



INTERNATIONAL JOURNAL OF MULTIDISCIPLINARY RESEARCH

IN SCIENCE, ENGINEERING, TECHNOLOGY AND MANAGEMENT

Volume 11, Issue 4, April 2024



INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.802



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Using EPS Wall Panel as Construction Material

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ABSTRACT: Sandwich EPS (Expanded Polystyrene) wall panels have emerged as a popular choice in contemporary construction practices due to their lightweight nature, thermal efficiency, and ease of installation. This paper provides a comprehensive overview of the design, construction, and applications of sandwich EPS wall panels, highlighting their significance in the construction industry.

The design considerations of sandwich EPS wall panels encompass various factors such as structural integrity, thermal performance, fire resistance, and acoustic properties. Advanced computer-aided design (CAD) techniques and simulation tools facilitate the optimization of these panels to meet specific project requirements while adhering to regulatory standards.

Construction methodologies for sandwich EPS wall panels involve prefabrication off-site or on-site assembly, depending on project constraints and logistics. Off-site manufacturing offers benefits of precision, quality control, and accelerated construction timelines, whereas on-site assembly provides flexibility in adapting to site conditions and customization.

The applications of sandwich EPS wall panels are diverse, spanning residential, commercial, industrial, and institutional sectors. These panels are extensively used in exterior walls, partitions, roofing systems, and insulation applications, contributing to energy efficiency, sustainability, and cost-effectiveness in building projects.

I. INTRODUCTION

EPS Sandwich Panel is a kind of lightweight energy saving wall material, which uses cement Fiber board as face panel, filled with cement and expanded polystyrene (EPS) foam particles as core material.

EPS panels refer to expandable polystyrene panels that are manufactured using polystyrene beads that are expanded to more than 50 times their size through a chemical process that uses heat. Once they've melded, they're compressed between PPGI sheets into varying sizes of EPS blocks through different molds. These are further cut and shaped for different industry requirements. They are also customizable and can be manufactured in different densities as per client requirements.

EPS Cement Sandwich Panel, also known as Extruded Polystyrene (EPS) Panel is a structural insulated panel used in the construction industry for creating partition walls. It consists of a rigid Insulating layer sandwiched between two layers of board. The structural board of the EPS Cement Sandwich Panel can either be of Magnesium Oxide Board (MgO) or Cement Fiber Board. The rigid insulation core of the EPS Panel acts as a web, while the outer boards fulfill the function of the flanges. EPS Cement sandwich panels combine several components such as studs, joists, insulation, vapor and air barrier.

With EPS cement sandwich panels being lightweight and durable, they can be used of many different Interior and Exterior Applications.

II. LITERATURE REVIEW

The investigation of Expanded Polystyrene (EPS) in various construction applications showcases its versatility and potential in revolutionizing the building sector. Researchers across multiple studies emphasize EPS's attributes such as lightweight nature, thermal insulation properties, and sustainability benefits. From lightweight concrete to sandwich panels and insulated formwork, EPS emerges as a key player in addressing challenges like urbanization, housing demand, and environmental concerns. Experimental studies delve into EPS's structural behavior, compressive strength, and performance under accelerated corrosion, providing valuable insights for practical applications. Furthermore, the feasibility of using EPS-based panels for staircases highlights innovative solutions for maximizing space utilization in compact housing units. Overall, the research underscores EPS's significant role in advancing sustainable and efficient construction practices, offering promising avenues for future development and implementation.

Problem Definition: The use of EPS (expanded polystyrene) wall panels as construction material presents several challenges that need to be addressed. Firstly, EPS panels may lack structural integrity, posing potential safety risks if not properly reinforced or supported. Secondly, their installation requires meticulous attention to detail to ensure proper insulation and sealing against moisture penetration, which could lead to mold growth and structural decay over time. Thirdly, the lightweight nature of EPS panels may make them susceptible to damage from external forces such as wind or impact, necessitating additional protective measures. Fourthly, compatibility with other construction materials and techniques must be carefully considered to avoid compatibility issues or compromises in structural stability. Fifthly, the fire resistance of EPS panels needs to be evaluated to ensure compliance with building codes and safety standards, as they may pose a higher fire risk compared to traditional construction materials. Sixthly, the long-term durability of EPS panels in varying environmental conditions must be assessed to determine their suitability for different climates and locations. Seventhly, the cost-effectiveness of using EPS panels compared to alternative materials needs to be evaluated, considering factors such as initial installation costs, maintenance requirements, and energy savings over the lifespan of the building. Eighthly, the environmental impact of EPS production, use, and disposal should be taken into account, including considerations of energy consumption, greenhouse gas emissions, and waste generation. Ninthly, potential regulatory hurdles or permitting requirements associated with the use of EPS panels may need to be addressed to ensure compliance with local building codes and regulations. Tenthly, the availability of skilled labor and specialized expertise for the installation and maintenance of EPS panel systems may pose challenges in some regions. Eleventhly, transportation and logistics considerations must be factored in when sourcing EPS panels, especially for large-scale construction projects located in remote or inaccessible areas. Twelfthly, proper training and education of construction workers and contractors are essential to ensure correct installation techniques and best practices for working with EPS panels. Thirteenthly, ongoing research and development efforts are necessary to improve the performance, durability, and sustainability of EPS panels as construction materials. Fourteenthly, potential aesthetic limitations of EPS panels, such as limited design flexibility or surface finishes, may need to be addressed to meet the architectural requirements of a project. Lastly, effective communication and collaboration among architects, engineers, contractors, and suppliers are crucial to successfully overcome the challenges associated with using EPS wall panels in construction projects.

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III. METHODOLOGY

EPS (Expanded Polystyrene) sandwich wall panels are a type of building material commonly used in construction for their insulation properties, lightweight nature, and ease of installation. Here are the details of their design, working principles, and processes involved:

Design: The design of EPS sandwich wall panels typically involves several considerations:

Structural requirements: This includes determining the load-bearing capacity of the panels based on the specific application (e.g., residential, commercial, industrial).

Thermal insulation: EPS panels are known for their excellent thermal insulation properties, so the design must ensure sufficient insulation for energy efficiency.

Fire resistance: Depending on local building codes and safety standards, the panels may need to meet certain fire resistance ratings.

Moisture resistance: Proper design should also account for preventing moisture infiltration into the building envelope.

Working Principle: EPS sandwich wall panels consist of three main components:

Outer and inner facing materials: These are typically made of materials like steel, aluminum, or fiberglass reinforced plastic (FRP). These provide structural

EPS core: Expanded polystyrene foam is sandwiched between the facing materials. This EPS core provides insulation and contributes to the lightweight nature of the panels.

Adhesive or bonding agent: This is used to adhere the facing materials to the EPS core.

The working principle involves assembling these components into panels of desired dimensions, ensuring proper bonding and alignment to create a structurally sound and thermally efficient wall system.

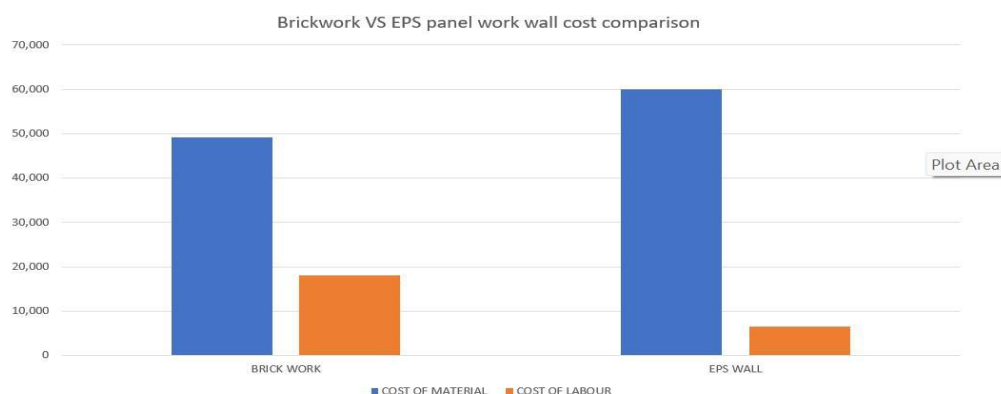
Processes Involved:

1. **Panel Fabrication:** The fabrication process involves cutting the EPS foam to the required dimensions and sandwiching it between the facing materials. This can be done using specialized machinery in a manufacturing facility.
2. **Bonding:** Adhesive or bonding agents are applied to the facing materials, and the EPS core is inserted between them. The panels are then pressed together to ensure proper bonding.
3. **Trimming and Finishing:** After the panels are bonded, excess material may be trimmed off, and any finishing touches, such as adding edge profiles or surface treatments, are applied.
4. **Installation:** Once fabricated, the panels are transported to the construction site for installation. They are typically fixed to the building structure using various methods such as adhesive, mechanical fasteners, or a combination of both.
5. **Integration:** During installation, other building components such as windows, doors, electrical wiring, and plumbing may be integrated into the wall panels as per the building design.
6. **Quality Control:** Throughout the manufacturing and installation processes, quality control measures are essential to ensure the panels meet design specifications and regulatory requirements. This may include testing the thermal conductivity, compressive strength, fire resistance, and dimensional accuracy of the panels.
7. By following these design principles and processes, EPS sandwich wall panels can provide an efficient, durable, and cost-effective solution for building construction.

Design points on eps wall panel

- The design shall satisfy the standards of IS 456, IS 1905, IS 11447, IS 875 (Part 1-5), IS 1893 (Part 1), IS 4326, IS 13920
- Cutting drawings shall be prepared with clarity to facilitate the cutting at the manufacturing plant of the various wall or floor panels to appropriate sizes. In case of wall panels opening for doors, windows etc. shall be suitably marked in the respective panels.
- When the panels are to be cut at the factory in accordance with the cutting joints, these shall be suitably marked on the surfaces beforehand to facilitate correct identification for proper placement during erection at the construction site

IV. RESULTS





V. CONCLUSION

1. EPS wall panels offer a lightweight yet sturdy solution for construction projects, combining insulation properties with structural integrity.
2. The versatility of EPS panels enables efficient installation, reducing construction time and labor costs compared to traditional building materials.
3. These panels provide excellent thermal insulation, helping to regulate indoor temperatures and enhance energy efficiency in buildings.
4. With their resistance to moisture and mold, EPS wall panels contribute to healthier indoor environments by preventing the growth of harmful microorganisms.
5. Incorporating EPS panels into construction projects promotes sustainability by reducing energy consumption and minimizing environmental impact throughout the building's lifecycle.

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