

# CHAPTER ONE: INTRODUCTION

## 1.1 Background of the Study

Doors are integral to every building's structural framework, serving functions that extend beyond basic entry and exit. They contribute to privacy, security, soundproofing, and environmental control, such as heat and airflow regulation. Among the wide variety of door types available, metal doors have gained prominence for their superior strength, fire resistance, and longevity when compared to wooden or plastic alternatives.

The twin-panel metal door, characterized by its dual-sheet metal construction with internal reinforcement, is particularly valued for security-sensitive areas such as residential entries, safe rooms, schools, and industrial facilities. These doors typically consist of two layers of mild steel or galvanized metal welded onto a supporting frame, sometimes incorporating insulation or stiffeners for added rigidity and acoustic performance.

In Nigeria, the rising rate of property crime, poor building materials, and high importation costs have led to increased demand for locally fabricated, high-quality doors (Akinbile et al., 2022). By utilizing mild steel, a readily available and economically viable material, it is feasible to fabricate functional, durable twin-panel doors within small-scale workshops or institutional settings. This project seeks to demonstrate this feasibility by engaging in a full cycle of design, fabrication, and evaluation of a twin-panel metal door.

Recent Study: According to Olabode & Sanni (2023), local fabrication using mild steel reduces production costs by over 40% compared to imported steel security doors, making it a viable alternative for mass housing in Nigeria.

## 1.2 Statement of the Problem

The Nigerian construction industry is plagued by a reliance on substandard or expensive imported doors, many of which fail to meet the required standards for strength, security, or aesthetics. Locally fabricated alternatives often suffer from poor craftsmanship, inadequate design considerations, and suboptimal material choices, leading to short lifespans, safety concerns, and dissatisfaction among end-users.

This project addresses these challenges by:

- Demonstrating the systematic fabrication of a twin-panel metal door using standardized methods.
- Emphasizing proper material selection, welding techniques, and dimensional accuracy.
- Highlighting cost-effectiveness without compromising functionality or durability.

## 1.3 Aim and Objectives

### Aim:

To design and fabricate a secure, functional, and cost-effective **twin metal panel door** using mild steel and standard fabrication practices.

### Objectives:

- To **select appropriate materials** based on mechanical properties and cost.
- To **design the door and frame** using standard residential/institutional dimensions.
- To fabricate the door using processes such as **cutting, welding, grinding, and surface finishing**.
- To **evaluate the final product** for strength, durability, fit, and cost-efficiency.

## 1.4 Scope of the Project

This project focuses on the **fabrication of a twin-panel metal door** suitable for residential or institutional use. It covers:

- **Material selection**
- **Design and dimensioning**
- **Construction/fabrication**
- **Evaluation**

### Exclusions:

- Powder coating or anodizing
- Automation (e.g., remote control locking)
- Mass production considerations

## 1.5 Significance of the Study

This project demonstrates:

- **Practical skills in metalworking** (cutting, welding, grinding, and assembling).
- A **locally sustainable alternative** to imported security doors.
- That **quality metal doors** can be fabricated within school workshops or small-scale enterprises.
- That **cost and security efficiency** can be achieved simultaneously through proper

design and fabrication.

Oyekan & Adetunji (2021) emphasize the need for local technical institutions to teach hands-on fabrication skills that support economic growth and reduce import dependence in the construction sector.

## 1.6 Project Justification

Local fabrication:

- **Reduces production costs**
- **Promotes vocational skills**
- **Encourages use of indigenous materials**
- **Aligns with national goals for industrial self-sufficiency** (FMITI, 2022)

It is justified as a model for **affordable, secure, and scalable metal door production**, especially in developing urban areas.

## 1.7 Limitations

- **Workshop Limitations:** Limited equipment like CNC or powder coating tools.
- **Time Constraints:** Advanced finishing processes were not feasible within the project period.
- **Financial Constraints:** Restricted the bulk procurement of high-grade steel or enhanced hardware (e.g., biometric locks).

# CHAPTER TWO: LITERATURE REVIEW

## 2.1 Historical Development of Metal Doors

Historically, **metal doors** date back to the use of **bronze and wrought iron** in ancient fortifications and castles. These materials offered **defensive advantages** and durability. With the advent of the **Industrial Revolution**, steel manufacturing and welding advancements allowed mass production of doors for urban buildings.

In modern times, **mild steel, stainless steel, and aluminum** dominate the market due to:

- Corrosion resistance
- Fireproof properties
- Ease of forming and welding

Ekong (2023) notes that steel doors became prevalent in African urban housing developments after the 1980s due to their superior resilience and low maintenance.

## 2.2 Types of Metal Doors

Metal doors are classified by design, structure, and application:

1. **Flush Metal Doors** – Feature flat, plain surfaces often used in internal spaces.
2. **Panel Metal Doors** – Include decorative or structural panels for aesthetic or functional purposes.
3. **Reinforced Security Doors** – Heavy-duty, multi-layer doors with additional locking mechanisms.
4. **Twin Panel Metal Doors** – Consist of two steel sheets forming an inner and outer panel, joined by a central or perimeter frame. Often includes internal reinforcements or insulation.

Yusuf & Musa (2024) highlight that twin panel doors combine elegance and strength, ideal for homes and institutional buildings exposed to weather and vandalism.

## 2.3 Materials Used in Door Fabrication

### 1. Mild Steel

- Most commonly used due to **availability, low cost, and ease of welding**.
- Requires proper coating to prevent corrosion.

### 2. Stainless Steel

- Used in sanitary or luxury environments.
- Offers excellent **corrosion resistance** but is costlier.
- **3. Galvanized Iron (GI)**
- Mild steel coated with **zinc for rust resistance**.
- Ideal for external doors in humid environments.

Adebayo & Okoro (2022) found mild steel to provide an optimal balance of **cost and mechanical performance** for residential doors in West Africa.

## 2.4 Welding and Fabrication Techniques

Welding is a cornerstone of metal door fabrication. Common techniques include:

- **SMAW (Shielded Metal Arc Welding)**: Economical, simple, and suitable for small workshops.
- **MIG (Metal Inert Gas Welding)**: Clean, fast, and ideal for large-scale production.
- **TIG (Tungsten Inert Gas Welding)**: High-quality welds for thinner sheets or stainless steel.

Fabrication stages:

- **Measuring and cutting** using angle grinders or guillotine shears.
- **Joining panels and frame** using fillet welds.
- **Grinding and finishing** to smoothen welds and prepare for painting.

**Reference:** ASME (2021) Welding Standards recommend SMAW for general-purpose structural welding where access to inert gas is limited.

## 2.5 Design Considerations for Twin Panel Doors

Key factors influencing performance:

- **Panel Thickness**: Typically 1.2–1.5 mm for residential security doors.
- **Frame Strength**: 25–40 mm angle or square bar used for rigidity.
- **Hinge and Lock Placement**: Proper reinforcement prevents sagging and improves security.
- **Reinforcement Bars**: Internally placed to prevent buckling or forced entry.
- **Finishing**: Priming and painting to prevent corrosion and improve aesthetics.

Oyekan & Adetunji (2021) suggest that good design reduces lifecycle costs by minimizing repair frequency and improving user safety.

## 2.6 Safety and Durability Requirements

For doors to be considered **safe and durable**, they must:

- **Resist physical force** and intrusion.
- **Last under harsh environmental conditions.**
- **Resist corrosion** using paints or galvanization.
- Meet minimum standards for **fire resistance** in public or commercial settings.

British Standards Institution (2020) in BS EN 16034 specifies performance standards for metal doors in terms of fire resistance, mechanical durability, and weather performance.