 16 mm thick window burglary was fabricated as shown in Fig. 2. Also, red aluminum frames glass double swing windows were also assembled and installed as shown in Fig. 2

The window burglaries were fabricated according to designed specifications and standards as depicted in Fig.3. Also, the researchers can also assemble red aluminum double swing frames to standard with the aid of the knowledge gained during this exposure as shown in Fig. 2. The fabricated burglaries and the assembled red aluminum double swing glass window were fitted within the clients newly constructed building as shown in Fig. 2, thus confirming conclusively that the work was skillfully and thoroughly done in line with modern engineering practices.

9. Conclusion

After the successful completion of the research, the following conclusions were drawn:

1. The research was feasible and economical.
2. The work helped the research to be conversant with the tools and machinery in preparation for longer period of industrial and engineering practices.
3. Through the program researchers' innovative, creative abilities and skills were developed.
4. It affords researchers great opportunity to match engineering theories with practical works.

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11. Conflict of Interest

The authors express no conflict of interest as the work was properly scrutinized under their research.

References

- [1]. Akinnuli, B. O. (2010).Applied Manufacturing Engineering Methods. Department of Mechanical Engineering, Federal University of Technology, Akure, Ondo State, Nigeria. pp. 465-500.
- [2]. Cary, H. B. and Helzer S. C. (2006).Modern Welding Technology. New Jersey, pp. 103-106. Census Of Manufactures. (1990). Industry Series, U. S. Department Of Commerce, Bureau of Census, Washington, DC.
- [3]. Heile, R. F. and Hill, D. C. (1975). "Particulate Fume Generation In Arc Welding Processes", *Welding Journal*, 54(7): pp. 201-210.
- [4]. Houghton, K. and Kuebler, P. (1984). "Consider A Low Fume Process For Higher Productivity", Presented at the Joint Australasian Welding and Testing Conference, Australian Welding Institute And Australian Institute For Nondestructive Testing, Perth, Australia.*Criteria for a Recommended Standard Welding, Brazing, And Thermal Cutting*, Publication.
- [5]. Kalpakjian, S. and Schimid, S. R. (2001). Manufacturing Engineering and Technology, pp. 780-785.
- [6]. Welding Handbook and Welding Processes, Volume 2, Eighth Edition.(1991). American Welding Society, Miami, FL.
- [7]. Weman, K. (2003).Welding Processes Handbook.Newyork CRC Press, pp. 63-68.