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Artificial panel Wall By using Recycled plastic

Mr. Bhavesh Shinde
Department of Civil Engineering
Jspm's BSP, Wagholi, pune,
Maharashtra-412207

Mr. Dnyaneshwar Shelar
Department of Civil Engineering
Jspm's BSP, Wagholi, pune,
Maharashtra-412207

Mr. Siddhant Kamble
Department of Civil Engineering
Jspm's BSP, Wagholi, pune,
Maharashtra-412207

Mr. Yash Gambhire
Department of Civil Engineering Jspm's BSP,
Wagholi, pune, Maharashtra-412207

Guide - Mrs.Gawale L.C
Faculty of Civil Engineering Dep. Jspm's BSP,
Wagholi, pune, Maharashtra-412207

Abstract - Plastic waste has become one of the major environmental problems due to its non-biodegradable nature. Large quantities of plastic are disposed of daily, causing pollution and landfill issues. The main objective of this Capstone Project is to reuse waste plastic for the production of an artificial panel wall suitable for non-load-bearing applications.

In this project, waste thermoplastic materials such as HDPE and LDPE were collected, cleaned, and melted under controlled temperature. The molten plastic was poured into a mold to obtain the required panel shape. After cooling and solidification, coloring was done for aesthetic appearance, and a waterproofing coating was applied. The panel was then allowed to dry for 24 hours to achieve proper finishing and durability.

The developed artificial panel wall is lightweight, waterproof, corrosion-resistant, and cost-effective. Although it is not suitable for load-bearing structures, it can be effectively used for interior partitions, temporary structures, and decorative purposes.

This project promotes sustainable construction practices, reduces plastic waste, and encourages innovative use of recycled materials in civil engineering applications.

Key Words : - **Wall of Plastic Panel, Plastic Waste Utilization, Material Composition**

1. INTRODUCTION

The extensive use of plastic in modern applications has led to a significant increase in plastic waste generation, posing serious environmental challenges due to its non-biodegradable nature and long-term persistence. Improper disposal of plastic waste results in land and water pollution, blockage of drainage systems, and adverse impacts on ecosystems. Conventional waste management methods such as landfilling and incineration are not sustainable, as they either require large land areas or generate harmful emissions. Therefore, the reuse and recycling of plastic waste have become essential for sustainable development.

In recent years, the construction industry has emerged as a promising sector for the utilization of recycled plastic materials. Several studies have demonstrated the feasibility of incorporating plastic waste into construction products such as bricks, blocks, tiles, and panels, offering advantages like lightweight characteristics, moisture resistance, and cost-effectiveness. These properties make recycled plastic materials particularly suitable for non-load-bearing applications.

The present study focuses on the development of an artificial panel wall using melted thermoplastic waste, specifically High Density Polyethylene (HDPE) and Low Density Polyethylene (LDPE). The collected plastic waste is processed through a melting and moulding technique to produce a panel of defined dimensions. Post-processing treatments such as finishing and waterproofing are applied to enhance the surface quality and performance of the panel.

The objective of this research is to evaluate the feasibility, performance, and economic viability of the developed plastic panel for applications such as compound walls, partitions, and temporary structures. The study aims to contribute to sustainable construction practices by promoting the effective reuse of plastic waste as an alternative building material.

2.1 Meteorology

(Fig 1.1)

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Step 1: Collection of Waste Plastic Materials

Waste plastic materials required for the experimental study were procured from a local scrap supplier, Trimurti Scrap Center, which serves as an accessible and economical source of recyclable materials. The collected waste included a variety of thermoplastic materials such as drip irrigation pipes, plastic bottles, plastic carry bags, and other packaging plastics, which are predominantly composed of High Density Polyethylene (HDPE) and Low Density Polyethylene (LDPE). These materials were specifically selected due to their thermoplastic properties, which enable them to soften and melt when subjected to elevated temperatures, making them suitable for molding and reshaping processes. A total quantity of approximately 9–10 kg of plastic waste was collected at a nominal cost of ₹200, highlighting the cost-effectiveness of using waste materials for construction applications. This quantity of plastic was sufficient to manufacture an artificial panel wall with an approximate surface area of 3.50 sq. ft, meeting the design requirements of the project. Following collection, the plastic waste was thoroughly inspected, sorted, and segregated to remove non-plastic impurities such as metal fragments, paper, dust, and other foreign substances that could adversely affect the melting process and final product quality. The segregation process ensured that only suitable thermoplastic materials were selected for further processing. Proper collection and selection of raw materials play a vital role in achieving uniform melting characteristics, improved bonding between plastic particles, and enhanced structural integrity of the final panel, thereby forming a critical foundation for the subsequent stages of manufacturing the artificial plastic panel wall.

Step 2: Segregation and Cleaning of Plastic

After the collection of waste plastic materials, the next step involved the segregation and cleaning process. In this stage, the collected plastic waste was carefully sorted to separate suitable thermoplastic materials such as HDPE and LDPE from other unwanted materials. Non-plastic impurities like paper, metal pieces, rubber, and other foreign substances were removed to ensure the quality of the raw material used in the manufacturing process.

The selected plastic materials were then washed thoroughly with water to remove dust, dirt, and other contaminants that could affect the melting and molding process. After washing, the plastic pieces were allowed to dry properly to eliminate moisture content. Proper drying is essential to achieve uniform melting and better bonding of plastic during heating.

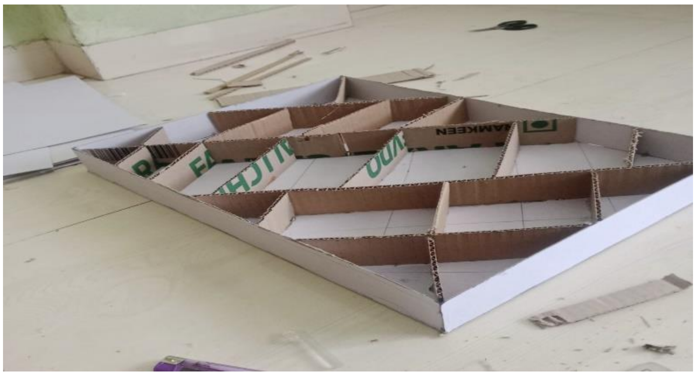
This segregation and cleaning process help in obtaining pure and suitable plastic material, which improves the efficiency of the melting process and enhances the overall quality, durability, and performance of the artificial panel wall.

Step 3: Preparation of Mold and Design Layout

After the segregation and cleaning of plastic waste, the next step involved the preparation of the mold and layout design for the artificial panel wall. The mold was prepared using cardboard sheets and supporting materials to obtain the required panel dimensions of 2.5 ft × 1.5 ft with a thickness of approximately 6.5 cm.

Cardboard sheets were arranged to form internal partitions and structural support within the panel. These partitions helped in maintaining the proper shape and uniform thickness during the casting of molten plastic. The mold was fixed properly to avoid displacement during the pouring of melted plastic.

In this project, the mold structure was not removed after casting. Instead, it remained as a part of the panel to provide additional support and stability to the artificial wall panel. Proper design and preparation of the mold ensured uniform distribution of plastic material and improved structural integrity of the final panel.



(Fig1.2)

Step 4: Cutting / Shredding of Plastic

After segregation and cleaning, the collected plastic waste was cut into smaller pieces to facilitate the melting process. Large plastic materials such as drip pipes, bottles, and other plastic items were manually cut using suitable cutting tools. The cutting process was carried out to obtain uniform and manageable plastic pieces.

Reducing the size of plastic materials helps in faster and more uniform melting during heating. Smaller plastic pieces also ensure better mixing and distribution of molten plastic inside the mold during the casting process.

Step 5: Heating and Melting Process

After cutting the plastic into smaller pieces, the material was subjected to a heating process to convert it into a molten state. The plastic pieces were placed in a metal container and heated using a locally available heat source. Thermoplastic materials such as High-Density Polyethylene (HDPE) and Low-Density

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Polyethylene (LDPE) generally start softening and melting at a temperature of approximately 120°C to 130°C.

During heating, the plastic gradually transformed from a solid state into a semi-liquid molten form suitable for moldings. The material was carefully observed to ensure that the plastic melted properly and achieved the required consistency for pouring.

The molten plastic was then immediately transferred into the prepared mold to form the artificial panel wall. Proper melting of the plastic is essential to achieve uniform distribution of material, good bonding, and the desired shape of the panel.

Step 6: Pouring of Molten Plastic into Mold

After the plastic waste was completely melted and converted into a semi-liquid molten form, the molten plastic was carefully poured into the prepared mold. The mold was already arranged according to the required panel dimensions and design layout. The molten plastic was gradually transferred from the heating container into the mold to ensure proper filling of all sections.

During the pouring process, care was taken to ensure uniform distribution of molten plastic throughout the mold so that the panel would achieve the required thickness and structural uniformity. The molten plastic was allowed to spread within the mold and fill the internal partitions properly.

This step plays a crucial role in the manufacturing process because proper pouring ensures the formation of a compact and well-shaped artificial panel wall. After pouring, the material was left undisturbed to allow cooling and solidification of the plastic inside the mold.

(Fig 1.3)

Step 7: Cooling and Solidification Process

After the molten plastic was poured into the prepared mold, the material was allowed to cool naturally at room temperature. During this stage, the molten plastic gradually lost heat and started to solidify and harden inside the mold.

The cooling process is important because it helps the plastic material retain the required shape, thickness, and structural form of the panel. The mold was kept undisturbed during this period to avoid any deformation or uneven surface formation.

As the temperature decreased, the molten plastic transformed from a semi-liquid state into a solid panel structure. Proper cooling ensures better bonding between plastic layers and improves the overall strength and stability of the artificial panel wall.

Step 8: Finishing and coloring

After the cooling and solidification of the plastic material, the next step involved finishing and coloring of the artificial panel wall. In this stage, the surface of the panel was carefully inspected and minor irregularities or rough edges were corrected using suitable tools to obtain a smoother and uniform surface finish.

After completing the finishing work, color was applied on the surface of the panel to improve its aesthetic appearance. The coloring process enhances the visual quality of the panel and makes it more suitable for practical applications such as compound walls and decorative purposes.

Proper finishing and coloring are important steps as they help in improving the overall appearance, surface quality, and usability of the developed artificial panel wall.

Step 9: Application of Waterproofing and Surface Treatment

After completing the finishing and colorings process, a waterproofing treatment was applied to the surface of the artificial panel wall to improve its resistance to water and moisture. For this purpose, a waterproofing chemical known as Life burg Water proofer was used. The waterproofing material was uniformly applied on the top surface of the panel to create a protective layer against water penetration.

The cost of the waterproofing material used for the project was approximately ₹200. The application of this waterproofing coating helps in enhancing the durability and water resistance of the panel, making it more suitable for applications such as compound walls and exterior surfaces.

After applying the waterproofing material, the panel was allowed to dry for approximately 24 hours to ensure proper setting of the coating. This surface treatment improves the overall performance, service life, and protection of the artificial panel wall against moisture exposure.

Step 10: Final Artificial Panel Wall Preparation

After the completion of all previous processes such as melting, molding, cooling, finishing, coloring, and waterproofing, the artificial panel wall was ready for final preparation. The panel was carefully inspected to ensure that the surface finish,

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dimensions, and structural form were achieved as per the design requirements.

The prepared panel had approximate dimensions of 2.5 ft × 1.5 ft with a thickness of about 6.5 cm and a total surface area of around 3.50 sq. ft. The panel structure was stable and compact due to the proper distribution and solidification of the melted plastic material within the mold.

After the waterproofing layer had completely dried, the final artificial panel wall was considered ready for demonstration and testing purposes. The developed panel can be used for non-load-bearing applications such as compound walls, temporary

(Fig 1.4)

partitions, and decorative structures.

Through this methodology, we successfully transformed waste plastic into a value-added construction material. The process is economical, simple, and environmentally friendly.

Testing and Results

After the successful fabrication of the artificial panel wall using waste plastic materials, a series of basic tests and observations were carried out to evaluate its performance, durability, strength, and suitability for non-load-bearing applications. As the project was conducted at the polytechnic level, simple and practical testing methods along with visual inspections were adopted. These tests provided a clear understanding of the behavior and characteristics of the developed panel under normal conditions.

1. Visual Inspection Test

The panel was thoroughly examined to evaluate its surface quality, uniformity, thickness consistency, presence of cracks, bonding between materials, and overall shape accuracy. This inspection was important to ensure that the molding and casting process was carried out effectively.

Result: The panel surface was observed to be smooth and uniform with no major cracks or visible defects. The thickness was consistent throughout the panel due to proper mold preparation and controlled pouring of molten plastic. The bonding between plastic layers was satisfactory, resulting in a stable and well-formed structure.

2. Water Resistance Test

To assess the waterproofing capability of the panel, water was poured on the top surface and observed over a period of time. This test was essential to determine the panel's suitability for applications exposed to moisture.

Observation: Water remained on the surface without penetrating into the material. No signs of swelling, softening, or deformation were noticed.

Result: The panel exhibited excellent water resistance, which can be attributed to the non-porous nature of plastic and the application of waterproofing coating. This property makes the panel suitable for use in areas where moisture resistance is required, such as compound walls and interior partitions.

3. Weight Measurement

The weight of the developed panel was assessed and compared with a conventional brick element of similar size to understand its practicality in construction.

Observation: The plastic panel was significantly lighter than traditional brick masonry. It was easy to lift, handle, and transport without requiring heavy labor.

Result: The lightweight nature of the panel reduces the overall dead load on the structure, making it advantageous for non-load-bearing applications and temporary structures. It also improves ease of installation and handling efficiency.

4. Strength Observation Test

A basic strength assessment was carried out by applying moderate manual pressure on the panel surface to observe its resistance to bending and cracking.

Observation: The panel did not crack under light to moderate pressure. It exhibited slight flexibility and returned to its original shape after the load was removed.

Result: The panel possesses adequate strength and flexibility for non-load-bearing applications. However, due to its material characteristics, it is not suitable for structural or load-bearing purposes.

5. Surface Finish and Appearance Test

After completing finishing and coloring, the panel was visually inspected to evaluate its aesthetic quality and surface texture.

Observation: The surface appeared smooth and visually appealing. The applied color was evenly distributed without any patches, peeling, or defects.

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Result: The finishing and coloring process significantly improved the appearance and usability of the panel, making it suitable for decorative and practical applications.

Overall Result

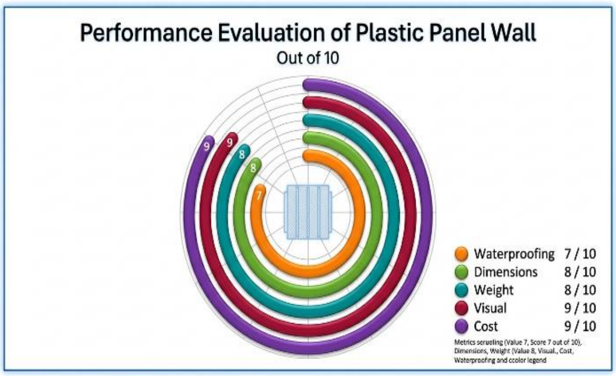
Based on the conducted tests and observations, the artificial panel wall demonstrated satisfactory performance in terms of water resistance, lightweight characteristics, structural stability, and surface quality. The panel is economical, easy to handle, and suitable for non-load-bearing applications such as compound walls, partitions, and temporary structures. This confirms that waste plastic can be effectively utilized as an alternative construction material while contributing to sustainable waste management practices.

Results Table

(Table 1.)

Sr. no	Test conducted	Method used	Observation	Results
1	Visual Inspection Satisfactory	Panel surface was visually examined	Surface was smooth and properly formed	Satisfactory
2	Dimensional Check	Measured using measuring tape	Size: 2.5 ft × 1.5 ft, Thickness: 6.5 cm	As per design
3	Waterproofing Test	Panel was immersed in water	No cracks, swelling, or deformation observed	Passed
4	Weight Measurement	Panel weight measured	Approximate weight: 9–10 kg	Acceptable
5	Cost Analysis	Total material cost calculated	Panel cost: ₹600–₹700	Economical

Bar chart of results



CONCLUSION

From this project, it can be concluded that waste plastic materials can be successfully converted into an artificial panel wall through melting and molding processes. The prepared panel is lightweight, waterproof, cost-effective, and environmentally friendly.

The project promotes sustainable construction practices by reducing plastic waste and encouraging recycling. Although the panel is not suitable for heavy structural loads, it can be effectively used for interior partition walls, decorative panels, and temporary structures.

This project proves that innovative use of waste materials can contribute to environmental protection and resource conservation. It also enhances practical knowledge and technical skills in the field of civil engineering.

In conclusion, the Artificial Panel Wall Using Waste Plastic is a simple, economical, and eco-friendly solution for non-load-bearing construction applications.

Discussion

The main objective of this project was to recycle waste plastic and convert it into an artificial panel wall suitable for non-load-bearing applications. From the practical work and testing results, it was observed that thermoplastic materials such as HDPE and LDPE can be effectively melted, molded, and reshaped into useful construction products.

During the melting process, proper temperature control was very important. Overheating caused excessive smoke and reduced material quality, while insufficient heating resulted in incomplete melting. Therefore, controlled heating ensured uniform melting and proper bonding in the panel.

Tap on a clip to paste it in the text box.The mould preparation and covering of the top surface played a major role in maintaining uniform thickness and improving strength. Proper compaction removed air gaps and enhanced density. Cooling was also an important stage, as gradual cooling prevented cracks and internal stresses.

From the water resistance test, it was clear that the plastic panel does not absorb water and remains unaffected by moisture. This makes it suitable for interior partition walls and damp areas. The lightweight nature of the panel reduces structural load and makes transportation and installation easier compared to conventional bricks.

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