Eps Monolithic Panel System: A Sustainable Alternative in Construction

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Abstract: The civil construction sector in Brazil is still marked by the predominant use of the conventional masonry method, which has become established due to its reliability, but presents challenges such as material waste and considerable environmental impact. In this scenario, the industry seeks more efficient and sustainable alternatives, such as monolithic EPS panels. These panels offer benefits in terms of thermal and acoustic performance, execution speed, waste reduction, and cost-effectiveness. EPS panels are made of expanded polystyrene, reinforced with galvanized steel mesh and coated with mortar, presenting lightness, versatility, high durability, and, additionally, being a recyclable material. Thus, this study was carried out to analyze the use of monolithic EPS panels as a replacement for the conventional block masonry system, through a literature review and a survey of case studies. To assess the competitiveness of monolithic and conventional construction techniques, a comparative cost analysis was developed based on data presented in indirect studies, making it evident that, regardless of the size of the residence, the monolithic EPS panel system presents a superior cost-benefit ratio compared to the ceramic block system. Furthermore, EPS stands out as a 100% recyclable, odorless, and low environmental impact material, significantly reducing waste generation on construction sites. Another important aspect is that, being prefabricated, the system eliminates waste and optimizes the use of resources, contributing to more sustainable practices. In medium-sized projects, the use of monolithic EPS panels has also been associated with cost reductions of up to 38% when compared to traditional masonry, mainly due to faster execution and lower labor demand. Standardization by ABNT, through standards such as NBR 16866:2022, ensures technical safety and consistency for its application, reinforcing its viability as a modern and efficient alternative.

Keywords: Construction. Monolithic EPS panels. Expanded polystyrene. Conventional masonry.

1. Introduction

Brazil's construction sector relies heavily on ceramic masonry and reinforced concrete, traditional methods known for their reliability. However, they pose environmental challenges, including high resource use and waste generation. Sustainable alternatives—like steel framing, drywall, precast concrete, and monolithic EPS (Expanded Polystyrene) panels—offer solutions but face low adoption due to professional resistance and limited information.

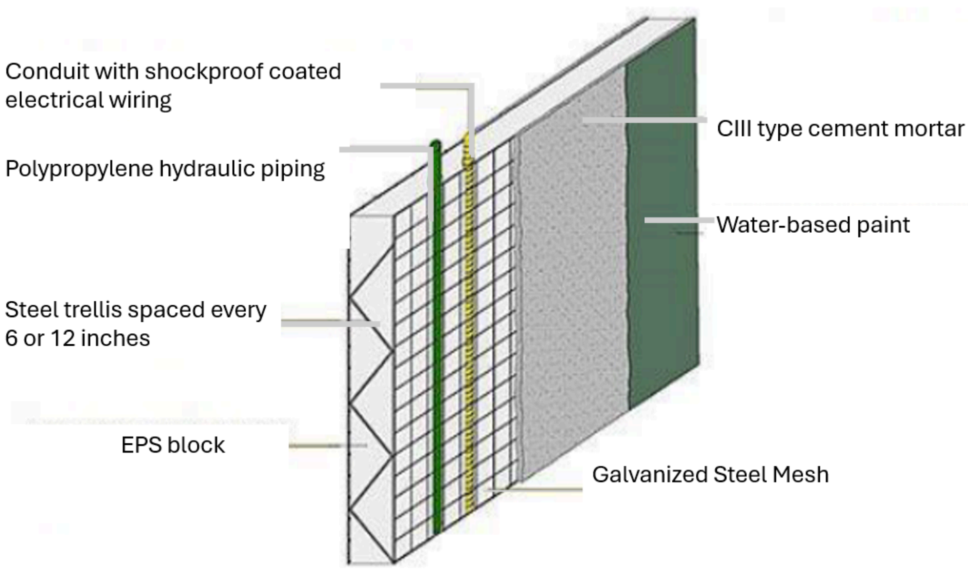
Developed in 1980s Italy for earthquake safety, monolithic EPS panels combine EPS cores with galvanized steel mesh and structural mortar. They allow faster construction, thermal and acoustic efficiency, and reduced structural load, enabling flexible architectural design.

Introduced in Brazil in the 1990s and approved by IPT São Paulo, this system remains underutilized due to lack of awareness and hesitation to replace conventional methods. This article evaluates the feasibility of EPS panels as an alternative to traditional systems, considering execution time and cost.

2. Monolithic Eps Panel System

EPS (Expanded Polystyrene), commercially known as Styrofoam®, is a vapor-expanded plastic composed of 98% air and 2% polystyrene, offering lightweight properties and thermal insulation [1] The system integrates modular panels with structural and closure functions. These monolithic panels feature flat or contoured EPS cores, reinforced with low-carbon steel mesh and galvanized wires. Panels are interconnected with galvanized steel trusses and coated on both sides with micro-concrete (fck = 25 MPa, minimum 3.5 cm thickness), custom-cut per project (Figure 1).

Figure 1. Structure of the panels



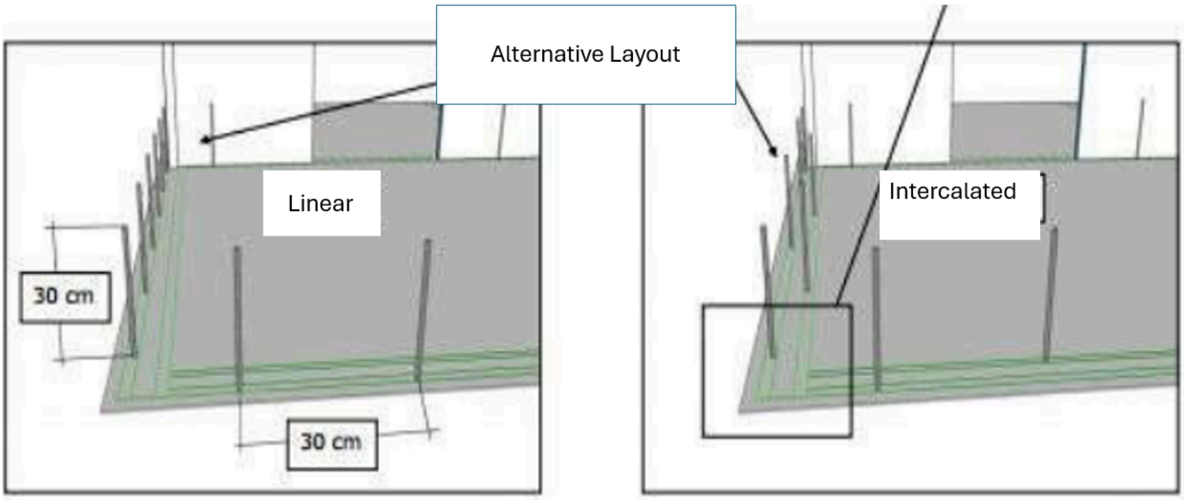
Source: Barreto, [2]

There are different types of panels: basic ones, used for walls and enclosures; double panels, which consist of two panels joined by a concrete core for added strength; curved panels, which are flexible and adaptable to complex architectural designs; and special panels, which include additional insulating materials such as rock wool and cork to enhance thermal and acoustic performance [2].

The construction process using monolithic EPS panels begins with the foundation, typically a raft type, which distributes loads evenly over the soil. Next comes the wall assembly, where panels are secured with steel bars and reinforced at corners and openings (Figure 2). To ensure alignment, braces are used prior to applying the coating [3]. According to Medeiros [4], electrical and plumbing installations are carried out after the wall assembly, with grooves for pipes created using heat blowers (Figure 3). The coating is applied through mechanically sprayed mortar, forming a resistant layer. Slabs and roof structures use special panels reinforced with metal frames to ensure structural stability.

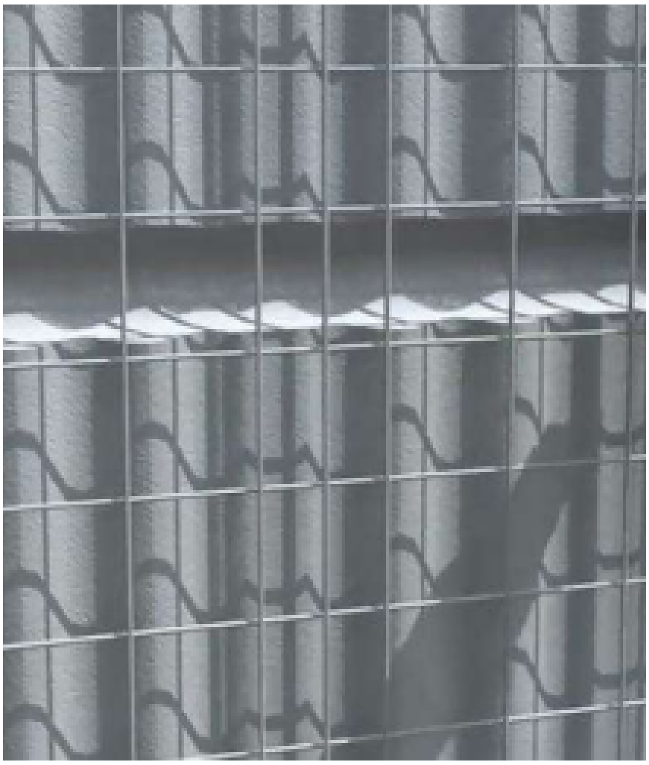
To guarantee quality and safety, the system adheres to technical standards from the Brazilian Association of Technical Standards (ABNT), such as NBR 16866 [5], which defines testing methods for EPS; NBR 11949 [6], which specifies criteria for apparent density; and NBR 7973 [7], which addresses water of absorption. EPS stands out for its lightness, ease transport and assembly, durability, impermeability, and sustainability. It also offers thermal and acoustics.

Figure 2. Configuration of Anchoring Rods



Source: CASSAFORMA [3]

Figure 3: Groove Cutting for Auxiliary Installations



Source: Tecnopanel s.d.

insulation, improving energy efficiency and indoor comfort, while providing high strength—able to bear structural loads without significant deformation. Based on these qualities, this construction system presents an innovative solution for buildings up to six stories high, enabling cost reduction, increased efficiency, and lower environmental impact [2].

Time is a crucial factor in civil construction, affecting cost, planning, and client satisfaction. The traditional method involves a rigid sequence of steps that cannot be expedited, with each phase depending on the completion of the previous one, often resulting in delays. Stages such as site layout, masonry, installations, and finishes take considerable time, usually leading to higher expenses due to labor and equipment rentals. Innovations like concrete 3D printing can help reduce time but do not eliminate the sequential nature of the process.

In contrast, the EPS system allows for fast assembly, with prefabricated panels that can be installed in just a few days. Installations, such as plumbing and electrical systems, are more efficient with minimal cutting, and finishes like mortar application are also quicker—reducing total construction time and consequently labor and equipment costs. However, the installation of additional systems, such as insulation or sealing, may require extra time depending on the design. While EPS offers a more agile and economical solution, choosing between the two methods depends on the type of project, budget, and client requirements. The traditional method remains preferred for builds requiring greater robustness and customization, while EPS is ideal for faster, more efficient construction. Table 1 summarizes the characteristics of both methods.

Table 1. Comparison Between Traditional and EPS Construction Methods

Aspect	Traditional Method	EPS Method
Rental Time	Long (weeks to months)	Short (days to weeks)
Installation and Assembly	Sequentially, with several steps requiring more time and coordination between teams.	Fast installation of prefabricated panels, reducing assembly time.
Utilities Installation	Deep and detailed grooves for electrical and hydraulic piping, requiring more time and possibly leading to rework.	Minimal cuts to embed piping, speed up the process and reduce wall impact.

Finishes	Time-consuming steps such as roughcast, base coat, and plaster, requiring additional drying and curing time.	Fast application of projected mortar, with shorter drying times.
Total Time	High (months, depending on project and conditions).	Low (weeks, with significant total time reduction).
Labor Costs	Generally higher due to the need for more workers and time-consuming steps.	Lower labor costs, as the work is faster and requires fewer professionals.
Equipment Costs	Higher, due to prolonged use of heavy equipment and tools.	Lower equipment costs, assembling prefabricated panels requires fewer heavy tools.
Adaptability to Site	High flexibility, allowing adjustments according to local conditions and project requirements.	Lower flexibility, as the system is more standardized and may not adapt well to certain types of projects.
Durability and Maintenance	Lower needs for maintenance over time, especially in stable climates.	May require specific care in certain climates, such as protection against excessive moisture.
Sustainability	Higher waste generation and material waste during construction.	Less material waste and better resource utilization, contributing to more sustainable practices.
Execution Complexity	More complex processes, with more steps and greater chances of execution errors.	Simpler and more direct execution, with lower chances of mistakes and rework.

3. Methodology

This qualitative and exploratory study compares monolithic EPS panels with conventional masonry systems over a 15-year period (2009–2024), emphasizing the last five years. The research followed three main stages:

Literature Review: Identified key concepts, technical characteristics, construction processes, and regulations related to EPS panels and traditional masonry. Sources included CAPES Journals Portal, SciELO, and ABNT standards such as NBR 16866 [5]

Case Study Analysis: Examined execution time and cost data from two projects—Casa A (low-income housing in Paraíba) and Casa B (high-end residence in Camaçari-BA) both utilizing EPS panels, allowing direct structural and financial comparisons.

Comparative Evaluation: Synthesized findings into tables to assess cost-benefit, environmental impact, and waste generation. The analysis highlights the advantages and challenges of adopting EPS panel systems in Brazilian construction.

4. Results and Discussion

Two case studies demonstrate the technical, economic, and sustainable feasibility of the monolithic EPS system in Brazilian civil construction.

House A, analyzed by Balbino [1], is a low-income single-family home of 46.80 m² with thermal-acoustic roofing and basic rooms. Based on SINAP data from June 2020 (Paraíba), EPS construction resulted in a 29.13% cost reduction compared to the conventional method, totaling R$35,022.43 versus R$49,421.77 for traditional masonry. This reduction is attributed to lower infrastructure demand and efficient planning of electrical and hydraulic systems. In addition, the panel assembly requires significantly less time than building walls and structures.

House B, studied by Garcia [8] is a 361.66 m² two-story residence with leisure areas, kitchen, and a kiosk. Built using the monolite method, it demonstrated lower material costs and faster execution, according to SINAPI [9, 10] data from the second half of 2009. The lightweight nature of the panels reduced structural reinforcement needs, positively impacting foundation costs. Although the study didn't specify labor hours, it emphasized reduced labor demand.

Table 2 - Case Study Summary

PROJECT		HOUSE A [1]		HOUSE B [8]	
Description	Location	Paraíba		Busca Vida, Camaçari - BA	
	Typology	Low-income		High-end	
	Built Area	46,80 m²		361,66m²	
Space program	Program	Living/dining room, two bedrooms, kitchen, circulation, bathroom, and service area		2 Living rooms, 3 suites, 2 bathrooms, leisure area, 1 kitchen, and 1 kiosk	
	No. of floors	1		2	
Structural System	Foundation	Pile		Pile	
	Structural System	EPS monolithic panels	Reinforced concrete	EPS monolithic panels	Reinforced concrete
Construction system	Partition System	EPS monolithic panels	Ceramic blocks	EPS monolithic panels	Ceramic blocks
Total Cost	Total cost	R$ 35.022,43	R$ 49.421,77	R$ 100.491,36	R$ 163.199,47
	Cost reduction (%)	29,13%		38,42%	

Both buildings reinforce the technical and economic advantages of EPS, which also stands out for its sustainability, being recyclable and environmentally viable. The findings suggest that EPS is a strategic alternative, especially for affordable housing, offering cost savings, faster construction, and ecological responsibility.

Comparative analysis has shown that the monolithic EPS system is economically advantageous, with cost reductions of 29.13% in House A and 38.42% in House B (Table 2).

Larger projects present even more significant savings, making EPS an efficient alternative. In addition to cost reduction, sustainability stands out, as conventional masonry consumes more natural resources and generates greater waste. EPS also offers constructive efficiency by enabling swift assembly and the pre-planned integration of plumbing and electrical systems, reducing the need for rework.

By contrast, conventional masonry involves more time-consuming procedures. However, challenges such as limited access to suppliers and a shortage of specialized labor hinder its adoption, especially in less developed areas. The results show that in larger constructions, proportional savings with EPS are even greater. Its feasibility for low-income housing is promising, as it reduces costs and accelerates construction without compromising structural quality. Thus, expanding the use of EPS can contribute to a more efficient and sustainable sector, aligned with the contemporary demands construction in Brazil.

5. Final Considerations

Monolithic EPS panels emerge as an innovative and sustainable alternative to conventional masonry, significantly reducing material waste, environmental impact, and execution time. Lightweight, versatile, and offering thermal and acoustic efficiency, these panels allow for fast assembly and reduced demand for specialized labor.

Cost analysis revealed substantial savings: a 29.13% reduction in the smaller house and 38.42% in the larger one, highlighting the economic viability of the system. Moreover, EPS required fewer natural resources and less time, underscoring its superiority in terms of sustainability.

In the context of Brazil's construction sector, broader adoption of EPS panels could modernize the industry and align it with current demands for resource optimization and sustainable practices. However, overcoming cultural and technical barriers remains essential. This includes promoting public policies, professional training, and reliable information dissemination on EPS applications.

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