DESIGN AND FABRICATION OF WALL MOUNTED BASKET FOR AIR CONDITIONER OUTDOOR UNIT MAINTENANCE

A PROJECT REPORT

Submitted by

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M.KUMARASAMY COLLEGE OF ENGINEERING, KARUR

BONAFIDE CERTIFICATE

Certified that this project report **"DESIGN AND FABRICATION OF WALL MOUNTED BASKET FOR AIR CONDITIONER OUTDOOR UNIT MAINTENANCE"** the bonafide work of **KANNYA DHARSHINI V (927622BME033), KARUNAKARAN S (927622BME035), LIVIN KUMAR M (927622BME307)** who carried out the project work during the academic year 2024 – 2025 under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other project report or dissertation on the basis of which adegree or award was conferred on an earlier occasion on this or any other candidate.

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INTERNAL EXAMINER **EXTERNAL EXAMINER**

DECLARATION

We affirm that the Project titled **"DESIGN AND FABRICATION OF WALL MOUNTED BASKET FOR AIR CONDITIONER OUTDOOR UNIT MAINTENANCE"** being submitted in partial fulfillment of for the award of Bachelor of Engineering in Mechanical Engineering, isthe original work carried out by us. It has not formed the part of any otherproject or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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INSTITUTION VISION & MISSION

Vision

- To emerge as a leader among the top institutions in the field of technical education.

Mission

- Produce smart technocrats with empirical knowledge who can surmount the global challenges.
- Create a Diverse, fully engaged, learner- centric campus environment to provide quality education to the students.
- Maintain mutually beneficial partnerships with our alumni, industry and professional associations

DEPARTMENT VISION, MISSION, PEO, PO & PSO

Vision

- To create globally recognized competent Mechanical engineers to work in multicultural environment.

Mission

- To impart quality education in the field of mechanical engineering and to enhance their skills, to pursue careers or enter into higher education in their area of interest.
- To establish a learner-centric atmosphere along with state-of-the-art research facility.
- To make collaboration with industries, distinguished research institution and to become a center of excellence

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

The graduates of Mechanical Engineering will be able to

- PEO1: Graduates of the program will accommodate insightful information of engineering principles necessary for the applications of engineering.
- PEO2: Graduates of the program will acquire knowledge of recent trends in technology and solve problem in industry.
- PEO3: Graduates of the program will have practical experience and interpersonal skills to work both in local and international environments.
- PEO4: Graduates of the program will possess creative professionalism, understand their ethical responsibility and committed towards society.

PROGRAM OUTCOMES

The following are the Program Outcomes of Engineering Graduates: Engineering Graduates will be able to:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs)

The following are the Program Specific Outcomes of Engineering Graduates:

The students will demonstrate the abilities

1. **Real world application:** To comprehend, analyze, design and develop innovative products and provide solutions for the real-life problems.
2. **Multi-disciplinary areas:** To work collaboratively on multi-disciplinary areas and make quality projects.
3. **Research oriented innovative ideas and methods:** To adopt modern tools, mathematical, scientific and engineering fundamentals required to solve industrial and societal problems.

Course Outcomes	At the end of this course, learners will be able to:	**Knowledge Level**
CO-1	Identify the issues and challenges related to industry, society and environment.	Apply
CO-2	Describe the identified problem and formulate the possible solutions	Apply
CO-3	Design / Fabricate new experimental set up/devices to provide solutions for the identified problems	Analyse
CO-4	Prepare a detailed report describing the project outcome	Apply
CO-5	Communicate outcome of the project and defend by making an effective oral presentation.	Apply

MAPPING OF PO & PSO WITH THE PROJECT OUTCOME

Cos	COURSESTATEMENT	BLOOMS LEVEL	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
1	Formulate a real world problem, identify the requirement and develop the design solutions.	K3	3	3	3			3	3	3	3	3			3	3	3
2	Identify technical ideas, strategies and methodologies	K3	3	3	3			3	3	3	3	3			3	3	3
3	Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project	K4	3	3	3	3	3	3	3	3	3	3		3	3	3	3
4	Test and validate through conformance of the developed prototype and analysis the cost-effectiveness.	K4	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
5	Prepare report and present oral demonstration	K4	3							3	3	3		3	3		3
	Average		3	3	3	3	3	3	3	3	3	3	3	3	3	3	3

ABSTRACT

This project introduces a practical solution to enhance the efficiency of air conditioning (AC) maintenance tasks a custom-designed wall-mounted basket. By providing a dedicated storage space for essential tools, equipment, and spare parts, this innovative tool aims to improve organization, reduce downtime, and boost overall productivity. The basket is designed to be durable, easy to install, and capable of handling the demands of daily maintenance operations. Rigorous testing has ensured the basket's reliability and performance. The inefficiencies associated with disorganized tool storage during AC maintenance can significantly impact productivity. To address this issue, we have developed a specialized wall-mounted basket designed to streamline the maintenance process. This innovative solution offers a dedicated storage space for essential tools, equipment, and spare parts, thereby improving organization, accessibility, and overall efficiency.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLE

CHAPTER 1

INTRODUCTION

Air conditioning (AC) systems have become essential components in modern residential, commercial, and industrial settings. As the demand for thermal comfort continues to rise, the importance of regular and efficient maintenance of AC units also increases. Proper maintenance not only ensures optimal performance and extended lifespan of the system but also minimizes energy consumption and prevents costly breakdowns. However, maintenance activities often face practical challenges, particularly in the organization and accessibility of necessary tools and spare parts.

Technicians working in the field of AC servicing are frequently required to carry various tools, electrical components, and spare parts. In many cases, these items are stored in a scattered or unorganized manner, either in toolboxes or loosely carried to the site. This lack of organization can lead to delays in identifying the required tools, misplacement of components, and ultimately, decreased productivity. Over time, this disorganization also contributes to technician fatigue and reduces the efficiency of the overall maintenance process.

To address this common yet overlooked issue, the concept of a wall-mounted storage basket was introduced. The primary aim of this project is to design and fabricate a customized storage solution that can be mounted on a wall near the AC unit or workbench. This basket serves as a centralized station to hold essential tools, spare parts, and small accessories needed during maintenance tasks. By ensuring that all materials are easily accessible and neatly arranged, the wall-mounted basket helps in streamlining the technician's workflow and minimizing unnecessary movements.

This project explores various aspects involved in the development of the storage basket, including design parameters, material selection, fabrication process, and performance testing.

CHAPTER 2

LITERATURE REVIEW

While a comprehensive literature review specific to a custom-designed wall basket for AC maintenance might not be readily available due to its niche nature, we can draw insights from existing research on tool organization, workplace efficiency, and product design.

Relevant Research Areas:

1. **Workplace Ergonomics and Efficiency:**
    - Studies on ergonomic workstation design and tool organization principles can inform the optimal placement and design of the wall basket.
    - Research on the impact of efficient tool storage on worker productivity and job satisfaction can provide a theoretical framework for evaluating the potential benefits of the proposed solution.
2. **Product Design and Development:**
    - Principles of industrial design and human-centered design can guide the development of a user-friendly and visually appealing product.
    - Considerations for material selection, manufacturing processes, and quality control are essential to ensure the durability and functionality of the wall basket.
3. **Lean Manufacturing :**
    - Lean manufacturing principles, particularly the 5S methodology (Sort, Set in Order, Shine, Standardize, Sustain), can be applied to optimize the workspace and improve the efficiency of AC maintenance tasks.
    - The wall basket can be seen as a tool to support the 5S principle of "Set in Order," ensuring that tools and equipment have a designated place and are readily accessible.

CHAPTER 3

METHODOLOGY

3.1 Design Phase:

- **Needs Assessment:** Identify the specific needs of AC technicians, considering factors like tool size, weight, and frequency of use.
- **Conceptual Design:** Generate multiple design concepts, focusing on functionality, ergonomics, and aesthetics.
- **CAD Modeling:** Utilize computer-aided design (CAD) software to create detailed 3D models of the selected design.
- **Material Selection:** Choose suitable materials, considering factors like strength, durability, corrosion resistance, and weight.

3.2 Fabrication Phase:

- **Cutting:** Utilize appropriate cutting techniques (e.g., laser cutting, waterjet cutting, or manual cutting) to shape the metal components.
- **Bending:** Form the metal components into desired shapes using bending machines or manual techniques.
- **Welding:** Join the components together using suitable welding techniques (e.g., TIG welding, MIG welding, or spot welding).
- **Finishing:** Apply appropriate finishing techniques (e.g., powder coating, painting, or polishing) to enhance the appearance and durability of the basket.

3.3 Testing and Evaluation:

- **Load Testing:** Assess the basket's ability to withstand the weight of tools and equipment.
- **Durability Testing:** Evaluate the basket's resistance to wear and tear, corrosion, and other environmental factors.
- **Ergonomic Evaluation:** Assess the ease of use and comfort of the basket design.
- **User Feedback:** Gather feedback from AC technicians to refine the design and identify areas for improvement.

CHAPTER 4

MATERIALS USED

4.1 Metal Frame

The Metal frame is generally made of **Mild steel** bars for machining, suitable for lightly stressed components including studs, bolts, gears and shafts. It can be case-hardened to improve wear resistance. They are available in bright rounds, squares and flats, and hot rolled rounds .Suitable machining allowances should therefore be added when ordering. It does not contain any additions for enhancing mechanical or machining properties. Bright drawn mild steel is an improved quality material, free of scale, and has been cold worked (drawn or rolled) to size. It is produced to close dimensional tolerances. Straightness and flatness are better than black steel. It is more suitable for repetition precision machining. Bright drawn steel has more consistent hardness, and increased tensile strength. Bright steel can also be obtained in precision turned or ground form if desired.

Figure 4.1 Photography of Metal Frame

4.2 Welding Rods

Welding rods are classified based on their chemical composition, physical properties, and intended use. They are also identified by a code that indicates their characteristics, such as the AWS (American Welding Society) classification system. Welding rods can be used for various welding processes, including shielded metal arc welding (SMAW), gas metal arc welding (GMAW), gas tungsten arc welding (GTAW), and flux cored arc welding (FCAW). The choice of welding rod depends on the type of metal being welded, the welding process, and the desired properties of the weld. Welding rods can be stored for long periods of time, but they must be kept in a dry, cool place to prevent damage. The quality of the welding rod can affect the quality of the weld, so it's important to choose a high-quality rod that meets the required specifications**.**

Figure 4.2 Welding Rod

4.3 Wheels

There are two aspects to how pneumatic tires support the rim of the wheel on which they are mounted.First, tension in the cordspull on the beaduniformly around the wheel, except where it is reduced above the contact patch.Second, the bead transfers that net force to the rim.Air pressure, via the ply cords, exerts tensile force on the entire bead surrounding the wheel rim on which the tire is mounted, pulling outward in a 360-degree pattern. Thus the bead must have high tensile strength. With no force applied to the outer tread, the bead is pulled

equally in all directions, thus no additional net force is applied to the tire bead and wheel rim. However, when the tread is pushed inward on one side, this releases some pressure on the corresponding sidewall ply pulling on the bead. Yet the sidewall ply on the other side continues to pull the bead in the opposite direction. Thus the still fully tensioned sidewall ply pulls the tire bead and wheel rim in the direction opposite to the tread displacement and matching the total force applied to push the tread inward.

Figure 4.3 Photography of Wheel

4.4 Sidewall

Sidewall Uneven sidewall wear, down to fabric plies, due to significant under-inflation The sidewall is that part of the tire that bridges between the tread and bead. The sidewall is largely rubber but reinforced with fabric or steel cords that provide for tensile strength and flexibility. The sidewall contains air pressure and transmits the torque applied by the drive axle to the tread to create traction but supports little of the weight of the vehicle, as is clear from the total collapse of the tire when punctured. Sidewalls are molded with manufacturer-specific detail, government mandated warning labels, and other consumer information, and sometimes decorative ornamentation, like whitewalls.

4.5 Sheet Metal

Sheet metal is metal formed by an industrial process into thin, flat pieces. It is one of the fundamental forms used in metalworking and it can be cut and bent into a variety of shapes. Countless everyday objects are fabricated from sheet metal. Thicknesses can vary significantly; extremely thin thicknesses are considered foil or leaf, and pieces thicker than 6 mm (0.25 in) are considered plate.Sheet metal is available in flat pieces or coiled strips. The coils are formed by running a continuous sheet of metal through a roll slitter. There are many different metals that can be made into sheet metal, such as aluminum, brass, copper, steel, tin, nickel and titanium. For decorative uses, important sheet metals include silver, gold, and platinum (platinum sheet metal is also utilized as a catalyst.) Sheet metal is used in automobile and truck (lorry) bodies, airplane fuselages and wings, medical tables, roofs for buildings (architecture) and many other applications. Sheet metal of iron and other materials with high magnetic permeability, also known as laminated steel cores, has applications in transformers and electric machines. Historically, an important use of sheet metal was in plate armor worn by cavalry, and sheet metal continues to have many decorative uses, including in horse tack. Sheet metal workers are also known as "tin bashers" (or "tin knockers"), a name derived from the hammering of panel seams when installing tin roofs.

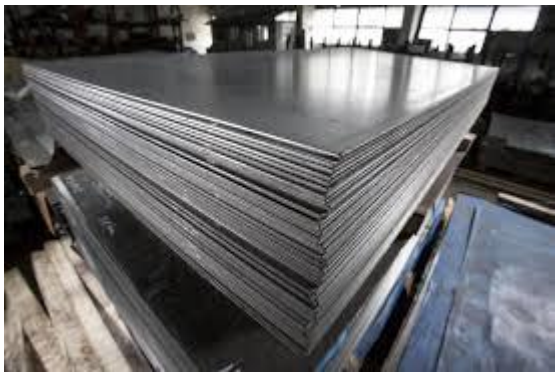


Figure 4.4 Photography of SheetMetal

CHAPTER 5

FABRICATION PROCESS

5.1 Metal Cutting Tools

The fabrication of a wall basket for AC maintenance, metal cutting tools are used to cut and shape the metal components, such as the frame, shelves, and supports. Common metal cutting tools used in this project include hacksaws, band saws, circular saws, and angle grinders, as well as specialized tools like metal snips, nibblers, and shears. These tools enable the fabrication of precise cuts, curves, and angles in the metal components, allowing for the creation of a sturdy and functional wall basket. Cold saws are saws that make use of a circular saw blade to cut through various types of metal, including sheet metal. The name of the saw has to do with the action that takes place during the cutting process, which manages to keep both the metal and the blade from becoming too hot. A cold saw is powered with electricity and is usually a stationary type of saw machine rather than a portable type of saw.

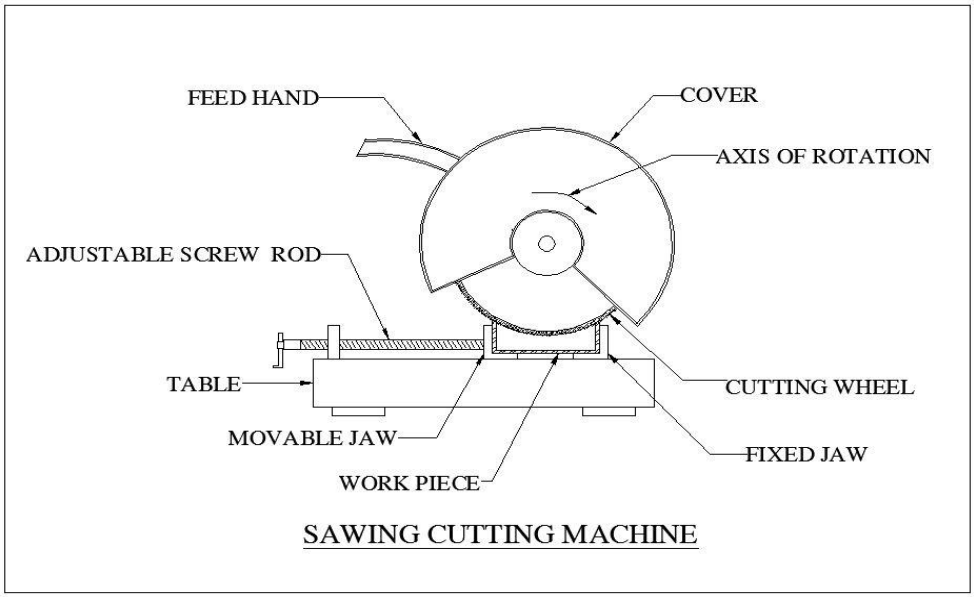


Figure 5.1 Photography of Saw Cutting Machine

5.2 Welding Machine

In the fabrication of a wall basket for AC maintenance, a welding machine is used to join the metal components together, creating a strong and durable bond. The welding machine used in this project is typically a Metal Inert Gas (MIG) or Shielded Metal Arc Welding (SMAW) machine, which uses a continuous wire feed or electrodes to weld the metal parts together. The welding machine is used to weld the frame, shelves, and supports of the wall basket, ensuring a sturdy and reliable structure that can hold the weight of the AC unit and other equipment. Welding is a process for joining similar metals. Welding joins metals by melting and fusing **1,** the base metals being joined and **2,** the filler metal applied. Welding employs pinpointed, localized heat input. Most welding involves ferrous-based metals such as steel and stainless steel.Weld joints are usually stronger than or as strong as the base metals being joined.

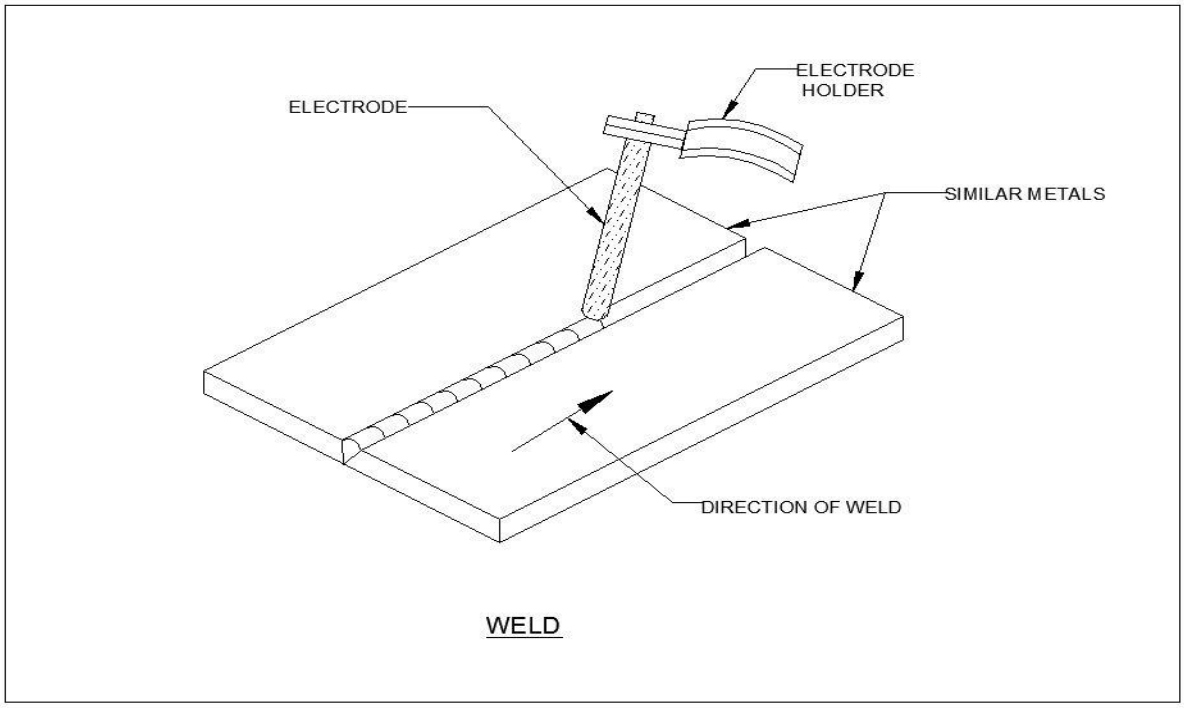


Figure 5.2 Photography of Welding Machine

5.3 Drilling Machine

In the fabrication of a wall basket for AC maintenance, a drilling machine is used to create precise holes in the metal components, such as the frame, shelves, and supports, for screwing, bolting, or riveting purposes. The drilling machine used in this project is typically a bench drill press or a handheld drill, which uses drill bits of various sizes to create holes of different diameters and depths. The drilling machine is used to drill holes for screws, bolts, and rivets, ensuring accurate and precise placement of these fasteners. Drilling is a cutting process that uses a drill bit to cut or enlarge a hole of circular cross-section in solid materials. The drill bit is a rotary cutting tool, often multipoint. The bit is pressed against the work piece and rotated at rates from hundreds to thousands of revolutions per minute. This forces the cutting edge against the work piece, cutting off chips (sward) from the hole as it is drills.

Several welding processes are based on heating with an electric arc, only a few are considered here, starting with the oldest, simple arc welding, also known as shielded metal arc welding (SMAW) or stick welding. In this process an electrical machine (which may be DC or AC, but nowadays is usually AC) supplies current to an electrode holder which carries an electrode which is normally coated with a mixture of chemicals or flux. An earth cable connects the work piece to the welding machine to provide a return path forthe current. The weld is initiated by tapping ('striking') the tip of the electrode against the work piece which initiates an electric arc. The high temperature generated (about 6000^{o}C) almost instantly produces a molten pool and the end of the electrode continuously melts into this pool and forms the joint. The operator needs to control the gap between the electrode tip and the work piece while moving the electrode along the joint.

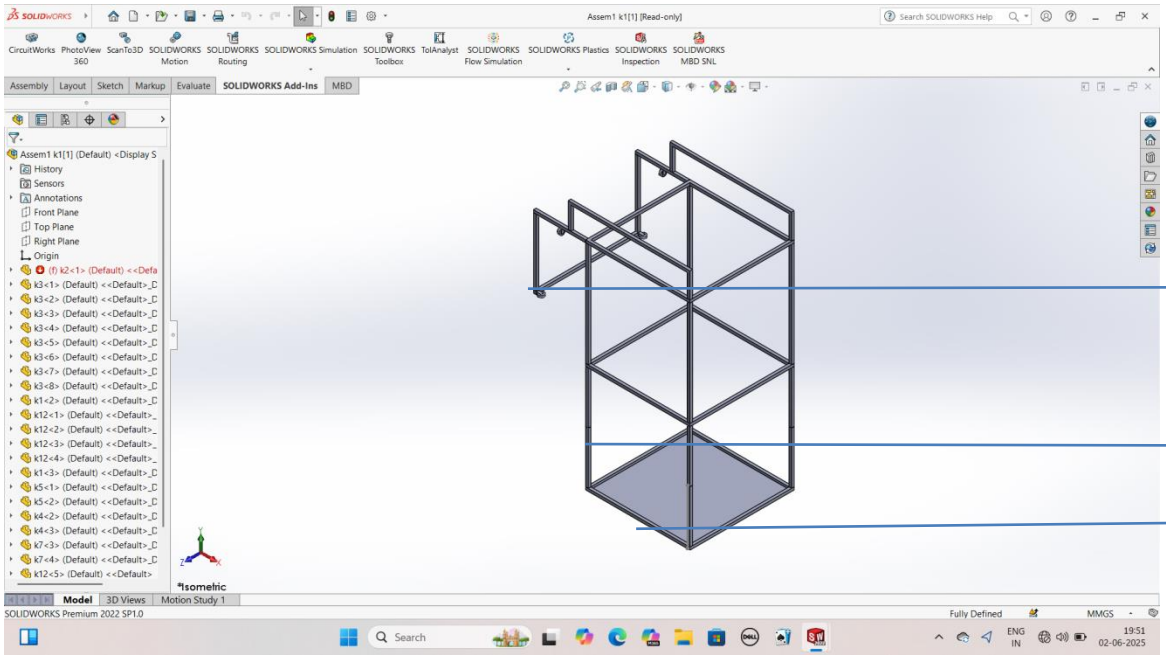
5.4 Advantages

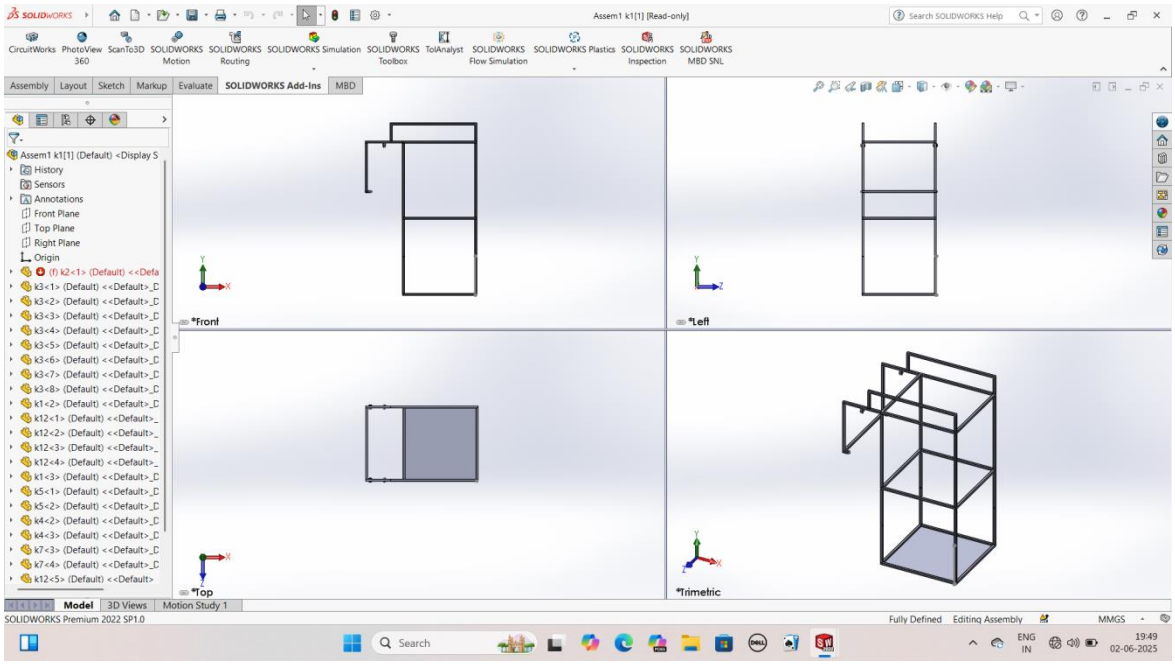
The sheet metal wall basket provides several advantages in AC maintenance. It enhances technician safety by minimizing the risk of falls compared to ladders. Its portable design allows easy movement and setup at various locations. The use of durable sheet metal ensures long-term structural strength and resistance to environmental factors. Integrated wheels and safety features like railings and harness loops increase usability and safety. The basket is also cost-effective and reusable, reducing the need for scaffolding or multiple ladder setups. Overall, it offers an efficient, practical, and professional method for servicing elevated AC units.

5.5 Applications

This wall basket system is ideal for residential and commercial air conditioner maintenance. It can be used by HVAC technicians, service companies, and maintenance personnel for safe and efficient installation or repair of wall-mounted split AC units, especially in urban buildings or areas with restricted access.

5.6 Project Sketch





5.7 Glimpse of Project

Figure 5.3 Photography of Project

CHAPTER 6

COST ESTIMATION

S.NO	MATERIAL	QUANTITY	ESTIMATED COST IN INR
1	Mild Steel/Aluminum Sheet (1.5mm),Steel/Aluminum Angles (20x20mm), Steel/Aluminum Pipes (10mm)	As per design	1550
2	Welding Rods	As per welding requirements	450
3	Paint and Paint brushes	As per surface area	300
4	Hardware (Screws, nuts, bolts, hinges, brackets)	As per design requirements	700
5	Cutting Tools, Welding Machine, Drilling Machine	As needed	650
6	Labour cost	As needed	850
7	Miscellaneous	As required	450
8	Total Cost		4950

Table 6.1 Cost Estimation

CHAPTER 7

CONCLUSION

The design and fabrication of a dedicated wall-mounted basket for AC maintenance has resulted in a practical and effective solution to improve the efficiency and productivity of technicians. By providing a centralized and organized storage space, this innovation addresses the challenges associated with disorganized tool storage and minimizes downtime.

The successful implementation of this wall basket can significantly enhance the overall quality of AC maintenance services. Future research could explore further customization options, such as incorporating additional features like tool holders or integrated lighting, to further optimize the design and functionality of the basket.

The future scope of wall-mounted baskets for AC outdoor unit maintenance includes several innovative directions, such as the exploration of advanced, durable, and eco-friendly materials to enhance longevity and reduce environmental impact. Integrating smart technology, like sensors for monitoring AC unit conditions, could provide users with timely maintenance alerts. Additionally, developing modular designs for various AC sizes and types would increase versatility, while user-friendly features could simplify installation and maintenance. Collaborating with HVAC professionals for feedback, ensuring compliance with industry regulations, and creating educational resources on AC maintenance are also vital. Finally, investing in research and development will facilitate continuous improvement based on user needs and technological advancements, positioning these baskets as essential tools for efficient AC maintenance. Finally, investing in ongoing research and development will facilitate continuous innovation, allowing for the adaptation of the baskets to meet evolving user needs and technological advancements. By focusing on these areas, the future of wall-mounted baskets for AC outdoor unit maintenance can be positioned as a critical component in promoting energy efficiency, reducing operational costs, and extending the lifespan of HVAC systems.

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