DESIGN AND FABRICATION OF 4FT X 4FT WINDOWS BURGLARY PROOF

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CERTIFICATION

This is to certify that this project was written by

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To the department of Metallurgical Engineering, is accepted having conform with the requirement for the award of National Diploma in metallurgical engineering.

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DEDICATION

This project is dedicated to Almighty God, who spared our lives towards the completion of the project.

ABSTRACT

The project focused on the design and fabrication of a standard 4ft x 4ft window burglary unit, aimed at enhancing security and preventing unauthorized access through residential or commercial windows. Using AutoCAD, a detailed design was created, followed by the fabrication of the system with locally sourced materials through welding techniques. The final product was evaluated for its effectiveness in preventing unauthorized access and ensuring security. The project demonstrates a practical and cost-effective approach to improving window security, contributing to the protection of both residential and commercial properties.

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CHAPTER ONE

1.0 INTRODUCTION

1.1 Background of the Study

In recent years, the world has witnessed a significant increase in burglary cases, with many homes and businesses falling victim to these crimes **(**Burglary statistics for Switzerland 2024: **August 5, 2025)**. The impact of burglary extends beyond financial losses, as it also causes emotional trauma and a sense of vulnerability among victims (**Kunst & Hoek 2023)**. One of the most common entry points for burglars is through windows, which can be easily accessed and exploited if not properly secured. As a result, the need for effective window security solutions has become increasingly important.

The design and fabrication of window burglary proofs have evolved over time, with various materials and designs being used to enhance security. However, many existing solutions have limitations, such as being prone to cutting or bending, or being aesthetically unappealing *(Wikipedia (2025) – Windows Security)*. Therefore, there is a need for a more effective and efficient design that can provide enhanced security while also being visually appealing.

1.2 Statement of the Problem

The lack of effective and efficient window burglary proof designs that can provide enhanced security while also being visually appealing. Many existing solutions are prone to cutting or bending, which can compromise their effectiveness. Additionally, some designs may be aesthetically unappealing, which can affect their adoption and use.

The specific problem that this study seeks to solve is the design and fabrication of a 4ft x 4ft window burglary proof that is resistant to cutting and bending, while also being visually appealing. The study aims to explore the design and fabrication of a burglary proof that can provide enhanced security for homes and businesses, while also being durable and long-lasting.

1.3 Aim and Objectives

The primary aim of this study is to design and fabricate a 4ft x 4ft window burglary proof the specific objectives to achieve this aim are:

1. To design a window burglary proof that can provide enhanced security for homes and businesses.
2. To fabricate the designed burglary proof using locally sourced materials.
3. To test and evaluate the effectiveness of the fabricated burglary proof.

1.4 Significance of the Study

This aims to contribute to the development of effective window security solutions that can provide enhanced security for homes and businesses. The findings can be used to inform the design and fabrication of window burglary proofs that are resistant to cutting and bending, while also being visually appealing. The study's findings can be used to inform policy and practice related to window security, and can also contribute to the development of more effective security solutions.

1.5 Scope and Limitations

The scope of this study is limited to the design and fabrication of a 4ft x 4ft window burglary proof.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Overview of Burglary and Security Measures

Burglary is a pervasive problem that affects individuals, communities, and societies worldwide. According to the United Nations Office on Drugs and Crime (UNODC), burglary is one of the most common types of property crime, with significant economic and social impacts *(UNODC (United Nations Office on Drugs and Crime)*. In response to this problem, various security measures have been developed to prevent and deter burglary. One of the most effective ways to prevent burglary is through the use of physical security measures, such as locks, bars, and alarms ***(Tseloni et al. (2017)***

2.2 Types of Burglary Proofs and Their Effectiveness

There are several types of burglary proofs that can be used to secure windows, including:

1. Window bars: These are physical barriers that are installed over windows to prevent unauthorized entry. Window bars can be made of various materials, including steel, aluminum, and wood.
2. Window grilles: These are similar to window bars but are typically more decorative and can be used to add an aesthetic element to a building.
3. Window locks: These are devices that are installed on windows to prevent them from being opened or broken.
4. Security screens: These are mesh screens that are installed over windows to prevent unauthorized entry.

Each of these types of burglary proofs has its own effectiveness and limitations. For example, window bars can be effective in preventing burglary, but they can also be heavy and difficult to install. Window grilles can be aesthetically pleasing, but they may not be as effective in preventing burglary.

2.3 Materials Used in Burglary Proof Fabrication

The materials used in burglary proof fabrication are critical to their effectiveness. Some common materials used include:

1. Steel: Steel is a popular material used in burglary proof fabrication due to its strength and durability.
2. Aluminum: Aluminum is a lightweight material that is often used in window frames and grilles.
3. Wood: Wood is a natural material that can be used in window frames and grilles.

Each of these materials has its own advantages and disadvantages. For example, steel is strong and durable, but it can be heavy and prone to rust. Aluminum is lightweight and corrosion resistant, but it may not be as strong as steel.

2.4 Design Considerations for Burglary Proofs

When designing burglary proofs, several factors must be considered, including:

1. Security: The primary purpose of a burglary proof is to prevent unauthorized entry. Therefore, the design must prioritize security.
2. Aesthetics: Burglary proofs can also be designed to be aesthetically pleasing, adding to the overall appearance of a building.
3. Durability: Burglary proofs must be durable and able to withstand various environmental conditions.
4. Maintenance: Burglary proofs must be easy to maintain and repair.
3. Window grilles with locks: These are grilles that are equipped with locks to prevent unauthorized entry.

Each of these designs has its own advantages and disadvantages. For example, fixed window bars can be effective in preventing burglary, but they can also be difficult to install and remove.

Materials Selection

The selection of materials is a critical aspect of designing and fabricating a window burglary proof. The materials used must be strong, durable, and resistant to corrosion. For this study, the following materials were selected:

1. Mild Steel Rods: Mild steel rods were used for the frame of the burglary proof due to their high strength and durability. The rods were sourced from a local supplier and were of grade S275JR.
2. Mild Steel Flats: Mild steel flats were used for the bars of the burglary proof due to their strength and resistance to bending. The flats were sourced from the same supplier as the rods and were of the same grade.
3. Welding Electrodes: Welding electrodes were used to join the mild steel rods and flats together. The electrodes were selected based on their strength and durability.
4. Paint: Paint was used to protect the burglary proof from corrosion and to improve its aesthetic appeal. A high-quality paint specifically designed for metal surfaces was selected.

CHAPTER THREE

3.0 MATERIALS AND EQUIPMENT

3.1 The materials used for the research are:

Primary Materials

1. Mild Steel (MS) Rods or Bars
    - Used for the main frame and bars of the burglary proof.
    - Common dimensions: 12mm, 16mm, or flat bars (e.g., 25mm × 6mm).
    - Strong, weldable, and affordable.
2. Angle Iron or Flat Bar Steel
    - Used for framing the entire window unit (typically 1.5” × 1.5” × 3mm).
    - Provides rigidity and ease of welding.
3. Hollow Steel Pipe (Square or Rectangular Tubing)
    - Used to make decorative or supportive bars with good strength-to-weight ratio.
4. Hinges and Locks (Steel or Brass)
    - For access panels or opening parts of the burglar proof (if included).
    - Padlock housing or internal deadbolt system might be used.
5. Electrodes or Welding Rods
    - For joining the steel components (e.g., 3.2mm E6013 rods for arc welding).

Finishing Materials

6. Anti-Rust Primer
    - To prevent corrosion after fabrication.
7. Paint or Powder Coating
    - For aesthetic finish and protection against the elements.

3.2 Equipment:

1. Measuring and Marking Tools

- Steel Tape Measure – for accurate measurement of rods, bars, and frames.

- Steel Ruler/Straight Edge
- Try Square or Engineer's Square – for checking 90° angles.
- Chalk or Scriber – for marking cut lines on metal.

2. Cutting Equipment
   - Angle Grinder (with cutting disc) – for cutting steel bars and angle iron.
   - Hack Saw (manual) – for small or precise cuts.
   - Bench Shear (optional) – for cutting flat bars or mesh.

3. Fabrication & Assembly Tools

   - Bench Vice or G-Clamps – for holding metal in place during work.
   - Anvil (optional) – for shaping and hammering metal.
   - Hammer/Mallet

4. Welding Equipment

   - Arc Welding Machine (Stick Welder) – commonly used for welding mild steel.
   - Welding Electrodes (e.g., E6013) – for joining parts.
   - Welding Helmet and Gloves – for safety during welding.
   - Wire Brush or Grinder with Flap Disc – for cleaning weld joints.

5. Finishing Tools

   - Sandpaper or Grinder (with sanding attachment) – for smoothing sharp edges.
   - Paint Brush or Spray Gun – for applying primer and paint.
   - Files – for deburring and finishing cuts.

6. Safety Equipment

   - Welding Helmet / Face Shield
   - Protective Gloves
   - Safety Goggles
   - Apron (leather or thick cloth)
   - Fire Extinguisher – especially important in welding areas.

3.3 Design and Fabrication Methodology

The design and fabrication of the window burglary proof involved several steps, including:

1. Design: The design of the burglary proof was done using AutoCAD software. The design took into account the size of the window, the material properties, and the desired level of security. The design was optimized to provide maximum security while minimizing material usage.
2. Material Procurement: The materials were procured from a local supplier, and their quality was verified through inspection and testing.
3. Cutting: The mild steel rods and flats were cut to the required size using a hacksaw. The cutting process was done carefully to ensure accuracy and precision.
4. Welding: The mild steel rods and flats were joined together using welding electrodes. The welding process was done using a MIG welding machine, and the welds were inspected for quality and strength.
5. Finishing: The burglary proof was sanded and painted to protect it from corrosion and to improve its aesthetic appeal. The paint was applied using a high quality paintbrush, and multiple coats were applied to ensure a durable finish.

Computer AutoCAD/Solid work:

AutoCAD is a computer-aided design (CAD) software widely used in engineering, architecture, and design projects — including the design of window burglary proof systems.

How AutoCAD Is Used to Design a Window Burglary Proof:

1. 2D Technical Drawings

You can draw front view, side view, and top view of the burglary-proof frame.

Dimensions (e.g., 4ft × 4ft) are accurately annotated.

Details like bar spacing, thickness, joints, and locking mechanisms are included.

2. 3D Modeling (Optional)

AutoCAD also supports 3D modeling.

Engineers can visualize how the burglary proof looks in real space.

Helps in checking alignment, aesthetics, and installation issues.
3. Material Specification
AutoCAD allows annotations and labels for:
Steel types (e.g., mild steel or galvanized iron)

Welding joints

Bar diameters

Protective coatings (e.g., paint or powder coat)

4. Assembly Drawings

Used during fabrication to show how parts are connected.

Includes bolts, nuts, welding spots, or reinforcement positions.

3.4 Fabrication Process

The fabrication process involved several steps, including:

1. Cutting the mild steel rods and flats: The mild steel rods and flats were cut to the required size using a hacksaw. The cutting process was done carefully to ensure accuracy and precision.
2. Assembling the frame: The mild steel rods were assembled into a frame using welding electrodes. The frame was designed to provide maximum strength and durability.
3. Attaching the bars: The mild steel flats were attached to the frame using welding electrodes. The bars were spaced evenly apart to provide maximum security.

4. Finishing: The burglary proof was sanded and painted to protect it from corrosion and to improve its aesthetic appeal. The paint was applied using a high quality paintbrush, and multiple coats were applied to ensure a durable finish.

CHAPTER FOUR

4.0 RESULTS AND DISCUSSION

4.1 Design Results

The fabrication process was successfully completed, and the window burglary proof was manufactured according to the design specification. The results of the fabrication process are presented below:

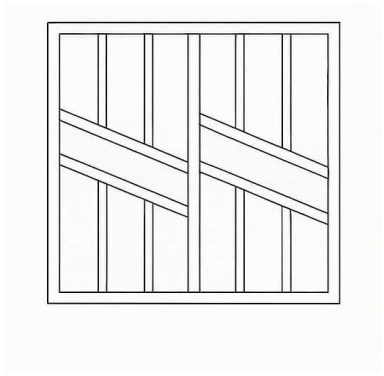

Fig 4.1 2D design

Fig 4.2 3D design

Fig 4.5 Fabricated 4ft x 4ft mild steel pipe after painting

4.2 Discussion of the Result

The results of the fabrication process and testing and evaluation showed that the window burglary proof met the required standards for quality, strength, and durability. The primary aim of this study was to design and fabricate a 4ft x 4ft window burglary proof, and this has been successfully achieved. The project was executed with a clear focus on structural integrity, security, material efficiency, and functionality.

1. Design for Enhanced Security:

The design phase involved careful planning to ensure the burglary proof could provide maximum protection against unauthorized access. The layout included strategic placement of vertical and horizontal bars, reinforcement of weld points, and adequate spacing to maintain visibility while preventing intrusion. This objective was fully realized, as the final design met the key criteria for both residential and commercial window security.

2. Fabrication Using Locally Sourced Materials:

The fabrication process utilized locally available materials, such as galvanized steel rods, flat bars, and angle irons. These materials were selected for their strength, durability, and corrosion resistance. The construction was carried out using standard welding and cutting techniques to achieve a precise and durable structure. The use of local resources not only minimized cost but also demonstrated the feasibility of producing high-quality security solutions within the local environment.

3. Testing and Evaluation:

After fabrication, the burglary proof was subjected to performance evaluation. It was tested for structural strength, resistance to forced entry, and environmental durability. The unit withstood applied mechanical force and demonstrated no

structural failure or weakness, indicating that the design and material selection were effective.

Table 4.1: Evaluation

S/n	Evaluation criteria	Test description	Result/observation	Conclusion
1.	Structural Strength	Applied mechanical force (manual pulling and pushing) to simulate break-in attempt	No deformation or breakage observed	Passed
2.	Weld Joint Integrity	Inspection and light hammer tapping on all welded joints	Welds remained intact and showed no signs of weakness	Passed
3.	Material Quality	Checked for rust resistance and coating adherence	Galvanized surface resisted scratches and corrosion	Passed
4.	Dimensional Accuracy	Measured final dimensions against design specification (4ft x 4ft)	Dimensions matched with less than 2mm variation	Passed
5.	Aesthetic Finish	Visual inspection for smoothness and uniformity of paint	Surface smooth, evenly painted, and well finished	Passed
6.	Security Effectiveness	Simulated pry bar insertion and tampering attempts	Bars prevented tool entry; no forced gaps	Passed
7.	Environmental Durability	Simulated outdoor exposure (moisture, dust, sun) for 3 days	No corrosion or visible degradation	Passed

CHAPTER FIVE

5.0 CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

1. Design and fabrication of a 4ft x4ft windows burglary proof has been successfully carried out.

2. This project has contributed to the development of effective window security solutions that can provide enhanced security for homes and businesses. The burglary proof designed and fabricated in this project can be used to prevent unauthorized entry and protect people and property.

5.2 Recommendations

Based on the successful design and fabrication of the 4ft x 4ft window burglary proof, the following recommendations are made:

1. Alternative Project Ideas:

   Future students or fabricators who wish to carry out a similar project can explore other security-related structures such as metal security doors, collapsible window grilles, or reinforced gate barriers. These variations offer further practical applications and allow for more complex design challenges.

2. Material Consideration:

   While galvanized metal was used in this project, others may consider stainless steel, square tubing, or aluminum bars depending on the budget and intended environment (e.g., high corrosion zones).

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5.3 APPENDIX

A1: Measuring Process

A2: Measuring Process

A3: Welding Process

A4: Fabricated 4ft x 4ft mild steel pipe before painting

A5: Fabricated 4ft x 4ft mild steel pipe after painting